Artificial Intelligence & *Hikmah*

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Foreword

One of the ultimate purposes of Islam, as the *deen* or way of life, is for a Muslim to achieve *hikmah*. The word *hikmah* can be loosely translated as wisdom. It is not easy to arrive at *hikmah*, unless the Muslim has (and maintains) a "pure" heart or *qalb salim,* i.e. a heart that is clean from hypocrisy or *nifaq*, as it is the prerequisite for the absorption of *'ilm* or knowledge (which itself is a part of wisdom). Knowledge cannot be absorbed and thus comprehended when the heart is blackened with sins (as each sin will stamp a black dot on the heart). Sins, as mentioned by Al-Ghazali, are like oil that cannot be mixed with the water that fills the heart. The water purifies and cleanses the heart so that knowledge (which comes from Allah, and thus sacred) can be bestowed upon the Muslim.

In addition, deep contemplation of the tribulations faced throughout his life, i.e., looking at positive aspects of these incidents (and therefore maturity that comes with wide experience in life), is another important factor that enables a Muslim to grasp *hikmah*.

The abovementioned prerequisites are the traditional understanding of knowledge in the Islamic tradition. With the advent of artificial intelligence technology, the new challenge is whether such artificial intelligence delivers the knowledge that carries *hikmah* from the Islamic precepts with it? In other words, can it become a reliable tool for a Muslim in decision-making processes?

The process of exhaustive data analysis to conclude is the practice of artificial intelligence. However, can such an automated analysis be considered as a comprehensive analysis (and thus brings the best result) when the analysis is based only on these so-called "exhaustive" data, but in the process, it excludes the data that are available outside the cyberspace i.e. those data "*hikmatic*" data that can only be obtained from the mind of a Muslim scholar or ulama'?

Hence, the next debate in Islam is whether Muslims can get rid of these logical deductions of an *ulama'* (who has strong knowledge in the Islamic precepts with a strong *iman* or belief in Allah and has acquired vast experiences in making decisions). In short, the combination of human reason and sacred revelation, together with vast life experiences, when compared

with the exhaustive data analysis from cyberspace. Which one should be trusted?

This prompts the question of trustworthiness. For the former, can a Muslim be confirmed that the *ulama'* that he is relying on is really a "true" *ulama'*? Has the *ulama'* reached the level of wisdom that enables him to reach *hikmah* as expected/required? A clear understanding of the term *ulama'* is another important matter. The term must not be confined to the field of the so-called "religious" studies only. In Islam, again, as the *deen*, supposedly, there is no dichotomy between Islamic studies and natural and human sciences.

All types of study fields must be in line with the Islamic precepts/worldview. Therefore, in decision-making, if a Muslim does not feel that he has the intellectual capacity to answer his questions, then he must refer to an *ulama'* who is an expert who can enlighten by delivering the extensive and in-depth knowledge (*hikmah*) relevant to the field.

Allah s.w.t says in the Holy Quran 2: 269 the meaning of which "And one who is given *hikmah* surely he has been given a lot of good, and many do not take heed except *ulul al-Bab* – those who use intellect" This means if the matter is related to economics, then he should refer to an economist that can deliver an analysis that is imbued with the *hikmatic* inputs. As the term *ulama'* means a wise men, hence, it does not apply only to theologians.

These are some of the challenges prompted by the advancement of artificial intelligence that require Muslims to rethink the extent of the debates in Islamic epistemology, particularly on the concept of *hikmah* as the pivotal point or premise that anchors the Islamic framework on the matter. This book is a result of such rethinking.

Zahid Zamri and Hamidon Abd Hamid.

December 2024

Preface

بسم الله الرحمن الرحيم

In the name of God, Most Gracious, Most Merciful.

Artificial Intelligence (AI) is changing the world, shaping how we work, live, and solve problems. From automating tasks to tackling complex challenges, AI offers great potential. However, this rapid progress raises ethical questions: Can AI be used responsibly? How do we ensure AI benefits everyone fairly? This book, **Artificial Intelligence and *Hikmah***, explores these questions through the lens of ***Hikmah***, an Islamic concept of wisdom that blends knowledge, ethics, and practical action.

Hikmah is about making thoughtful, balanced decisions that align with moral and spiritual values. When combined with AI, it provides a framework for creating technology that not only solves problems but also respects human dignity and ethical principles. By grounding AI in *hikmah*, we can design systems that are fair, transparent, and accountable.

This book looks at how *hikmah* can guide AI in different areas, like education, healthcare, cybersecurity, and governance. Each chapter shows how wisdom can help AI serve humanity better, ensuring it promotes justice and well-being. It also highlights the importance of Islamic teachings in shaping ethical technology, showing that science and faith can work together.

This book is a collaborative effort, involving the Centre for Islamisation and the Kulliyyah of Information and Communication Technology, International Islamic University Malaysia. It stems from a need to contribute to providing some references on guiding the rapid development of AI from an Islamic perspective. This is much needed as various concerns are emerging within the society when looking into how fast and widely AI has affected the daily affairs of humans within a short period. We aim to inspire developers, educators, policymakers, and anyone interested in technology to think about AI's impact on society. We hope this book sparks conversations about using technology responsibly and wisely, guided by timeless ethical values.

In the chapters ahead, readers will see how *hikmah* can transform AI into a tool for good—creating a future where technology supports fairness, compassion, and harmony. Let this book be a guide for aligning innovation with the principles of wisdom and ethics.

Aznan Zuhid Saidin, Akram M. Zeki and Noor Azura Zakaria

December 2024

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In the name of Allah, the Most Gracious, the Most Merciful. All praise and thanks are due to Allah (SWT), who granted us the strength, guidance, and wisdom to complete this book. Without His blessings, this work would not have been possible.

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Our sincere thanks go to the **Kulliyyah of Information and Communication Technology (KICT)** for fostering an environment that encourages academic exploration and collaboration. We are deeply appreciative of **Professor Murni Mahmud, the Dean of KICT**, for her leadership and continuous encouragement throughout this journey. We also acknowledge the contributions of the **KICT management team**, whose efforts ensured the smooth progress of this work.

Finally, we express our gratitude to all **authors, reviewers, and colleagues** who shared their insights, ideas, and feedback. Their collective wisdom and dedication have enriched this book, and we hope it will inspire others to explore the intersection of technology and wisdom for the betterment of humanity.

May Allah accept this humble effort and make it beneficial for all. Ameen.

List of Abbreviations

(Selected)

AI: Artificial Intelligence
AI4SDGs: Artificial Intelligence for Sustainable Development Goals
AIoT: Artificial Intelligence of Things
APT: Advanced Persistent Threat
CPS: Cyber-Physical Systems
CSIRTs: Computer Security Incident Response Teams
CTI: Cyber Threat Intelligence
DDoS: Distributed Denial of Service
FAT: Fairness, Accountability, and Transparency
GAI: Generative Artificial Intelligence
GAN: Generative Adversarial Network
GRC: Governance, Risk, and Compliance
IDS: Intrusion Detection System
IoT: Internet of Things
IPS: Intrusion Prevention System
KPIs: Key Performance Indicators
ML: Machine Learning
MLP: Multilayer Perceptron (type of neural network)
NIST: National Institute of Standards and Technology
NLP: Natural Language Processing
OODA: Observe, Orient, Decide, Act (Loop)
SMEs: Small and Medium Enterprises
STIX: Structured Threat Information Expression
TTPs: Tactics, Techniques, and Procedures
XAI: Explainable Artificial Intelligence
X-IDS: Explainable Intrusion Detection Systems

Introduction

Hikmah: A Guiding Light in the Artificial Intelligence Wilderness

Aznan Zuhid Saidin
Akram M. Zeki
Noor Azura Zakaria

The prevalence of Artificial Intelligence (AI) has shifted from a technology limited within the domain of those having expertise in it, to something that is employed in many applications used daily. The emergence of generative AI that is now easily available further positions AI as a technology that will become a norm in society. However, unlike previous technologies that have caused disruption to humanity (Byrne, 2023; Wong, 2024), the challenges brought about by AI are different as they relate to intelligence, something that was previously limited to human beings.

The main challenge is how far human beings can accept the 'intelligence' of AI, especially generative AI, which ranges from total embrace to cautious acceptance. Outright rejection is not an option, as what is seen with previous disruptive technologies. Considering such a challenge, humanity needs guidance on how to navigate a new world living side by side with a technology that day by day exhibits human-like features, as if emerging as a new 'species', hence AI is seen by some as more than a mere tool. Such guidance is important for the users and developers of AI technology (Solaiman, 2023). In this book, "Artificial Intelligence and *hikmah*", we explore the relation between AI and *hikmah*, a concept in Islam that is mentioned more than 50 times in the Quran and several Hadith (Elias, 2023). *Hikmah* here is positioned as the guidance needed for humanity in living with AI. In the Islamic context, *hikmah* often denotes a deep understanding, wise judgment, and the ability to make sound decisions based on knowledge and insight (Zulkifli, 2020). *Hikmah* is translated in English as wisdom. It encompasses not just intellectual and philosophical wisdom but also practical wisdom in applying religious knowledge and ethical principles in daily life. This book would put forward discussions centred around how *hikmah* can create guiding principles in developing, distributing, and using AI in various aspects of human life.

Some discussion on fundamental concepts is presented in this book. Chapter 1 examines how concepts of creation can inspire the development of Artificial Intelligence (AI). The Quran emphasises the intricate design and harmony of the natural world as signs of God's existence and attributes, encouraging deep contemplation (*tafakur*). This aligns with Islamic principles that encourage contemplation of God's creations to understand His wisdom. While AI enhances human capabilities and revolutionises industries, it also raises concerns about materialism and consumerism. Islam emphasises the importance of balancing material pursuits with spiritual and ethical values. By incorporating spiritual and ethical considerations into AI development, we can ensure that these advancements serve humanity and promote a balanced and fulfilling life.

Chapter 2 examines how the Quran encourages intellectual pursuits through observation, contemplation, and deep reflection (*tadabbur*). Islam believes that understanding the world leads to a better understanding of the Creator. It actively supports the pursuit of knowledge, even in new areas, fostering creativity and technological advancement. The chapter investigates the compatibility between Islam's emphasis on intellectual inquiry and contemporary approaches to knowledge acquisition, demonstrating the harmony between Islam, knowledge, and technological breakthroughs, and highlighting the connection between religion and progress in the modern world.

Islam encourages embracing technology while upholding faith and values. Humanising AI from an Islamic perspective involves integrating human qualities like compassion and justice, ensuring fairness, transparency, and accountability. Ethical considerations, including privacy, data protection, and job displacement, must be addressed based on Islamic principles. Collaboration between Islamic scholars and technologists is crucial to develop ethical guidelines and ensure AI systems align with Islamic values, empowering Muslims to benefit from AI while safeguarding their faith and promoting societal well-being. This is discussed in Chapter 3.

Similarly, ethical decision-making within AI systems that are guided by wisdom (Hikmah) is discussed in Chapter 4. It investigates the intersection of wisdom and artificial intelligence (AI) in the context of the rapid advancement of AI technologies. It also examines how wisdom can guide ethical decision-making and promote transparency, fairness, and

accountability in AI systems. Through interviews with experts in AI ethics, philosophy, and technology development, the chapter explores how to integrate wisdom into AI design and development. The study also delves into the ethical dilemmas and challenges arising from the increasing integration of AI across various sectors and examines how wisdom can inform more responsible and ethical AI practices.

Prophetic teachings emphasise wisdom for a meaningful life. In education, wisdom integrates knowledge with Islamic principles. Education is an area that makes use of AI extensively. Chapter 5 advocates for "wisdom-based AI" in education, especially for guiding generative AI use. By aligning with Islamic principles, AI can foster critical thinking and deeper understanding, cultivating ethically conscious learners who can navigate modern technology and society effectively within the framework of *Maqasid al-Shariah*.

One aspect in which AI can assist in education is integrity. Chapter 6 looks into how AI can be employed in education to foster originality and creativity while upholding academic honesty. It explores various applications of generative AI, including personalised learning experiences, automated grading systems, and content generation for educational materials. The objective is to illuminate the potential of generative AI in enhancing academic integrity and preparing academia for the future of education.

Chapter 7 explores the transformative impact of AI on the lives of Muslim elderly in Malaysia. It examines AI-driven solutions such as telemedicine services, health monitoring devices, cognitive support tools, and mobility aids, all tailored to their specific needs. AI enhances access to healthcare, provides mental and spiritual support, and improves safety and security. The chapter highlights the use of AI in facilitating religious practices, including Quran apps and virtual religious gatherings. Ethical considerations, such as privacy and inclusivity, are emphasised. Through case studies, the chapter demonstrates the practical benefits of AI in enhancing the well-being and spiritual fulfilment of Muslim elderly in Malaysia.

Within the landscape of startup businesses, AI significantly aids startups. Early on, it powers market research, analyses customer behaviour, and automates marketing, optimising resource allocation. As startups grow, AI automates tasks, personalises marketing, informs data-driven decisions, and enables efficient scaling to manage increased customer interactions and

enhance overall business strategies. Chapter 8 emphasises the importance of employing AI ethically and in accordance with *hikmah* within the startup ecosystem. It delves into the ethical and Islamic-guided utilisation of AI tools and products and highlights the need for continuous learning and responsible AI use for Muslim startups to navigate the evolving AI landscape successfully while promoting societal benefit and positive change.

Cybersecurity has become a fundamental matter of the present time, and AI has an important role in creating a robust, secure online environment. In this respect, *hikmah* can play a role in guiding AI for cybersecurity. Chapter 9 outlines a new approach to Artificial Intelligence (AI) in cybersecurity that incorporates ethical wisdom, specifically via a *hikmah*-guided Artificial Intelligence (AI) approach. This approach seeks to create cyber defences that not only effectively protect systems but also adhere to ethical guidelines. By aligning AI's powerful capabilities with ethical principles, the goal is to build more robust and trustworthy cybersecurity systems.

This is further mentioned in Chapter 10, which looks into Cyber Threat Intelligence (CTI) mining, where AI helps organisations quickly find, analyse, and understand critical data related to cyber risks. With modern cyber threats constantly evolving, this makes them difficult to detect and stop with traditional security systems that rely on predefined rules. AI offers a solution by enabling organisations to proactively identify and respond to cyber threats by collecting and sharing real-time threat information more accurately and efficiently. This is particularly important in CTI. Cybersecurity frameworks can be made more ethically sound by integrating AI-guided CTI mining with *hikmah* principles.

The Internet of Things (IoT) faces significant security challenges due to its interconnected nature. Chapter 11 explores how blockchain technology, with its inherent security and transparency, can enhance IoT security. Blockchain can improve data security, authentication, and transparency, fostering a more secure and resilient IoT ecosystem. This aligns with the concept of *hikmah* by promoting communal well-being and data integrity. Blockchain's decentralised approach embodies principles of equity and justice, creating a secure and dependable technological framework that benefits the entire community and safeguards the integrity of data.

Concerns have arisen regarding the potential for players to confuse in-game violence with real-world actions, leading to moral panic. While games should be entertaining, realistic, and rewarding, ethical game design must also consider the moral implications of in-game actions. Chapter 12 explores how AI can be used to predict the behaviour of violent video game players when faced with moral dilemmas within the game. By analysing player choices and actions throughout the game, AI can dynamically adjust the game's narrative, presenting challenges that reflect the player's demonstrated morality. This approach allows for a more nuanced and engaging gaming experience while also encouraging players to consider the ethical consequences of their in-game choices.

AI can also play an important role in the field of mental health. Chapter 13 investigates how AI and machine learning can be used to analyse social media data (from platforms like Facebook, Twitter, and Reddit) and identify potential suicide risks by detecting linguistic patterns associated with suicidal thoughts. The chapter also addresses the ethical considerations surrounding the use of AI for such sensitive tasks, emphasising the importance of accuracy, privacy, and user consent. Furthermore, it explores how the application of AI in this context can be aligned with the principle of *hikmah*, which promotes discernment, compassion, and the preservation of life.

Chapter 14 introduces an AI governance framework rooted in Islamic principles, emphasising accountability, transparency, fairness, trust (*Amanah*), justice (*Adl*), responsibility (*Muhtam*), explainability (*Mubin*), and ethical leadership (*Khalifah*). The framework utilises Retrieval-Augmented Generation (RAG) systems for large language models (LLMs). RAG enhances accuracy and relevance by dynamically retrieving external knowledge, aligning AI outputs with Islamic values. By operationalising these principles, RAG systems can support ethical, trustworthy, and socially beneficial AI applications across various sectors, including education, healthcare, finance, and environmental governance. This value-driven paradigm offers a foundation for responsible AI development. Chapter 15 presents the main ideas of each chapter as a conclusion.

For every area of AI application, humanity needs to make sure that the technology being developed and used does not cause harm. The possibilities of *hikmah* becoming the guiding concept in various applications of AI are endless. From the discussions provided in the chapters of this book, more

efforts are hoped to emerge to further expand the role of Islamic teachings in guiding the development of AI for human civilisation.

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Chapter 1

Allah's Wisdom in Creating the Universe as a Source of Inspiration in Artificial Intelligence

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Abstract
In the Quran, the intricate design and harmony of the natural world are presented as signs (*ayat*) of Allah's existence and attributes, encouraging deep reflection on His creation. This perspective aligns with the importance of *Tafakur* in Islam, which involves reflecting on the signs of Allah in the universe and understanding His wisdom. As artificial intelligence (AI) continues to transform human capabilities, enabling machines to replicate cognitive functions and behaviours, the importance of balancing material pursuits with spiritual and ethical considerations becomes increasingly significant. AI has revolutionised industries by enhancing efficiency and personalisation, but has also contributed to materialistic influences and consumerism. Islam emphasises the need to balance these pursuits with spiritual and ethical values, highlighting the central role of the Soul (الروح) in human interactions, together with technological advancements. *Tafakur* is , encouraged as a means of strengthening faith and achieving wisdom (حكمة *hikmah*), which involves applying knowledge in a just and purposeful manner. The article further explores how nature-inspired algorithms, such as Particle Swarm Optimisation, Ant Colony Optimisation, and the Bat Algorithm, draw from natural processes to solve complex modern problems, reflecting the Quranic encouragement to seek insights from the natural world. This tradition of learning from nature not only advances knowledge and technology but also aligns with the Islamic view of humanity's role as *Khalifah* on Earth, integrating spiritual and scientific exploration.

Keywords: AI, Meditation, *Tafakur*, AI Algorithms, Wisdom

Introduction

Nature, with its complexities and wonders, has long been seen as a reflection of divine insight in various religious and philosophical beliefs. In the Quran, human relations with nature are shown as a sign of Allah's creation and wisdom. The Quran emphasises the connection of all living beings and the responsibility of humans as *Khalifah* on Earth. Nature, on the other hand, is shown in the Quran as a manifestation of Allah's power and wisdom. The complicated design and harmony observed in the natural world serve as signs (*ayat*) of Allah's existence and attributes.

صُنْعَ ٱللَّهِ ٱلَّذِىٓ أَتْقَنَ كُلَّ شَىْءٍ

"*That is the design of Allah, Who has perfected everything."*
[*Surah Al-Naml*:88]

In this era, artificial intelligence (AI) is transforming human capabilities, enabling machines to replicate cognitive functions and demonstrate behaviours like human intelligence. The importance of meditation / *Tafakur* (التفكّر) becomes increasingly important as individuals navigate a world flooded with technological advancements and digital devices.

The impact of artificial intelligence on human experience brings both opportunities and challenges, reflecting on the ethical and spiritual dimensions of technological advancement. AI has revolutionised industries by enhancing efficiency, precision, and personalisation in various fields, such as healthcare and finance. However, the materialistic influence also extends to consumerism, with AI driving targeted marketing and increasing consumption, potentially shifting how individuals perceive and value material goods. Islam emphasises the importance of balancing material pursuits with spiritual and ethical considerations. The rise of AI raises concerns about the Soul (الروح) as the central entity controlling human interaction, as technology mediates more of our daily experiences.

Tafakur (تَفَكُّر) refers to deep contemplation, reflection, or meditation, particularly on the signs of Allah S.W.T in the universe, nature, and the human self. It is an act of using one's intellect to ponder over the creation of Allah S.W.T, His attributes, and the wisdom behind His decrees. *Tafakur* is highly encouraged in Islam as a means of strengthening one's faith, understanding the reality of life, and recognising the greatness of Allah S.W.T.

Wisdom (حِكْمَة, *Hikmah*) in Islam is closely related to *Tafakur*. Wisdom is seen as a gift from Allah, often granted to those who engage in deep reflection and contemplation. Through *Tafakur*, a believer can reach a higher level of understanding and insight into the divine purposes behind creation, leading to wisdom. Wisdom involves not just knowledge, but the ability to apply that knowledge in a just, beneficial, and purposeful manner, in alignment with divine guidance.

Engaging in *Tafakur* leads to the development of wisdom, and possessing wisdom further enhances one's capacity for meaningful reflection. Islamic teachings suggest that those who frequently practice *Tafakur* are more likely to reach wisdom, as they align their thoughts with divine guidance and the deeper truths of existence. This process ultimately helps believers live a life of purpose, righteousness, and understanding in accordance with the will of Allah.

The *Tafakur* is a way to learn about the attributes of Allah (SWT) and become closer to Him, and it is a profound way to enhance mental clarity, emotional flexibility, and cognitive well-being in the rapid pace of technological innovation. Islamic *Tafakur* take a more advanced level than secular meditation as it links the human and nature to the next life as mentioned in the Ayat:

إِنَّ فِى خَلْقِ ٱلسَّمَـٰوَٰتِ وَٱلْأَرْضِ وَٱخْتِلَـٰفِ ٱلَّيْلِ وَٱلنَّهَارِ لَـَٔايَـٰتٍ لِّأُو۟لِى ٱلْأَلْبَـٰبِ . ٱلَّذِينَ يَذْكُرُونَ ٱللَّهَ قِيَـٰمًا وَقُعُودًا وَعَلَىٰ جُنُوبِهِمْ وَيَتَفَكَّرُونَ فِى خَلْقِ ٱلسَّمَـٰوَٰتِ وَٱلْأَرْضِ رَبَّنَا مَا خَلَقْتَ هَـٰذَا بَـٰطِلًا سُبْحَـٰنَكَ فَقِنَا عَذَابَ ٱلنَّارِ

“Indeed, in the creation of the heavens and the earth and the alternation of the day and night, there are signs for people of reason. ˹They are˺ those who remember Allah while standing, sitting, and lying on their sides, and reflect on the creation of the heavens and the earth ˹and pray˺, “Our Lord! You have not created ˹all of˺ this without purpose. Glory be to You! Protect us from the torment of the Fire.” [*Surah Al-Imran*: 190-191]

In his *tafseer* of *ayah* 2:164, Syed Qutub said:

This unique *Qur’ānic* approach in addressing the human mind and heart tends to heighten man’s feelings and emotions and make him behold and contemplate the wonders of the Universe. Familiarity may have blunted man’s appreciation of these marvels, but the verses invite him to reflect on

the world around, as if for the first time, with open eyes and eager senses and a conscious heart. The physical world is full of beautiful mysteries and awe-inspiring events that have captivated many an eye and fascinated many a heart. The world is a boundless festival of mystery, splendour and beauty. The Heavens, the Earth, the planets, the stars, the galaxies, are all floating along their decreed orbits with incredible harmony, in a vast expanse of limitless space of dizzying dimensions. Man has been fascinated by this vast gallery of wonders long before he was able to get a glimpse, through study and science, of how it works and what lies behind it (Syed Qutb, 1959).

In a parallel line, this deep sense of wonder and discovery has inspired the development of various artificial intelligence (AI) algorithms that draw from the patterns and processes observed in the natural world. For example, Particle Swarm Optimisation reflects the collective behaviour of swarms and flocks. Ant Colony Optimisation is inspired by the foraging behaviour of ants, and the Bat Algorithm emulates the echolocation of bats. These nature-inspired algorithms illustrate how human initiative utilises the complexities and efficiencies of natural systems to solve modern problems, continuing the tradition of looking to nature for inspiration and understanding. For Muslims, this spirit of drawing inspiration from the natural world is deeply rooted in the Quranic encouragement to discover the universe's secrets. Embracing this approach, Muslims can engage more profoundly with both spiritual and scientific inquiries of seeking insights from nature to advance knowledge and technology to be the *Khalifah* on earth.

Islamic wisdom can also provide a rich ethical framework that inspires the design and development of artificial intelligence (AI). By embedding principles rooted in justice, accountability, and the preservation of human dignity, AI can be shaped into a force for good, aligning with universal values and promoting societal well-being.

Collaboration between modern science and spirituality fosters a harmonious balance in technological development by rooting innovation in ethical and moral principles. This partnership ensures that advancements serve humanity holistically, addressing both material and spiritual needs.

A key foundation in Islamic ethics is the emphasis on honesty (الصدق) and transparency. AI systems should provide clear, truthful, and unbiased information, ensuring trustworthiness. Moreover, accountability (المسؤولية) is

essential in AI development, requiring developers and organisations to take responsibility for the societal impacts of their creations and to ensure they operate fairly and justly.

Justice (العدل) is another cornerstone of Islamic ethics, which can guide AI to avoid discriminatory practices and biases. The intention (النية) behind any action holds significant importance in Islamic thought. AI development, therefore, should be driven by a purpose that aligns with the *Maqasid Al-shariah* (objectives of Islamic law), such as preserving life, intellect, and human welfare.

By drawing on these Islamic principles, AI can be developed not merely as a technological tool but to enhance ethical progress. From addressing biases and ensuring fairness to promoting sustainability, the integration of Islamic wisdom offers a holistic approach to AI development that prioritises human and societal well-being.

AI Algorithms Derived from Nature

The exploration of nature's complicated systems and behaviours has long fascinated scientists and researchers. In the area of artificial intelligence (AI), this fascination has translated into the development of algorithms inspired by natural phenomena. By observing and copying the processes and patterns found in the natural world, AI researchers have created innovative solutions that emulate the efficiency, adaptability, and complexity inherent in biological systems. These nature-derived algorithms, such as Genetic Algorithms, Particle Swarm Optimisation, and Ant Colony Optimisation, draw upon collective behaviour, and natural resource management strategies to address complex computational problems. This subsection explores how these algorithms, inspired by the dynamics of the natural world, have shaped modern AI and continue to drive advancements by integrating the signs of Allah's wisdom shown in nature into technological innovation:

Ant Colony Optimisation (ACO)

Ant Colony Optimisation (ACO) is an optimisation algorithm modelled after the searching behaviour of real ants (Zolghadr-Asli, 2023a). Both in nature and in ACO, the primary mechanism is the use of pheromone trails to communicate and find efficient paths to resources. In real life, ants lay down pheromones as they travel, with the intensity of the path indicating the quantity and quality of the food source. Other ants follow these pheromone

trails, reinforcing successful paths that lead to abundant food. Similarly, in ACO, artificial ants navigate the search space, laying down virtual pheromones on paths that lead to good solutions. The probability of an ant choosing a path is influenced by the amount of pheromone, mirroring how real ants are more likely to follow stronger pheromone paths.

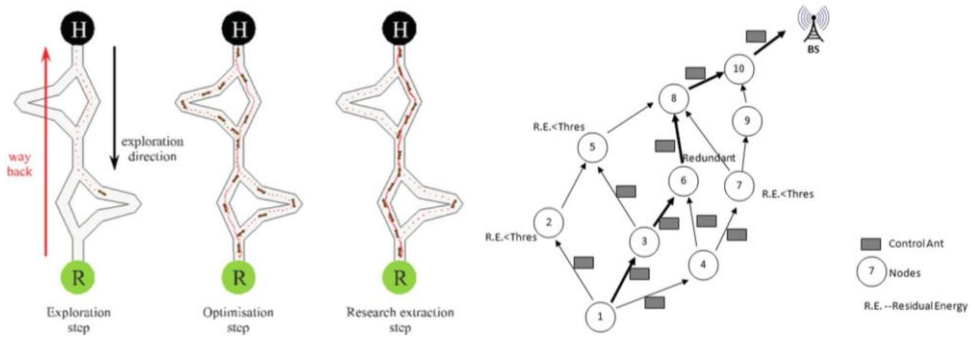


Figure 1: Ant Colony Optimisation (Katona et al., 2019)

Both systems rely on a balance of exploration and exploitation. In the natural world, ants initially explore randomly but increasingly follow pheromone paths as they find food sources, allowing the colony to quickly exploit the best resources. In ACO, artificial ants also start with random exploration and gradually converge on the optimal solution as successful paths accumulate more pheromone. This iterative process helps both real and artificial ants optimise their search over time, ensuring that the most efficient routes are found and utilised.

Allah S.W.T created ants with the instinct to search for food and guided them in their ways to search for food to sustain their colony. Meanwhile, ACO is designed to solve complex mathematical and engineering optimisation problems, such as finding the shortest path in a network or optimising scheduling tasks. This distinction highlights the practical and theoretical difference between biological systems and computational algorithms.

Another key difference lies in the mechanism of pheromone evaporation. In nature, pheromones naturally dissipate over time, preventing ants from becoming fixated on suboptimal paths and encouraging continuous exploration. In ACO, pheromone evaporation is mathematically modelled, with parameters controlling the rate of evaporation to balance exploration and exploitation. This allows for the precise setting of the algorithm to ensure optimal performance across various problem domains.

The scale and complexity of the environments also differ. Real ants operate in physical, three-dimensional environments with dynamic changes, such as weather conditions and predator presence. They must navigate these complexities using simple, local rules and limited sensory information.

Ant Colony Optimisation (ACO) has found many applications in solving complex real-life problems, particularly those that require optimisation. One of the significant uses of ACO is in routing within telecommunications networks, where it dynamically finds the shortest and most efficient paths for data packets, thereby reducing latency and improving network performance. In logistics and supply chain management, ACO is widely applied to the Vehicle Routing Problem (VRP), optimising routes for a fleet of vehicles to minimise travel distance, time, and cost while meeting delivery constraints. Similarly, ACO has proven effective in tackling the classic Travelling Salesman Problem (TSP), where it identifies the shortest route for visiting multiple cities, a task crucial for efficient route planning in industries like manufacturing.

Moreover, ACO has been used to address assignment problems, such as allocating jobs to machines or staff to shifts, optimising productivity and minimising completion time. In computer networks, ACO aids in load balancing by evenly distributing network traffic across resources, preventing bottlenecks and enhancing performance. One example of how ACO can be utilised is in overcrowded hospitals, which often face challenges in managing patient admissions, discharges, and transfers between departments. ACO can optimise patient flow by identifying the shortest and least congested pathways for transferring patients or scheduling resources like operating rooms, medical staff, or equipment.

Artificial Neural Networks (ANN)

Artificial Neural Networks (ANNs) are computational models inspired by the structure and function of biological neural networks found in the human brain (Tilp, 2024). In biological neural networks, neurons are the basic units that process and transmit information. They consist of a cell body (soma), dendrites that receive signals from other neurons, and an axon that transmits signals to other neurons through synapses. Similarly, artificial neurons in ANNs are interconnected nodes that receive inputs, apply weights to these inputs, sum them, and then apply an activation function to produce an

output. This signal transmission and processing mechanism enables both systems to recognise patterns, learn from data, and make decisions based on input information. This structural similarity allows ANNs to process and learn from data in a manner similar to biological neural networks.

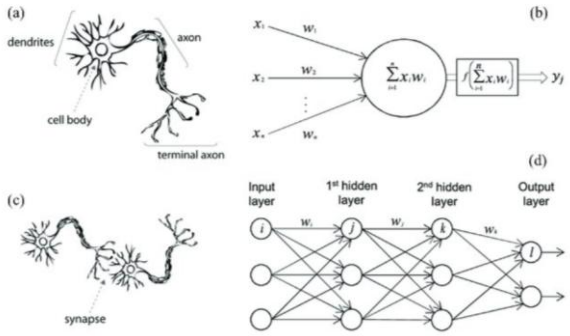


Figure 2: A biological neuron in comparison to an artificial neural network: (a) human neuron; (b) artificial neuron; (c) biological synapse; and (d) ANN synapses (Meng et al., 2020)

Biologically, neural networks in the brain are highly complex and adaptive systems to perform a wide range of cognitive and sensory functions essential for survival. They exhibit remarkable adaptability through synaptic plasticity, where the strength of connections between neurons changes based on experience and learning, enabling humans and other organisms to learn, remember, and adapt to new situations.

Meanwhile, ANNs are designed for specific computational tasks, such as pattern recognition, classification, regression, and optimisation. They are implemented on digital computers using mathematical algorithms and numerical computations to simulate the behaviour of neurons and synapses. While ANNs can perform complex computations and learn from large datasets. In ANNs, learning is typically achieved through algorithms such as backpropagation, where errors between predicted and actual outputs are used to adjust the weights of connections between artificial neurons. While effective for training ANNs on specific tasks, this learning method is more fixed and less adaptable compared to the continuous, adaptive learning observed in biological systems.

Artificial Neural Networks (ANNs) have become essential in many real-life applications across multiple industries, thanks to their ability to model complex patterns and learn from large datasets. In healthcare, ANNs are used

for medical diagnosis by analysing images like X-rays and MRIs to detect diseases such as cancer, as well as predicting patient outcomes and personalising treatments. In the financial sector, ANNs aid in credit scoring, fraud detection, and stock market prediction by identifying patterns in financial data. They are also a key component in the development of autonomous vehicles, where they process sensor and camera data to enable real-time navigation and safety decisions. In Natural Language Processing (NLP), ANNs power applications such as speech recognition, language translation, and sentiment analysis, making virtual assistants like Siri and Alexa more effective. Additionally, recommender systems on platforms like Netflix and Amazon rely on ANNs to suggest personalised content by analysing user preferences. In manufacturing, ANNs are used for predictive maintenance and quality control, ensuring that machinery operates efficiently and products meet quality standards.

Particle Swarm Optimisation (PSO)

Particle Swarm Optimisation (PSO) is an optimisation algorithm inspired by the social behaviour observed in bird flocking and fish schooling. This algorithm simulates how these animals move and adapt their positions based on both individual and group experiences to locate optimal solutions within search spaces. In both natural systems and PSO, collective behaviour is a key similarity. In nature, birds and fish adjust their positions relative to their neighbours to maintain group cohesion and avoid predators. Similarly, in PSO, particles, representing potential solutions, move through the search space influenced by their personal experience and the collective knowledge of the swarm.

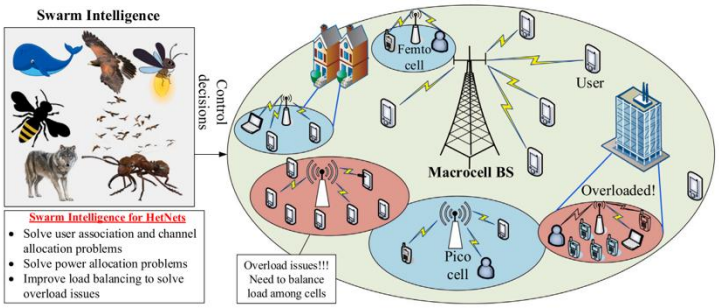


Figure 3: Illustration of a three-tier HetNet, including macro cell, pico cell, and femto cell, and the applications of SI (Pham et al., 2021)

The mechanism of position and velocity updates is another point of similarity. In the natural world, animals adjust their velocity and direction based on the positions of their neighbours, aiming for optimal positioning within the group. In PSO, each particle updates its velocity and position based on its personal best position and the global best position found by the swarm. This mimics the way animals adjust their movements based on the best locations discovered by their group. Additionally, both systems utilise collective behaviour to optimise outcomes. Birds and fish optimise their movement patterns to find food, avoid predators, or migrate efficiently, leveraging the shared information within the group. In PSO, particles share information about the best positions they have found, helping the entire swarm converge towards the optimal solution by exploiting collective intelligence.

Despite these similarities, there are significant differences between real-life swarm behaviour and PSO. The purpose and application of each are fundamentally different. Real-life swarms aim for survival, foraging, and efficient migration, driven by biological needs and environmental pressures. In contrast, PSO is designed for mathematical and engineering optimisation problems, finding optimal solutions in abstract search spaces like minimising a function or optimising a design. Another key difference lies in the method of information sharing. In natural swarms, information is shared indirectly through visual, auditory, or chemical cues, without explicit communication of "best" positions. In PSO, information sharing is explicit, with particles having access to the exact coordinates of the best positions found by themselves and the swarm, enabling precise adjustments.

Scalability and control also distinguish the two systems. Real-life swarms are governed by simple, local rules and are limited by the physical and sensory

capabilities of the animals. PSO, however, can scale to large numbers of particles and is controlled by mathematical equations and parameters (such as inertia weight, cognitive, and social coefficients), allowing fine-tuning and adaptability to various problem domains. Furthermore, while birds and fish move in three-dimensional space, dealing with physical constraints and real-world dynamics, PSO particles can operate in n-dimensional abstract search spaces, which are not bound by physical constraints. This flexibility allows PSO to tackle a wide range of complex optimisation problems.

Lastly, the adaptation mechanisms differ significantly. Adaptation in animal behaviour is driven by evolutionary processes, learning, and immediate sensory feedback. In contrast, adaptation in PSO is purely algorithmic, based on iterative updates of positions and velocities guided by mathematical rules and objective functions.

Particle Swarm Optimisation (PSO) has been effectively applied to solve a range of real-world problems across various fields. In engineering and design optimisation, PSO is prominently used in aerospace engineering to refine the design of aircraft components, enhancing performance and efficiency. In healthcare, PSO improves the accuracy of image segmentation in medical imaging, particularly aiding in the detection of tumours in MRI scans by precisely identifying and delineating abnormal tissues. Additionally, PSO plays a significant role in robotics, where it is employed in path planning for autonomous robots. The algorithm helps determine the most efficient route for robots to reach their destinations while avoiding obstacles, thereby optimising navigation and operational efficiency. These applications showcase PSO's versatility and effectiveness in addressing complex challenges across different domains.

Bee Colony Optimisation (BCO)

Bee Colony Optimisation (BCO) is an optimisation algorithm inspired by the foraging behaviour of real honeybees. It mimics how bees collectively search for the best food sources to optimise their colony's survival and productivity. Similarly, in nature, bees exhibit complex foraging behaviours driven by the need to gather nectar and pollen efficiently. The behaviour of the bees described is presented in Figure (4) and it shows the collaborative approach for obtaining the optimum solution. The algorithm and real bees both share fundamental principles of collective decision-making and resource optimisation.

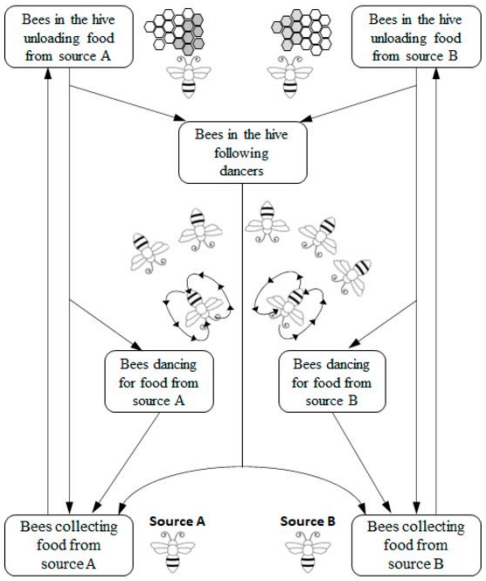


Figure 4: General schema of bee behaviour (Forcael et al., 2024)

In BCO, artificial bees represent candidate solutions to optimisation problems, with each bee exploring the search space to find better solutions. Bees communicate information about good solutions through dances and pheromone trails in real life, which influences other bees' decisions on where to forage. This communication ensures the colony efficiently exploits rich food sources while avoiding the less rewarding ones. Similarly, in the algorithm, artificial bees share information about promising solutions through the exchange of data structures like pheromones or solutions. This facilitates a collaborative search process where the entire swarm converges towards optimal solutions over successive iterations.

Despite these similarities, there are significant differences between BCO and real bees. The primary difference lies in their purpose and context. Real bees engage in foraging behaviours to sustain their colonies, ensuring their survival and growth within natural ecosystems. Their decisions are driven by biological imperatives such as energy efficiency, resource availability, and environmental conditions. In contrast, BCO is utilised in computational optimisation problems where the goal is to find optimal solutions within defined problem spaces. The algorithm operates in abstract environments defined by mathematical models, focusing on maximising performance metrics rather than biological fitness or survival.

Furthermore, the mechanisms of communication and decision-making differ. Real bees rely on sophisticated sensory and communication systems, including dances and pheromones, to transmit information about food sources. This communication is decentralised and based on local interactions among bees in the hive or foraging areas. In contrast, BCO uses algorithms to simulate these behaviours, with parameters and rules governing how artificial bees communicate and share information. This centralised control allows for precise tuning and optimisation of the algorithm's performance but lacks the adaptive and dynamic nature of real bee communication.

Bee Colony Optimisation (BCO) has been effectively utilised across various fields to address complex optimisation problems. In telecommunications, BCO helps optimise routing and resource allocation in wireless sensor networks and other communication systems, improving efficiency and performance. In logistics, the algorithm is employed to solve vehicle routing problems, aiming to minimise the distance travelled or the cost of delivery, thereby enhancing operational efficiency. In engineering design, BCO assists in finding optimal designs for structures, systems, and components, contributing to more effective and resource-efficient solutions. Additionally, BCO is applied in data clustering, where it groups large datasets into meaningful clusters, facilitating data mining and machine learning processes by making data more manageable and insightful. These diverse applications highlight BCO's versatility in solving optimisation challenges across different domains.

Bat Algorithm (BA)

The Bat Algorithm (BA) in artificial intelligence draws inspiration from the echolocation behaviour of bats in nature. This optimisation algorithm is designed to simulate how bats hunt for prey using sound waves, specifically through a technique known as echolocation (Zolghadr-Asli, 2023b). Bats send out ultrasonic pulses and listen for the echoes that come back from objects or prey in their environment. This process allows them to navigate, locate food, and avoid obstacles in darkness, showcasing their remarkable ability to optimise their hunting strategy based on sensory feedback.

In the Bat Algorithm, artificial bats represent candidate solutions to optimisation problems. Each bat's position in the solution space corresponds to a potential solution, and its echolocation behaviour is simulated through frequency tuning. Bats adjust their frequency transmitting dynamically to

explore the search space and improve their solutions iteratively. When a bat finds a better solution (e.g., higher fitness in optimisation terms), it adjusts its position accordingly. This copies how real bats adjust their flight path and hunting strategies based on the quality of echoes received from potential prey or obstacles.

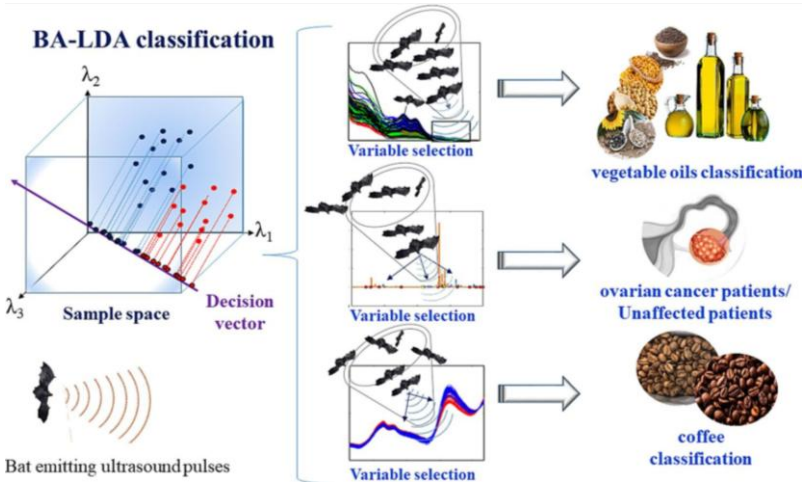


Figure 5: Bat algorithm for variable selection in multivariate classification modelling (Souza et al., 2023)

The algorithm operates within a computational framework, driven by mathematical models and algorithms to simulate the echolocation and movement behaviours of bats. It focuses on optimising solutions to complex problems such as function optimisation, clustering, and pattern recognition in digital environments. While real bats utilise echolocation as a sensory adaptation for survival, navigation, and prey detection in natural environments, influencing their ecological roles and interactions within ecosystems.

Artificial bats adjust their frequencies and positions in the solution space based on experimental rules and parameters set by the algorithm designer, aiming to reach towards optimal solutions over successive iterations. This contrasts with the adaptive and dynamic nature of echolocation in real bats, which involves complex neural processing and behavioural responses to real-time environmental influences.

The Bat Algorithm has been effectively applied to different real-life optimisation challenges across multiple fields. In engineering, it optimises the design of structures like buildings and bridges, ensuring strength and stability

while minimising material usage. In wireless communications, the algorithm is used to optimise the placement of antennas and base stations for maximum coverage and signal strength, as well as channel allocation to reduce interference. In image processing, the Bat Algorithm stands out in tasks like image segmentation and feature extraction, which are crucial for medical imaging, satellite analysis, and biometric identification. In robotics, it aids in path planning and navigation for autonomous robots and drones, ensuring efficient and accurate operations in dynamic environments.

Cuckoo Search (CS)

The Cuckoo Search algorithm (CS) in artificial intelligence is inspired by the reproductive behaviour of cuckoo birds in nature, specifically the dependent behaviour exhibited by some cuckoo species (Kouziokas, 2023). These birds lay their eggs in the nests of other bird species, relying on the host birds to hatch their eggs and raise their chicks. This strategy minimises the cuckoo's investment in parental care while maximising reproductive success. The algorithm copies this behaviour to solve optimisation problems, aiming to efficiently find optimal solutions through a process of exploration and exploitation.

Figure 6: Cuckoo bird Search (Khalifa et al., 2024)

In the Cuckoo Search algorithm, candidate solutions to optimisation problems are represented as cuckoo eggs. These eggs correspond to potential solutions within a search space, each with a certain fitness or quality measure. The algorithm iteratively improves these solutions by copying the process of a cuckoo laying eggs in a nest and potentially replacing

eggs with higher fitness values. This is similar to how real cuckoos may lay eggs in multiple host nests, with the hope that some eggs will be nurtured by unaware hosts to maturity.

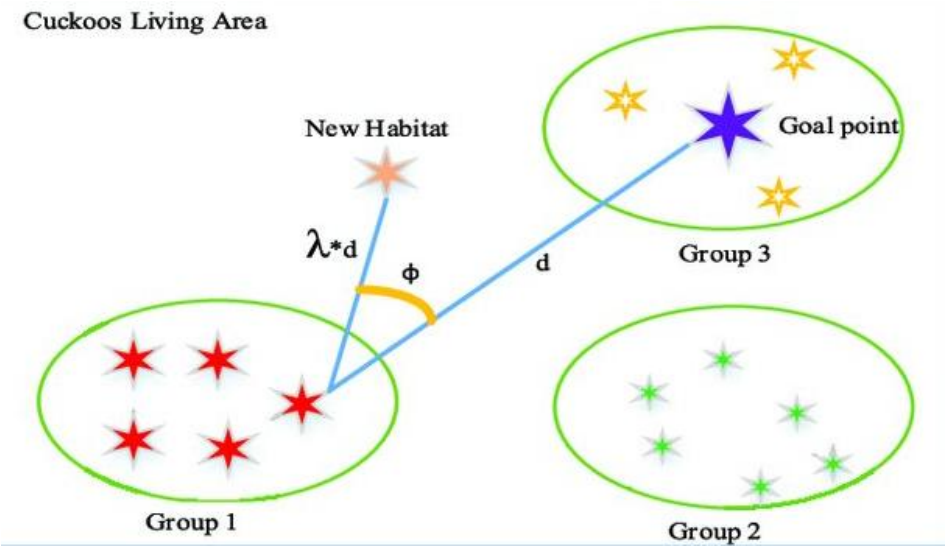


Figure 7: Migration of cuckoos to the target (Jalali Zand et al., 2022)

The algorithm operates within a computational framework defined by mathematical models and algorithms. It utilises experimental rules and probabilistic methods to simulate the cuckoo's reproductive strategy, optimising solutions to complex problems such as function optimisation, parameter estimation, and machine learning tasks. In contrast, real cuckoos' reproductive behaviour affects their survival, population dynamics, and interactions with host species.

Additionally, the Cuckoo Search algorithm employs randomisation and a levy flight strategy to explore the search space and improve candidate solutions iteratively. This random approach aims to balance exploration (finding new potential solutions) and exploitation (improving existing solutions) to converge towards optimal outcomes.

Cuckoo Search has been applied effectively across many real-life domains to tackle complex optimisation problems. In wireless sensor networks, Cuckoo Search is used to determine optimal sensor placements, ensuring maximum coverage and efficient data transmission while conserving energy. In image

processing, it aids in tasks like image segmentation and feature selection, which are crucial for applications in medical imaging, satellite analysis, and object recognition. In data mining and machine learning, Cuckoo Search helps optimise algorithm parameters and feature selection, enhancing model performance. Additionally, in renewable energy systems, Cuckoo Search optimises the operation of wind turbines and solar panels to maximise energy production.

Firefly Algorithm (FA)

The Firefly Algorithm (FA) is a nature-inspired optimisation algorithm based on the flashing behaviour of fireflies. The key idea behind the algorithm is that the flashing lights of fireflies attract other fireflies (Pacheco da Luz et al., 2023). In nature, fireflies use bioluminescence to attract mates or prey. The brighter the flash, the more attractive the firefly. This behaviour is translated into the algorithm where fireflies are considered as agents that explore the solution space, and their attractiveness is proportional to their brightness, which in turn is associated with the quality of the solution they represent.

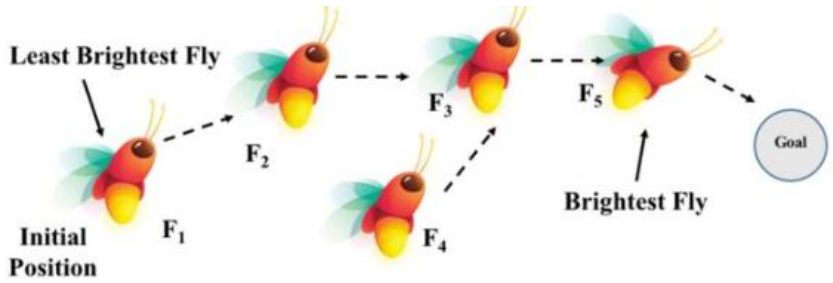


Figure 8: Diagram representing working of Firefly algorithm (Sharma & Doriya, 2020)

In the Firefly Algorithm, each firefly moves towards brighter fireflies, thus exploiting the search space. The brightness of a firefly decreases with distance, making nearby fireflies more attractive than those farther away. This characteristic ensures that the algorithm performs both local and global search effectively. The fireflies with less brightness move towards those with more brightness, and this movement is influenced by attractiveness and randomness, providing a balance between exploration and exploitation.

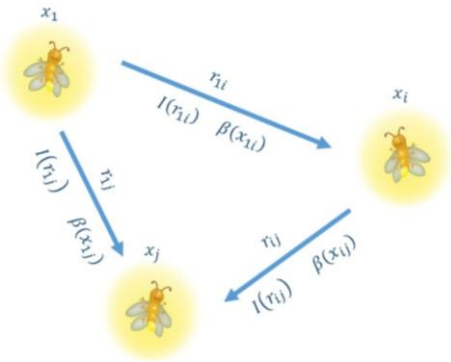


Figure 9: A conceptual view of the firefly algorithm relationships, including locations x , distance r, brightness $I(r)$, and attractiveness $\beta(r)$ (Louzazni et al., 2018)

For real fireflies, the bioluminescence is produced through a chemical reaction involving luciferase, luciferin, ATP, and oxygen. This natural phenomenon is highly efficient and serves as a communication signal to attract potential mates over distances. Additionally, some fireflies use their flashes to lure prey, particularly in species where predatory behaviour is observed. The Firefly Algorithm is designed for optimisation problems, using the metaphor of light attraction to find optimal or near-optimal solutions in complex search spaces.

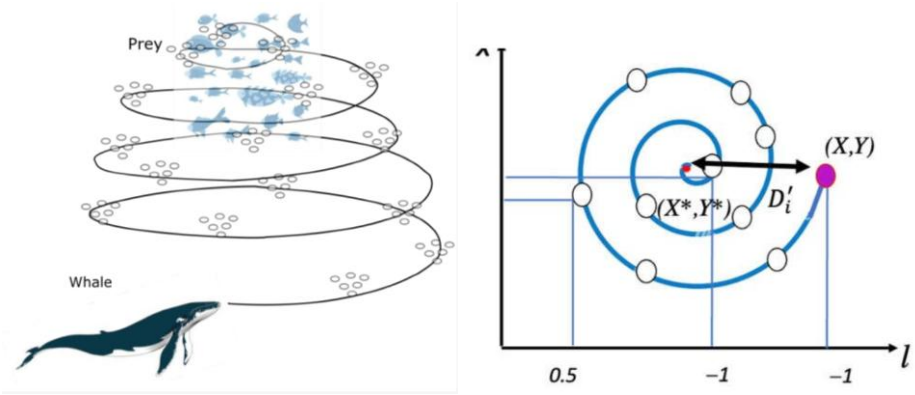
The Firefly Algorithm abstracts and simplifies the behaviour of real fireflies. In the algorithm, fireflies are uniformly attracted to one another based solely on brightness, and this interaction is mathematically modelled to suit optimisation tasks.

The Firefly Algorithm has been effectively applied to a different range of real-life problems across various domains. In automotive design, it optimises vehicle aerodynamics and engine tuning, enhancing fuel efficiency and performance. For environmental monitoring, the algorithm optimises the placement of sensors and pollution control devices to maximise data accuracy and minimise environmental impact. In healthcare, it enhances medical image analysis and assists in drug discovery by optimising diagnostic algorithms and evaluating promising compounds. In traffic management, it refines traffic signal timings and public transportation schedules to reduce congestion and improve service efficiency. Additionally, the algorithm is used in energy storage systems to optimise battery management and energy grid

operations, and in game development to enhance AI behaviour and level design, creating more engaging and challenging gameplay experiences.

Whale Optimisation Algorithm (WOA)

The Whale Optimisation Algorithm (WOA) is a nature-inspired optimisation technique that copies the hunting behaviour of humpback whales. This algorithm is based on the bubble-net feeding strategy of humpback whales, a unique method where whales create spiral-shaped bubble nets to encircle and trap groups of fish (Liang et al., 2024). The WOA uses this strategy to perform global optimisation by modelling the social behaviour and cooperative hunting techniques of these marine mammals.



(a) (b)

Figure 10: General representation of a bubble-net search mechanism in WOA (X* is the best solution obtained to date): (a) shrinking encircling mechanism and (b) spiral updating position. (Rana et al., 2020)

In the Whale Optimisation Algorithm, candidate solutions are represented as whales in the search space. The algorithm simulates the whales' bubble-net hunting method in two phases: encircling prey and spiral updating position. In the encircling phase, whales move towards the best-known solution, simulating the way real whales gather on their prey. The spiral updating phase models the bubble-net method by creating a spiral-shaped path for the whales to follow, which allows the algorithm to exploit the search space around the best solution. This combination of exploration and exploitation helps the algorithm to find optimal solutions efficiently.

Real humpback whales, on the other hand, use their bubble-net feeding strategy as a cooperative hunting technique. Groups of whales work together

to create bubbles in a circular pattern to confine fish to a small area, making it easier to capture them. This behaviour involves complex communication and coordination among the whales, highlighting their social and intelligent nature. The efficiency of this method relies on the whales' ability to create bubbles and swim in precise patterns to trap their prey effectively.

While the WOA draws inspiration from the bubble-net feeding behaviour of humpback whales, there are several key differences between the algorithm and the real-life behaviour of whales. The WOA abstracts and simplifies the complex behaviours of whales into mathematical models that can be applied to optimisation problems. For example, in the algorithm, the movement of whales towards the best solution is governed by equations that ensure convergence, whereas real whales rely on instinct, experience, and social cues to hunt.

Artificial Immune System (AIS)

The Artificial Immune System (AIS) is a computational approach that draws inspiration from the principles and processes of the biological immune system. The biological immune system is a complex network of cells, tissues, and organs that work together to identify and neutralise pathogens such as bacteria, viruses, and other foreign substances (Ren et al., 2024). It relies on mechanisms such as recognition, learning, memory, and adaptation to protect the organism from infections and maintain homeostasis.

Similarly, the AIS is designed to solve complex computational problems by copying these immune processes. It utilises algorithms that simulate the immune system's ability to recognise patterns, adapt to new threats, and remember past encounters. AIS models typically include components such as artificial antibodies, antigen recognition, and clonal selection, which are used to identify and respond to patterns within data. These systems are applied in different fields, including anomaly detection, optimisation, and machine learning.

One of the key similarities between the AIS and the real immune system is their reliance on pattern recognition and adaptive learning. In the biological immune system, immune cells such as B-cells and T-cells recognise and bind to antigens through receptors. This process is highly specific and allows the immune system to distinguish between self and non-self, as well as to remember previous encounters with pathogens. In AIS, pattern recognition

algorithms are employed to detect anomalies or patterns in data, and the system can adapt over time to improve its performance, similar to how the biological immune system learns and adapts through exposure to pathogens.

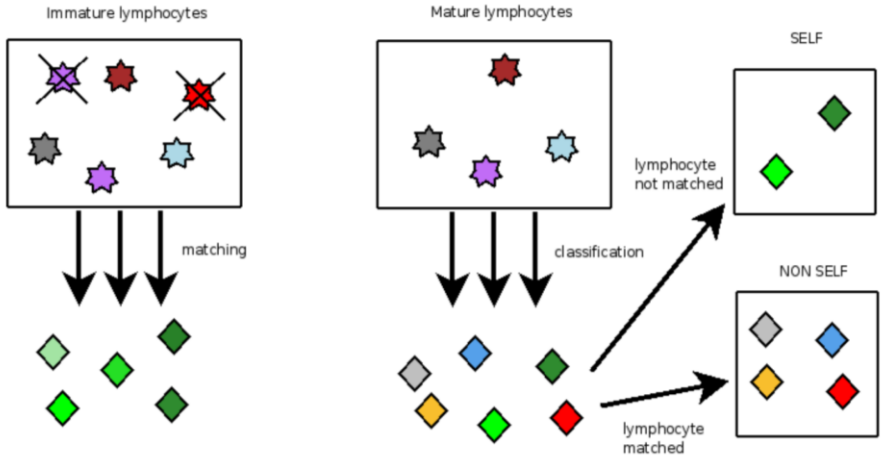


Figure 11: An Intelligent Spam Detection Model Based on Artificial Immune System (Saleh et al., 2019)

Another similarity is the concept of clonal selection and diversity. In the biological immune system, clonal selection involves the explosion of immune cells that have successfully recognised an antigen, followed by mutation and differentiation to produce a diverse pool of antibodies capable of targeting a wide range of pathogens. AIS algorithms incorporate clonal selection principles to generate diverse solutions to problems, enhancing the system's ability to explore and exploit the solution space effectively.

The biological immune system operates within a highly dynamic and complex biological context, involving numerous types of cells, signalling molecules, and interactions that are difficult to replicate fully in artificial systems. The AIS, on the other hand, simplifies and abstracts these processes into computational models that can be implemented in software or hardware and designed for specific problem-solving tasks, such as anomaly detection in network security or optimisation in engineering. While these models capture the essence of immune functions, they lack the full complexity and biological intricacies of the natural immune system.

The Artificial Immune System (AIS) has found impactful applications across different domains. In cybersecurity, AIS enhances network security by detecting and responding to cyber threats through pattern recognition and

anomaly detection. In medical diagnostics, it improves systems for identifying diseases by analysing complex medical data and detecting anomalies in medical images. In pattern recognition tasks, AIS excels in machine learning applications like handwriting recognition and speech analysis. In finance, AIS helps predict market trends and manage risks by analysing financial data, thereby aiding investment decisions. Additionally, in bioinformatics, AIS supports genetic data analysis and understanding biological systems, contributing to research in genomics and personalised medicine.

Searching Engine's Spiders

Search engine spiders, also known as crawlers or bots, fulfil a critical role in the digital landscape by systematically navigating the internet and indexing web pages for search engine databases (Van Looy, 2022). Their function parallels the exploratory behaviour of real spiders in nature, which methodically search their surroundings for food or suitable locations to build webs. Both types of spiders engage in systematic exploration: real spiders survive and thrive within their ecosystems, and search engine spiders catalogue and make accessible substantial amounts of online information. They gather information from web pages they visit, extracting content, keywords, and links to build a comprehensive index that aids in retrieving relevant web pages for users' search queries.

Figure 12: Functions of search engine spider
(Lawankar & Mangrulkar, 2016)

While real spiders operate within the limits of their physical environments, interacting with their surroundings through webs and physical movements, search engine spiders are software programs designed by humans. They navigate the internet digitally, following hyperlinks rather than physical paths. Their purpose is to enhance the accessibility and usability of online

content by organising it efficiently for search engine users. Real spiders exhibit adaptive behaviours and physiological adaptations to environmental changes, contributing to ecological dynamics, whereas search engine spiders adhere strictly to programmed algorithms for data collection and indexing, lacking biological or ecological context.

Searching engine spiders are used in different applications beyond their primary role in indexing web pages. For example, they are integral to search engines like Google, where they continuously crawl the internet to index websites, ensuring that users receive relevant search results. Price comparison websites use spiders to gather and update pricing information from different online retailers, helping users find the best deals. Companies use spiders for market research, scraping social media, forums, and review sites to gain insights into consumer behaviour and competitive strategies. In academic research, spiders are used to gather data from digital libraries and online repositories, facilitating literature reviews and large-scale data analysis. Job search engines utilise spiders to compile job listings from different boards and career pages, enhancing the efficiency of job searches. Social media monitoring tools also employ spiders to track brand mentions and sentiment across platforms, aiding in reputation management and customer engagement.

Discussion

In reflecting upon the intricate relationship between the natural world and human understanding, it becomes clear that the study of nature offers more than just scientific insights; it provides a deep connection to the principles of creation and the divine order that governs the universe. Throughout this chapter, we have explored the many ways in which nature serves as both a source of inspiration and a guiding framework for human innovation, particularly in the field of artificial intelligence. The development of AI algorithms, such as Particle Swarm Optimisation, Whale Optimisation and Ant Colony Optimisation, demonstrates how closely connected our technological advancements are with the biological processes and behaviours observed in the natural world.

These algorithms, inspired by the very mechanisms that drive life on Earth, embody the spirit of discovery and innovation that has driven humanity forward. They show how, by observing and emulating nature, we can solve complex problems and create systems that are efficient, adaptive, and

resilient. This approach not only highlights the brilliance of Allah's creatures but also highlights the importance of humility and respect in the face of such extensive complexity. It is a reminder that, while we have made great progress in understanding and discovering these natural processes, there is still much to learn and discover.

As Syed Qutub said, "The examples we have quoted are but a few of the large number of remarkable aspects science has recorded in the worlds of plants, insects, birds and animals. But all these aspects reflect only a part of the import of the two verses:

ٱلَّذِى خَلَقَ فَسَوَّىٰ . وَٱلَّذِى قَدَّرَ فَهَدَىٰ

"*Who creates and proportions well, Who determines and guides*."
(Surah Al-A'la: 2-3)

For our knowledge covers only a scanty part of what is in the visible universe, beyond which extends a whole world of which we know nothing apart from the few hints God has chosen to drop us, as befits our limited abilities." (Syed Qutb, 1959)

Moreover, the discussion in this chapter should open a broader, more philosophical point about the role of nature in human life. Nature is not merely a resource to be exploited or a subject to be studied; it is a teacher, a guide, and a source of endless wonder. The Quranic verses that encourage the study of the natural world are not just calls to observe but invitations to engage with creation on a deeper level. They urge us to see the signs of the Creator in the harmony and order of the universe and to draw lessons from the natural world that can enhance both our spiritual and intellectual interests.

Modern science, when divorced from spiritual guidance, risks becoming a tool of exploitation—serving greed, fostering inequality, and inflicting harm. But when science walks hand in hand with spirituality, it becomes an instrument of mercy (الرحمة). Technology guided by faith becomes a light that leads humanity from darkness into clarity

For Muslims, this connection between nature and knowledge is particularly significant. The Islamic tradition places a strong emphasis on seeking knowledge and observing of the natural world as a means of understanding

the Creator's will. In this context, the development of nature-inspired AI algorithms can be seen as a continuation of this tradition—a modern expression of the Islamic practice of seeking wisdom in the signs of the universe. It calls on Muslims to engage with science and technology in a way that is deeply rooted in their spiritual values, using these tools to contribute to the improvement of humanity while remaining mindful of the ethical and moral implications of their work.

As we move forward in an era increasingly dominated by technology, the lessons drawn from nature become ever more relevant. The challenges we face require solutions that are as innovative as they are instructed in the wisdom of the natural world. By looking to nature for inspiration, we can develop systems and strategies that not only address these challenges but do so in a way that respects the balance of life on Earth.

In conclusion, the study of nature and its application in fields like AI is a reminder that, even in an age of rapid technological advancement, the fundamental principles that govern life remain the same. By aligning our innovations with these principles, we can create a future that is not only technologically advanced but also spiritually and ethically sound. The journey of discovery, both in science and in faith, is an ongoing process—one that requires us to continuously seek knowledge, reflect on the world around us, and remain open to the lessons that nature has to offer.

Conclusion

In conclusion, the exploration of nature through both scientific inquiry and spiritual reflection offers Muslims a profound opportunity to harmonise their faith with modern advancements. The Quran encourages a deep observation of the natural world, recognising it as an indicator of Allah's wisdom and power. As AI technologies continue to evolve, drawing inspiration from nature's complexities, Muslims are reminded of their responsibility as *Khalifah* on Earth. It is essential to approach these innovations with a balance of material progress and spiritual mindfulness, ensuring that advancements in AI and technology are guided by ethical principles and a commitment to the greater good. Muslims are encouraged to engage in *Tafakur*, reflecting on the signs of Allah in the universe, to deepen their understanding and wisdom. By doing so, they can contribute to the development of technology that aligns with Islamic values, promotes justice, and serves humanity in a way that honours their role as *Khalifah* on the Earth. The merging of modern

science, spirituality, and divine wisdom is not a compromise but a completion—a realisation that the laws of the universe are inseparable from the moral laws of the Creator. For Muslims, it is a call to action, a call to rise as witnesses to humanity (شهداء على الناس), demonstrating how technology, infused with faith, can lead not only to progress but to true prosperity for all.

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Chapter 2

Islam and Epistemology of Knowledge and Technology

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Abstract

Islam, being a global religion, fosters technological advancement by cultivating the human brain to act as representatives of Allah on Earth. This chapter examines the Quranic verses that promote intellectual pursuits through different cognitive approaches, including observation, contemplation, and profound reflection (*tadabbur*). It emphasises Islam's conviction that a more comprehensive grasp of the world results in a greater understanding of the Creator. Islam not only encourages but also welcomes the search for knowledge in unexplored areas, which in turn promotes creativity and technological progress. Islam promotes a careful and analytical attitude to obtaining knowledge, as seen by verses such as *Surah al Rahman*:33, which presents a challenge to both humans and genies, and *Surah al Baqarah*:260, which recounts Prophet Ibrahim's pursuit of truth. The primary revelation in *Surah al 'Alaq*:1-5 underscores Islam's emphasis on the attainment of practical knowledge, as indicated by the directive to 'read.' Islam acknowledges knowledge as a dynamic process, which results in favourable consequences such as technical advancement and human improvement. This chapter examines the compatibility between Islam's promotion of intellectual inquiry and experimentation and contemporary approaches, creating a favourable atmosphere for encouraging innovation. This chapter explores the relationship between Islam, knowledge acquisition, and technical breakthroughs, providing insights into the connection between religion and progress in the modern world.

Keywords: Global Religion, Islam and Technical Advancement, Islamic Intellectual Inquiry

Introduction

This section aims to discuss how Islam deals with the advancement of knowledge, especially in technology. The emphasis will be on digital

technology, based on either direct or indirect guidelines from Quranic verses or the Hadith of the Prophet Muhammad SAW. With that goal in mind, the author defines "Islam and the epistemology of knowledge and technology" as an examination of the intersection of Islamic ideas, principles, and traditions, as well as the comprehension and use of knowledge and technology based on direct or indirect indicators from the Quran and Hadith. Islam is a universal religion that supports technological development. Islam inspires humans to maximise their intellectual capacity, enabling them to fully function as vicegerents of Allah in this world.

General Principles on Islamic Epistemology or 'Theory of Knowledge'

The Quranic verses generally establish three principles that form the basis of Islamic epistemology. These three principles serve as the cornerstone for Muslim ICT professionals to comprehend the Islamic theory of knowledge, and with this understanding, they hope to discover new digital technologies that can empower Islam.

First Principle: Allah is the origin of all knowledge

The first principle is that all knowledge originates from Allah, which means that the origin of knowledge is Allah and not from other sources. In *Surah Tahaa (98*):

إِنَّمَآ إِلَٰهُكُمُ ٱللَّهُ ٱلَّذِى لَآ إِلَٰهَ إِلَّا هُوَ ۚ وَسِعَ كُلَّ شَىْءٍ عِلْمًا ﴿٩٨﴾

Your god is only Allah, except for whom there is no deity. He has encompassed all things in knowledge." (*Tahaa: 98).*

The other verse from *Surah al Baqarah* (32) also verifies Allah as the origin of all knowledge, as He said:

قَالُوا۟ سُبْحَٰنَكَ لَا عِلْمَ لَنَآ إِلَّا مَا عَلَّمْتَنَآ ۖ إِنَّكَ أَنتَ ٱلْعَلِيمُ ٱلْحَكِيمُ ﴿٣٢﴾

They said, "Glory be to You! We have no knowledge except what You have taught us. It is you who are the Knowledgeable, the Wise

Second Principle: The nature of knowledge

The second principle focuses on the acquirable and researchable nature of knowledge. The first revelation, *Surah al 'Alaq* (1-5), underscores Islam's focus on practical approaches to the acquisition of knowledge. The

instruction to 'read' serves as a clear indication of Islam's appreciation for the pursuit of knowledge as a dynamic process and, naturally, the positive outcomes it yields, including technological advancements and new discoveries, all geared towards the improvement of humanity.

ٱقۡرَأۡ بِٱسۡمِ رَبِّكَ ٱلَّذِي خَلَقَ ﴿١﴾ خَلَقَ ٱلۡإِنسَٰنَ مِنۡ عَلَقٍ ﴿٢﴾ ٱقۡرَأۡ وَرَبُّكَ ٱلۡأَكۡرَمُ ﴿٣﴾
ٱلَّذِي عَلَّمَ بِٱلۡقَلَمِ ﴿٤﴾ عَلَّمَ ٱلۡإِنسَٰنَ مَا لَمۡ يَعۡلَمۡ ﴿٥﴾

Read! In the Name of your Lord, Who has created (all that exists), (1) He has created man from a clot (a piece of thick coagulated blood) (2) Read! And your Lord is the Most Generous, (3) Who has taught (the writing) by the pen. (4) He has taught man that which he knew not. (5) (al ʿAlaq: 1-5).

Some Quranic verses demonstrate this by encouraging scholarship through methods such as observation, contemplation, engrossment, concentration, reflection, absorption, and deep thought (*tadabbur*). For example, in Surah *al Baqarah* (164), Allah said:

إِنَّ فِي خَلۡقِ ٱلسَّمَٰوَٰتِ وَٱلۡأَرۡضِ وَٱخۡتِلَٰفِ ٱلَّيۡلِ وَٱلنَّهَارِ وَٱلۡفُلۡكِ ٱلَّتِي تَجۡرِي فِي
ٱلۡبَحۡرِ بِمَا يَنفَعُ ٱلنَّاسَ وَمَآ أَنزَلَ ٱللَّهُ مِنَ ٱلسَّمَآءِ مِن مَّآءٖ فَأَحۡيَا بِهِ ٱلۡأَرۡضَ بَعۡدَ مَوۡتِهَا وَبَثَّ
فِيهَا مِن كُلِّ دَآبَّةٖ وَتَصۡرِيفِ ٱلرِّيَٰحِ وَٱلسَّحَابِ ٱلۡمُسَخَّرِ بَيۡنَ ٱلسَّمَآءِ وَٱلۡأَرۡضِ
لَأٓيَٰتٖ لِّقَوۡمٖ يَعۡقِلُونَ ﴿١٦٤﴾

In the creation of the heavens and the earth; in the alternation of night and day; in the ships that sail the oceans for the benefit of mankind; in the water that God sends down from the sky, and revives the earth with it after it had died, and scatters in it all kinds of creatures; in the changing of the winds, and the clouds disposed between the sky and the earth; are signs for people who understand. (al Baqarah: 164)

In Islam, it is believed that individuals who possess a deeper comprehension of the world will also gain a more profound understanding of their Creator. Consequently, Islam does not discourage Muslims from venturing into uncharted realms of thought and imagination. By employing such cognitive approaches, innovations and technologies may emerge. For instance, in S*urah al Rahman:33*, Allah presents a challenge to both humans and genies:

يَٰمَعۡشَرَ ٱلۡجِنِّ وَٱلۡإِنسِ إِنِ ٱسۡتَطَعۡتُمۡ أَن تَنفُذُواْ مِنۡ أَقۡطَارِ ٱلسَّمَٰوَٰتِ وَٱلۡأَرۡضِ فَٱنفُذُواْۚ لَا
تَنفُذُونَ إِلَّا بِسُلۡطَٰنٖ ٣٣

O assembly of the jinn and the men! If you are able to pass through the regions of the heavens and the earth, then pass through; you cannot pass through but with authority (al Rahman: 33).

In addition, Islam advocates for the use of thoughtful and critical methods, including experimentation and argumentation, to pursue the truth. *Surah al Baqarah*: 260, which documents Prophet Ibrahim's quest to understand the truth of resurrection from Allah, exemplifies this aspect.

وَإِذۡ قَالَ إِبۡرَٰهِـۧمُ رَبِّ أَرِنِي كَيۡفَ تُحۡيِ ٱلۡمَوۡتَىٰۖ قَالَ أَوَلَمۡ تُؤۡمِنۖ قَالَ بَلَىٰ وَلَٰكِن
لِّيَطۡمَئِنَّ قَلۡبِيۖ قَالَ فَخُذۡ أَرۡبَعَةٗ مِّنَ ٱلطَّيۡرِ فَصُرۡهُنَّ إِلَيۡكَ ثُمَّ ٱجۡعَلۡ عَلَىٰ كُلِّ جَبَلٖ مِّنۡهُنَّ
جُزۡءٗا ثُمَّ ٱدۡعُهُنَّ يَأۡتِينَكَ سَعۡيٗاۚ وَٱعۡلَمۡ أَنَّ ٱللَّهَ عَزِيزٌ حَكِيمٞ ٢٦٠

And when Abraham said, "My Lord, show me how You give life to the dead." He said, "Have you not believed?" He said, "Yes, but to put my heart at ease." He said, "Take four birds, and incline them to yourself, then place a part on each hill, then call to them; and they will come rushing to you. And know that God is Powerful and Wise." (al Baqarah: 260).

Third Principle: The value of knowledge to humanity

The third principle of Islamic epistemology of knowledge emphasises the importance of knowledge for both humanity and livelihood. Quranic passages commend scholars who possess knowledge that benefits humanity, elevating their status in Islam. For instance, in *Surah Fathir*: 28 and *Surah al Mujadilah*: 11, Allah expresses this acknowledgement:

إِنَّمَا يَخۡشَى ٱللَّهَ مِنۡ عِبَادِهِ ٱلۡعُلَمَٰٓؤُاْۗ إِنَّ ٱللَّهَ عَزِيزٌ غَفُورٞ ٢٨

Only those fear Allah, from among His servants, who have knowledge. Indeed, Allah is Exalted in Might and Forgiving (Fathir: 28)

وَإِذَا قِيلَ ٱنشُزُواْ فَٱنشُزُواْ يَرۡفَعِ ٱللَّهُ ٱلَّذِينَ ءَامَنُواْ مِنكُمۡ وَٱلَّذِينَ أُوتُواْ ٱلۡعِلۡمَ دَرَجَٰتٖۚ وَٱللَّهُ بِمَا تَعۡمَلُونَ خَبِيرٞ ١١

and when it is said: Rise up, then rise up. Allah will exalt those of you who believe, and those who are given knowledge, in high degrees; and Allah is Aware of what you do. (al Mujaadilah: 11)

To conclude, knowledge is a blessing from Allah to humanity so that they will be able to function effectively and efficiently as servants and vicegerents of Allah.

Islam and Digital World: An overview

Consequently, understanding Islamic epistemology can provide Muslim ICT professionals with valuable insights to creatively address the advancement of ICT. ICT, a subfield of digital technologies, has become an integral part of society and our everyday existence. Initially centered on the automation of data transfer among technical devices, corporate operations, and security, ICT has now infiltrated every facet of our existence. Islam, being a faith that aims to offer explicit instruction to its followers, cannot remain indifferent to technological progress. It is necessary for them to be flexible and open to incorporating new elements that arise in human existence. Islam should offer instruction to help its followers understand the intricacies of life in a technologically dominated environment.

The essence of human nature essentially includes the ability to adapt and accommodate to new environments and changes. The Quran recognises and underscores the innate capacity of humanity to improve their lives by harnessing the power of technology. Allah said in *Surah Luqman* (20):

أَلَمۡ تَرَوۡاْ أَنَّ ٱللَّهَ سَخَّرَ لَكُم مَّا فِي ٱلسَّمَٰوَٰتِ وَمَا فِي ٱلۡأَرۡضِ وَأَسۡبَغَ عَلَيۡكُمۡ نِعَمَهُۥ ظَٰهِرَةٗ وَبَاطِنَةٗۗ وَمِنَ ٱلنَّاسِ مَن يُجَٰدِلُ فِي ٱللَّهِ بِغَيۡرِ عِلۡمٖ وَلَا هُدٗى وَلَا كِتَٰبٖ مُّنِيرٖ ٢٠

Do you not see how God placed at your service everything in the heavens and the earth? How He showered you with His blessings, both outward and inward? Yet among the people is he who argues about God without knowledge, without guidance, and without an enlightening Scripture. (Luqman: 20).

ICT is a manifestation of this divinely inspired capacity. Initially intended for military applications like the Enigma machine during World War II, Information and Communication Technology (ICT) has now spread widely, impacting every facet of human life. The Quran has numerous explicit and implicit references to technology. However, because the primary objective of the Quran is to function as a guidebook for living a righteous life as a devout believer in God, it does not include specific details about certain technological progressions. Rather, it provides comprehensive concepts for the advancement of technology.

Essentially, Islam does not have a fundamental opposition to technology. On the contrary, it recognises the potential of technology to serve both positive and negative objectives. Ensuring the employment of technology aligns with Islamic beliefs and principles is crucial. To provide the ground for discussion about Islam and its stands towards epistemology of knowledge and technology, the author has highlighted three relevant points in the following sub-sections.

Quranic indicators on ICT

This first sub-section provides further elucidation on several verses taken from the Quran, which serve as a technological lens for identifying current digital technologies and exploring future ones. The approach to using al-Quran as a technological lens is based on the first principle of Islamic epistemology: that every knowledge originates from Allah, and al-Quran is His final book for humanity.

The database or live records

A database is a methodically organised collection of structured data, also known as information, typically stored in an electronic format on a computer system. Indirect verses of the Quran illustrate the operation of a device that bears resemblance to a database and logs the virtuous and evil deeds of humanity. In *Surah al Isra'* (13), Allah said:

وَكُلَّ إِنسَٰنٍ أَلْزَمْنَٰهُ طَٰٓئِرَهُۥ فِى عُنُقِهِۦ ۖ وَنُخْرِجُ لَهُۥ يَوْمَ ٱلْقِيَٰمَةِ كِتَٰبًا يَلْقَىٰهُ مَنشُورًا ﴿١٣﴾

And We have fastened every man's deeds to his neck, and on the Day of Resurrection, We shall bring out for him a book which he will find wide open. (al Isra': 13).

In Surah *Yaseen* (12), Allah said:

إِنَّا نَحْنُ نُحْيِي الْمَوْتَىٰ وَنَكْتُبُ مَا قَدَّمُوا وَآثَارَهُمْ ۚ وَكُلَّ شَيْءٍ أَحْصَيْنَاهُ فِي إِمَامٍ مُّبِينٍ ﴿١٢﴾

Verily, We give life to the dead, and We record that which they send before (them), and their traces [1] and all things We have recorded with numbers (as a record) in a Clear Book. (Yaseen: 12)

In *Surah Qaf* (18), Allah mentioned:

مَّا يَلْفِظُ مِن قَوْلٍ إِلَّا لَدَيْهِ رَقِيبٌ عَتِيدٌ ﴿١٨﴾

Not a word does he (or she) utter, but there is a watcher by him ready (to record it). (al Qaf: 18)

The approach by which human actions are perpetually documented in this world, akin to databases, is alluded to inferentially in these three verses. It is evident that the technological advancements of their era influenced the definitions of the term "book," as proposed by two prominent commentators, *Ibn Kathir* and *Tabari*, on these matters. During that period, the use of tangible books by the designated angels, *Raqib* and *Atid*, was the most reasonable interpretation.

The Multimedia Nanotechnology

Nanotechnology is the systematic exploration of altering matter at a nearly atomic scale to create new structures, materials, and technologies. Multimedia nanotechnology is a distinct subfield of nanotechnology that focuses on producing video-graphic structures at the atomic level, capable of real-time display and animation. Allah said in *Surah al Zalzalah* (7 and 8):

فَمَن يَعْمَلْ مِثْقَالَ ذَرَّةٍ خَيْرًا يَرَهُ ﴿٧﴾

So whosoever does good equal to the weight of an atom (or a small ant), shall see it.

وَمَن يَعْمَلْ مِثْقَالَ ذَرَّةٍ شَرًّا يَرَهُۥ ﴿٨﴾

And whosoever does evil equal to the weight of an atom (or a small ant), shall see it.

This verse describes humanity's state on the day of judgment, when all of their deeds, no matter how big or small, will become clear to them. However, this passage also signifies two alternatives. Firstly, it is possible for a deed of microscopic size to exist in nature and still be included in the count. It is impossible to measure that atomic deed using any method. Furthermore, it highlights the possibility of introducing innovative nanotechnology in a dynamic manner, provided that the required infrastructure is there to facilitate its implementation and scientists have devised methods to measure it.

The hologram and teleportation technology

In the story of Prophet Sulaiman with Princess of Saba', Allah illustrated in Surah *al Naml* (40)

قَالَ ٱلَّذِى عِندَهُۥ عِلْمٌ مِّنَ ٱلْكِتَٰبِ أَنَا۠ ءَاتِيكَ بِهِۦ قَبْلَ أَن يَرْتَدَّ إِلَيْكَ طَرْفُكَ ۚ فَلَمَّا رَءَاهُ مُسْتَقِرًّا عِندَهُۥ قَالَ هَٰذَا مِن فَضْلِ رَبِّى لِيَبْلُوَنِىٓ ءَأَشْكُرُ أَمْ أَكْفُرُ ۖ وَمَن شَكَرَ فَإِنَّمَا يَشْكُرُ لِنَفْسِهِۦ ۖ وَمَن كَفَرَ فَإِنَّ رَبِّى غَنِىٌّ كَرِيمٌ ﴿٤٠﴾

Said one who had knowledge of the Book: "I will bring it to thee within the twinkling of an eye!" Then, when (Solomon) saw it placed firmly before him, he said: "This is by the Grace of my Lord! to test me whether I am grateful or ungrateful! and if any is grateful, truly his gratitude is (a gain) for his own soul; but if any is ungrateful, truly my Lord is Free of all Needs, Supreme in Honour !" (al Naml: 40).

Ibn Kathir's major commentary initially interpreted this verse as the result of *Ashif bin Barkhiya's* exceptional aptitude or supernatural acts (*al karomah*), which Allah SWT bestowed upon him as a divine blessing. However, this passage implies the existence of two potential technologies. Hologram technology involves projecting three-dimensional images or films onto a

surface using lasers or lights originating from a separate source and directed at certain regions. Sulaiman saw the palace of *Saba*' in its flawless arrangement. Teleportation is a technology that enables the transfer of an object or person from one location to another in physical space. Simply put, the process involves disassembling an object's components into separate molecules, then rearranging them in different locations to reconstruct the object's original structure.

The Audio technology for human-animal communication

In *Surah al Naml* (18-19), Allah explained the extraordinary ability of Prophet Sulaiman to understand the language and communication of ants. According to this verse, Allah stated:

حَتَّىٰٓ إِذَآ أَتَوۡاْ عَلَىٰ وَادِ ٱلنَّمۡلِ قَالَتۡ نَمۡلَةٞ يَٰٓأَيُّهَا ٱلنَّمۡلُ ٱدۡخُلُواْ مَسَٰكِنَكُمۡ لَا يَحۡطِمَنَّكُمۡ سُلَيۡمَٰنُ وَجُنُودُهُۥ وَهُمۡ لَا يَشۡعُرُونَ ١٨

Till, when they came to the valley of the ants, one of the ants said: "O ants! Enter your dwellings, lest Sulaimân (Solomon) and his hosts should crush you, while they perceive not. (al Naml - 18)

فَتَبَسَّمَ ضَاحِكٗا مِّن قَوۡلِهَا وَقَالَ رَبِّ أَوۡزِعۡنِيٓ أَنۡ أَشۡكُرَ نِعۡمَتَكَ ٱلَّتِيٓ أَنۡعَمۡتَ عَلَيَّ وَعَلَىٰ وَٰلِدَيَّ وَأَنۡ أَعۡمَلَ صَٰلِحٗا تَرۡضَىٰهُ وَأَدۡخِلۡنِي بِرَحۡمَتِكَ فِي عِبَادِكَ ٱلصَّٰلِحِينَ ١٩

So he [Sulaimân (Solomon)] smiled, amused at her speech [1] and said: "My Lord! Grant me the power and ability that I may be grateful for Your Favours which You have bestowed on me and on my parents, and that I may do righteous good deeds that will please You, and admit me by Your Mercy among Your righteous slaves." (al Naml:19)

Ibn Kathir initially offered an interpretation of this passage that centred on the extraordinary privileges of the prophets, commonly referred to as *Mu'jizaat*. However, the verse also implies the potential for utilising technology to understand animal communication. An example of such a device is one that has the capacity to decipher signals or vocalisations emitted by animals or insects as a result of thorough examinations carried

out by entomologists. Computer technology can transform the gathered information from this device into human languages.

The use of intelligent tools/mechanisms

وَلِسُلَيْمَٰنَ ٱلرِّيحَ غُدُوُّهَا شَهْرٌ وَرَوَاحُهَا شَهْرٌ ۖ وَأَسَلْنَا لَهُۥ عَيْنَ ٱلْقِطْرِ ۖ وَمِنَ ٱلْجِنِّ مَن
يَعْمَلُ بَيْنَ يَدَيْهِ بِإِذْنِ رَبِّهِۦ ۖ وَمَن يَزِغْ مِنْهُمْ عَنْ أَمْرِنَا نُذِقْهُ مِنْ عَذَابِ ٱلسَّعِيرِ ﴿١٢﴾

And to Solomon (We made) the Wind (obedient): Its early morning (stride) was a month's (journey), and its evening (stride) was a month's (journey); and We made a Font of molten brass to flow for him; and there were Jinns that worked in front of him, by the leave of his Lord, and if any of them turned aside from our command, We made him taste of the Penalty of the Blazing Fire. (Saba': 12)

يَعْمَلُونَ لَهُۥ مَا يَشَآءُ مِن مَّحَٰرِيبَ وَتَمَٰثِيلَ وَجِفَانٍ كَٱلْجَوَابِ وَقُدُورٍ رَّاسِيَٰتٍ ۚ ٱعْمَلُوٓا۟
ءَالَ دَاوُۥدَ شُكْرًا ۚ وَقَلِيلٌ مِّنْ عِبَادِىَ ٱلشَّكُورُ ﴿١٣﴾

And We caused a fount of (molten) brass to flow for him, and there were jinn that worked in front of him, by the Leave of his Lord, And whosoever of them turned aside from Our Command, We shall cause him to taste of the torment of the blazing Fire. (Saba': 12).

In accordance with traditional interpretations, these two lines frequently allude to the extraordinary occurrences referred to as *Mu'jizaat*, which the prophets executed. Nevertheless, it is imperative that Muslim scientists analyse this passage in light of forthcoming technological advancements. One notable example of such technology that has already achieved widespread recognition is Robotic Process Automation (RPA).

As a conclusion, to become a Muslim, one must recognise the Quran as the ultimate source of revelation. The Quran is filled with stories about prophets and revered individuals, as well as practical life guidance. We can interpret these extraordinary narratives as divine instructions about the capabilities of contemporary technology. This practice is accordance with the Islamic

epistemology of knowledge on the nature of knowledge, which is researchable and acquirable.

Islamic epistemology of knowledge and philosophy of ICT and Islam

Inquiry and research are two cores in Islamic epistemology of knowledge. These two processes are part of the philosophy of ICT and Islam. The social and ethical effects of technology on human civilisations and society are generally the main topics of information and communication technology (ICT) philosophy. It goes into detail about problems, ideas, and theories pertaining to how technology might affect people's values, attitudes, and actions. The goal of Islamic philosophy, on the other hand, is to rationalise topics under metaphysics and elements of Islamic doctrine. From a philosophical standpoint, the relationship between ICT and Islam is a complicated and multidimensional topic.

Islam is a faith that places great importance on the use of rationality and logical thinking. It does not contradict rationality but rather promotes the complete use of human reasoning. Nevertheless, human reasoning must be supplemented by divine revelation from Allah the Almighty, since He recognises that logic alone is inadequate to steer humanity. This is due to the occurrence of phenomena in the world that transcend rationality and defy logical explanation. Philosophy contributes to the clarification and establishment of solutions and definitions for concepts, constructions, and ideas. Comprehending the many elements of technology is also crucial. Technologists must possess a comprehensive understanding of different concepts and issues within their field, including signal electrical communication, data transmission, and the sorts of devices required for wireless data transmission between terminals. Each of these studies exemplifies scientific or philosophical investigations.

ICT, or Information and Communication Technology, is a technological field that combines numerous disciplines of knowledge, including both software and hardware technology. Soft technology encompasses various fields of knowledge that pertain to the software components of computers, such as mathematics, human logic, algorithms, human-computer interactions, software functions, business operations and solutions, communications, and other related branches of study. On the other hand, hard knowledge includes the engineering of computer components such as CPUs and motherboards, networking hardware infrastructure, and other areas of expertise related to

hardware. In order to advance digital technologies, it is necessary to get a deeper grasp of the sub-ideas, constructions, and components that fall under both the soft and hard components. The process of apprehending is an integral component of philosophical investigations.

Hence, the primary purpose of exploring the intersection of ICT and Islam is to guarantee the ongoing relevance of this technology for the advancement and improvement of humanity. Presently, Information and Communication Technology (ICT) is still constrained by its constraints. There are still several hypothetical technologies that have not been created because there is a lack of infrastructure and conceptual frameworks to characterise them. By engaging in philosophical inquiry on this topic, a multitude of novel concepts will be introduced, perhaps paving the way for the realisation of new technologies. For instance, the philosophical and scientific confirmation of the composition of the heart, also known as '*qalb*', is still pending. Is it figurative or literal? Does it exhibit similarities to the brain or human cognitive abilities? Is it quantifiable or not? What is its actual mode of operation? Once reasonable solutions have been provided to all of these concerns, technological instruments can be built to materialise or assist the solution. In the future, there will be technology capable of converting the inner voice, images, or thoughts within a person's brain into graphical representations.

The correlation between different behaviours in Islam and the advantages of ICT can be identified by analysing the matter philosophically. For instance, a query regarding enhancing the allocation of *zakah* to the *asnaf* (the beneficiaries) while avoiding unnecessary bureaucratic obstacles. A new best practice will arise by comprehending the possibilities of interoperability across various systems and the characteristics of *zakah* distributions. The following lists provide a concise summary of the reasons to engage in philosophical discussions on the intersection of ICT and Islam:

1) To explore novel thoughts and constructs pertaining to the issue, which can be applied in the development of forthcoming digital technology. For instance, the idea of 'digital *iktikaf*' uncovered through virtual reality could potentially result in the creation of a virtual mosque.
2) To convert the information contained in the Quran into practical and applicable technologies. The Quran recounts remarkable occurrences that befell the prophets and servants of Allah. For instance, the

application of Artificial Intelligence and acoustic signal technologies to comprehend the language of animals or insects, as emphasised in *Surah al-Naml*.

3) To identify and reveal the challenges encountered by the Muslim world and explore the possibilities of Information and Communication Technology (ICT) as a means to address these issues. For instance, employing a database to collect data from various primary sources among different sects of Islam in order to ascertain shared beliefs or principles. AI can impartially propose a few areas of agreement that everyone can collaborate on, free from any preconceptions or biases.
4) To establish novel domains of technical expertise by defining concepts, themes, and terminologies in the fields of ICT and Islam. For instance, there is potential for exploring technology that can assess human spirituality, as indicated in the Quran with terms like '*qalb', 'fuad*', and *'lub'*.
5) To assist the Mufti's office in providing rulings (*halal, haram, wajib, makruh, mandub*, and *jaa'iz*) on ambiguous aspects of ICT that are not expressly addressed in the Quran or Sunnah.
6) To foster innovative and visionary approaches in addressing current and next technological advancements. For instance, contemplating the future of computer technology beyond its current reliance on electrical infrastructure. A question arises: Will future technology depend on a combination of electrical and biological methods?
7) To enhance the efficiency of delivering Islamic rituals and duties through Information and Communication Technology (ICT). For instance, employing interoperable information systems among several agencies to distribute *zakah* (*alm*).

To conclude, philosophy of ICT and Islam is one part of Islamic epistemology of knowledge in the process of inquiry and research. The ability to philosophise constructs, subjects, issues, phenomena, and items in all aspects, including ICT, is an initial process of knowledge inquiry and research.

Quran and Hadith as inspiring sources for future technologies

The Quran and Hadith serve as the primary foundational sources of Islamic faith and practice, providing a comprehensive repository of knowledge and wisdom that transcends various aspects of life, including technological advancements. The Quran places significant emphasis on the importance of knowledge and learning, as exemplified by numerous verses that highlight

the divine elevation of individuals in knowledge and abilities. For instance, verse 6:165 underscores the divine differentiation in knowledge and abilities as a test of how these endowments are utilised, thereby underscoring the significance of responsible application of knowledge in Islamic tradition.

وَهُوَ ٱلَّذِى جَعَلَكُمْ خَلَٰٓئِفَ ٱلْأَرْضِ وَرَفَعَ بَعْضَكُمْ فَوْقَ بَعْضٍ دَرَجَٰتٍ لِّيَبْلُوَكُمْ فِى مَآ ءَاتَىٰكُمْ ۗ إِنَّ رَبَّكَ سَرِيعُ ٱلْعِقَابِ وَإِنَّهُۥ لَغَفُورٌ رَّحِيمٌ ﴿١٦٥﴾

It is He Who has made you (His) agents, inheritors of the earth: He has raised you in ranks, some above others: that He may try you in the gifts He has given you: for thy Lord is quick in punishment: yet He is indeed Oft-forgiving, Most Merciful. (Al-An'aam: 165)

A verse relevant to technology, found in verse *al Jaathiah*:13, elucidates humanity's responsibility as stewards over the heavens, the earth, and their resources, highlighting the potential to employ technology for the advancement of human welfare. This divine directive underscores the capacity granted to humanity by Allah to responsibly harness technological innovations for the betterment of human life.

وَسَخَّرَ لَكُم مَّا فِى ٱلسَّمَٰوَٰتِ وَمَا فِى ٱلْأَرْضِ جَمِيعًا مِّنْهُ ۚ إِنَّ فِى ذَٰلِكَ لَءَايَٰتٍ لِّقَوْمٍ يَتَفَكَّرُونَ ﴿١٣﴾

And He has subjected to you, as from Him, all that is in the heavens and on earth: Behold, in that are Signs indeed for those who reflect. (Al-Jaathiah: 13).

The Islamic tradition, as embodied in the Hadith, also emphasises the imperative of knowledge acquisition and the embrace of technology. The Hadith, as reported by Ibn Majah, quotes the Prophet Muhammad (PBUH) stating that "Seeking knowledge is an obligation upon every Muslim." This directive underscores the duty for Muslims to actively pursue knowledge, including technological knowledge, as an integral part of their faith.

مسلمٍ كلِّ على فريضةٌ العِلمِ طلبُ

Another Hadith documented by Bukhari strengthens this principle by emphasising that "The best among you are those who learn the Quran and teach it," thereby confirming the Prophet Muhammad's (peace be upon him) emphasis on the importance of acquiring and sharing knowledge, including

knowledge related to technology. This Hadith underscores the significance of not only gaining knowledge but also imparting it to others, reflecting the holistic approach to knowledge advocated in Islamic teachings.

خَيْرُكُمْ من تعلم الْقُرْآن وَعلمه

The Quran and Hadith serve as foundational texts within Islam, providing a robust framework for the ethical development and application of future technologies. These sources emphasise the importance of knowledge acquisition (epistemology), the obligation to utilise human potential for the collective benefit (social good), and the duty to share knowledge (education). These principles have the potential to guide the responsible development of a wide range of technologies, from artificial intelligence to renewable energy sources.

In recent times, there has been an escalating interest in harnessing Islamic principles to steer the course of technological progress, driven by factors such as the expanding global Muslim populace and a growing recognition of the potential advantages stemming from the incorporation of Islamic ethics in technological innovation; numerous avenues exist through which the Quran and Hadith can stimulate the development of forthcoming technologies, including the concept of "*Maslahah*" (public interest) as a guiding framework for designing technologies that confer societal benefits, the principle of "*Ihsan*" (doing good) as an impetus for developing technologies with virtuous purposes, and the concept of "*Qadr*" (divine destiny) as a reminder to align technological progress with divine intentions, reflecting a desire to ensure that advancements in science and technology are aligned with ethical and spiritual values and contribute to the realisation of God's plan for humanity.

The advancement of future technology is an intricate and challenging endeavour. However, the Quran and Hadith provide a priceless collection of concepts to guide this path. By following these ideas, we can create and foster technologies that not only benefit society but also align with moral goals. In addition to the Quran and Hadith, several Islamic sources can inspire the advancement of future technology. These include the works of renowned Islamic thinkers, such as Al-Kindi, Al-Razi, and Ibn Khaldun, who made significant contributions to subjects such as physics, mathematics, and philosophy. Their historical impact can provide valuable insights and energise the progress of upcoming technology.

The domain of future technological advancement offers immense potential to improve the lives of countless people. By drawing inspiration from the Quran, Hadith, and other Islamic scriptures, we have the ability to develop technologies that not only benefit society but also align with noble goals. The Quran and Hadith serve as the fundamental scriptures of Islam, encompassing a vast reservoir of knowledge and sagacity that may be universally applied to other domains of life, including the realm of technology.

The Quran underscores the significance of knowledge and education. For instance, it asserts that God has bestowed upon individuals varying degrees of knowledge and abilities as a means of testing them and seeing how they will employ these gifts. The Hadith also emphasises the significance of knowledge and technology. The Prophet Muhammad (PBUH) stated that it is incumbent upon every Muslim to actively pursue knowledge. According to Islamic teachings, Muslims are not only allowed but also required to actively pursue knowledge, including information related to technology.

The Quran and Hadith provide a robust basis for the advancement of forthcoming technologies. They instil in us the significance of knowledge, the need to utilise our capabilities to enhance the globe, and the duty to disseminate our information to others. These ideas are universally applicable to the creation of any technology, ranging from artificial intelligence to renewable energy. There has been an increasing fascination with applying Islamic precepts to steer the advancement of technology in recent years. This can be attributed partially to the rising population of Muslims worldwide, together with the expanding recognition of the potential advantages of Islamic ethics.

The Quran and Hadith offer numerous avenues for deriving inspiration to drive the advancement of future technology. For instance, the principle of "*Maslahah*" (public interest) can serve as a guiding principle in the advancement of innovations that bring benefits to society. The concept of "Ihsan" (doing good) can serve as a source of inspiration for the creation of technologies that are utilised for benevolent objectives. The concept of "*Qadr*" (divine destiny) serves as a reminder to align our usage of technology with God's intentions. Advancing future technology is a multifaceted and demanding endeavour. Nevertheless, the Quran and Hadith offer us a valuable collection of concepts that can effectively steer us in this

undertaking. By adhering to these principles, we can create technologies that are advantageous to society and are employed for benevolent reasons.

Aside from the Quran and Hadith, there exist numerous additional Islamic materials that can serve as inspiration for the advancement of future technology. These encompass the literary contributions of notable Islamic intellectuals, such as Al-Kindi, Al-Razi, and Ibn Khaldun. These experts have made noteworthy contributions to the disciplines of science, mathematics, and philosophy, and their work can serve as a valuable resource for the advancement of future innovations. The advancement of emerging technologies is a highly auspicious domain that holds the capacity to enhance the quality of life for a vast multitude of individuals. By utilising the teachings of the Quran, Hadith, and other Islamic sources, we can create technologies that are advantageous to society and are employed for virtuous objectives.

Below are concrete instances demonstrating the practical application of the Quran and Hadith in the advancement of forthcoming technologies:

- The concept of "*Maslahah*" or public interest can serve as a guiding principle for the advancement of artificial intelligence. AI has the potential to be employed in the development of systems that can diagnose diseases with greater precision than humans, as well as in the creation of personalised learning platforms that can enhance students' learning outcomes.
- The principle of "*Ihsan*" (doing good) might serve as a source of inspiration for the advancement of renewable energy solutions. For instance, solar panels and wind turbines can be utilised to produce environmentally friendly energy that does not contaminate the surroundings.
- The concept of "*Qadr*" (divine destiny) serves as a reminder for us to utilise technology in accordance with God's will. As an illustration, it is imperative that we refrain from utilising technology with the intention of causing harm to others or infringing upon their privacy.

The Quran and Hadith serve as a valuable reservoir of sagacity and direction that can be implemented in all facets of life, including the realm of technology. By utilising these texts, we can create technologies that are advantageous to society and are employed for benevolent objectives.

Conclusion

In conclusion, because it is consistent with its teachings and tenets, Islam places a high importance on the expansion of knowledge, especially in the

field of technology. Three fundamental ideas are emphasised by the Islamic epistemology of knowledge, which is based on the Quran and Hadith:

- Allah as the Source of All Knowledge: All knowledge comes from Allah, providing a divine basis for all human comprehension and creativity.
- The nature of knowledge is that it can be learned and studied. As evidenced by the first revelation, which emphasises the value of reading and learning, Islam promotes pragmatic methods of information acquisition.
- The Value of Knowledge to Humanity: Scholars who contribute to the advancement and well-being of society are regarded as having a higher position because of the great value that knowledge has for humanity.

These tenets support the notion that Islamic teachings and technical achievements can coexist peacefully by directing Muslim ICT professionals as they investigate and create new digital technologies that can strengthen and empower Islamic practice. As a gift from Allah, knowledge empowers Muslims to act as His vicegerents on Earth, encouraging creativity and advancement for the benefit of all people.

The intricate connection between technology and Islamic values is highlighted by the fusion of research and inquiry in Islamic epistemology with the philosophy of information and communication technology (ICT). This relationship is examined from the prisms of reason, logic, and divine revelation, emphasising how crucial it is to understand how technology affects human values and behaviour on both a social and ethical level.

Islamic philosophy acknowledges that some events defy rational explanation and stresses the need to augment human thinking with divine direction. This method is in line with the thorough comprehension of ICT that is necessary, which includes both hardware and software components. The goal of philosophical research on ICT and Islam is to make sure that technical developments continue to be useful to people.

Philosophical investigation can lead to the development of new ideas and technologies that overcome existing constraints in conceptual frameworks and ICT architecture. Innovations include the transformation of ideas into graphical representations, and more effective implementation of Islamic routines could result from this investigation. In the end, the continuous discussion between Islamic philosophy and ICT seeks to balance

technological progression with Islamic ethical and spiritual principles, promoting innovations that benefit society as a whole.

Chapter 3

Islamic Ethics in Artificial Intelligence through a Faith-Based Approach

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Abstract

Humanising artificial intelligence (AI) from an Islamic perspective is vital as Islam encourages embracing technology while upholding faith and values. Humanising AI involves integrating human qualities, aligning with Islamic teachings of compassion, empathy, and justice. Adhering to Islamic ethical principles, AI systems must ensure fairness, transparency, and accountability, avoiding biases and discrimination. Privacy, data protection, job displacement, and ethical challenges like autonomous weapons require careful consideration based on Islamic principles. Collaboration between Islamic scholars and technologists is essential to develop ethical guidelines, ensuring AI systems align with Islamic values. Embracing an Islamic perspective on humanising AI empowers Muslims to benefit from AI while safeguarding their faith and promoting societal well-being.

Keywords: AI, Humanising AI, AI and Ethics, ICT and Islam

Introduction

The prospect of creating intelligent computers has fascinated many people for as long as computers have been around, and, as we shall see in the historical overview, the first hint in the direction of artificial intelligence (AI) dated even before that (Sheikh et al., n.d.). The precise definition and meaning of the word intelligence, and even more so of AI, are the subject of many discussions and have caused a lot of confusion. Defining AI is not easy; in fact, there is no generally accepted definition of the concept. A common definition of AI is that it is a technology that enables machines to imitate various complex human skills. This, however, does not give us much to go on. In fact, it does no more than render the term 'artificial intelligence' in

different words. As long as those ‘complex human skills’ are not specified, it remains unclear exactly what AI is. The same applies to the definition of AI as the performance by computers of complex tasks in complex environments (Sheikh et al., n.d.).

Nonetheless, like other transformations, AI has both benefits and drawbacks. The utilisation of smartphones, drones, autonomous vehicles, robotics, and the production of automated weaponry highlights significant difficulties arising from the transition induced by AI. This ignorance is dangerous since Muslims may unknowingly confront the consequences of AI technology when it breaks Islamic ethical or religious boundaries in pursuit of their objectives. Therefore, there is a significant reason for concern regarding this mindset, given the widespread adoption of AI technology in the lives of Muslims today (Nawi et al., 2021).

The *Maqasid al-Shari’ah* comprehensively tackles every aspect of human activity in enhancing the public good (*maslaha*) and avoiding actions that are harmful to individuals and society to ensure well-being and harmony (Rahman, 2016).

Humanising AI is a process that involves the use of human beings, technology, data, and processes. Humanisation can be achieved by making an AI system more personable by adding some human elements.

AI is presently noticed to incorporate schooling, medical care, and monetary administrations, which influence human existence directly, socially, actually, what's more, financially.

AI is a powerful technology that offers both potential benefits and concerns. The combined efforts of religious, social, and economic organisations caused debates and challenges. In Islam, artificial intelligence presents both obstacles and potential. It can fulfil the aims of Islamic Law, preserve and digitise sacred texts, and engage with the socio-economic dynamics of Muslim-majority communities. This article addresses the humanising of AI through an Islamic perspective in order to promote the integration of AI systems with faith and values while harnessing technological progress (Hemmet, 2023).

Healthcare: Utilising neural organisation, AI calculation can recognise and sort the degree of sorrow by investigating attributes of discourse, the measure of breath, word decision, and so forth. Medical care experts should reexamine their practices when considering patients to guarantee quality care dependent on adaptation (Sruthi Gadde & Gadde, 2020a). Figure 1 shows an illustration of the Human-AI system in medical services.

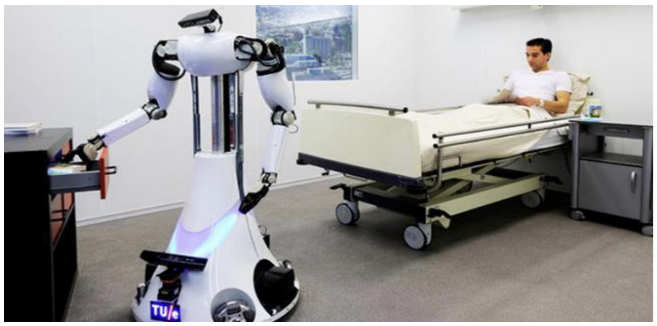

Figure 1: An example of a Human-AI system in healthcare(Sruthi Gadde & Gadde, 2020b)

Financial Services: Several global monetary organisations are trying different things with AI in finance to bring more advantages to clients. Monetary administration ventures would, in general, form safer frameworks as people's cash is at stake. Organisations are utilising AI standards to jump ahead in development and productivity.

Education: AI and personalisation go inseparably. Customised learning through investigation and fake insight has been empowered for a few homerooms by pioneers. Simulated intelligence can be used to actively engage students in solving real-world problems. Training will be significant in the 21st century and may be updated to meet the challenges.

The importance of having an ethical AI is very curtail because ethical AI makes the system available for the individual, society, and the environment's sake. It will work for the benefit of mankind. Also, it avoids unfair bias, an AI system that is designed is ethically fair. It will not do any unfair discrimination against individuals or groups. It provides equitable access and treatment. It detects and reduces unfair biases based on race, gender and nationality.

Furthermore, AI systems keep data security at the top. Ethical AI-designed systems provide proper data governance and model management

systems. Privacy and preserving AI principles help to keep the data secure. At the same time, the AI system works only for the intended purpose, thus reducing unknown mishappenings. Implementing ethics in AI systems will lead to transparency and explainability. The ethical system explains each prediction and output. It provides transparency for the logic of the model. Users get to know the contribution of data to the output. This disclosure justifies the output and builds trust.

Humanisation of AI

Acculturated AI endeavours to make AI that is more human. It is a call for building human frameworks where proficiency, projects, cycles, and results can be evaluated and enhanced. It imagines the condition of people and machines cooperating, each utilising its relative points of interest, with people in the driver's seat. Different endeavours have been made to incorporate, in a general sense, human thoughts like judgment, compassion, or reasonableness into an AI condition. Whatever influences people requires an adapted methodology. Computer-based intelligence is no exception. Refined AI gets human feelings like joy, stress, desperation, and outrage to identify feelings like chuckling, outrage, excitement, and torment. It reacts to characteristic language, particularly like a human companion.

Anything that affects humans, as opposed to just other machines, requires a humanised approach. AI is no different. Humanised AI is that which understands human emotions like happiness, stress, urgency, anger and pain when humans display them through speech, facial and physical expressions, and has considerable empathy to respond to the end user in a human-like or natural manner.

This is different from traditional behavioural analytics. Humanised AI not only derives insight from the user data but also responds to the user in a manner and language best suited to his/her emotional profile. True Humanised AI, for instance, is able to understand the criticality of the tasks scheduled in your calendar and prioritise them based on importance and urgency. It responds to you in natural language, very much like a human friend. (Tapati, n.d.-a).

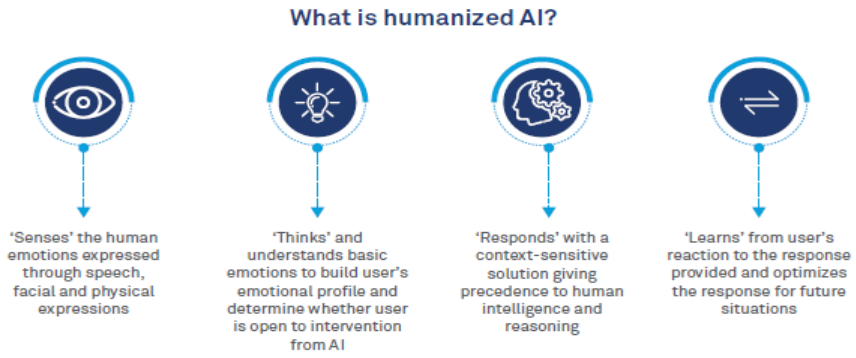

Figure 2: Humanising AI from an algorithm perspective (micro) (Tapati, n.d.-b)

The Importance of Humanising AI

It is not only the prospects of AI that need to be addressed, but also the way it is currently used. Big data companies such as social media platforms are renowned for their ability to influence human behaviour, which has led to scandals and data privacy breaches (e.g., [46, 47]). Not addressing this will only make it more difficult for policymakers to make any significant changes to how big tech companies leverage human data to maximise gain. It is naive to continue to think of humans as superbeings able to fully control themselves in the face of increasingly sophisticated online persuasion and manipulation tactics. Equally concerning is the way mechanistic algorithms (the application of narrow or weak AI) influence complex human behaviour (Fenwick & Molnar, 2022).

As a result, humanising AI can help you:

Increase trust in the technology: When people feel that they are being treated fairly and respectfully, they are more likely to adopt something new. This increases adoption and also makes it easier for customers to interact with your brand because they know what to expect from you, and it's more likely that they'll stay loyal enough not only for current needs but also for future ones as well.

Increase innovation: In your company, by allowing employees more autonomy over work tasks, which could lead them down new paths of research or discovery that may benefit all parties involved (including yourself).

Improve profitability: Through increased productivity due to less downtime caused by error aversion among staff members who trust each other enough not only during normal operations but also when dealing with emergencies like fires breaking out, etcetera.

AI and Ethics

In no other field is the ethical compass more relevant than in artificial intelligence. These general-purpose technologies are re-shaping the way we work, interact, and live. The world is set to change at a pace not seen since the deployment of the printing press six centuries ago. AI technology brings major benefits in many areas, but without the ethical guardrails, it risks reproducing real-world biases and discrimination, fueling divisions and threatening fundamental human rights and freedoms. The rapid rise in AI has created many opportunities globally, from facilitating healthcare diagnoses to enabling human connections through social media and creating labour efficiencies through automated tasks. However, these rapid changes also raise profound ethical concerns. These arise from the potential that AI systems have to embed biases, contribute to climate degradation, threaten human rights and more. Such risks associated with AI have already begun to compound on top of existing inequalities, resulting in further harm to already marginalised groups (*Ethics of Artificial Intelligence | UNESCO*, n.d.).

Figure 3: A Connected World Demands Ethical AI Solutions
Source: Shutterstock.com

There are many necessary activities that we would like to be able to turn over entirely to autonomously functioning machines, because the jobs that need

to be done are either too dangerous or unpleasant for humans to perform, or there is a shortage of humans to perform the jobs, or machines could do a better job performing the tasks than humans. We must ensure, however, that they carry out their tasks in an ethical manner.

AI Ethical Challenges

Basic ethical norms are universally agreed upon, but some ethical aspects differ between civilisations, nations, or societies. The rise of AI presents both immediate and potential long-term ethical challenges across various domains encompassed by UNESCO's mandate. (UNESCO, 2023).

Immediate Ethical Challenges

Privacy and Data Protection: AI systems often rely on vast amounts of personal data, raising concerns about privacy breaches, unauthorised access, and potential misuse of information. Safeguarding individuals' privacy while harnessing the power of AI is a significant challenge. In the context of AI, privacy is essential to ensure that AI systems are not used to manipulate individuals or discriminate against them based on their personal data. AI systems that rely on personal data to make decisions must be transparent and accountable to ensure that they are not making unfair or biased decisions.

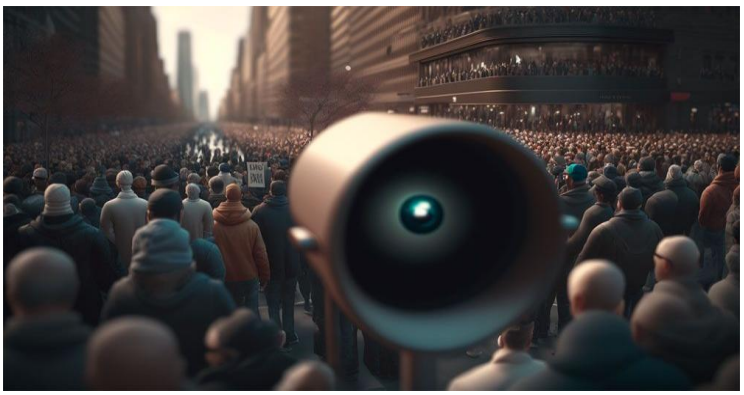

Figure 4: Privacy and Data Protection

Bias and Discrimination: AI algorithms can perpetuate biases present in the training data, leading to unfair outcomes and discrimination against certain groups. Ensuring fairness, equity, and non-discrimination in AI systems is crucial. Another challenge posed by AI technology is the potential for bias and discrimination. AI systems are only as unbiased as the data they are trained on; if that data is biased, the resulting system will be too. This can

lead to discriminatory decisions that affect individuals based on factors such as race, gender, or socioeconomic status. It is essential to ensure that AI systems are trained on diverse data and regularly audited to prevent bias.

Furthermore, AI bias is also a significant cause of racial discrimination. In 2019, it was identified that US hospitals used an AI algorithm that was favouring white over black patients. This AI solution was designed to predict the need for additional medical care for more than 200 million people. It is interesting to notice that in this case, the race was not a variable considered by the algorithm, but healthcare cost history [TS] and the black patients had lower healthcare costs for a variety of reasons, compared to the white ones. It can be easily concluded that income and race are very converging metrics (Klepper & Swenson, 2024).

Figure 5: Bias and Discrimination

The Use of AI in Surveillance

One of the most controversial uses of AI technology is in the area of surveillance. AI-based surveillance systems have the potential to revolutionise law enforcement and security, but they also pose significant risks to privacy and civil liberties.

AI-based surveillance systems use algorithms to analyse vast amounts of data from a range of sources, including cameras, social media, and other online sources. This allows law enforcement and security agencies to monitor individuals and predict criminal activity before it occurs. While the use of AI-based surveillance systems may seem like a valuable tool in the fight against crime and terrorism, it raises concerns about privacy and civil liberties. Critics

argue that these systems can be used to monitor and control individuals, potentially losing freedom and civil liberties (Dr Mark van Rijmenam, 2023).

To make matters worse, the use of AI-based surveillance systems is not always transparent. It can be difficult for individuals to know when they are being monitored or for what purpose. This lack of transparency can erode trust in law enforcement and security agencies and create a sense of unease in the general public (Dr Mark van Rijmenam, 2023).

Figure 6: The Use of AI in Surveillance

Transparency and Explainability: AI algorithms can be complex and opaque, making it difficult to understand how decisions are reached. Lack of transparency can lead to mistrust and hinder accountability. There is a need to develop methods to make AI systems more transparent and explainable.

The Issue of Job Displacements for Workers: AI advancements may lead to job displacement and economic inequality. Preparing societies for the changing nature of work and ensuring equitable distribution of the benefits and burdens of AI technologies is an ethical challenge. As AI systems become more advanced, they are increasingly capable of performing tasks that were previously done by humans. This can lead to job displacement, economic disruption in certain industries, and the need for individuals to retrain for new roles.

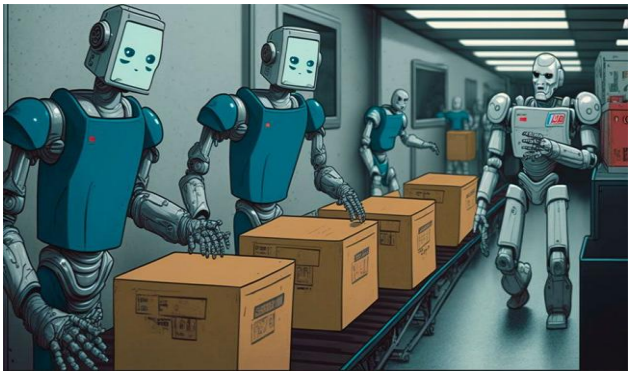

Figure 7: Job Displacements for Workers

Potential Long-Term Ethical Challenges

Autonomous Weapons: Technological progress has brought about the emergence of machines that have the capacity to take human lives without human control. These represent an unprecedented threat to humankind. AWS are lethal devices that identify potential enemy targets and independently choose to attack those targets on the basis of algorithms and AI. AWS, other than stationary sentry guns, require the integration of several core elements: a mobile combat platform, sensors of various types to scrutinise the platform's surroundings, a processing system to classify objects discovered by the sensors, and algorithms that prompt the system to initiate attack when an allowable target is detected (Lettieri et al., 2023).

Figure 8: Autonomous Weapons

The development of autonomous weapons systems raises ethical concerns about their potential misuse, lack of human oversight, and violation of

international humanitarian law. Establishing regulations to govern the use of AI in warfare is critical.

Social Manipulation and Disinformation: AI-powered systems can be used to manipulate public opinion, spread disinformation, and deepen societal divisions. Combating the ethical challenges associated with AI-enabled social manipulation is essential for preserving democratic values and societal cohesion. Furthermore, Sophisticated generative AI tools can now create cloned human voices and hyper-realistic images, videos and audio in seconds, at minimal cost. When strapped to powerful social media algorithms, this fake and digitally created content can spread far and fast and target highly specific audiences, potentially taking campaign dirty tricks to a new low (Klepper & Swenson, 2024) .

The implications for the 2024 campaigns and elections are as large as they are troubling: Generative AI can not only rapidly produce targeted campaign emails, texts or videos, but it could also be used to mislead voters, impersonate candidates and undermine elections on a scale and at a speed not yet seen (Klepper & Swenson, 2024).

Challenges in Establishing Ethical Frameworks and Principles

Diverse Perspectives: Different regions of the world may have varying cultural, social, and ethical norms. Reconciling these perspectives and reaching a global consensus on ethical frameworks for AI can be difficult. Rapid Technological Advancements: The rapid rise in AI has created many opportunities globally**,** from facilitating healthcare diagnoses to enabling human connections through social media and creating labour efficiencies through automated tasks. However, these rapid changes also raise profound ethical concerns**.** These arise from the potential that AI systems have to embed biases, contribute to climate degradation, threaten human rights and more. Such risks associated with AI have already begun to compound on top of existing inequalities, resulting in further harm to already marginalised groups (UNESCO, 2023). Finally, Interdisciplinary Collaboration: Developing ethical frameworks for AI requires collaboration between technologists, policymakers, ethicists, and other stakeholders. Bridging the gap between these disciplines and fostering effective communication is crucial.

Islamic View on Humanising AI

Islam is a progressive religion that allows its adherents to get the best out of new technologies. AI brings many promising opportunities for Muslims, but it also contains unprecedented threats to the religion, by potentially undermining the sanctity of the Quran. Muslims must work proactively to ensure that they derive the benefits of AI while protecting themselves from its dangers (Al-Ubaydli Omar, 2023).

Muslims must adopt an Islamic worldview in understanding science, where a man strives to conduct science with the objective of understanding Allah. The term worldview originates from the German word Weltanschauung, which means our ability to understand and represent the world that we experience in our mind.

In the context of the Islamic worldview, it means our ability to understand and represent the world according to basic Islamic tenets, especially al-Tauhid. The Islamic worldview must be adhered to by all Muslims, or we will risk losing scientific inquisitive skills that can further decline scientific understanding in Muslim society. Muslim scholars should also contribute to the development of Artificial General Intelligence (AGI). This will enable robots' development with an Islamic perspective being included during the development. At the same time, Muslim scholars should initiate debate on the creation and possible implications of AGI robots on Muslims' daily life (Akbar Dahlan, 2018).

We should be prepared for a change. Our conservative ways stand in the way of progress. The most traditionalists consider the ummah's traditional thought to be self-sufficient and capable of being presented as it is or with very little alteration. This approach holds that the ummah's intellectual life can be founded and organised, and that the structure of its civilisation can be built on this basis.

We should find a way to select our strategies in absorbing new technologies from the traditional thought, what is most sound and from modern contemporary thought that one considers and proves to be correct, and weld the two to find an intellectual structure, which will provide a guaranteed basis for achieving what is required. In response to change, our vision of new technology and our mission of Higher Islamic Education in the Muslim World needs to be revised. The wake of globalisation is multi-dimensional in nature.

AI is a new step that is very helpful to society and its development. Machines can do jobs that require detailed instructions followed and mental alertness. AI with its learning capabilities can accomplish those tasks, but only if the world's conservatives are ready to change and allow this to be a possibility (Ali AZ, 2011).

Figure 9: Humanising AI

AI Humanisation from Maqasid Al-Shariah Perspective

The *Maqāṣid* theory, as developed historically, acts as an ethical compass that allows Muslim communities to live out all dimensions of their life in accordance with the *Sharʿīah*. By applying the *Maqāṣid* approach, we can discover ethical principles for all situations faced by human beings. The *Maqāṣid* follow a hierarchy in terms of prioritisation of the necessities, needs and enhancements as can be seen in Figure 10 *Essentials* (*ḍarūrāt*) refer to absolute necessities; *Needs* (*ḥājiyyāt*) are necessities to a lesser extent; while *Enhancements* (*taḥsīniyyāt*) are dispensable needs that are desirable nonetheless for beautifying/facilitating purposes. At the level of *Essentials*, *Sharʿīah* necessitates that the five essential objectives—including religion (*dīn*), life (*nafs*), progeny (*nasl*), property or wealth (*māl*) and intellect (*ʿaql*)—should be preserved. This is the traditional *Maqāṣid* classification figure 11 given among others by al-Ghazzāli. Whatever has the potential to cause harm to any of the five objectives is strongly prohibited (Raquib et al., 2022).

In the context of AI, these concepts have gained importance. AI technologies, due to their ability to shape perception and interactions, must be utilised carefully to improve valuable information and prevent the spread of misinformation. Implementing the principles of the Qur'an in our digital interaction ensures that AI functions as an instrument for promoting the good and beneficial while prohibiting the evil (Al-Qur'an, 3:104) (Rafikov, 2024).

وَلۡتَكُن مِّنكُمۡ أُمَّةٞ يَدۡعُونَ إِلَى ٱلۡخَيۡرِ وَيَأۡمُرُونَ بِٱلۡمَعۡرُوفِ وَيَنۡهَوۡنَ عَنِ ٱلۡمُنكَرِۚ وَأُوْلَٰٓئِكَ هُمُ ٱلۡمُفۡلِحُونَ ١٠٤

"Let there be a group among you who call ˹others˺ to goodness, encourage what is good, and forbid what is evil—it is they who will be successful."

Furthermore, the significance of protecting personal information corresponds to Islamic principles. Islam emphasises the protection of personal information as a crucial component of the right to privacy. Verse 12 of *Surah Al-Hujurat* and verse 27 of *Surah An-Nur* substantiate this claim.

يَٰٓأَيُّهَا ٱلَّذِينَ ءَامَنُواْ لَا تَدۡخُلُواْ بُيُوتًا غَيۡرَ بُيُوتِكُمۡ حَتَّىٰ تَسۡتَأۡنِسُواْ وَتُسَلِّمُواْ عَلَىٰٓ أَهۡلِهَاۚ ذَٰلِكُمۡ خَيۡرٞ لَّكُمۡ لَعَلَّكُمۡ تَذَكَّرُونَ ٢٧

"O believers! Do not enter any house other than your own until you have asked for permission and greeted its occupants. This is best for you, so perhaps you will be mindful."

Consequently, it is imperative and consistent with Islamic principles to safeguard all forms of personal data, encompassing structured, unstructured, geographic, time-series, event, network, and connected data (Nawi et al., 2021).

In the Islamic ethical framework, humanising AI can be understood within the context of the five necessities, also known as the *Maqasid al-shariah*. These five necessities are:

1. Protection of Religion: AI should be developed and used in a way that respects and safeguards religious beliefs and values. It should not be used to undermine or attack religious principles, practices, or institutions.

2. Protection of Life/Health: AI should prioritise the preservation and promotion of human life and well-being. It should be used to enhance healthcare, improve medical diagnostics, and contribute to the overall betterment of human health while avoiding any actions that may cause harm or risk to human life.

3. Protection of Brain/Intellect: AI should be utilised to enhance human intellectual capabilities, promote knowledge acquisition, and contribute to the advancement of scientific and intellectual pursuits. It should not be used to manipulate or exploit human intellect or promote harmful ideologies.

4. Protection of Property/Wealth: AI should respect the rights of individuals to their property and wealth. It should not be used for theft, fraud, or any form of economic exploitation. Additionally, it should not contribute to unfair distribution of resources or exacerbate economic inequalities.

5. Protection of Offspring/Lineage: AI should be used in a manner that ensures the protection and well-being of future generations. It should contribute to sustainable development, environmental preservation, and the overall welfare of society to ensure a better future for generations to come.

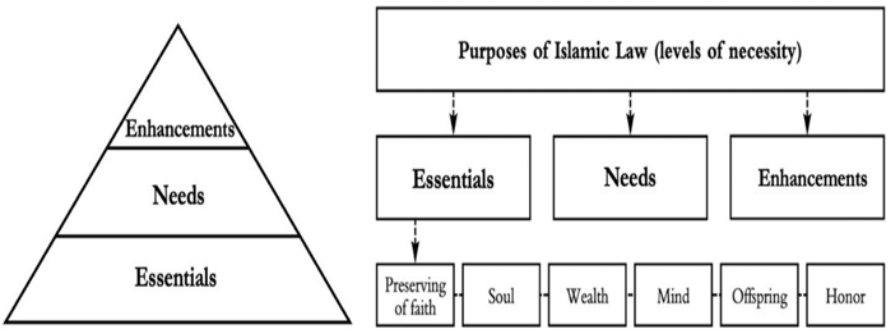

Figure 10: Specifying the Levels of Necessity in *Maqāṣid* discourse (Raquib et al., 2022)

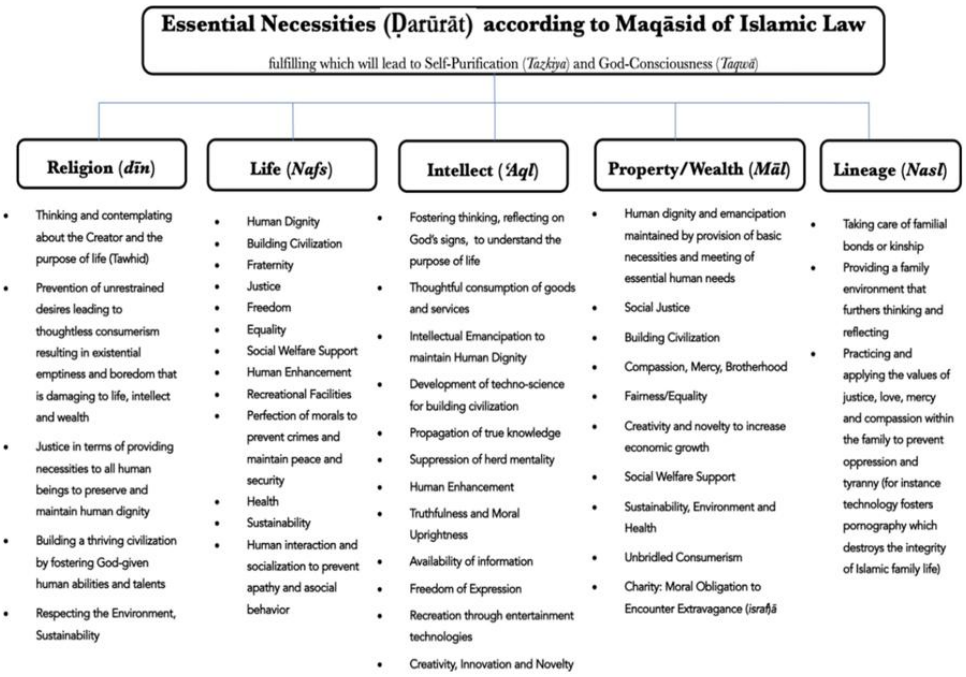

Figure 11: Essential Necessities according to *Maqāṣid* of Islamic Law (Raquib et al., 2022)

The *Essentials* are critical for the preservation and sustenance of the *Maqāṣid*; while *Needs* and *Necessities* support and complement the *Essentials*; and finally, *Enhancements* complement the *Essentials*, while making improvements to the five objectives. The *Essential* elements have priority over *Need* elements, which are to be prioritised over *Enhancements*. It is also important to note that the three categories are not absolute and vary depending on the circumstances of individuals and societies; however, the good of the community always has priority over the good of an individual (Raquib et al., 2022).

The Islamic perspective affirms creative technology as knowledge taught by prophets. In *Surah Hud* (11:37), the story of Prophet Nuh's construction (*sin'ah*) of the Ark under the guidance and providence of God in anticipation of the Great Flood reveals the spiritual dimension of technology.

وَيَصْنَعُ ٱلْفُلْكَ وَكُلَّمَا مَرَّ عَلَيْهِ مَلَأٌ مِّن قَوْمِهِۦ سَخِرُوا۟ مِنْهُ ۚ قَالَ إِن تَسْخَرُوا۟ مِنَّا فَإِنَّا نَسْخَرُ مِنكُمْ كَمَا تَسْخَرُونَ ٣٨

“So, he began to build the Ark, and whenever some of the chiefs of his people passed by, they mocked him. He said, “If you laugh at us, we will soon laugh at you similarly”.

In the context of the verse, technology becomes a means to carry out divine will and, in the process, the tool to save believers from mortal danger.

Conclusion

In conclusion, humanising artificial intelligence (AI) from an Islamic perspective is crucial to ensure the integration of AI systems with faith and values while benefiting from technological advancements. Humanising AI involves incorporating human qualities and aligning with Islamic teachings of compassion, empathy, and justice. Adhering to Islamic ethical principles, AI systems must prioritise fairness, transparency, and accountability while avoiding biases and discrimination.

Several ethical challenges associated with AI, such as privacy and data protection, bias and discrimination, transparency and explainability, accountability and liability, job displacements, and the use of AI in surveillance, need careful consideration based on Islamic principles. Collaboration between Islamic scholars and technologists is essential to develop ethical guidelines and ensure that AI systems align with Islamic values. Moreover, AI ethics extend beyond immediate concerns and encompass potential long-term challenges such as autonomous weapons and social manipulation. Establishing regulations and ethical frameworks to govern the use of AI in warfare and combat social manipulation is crucial for preserving human rights, democracy, and societal cohesion.

Addressing these ethical challenges requires considering diverse perspectives, reconciling cultural and social norms, and reaching a global consensus on ethical frameworks for AI. It is important to balance the benefits of AI with the potential risks and ensure that AI systems operate ethically, transparently, and in alignment with human values. By embracing an Islamic perspective on humanising AI, Muslims can harness the potential of AI while safeguarding their faith and promoting societal well-being.

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Chapter 4

The Role of Wisdom in Guiding Ethical Decision Making within Artificial Intelligence Systems

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Abstract
With the rapid advancement of artificial intelligence (AI) technologies, questions surrounding ethics, decision-making, and responsible innovation have become paramount. This study explores the intersection of wisdom and artificial intelligence, examines the role of wisdom in guiding ethical decision-making within AI systems. Through qualitative interviews with experts in AI ethics, philosophy, and technology development, this research investigates how wisdom can be integrated into AI design and development to promote transparency, fairness, and accountability. The study also explores the ethical dilemmas and challenges that arise from the increasing integration of AI in various sectors and examines the potential for wisdom to inform more responsible and ethical AI practices. The findings of this study contribute valuable insights to the ongoing discourse on ethical AI governance and offer recommendations for fostering a future where wisdom guides the development and deployment of AI technologies in a way that aligns with societal values and ethical principles, and the common good for humankind.

Keywords: Wisdom, AI, Ethics, Decision-Making

Introduction

In today's rapidly advancing technological landscape, artificial intelligence (AI) has become a ubiquitous presence in our daily lives. From virtual assistants like Siri and Alexa to autonomous vehicles and predictive algorithms, AI has the potential to revolutionise nearly every aspect of our society. However, as we continue to rely more heavily on AI, it is important to consider the role of wisdom in guiding our interactions with this powerful

technology.

Wisdom is the ability to make sound judgments and decisions in complex, uncertain, and ambiguous situations. It involves a deep understanding of ethical principles, empathy, and the ability to balance competing interests and values. In the context of AI, wisdom is essential for ensuring that technology is used ethically and responsibly.

One of the key challenges of AI is the potential for bias and discrimination in decision-making algorithms. AI systems are only as good as the data they are trained on, and if that data is biased or incomplete, the AI system may perpetuate and even amplify existing inequalities. wisdom can help us address these issues by guiding us in the development and implementation of AI systems that promote fairness, transparency, and equity.

Additionally, wisdom can help us navigate the ethical dilemmas that arise from the increasing integration of AI into various aspects of our lives. For example, how do we balance the benefits of AI-driven healthcare innovations with concerns about privacy and data security? How do we ensure that AI systems are accountable and transparent in their decision-making processes? These questions require a nuanced understanding of ethics, values, and the potential impacts of AI on society.

Ultimately, finding the balance between wisdom and AI is crucial for harnessing the full potential of this technology while also mitigating potential risks and challenges. By incorporating wisdom into the design and deployment of AI systems, we can ensure that technology serves the common good and enhances human flourishing.

In short, wisdom is essential for guiding our interactions with artificial intelligence in an increasingly technological world. By cultivating a deep understanding of ethics, empathy, and critical thinking, we can harness the potential of AI while also ensuring that it aligns with our values and serves the greater good. Let us strive to strike a balance between wisdom and artificial intelligence for a more ethical and sustainable.

Problem Statement

Despite the rapid advancement of AI technologies, there is a pressing need to address ethical concerns, decision-making processes, and responsible

innovation within AI systems. The lack of integration of wisdom in AI design and development has led to instances of bias, discrimination, and ethical dilemmas, raising questions about the impact of AI on society. This study aims to explore how wisdom can be incorporated into AI systems to promote ethical decision-making, reduce bias, and ensure accountability, transparency, and fairness in AI-driven processes, ultimately contributing to the development of more responsible and ethical AI technologies aligned with societal values and the common good for humankind.

Objectives

- Investigate how wisdom can be incorporated into the design and development of AI systems to promote ethical decision-making, mitigate bias, and enhance transparency in decision processes.
- Explore the ethical dilemmas and challenges arising from the integration of AI technology in various sectors, with a specific focus on understanding how wisdom can guide responsible decision-making and governance in AI applications.
- Examine strategies for cultivating wisdom among individuals and organisations interacting with AI technologies to foster ethical practices, accountability, and transparency in AI-driven decision-making processes.

Research Questions

- How can wisdom be incorporated into the design and development of AI systems to promote ethical decision-making and mitigate bias and discrimination?
- What ethical dilemmas and challenges arise from the increasing integration of AI in various sectors, and how can wisdom guide us in navigating these issues to ensure the technology benefits society as a whole?
- How can individuals and organisations cultivate wisdom in their interactions with AI to foster responsible use, accountability, and transparency in AI-driven decision-making processes?

Literature Reviews

Before Responsible Innovation: Teaching Anticipation as a Competency for Engineers (Stone et al., 2020)

This study focuses on applying historically informed anticipation to teach engineers Responsible Innovation (RI) as a competency. The methodology suggested is called the "value-genealogy of technology," and it entails

examining how values and technologies evolved over time in order to develop a critical understanding of context, limits of foresight, and the socially and historically generated nature of values.

The research is important because it examines the difficulties in predicting the effects of emerging technology and understanding values such as sustainability and privacy. Based to the findings, moral sensitivity, epistemic humility, and moral imagination are crucial attributes that engineers should be taught in RI programs to better predict the effects of innovations and match technological advancements with ethical standards. Students can get a sophisticated grasp of values, analyse technology-value relations critically, and become more equipped to handle ethical issues in engineering practices by cultivating historically informed anticipation.

Anticipatory Ethics as a Method for Teaching Engineering Ethics (Wilson, 2021)

With an emphasis on ethical challenges raised by the fast development of engineering technologies, the study investigates the concept of anticipatory ethics in the context of teaching engineering ethics. Three different types of case analysis—historical, current, and expected future—as well as case comparisons and future technological development projections, are all part of the technique. For the study of human-technology relationships, a case-based methodology combining postphenomenology would be beneficial.

The findings emphasise the necessity of anticipatory ethical analysis, promoting ethical discussions in engineering and ICT curriculum to address ethical challenges early in technological development. The study of historical cases lays the foundation for future advances, allowing students to deal with contemporary and developing challenges, including the moral assessment of technical objects and the impacts of technology on human experiences.

The research is significant as it offers an approach for evaluating a broad variety of ICT and engineering issues related to ethics, bridging the gap between predicted and prior technological advances. Students have a stronger capacity to think critically and ethically about future challenges in engineering and ICT through the application of postphenomenology and anticipatory ethics to help them recognise and deal with ethical issues in developing technologies.

ETHICS-2021 Special Session 7: Integrating Virtue Ethics into STEM Courses (Henslee et al., 2021)

The integration of virtue ethics into STEM courses will be discussed in the publication, with a concentration on character education and fostering of virtues in engineering students. A framework for integrating character education into the curriculum is being established as part of the methodology, and examples of how it's used in a Wake Forest University robotics course are offered. Weekly talks on issues like employment, inequality, biases in AI, etc., were an element of the robotics course. Students' ethical reflection and the clarity of the media they viewed were evaluated.

The study's findings emphasise how important it is to integrate ethics into engineering practice and education since accomplishing so will better equip students for the complexity of the STEM job sector of the future. It emphasises how essential it is to start small, provide safe spaces for students to fail, and employ resources for implementation. Students are better equipped to make hard decisions and grow morally to meet the demands of the continuously developing job market when virtue ethics are integrated into STEM courses.

WIP: How Should We Decide? The Application of Ethical Reasoning to Decision Making in Difficult Cases (van Tyne, 2020)

This study explores the different ethical frameworks— Deontology, Virtue Ethics, Consequentialism, and Utilitarianism—that first-year engineering students use to address moral conundrums. The study's methodology involved collecting and analysing twelve essays written by non-traditional first-year engineering students who had just transferred to Virginia Tech. The writings were coded for identifying the topic, recommended fixes under each ethical framework, and the participants' amount of understanding and implementation of each framework.

The study's conclusions indicated that very few participants could differentiate across the four ethical frameworks with precision and offer recommendations that might take into account any negative consequences. Some participants applied the ethical frameworks to the ethical challenges offered with insufficient effort, comprehension, or adherence to the assignment's purpose. The study also revealed certain misconceptions and

discrepancies in the participants' application of the various ethical frameworks, suggesting that first-year engineering students still need to work on their comprehension and application of ethical reasoning concepts.

The importance of this paper lies in its contribution to the engineering ethics community by assessing how well first-year engineering students understand and apply different ethical frameworks. By identifying areas of misconceptions and inconsistencies in the application of ethical reasoning principles, this study can inform educators and curriculum developers about the need for more focused training and guidance in engineering ethics for students. Additionally, this study underscores the importance of providing opportunities for students to practice ethical decision-making in resolving ill-structured societal problems, thereby fostering a sense of professional responsibility among future engineers.

Wisdom in the Age of AI Education (Peters & Green, 2024)

AW transcends traditional AI capabilities. It involves not only processing vast amounts of information but also making decisions that reflect deep ethical understanding, empathy, and alignment with human values. Unlike standard AI, which focuses on data-driven tasks, AW integrates ethical reasoning and societal context. The study reviews literature on wisdom and AI technologies, exploring their integration into society. The findings emphasise the importance of AI systems incorporating ethical reasoning and empathy to align with diverse societal norms. The paper highlights AI's evolution from basic tools to systems that emulate human wisdom. It discusses embedding ethical frameworks in AI, ensuring responsible decision-making. Institutions play a crucial role in governing AI technologies. Addressing the role of institutions ensures ethical AI development and application. The significance of aligning AI with human values is essential for successful integration into various aspects of human life. AW-driven AI envisions enhancing human lives while upholding core values. The paper envisions a future where AW-driven AI contributes positively to humanity. A new framework for planetary ethics should guide wisdom in the age of AI. In summary, AW represents a shift toward AI systems that exhibit wisdom, empathy, and ethical reasoning. Its integration into education can empower students with critical capacities for democratic planetary stewardship in the age of AI.

Technological-Progress-Artificial-Intelligence-Development-and-Ethical-Paradigms (Maharani et al., 2022)

The study, named "Technological Advancements, the Growth of Artificial Intelligence, and Moral Frameworks," delves into how the advancement of artificial intelligence in Indonesia is affecting society and proposes a moral framework to navigate these effects. The approach taken in this research is through a review of existing literature, employing philosophical hermeneutic techniques to examine the moral implications of artificial intelligence's influence on human existence. The study points out the mutually beneficial relationship between technology and humans, underlining the importance of ethics in preserving human dignity and the balance of life. The conclusions indicate that technology, being a key component of human existence, molds the future of humanity. It also stresses the need for a carefully planned national approach to address artificial intelligence's growth, with a primary emphasis on integrating ethics as a core component of this approach. The significance of this study is in promoting transparent guidelines and plans to oversee the moral consequences of artificial intelligence's growth, ensuring that technology's beneficial aspects are utilised in a responsible manner.

Postphenomenological Method (Ritter, 2021)

This research delves into the postphenomenology method, which combines insights from phenomenology and pragmatism to investigate how technologies shape human-world interactions and affect the perception of the world and individuals. The author thoroughly examines the strengths and potential of postphenomenology, with a particular focus on its capacity to engage with technological objects and its shift towards empirical research. The research strategy includes analysing the theoretical structures of key postphenomenologists such as Don Ihde and Peter-Paul Verbeek. The document emphasises the necessity of philosophical precision and reinforcement from a phenomenological viewpoint to overcome the shortcomings of postphenomenology in identifying and examining technological mediation beyond traditional definitions of technology.

To sum up, the document seeks to illustrate the necessity of adopting a phenomenological perspective on technology within the framework of postphenomenology, emphasising the equilibrium between phenomenology and pragmatism in the study of technological mediation. The research strategy involves a critical evaluation of postphenomenology's

stance on technological entities and its shift towards empirical research, ultimately highlighting the significance of expanding the research area to comprehensively understand the intricacies of technological mediation.

The Product Development of Portable Laboratory Integrated with Local Wisdom PL-ILW by Undergraduate Student (Susanto et al., 2022)

The research delves into the creation of a Portable Laboratory integrated with Local Wisdom (PL-ILW) by undergraduate students, aiming to offer a cost-effective and portable laboratory solution to enhance science education in remote and underprivileged regions. The methodology employed in the development process encompasses design, construction, and testing phases of the PL-ILW, along with evaluating its efficacy in teaching science in a rural village in Indonesia. The study's results underscore that the PL-ILW serves as a pragmatic and efficient means of delivering fundamental science education in areas where conventional laboratories are impractical or unaffordable.

The significance of this paper lies in demonstrating the importance of innovation and local wisdom in devising practical solutions that can tackle societal challenges, particularly in remote and underprivileged areas. By introducing the PL-ILW, the paper underscores the potential to narrow the gap in science education accessibility in underserved communities, ultimately contributing to enriching educational opportunities and nurturing scientific curiosity and knowledge in those regions.

Integration of Ethics Focused Modules into the Steps of the Engineering-Design Process (Edelson et al., 2021)

This paper explores the incorporation of engineering ethics education into a first-year design course at Duke University. The approach involved the creation of four modules that were integrated into the course curriculum, each targeting different stages of the engineering design process to facilitate discussions on ethical considerations. The effectiveness of these modules was assessed through a pre/post study that measured changes in students' ethical awareness using established surveys. The results indicated some progress in students' ability to recognise trade-offs in design criteria and other factors that influence product development. However, overall, the ethics modules did not demonstrate a significant impact on ethical awareness. The document emphasises the importance of integrating ethics education into engineering curricula to foster responsible and thoughtful

design practices. The developed modules aim to instil an ethical mindset in students early on in their engineering education, encouraging them to critically analyse their design choices and consider the broader implications of their designs on society. Further research is planned to evaluate the long-term effects of these ethics modules on students' ethical mindset.

On the Ethics of Algorithmic Intelligence (Simanowski et al., 2019)

The article authored by Roberto Simanowski, titled "On the Ethics of Algorithmic Intelligence," delves into the ethical ramifications of AI technology. The approach taken in the study involves scrutinising the authority wielded by scientists and entrepreneurs in the creation and application of AI innovations, while also analysing the effects of AI on individual autonomy and societal dynamics.

The conclusions drawn in the article indicate the possibility of AI curtailing human freedom and presenting hazards if not employed ethically. Nevertheless, it is acknowledged that embracing AI has the potential to yield positive results, such as reducing fatalities on the roads and enhancing safety in hazardous occupations. The article poses fundamental inquiries regarding the interplay between AI and ethics, fostering a discourse on the appropriate utilisation of AI to benefit humanity rather than exert control over it.

In essence, the significance of this article lies in instigating dialogues on the ethical considerations associated with AI technology. It underscores the necessity for meticulous deliberation on the development, utilisation, and regulation of AI to ensure its societal advantages while upholding individual autonomy. The article underscores the pivotal role of ethics in shaping the application of AI technology and encourages contemplation on the potential consequences of advancing AI capabilities.

Students taking action on engineering-ethics (Dillon et al., 2020)

This document explores the creation and execution of an original classroom project module designed to improve the ethical skills of engineering students. The approach involved introducing an ethics dilemma concerning a vaccine transportation device into a heat transfer course at the University of Portland. Students were tasked with devising an action plan to tackle the ethical issue, and their progress was evaluated through surveys and assessments. The results demonstrated a notable enhancement in students'

capacity to explore various solution paths, recognise the needs of stakeholders, and formulate action plans for ethical challenges. The significance of this paper lies in its emphasis on practical abilities in ethical decision-making and communication with authorities, surpassing conventional engineering ethics education. The outcomes suggest that such modules can have a pivotal role in moulding the character development of engineers and preparing them to make well-informed decisions in diverse professional settings. By integrating ethics education into engineering curricula, students are furnished with the essential skills to navigate ethical dilemmas in their forthcoming careers. The triumph of the study sets the stage for future modifications and introductions of similar modules in engineering education to cultivate an entrepreneurial mindset and boost students' capabilities in effectively addressing ethical predicaments.

Summary: The texts discussed focus on various aspects of integrating ethics into engineering education, with a particular emphasis on responsible innovation, anticipatory ethics, virtue ethics, ethical reasoning, AI ethics, and character education. Each paper proposes different methodologies for teaching ethics in engineering, including historical analysis, case studies, character education frameworks, and ethical dilemma modules. The importance of integrating ethics into engineering curricula is highlighted in all texts, as it prepares students to navigate complex ethical challenges in their future careers.

A comparison between these studies shows that they all emphasise the need for ethical considerations in engineering education and practice. They suggest different approaches to teaching ethics, such as historical analysis, case studies, virtue ethics frameworks, and ethical reasoning frameworks. Each text highlights the importance of developing ethical awareness, critical thinking skills, and ethical decision-making abilities among engineering students to address the ethical implications of emerging technologies and design practices. Overall, the texts contribute to the ongoing discussion on integrating ethics into STEM education to prepare students for the ethical challenges of the future job market and societal demands.

What is wisdom?

Wisdom is a multidimensional concept that can be cultivated through educational means, particularly in the realm of gifted education. Neglecting the significance of wisdom within educational environments may

contribute to the current societal unrest. Given the perceived need for wisdom in today's world, it is crucial to carefully consider ways in which wisdom can be nurtured. The advantages of wisdom in the context of gifted education are evident, as it is built upon advanced cognitive abilities, self-control, innovative thinking, decision-making skills, and ethical conduct that collectively yield favourable results for both individuals and their communities. Furthermore, according to Renzulli (2002), the primary objective of gifted education is not only to foster self-actualisation in talented individuals but also to elevate the calibre of leaders within society. We posit that wisdom plays a pivotal role in achieving these objectives, as its fundamental elements are closely aligned with the aims of gifted education: enhancing social capital and cultivating competent, empathetic leadership will effectively prepare individuals for the challenges of the future (Karami et al., 2020).

Wisdom from an Islamic Perspective

Through research in Islamic heritage and the writings of scholars, it became clear that most research deals with some of the meanings of wisdom or about wisdom in one of its meanings, parts, components, or some of its outcomes, which is not wisdom in the total sense.

It is possible to combine what was previously mentioned about the definition of wisdom as follows. Despite the difficulty of finding wisdom itself, it can be estimated how close people are to this ideal state, as wisdom is considered a personal trait, and it is also a typical type that attempts to combine reality and ideal, because few people may meet the definitions and descriptions. It can also be concluded that wisdom is composed of dimensions. These dimensions reinforce each other, in an integration that we can define as follows (Al-Hidabi, Dawood & Khiati, 2022):

1) The cognitive dimension of wisdom refers to an acquired quality that helps understand life, that is, understanding the significance and deep meaning of phenomena and events, especially those related to personal matters and those related to others. This includes knowledge of the positive and negative aspects of human nature, the limitations of human knowledge, the inability to predict and the lack of certainty.

2) The practical dimension: Knowledge alone is not enough. It must be accompanied by application. Preparation alone is not enough. Action

must be done. Indeed, knowledge without implementation can lead to failure, frustration, and people's discontent. Wisdom is for a person to know what he is doing, and skill is to know how to do it, and success is doing it according to that skill.

3) The moral dimension: It is a set of principles and standards that guide an individual's behaviours and help him determine what is right and what is wrong. The moral dimension also refers to that force that leads a person to distinguish between good and evil. Sobriety, calm, honesty, courage, boldness, justice, striving to achieve common benefit, and adopting the principles of social responsibility are at the core of this dimension.

4) The contemplative dimension: It is a prerequisite for developing the cognitive dimension of wisdom. Life can only be understood more deeply if one can perceive reality as it is without any distortions. To do this, one needs to engage in contemplative thinking by looking at phenomena and events from many perspectives. Considering the development of self-insight and awareness, this practice will gradually reduce self-centredness, increase insight into the reality of things, including the motivations for one's own behaviour and of others, and increase cooperation with them.

5) The emotional dimension: It appears in the lack of self-centredness and transcendence of subjectivity, and this is what allows the individual to have a more comprehensive understanding of life in general and different human situations in particular, which leads the individual to a greater understanding of the behaviours of other people with increased empathy, compassion, love for others, and altruism.

These five dimensions are not independent of each other, but they are not conceptually identical. For example, understanding (cognitive dimension) is quite different from feeling empathy for others (affective dimension). However, the five dimensions must be present together for it to be considered that a person is "wise" even if in different amounts depending on what the situation requires.

Wisdom consists of five dimensions: cognitive, contemplative, emotional, practical, and moral, in an integrated and balanced way of the individual's personality related to their life in society. Wisdom can be considered a

personal trait that distinguishes an individual from others through practical manifestations. Researchers can measure its five components, and the decisions made to reach positive and beneficial outcomes for the individual and society (Al-Hidabi, Dawood & Khiati, 2022).

Definition of Wisdom

Wisdom is defined as the process of making the right decision and taking the correct action by integrating knowledge and expertise, utilising reason, acting within the framework of values and ethics, and understanding the balance of interests and concerns. In order to achieve benefits or avoid harm, based on the context (Al-Hidabi, Dawood & Khiati, 2021).

How can wisdom be incorporated into the design and development of AI systems to promote ethical decision-making and mitigate bias and discrimination?

Artificial wisdom, also known as artificial general intelligence (AGI), strives to create machines capable of grasping and comprehending any intellectual phenomena, such as contemplation, learning, and decision-making, in the same way that humans can. AGI is currently in its early phases of development. Human cognition serves as the foundation for AI training, since individuals create learning models and datasets. However, humans must be in charge and monitor AI decision-making while it is being developed and used (Lim et al., 2023). Artificial wisdom, which is referred to as artificial general intelligence (AGI), strives to create intelligent machines capable of grasping and comprehending any intellectual phenomena, such as contemplation, learning, and decision-making, in a manner that humans can. AGI is currently in its early phases of development. Human cognition serves as the foundation for AI training, since individuals create learning models and datasets (Lim et al., 2023).

To include wisdom into the design and development of AI systems in order to enhance ethical decision-making and minimise bias and prejudice, numerous factors must be considered. First, it is critical to appreciate the value of human involvement in reviewing AI judgments. In terms of safety and ethics, near-term research objectives include human oversight of AI decisions. Supervision may be required when the vulnerability is high. With human-focused rendition, the machine makes a judgment; nevertheless, having the ability to evaluate the amount of uncertainty of that choice is

one of the critical criteria so that when vulnerability goes under an appropriate limit, human management is sought (Leavitt et al., 2012). To ensure ethical outcomes, consumers have to monitor and validate the decisions made by AI systems. In addition, AI models must incorporate components of human intelligence, decision-making, and moral goals to guarantee that judgments produced by AI systems indicate the Company's ethical standards.

Human wisdom and artificial intelligence will improve each other's comprehension and utility while additionally encouraging one another's progress. Thus, AI models should be developed to maintain our human attributes, decision-making abilities, and moral goals, or at least the finest aspects of our perspectives. Consequently, advancing Artificial Wisdom (AW) will require extensive cooperation among computer scientists, neuroscientists, psychologists, and ethicists (Jeste, 2020). Essentially, AW is going to reflect the qualities of wise people. As a result, human management is supposed to be consistent. Further, the solution is a whole set of methodologies, an entire set of concepts that we term "human-focused artificial reasoning," i.e., artificial wisdom (Leavitt et al., 2012). It is also necessary to consider the ethical and societal consequences of using AI, notably in terms of culpability in the case of machine oversight or harm. Incorporating wisdom into AI systems may be performed by including moral and wise components as an ethical standard for sensitive platforms, including online gambling. (Marcus et al., 2022).

Another realistic reason to worry about AI is its harmful impact on dependence and gambling offerings. Many interactive online platforms incorporate eye-catching and addictive components that enhance user engagement and encourage greater levels of online presence, interaction, and commerce. Excessive use of such technology is unsafe and could be designated as addictive behaviour. Cemiloglu et al. (2020) examined the application of AI in online gambling, providing an excellent illustration of addictive technology. Gambling or betting is a horrendous sort of addiction or habit formation that can lead to significant implications for one's personal well-being, social position, and financial status. Integrating wisdom into AI may be accomplished by establishing moral and wise components as the norm of ethics for such gambling systems. Additionally, there is a need to ensure that AI systems do not generate biased or discriminatory content by integrating a human-centred approach in learning AI models (Cemiloglu

et al., 2020).

One possible worry about generative AI is the development of biased or inappropriate information. For example, if the training data contains gender or racial prejudices, the resulting content may equivalently be prejudiced or discriminatory. The recommendation currently is to switch from 'Artificial Intelligence' (AI) to 'Artificial Wisdom'. The way psychological science and cognitive science have informed the AI field, similar approaches can be followed to develop AW. We must build bridges between wisdom studies and AI to proceed in the right direction. As a result, now is the best time to investigate and understand the knowledge, as well as to turn it into a practical notion as the fundamental concept for AW. AW is only possible if we go with the specificationism approach (Tsai, 2020) (i.e., identifying and addressing the practical approach of how the system should be able to generate practical reasoning) rather than the instrumentalism approach (i.e., talking about practical reasoning only in philosophical terms and concepts) (Tsai, 2020).

The specificationism approach, which involves describing comprehensively how the system should be able to create practical reasoning, is critical to developing human-centred artificial intelligence. The recommendation currently is to switch from "Artificial Intelligence" (AI) to "Artificial Wisdom" (AW). The way psychological science and cognitive science have informed the AI field, similar approaches can be followed to develop AW. We must build bridges between wisdom studies and AI to proceed in the right direction (Salvagno et al., 2023). As a consequence, now is an ideal time to investigate and fully understand the knowledge, as well as to turn it into a useful notion as the fundamental concept for AW. AW is only possible if we take the specificationism approach (Tsai, 2020) (i.e., specify and discuss the practical approach of how the system should be able to generate practical reasoning) rather than the instrumentalism approach (i.e., merely addressing practical reasoning in philosophical terms and concepts) (Tsai, 2020). Finally, by considering these various elements and integrating human wisdom, human supervision, and ethical criteria into the design and development of AI systems, it is possible to promote ethical decision-making while minimising the risks of bias and discrimination that these systems may present.

What ethical dilemmas and challenges arise from the increasing integration

of AI in various sectors, and how can wisdom guide us in navigating these issues to ensure the technology benefits society as a whole?

The increasing integration of AI in various sectors brings forth a multitude of ethical dilemmas and challenges that must be addressed to ensure the technology benefits society. Some of the key ethical issues include privacy concerns, algorithmic bias, accountability for errors, transparency, diversity, non-discrimination, and fairness. These challenges highlight the need to balance the opportunities of AI technologies with respect for ethical principles such as privacy and fairness (Benjamin Samson Ayinla et al., 2024). One of the crucial dilemmas is bias in AI systems, as it can lead to unfair outcomes and exacerbate inequalities. Addressing bias in AI algorithms requires a concerted effort to recognise and mitigate biases, emphasising collaboration among stakeholders and integrating ethics into the skill set of AI developers (Siqueira De Cerqueira et al., 2022).

In the healthcare sector, the integration of AI presents challenges related to maintaining empathy and intuition in medical practices while leveraging AI's proficiency in deciphering complex medical data. It is essential to ensure that AI augments, rather than replaces, physicians, highlighting the importance of balancing technological innovation with human insight (Umbrello, 2022). To navigate these ethical dilemmas and challenges, wisdom can guide us in making informed decisions that prioritise ethical considerations and societal values. Wisdom can guide us in fostering a comprehensive approach that integrates ethics into AI development and usage, ensuring equitable outcomes that benefit society while respecting human values. By promoting transparency, accountability, multi-stakeholder collaboration, and public engagement, we can navigate these ethical issues effectively and ensure that AI technologies serve the greater good. Ultimately, using wisdom as a compass in addressing ethical challenges in AI can pave the way for the responsible and sustainable development of AI technologies that align with societal values and individual rights (Benjamin Samson Ayinla et al., 2024).

How can individuals and organisations cultivate wisdom in their interactions with AI to foster responsible use, accountability, and transparency in AI-driven decision-making processes?

To cultivate wisdom in their interactions with AI and foster responsible use,

accountability, and transparency in AI-driven decision-making processes, individuals and organisations can take several key steps:

1) Create an Environment that Supports Informed Choice: Individuals and organisations should prioritise providing users with sufficient information to enable informed decision-making. This involves ensuring that users have a clear understanding of how AI systems function and the potential risks associated with their online behaviour. By offering transparency about the characteristics and operation of AI systems, such as the probability of outcomes and the influence of independent events, users can make more informed choices (Singhal et al., 2024).

2) Limit Influence on User Behaviour: It is crucial to decrease the influence that AI systems may have on user behaviour to promote conscious decision-making. This can be achieved by setting design constraints on platforms to prevent creating illusions of control and ensuring transparency about the intentions behind system functionalities (Mittal et al., 2023).

3) Monitor User Data to Identify Risk Factors: Organisations should implement systems to monitor user data to detect risky behaviour and intervene proactively. By analysing data such as betting history, time spent on a platform, and emotional stress levels, organisations can identify potential issues and provide support to individuals at risk of addiction. This step is essential in promoting responsible gambling practices and preventing harmful behaviour (Metcalf et al., 2023).

4) Provide Information about AI Systems: AI platforms should aim to be more transparent in how they operate in order to empower user understanding of why and how AI systems make decisions. Through Explainable AI techniques, users can gain insights into the functioning of AI algorithms, helping them to make more informed decisions about whether to follow AI recommendations (Tao et al., 2022).

5) Offer Referral to Responsible Usage Applications and Resources: Organisations should provide users with information about resources and support services for responsible usage. By offering access to care services, phone numbers, and websites for assistance, individuals can seek help when needed and make informed choices about their online

behaviour (Hosseini et al., 2018). By following these ethical requirements and incorporating them into their interactions with AI systems, individuals and organisations can cultivate wisdom, promote responsible use of technology, and enhance accountability and transparency in AI-driven decision-making processes.

Methodology

To answer the research questions on the intersection between wisdom and AI, a qualitative research method may be beneficial.

The qualitative analysis: by conducting interviews or surveys with experts in AI ethics, philosophy, and technology development to gather insights on the role of wisdom in guiding ethical decision-making in AI systems. These qualitative data can provide rich, detailed perspectives on the challenges and opportunities in integrating wisdom into AI design and development. Qualitative methodology allows researchers to gain a deep understanding of complex phenomena by exploring participants' perspectives and experiences (Yu & Yu, 2023).

Sample size: While interviews with experts can provide nuanced insights and expert opinions, it is essential to have a sufficiently diverse sample size to capture a range of perspectives and experiences. Consider including a variety of experts from different backgrounds, disciplines, and viewpoints to ensure a comprehensive understanding of the topic.

For a qualitative research study exploring the intersection of wisdom and artificial intelligence, and the role of wisdom in guiding ethical decision-making in AI systems, a sample size of around 5 to 10 experts would be a good starting point. This number allows for a diverse range of perspectives to be captured while also ensuring that the data collection and analysis remain manageable and focused. When interviewing experts, the minimum sample size may vary due to the specialized knowledge and expertise they possess (Marshall et al., 2013).

Questions for the Interview

1. Would you provide examples of ethical dilemmas or challenges that have arisen in the development and deployment of artificial intelligence systems?

2. In your opinion, what role does wisdom play in guiding ethical decision-making in the design and implementation of AI technologies?

3. How can wisdom be integrated into AI systems to promote fairness, transparency, and accountability in decision-making processes?

4. How can we define and measure wisdom in the context of AI systems and decision-making processes?

5. How can individuals and organisations be proactive in cultivating wisdom in their interactions with AI, and what strategies can be implemented to ensure responsible use and accountability?

Data Collection

Qualitative research, with its nuanced approach to understanding human behavior and social phenomena, demands meticulous methods for data analysis. Among the repertoire of techniques available, the Saldaña method stands out for its structured yet flexible coding processes, developed by Johnny Saldaña, a luminary in qualitative research. This method, known for its wide applicability across diverse research settings, involves a series of sequential steps designed to transform raw data into insightful conclusions. The following schema offers an overview of this approach, tailored to provide clarity and direction for researchers embarking on qualitative analysis.

The Saldaña method begins with data collection, where researchers gather information through interviews, focus groups, observations, or document reviews. This foundational step feeds into the first cycle of coding, where data are segmented and labelled to capture the essence of the information. This includes Descriptive Coding, In Vivo Coding, Process Coding, and Initial Coding, each contributing to a granular understanding of the data. The second cycle of coding refines these insights, using Pattern Coding, Focused Coding, and Axial Coding to identify and relate major themes. Subsequent steps, such as Data Condensation and Data Display, allow for the distillation and visual representation of the data, aiding in the synthesis of information. The process culminates in the drawing of conclusions and verification of findings, ensuring robustness through techniques like member checking. Finally, reporting encapsulates the research in a structured format, aligning findings with theoretical

frameworks and discussing broader implications. Through this method, researchers can systematically dissect complex qualitative data, paving the way for significant contributions to knowledge and practice.

Because qualitative research takes a complex approach to understanding social phenomena and human behaviour, careful data analysis techniques are needed. The Saldaña method, created by renowned qualitative researcher Johnny Saldaña, is notable for its methodical yet adaptable coding procedures among the various techniques available. This approach, which is well-known for being broadly applicable in a variety of research contexts, consists of a collection of sequential procedures meant to convert unprocessed data into meaningful findings. A simplified overview of this methodology is provided in the schema below, which is intended to give researchers starting a qualitative study some guidance and clarity.

The first step of the Saldaña technique is data gathering, when researchers engage in focus groups, observations, interviews, and document reviews to obtain information. This preliminary phase feeds into the initial coding cycle, in which data are labelled and segmented to extract the most important information. The previous techniques—Descriptive Coding, In Vivo Coding, Process Coding, and Initial Coding—all aid in providing an accurate understanding of the data.

By identifying and connecting the main themes using Pattern Coding, Focused Coding, and Axial Coding, the second coding cycle improves upon these discoveries. Information synthesis is aided by subsequent procedures like data condensation and data display, which enable the data to be presented graphically and reduced (Saldaña, 2015).

At the end of the process, conclusions are drawn, findings are verified, and robustness is ensured using methods like member checking. The research is finally summarised in a systematic manner in the report, which also discusses the wider ramifications and matches the results with theoretical frameworks. This approach enables scholars to methodically analyse intricate qualitative data, opening the way to important advances in both theory and practice.

A schema for qualitative analysis using the Saldaña method can be broken down into several steps. Johnny Saldaña, an influential figure in qualitative

research, developed coding methods that are widely used in analysing qualitative data. Here's a simplified schema based on his approach:

Data Collection: Collect qualitative data through interviews, focus groups, observations, or document reviews.

First Cycle Coding:
Descriptive Coding: Assign labels to data segments to summarise the basic topic of a passage.
In Vivo Coding: Use the participants' own language to code the data.
Process Coding: Use gerunds to denote observable and conceptual actions.
Initial Coding: Open coding to begin breaking down the data into discrete parts, closely examining similarities and differences.

Second Cycle Coding:
Pattern Coding: Group first cycle codes into a smaller number of sets, themes, or constructs.
Focused Coding: Narrow down to the most significant initial codes to develop major themes and constructs.
Axial Coding: Relate codes to each other via a combination of inductive and deductive thinking.

Data Condensation: Reduce the volume of data by summarising and abstracting it while retaining the essence.

Data Display: Create visual displays like matrices, charts, graphs, or tables to organise and present the data in a comprehensive way.

Conclusion Drawing and Verification: Interpret the data, identifying meaningful patterns and insights. Verify findings through further methodological approaches like member checking, peer review, or revisiting the data.

Reporting: Present the findings in a structured format, aligning them with research questions and literature, while also discussing limitations and implications. Each of these steps helps in systematically breaking down complex qualitative data into understandable, insightful conclusions that can guide further research or practical applications.

Interview answers coding

Table 1 : Interview answers coding

Detailed Answers with Expert Identification	Main Ideas	Themes
"Wisdom plays a crucial role in guiding ethical decision-making when developing AI technologies mainly because it prioritises human values, morals, and the potential consequences of our actions over plain results." (Expert 1) "Wisdom can play a crucial role in guiding ethical decision-making by considering the consequences of building super intelligent AI systems, the risks related to AI handling autonomous tasks and by establishing an organisation that sets rules for developing AI systems to avoid any misuse or any deviation of AI systems." (Expert 4)	1. Integration of wisdom in AI 2. Ethics in decision-making 3. Consideration of human values	**Ethical Decision-Making**
"Some of the ethical problems that can be found while developing AI systems include AI bias and fairness, accountability, and job displacement due to automation." (Expert 1)	1. AI bias and fairness 2. Accountability in AI systems	**AI Technology Development**
"Wisdom is an important factor playing a crucial role in an individual's character. Personal traits shape one's approach and purpose in utilising tools. Wisdom also plays a role in identifying key areas that need development and directing all efforts towards noble causes and the ultimate goal in the lives of humanity as a whole." (Expert 2)	1. Role of personal traits in AI usage 2. Development directed by human values	**Human Values in AI**
"Wisdom also plays a role in identifying key areas that need development and directing all efforts towards noble causes and the ultimate goal in the lives of humanity." (Expert 2)	1. Directing AI development towards ethical purposes 2. Aiming for humanity's ultimate goals	**AI Ethical Purposes**

Detailed Answers with Expert Identification	Main Ideas	Themes
"AI systems are supposed to achieve balance, anticipate outcomes and consequences, and ensure that industrial progress does not encroach on ethics and values." (Expert 3) "Advanced AI systems can easily do simple tasks (repetitive tasks as well). This can affect the job market and can cause job displacement. For example, clerical tasks can easily be done using a specialised AI programme which may push firms and companies to prioritise developing this kind of system instead of hiring an expert for the job." (Expert 1)	1. Balancing ethical considerations in AI systems 2. Anticipating outcomes and consequences 3. Impact of automation on job displacement	**AI Systems and Ethics**
"The risks related to AI handling autonomous tasks." (Expert 4)	1. Managing autonomous tasks 2. Establishing guidelines to prevent misuse	**Risks of Super-Intelligent AI**
"AI systems should be open-source to avoid having any organisation controlling AI (especially with the race towards AGI). By having transparent and open-source algorithms and establishing guidelines and perhaps rules in developing AI systems, and by ensuring having human control in the development process." (Expert 4)	1. Promoting open-source to prevent monopolies 2. Managing the race towards AGI	**Open-source AI and AGI Control**
"Integrating wisdom in an AI system if it is possible at all would require a lot more effort than anything else while developing an AI especially if we want it to promote."	1. Efforts required for integrating wisdom	**AI Wisdom Integration**
"Fairness transparency and accountability." (Expert 1)	1. Promoting fairness, transparency, and accountability	

Detailed Answers with Expert Identification	Main Ideas	Themes
"Here lies the primary and essential capability of wisdom in the AI system, where experience can be defined in the informational system with a vast database." (Expert 2)	1. Decision-making based on extensive databases 2. Essential capabilities of wisdom in AI	**AI Decision-making Systems**
"It is better to build AI systems from the ground up on foundational principles rather than merely as auxiliary and supportive systems." (Expert 3)	1. Building on solid principles 2. Encouraging evolution through continuous feedback	**AI Foundational Principles**
"There must be transparency in dealing with AI systems and clear accountability to avoid future problems." (Expert 3)	1. Ensuring operational transparency 2. Importance of human oversight in AI development	**AI Transparency and Supervision**
"Wisdom plays a crucial role in guiding ethical decision-making when developing AI technologies mainly because it prioritises human values, morals, and the potential consequences of our actions over plain results." (Expert 1) "Wisdom can play a crucial role in guiding ethical decision-making by considering the consequences of building super intelligent AI systems, the risks related to AI handling autonomous tasks and by establishing an organisation that sets rules for developing AI systems to avoid any misuse or any deviation of AI systems." (Expert 4)	1. Integration of wisdom in AI 2. Ethics in decision-making 3. Consideration of human values	**Ethical Decision - Making**

Discussion

The concept of this interview is summarised as, the "Responsible AI Framework" emphasises a holistic approach to AI development, where ethical considerations are embedded at every stage, from conception

through deployment and operational use. By adhering to this framework, stakeholders can ensure that AI technologies are developed responsibly, with a clear focus on enhancing societal well-being and respecting human dignity. This theoretical approach aims to bridge the gap between rapid technological advancements and the slower pace of ethical norm development, ensuring that AI serves humanity's best interests.

Conclusion

The study on wisdom and artificial intelligence has illuminated the critical role of wisdom in guiding ethical decision-making and promoting responsible AI governance. Through qualitative interviews with experts in AI ethics, philosophy, and technology development, key insights have been gathered on the integration of wisdom into AI systems to enhance transparency, fairness, and accountability.

The findings of this study underscore the complexity and significance of ethical considerations in AI technology, as well as the opportunities and challenges in leveraging wisdom to address these concerns. By examining the ethical dilemmas and challenges that arise from the increasing use of AI across various sectors, the study has highlighted the urgent need for ethical frameworks and guidance that prioritise human values and societal well-being.

Moving forward, fostering a culture of ethical decision-making and integrating wisdom into AI design and deployment processes are essential steps in ensuring that AI technologies align with ethical principles and serve the greater good. Collaboration among stakeholders, including ethicists, technologists, policymakers, and end-users will be crucial in shaping an ethical framework for AI that embodies wisdom and promotes responsible innovation.

In conclusion, this study contributes valuable insights to the ongoing dialogue on ethical AI governance and offers recommendations for promoting ethical AI practices that prioritise human values and ethical considerations. By aligning wisdom with artificial intelligence, we can pave the way for a future where AI technologies contribute to a more ethical, equitable, and sustainable society.

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Chapter 5

Towards a Wisdom-Based Artificial Intelligence in Education

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Abstract

Wisdom, also known as '*hikmah*' is an important concept in education that helps learners and educators find a way to live a balanced learning life in this world. The teachings of prophets always emphasise the importance of wisdom as it leads human beings and the whole of mankind to live a more meaningful life in this world. In terms of education, having wisdom, we can know a lot of information and may be familiar with facts and figures, but also can integrate the knowledge with the principles of Islam. It also helps us make decisions in our lives wisely and seek ways to apply our learning to our everyday experiences and challenges. In this new era, Artificial Intelligence (AI) is getting more attention in education as it has become a real challenge for learners and educators in the presence of generative AI. Although generative AI brings with it many benefits, there are still challenges to overcome. These include an increasing reliance on automatic responses, and it's even harder to differentiate between what is human and what might be the response generated by AI. There is also worry about whether students will become critical thinkers and, thus, producers of their own analyses or solutions. Thus, incorporating wisdom-based AI in education can be particularly important in nurturing more purposeful and thoughtful usage of generative AI. When used in this positive sense, these AIs can provide teachers and students with guided tools that offer meaningful intuitions built on real data, fostering critical and inventive modes of thinking in line with Islamic principles. Thus, AI can be of greater use in opening up distinct aspects of ideas to be explored in comparative depth instead of just providing an AI that provides fast and superficial information. Therefore, within the principle of *Maqasid Syariah*, this paper aims to discuss an AI in education that cultivates well-rounded, ethically conscious learners and educators who can effectively engage with modern technology and global society. It first

gives an overview of AI in education, followed by the principles of Wisdom-based AI in education. Finally, the paper explores the impacts of integrating Wisdom-based AI based on *Maqasid Syariah* to be integrated in education.

Keywords: Wisdom-Based AI, Education, *Maqasid Syariah*

Introduction

Artificial Intelligence (AI) in education refers to the combination of AI technologies in educational settings to improve learning experiences and outcomes. AI can be combined with educational technology to create the most effective digital learning environment. That involves AI tools and systems to help in teaching and learning processes, personalise the educational process or experience, automate administrative tasks, and provide data-driven insights for educators and learners (Lai et al., 2023). This can be implemented through adaptive education platforms that adjust the content of learning to individual student needs, intelligent tutoring systems capable of providing personalised answers, and automated grading methods that free up time for educators. It provides several benefits, such as better access to education, adaptive learning paths for students, course configuration and blending of the curriculum, and increased efficiency in educational organisations (Lai et al., 2023; Martin et al., 2024). Despite this capacity, utilising AI in education also presents challenges related to data privacy and security concerns, along with the digital divide, as well as educators need to learn the new technologies. Furthermore, increases in its use within education also have social and emotional consequences for students (Lai et al., 2023). In addition, attention must be paid to AI ethics to ensure the usage of these educational AI applications in a proper manner. Furthermore, it must address equity and access issues to ensure AI serves all students regardless of their background (Martin et al, 2024).

Because of the above reason, there is a need to shift towards a wisdom-based approach in education. The use of wisdom allows for embedding knowledge, values and practices developed through long-term interactions between people and their respective environments into the learning process (Nurhayani et al, 2024), which supports this method. This will make sure that education has a useful effect on the true capability of students and that one comprehends his/her own culture and environment better, fostering a deeper understanding and gratitude of their own culture and environment, which in turn improves local identity and pride (Nurhayani et al, 2024). To

sum up, AI in education provides an innovative teaching and learning model with both potential benefits and challenges that require ongoing research to unpack their impacts on practice.

Challenges and Ethical Considerations

The integration of Artificial Intelligence (AI) in education presents countless ethical issues that require careful consideration to ensure responsible and equitable use. One of the primary concerns is the potential for algorithmic bias, which can spread existing inequalities and lead to unfair treatment of students based on race, gender, or socioeconomic status (Tomak & Virlan, 2024). Additionally, the use of AI in educational settings raises significant privacy concerns, as the collection and analysis of student data can lead to breaches of confidentiality and misuse of personal information (Tomak & Virlan, 2024). The erosion of student autonomy is another ethical issue, as AI-driven systems may limit students' ability to make independent decisions about their learning paths (Nurhayani et al, 2024). Furthermore, the role of educators is evolving, with a need for them to become ethical leaders who guide the integration of AI technologies while fostering a critical spirit and ensuring that the emotional and spiritual dimensions of education are not neglected. Inclusivity is also a critical concern, as AI systems must be designed to accommodate diverse learning needs and ensure equal access to educational opportunities for all students (Sywelem & Mahklouf, 2024). Ethical frameworks and guidelines are crucial for balancing the risks and opportunities associated with generative AI technologies in education, providing a foundation for responsible use. By adopting privacy-preserving protocols, bias mitigation strategies, and inclusivity measures, stakeholders can promote a responsible and equitable future for AI in education, ensuring that these technologies enhance rather than hinder the learning experience (Sywelem & Mahklouf, 2024). In solving these challenges and ethical considerations, a Wisdom-based AI in education may be adapted that focuses on the integration of *Maqasid Syariah*.

Principles of Wisdom-based AI in Education

Al-Hikmah or Wisdom means complete insight and having sound judgment concerning a matter or situation through understanding cause and effect phenomena. Al-Hikmah constitutes one of the three significant teachings of the Prophet Muhammad (PBUH). Verse 2:129 of the Qur'an, below, expresses Prophet Muhammad's mission with the three major categories: *Al-Kitab* (The knowledge of the Holy Qur'an), al-Hikmah (the Wisdom), and *al-*

Tazkiyah (the inner-self-purification). Each class is dependent upon the other. These three fundamental teachings combined are the foundations required to make up the character of a true Muslim.

رَبَّنَا وَٱبۡعَثۡ فِيهِمۡ رَسُولٗا مِّنۡهُمۡ يَتۡلُواْ عَلَيۡهِمۡ ءَايَٰتِكَ وَيُعَلِّمُهُمُ ٱلۡكِتَٰبَ وَٱلۡحِكۡمَةَ وَيُزَكِّيهِمۡۚ إِنَّكَ أَنتَ ٱلۡعَزِيزُ ٱلۡحَكِيمُ ١٢٩

"*Our Lord! Raise from among them a messenger who will recite to them Your revelations, teach them the Book and wisdom, and purify them. Indeed, You alone are the Almighty, All-Wise."* (Quran 2: 129)

Wisdom-based AI in education is a technological capability that is integrated into the educational environment in an integrated way with social-holistic and human ethics. Wisdom-based AI is not only designed to impart knowledge but also to help learners cultivate their critical thinking skills and ethical sense. The fundamental concept of wisdom education is based on large-scale data, intelligent systems with adaptive learning models and smart technology providing customised teaching programs (Reddy et al., 2023; Zhou, 2023; Liu, 2018). The integration of AI in education must also avoid representational harms by ensuring that language and content generated by AI systems do not reinforce prejudices or negative stereotypes; in this way, it helps promote equality, diversity and inclusion (Buddemeyer et al., 2021). Developing wisdom-based education systems also means building an intelligent learning environment that considers learners' individual characteristics. These environments can use cloud computing, the Internet of Things and large data to adapt themselves automatically to the needs of learners. They offer "intelligent" teaching that is systematic, thorough, as well as flexible. Moreover, wisdom-based AI in education should incorporate transdisciplinary thinking, drawing from various fields such as philosophy, psychology, history, and sustainability, to address complex, multi-layered problems and prepare students for a volatile, uncertain, complex, and ambiguous world (Bloom, 2022).

In education, wisdom-based AI is very important. It greatly helps different fields, such as society, politics, economy and culture, to develop harmoniously, and it plays a significant role in the survival and prosperity of nations and individuals (Ma et al., 2022). Moreover, inserting wisdom content into education syllabi, such as in Islamic Religious Education, can

encourage students to differentiate religious values from those they encounter on a daily basis in the social and cultural context (Nurhayani et al., 2023). The future of wisdom education also involves the development of artificial wisdom systems, which aim to emulate the highest human excellence, practical wisdom, by addressing philosophical challenges and creating a conceptual framework for AI that guides future research (Tsai, 2020). In summary, the principles of wisdom-based AI in education mean using advanced technology to build inclusive, adaptive, and integrated teaching environments that can cultivate critical thinking skills and professional capabilities while also preparing students to navigate and address the complexities of the modern world. In summary, the principles of wisdom-based AI in education mean using advanced technology to build inclusive, adaptive, and integrated teaching environments that can cultivate critical thinking skills and professional capabilities while also preparing students to navigate and address the complexities of the modern world.

Integrating Wisdom-based AI in Education with *Maqasid Syariah*

Maqasid Syariah may be stated simply as the higher objectives of the rules of the *Syariah*, as the objectives or ultimate aims of Islamic law. It aims to engage people in welfare and benefit-worthy life in this life and the hereafter. It revolves around guarantying satisfied protection for all objects with five definite purposes, religion (*hifz al-din*), life (*hifz an-nafs*), intellect (*hifz al- 'aql*), family posterity *(hifz al-nasl*), and property (*hifz al-mal*) (Fajri, 2024; Tahir & Hamid, 2024; Sumarta et al., 2024). These objectives govern the creation and implementation of Islamic law, ensuring that justice and balance and societal welfare are protected and professionalised, which are aligned with Islamic values promoting peace and justice. *Maqasid Syariah* is not fixed but must be expanded to keep pace with changes. It now includes concerns for social, environmental and state welfare and has thus evolved from a system of protection to one of development and human rights. This flexibility is demonstrated in a variety of applications instance, the changeover to Islamic banks from conventional banks is consistent with the *Maqasid Syariah*. It also prevents usury and brings financial practices in line with ethics (Fajri, 2024). To conclude, *Maqasid Syariah* is a live system, that affects the contents of Islamic law, ensuring that its principal aim remains human welfare with justice and fair measure. To integrate with *Maqasid Syariah* in wisdom-based AI, it needs to focus on curriculum design, methods of teaching and learning, appraisal and evaluation, and professional development as shown in Figure 1. By having this integration, it will help

bridge the gap between AI as the technological advancements and Islamic values, ensuring that education is both progressive and ethically grounded.

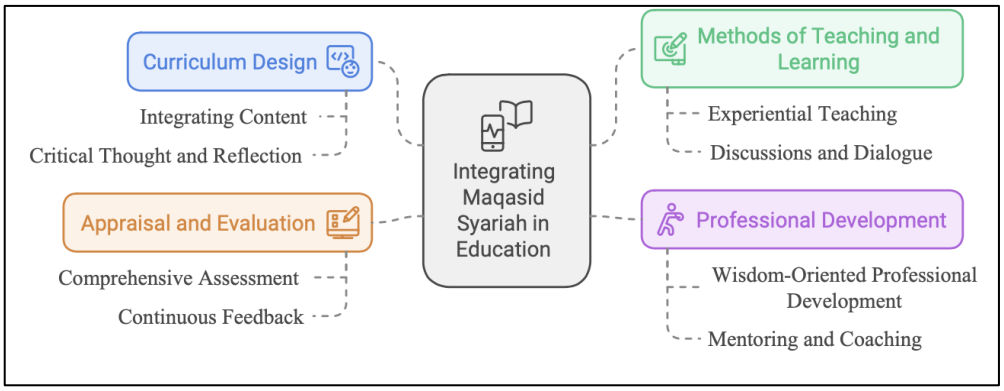

Figure 1: Integration of Wisdom-based AI in Education with *Maqasid Syariah*.

Figure 1 illustrates the following key points, which are discussed in detail below:

i. Curriculum Design

- Integrating Content: Develop a curriculum that focuses not only on academic knowledge but also includes emotional intelligence, ethics, and sociology lessons for students to gain a balanced development, which is consistent with the ideas of Wisdom.
- Critical Thought and Reflection: Incorporate activities that encourage critical thinking, reflection, and troubleshooting. Wisdom-based education emphasises the ability to judge correctly, which can be nurtured through inner refinement practice.

ii. Methods of Teaching and Learning

- Experiential Teaching: Employ experiential teaching methods like project-based learning. This enables students to apply theoretical knowledge in practical settings and acquire wisdom out of experience.
- Discussions and Dialogue: Encourage dialogue and discussion in the classroom. This helps students understand a variety of viewpoints and sensitivities, a major component of wisdom. The knowledge communicated should always be two-way.

The Qur'an mentioned, “Consult one another in your affairs” (*Surah* 42:38 *Ash-Shura*), and those who follow leading from behind will also be in front.

iii. Teach Assignment and Enhancement

- Learning through Wisdom-Oriented Professional Development: Professional development programs should follow the wisdom-oriented teaching practices of teachers. This might mean teaching or instruction on how to imbue one's teaching with ethical discussion notes, critical thinking exercises, and thoughtful practice.
- Mentoring and Coaching: Run a mentoring and coaching program where those involved in the wisdom-based learning project guide others about how best to proceed. The Qu’ran told us to keep guiding and shepherding (*Surah Al-Kahf*, 18:66).

iv. Appraisal And Evaluation

- Comprehensive Assessment: Abandoning the traditional exam format examine an item such as emotional intelligence, ethical thinking, and social skills. Portfolios, reflective diaries peer assessments can be useful tools.
- Continuous Feedback: Provide continuous and formative feedback instead of relying solely on summative evaluations. This way, students can constantly learn from their experiences and gradually develop wisdom to address new ones. The Quran emphasises the importance of continuous self-improvement and striving for excellence.

Conclusion

In conclusion, wisdom, or "*hikmah*," is of utmost importance in education, guiding learners and educators towards a balanced and meaningful life. As emphasised in prophetic teachings, wisdom fosters a deeper understanding of the world and facilitates the application of knowledge to everyday life. In the age of AI, the integration of wisdom-based AI can be particularly beneficial in mitigating the challenges posed by generative AI and other advancement of AI. By fostering critical thinking, creativity, and alignment with *Maqasid Syariah*, wisdom-based AI can empower learners and educators to utilise AI as a tool for deeper exploration and thoughtful

analysis, ultimately leading to a more purposeful and meaningful learning experience.

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Chapter 6

Exploring the Potential of Generative Artificial Intelligence in Enhancing Academic Integrity

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Abstract
The potential of generative artificial intelligence (AI) in enhancing academic integrity is a subject of growing interest and importance in education. AI's role in academia is becoming more prominent as technology advances, leading to opportunities and challenges in preserving academic integrity. Generative AI (GenAI), a subset of artificial intelligence, can imitate original and authentic content, presenting a unique opportunity to support academic integrity efforts. To fully harness its potential, educators and institutions must understand the basics of generative AI and its educational applications. This understanding will prepare academia for the future of education, where AI can promote originality and creativity while maintaining academic honesty. This research aims to delve into the various objectives of applications of generative AI in education, such as personalised learning experiences, automated grading systems, and content generation for educational materials. This study aims to shed light on the potential of generative AI in enhancing academic integrity and provide insights that can guide educators, policymakers, and stakeholders in making informed decisions about integrating AI technologies into the educational landscape.

Keywords: AI, *hikmah*, Generative AI, Academic Integrity, Academic Honesty

Introduction

Various technologies are rooted in the education sector, whereby integrating various technologies in education has transformed the learning environment, making it more interactive, personalised, and easily accessible. Some key technologies are currently being used in education, including the learning management system (LMS), virtual and augmented reality (VR/AR),

gamification, mobile learning, online collaboration tools, cloud computing, 3D printing, blockchain, data analytics, internet of things (IoT), flipped classroom, digital libraries, voice assistants, robotics and the latest one is artificial intelligence or AI.

Recently, AI has entered every aspect of human life, blurring the boundaries between human wisdom and artificial wisdom. AI encompasses a broad range of technologies and applications. Generative artificial intelligence, known as Generative AI or GenAI, is a subset of artificial intelligence with a specific focus on creating new realistic synthetic content in the form of text, images, music, data, or other media based on advanced algorithms such as Generative Adversarial Networks (GANs), Variational Autoencoders (VAEs), and Transformer models. GenAI interacts with data by learning its patterns and characteristics to generate new data that resembles the original, offering practical applications that enhance productivity, creativity, and convenience across various domains.

GenAI's impact spans across several sectors, such as tourism, education, healthcare, finance, business, navigation, and home automation, revolutionising our lifestyles and professional endeavours. GenAI is a platform for developing systems that possess human-like intelligence, enabling them to carry out tasks such as learning, problem-solving, and pattern recognition. Although GenAI has the ability to rapidly and effectively handle large quantities of data, wisdom encompasses deeper understanding, ethical deliberation, and decision-making that often surpasses the capabilities of algorithmic processing. Acquiring wisdom necessitates having a contextual awareness, demonstrating empathy, and comprehending human values where GenAI is lacking. Hence, the implementation of GenAI in education necessitates cautiousness, as it offers numerous benefits but also exposes it to potential problems.

In Islam, wisdom is closely related to the concept of *hikmah*. The Arabic word *hikmah* is derived from the root word *hakama, yahkumu, hikm*, which means to prevent, restrain, or withhold (Yaman, 2008) or generally means wisdom. Wisdom means complete insight and sound judgement concerning a matter or situation through understanding the cause and effect of a particular phenomenon. It refers to the judicious application of knowledge, experience, and deep understanding to make sound decisions. The term *hikmah* as discussed by Noh et al. (2023) encompass deeper and multifaceted

dimensions including practical wisdom, spiritual insight, balanced judgement, and purposeful knowledge as rooted in the five major goals of *Maqasid al-Shari'ah*. *Hikmah* is considered a gift from Allah (SWT) to those who seek knowledge sincerely and use it responsibly. It is often associated with the Qur'anic verse in surah *Al-Baqarah* (2:269):

يُؤْتِي ٱلْحِكْمَةَ مَن يَشَآءُ ۚ وَمَن يُؤْتَ ٱلْحِكْمَةَ فَقَدْ أُوتِيَ خَيْرًا كَثِيرًا ۗ وَمَا يَذَّكَّرُ إِلَّآ أُو۟لُوا۟ ٱلْأَلْبَٰبِ

"He grants wisdom to whom He wills, and whoever has been granted wisdom has certainly been given much good. And none will remember except those of understanding."

This study thus seeks to explore the impacts of generative AI in education, examine the role of *hikmah* (wisdom) in guiding its ethical use, and propose strategies for educational institutions to address the challenges it poses. This study presents the following three research questions emphasising both the exploration of the current landscape and the development of actionable solutions within an ethical framework rooted in *hikmah*:

1. What are among the impacts of generative AI usage in education?
2. How *hikmah* can guide the ethical use of AI in education?
3. What are specific strategies for educational institutions to address the challenges of generative AI?

Literature Review

Academic integrity, a global issue, remains a significant concern within Malaysian higher education. It encompasses the commitment to ethical practices in teaching, learning, research, and academic activities, prohibiting dishonest behaviors such as cheating, plagiarism, and falsification (Whitley & Keith-Spiegel, 2002). The COVID-19 pandemic in 2020, which drove the adoption of online learning platforms, coupled with advanced technologies and widespread internet usage, has exacerbated academic integrity challenges (Mustapha et al., 2020; Ibrahim et al., 2020; Yussof & Ismail, 2018). The internet has facilitated access to unlimited resources, but it has also enabled academic misconduct during exams, coursework, and clinical tests (Nyamasvisva et al., 2020a; Abusafia et al., 2018; Hamdzah, 2020). Critics argue that internet reliance contributes to academic dishonesty (Hussein et al., 2021; Rusdi et al., 2019) whereas significant misconduct among students occured in various disciplines, with high self-reported cases of plagiarism and cheating during assessments (Rusdi et al., 2019; Khalid et al., 2020).

Moreover, researchers highlight the role of digital tools and social media in facilitating misconduct. For instance, electronic cheating involves copying material from unauthorised sources, and technology such as social media platforms amplifies this issue (Hussein et al., 2021; Rusdi, 2019). In another note, nursing students, due to academic and clinical workload pressures, are particularly prone to plagiarism (Abusafia et al., 2018). It happened that, technology's impact is more profound in assignments than in clinical tasks, as students exploit easily accessible online resources in their academic works (Hussein et al., 2021).

Malaysia's higher education system, known for its global reputation in research and institutional excellence, faces academic integrity challenges that threaten its progress. The Malaysian Education Ministry has empowered universities to address academic misconduct through statutes and policies (Mohamed et al., 2018). Institutions have adopted measures such as plagiarism detection software, online monitoring tools, and lockdown browsers to mitigate cheating (How et al., 2021). Innovative solutions have been introduced, such as biometric authentication for online exams, which aim to strengthen integrity in assessments (Karim & Shukur, 2016). The emergence of AI tools like ChatGPT has introduced new dimensions to academic integrity. While these tools enhance learning, they also raise risks of plagiarism and dishonest practices. In this context, *hikmah* could guide ethical and balanced decision-making, particularly in sensitive matters like AI, where both risks and opportunities must be carefully managed.

Exploring the intersection of *hikmah* and artificial intelligence (AI) technology has garnered scholarly attention, particularly within the context of Islamic ethics. Ziaee (2011) investigates AI ethics from an Islamic viewpoint, arguing for a pluralist approach to establishing ethical principles and addressing issues of autonomy, privacy, and fairness. In another study by Raquib et al. (2022), an Islamic virtue-based AI ethics framework based on the purposes of Islamic law (maqāṣid) has been proposed. In addition to that, Ezieddin Elmahjub (2023) aims at tackling AI's ethical issues, drawing on Islamic traditions to create a vision of ethical value and action that will guide AI design and deployment. The concept of maṣlaḥa (public interest) serves as a guideline for evaluating AI's ethical behavior. In a later study, Al-Kubaisi (2024) investigates the ethics of AI through the teachings of the Prophet Muhammad's sunnah, with the goal of developing ethical guidelines for AI use that are consistent with Islamic values.

Since academic integrity remains a pressing issue in Malaysian higher education, especially with the increasing reliance on digital technologies and the emergence of generative AI tools like ChatGPT, which present both opportunities and risks, the integration of *hikmah* offers a profound ethical framework to navigate these challenges. Fostering balanced decision-making and aligning technological use with moral and societal values are among possible ways to manage the risks. Islamic ethics, through principles like *maqāṣid* (purposes of Islamic law) and *maṣlaḥa* (public interest), provides a robust foundation for addressing AI's ethical dimensions, as seen in recent scholarly contributions. While institutions have implemented various measures to combat misconduct, the rapid evolution of technology demands continuous adaptation of strategies, emphasising the need for innovative yet ethically grounded solutions. Ultimately, the intersection of technological advancement, academic integrity, and Islamic ethical principles underscores the importance of a holistic approach to sustaining integrity in education.

Method

The review involved four processes: "identification of inclusion and exclusion criteria, data sources and search strategies, quality assessment, and data coding and analysis" (Kitchenham & Charters, 2007). The preceding sub-sections detail the characteristics of these steps. The guidelines utilised to perform the current systematic review can be found in Kitchenham and Charters (2007). In terms of enhanced organisation, this study also employed the systematic literature review (SLR) methodologies proposed by Moher et al. (2009). The created SLR approach includes the first step of setting a review standard and the review stages of planning, conducting, and evaluating the review. The approaches used in the review are as follows. The search was chosen, the quality of the work was assessed, the major research was chosen, the data were synthesised, the review was documented, the data was retrieved, and finally, validation was performed.

Furthermore, the research question formulation is a key step in the SLR process since it determines the research's frames of reference. Figure 1 displays the six steps of the review approach used in this study and depicts the process of combining a search strategy that prioritises developing preliminary research. Even if this procedure is done, a technique for selecting search criteria must be devised, and the preliminary study must be linked to the SLR.

Figure 1: Protocol Review Stages (Moher et al., 2009)

Inclusion/Exclusion Criteria

The articles that meet the inclusion and exclusion criteria listed in Table 1 will be analysed for the review research.

Table 1 Inclusion and Exclusion Criteria

Inclusion Criteria	Exclusion Criteria
Articles on generative AI in education	Articles on generative AI but not in education
Articles on generative AI impacts on academic integrity	Articles on academic integrity without generative AI
Must be written in English language	Articles published in non-English language
Must be published between 2020 and 2024	Articles published before 2020-2024

Data Sources and Search Strategies

The search for articles to be considered in this systematic review begins in May 2024. The "IEEE Xplore and Emerald Insight" databases were used to thoroughly search published research to gather the research articles for inclusion in this systematic review. The search phrases used to discover relevant publications were based on the keywords in Table 2. Because keywords serve as the foundation for access to relevant publications, accurate keyword selection is essential when selecting papers for inclusion in the systematic review (Costa & Monteiro, 2016). The search results obtained using the previously indicated keywords enabled access to 36 articles (see Table 3), which included six redundant articles that were extracted. As a result, we got 30 articles. The researchers assessed each article using the inclusion and exclusion criteria, and 26 research articles met the inclusion criteria and were included in the evaluation method. The Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) were utilised during the article search and filtration phases for the current review publication (Moher et al., 2009). Figure 2 depicts the PRISMA flowchart.

Table 2 Keyword Search

Fixed Keyword
(generative AI AND (education) AND (academic integrity))

Table 3 Final search results across databases

No	Database	Count
1	IEEE Explore	21
2	Emerald Insight	15
	Total	36

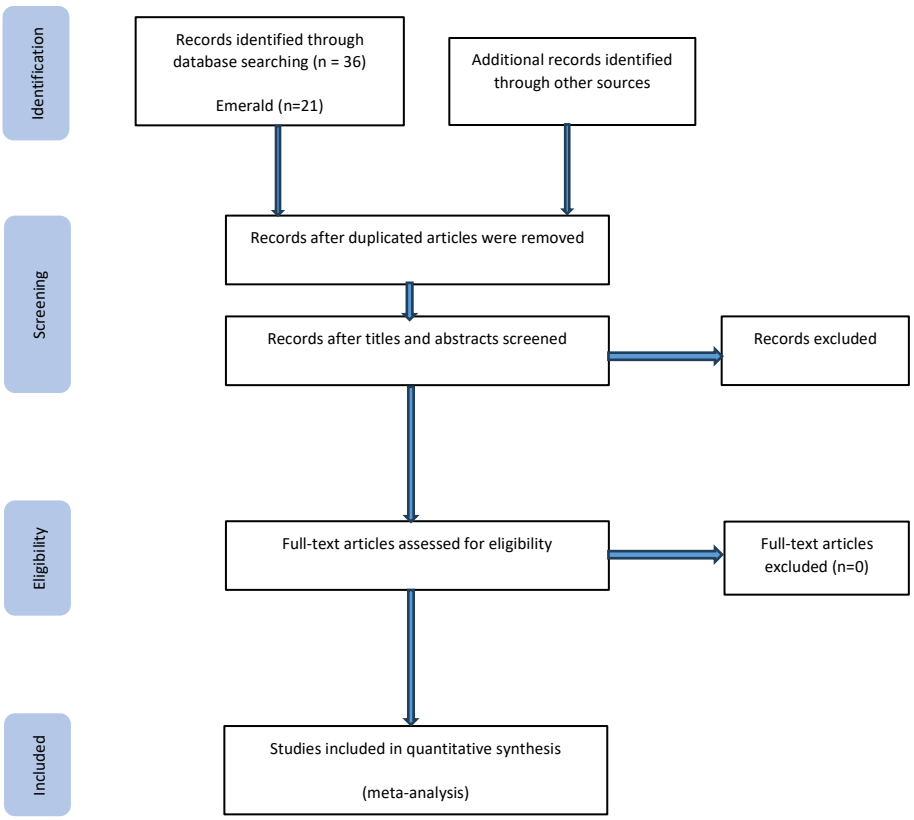

Figure 2: PRISMA flow diagram

Quality Assessment

Following filtration (n=26), seven criteria from the quality evaluation checklist were utilised to evaluate the research articles that qualified for further study. Quality assessment is equally important as inclusion and exclusion criteria (Al-Emran et al., 2018). The quality assessment checklist is shown in Figure 3. The checklist was a modified version of Kitchenham and Charter's (2007) proposals and was not intended to denounce any of the researchers' initiatives. The questions were scored on a three-point scale, as is typical for scoring questions, with one point for 'Yes,' zero for 'No,' and 0.5 for 'Partially.' Any research could get anywhere from 0 to 7 points. The research's higher total grade implies it can better address the research questions. Table 4 displays the findings of each research's quality assessment, which reveal that all 26 studies met the quality assessment criteria, demonstrating their acceptability and competency for further investigation.

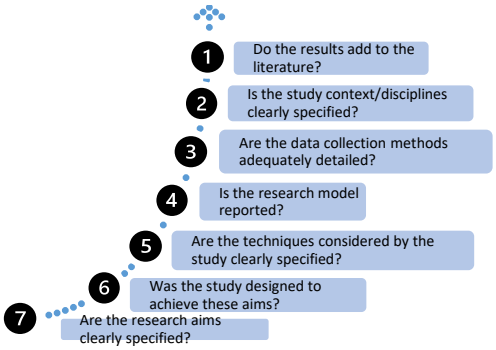

Figure 3: Quality assessment checklist (Kitchenham & Charters, 2007)

Data Coding and Analysis

The following attributes of research methodological dependability were coded: (i) publication year, (ii) principal study area in generative AI, (iii) research method, (iv) educational level, (v) country, and (iv) database.

Table 4: Quality assessment results

Article	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Total	Percentage (%)
A1	1	1	0.5	1	1	1	1	6.5	93%
A2	1	1	1	0	1	1	1	6	86%
A3	1	0.5	1	0	0.5	1	1	5	71%
A4	1	1	1	0	0.5	1	1	5.5	79%
A5	1	1	1	0	1	1	1	6	86%

Article	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Total	Percentage (%)
A6	1	1	1	0	1	1	1	6	86%
A7	1	1	1	1	1	1	1	7	100%
A8	0.5	0.5	1	0	0.5	1	1	4.5	64%
A9	0.5	1	1	0	0.5	1	1	5	71%
A10	1	1	1	0	1	1	1	6	86%
A11	1	1	1	0	1	1	1	6	86%
A12	1	1	1	0	1	1	1	6	86%
A13	1	1	1	0	1	1	1	6	86%
A14	1	0.5	1	1	1	1	1	6.5	93%
A15	1	1	1	0	1	1	1	6	86%
A16	0.5	0.5	1	0	0.5	1	1	4.5	64%
A17	1	1	0.5	0	1	1	1	5.5	79%
A18	1	0.5	1	1	1	1	1	6.5	93%
A19	1	1	1	0	1	1	1	6	86%
A20	1	1	1	0	1	1	1	6	86%
A21	1	1	1	0	1	1	1	6	86%
A22	1	0.5	1	0	0.5	1	1	5	71%
A23	1	0.5	1	0	0.5	1	1	5	71%
A24	1	1	1	1	1	1	1	7	100%
A25	1	0.5	0.5	1	0.5	1	1	5.5	79%
A26	1	0.5	0.5	1	1	1	1	6	86%

Results and Discussion

To obtain responses to three research questions, the present systematic literature review looked at 26 research publications about Generative AI in enhancing academic integrity that were conducted from 2020 to 2024

RQ1: What are the impacts of generative AI usage in education?

Artificial Intelligence (AI) stands poised to revolutionise the educational landscape in the coming years. Scholars delve into its transformative potential, and one of the most exciting possibilities is AI's ability to tailor instruction to individual student needs, known as personalised learning (Dhruv et al., 2024). AI can analyse student data, learning styles, and progress to dynamically adjust content, pace, and teaching methods (Leelavathi & Surendhranatha, 2024; Ogunfunmi, 2024). Aure and Cuenca (2024) found that students leverage GenAI tools as brainstorming partners, co-writers, and co-readers, enhancing research efficiency and comprehension. Consider classrooms where a "one-size-fits-all" approach no longer constrains

students but thrives in a personalised learning environment that maximises their potential. This tailored approach could significantly improve student engagement and learning outcomes (Ciolacu et al., 2024).

Second, AI can automate administrative tasks, freeing up valuable educator time by taking over tedious administrative tasks like grading exams and managing student data (Guillén-Yparrea & Rodríguez, 2024). Teachers will be relieved of these time-consuming chores, allowing them to focus on what matters most—creating engaging learning experiences and fostering meaningful interactions with students. The saved time could be used for lesson planning, individualised instruction, or additional support to struggling students (Fegade et al., 2023).

Third, to improve accessibility, AI-powered online and mobile learning tools have the potential to democratise education (Wood & Moss, 2024), making it more accessible to a wider range of learners (Ciolacu et al., 2024). Students in remote locations, those with physical limitations, or those facing other challenges can benefit from flexible learning opportunities that AI-driven tools can provide (Leelavathi & Surendhranatha, 2024; Zastudil et al., 2023). This can significantly bridge the equity gap in education and empower learners from all backgrounds to pursue knowledge and reach their full potential (Strachan et al., 2024).

Fourth, enhanced student support could be done through an approach where AI can serve as a tireless and insightful learning companion for students (Milinković & Vuleta, 2024). Real-time feedback can identify areas of difficulty and provide targeted support (Banavar et al., 2023; Duong et al., 2024), while adaptive learning platforms can adjust to a student's understanding, ensuring they grasp concepts before moving on (Strachan et al., 2024; Ogunfunmi, 2024). This personalised support system can empower students to take ownership of their learning and become more self-directed learners (Balart & Shryock, 2024). However, overreliance and accuracy concerns, data privacy (Weber et al., 2024), and algorithmic biases (Slomp et al., 2024) dominated the perceived benefit of generative AI tools among ICT and engineering students (Banavar et al., 2023; Rahman et al., 2024).

In response to GenAI's positive impacts, numerous negative impacts emerged, making it vulnerable to academic integrity. In their 2024 publication, Bukar et al. devised a decision-making framework to employ

GenAI in education effectively. The essential issues of whether to enforce limitations or enact legislation regarding utilising Gen-AI were discussed, with ChatGPT serving as a central case study. The Analytic Hierarchy Process (AHP) examined ten ethical concerns. The top concerns identified were copyright, legal, and compliance issues, privacy and confidentiality, academic integrity, inappropriate reference and citation methods, and safety and security concerns (Elbanna & Armstrong, 2024). This study provides insights for educational institutions and policymakers, indicating the necessity of inclusive discussions, pilot programs to evaluate the effects on critical thinking, establishing explicit guidelines, adaptable regulatory frameworks, awareness campaigns, and potential approaches for ethical and responsible utilisation (Zeb et al., 2024).

RQ2: How can hikmah guide the ethical use of AI in education?

The concept of *hikmah* can profoundly shape the ethical use of AI in education by offering a framework for thoughtful, just, and balanced decision-making. Hence, *hikmah* can guide the ethical use of AI through diverse perspectives, including purpose-driven implementation, moral accountability, fostering equity and justice, balancing innovation and tradition, advocating *hikmah* among students, continuous reflection and adaptation, sustainability and long-term vision.

Hikmah involves upholding justice and fairness. AI applications should not favour specific groups over others or perpetuate inequalities. As the landscape of higher education is constantly evolving, with this evolution comes new challenges. The emergence of generative AI tools presents a unique threat to the integrity of assessments. As AI tools become more sophisticated, educators face the challenge of ensuring assessments measure student learning, not just their ability to use AI. To address this with *hikmah*, AI tools in education can be programmed to reduce bias in grading systems or admissions, ensuring fair treatment regardless of race, gender, or socioeconomic status.

Consider the Generative AI-Based Academic Evaluation Model (GAI-BAEM), which offers a valuable framework for managing AI in educational assessments (Dhruv et al., 2024). The model assessed AI performance based on fulfilment, helpfulness, and presentation metrics and delineated varying degrees of acceptable AI utilisation, enabling educators to customise assessments according to precise learning goals. The GAI-BAEM promotes

transparency among students and educators, acknowledging AI's educational benefits while respecting scenarios where conventional assessment methods remain crucial.

Hikmah by balancing innovation and tradition lies in integrating modern innovations without undermining traditional educational values. While AI can automate processes, the teacher's role in mentoring and nurturing students remains irreplaceable. Strachan et al. (2024) emphasised that the most effective way to address academic misconduct is through the implementation of high-quality teaching methods (Zastudil et al., 2023), well-designed assessments (Fegade et al., 2023), and accessible and supportive tutors (Balart & Shryock, 2024). Academic institutions must meticulously provide rigorous academic assessments (Weber et al., 2024), efficient educational offerings (Banavar et al., 2023), strong staff ethics, student incentives to prevent misconduct, active student participation in teaching and learning (Ogunfunmi, 2024), and user-friendly student guidance (Oliveira, 2023; Santos et al., 2024).

A *hikmah* approach requires recognising the moral accountability and implications of technology usage. Educators and developers must ensure AI is used responsibly, avoiding harm (e.g., data privacy breaches or biases in algorithms). In the context of addressing misconduct, it is crucial to thoroughly examine ChatGPT's capabilities to determine its conversational AI functionalities (Wood & Moss, 2024; Zeb et al., 2024). Cingillioglu (2023), in research, proposed a method and necessary strategies to confront ChatGPT utilising the support vector machine (SVM) algorithm with a 100% accuracy recorded for identifying human-generated essays. Next, examine the significance of these talents in tackling the issue of academic honesty and the potential to enhance existing chatbots with human-like discourse for improved intelligent automation. De Silva et al. (2023) plan to further develop a comprehensive framework incorporating these guidelines to use generative AI in various academic fields and industries effectively.

Hikmah emphasises aligning actions with a higher purpose and ethical objectives. In education, this means leveraging AI tools not merely for convenience or profit but to enhance learning, inclusivity, and student well-being. AI-powered tools should be designed to support diverse learning needs. Ilic and Carr (2023), for example, investigate the function of rubrics in reducing the adverse effects of generative AI, such as ChatGPT, on the

evaluation of writing in STEM fields. This strategy aims to meet the increasing demand for creative ways to guarantee student academic honesty and genuineness in the fast-expanding AI tools environment. The student's ability to analyse written text and distinguish between information produced by humans and content generated by artificial intelligence is evaluated using a rubric consisting of four criteria. The material is classified based on the rubric ratings for each student. It is categorised as either true positive (TP), true negative (TN), false positive (FP), or false negative (FN), depending on whether the sentence frame evaluation method accurately recognised the origin of the content.

Promoting *hikmah* among students should be the main educational agenda. In nurturing *hikmah*, AI should be used to encourage them to think critically, act ethically, and appreciate the broader implications of their knowledge. Hence, scholars suggest integrating AI literacy into academic curricula to educate students on ethical AI use, emphasising preventive rather than punitive approaches considered as a good effort. Few studies highlight the importance of adapting assessment methods to counter AI-related misconduct. For example, personalised assessments and AI detection tools can promote integrity in education. William and Taylor (2023) underscores the need for ethical guidelines and educator training to navigate AI's impact on academic environments effectively.

Despite the challenges, technology offers solutions to uphold academic integrity. Continuous educator training, stricter policies, and fostering a culture of integrity are vital to addressing misconduct. The Muslim perspective on *hikmah*—wise and ethical technology use—provides a thoughtful framework for addressing these issues. Future research should explore the integration of such values into academic policies to ensure ethical practices align with technological advancements. Continuous reflection and adaptation of the impact of AI, ensuring its use aligns with ethical and spiritual values. The periodic reviews of AI tools' effectiveness and fairness not only help to identify but also mitigate unintended consequences in future prioritising the development of sustainable AI tools that are cost-effective, environmentally friendly, and accessible to underserved communities.

RQ3: What are specific strategies for educational institutions to address the challenges of generative AI?

The use of AI raises valid concerns about student privacy, potential biases within algorithms, and the possibility of AI replacing human teachers. It's crucial to develop and implement AI tools with ethical considerations in mind, ensuring data protection, fairness in algorithms, and the continued importance of human educators' expertise and guidance (Dhruv et al., 2024).

As for the technological infrastructure, the successful adoption of AI hinges on access to adequate technological infrastructure, including reliable internet connectivity and devices. The digital divide must be addressed to ensure all students have the opportunity to benefit from AI-powered learning (Elbanna & Armstrong, 2024).

Guillén-Yparrea and Rodríguez (2024) proposed that educators must continuously upgrade with the latest skills and knowledge to leverage AI tools effectively and integrate them seamlessly into their teaching practices. Professional development programs should address these needs, empowering educators to become facilitators who can guide students through AI-assisted learning experiences (Strachan et al., 2024). While AI in education faces hurdles, its potential to personalise learning, automate tasks, enhance student support, and improve accessibility makes it a powerful force for positive change (Banavar et al., 2023). By addressing the challenges with *hikmah* and implementing AI ethically and strategically, educational institutions can harness this technology to empower educators and unlock a brighter future for learners (Slomp et al., 2024; Zastudil et al., 2023).

The rapid integration of Artificial Intelligence (AI) in education demands a robust ethical framework to ensure responsible use by both students and educators (Guillén-Yparrea & Rodríguez, 2024). This framework should prioritise several key principles. First, transparency and explainability are crucial. AI models employed within academic settings must undergo rigorous audits to identify and mitigate potential biases (Balart & Shryock, 2024). Additionally, the decision-making processes of these models should be readily understandable by users (Leelavathi & Surendhranatha, 2024). Furthermore, educators play a critical role in equipping students with the critical thinking skills to evaluate AI-generated content effectively (Rahman et al., 2024).

Second, robust data protection policies are essential to safeguard student privacy when utilising AI tools (Fegade et al., 2023). Institutions must establish clear frameworks outlining how student data is collected, stored, and utilised within these systems. Students should be informed and empowered regarding the potential uses of their data in AI-powered learning environments (Duong et al., 2024; Wood & Moss, 2024).

Third, promoting equitable access is vital. The digital divide must be addressed to ensure all students have equal opportunities to leverage the benefits of AI tools (Oliveira, 2023). Accessibility features should be a core consideration when developing AI-powered educational technologies, ensuring student participation with diverse needs (Sabraz Nawaz et al., 2024).

Fourth, faculty development plays a critical role. Institutions should provide ongoing professional development opportunities to enhance educators' understanding of AI capabilities, limitations, and the ethical considerations surrounding its integration into teaching and learning (Santos et al., 2024; Wood & Moss, 2024). Regular study on how GenAI affects student learning, integrity, and creativity is among the crucial steps to be taken. In addition to that, monitoring the emerging technologies and their potential implications for education and providing support for academic research on the ethical, cultural, and social dimensions of GenAI in education will help in predicting the future coming of challenges.

Finally, establishing clear institutional policies is essential (Strachan et al., 2024). These policies should provide comprehensive guidance on the acceptable use of AI in academic settings. Critical issues such as academic integrity, potential biases within AI systems, and fostering responsible innovation within the academic community must be addressed (Milinković & Vuleta, 2024). By proactively addressing these ethical considerations, academia can leverage the transformative potential of AI while upholding core values of academic integrity and fostering inclusive, equitable learning experiences for all students (Balart & Shryock, 2024; Ciolacu et al., 2024). By combining these strategies, educational institutions can proactively address GenAI challenges, fostering an academic environment that upholds integrity, promotes innovation, and prepares students to use AI responsibly.

Conclusion

Integrating artificial intelligence (AI) into the educational landscape has brought about profound transformations, offering unprecedented opportunities to enhance learning experiences and educational outcomes. This research paper has delved into the multifaceted dimensions of AI usage in education, focusing on the ethical considerations and wisdom required to navigate this rapidly evolving domain.

AI technologies, such as intelligent tutoring systems, personalised learning platforms, and automated assessment tools, have demonstrated significant potential in tailoring education to individual student needs, promoting equity and inclusivity. These innovations have shown promise in identifying learning gaps, providing timely feedback, and supporting educators in delivering more effective instruction. However, deploying AI in education is not without its challenges and risks.

A critical examination of the ethical implications of AI in education reveals several key concerns. Privacy and data security are paramount, as collecting and analysing vast amounts of student data raises questions about consent, data ownership, and potential misuse. Ensuring that AI systems are transparent, explainable, and free from biases is essential to maintain trust and fairness. Moreover, the role of educators must be redefined in the context of AI-enhanced learning environments. Rather than being replaced by machines, educators should be empowered to work alongside AI, leveraging its capabilities to enrich the teaching and learning process.

Wisdom in applying AI in education calls for a balanced approach that considers both the benefits and the ethical challenges. Policymakers, educators, and technologists must collaborate to establish robust ethical guidelines and regulatory frameworks that govern AI usage. This includes fostering a culture of ethical AI development, where transparency, accountability, and inclusivity are prioritised. It is crucial to engage all stakeholders, including students, parents, and the broader community, in discussions about the ethical implications of AI in education.

In conclusion, while AI has the potential to revolutionise education, its implementation must be guided by ethical principles and informed by wisdom. By addressing the ethical challenges and fostering a collaborative approach, we can harness the power of AI to create more effective,

equitable, and humane educational systems. Future research should continue exploring AI's long-term impacts on education, ensuring its benefits are maximised while mitigating potential risks. The journey towards integrating AI in education with ethics and wisdom is ongoing, and it requires sustained commitment and vigilance from all stakeholders involved.

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Appendix

Analysis of generative AI research articles

Article ID	Author (Year)	Country	Objectives	Database (DOI)	Method (Sample)	Paper Classification
A1	Dhruv et al. (2024)	Canada	This study highlights the need for rules and systems to protect academic integrity as AI expands in education.	[IEEE] 10.1109/InCACCT61598.2024.10551108	Three important metrics: Fulfilment, Presentation, and Helpfulness.	IEEE Conferences
A2	Guillén-Yparrea and Rodríguez (2024)	Mexico	This study explores and analyses university students' and professors' understanding of GenAI, the applications they are using in their academic lives today, and the ethical implications they perceive in its adoption.	[IEEE] 10.1109/EDUCON60312.2024.10578876	Likert scale questionnaire, group discussion, and testimonials (70 university students, 10 professors)	IEEE Conferences
A3	Ciolacu et al. (2024)	Germany	This paper explores whether AI can serve as a bicycle for human creativity and innovation.	[IEEE] 10.1109/EDUCON60312.2024.10578712	Survey conducted at the Faculty of Electronics, Technology and IT	IEEE Conferences
A4	Milinković and Vuleta (2024)	Hrvatska	The study aimed to investigate whether students use generative AI tools for writing assignments and academic papers, how they perceive academic integrity in relation to the use of generative AI tools, and the advantages and disadvantages of generative intelligence tools.	[IEEE] 10.1109/MIPRO60963.2024.10569274	Online survey (students)	IEEE Conferences
A5	Strachan et al. (2024)	England	This study aims to provide a greater understanding of AM from the perspective of the computing PGT student.	[IEEE] 10.1109/EDUCON60312.2024.10578821	Case study (postgraduate students)	IEEE Conferences
A6	Ogunfunmi (2024)	USA	Examine the various concepts tested in each question and relate their importance to a quality overall course in Electric Circuits.	[IEEE] 10.1109/ISCAS58744.2024.10558391	Systematic literature review	IEEE Conferences
A7	Balart and Shryock (2024)	USA	This research explores the integration of ChatGPT, an advanced AI language model, in engineering and computer science education.	[IEEE] 10.1109/EDUCON60312.2024.10578789	Qualitative and quantitative approaches (group and observation)	IEEE Conferences
A8	De Silva et al. (2023)	Australia	Investigate these formative capabilities and present guidelines for leveraging ChatGPT and similar generative AI models.	[IEEE] 10.1109/ICIT58465.2023.10143123	Systematic literature review	IEEE Conferences
A9	Oliveira (2023)	Portugal	The aim of this paper is the following: in what ways can a non-expert on ChatGPT (e.g. this paper's author) incorporate this technology within their teaching/learning activities?	[IEEE] 10.1109/exp.at2358782.2023.10545839	Observation	IEEE Conferences
A10	Zastudil et al. (2023)	Philadelphia	Aims about their awareness, experiences, and preferences regarding the use of tools powered by generative AI in computing classrooms.	[IEEE] 10.1109/FIE58773.2023.10343467	Semi-structured interviews (students and instructors)	IEEE Conferences

Article ID	Author (Year)	Country	Objectives	Database (DOI)	Method (Sample)	Paper Classification
A11	Santos et al. (2024)	Spain	This paper presents a comprehensive literature review on the integration of Generative Artificial Intelligence (Gen AI) in the teaching and learning processes within Information and Communication Technologies (ICT) engineering education.	[IEEE] 10.1109/MIPRO60963.2024.10569779	Synthesising existing literature	IEEE Conferences
A12	Weber et al. (2024)	USA	Aim to measure the adoption and perception of LLMs among the CS education community in an R1 University to distinguish reality from hype	[IEEE] 10.1109/EDUCON60312.2024.10578596	Survey (university students)	IEEE Conferences
A13	Slomp et al. (2024)	Brazil	Explores the impact of Artificial Intelligence (AI) on enhancing academic performance in engineering courses, focusing on adaptive learning systems	[IEEE] 10.1109/EDUNINE60625.2024.10500580	Integrative literature review	IEEE Conferences
A14	Fegadeet al. (2023)	India	The study aims to explore the potential uses of generative AI (GAI) in academics through its current capabilities and applications.	[IEEE] 10.1109/IC3I59117.2023.10397917	Questionnaire (students and professors)	IEEE Conferences
A15	Banavar et al. (2023)	New York	According to the hypothesize that in engineering areas such as signal processing, tools such as ChatGPT do not threaten academic integrity in the classroom.	[IEEE] 10.1109/FIE58773.2023.10342917	Surveys and discussions (students)	IEEE Conferences
A16	Rahman et al. (2024)	Madinah	This paper delves deep into the security, privacy, compliance, and trustworthiness of LLMs and LMMs, offering a comprehensive survey of their vulnerabilities.	[IEEE] 10.1109/LT60077.2024.10469434	Observation and literature review	IEEE Conferences
A17	Ilic and Carr (2023)	Japan	Explores the role of rubrics in mitigating the negative impact of generative AI, such as ChatGPT, on writing assessment practices in STEM.	[IEEE] 10.1109/FIE58773.2023.10343337	The correct identification of frames (students)	IEEE Conferences
A18	Bukar et al. (2024)	Malaysia	Educational institutions and policymakers, suggest the need for inclusive discussions, pilot programs to assess impacts on critical thinking, development of clear guidelines, flexible regulatory frameworks, and potential strategies for ethical and responsible use.	[IEEE] 10.1109/ACCESS.2024.3425172	Systematic literature review and frequency of occurrence analysis	IEEE Journals
A19	Leelavathi and Surendhranatha (2024)	India	Evaluate ChatGPT's effectiveness in facilitating active learning, promoting critical thinking, fostering students' creativity, and investigating the potential of ChatGPT as a tool for enhancing traditional teaching methods within management education.	Emerald https://doi.org/10.1108/JRIT-01-2024-0017	Questionnaire (UG & PG students, academics)	Research paper

Article ID	Author (Year)	Country	Objectives	Database (DOI)	Method (Sample)	Paper Classification
A20	Wood and Moss (2024)	USA	Evaluate the impact of generative artificial intelligence (GenAI) on students' learning experiences and perceptions through a master's-level course. The study specifically focused on student engagement, comfort with GenAI and ethical considerations.	Emerald https://doi.org/10.1108/JRIT-06-2024-0151	Interview, content analysis, observation, and questionnaire (PG students)	Research paper
A21	Aure and Cuenca (2024)	Philippines	Pedagogy innovation of undergraduate business research courses by integrating Generative Artificial Intelligence (GAI) tools, guided by human-centred artificial intelligence, social-emotional learning, and authenticity principles.	Emerald https://doi.org/10.1108/JRIT-03-2024-0076	Case study (UG students)	Research paper
A22	Elbanna and Armstrong (2024)	Qatar	To stimulate discussion on the effective application of ChatGPT as a tool for learning while remaining mindful of the ethical issues involved.	[EMERALD] https://doi.org/10.1108/MSAR-03-2023-0016	A literature search, screening and selection, analysis and synthesis.	Article
A23	Zeb et al. (2024)	Pakistan	This paper aims to examine the opportunities and challenges of using ChatGPT in higher education. Furthermore, it also discusses the potential risks and plunders of these tools.	[EMERALD] https://doi.org/10.1108/IJILT-04-2023-0046	Systematic literature review	Article
A24	Sabraz Nawaz et al. (2024)	India	Investigate Sri Lankan Government university students' acceptance of ChatGPT for educational purposes. Using the unified theory of acceptance and use of technology 2 (UTAUT2) model as the primary theoretical lens, this study incorporated personal innovativeness as both a dependent and moderating variable to understand students' ChatGPT use behaviour.	Emerald https://doi.org/10.1108/ITSE-11-2023-0227	Questionnaire (UG students)	Research paper
A25	Cingillioglu (2023)	Australia	With the advent of ChatGPT, a sophisticated generative artificial intelligence (AI) tool, maintaining academic integrity in all educational settings has recently become a challenge for educators. This paper discusses a method and the necessary strategies to confront this challenge.	[EMERALD] https://doi.org/10.1108/IJILT-03-2023-0043	Language model	Research paper
A26	Duong et al. (2023)	Vietnam	The emergence of artificial intelligence technologies, like ChatGPT, has taken the world by storm, particularly in the education sector. This study aims to adopt the unified theory of acceptance and use of technology to explore how effort expectancy and performance expectancy	[EMERALD] https://doi.org/10.1108/ITSE-05-2023-0096	Polynomial regression with response surface analysis	Research paper

Article ID	Author (Year)	Country	Objectives	Database (DOI)	Method (Sample)	Paper Classification
			individually, jointly, congruently and incongruently affect higher education students' intentions and actual uses of ChatGPT for their learning.			

Chapter 7

Empowering Muslim Elderly in Malaysia with Artificial Intelligence: Enhancing Well-being and Spiritual Fulfilment

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Abstract

As Malaysia's population ages, with the proportion of citizens over the age of 60 projected to reach 15.3% by 2030, the integration of artificial intelligence (AI) into elderly care becomes increasingly vital (Department of Statistics Malaysia, 2022). This chapter explores the transformative impact of AI on the lives of Muslim elderly individuals in Malaysia, focusing on tools and applications tailored to their unique cultural and religious needs. We examine AI-driven telemedicine services, such as DoctorOnCall, and health monitoring devices like Biofourmis' Biovitals, which provide personalised and accessible healthcare, crucial for managing chronic conditions prevalent among the elderly. Cognitive support tools, including the Muslim Pro app and AI chatbots in Bahasa Malaysia, offer mental health support and enhance spiritual practices. The chapter highlights AI applications in mobility and independence, such as Grab for safe transportation and smart wheelchairs for navigating public spaces. Safety and security are enhanced through local AI-powered fall detection devices and smart home solutions, ensuring peace of mind for elderly Muslims and their families. Furthermore, we explore tools that facilitate religious practices and social engagement, including AI-powered Quran apps, virtual reality experiences, and community platforms for virtual religious gatherings. Ethical considerations are addressed, emphasising the importance of privacy, data security, and inclusivity in AI design. Through case studies and success stories from Malaysia, we demonstrate the practical benefits of AI in enhancing the well-being and spiritual fulfilment of Muslim elderly individuals. By integrating technology with tradition, this chapter envisions a future where AI not only meets the healthcare needs of the elderly but also supports their holistic well-being in a culturally sensitive manner.

Keywords: AI, Elderly, Muslim, AI Application

Introduction

As Malaysia transitions into an ageing society, the proportion of citizens over the age of 60 is projected to reach 15.3% by 2030, posing significant challenges for the nation's healthcare and social systems. The elderly, particularly those within the Muslim community, have unique cultural and religious needs that must be addressed in any care strategy. Artificial Intelligence (AI) emerges as a pivotal tool in this landscape, offering innovative solutions that cater to both the physical and spiritual well-being of the elderly. In Malaysia, the integration of AI into elderly care is not merely about improving health outcomes but also about enhancing the overall quality of life in a culturally sensitive manner. This chapter explores the transformative potential of AI applications tailored specifically for Muslim elderly individuals. From AI-driven telemedicine services like DoctorOnCall, which provide accessible and personalised healthcare, to cognitive support tools such as the Muslim Pro app, these technologies are beginning to play a crucial role in addressing the multifaceted needs of the ageing Muslim population. Moreover, AI's role extends beyond healthcare. It supports the autonomy and safety of the elderly through smart mobility solutions like Grab and AI-powered fall detection devices, ensuring that they can live independently with peace of mind. Importantly, AI also enriches spiritual life by facilitating religious practices through apps and virtual experiences, thus enabling the elderly to maintain a strong connection with their faith. Through a combination of case studies, practical examples, and ethical considerations, this chapter delves into how AI can be harnessed to not only meet the healthcare needs of the elderly but also to support their holistic well-being. In doing so, it envisions a future where technology and tradition coexist, providing Muslim elderly individuals in Malaysia with the tools they need to thrive in their golden years.

AI in Healthcare for Muslim Elderly

As Malaysia's elderly population continues to grow, the healthcare system faces increasing pressure to provide effective, accessible, and culturally sensitive care. For Muslim elderly individuals, this care must also align with religious values and practices, making the integration of AI into healthcare a vital development. AI technologies offer innovative solutions that cater to the complex healthcare needs of the elderly while respecting their cultural and religious contexts.

Telemedicine Services

AI-driven telemedicine platforms are revolutionising healthcare, particularly for elderly patients, by enabling remote consultations and personalised care (Talati, 2023; Patel, 2023). These platforms leverage AI to analyse patient histories, current symptoms, and environmental factors, leading to improved diagnosis accuracy, enhanced patient experiences, and reduced in-person visits (Patel, 2023). For elderly Muslims managing chronic conditions like diabetes, AI can generate culturally sensitive health recommendations, such as dietary suggestions aligned with halal laws (Khan & Nayab, 2021). AI-powered telemedicine applications can also assist in medication management, potentially adjusting schedules for religious practices like Ramadan fasting (Hudiono & Watini, 2023). The integration of AI in telemedicine offers numerous benefits, including early intervention, reduced hospitalisations, and personalised treatment plans (Talati, 2023; Patel, 2023). However, challenges remain, such as ensuring data privacy and algorithm accountability (Patel, 2023).

Case Example: An elderly Muslim woman from a rural area with limited healthcare access was able to control her hypertension through DoctorOnCall. The platform's AI recommended lower-sodium meal plans, respectful of halal guidelines, and sent reminders for her prayer schedule, integrated with medication alerts. This reduced her hospital visits while maintaining her spiritual routines.

Figure 1: Screenshot of DoctorOnCall Telemedicine Platform. Adapted from DoctorOnCall. Source: https://www.doctoroncall.com.my

Health Monitoring Devices

Biofourmis' Biovitals is a personalised multivariate physiology analytics platform that uses wearable biosensors for remote patient monitoring (Jin Chen et al., 2019). The system continuously monitors various physiological parameters, including skin temperature, respiratory rate, blood pressure, pulse rate, and blood oxygen saturation (Chun-Ka Wong et al., 2020). Health monitoring is another area where AI has made significant contributions. Biofourmis' Biovitals device provides real-time monitoring of vital signs and health metrics, allowing for proactive management of chronic conditions. These AI-powered devices are particularly useful for elderly patients who require continuous health monitoring but may not have immediate access to healthcare facilities. For Muslim individuals of senior age, such devices can be life-changing. Continuous monitoring ensures that any health deterioration is detected early, allowing for prompt intervention. This is crucial for conditions that require ongoing management, such as diabetes, where fluctuations in blood glucose levels can have serious consequences. Furthermore, these devices can be programmed to respect religious practices, such as fasting during Ramadan, ensuring that monitoring and management of health conditions do not interfere with spiritual obligations.

Case Example: Biofourmis' Biovitals offers real-time health monitoring, which is particularly beneficial during Ramadan. AI algorithms in these devices adjust health alerts to accommodate fasting schedules. For example, they monitor blood glucose levels more intensively at pre-dawn (Suhur) and post-sunset (Iftar) times, alerting users and their caregivers to potential risks. Such customisation ensures elderly Muslims can observe fasting without compromising their health.

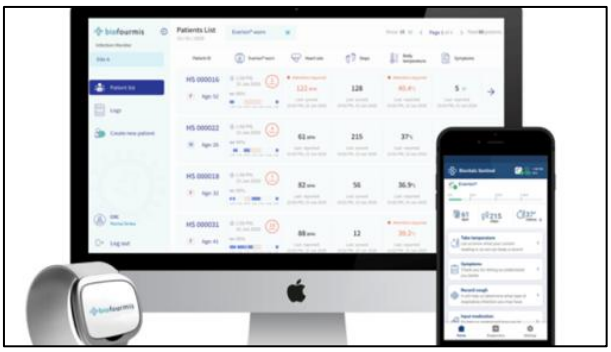

Figure 2: Screenshot of the Biofourmis App. Adapted from Healthcare IT News. Source: https://www.healthcareitnews.com/news/biofourmis-ai-fueled-remote-monitoring-tech-provides-insights-fight-against-covid-19

Challenges and Ethical Considerations

While AI offers numerous benefits in healthcare, it also raises several ethical considerations, particularly concerning privacy and data security. The sensitive nature of health data requires robust measures to protect patient confidentiality, a concern that is amplified in the context of AI-driven healthcare solutions. Ensuring that AI systems are designed with strong data encryption and security protocols is essential to maintaining patient trust, especially among the elderly who may be less familiar with technology. Additionally, there is the challenge of ensuring inclusivity in AI design. AI healthcare solutions must be accessible to all elderly individuals, regardless of their tech-savviness or socioeconomic status. This includes providing user-friendly interfaces and support in the local language, such as Bahasa Malaysia, to ensure that Muslim elderly individuals can fully benefit from these technologies without facing language or technical barriers.

Cognitive and Spiritual Support through AI

As the population of elderly individuals grows in Malaysia, cognitive decline and the need for spiritual fulfilment become increasingly pressing concerns. For the Muslim elderly, maintaining cognitive health is as crucial as upholding religious practices, which are integral to their identity and daily life. AI is stepping in to provide support in these areas, offering tools that not only help preserve cognitive function but also enhance spiritual engagement, thereby enriching the lives of the elderly in a culturally and religiously sensitive manner.

Mental Health Support

AI-powered chatbots in Bahasa Malaysia are emerging as valuable tools for mental health support, offering cognitive behavioural therapy interventions and stress mitigation (Ng et al., 2023). These chatbots integrate artificial intelligence, natural language processing, and machine learning algorithms to provide accessible mental health care (Muhammad Imran Ismael et al., 2022; Balcombe, 2023).

Cognitive decline is a common challenge among the elderly, with conditions such as dementia and Alzheimer's disease becoming more prevalent. To combat these issues, AI-powered tools are being developed to provide cognitive support and mental health assistance. AI chatbots, for instance, are increasingly being utilised to offer companionship, cognitive exercises, and mental health support. These chatbots, programmed in Bahasa Malaysia, can

engage elderly users in conversations that stimulate cognitive function, provide reminders for daily tasks, and offer reassurance during moments of confusion or anxiety. The use of AI chatbots also extends to providing mental health support tailored to the cultural and religious context of Muslim elderly. These tools can be programmed to include religious affirmations, reminders of prayer times, and even recitations of Quranic verses, helping to soothe and comfort users while also keeping them mentally engaged.

Case Example: An elderly Muslim man experiencing early dementia relied on an AI chatbot to stay engaged. The bot helped him track daily tasks, reminded him of Fajr prayers, and recited verses from Surah Yasin, creating a routine that supported both his mental and spiritual health.

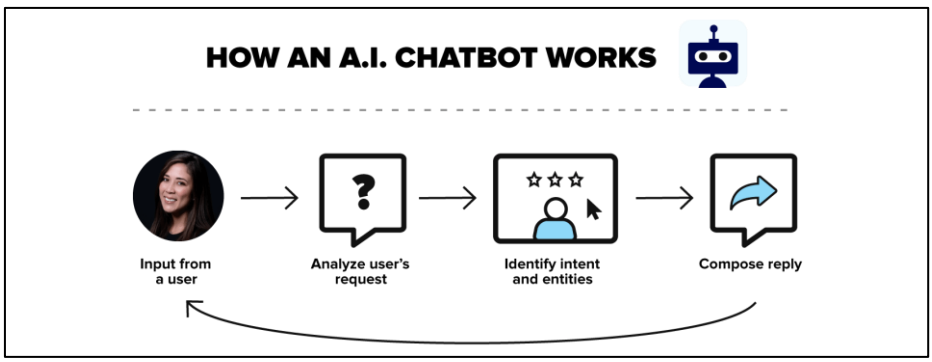

Figure 3: Screenshot of an AI-powered chatbot. Adapted from Salesloft, from https://www.salesloft.com/learn/ai-chatbots

Enhancing Spiritual Practices

For many Muslim elderly, spiritual practices such as prayer, Quran recitation, and participation in religious rituals are central to their daily lives. AI technologies are now playing a significant role in facilitating these practices, ensuring that the elderly can continue to engage with their faith even as their physical and cognitive abilities decline. One prominent example is the Muslim Pro app, which offers a range of features tailored to the needs of Muslim users, including prayer time notifications, Qibla direction, and audio recitations of the Quran (Muslim Pro, 2024). For the elderly, this app can be a lifeline, helping them maintain their religious routines with ease. The app's user-friendly interface and accessibility features, such as larger text options and voice commands, make it particularly suitable for elderly users.

Figure 4: Screenshot of Muslim Pro. Adapted from Muslim Pro. Source: https://www.muslimpro.com/features/

Virtual reality (VR) technology is emerging as an innovative tool for enhancing Hajj and Umrah experiences. VR simulations can provide realistic, interactive environments for pilgrimage education and training (S. M. Salleh et al., 2021; M. Rahim et al., 2011). These applications offer users the opportunity to practice rituals like Tawaf in a virtual setting, improving understanding and preparation for the actual pilgrimage (M. Rahim et al., 2011; Alvee Morsele Kabir et al., 2021). VR technology, along with companion mobile apps and websites, can benefit both prospective pilgrims and those seeking to learn about the rituals (Alvee Morsele Kabir et al., 2021).

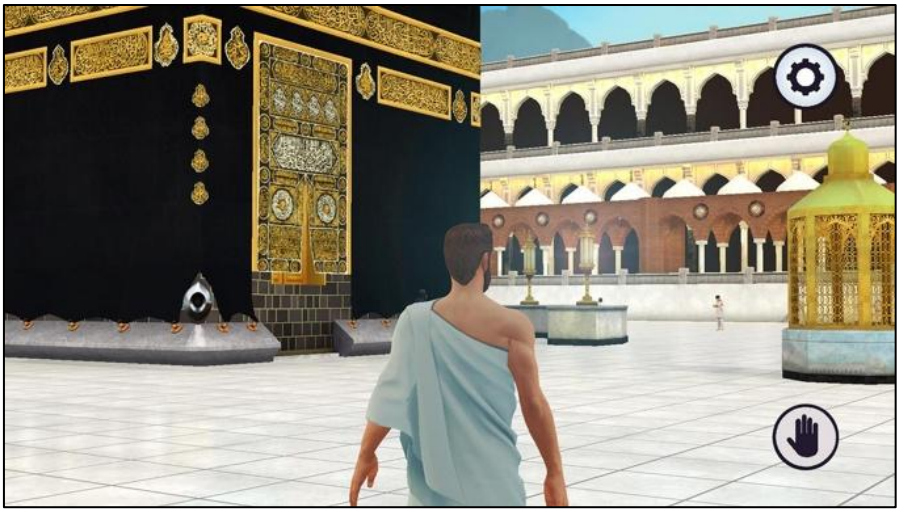

Figure 5: Screenshot of Virtual Reality App. Adapted from Islam Channel. Source: https://islamchannel.tv/the-tech-companies-providing-virtual-hajj-experiences/

Ethical and Cultural Considerations

While AI offers tremendous potential in cognitive and spiritual support, it also raises important ethical and cultural considerations. The design of AI tools must be sensitive to the religious and cultural contexts in which they are used. For example, AI chatbots and virtual assistants should be programmed with an understanding of Islamic etiquette and the appropriate ways to address religious content. Additionally, there is the issue of data privacy, particularly when it comes to personal religious practices and mental health information. Ensuring that AI tools have robust data protection measures in place is essential to maintaining the trust of elderly users, who may be more vulnerable to breaches of privacy.

Mobility and Independence

Maintaining mobility and independence is a significant concern for the elderly, particularly as physical abilities decline with age. For Muslim elderly individuals in Malaysia, this concern is compounded by the desire to remain active in religious and social activities, which are integral to their cultural and spiritual lives. AI is playing a transformative role in addressing these challenges by providing tools and technologies that enhance mobility and support independent living, enabling elderly individuals to maintain their autonomy and continue participating in community life.

AI-Enhanced Transportation

Ride-hailing services are transforming transportation for older adults and people with disabilities. These services enhance independence and mobility, particularly in areas with limited public transportation options (Vaishnav Kameswaran et al., 2018). Factors influencing adoption among older adults include age, education, income, urban dwelling, and smartphone ownership (S. Mitra et al., 2019; M. Z. Irawan et al., 2022). While younger seniors are more likely to adopt ride-hailing, middle-aged and less educated seniors tend to use these services more frequently once adopted (S. Mitra et al., 2019). Artificial Intelligence-based technologies can further improve mobility inclusion and safety for senior citizens (Anthony Jnr. Bokolo, 2023).

However, barriers such as limited technological proficiency and physical abilities can impact adoption (M. Z. Irawan et al., 2022). To address these challenges, some older adults rely on others to request rides (M. Z. Irawan et al., 2022).

Transportation is a critical aspect of maintaining independence for the elderly. However, with age, driving or using public transportation can become increasingly difficult. AI-driven transportation services like Grab are revolutionising how elderly individuals in Malaysia move about, offering safe, reliable, and accessible transportation options. Grab's platform, which provides ride-hailing services at the touch of a button, has become an essential tool for many elderly individuals who may no longer be able to drive themselves. For Muslim elderly, who may need to travel to mosques, attend religious gatherings, or visit family members, the convenience of AI-enhanced transportation services cannot be overstated. Grab's interface is user-friendly, with features that accommodate the needs of older adults, such as the ability to schedule rides in advance, monitor driver details for safety, and choose specific vehicle types to accommodate mobility aids like walkers or wheelchairs. These services are particularly beneficial for elderly women, who may face additional cultural barriers to mobility.

Figure 6: Screenshot of Grab App. Adapted from eCentral.
Source: https://ecentral.my/daftar-pemandu-grab/

Smart Wheelchairs and Navigation

Recent research highlights the development of AI-powered smart wheelchairs to enhance mobility and independence for elderly and disabled individuals. These wheelchairs incorporate various features such as voice-controlled navigation, obstacle detection, and autonomous movement capabilities (Balamurugan et al., 2024; Hou et al., 2021). The integration of IoT-based biophysical sensors allows for real-time health monitoring and data analysis, providing valuable feedback to users and healthcare providers (Hou et al., 2021). Researchers emphasise the importance of user-centred design, considering both functional and aesthetic aspects to improve social acceptance and user experience (Ito et al., 2020). Specific applications include designing wheelchairs for religious purposes, such as facilitating prayer at mosques for disabled Muslims (Irwandi et al., 2023). These innovations aim to address the needs of the growing population of individuals with mobility limitations, estimated at 65 million worldwide, by offering more flexible and responsive mobility solutions (Irwandi et al., 2023). Mobility aids like wheelchairs are essential for many elderly individuals, but traditional wheelchairs often have limitations in terms of functionality and ease of use. AI-driven innovations in smart wheelchairs are addressing these limitations, offering advanced features that enhance mobility and independence for elderly users. Smart wheelchairs equipped with AI technology can assist users in navigating complex environments, such as crowded public spaces or uneven terrain, which might otherwise be challenging or unsafe. For example, AI-powered wheelchairs can include

features like automatic obstacle detection, pathfinding capabilities, and even voice commands, allowing users to navigate independently without needing constant assistance. These technologies are particularly beneficial in public spaces, such as mosques or community centres, where Muslim elderly individuals frequently gather for prayers and social activities. By enhancing the functionality of mobility aids, AI is helping elderly individuals maintain their independence and continue participating in religious and community life with confidence

Figure 7: A smart wheelchair concept diagram illustrating advanced features, including sensors, a joystick control panel, a display screen, motorised wheels, and wireless connectivity for AI integration. Adapted for illustrative purposes.

Safety and Security Enhancements

Safety and security are paramount concerns for the elderly, especially as they become more vulnerable due to age-related physical and cognitive declines. For Muslim elderly individuals in Malaysia, the need for a secure living environment is intertwined with cultural and religious practices that emphasise family care and community support. AI is increasingly being employed to address these concerns, offering solutions that enhance safety and provide peace of mind for both the elderly and their families.

AI-Powered Fall Detection Systems

Current research has focused on developing AI-powered fall detection systems for elderly individuals living alone. These systems utilise various sensors, including accelerometers, gyroscopes, and depth cameras, to continuously monitor user movements (Rathod et al., 2023; Muheidat et al., 2018). Machine learning algorithms, such as deep neural networks and random forests, process the sensor data to accurately detect falls while minimising false positives (Rathod et al., 2023; Pillai et al., 2022). Some systems incorporate wearable devices that measure body acceleration and angular velocity (Pillai et al., 2022; Nafil et al., 2023).

Upon detecting a fall, these systems can immediately alert caregivers or emergency services through mobile applications or cloud-based platforms (Muheidat et al., 2018; Nafil et al., 2023).

Falls are a leading cause of injury among the elderly, often leading to serious health complications. AI-powered fall detection systems have emerged as a critical tool in mitigating this risk. These systems use a combination of sensors, cameras, and machine learning algorithms to monitor movements and detect falls in real time. Upon detecting a fall, the system can automatically alert caregivers, family members, or emergency services, ensuring that help is dispatched immediately.

For Muslim elderly, they provide a safety net that allows the elderly to maintain their independence while also ensuring that they are protected in the event of an accident. Moreover, these systems can be integrated with mobile apps that notify family members, offering them peace of mind knowing that their loved ones are safe.

Figure 8: Diagram of an AI-powered fall detection system illustrating key components, including wearable devices, home sensors, real-time data transmission, smartphone app integration, and emergency alert notifications. Adapted for illustrative purposes.

Smart Home Solutions for Security

AI-enhanced smart homes offer innovative solutions for Muslim households, integrating cultural norms with modern technology. These homes can incorporate features of traditional Islamic architecture while providing intelligent systems for improved efficiency and security (El Basyouni, 2017)

In addition to fall detection, AI-driven smart home solutions are enhancing security for elderly individuals. These systems include a range of features designed to monitor and protect the home environment. For instance, AI-powered surveillance cameras can recognise unusual activity or unauthorised entry, immediately notifying the elderly or their caregivers. These systems can also be programmed to distinguish between family members, visitors, and potential intruders, reducing false alarms and ensuring that the elderly are only alerted when necessary. For Muslim elderly who may have specific cultural and religious requirements, such as maintaining modesty and privacy, smart home solutions can be tailored to meet these needs. For example, cameras can be programmed to deactivate in private areas of the home, or when certain individuals are present, to respect the elderly's privacy. Additionally, smart locks can be integrated with the system, allowing the elderly to control access to their home remotely,

which is particularly useful during times of prayer or when they are unable to answer the door.

Figure 9: Screenshot of Smart Home App. Adapted from SmartEz Solution. Source: https://www.smartez.com.my/ezhome-smart-home/

Community and Family Connectivity

Another critical aspect of safety for the elderly is staying connected with family and community. AI-driven platforms are facilitating this connectivity by offering communication tools that are easy to use and accessible.

For example, AI-powered video calling apps that simplify the process of connecting with family members can be a lifeline for elderly individuals who may otherwise feel isolated. These tools can be integrated into the smart home system, allowing the elderly to initiate calls with a simple voice command or through a user-friendly interface. In Malaysia, where community and family play a central role in the care of the elderly, AI tools that enhance connectivity are particularly valuable.

AI-driven platforms can also enhance Quranic studies through personalised learning, interactive education, and text analysis (Mauluddin, 2024). These technologies facilitate virtual spaces for religious engagement, including online lectures and study groups (Sebihi & Moazzam, 2024). AI applications in Islamic contexts extend to financial services, with virtual assistants streamlining transactions in compliance with *Shariah* principles (Hemmet, 2023). For elderly Muslims with cognitive impairments, innovative solutions like the Smart Prayer Mat provide audible cues during prayer, supporting spiritual needs (Ismail et al., 2015).

Ethical and Cultural Considerations

While AI-driven safety and security solutions offer significant benefits, they also raise important ethical and cultural considerations. Privacy is a major concern, especially when it comes to monitoring technologies. These systems must be designed with robust data protection measures to ensure that the elderly's personal information is kept secure. Another consideration is the accessibility of these technologies. Ensuring that AI-powered safety and security systems are affordable and easy to use is crucial for their widespread adoption among the elderly. This includes providing instructions and support in local languages, such as Bahasa Malaysia, and designing interfaces that are intuitive for elderly users who may not be familiar with advanced technology.

Social Engagement and Community Building

Social engagement and community building are essential aspects of well-being for the elderly, contributing to their mental health, sense of belonging, and overall quality of life. For Muslim elderly individuals in Malaysia, maintaining connections with family, friends, and the broader religious community is particularly important, as these relationships are often intertwined with spiritual practices and cultural traditions (UNICEF Malaysia, 2022). AI is emerging as a powerful tool in facilitating social engagement and community building, offering solutions that help the elderly stay connected and actively participate in their communities, despite the challenges of ageing.

Virtual Religious Gatherings

For many Muslim elderly, regular participation in religious gatherings, such as prayers at the mosque, Quranic study groups, and community events, is a vital part of their spiritual life. However, physical limitations, health issues, or geographical distance can make attending these gatherings difficult. AI-powered platforms are addressing this challenge by enabling virtual religious gatherings, allowing the elderly to participate in communal worship and religious activities from the comfort of their homes. These platforms, often integrated with video conferencing tools, offer features tailored to the needs of the elderly.

AI-Driven Social Platforms

Social isolation is a significant concern for the elderly, particularly for those living alone or far from family members. AI-driven social platforms are helping to combat this isolation by creating virtual spaces where the elderly

can interact with peers, family, and community members. These platforms often feature user-friendly interfaces designed with the elderly in mind, making it easier for them to navigate and participate in social activities. These platforms can be customised to include religious and cultural content, such as Quranic discussions, Islamic lectures, and virtual prayer sessions. This not only provides them with social interaction but also ensures that their engagements are meaningful and aligned with their values.

Figure 10: Diagram of an app interface for a virtual religious gatherings' platform, featuring sections for live Quran recitations, prayer time notifications, virtual mosque sessions, and community chat rooms. Adapted for illustrative purposes.

Community Support Networks

AI is also playing a role in strengthening community support networks for the elderly. In Malaysia, where community care is an integral part of the cultural fabric, AI tools are being used to coordinate volunteer efforts, manage community resources, and provide support to elderly individuals in need. For example, AI-powered apps can connect volunteers with elderly community members who require assistance with daily tasks, such as grocery shopping, medical appointments, or home repairs. These platforms can also be used to organise and manage community events, ensuring that elderly individuals are included and have access to the resources they need to participate.

Figure 11: Diagram of an app designed to connect volunteers with elderly community members for assistance with tasks such as grocery shopping, medical appointments, and home repairs. Adapted for illustrative purposes.

Ethical and Cultural Considerations

While AI-driven solutions for social engagement and community building offer significant benefits, it is important to consider the ethical and cultural implications of these technologies. Privacy is a key concern, particularly in the context of virtual gatherings and social platforms. Ensuring that these platforms have robust data protection measures is essential to maintaining the trust of elderly users and their families. Cultural sensitivity is also crucial in the design and implementation of AI tools for social engagement

Ethical Considerations in AI for Elderly Care

AI in elderly care offers significant potential for enhancing independence, social interaction, and healthcare management for seniors (Yousefi et al., 2023; Mhlanga, 2024). However, its adoption raises ethical concerns, including privacy issues, potential depersonalisation of care, and risks of discrimination (Rubeis, 2020; Mhlanga, 2024). AI-based clinical decision support systems in geriatrics can be beneficial, particularly for patients with cognitive disorders, but may overlook patients' values and alter doctor-patient relationships (Skuban-Eiseler et al., 2023). To address these

challenges, a multidisciplinary approach involving seniors, caregivers, healthcare professionals, and AI developers is crucial (Mhlanga, 2024). Implementing AI in elderly care requires a balanced, human-centric approach that leverages technological advancements while aligning with the needs and values of the elderly population (Yousefi et al., 2023).

Privacy and Data Security

One of the most pressing ethical concerns in AI for elderly care is the issue of privacy and data security. AI-driven technologies often rely on the collection and analysis of large amounts of personal data, including health information, daily routines, and even religious practices. For elderly individuals, who may be less familiar with digital technologies, the concept of data privacy can be particularly challenging to navigate. In the context of Muslim elderly in Malaysia, privacy takes on additional cultural and religious significance. For example, the concept of modesty (haya) is deeply ingrained in Islamic culture, and technologies that intrude on personal spaces, such as AI-powered cameras or monitoring systems, could be perceived as invasive. It is crucial that AI systems are designed with strict data protection measures to safeguard the privacy of elderly users. This includes ensuring that data is encrypted, access is restricted, and data collection is minimised to only what is necessary for the functionality of the system.

Informed Consent and Autonomy

Another critical ethical consideration is the issue of informed consent. Given that many elderly individuals may have limited experience with technology, it is important to ensure that they fully understand the implications of using AI-driven tools and services. This includes understanding what the technology does, what data it collects, and how it might impact their daily lives. Informed consent in the context of AI for elderly care involves more than just obtaining a signature on a form; it requires meaningful communication and education. Caregivers, family members, and healthcare providers must take the time to explain AI technologies in a way that is accessible and comprehensible to the elderly. This might involve using simplified language, providing demonstrations, or offering support in the elderly's native language, such as Bahasa Malaysia. Respecting the autonomy of the elderly is also paramount.

Cultural and Religious Sensitivity

Cultural and religious sensitivity is particularly important when designing AI technologies for the Muslim elderly in Malaysia. AI systems must be developed with a deep understanding of Islamic values and cultural practices to ensure that they are not only effective but also respectful and inclusive. For example, AI-powered healthcare tools must consider the dietary restrictions of Muslim elderly, such as the prohibition of certain foods and the requirement for halal medication. Similarly, AI-driven social platforms should accommodate gender norms and the importance of modesty in social interactions. When integrating AI into religious practices, such as Quranic recitations, it is essential to ensure that these technologies are designed in a way that honours the sanctity of these practices.

The Risk of Bias and Discrimination

AI systems are only as good as the data they are trained on, and there is a risk that these systems could perpetuate biases or lead to discriminatory outcomes. In the context of elderly care, this could manifest in AI technologies that are less effective for certain groups of people, including those from minority backgrounds or with specific cultural needs. To mitigate this risk, AI systems must be trained on diverse datasets that reflect the varied needs and experiences of the elderly population. This includes considering factors such as ethnicity, religion, gender, and socioeconomic status. Developers of AI technologies must be vigilant in identifying and addressing any biases in their systems to ensure that AI solutions are equitable and fair for all users.

The Role of Human Oversight

While AI can provide valuable support in elderly care, it should not replace the human touch. Human oversight is critical to ensuring that AI technologies are used appropriately and that they complement, rather than replace, human caregivers. This is particularly important in the context of elderly care, where personal relationships and empathy play a vital role in the well-being of the elderly. AI systems should be designed to work alongside caregivers, providing them with tools and insights that enhance their ability to care for the elderly.

Real-World Achievements

The integration of AI into elderly care has yielded numerous success stories, particularly in Malaysia, where AI technologies have been tailored to meet

the unique needs of the Muslim elderly population. These case studies demonstrate how AI can enhance the quality of life for the elderly by providing personalised healthcare, facilitating social engagement, and supporting spiritual practices. The following examples highlight some of the successful implementations of AI in elderly care in Malaysia.

DoctorOnCall: AI-Driven Telemedicine for Personalised Healthcare

One of the most prominent examples of AI's impact on elderly care in Malaysia is the use of DoctorOnCall, an AI-driven telemedicine platform. DoctorOnCall has revolutionised access to healthcare for elderly individuals, particularly those living in rural areas or with mobility limitations (DoctorOnCall, 2024). The platform offers a range of services, including virtual consultations with doctors, AI-powered symptom checkers, and access to medication delivery services. The platform offers consultations with doctors who understand Islamic medical ethics, ensuring that treatments and advice are aligned with religious practices. Additionally, the platform's AI-driven symptom checker can be used in Bahasa Malaysia, making it accessible to elderly individuals who may not be proficient in English. One success story involves an elderly Muslim woman from a rural village in Kelantan who used DoctorOnCall to manage her diabetes. With limited access to healthcare facilities, she struggled to maintain regular check-ups and control her blood sugar levels. Through DoctorOnCall, she was able to receive regular consultations, AI-driven monitoring of her condition, and timely medication deliveries. This not only improved her health outcomes but also allowed her to stay connected with her religious community by participating in local mosque activities, knowing her health was being managed effectively.

Muslim Pro: AI-Powered Spiritual Support

Muslim Pro, an AI-powered app designed to support the religious practices of Muslims worldwide, has become an essential tool for many elderly Muslims in Malaysia (Muslim Pro, 2024). The app offers a range of features, including prayer time notifications, Quranic recitations, and Qibla direction, all of which are powered by AI to ensure accuracy and personalisation. For the elderly, Muslim Pro has been particularly beneficial in maintaining their spiritual routines, especially when physical limitations make it difficult to attend mosque or participate in communal prayers. The app's AI features can be customised to cater to the specific needs of the elderly, such as larger text sizes for those with visual impairments and simplified interfaces for ease of use. A notable success story involves an elderly couple from Kuala Lumpur

who relied on Muslim Pro during the COVID-19 pandemic when mosques were closed, and social gatherings were restricted. The app provided them with accurate prayer times, daily Quranic verses, and virtual access to sermons. This not only helped them maintain their religious practices but also provided a sense of connection to the broader Muslim community during a time of *isolation.*

AI-Driven Community Platforms: Fostering Social Connections

AI-driven community platforms have also played a crucial role in fostering social connections among elderly Muslims in Malaysia. These platforms offer virtual spaces where the elderly can engage with peers, participate in religious discussions, and stay connected with their communities. One such platform, designed specifically for the elderly, has been successful in bringing together Muslim seniors from different parts of Malaysia for virtual Quranic study groups and religious lectures. The AI algorithms powering the platform help match users with groups and activities that align with their interests and spiritual needs, ensuring that their social interactions are meaningful and fulfilling. A success story from this platform involves a group of elderly women from various states in Malaysia who formed a virtual Quranic study group during the pandemic. The platform's AI features helped them schedule regular meetings, share study materials, and even organise virtual iftar gatherings during Ramadan.

Potential Future Trends in AI Development for Elderly Care

AI shows great promise in addressing the challenges of elderly care amid a growing ageing population. AI technologies can enhance healthcare delivery, improve patient outcomes, and optimise resources (Koç, 2023). These technologies include socially assistive robots, wearable devices for health monitoring, and intelligent homes (Mohan Noone, 2020; Ma et al., 2022). AI applications can support various aspects of elderly care, such as rehabilitation, emotional support, social facilitation, supervision, and cognitive promotion (Ma et al., 2022). They can also assist in medication management, fall detection, and provide personalised care (Koç, 2023; Mohan Noone, 2020). While AI holds significant potential in supporting ageing adults and enhancing their quality of life, challenges remain in its implementation (Czaja & Ceruso, 2022). Future research should focus on well-designed randomised controlled trials to validate the roles of AI technologies in elderly (Ma et al., 2022).

Personalised AI for Faith-Based Living

Future AI technologies are poised to tailor experiences for elderly Muslims by aligning with their spiritual practices. For instance, AI could assist with rituals like Hajj or Umrah by providing step-by-step guidance personalised to an individual's pace and physical abilities. Additionally, dynamic algorithms may analyse patterns in users' religious activities, such as prayer or Quranic recitation, to recommend specific supplications or verses for reflection. Such personalised spiritual support would enhance faith-based living while ensuring accuracy and reverence.

Culturally Aware AI for Social Connection

As family structures and dynamics evolve, AI can bridge generational gaps while respecting cultural norms. For example, AI platforms could facilitate family engagement by scheduling virtual Quranic discussions or organising digital gatherings for intergenerational communication. On a broader scale, AI-driven community platforms might match elderly users with peers for shared religious activities, such as collective duas or virtual mosque sessions, thereby fostering a sense of belonging within the community.

Advanced AI in Health Monitoring for Islamic Practices

AI's role in health monitoring is set to expand with an emphasis on culturally sensitive practices like fasting during Ramadan. Future wearables might provide tailored guidance for managing health conditions during fasting hours, such as optimised meal timings and medication reminders. Additionally, AI-powered dietary tools could analyse food labels to ensure compliance with halal standards, helping elderly Muslims adhere to their religious commitments while maintaining good health.

AI for Enhanced Religious and Spiritual Accessibility

For elderly Muslims facing physical or cognitive limitations, AI can make religious practices more accessible. Voice-activated devices could assist with Quranic recitation or dhikr (remembrance of Allah), while virtual reality systems might offer immersive Hajj experiences enhanced by AI-guided rituals. These tools would ensure that elderly individuals can continue engaging with their faith, regardless of mobility or health challenges.

Ethical AI Governance for Islamic Contexts

As AI becomes more integrated into elderly care, ensuring *Shariah* compliance will be critical. Developers might collaborate with Islamic

scholars to design algorithms that respect Islamic ethics, such as ensuring modesty in surveillance systems or avoiding intrusive monitoring. Furthermore, AI systems could offer transparent decision-making processes, explaining their recommendations in ways that are culturally appropriate and easily understood by elderly users.

AI for Promoting Intergenerational Knowledge Transfer

AI can play a pivotal role in preserving and transmitting cultural and religious knowledge between generations. Platforms could enable elderly Muslims to share stories, religious teachings, and cultural traditions with younger family members, creating a digital legacy. Additionally, AI-curated archives of Islamic history and jurisprudence could empower elderly Muslims to actively contribute to the intellectual and spiritual development of their communities.

Next-Generation Smart Environments for Elderly Muslims

The future of smart environments lies in creating spaces tailored to the cultural and religious needs of elderly Muslims. AI-powered smart homes could support religious observances by dimming lights during prayers or activating gender-specific privacy settings. Similarly, AI-driven urban designs might include prayer-friendly public spaces with automated adhan (call to prayer) systems, ensuring inclusivity and ease of access for elderly Muslims.

Global Collaboration for Inclusive AI

The growth of the global Muslim population necessitates collaborative efforts in AI development to ensure inclusivity. Cross-cultural AI systems could incorporate diverse Islamic practices, catering to regional differences in Quranic recitations or religious observances. Furthermore, global data-sharing initiatives could create more representative datasets, ensuring that AI technologies address the varied needs of elderly Muslims worldwide effectively and equitably.

Conclusion

The integration of AI into elderly care presents a transformative opportunity to enhance the well-being of Muslim elderly individuals in Malaysia. This chapter has explored various facets of AI-driven solutions, from personalised healthcare and cognitive support to mobility, safety, and social engagement, all tailored to meet the unique cultural and religious needs of the elderly. AI technologies such as DoctorOnCall and Muslim Pro experiences have

demonstrated significant benefits in improving the quality of life for the elderly, enabling them to maintain their health, independence, and spiritual practices. These innovations not only address the practical challenges of ageing but also ensure that the elderly remain active, engaged, and connected to their communities. By offering solutions that are both technologically advanced and culturally sensitive, AI can help bridge the gap between modern healthcare needs and traditional values, fostering a more holistic approach to elderly care. However, as we embrace these advancements, it is crucial to navigate the ethical considerations associated with AI deployment. Issues such as privacy, informed consent, cultural sensitivity, and the potential for bias must be carefully managed to ensure that AI solutions are both effective and respectful of the values and autonomy of the elderly. By addressing these ethical concerns, we can create AI systems that not only meet the immediate needs of the elderly but also contribute to their long-term well-being in a manner that is dignified and inclusive. The case studies and success stories highlighted in this chapter illustrate the tangible benefits of AI in elderly care, providing a roadmap for future innovations that can further enhance the lives of the elderly. As Malaysia's population continues to age, the role of AI in elderly care will become increasingly important, offering new ways to support the health, safety, and spiritual fulfilment of Muslim elderly individuals. In conclusion, the integration of AI into elderly care represents a significant step forward in addressing the challenges of ageing within the Muslim community in Malaysia. By combining technological innovation with cultural sensitivity, AI has the potential to not only improve the quality of life for the elderly but also to enrich their spiritual and social lives, ensuring that they continue to thrive in their golden years.

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Chapter 8

Leveraging Artificial Intelligence for Growth in Muslim Startups: A *Hikmah*-Centred Approach

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Abstract

As a Muslim startup venture, artificial intelligence (AI) presents a valuable asset for growth. In the early stages, AI proves instrumental in conducting market research, analysing customer behaviour, and facilitating content creation and marketing automation. By leveraging AI to scrutinise social media discussions, customer feedback, and market trends, startups can gain insights into target demographics and refine their offerings, all at a reduced cost compared to conventional methods. Furthermore, AI tools streamline tasks such as scheduling social media posts, crafting basic content, and managing email campaigns, thereby optimising resource allocation toward core business functions. As the startup advances into the growth stage, AI assumes a pivotal role in automating tasks, tailoring marketing and sales efforts, and informing data-driven decision-making. This enables startups to efficiently scale operations, manage increased customer interactions, and enhance overall business strategies. This chapter highlights the importance of employing AI with wisdom (*hikmah*) within the startup landscape. It delves into the ethical and Islamic-guided utilisation of AI tools and products, emphasising their societal benefits, promotion of positive change, and alignment with Islamic principles. As the AI landscape and business environment constantly evolve, continuous learning, adaptation, and responsible use are critical for Muslim startups to navigate this dynamic space successfully.

Keywords: startup, AI marketing tools, business automation

Introduction

The digital landscape is a dynamic ecosystem where innovation reigns supreme. Artificial intelligence (AI) presents a powerful toolkit for Muslim startups seeking to scale operations and expand their reach. The startup challenge lies in reaching a wider audience and competing with established brands. By integrating AI-powered solutions, such as personalised recommendations based on consumer behaviour analysis, the platform can enhance customer experience and drive sales growth. Additionally, leveraging AI for targeted marketing campaigns and predictive analytics allows the platform to identify trends and adapt product offerings, all while aligning with its core values of ethical business practices and environmental consciousness. This strategic use of AI exemplifies how technology can foster financial success while upholding ethical considerations. A "*hikmah*-centred" approach emphasises utilising AI in a way that aligns with Islamic principles of justice, compassion, and responsibility. This entails being mindful of AI's societal impact, maintaining data transparency, and ensuring fairness in decision-making algorithms. This chapter explores a "*hikmah*-centred" approach, emphasising wisdom and ethical decision-making, to harness AI's potential for impactful and sustainable growth. By providing a roadmap for leveraging technology ethically and strategically, this chapter empowers Muslim startups to achieve impactful and sustainable growth that resonates with their values and beliefs.

AI in Early-Stage Startups

Traditional market research can be cumbersome and expensive. However, AI offers a revolutionary approach for startups. AI analyses vast amounts of data from social media conversations, customer reviews, and market trends to glean invaluable insights into target audiences. This data-driven approach provides a deeper understanding of customer needs, preferences, and pain points, enabling startups to develop highly targeted marketing campaigns and content that resonate deeply with their audience.

Beyond generating insights, AI empowers startups with automation capabilities. By automating repetitive tasks like social media post scheduling and email marketing management, AI frees up valuable human resources for more strategic endeavours. This allows startups to focus on core business operations while optimising marketing efforts with minimal resource allocation. AI essentially transforms startups into data-driven marketing powerhouses, equipping them with a distinct competitive edge. Through

data-driven strategies and efficient automation, AI fuels customer engagement, strengthens brand loyalty, and ultimately drives sustainable growth.

Boosting Startup Efficiency: How AI Automates Tasks and Fuels Growth

The adoption of AI technology in the startup's initial phase presents a plethora of opportunities for market research, customer behaviour analysis, and content creation. Leveraging AI algorithms, businesses can unlock valuable insights from diverse data sources such as social media conversations, customer reviews, and market trends, revolutionising traditional research methods.

Take Netflix, for instance. They use AI to understand their viewers better. By looking at what people watch, how they rate shows, and their watch history, AI algorithms recommend personalised content for each user. This data-driven approach helps Netflix keep people engaged and subscribed, proving how AI can be a powerful tool to understand customer behaviour and tailor products or services to individual preferences. Proactive implementation of artificial intelligence (AI) offers transformative solutions for market research and marketing strategies. Industry leaders like Netflix demonstrate the substantial advantages of AI in understanding customer behaviour, automating marketing tasks, and driving business growth (Needle, 2021).

AI can also automate marketing tasks, freeing up time for marketers to focus on other things. For example, HubSpot, a popular marketing platform, uses AI to send automated email campaigns, group customers with similar interests, and create personalised content based on how users interact with the platform. This automation saves time and helps marketers target the right people with the right message, which can significantly improve marketing results (Zchut, 2022; Zinck, 2024).

Marketing agency GrowthBar is a great example of how AI can boost results. They used AI tools to schedule social media posts and create content, which led to a 30% increase in finding new customers (lead generation) and a 25% cut in marketing costs. This shows how AI automation can not only improve marketing performance but also free up time for businesses to focus on what they do best (Clark, 2024).

AI-Powered Market Research: Uncovering Regional Consumer Preferences in the ASEAN Market

AI offers a powerful toolkit for regional market research. By analysing social media, reviews, and trends, AI helps businesses understand their target audience. This data-driven approach saves time and money compared to traditional methods and allows businesses to tailor strategies to the specific needs of regional consumers.

Southeast Asian ride-hailing and food delivery leader, Grab, exemplifies the transformative impact of AI on marketing strategies. By leveraging AI-powered algorithms, Grab personalises the customer experience by analysing user preferences and optimising delivery routes. This data-driven approach allows Grab to recommend targeted promotions, enhancing customer engagement and satisfaction, which contributes to sustained business growth in the competitive ASEAN market (Digital News Asia, 2024).

In the diverse and vibrant ASEAN market, cultural nuances play a significant role in shaping consumer behaviour. AI marketing automation tools offer substantial advantages for startups in this region by streamlining marketing operations and incorporating cultural insights. These tools automate repetitive tasks such as social media scheduling, content generation, and email marketing campaigns, enabling startups to focus on culturally relevant and engaging content.

Traveloka, a prominent Indonesian online travel booking platform, exemplifies the effectiveness of AI in this domain. By leveraging AI to personalise email marketing campaigns, Traveloka can target customers with highly relevant offers tailored to their cultural preferences and travel habits. This approach has demonstrably increased conversion rates and fostered customer loyalty, showcasing how understanding local culture can enhance AI's impact (AI, 2020; Hoon, 2024).

Early adoption of AI presents a strategic advantage for businesses globally. AI can transform market research, customer analysis, and marketing strategies by providing deep insights into cultural and regional trends. By harnessing AI tools and prioritising ethical considerations, organisations can achieve a competitive edge, cultivate deeper customer relationships, and drive sustainable growth within the dynamic digital landscape. Integrating AI with a deep understanding of cultural elements enables businesses to tailor their

marketing strategies effectively. This approach not only enhances customer engagement and satisfaction but also fosters loyalty and drives growth, ensuring that businesses remain competitive and relevant in diverse markets like ASEAN.

AI: The Productivity Powerhouse for Boot-Strapped Startups

AI tools are revolutionising the way startups operate by automating repetitive tasks such as scheduling social media posts, generating content, and managing email marketing. This automation allows startups to redirect valuable resources toward essential business operations, fostering growth and innovation.

Social media management is a crucial yet time-consuming task for startups. AI-powered tools like Buffer and Hootsuite automate the scheduling of social media posts across multiple platforms. For instance, Buffer's AI-driven analytics can determine the optimal times to post content for maximum engagement, freeing up time for startups to focus on creating compelling content and interacting with their audience. Hootsuite, on the other hand, uses AI to analyse social media performance and provide insights that help startups refine their social media strategies (Kenny & Aditham, 2024).

Content generation is another area where AI tools have made significant strides. Tools like Jasper (formerly Jarvis) and Copy.ai use natural language processing to generate high-quality content for blogs, social media, and websites. Jasper, for example, helps startups create engaging blog posts, social media updates, and even ad copy within minutes. This not only saves time but also ensures that the content is optimised for SEO, increasing visibility and driving traffic to the startup's website (Baxter, 2024; Clark, 2024).

Email marketing is essential for nurturing leads and maintaining customer relationships, yet it can be highly labour-intensive. AI tools like Mailchimp and HubSpot automate email marketing campaigns, from creating personalised email content to managing subscriber lists and analysing campaign performance. Mailchimp's AI capabilities include predictive analytics that help startups identify the best time to send emails and the type of content that will resonate most with their audience. This level of automation ensures that startups can maintain regular communication with

their customers without the need for a dedicated marketing team (Jepma, 2024).

Canva is a prime example of a company that thrives thanks to AI automation. Their AI-powered tools empower users and democratise graphic design, making it accessible to a wider audience. Canva uses AI to automate various marketing tasks, such as email marketing and social media scheduling. By leveraging AI tools, Canva has been able to scale its marketing efforts efficiently, allowing its team to focus on product development and customer engagement (Miller, 2024).

AI tools are indispensable for startups looking to streamline their operations and focus on growth. By automating tasks like social media scheduling, content generation, and email marketing, startups can allocate resources to more strategic initiatives, driving innovation and competitive advantage. As AI technology continues to evolve, its integration into business processes will undoubtedly become even more integral to the success of startups.

Chatbots with a Conscience: Blending *Shariah* and *hikmah* for Exceptional Customer Journeys

In today's AI age, chatbots are transforming customer interactions. But can they also be a vehicle for upholding Islamic values? To truly enhance customer experience, chatbots must mirror Islamic values. This means building them on a foundation of honesty, fairness, and respect, while strictly adhering to *Shariah* principles. From development to every interaction, chatbots should be a digital reflection of Islamic ethics. By avoiding the promotion of harmful products and services and prioritising halal recommendations, we can create chatbots that not only serve customers but also uphold our faith.

A Muslim startup can significantly benefit from a well-developed chatbot. It should be designed to provide exceptional customer service while upholding Islamic values. By incorporating *Shariah*-compliant principles, the chatbot can address sensitive issues such as finance, lifestyle, and entertainment with tact and precision. It should offer factual information grounded in Islamic teachings, while also serving as an educational tool for ethical decision-making. Moreover, prioritising user privacy and security is paramount to building trust. A chatbot that seamlessly blends Islamic ethics with modern

technology can position a Muslim startup as a reliable and trustworthy brand, attracting a significant customer base that values faith-based principles.

Today's youth rely heavily on chatbots to learn about others' experiences. Chatbots have the power to revolutionise customer satisfaction through these four key areas:

1) Speed and Responsiveness: Chatbots to the Rescue

Chatbots are game changers for customer service. They offer lightning-fast responses 24/7, handling multiple inquiries at once. This means customers get answers instantly, without long waits. And because chatbots can handle routine questions, human agents can focus on more complex issues, improving efficiency and satisfaction across the board (Chen et al., 2021; Ekechi et al., 2024)

2) Personalisation Powerhouse: Chatbots That Know You

Chatbots leverage data and AI to tailor conversations, recommendations, and solutions. They decipher what we mean, not just what we say, offering personalised and engaging experiences (Kaushal, 2023). Chatbots can analyse preferences in real-time, suggesting relevant products, promotions, and even smoothly escalating complex issues to human agents (Zumstein & Hundertmark, 2017). This personalised approach fosters customer satisfaction, loyalty, and conversions, making chatbots a powerful service tool.

3) Global Reach, Local Feel: Multilingual Chatbots

Chatbots break language barriers with AI-powered translations, offering real-time support in multiple languages (Asha et al., 2023). They adapt to cultural nuances, providing personalised experiences worldwide. Handling high volumes of multilingual conversations 24/7, they reduce costs and boost efficiency (Cassidy, 2024). When needed, chatbots seamlessly transfer conversations to human agents while preserving language preferences, ensuring a smooth customer journey.

4) Fostering Trust in Chatbot Development: Ethical Design Principles

Chatbots hold immense potential for revolutionising customer interactions. However, widespread adoption hinges on establishing trust. These key ethical considerations are crucial for developing trustworthy and responsible chatbots (Soufan, 2024):

- **Transparency:** Honesty is paramount. Chatbots should openly disclose their AI nature, managing user expectations and avoiding deception.
- **Data Privacy Champion:** User privacy is non-negotiable. Chatbots should collect only the minimum necessary data with explicit consent, coupled with robust data security protocols.
- **Ensuring Fairness and Bias Mitigation:** Algorithmic bias can lead to unfair outcomes. Implementing rigorous audits of training data and algorithms is crucial to promoting diversity and inclusivity, preventing unintended prejudice.
- **Prioritising User Safety:** Proactive measures safeguard users. Chatbots should utilise content filters to prevent harmful content dissemination, provide easy access to crisis support services, and actively monitor interactions for inappropriate behavior.
- **Informed Consent:** Transparency builds trust. Clearly explain data collection and utilisation purposes, obtaining explicit user consent before proceeding.
- **Accountability for Actions:** Establishing clear lines of accountability for chatbot behavior fosters responsible development. Implementing tools for swift identification and rectification of any errors or harm caused demonstrates a commitment to responsible AI.
- **Human Oversight:** Maintaining ethical behaviour is essential. Integrating human oversight ensures guidance and intervention when necessary. Humans can manage complex situations and unforeseen issues, reassuring users that their best interests are being prioritised.
- **Continuous Learning for Ethical Adaptation:** Ethical considerations are constantly evolving. Frequent monitoring and updates ensure chatbots adapt to emerging concerns and maintain optimal performance.
- **Accessibility for All Users:** Design chatbots with inclusivity in mind. Ensuring accessibility for individuals with disabilities expands the user base and benefits everyone.
- **Cultural Sensitivity:** Understanding cultural nuances is critical. Chatbots should be programmed to identify and respond appropriately to cultural subtleties, like language, communication styles, and societal norms, to avoid misunderstandings or offences.

By prioritising these ethical principles, organisations foster trust and broader acceptance of chatbots. Ultimately, this fosters a more positive and responsible user experience, paving the way for a future where chatbots become valuable and trusted companions for customers.

AI chatbots can significantly enhance customer loyalty in Islamic markets by aligning with cultural and religious values. Adhering to Islamic principles, understanding cultural nuances, and providing personalised services while respecting privacy are crucial. Additionally, offering support for halal products, prayer timings, and Islamic finance, coupled with educational content on Islamic values, can foster deeper connections with customers. Continuously improving chatbots based on customer feedback further strengthens loyalty and demonstrates a commitment to meeting the unique needs of the Islamic market.

Ethical AI: A Muslim Startup's Compass

The AI landscape is rapidly expanding, and Muslim startups are uniquely positioned to contribute. However, with this potential comes the imperative to develop AI ethically. This section delves into the intersection of AI and Islamic values, providing guidance for Muslim entrepreneurs to harness AI's power responsibly.

One core principle guiding Islamic AI development is the concept of *Maqasid al-Shariah*. This refers to the higher objectives of Islamic law, which aim to preserve human well-being through the protection of five essentials: faith (*din*), life (*nafs*), lineage (*nasl*), intellect (*aql*), and property (*mal*). This aligns with the potential of AI to solve problems and improve lives. AI development that upholds these objectives can be considered ethical.

As there are so many ethical questions arising from AI, *Shariah* scholars, AI experts, and entrepreneurs need to discuss and address issues in harmony and develop practical guidelines for ethical AI development within the Muslim startup ecosystem.

Looking from the ethical perspective, we take IBM as the mainstream example. IBM's approach to AI governance emphasises trust, accountability, and alignment with human values. The establishment of internal structures like the Cognitive Ethics Board and collaborations with multidisciplinary experts underscores IBM's commitment to developing AI responsibly. This includes ensuring algorithmic accountability, respecting privacy, and complying with existing policies while promoting inclusiveness and fairness. Their preference for "augmented intelligence" reflects a human-centric philosophy, focusing on enhancing human capabilities rather than replacing

them, fostering societal benefits, and mitigating risks associated with automation.

IBM also highlights the role of regulations in guiding ethical AI use, advocating for a balanced approach that safeguards individuals without stifling innovation. Initiatives such as the EU's General Data Protection Regulation and partnerships on AI ethics demonstrate their proactive stance in policy engagement. IBM's efforts aim to ensure that AI systems operate transparently, inclusively, and safely, aligning with ethical principles to maximise societal benefits while minimising harm. This dual focus on internal governance and external collaboration establishes a robust foundation for ethical AI development and deployment (Rossi, 2016) .

Early Stage: Market Research

AI can transform market research by analysing large datasets to uncover trends, consumer preferences, and market gaps. Muslim startups can leverage AI tools to gather valuable insights while ensuring that data collection respects privacy and confidentiality, aligning with Islamic values. Islam emphasises the importance of safeguarding personal data, as it is part of the right to privacy. This principle is supported by Surah Al-Hujurat, verse 12, and Surah An-Nur, verse 27. Therefore, protecting all forms of personal data, including structured, unstructured, geographic, time-series, event, network, and linked data, is not only crucial but also consistent with Islamic teachings.

Early Stage: Customer Behaviour Analysis

Understanding customer behaviour is crucial for any startup. AI can help Muslim startups gain insights into customer behaviour while adhering to Islamic values. AI tools can collect and analyse data in a clear and transparent manner, ensuring ethical business practices. Clear AI uses straightforward algorithms to accurately understand customer needs, while transparent AI openly shares how data is collected and used, building trust with customers. These insights should enhance customer experiences without exploiting personal data, maintaining fairness and transparency.

For Muslim startups, this approach ensures honesty, ethical conduct, and consideration of public interest, aligning with *Shariah* guidelines. This aligns with Surah Al-Baqarah, verses 42 and 282, which emphasise honesty and transparency. By being clear and transparent, startups can document their

actions and meet ethical and legal standards, supporting the well-being of individuals and communities. This approach is in line with Islamic principles and promotes a fair and ethical society.

Early Stage: Content Creation & Marketing Automation

AI-powered tools can streamline content creation and marketing campaigns, making them more efficient and targeted. Startups can leverage AI to generate relevant content and distribute it effectively. Ensuring that the content is truthful, respectful, and not deceptive is crucial to align with Islamic ethical principles. As stated in Surah Al-Anfal, verse 27: "O ye that believe! Betray not the trust of God and the Apostle nor misappropriate knowingly things entrusted to you," and in the Hadith narrated by Abu Hurairah, Book 7, Hadith No. 134: "Place trust in him who trusts you, but do not cheat him who cheats you." These references highlight the importance of *amanah* (trustworthiness) and honesty, which should be practised by Muslims.

Growth Stage: Task Automation

As startups grow, automating repetitive tasks can significantly boost efficiency. AI can handle customer support, inventory management, and financial reporting, but it's crucial to ensure automation doesn't lead to job losses that could harm the community, aligning with *Maqasid* Syariah's principle of preventing harm to support the maslahah.

Growth Stage: Personalised Marketing

AI enables highly personalised marketing by analysing individual customer data to deliver tailored messages and offers. While personalisation can enhance customer satisfaction, it's important to balance this with privacy concerns and avoid manipulative practices, ensuring marketing efforts are ethical and transparent.

Growth Stage: Data-Driven Decisions

AI assists startups in making data-driven decisions by providing insights and predictions based on vast amounts of data. Decisions should consider fairness and avoid biases that could result in unequal treatment of customers or employees, aligning with the Islamic principle of justice. According to a hadith from *at-Tarmizi*, practising *taqwa* (piety) and treating people with respect are essential. This guides businesses to develop knowledge and promote ethical values among all stakeholders, including employees, clients,

and suppliers. Compliance with rules, regulations, and industry best practices is also crucial.

Leveraging AI in a data-driven decision-making context can uphold these principles. By using AI ethically and responsibly, startups can ensure transparent and fair decision-making. AI helps identify best practices, ensure compliance, and promote ethical behavior, respecting and treating stakeholders with integrity. This approach enhances business operations and aligns with Islamic principles, fostering a trustworthy and respectful business environment.

Ethical Considerations

Muslim startups have a unique opportunity to leverage AI while adhering to Islamic ethical principles, particularly the concept of *Maqasid al-Shariah*, which seeks to protect faith, life, lineage, intellect, and property. AI is crucial across six total stages: three in the early stages and three in the growth stages. During the early stages, AI can significantly enhance market research, customer behaviour analysis, and content creation, allowing for increased efficiency and the acquisition of valuable insights while maintaining data privacy and transparency, as mandated by Islamic teachings. As these startups progress to the growth stage, the ethical application of AI facilitates task automation, personalised marketing, and data-driven decision-making without compromising fairness or causing harm to the community. It is crucial for *Shariah* scholars, AI experts, and entrepreneurs to collaborate in developing guidelines for ethical AI, ensuring that its use promotes honesty, trust, and respect in business practices, in alignment with the principles of *Maqasid al-Shariah*.

In conclusion, as the ethical landscape of AI evolves, Muslim startups must commit to ongoing learning and adaptation, regularly training employees, conducting ethical audits, and participating in AI ethics discussions. As Sunan Ibn Majah states, "Seeking knowledge is an obligation upon every Muslim". AI should be used to promote societal benefits like improved service access, enhanced quality of life, and economic growth, avoiding applications that cause harm or inequality. Muslim startups can harness AI's power responsibly and ethically.

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Chapter 9

Enhancing Cyber Resilience Through the *Hikmah* of Artificial Intelligence

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Abstract:
In an increasingly digital world, cyber threats present critical risks to organisations, governments, and individuals. Existing cybersecurity systems often prioritise technical efficiency over ethical considerations, resulting in challenges related to transparency, accountability, and fairness in combating these threats. This study introduces a *hikmah*-guided artificial intelligence (AI) approach, integrating ethical wisdom into AI-driven cybersecurity systems. By aligning AI capabilities with ethical principles, the approach aims to enhance cyber resilience while ensuring ethical accountability. The research identifies key challenges in modern cybersecurity and demonstrates how AI functionalities such as threat detection, adaptive controls, and predictive analytics can be optimised through the integration of *hikmah*. Findings indicate that this approach not only strengthens technical resilience but also fosters ethical values, including transparency, accountability, and fairness, within cybersecurity frameworks. The study concludes that a *hikmah*-driven AI framework provides a robust solution for addressing modern cyber threats. By promoting responsible and value-centred development of AI in cybersecurity, this approach ensures the safeguarding of digital infrastructures in a manner that upholds ethical standards.

Keyword: Cyber Resilience, AI, *Hikmah*, Human Value, Risk

Introduction

Cyber resilience has become a critical aspect of security in the digital age due to the escalating sophistication and frequency of cyber threats (Linkov & Kott, 2019).To effectively counter these risks, integrating Artificial Intelligence (AI) into cybersecurity strategies is essential. AI's capabilities in threat detection, predictive analytics, and adaptive security controls have the potential to revolutionise traditional cybersecurity measures, creating more resilient defence mechanisms (Adewale Daniel Sontan & Segun Victor Samuel, 2024a). By leveraging AI's capabilities, organisations can enhance their ability to detect and mitigate cyber threats while upholding ethical standards of transparency and fairness (Sarker et al., 2021). This holistic approach, guided by the capabilities of AI, promises to safeguard digital infrastructure and ensure a secure future in an interconnected world.

Core Components of Cyber Resilience

Definition and Importance

Cyber resilience is a fundamental component of modern cybersecurity strategies, encompassing an organisation's capacity to sustain operational continuity despite adverse cyber events. It surpasses traditional cybersecurity measures by including effective incident response and recovery capabilities (Al-Hawamleh, 2024a). Given the escalating cyber threats and the interconnected nature of digital environments, cyber resilience is indispensable for ensuring operational continuity, safeguarding sensitive data, and upholding stakeholder trust (Al-Hawamleh, 2024). Cyber resilience entails preparing for, responding to, and recovering from a wide array of cyber threats, surpassing conventional security measures (Al-Hawamleh, 2024). Unlike traditional cybersecurity, the primary objective of cyber resilience is to maintain an organisation as a "safe-to-fail" system, capable of preserving business operations even in the presence of unforeseen and unknown adversities (Carias et al., 2020). This resilience is critical for organisations to continue achieving their desired outcomes despite cyber disruptions (Munusamy & Khodadi, 2023). To bolster cyber resilience, organisations must invest in diverse cyber resilience policies covering various domains, reflecting the complexity of establishing resilience in the digital era (Carías et al., 2019). Additionally, fostering a cyber-secure culture within organisations, characterised by a dedication to cybersecurity and regular awareness programs, is deemed essential for fortifying cyber resilience, particularly in small and medium-sized enterprises (SMEs) (Lucky Bamidele Benjamin et al., 2024). Moreover, cyber resilience is not solely

about recovery but also about adapting to adverse events, including catastrophic cyberattacks (Godbole et al., 2022). It involves maintaining an acceptable level of performance in the presence of faults, disruptions, or adversarial actions, underscoring the significance of being able to absorb and overcome successful cyberattacks while preserving core functions (Garcia-Perez et al., 2023; Carter et al., 2019). In conclusion, cyber resilience is a multifaceted concept that plays a pivotal role in modern cybersecurity strategies. By encompassing prevention, detection, response, and recovery from cyber threats, organisations can ensure operational continuity, data protection, and stakeholder trust in today's interconnected digital landscape.

Challenges in Achieving Cyber Resilience

Achieving cyber resilience in the face of evolving cyber threats poses significant challenges for organisations. The landscape of cyber threats is continuously advancing, with adversaries employing sophisticated techniques such as advanced persistent threats (APTs), ransomware, and zero-day exploits (Kott & Linkov, 2021).Traditional cybersecurity measures often struggle to effectively counter these evolving attack vectors. Specific challenges faced by organisations include maintaining up-to-date defences, securing remote work environments, and integrating new technologies without introducing vulnerabilities (Bhusal et al., 2020). One critical aspect in addressing these challenges is the shortage of skilled cybersecurity professionals, which exacerbates the difficulty for organisations to stay ahead of threats (Bhusal et al., 2020). To enhance cyber resilience, a multifaceted approach is necessary, leveraging advanced technologies and strategic planning (AL-Hawamleh, 2024b). This approach involves developing resilience metrics, evaluation methods, and cyber resilience investment strategies to compare planning and operation alternatives, justify resilience enhancement, and navigate the complex process of building cyber resilience (Arghandeh et al., 2016).

Cyber resilience is not solely about resisting cyberattacks but also about accepting cyber compromise as a likely event and focusing on the system's ability to recover and adapt (Sahoo et al., 2021). Resilience-oriented control strategies are crucial for maintaining acceptable performance under any circumstances, even in the presence of extreme events and cyber-attacks (Sadabadi et al., 2021a); (Sadabadi et al., 2021b). Resilient synchronisation strategies and distributed control mechanisms play a vital role in ensuring system stability and continuity in the face of cyber threats (Belaid et al.,

2021). Furthermore, building a cyber-secure culture within organisations is identified as crucial for enhancing cyber resilience. The resilience of critical infrastructures, such as power systems and smart grids, is essential for protecting vital systems from cyberattacks and ensuring continued performance (Nguyen et al., 2020). Resilience moves beyond traditional risk assessment to deal with unexpected events, requiring mitigation and healing strategies.

In conclusion, addressing the challenges of achieving cyber resilience requires a comprehensive approach that encompasses technological advancements, strategic planning, resilience metrics, and the development of a cyber-secure culture within organisations. By leveraging these strategies and focusing on system recovery, adaptation, and stability, organisations can enhance their overall cyber resilience in the face of evolving cyber threats.

Introduction to the Concept of *Hikmah* and Its Relevance to AI

Hikmah, in definition, is an Arabic term that translates to "wisdom" or "sound judgment." In Islamic thought, *hikmah* refers to a deep, holistic understanding that contains knowledge, insight, and practical application aligned with moral and spiritual values. It is often linked to the ability to determine the most appropriate course of action in each situation, coordinating reason, ethical principles, and divine guidance. *Hikmah* consists of several aspects including spiritual insight, moral judgement, practical knowledge and purposeful action. It is often referring to the application of ethical judgment in decision-making. In the noble Quran Allah mentioned (*Al-Baqarah* 2:269),

"He gives wisdom to whom He wills, and whoever has been given wisdom has certainly been given much good."

In the context of AI-driven cybersecurity, *hikmah* emphasises ethical standards and accountability, guiding AI systems to uphold fairness, transparency, and respect for user privacy to enhance cyber resilience.

The integration of ethical principles, such as *hikmah*, into AI systems is crucial for ensuring transparency, accountability, and fairness in AI-driven cybersecurity solutions (Vinuesa et al., 2020). This integration not only enhances technical capabilities like advanced threat detection and predictive analytics but also upholds ethical standards that prioritise human values and

fairness (Adewale Daniel Sontan & Segun Victor Samuel, 2024b). Embracing *hikmah* in AI promotes a secure and equitable digital environment for all stakeholders, contributing to a more secure and fair digital landscape (Kaur et al., 2023). Explainable AI is essential in the realm of AI and cybersecurity to ensure transparency, accountability, and ethical standards (Hoenig et al., 2024a). It plays a vital role in addressing issues in Cyber-Physical Systems, enhancing the reliability and trustworthiness of AI-driven cybersecurity solutions (Capuano et al., 2022a). The fusion of AI with cybersecurity represents a paradigm shift in safeguarding digital assets against a dynamic threat landscape, emphasising the importance of aligning technical capabilities with ethical considerations (Adewale Daniel Sontan & Segun Victor Samuel, 2024c). In summary, the incorporation of *hikmah* into AI in cybersecurity is essential for ensuring that AI systems are technically proficient and ethically sound, promoting trust, reliability, and resilience in AI-driven cybersecurity solutions.

AI in Cybersecurity

Role of AI in Cyber Resilience

In the realm of cybersecurity, AI is a transformative technology that enhances cyber resilience by complementing traditional cybersecurity methods. AI's analytical capabilities enable it to process extensive datasets swiftly, identifying patterns and anomalies that may indicate potential threats (Sarker et al., 2021). This agility in data processing leads to improved speed and accuracy in threat detection, allowing organisations to prevent incidents before they escalate (Onih et al., 2024a). Additionally, AI's predictive analytics can anticipate upcoming cyber threats, providing proactive measures to mitigate risks (Shaukat et al., 2020). Through the integration of AI-driven adaptive security controls, organisations can adjust defence mechanisms dynamically in real-time, ensuring robust security as cyber threats evolve (Onih et al., 2024b). The use of AI in cybersecurity not only strengthens existing defences but also introduces agility and foresight crucial for maintaining cyber resilience in the face of a complex threat landscape (Sarker, 2022a). AI's role in cybersecurity is pivotal, representing a paradigm shift in how cyber threats are addressed and mitigated (Adewale Daniel Sontan & Segun Victor Samuel, 2024d). The application of AI in threat detection and response within cybersecurity infrastructures has been instrumental in enhancing security measures (Onih et al., 2024b). Furthermore, AI's ability to automate intelligent systems aligns with the current demand for smart and automated solutions (Sarker, 2022b). The

convergence of AI and cybersecurity highlights the need for a well-trained cybersecurity and AI workforce to protect data, networks, and systems from cyberattacks (Burrell & Mcandrew, 2023). As organisations in various sectors increasingly depend on interconnected digital systems, safeguarding national infrastructure from cyber threats becomes a critical priority (Abimbola Oluwatoyin Adegbite et al., 2023a). To effectively navigate the evolving cyber threat landscape, experts recommend integrating AI, Big Data analytics, and continuous risk assessment methodologies (Adedoyin Tolulope Oyewole et al., 2024). In a nutshell, the synergy between AI and cybersecurity provides a robust defence against cyber threats, offering improved threat detection, rapid response capabilities, and proactive risk mitigation strategies. By leveraging AI's analytical capabilities and adaptive security controls, organisations can enhance their cyber resilience and stay ahead in the ever-changing cybersecurity landscape.

AI Technologies for Cybersecurity

To enhance cyber resilience, AI plays a pivotal role by leveraging various technologies tailored to different aspects of cybersecurity. Key areas where AI significantly contributes include threat detection, predictive analytics, incident response, and adaptive security controls. Threat detection is bolstered by AI's ability to analyse network traffic and system behaviour to identify unusual patterns indicative of cyberattacks. Machine learning algorithms further enhance this capability by continuously learning from new data, thereby improving detection accuracy over time (Sarker et al., 2021). Predictive analytics, another crucial aspect, allows organisations to forecast potential threats and vulnerabilities by leveraging historical data. This proactive approach enables pre-emptive security measures to address weaknesses, thereby reducing the likelihood of successful cyberattacks (Sarker, 2022b). In incident response, AI streamlines processes by automating routine tasks and providing real-time insights during an attack. This automation not only accelerates response times but also alleviates the workload on human analysts, enabling them to focus on more complex tasks (Hamon et al., 2024). Additionally, AI's adaptive security controls dynamically adjust security settings and policies based on the evolving threat landscape. By continuously monitoring and responding to changes, AI ensures that security measures remain effective against emerging threats (Taddeo et al., 2019a). The integration of AI into cybersecurity represents a paradigm shift towards more resilient digital infrastructures (Kour et al., 2020). As organisations embrace AI-driven security solutions, they are poised to

enhance their resilience against evolving cyber threats and safeguard their digital assets with unprecedented efficacy and efficiency (Larriva-Novo et al., 2020). In conclusion, AI's role in bolstering cyber resilience through threat detection, predictive analytics, incident response, and adaptive security controls is instrumental in fortifying organisations against the ever-evolving landscape of cyber threats.

Introduction to the Concept of *Hikmah* and Its Relevance to AI

The concept of wisdom, or *hikmah*, is essential in guiding the ethical and effective utilisation of AI in cybersecurity. *Hikmah* emphasises ethical judgment, transparency, and accountability in decision-making processes related to AI-driven cybersecurity solutions. By incorporating *hikmah* principles, AI systems in cybersecurity can be developed to be transparent, accountable, and fair to all stakeholders. This approach ensures that AI technologies not only enhance security measures but also uphold human values and ethical standards, fostering a cyber-resilient environment that safeguards digital infrastructure while maintaining public trust and confidence. The ethical framework proposed by emphasises five ethical principles—beneficence, nonmaleficence, justice, autonomy, and explicability—in guiding the development and adoption of AI (Floridi et al., 2018). These principles align closely with the values promoted by *hikmah*, ensuring that AI systems in cybersecurity are designed to enhance human lives, avoid harm, promote fairness, respect autonomy, and maintain transparency and accountability. Moreover, the structured approach to cybersecurity ethics outlined by allows for the systematic identification of ethical conflicts while preserving the flexibility needed for context-sensitive ethical judgments (Formosa et al., 2021a). This structured approach resonates with the balanced perspective advocated by *hikmah*, which seeks to harmonise technological advancements with ethical imperatives. Incorporating *hikmah* into AI-driven cybersecurity solutions also addresses the ethical considerations highlighted by, such as the need for technologies to enhance human lives, avoid harm, improve fairness, respect autonomy, and ensure explicability (Sadeghi et al., 2023). By aligning with these ethical priorities, AI systems can be developed to prioritise ethical decision-making processes that uphold the values of *hikmah*. Additionally, the integration of explainable artificial intelligence (XAI) with cyber-physical systems can further enhance control, fairness, accountability, safety, cyber-resilience, and cybersecurity in AI applications (Hoenig et al., 2024b). This integration ensures that AI systems are not only effective but also transparent and

accountable, in line with the principles of *hikmah*. By infusing *hikmah* principles into the development and deployment of AI in cybersecurity, organisations can create a secure and equitable digital future. This approach ensures that AI technologies not only bolster security measures but also adhere to ethical standards, promoting transparency, accountability, and fairness in decision-making processes.

Hikmah of AI in Cybersecurity

Concept of Hikmah

In the realm of AI and cybersecurity, the integration of ethical principles and wisdom, known as *hikmah*, is crucial for ensuring the responsible and thoughtful deployment of AI technologies. By incorporating *hikmah* into AI in cybersecurity, the focus shifts towards enhancing security measures, upholding ethical standards, and human values, fostering trust and reliability among users and stakeholders. Ethical considerations surrounding AI in cybersecurity are paramount, especially in decision-making processes impacting individuals' rights and freedoms (Adewale Daniel Sontan & Segun Victor Samuel, 2024d). Trusting artificial intelligence in cybersecurity is described as a complex issue, emphasising the need for caution and thorough consideration of AI implications (Taddeo et al., 2019b).The deployment of AI in cybersecurity necessitates strategic resource allocation, professional training, and a comprehensive assessment of ethical implications to ensure effectiveness (Onih et al., 2024c). To address challenges posed by the rapid evolution of AI and its impact on cybersecurity, a balanced approach is essential (Shahana et al., 2024a). This approach involves leveraging popular AI techniques like machine learning, deep learning, natural language processing, and expert systems modelling to intelligently address cybersecurity issues (Shahana et al., 2024b). Additionally, the deployment of AI in cybersecurity must consider potential risks and challenges posed by new technologies like Generative AI (GAI) (Wang, 2024). The integration of *hikmah* with AI in cybersecurity emphasises ethical decision-making, transparency, and accountability in developing and implementing AI systems. By embracing *hikmah* principles, AI technologies can be responsibly utilised to enhance security measures while upholding ethical standards and human values in the cybersecurity domain.

Applications of Hikmah in AI-Driven Cybersecurity

The incorporation of ethical considerations and societal implications into AI-driven cybersecurity, through the integration of *hikmah* or wisdom, can

significantly enhance decision-making processes. By infusing *hikmah* into AI systems, organisations can improve transparency, accountability, and fairness within their cybersecurity frameworks (Taddeo & Floridi, 2018). This approach extends beyond traditional data-centric methods to include ethical dimensions, ensuring that decisions align with human values and principles of social justice (Formosa et al., 2021b). Transparent AI systems, which offer clear explanations for their decisions, can cultivate trust among users. Accountability mechanisms further ensure that responsible parties can be identified and held liable for the outcomes of AI-driven actions (Janssen et al., 2020). Additionally, fairness in AI systems guarantees that cybersecurity measures are applied equitably across all users (Formosa et al., 2021b). These principles are essential for constructing robust and ethically sound cybersecurity frameworks that effectively protect digital infrastructures while upholding ethical standards and societal values (Taddeo & Floridi, 2018). By integrating *hikmah* into AI-driven cybersecurity, organisations can develop systems capable of real-time detection of cyber threats and make informed and ethical decisions in response to these threats (Drydakis, 2022). This strategy enhances the proactive capabilities of cybersecurity teams by leveraging big data analytics to anticipate potential threats before they materialise, thereby bolstering overall security (Shahana et al., 2024b). Furthermore, the incorporation of *hikmah* can help address ethical and regulatory considerations related to AI in governance, risk, and compliance (GRC) processes, ensuring that decision-making aligns with ethical standards and legal requirements (Benita Urhobo, 2024). In conclusion, the integration of *hikmah* into AI-driven cybersecurity signifies a transformative shift in how organisations approach cybersecurity decision-making. By infusing wisdom into AI systems, organisations can enhance transparency, accountability, and fairness, leading to the creation of more resilient and ethically sound cybersecurity frameworks that safeguard digital infrastructures while respecting human values and promoting social justice.

Ethical and Responsible AI in Cybersecurity

Ethical Considerations

Incorporating ethical considerations into AI-driven cybersecurity practices is crucial for ensuring fairness, transparency, and accountability in the technology's applications. Transparency in AI decision-making is essential as it allows stakeholders to understand how AI systems reach specific conclusions or actions, fostering trust and enabling verification of the accuracy and fairness of AI decisions (Lepri et al., 2018). Accountability

ensures clear lines of responsibility for AI-driven solutions, enabling the identification of entities responsible for outcomes when AI systems make decisions (Lepri et al., 2018). Fairness in AI algorithms is vital to prevent disproportionate impacts on any group, ensuring impartiality and equitable treatment for all users (Lepri et al., 2018). Ethical considerations are central to cybersecurity practices, with every solution needing to be designed ethically to safeguard individuals and their rights (Pawlicka et al., 2021). The intersection of artificial intelligence and cybersecurity raises concerns about automated decision-making, emphasising the need to address the potential ethical implications of AI in cybersecurity, particularly in autonomous threat detection and response (Adewale Daniel Sontan & Segun Victor Samuel, 2024b).

The application of AI in cybersecurity encompasses various innovative practices such as threat detection, response strategies, and predictive analytics, highlighting the diverse ways AI is transforming cybersecurity operations (Shahana et al., 2024c). Moreover, explainable artificial intelligence (XAI) plays a crucial role in cybersecurity, emphasising the importance of structured data collection to evaluate AI transparency and its implications for cybersecurity practices (Onih et al., 2024a). XAI aids in understanding how AI systems arrive at decisions, contributing to transparency and accountability in AI-driven cybersecurity solutions (Capuano et al., 2022b). Additionally, the deployment of XAI tools in cybersecurity operations settings underscores the significance of automation in maintaining cyber defences effectively (Nyre-Yu et al., 2022). Overall, ethical considerations, transparency, accountability, and fairness are fundamental pillars that must underpin AI-driven cybersecurity practices to ensure that the technology benefits all stakeholders equitably and transparently. By integrating these principles into the development and deployment of AI systems in cybersecurity, organisations can enhance trust, mitigate biases, and promote responsible and ethical use of AI technologies in safeguarding digital infrastructures.

Challenges and Mitigation Strategies

Addressing biases in AI and ensuring ethical AI in cybersecurity are critical challenges in the development and deployment of AI systems. Biases can arise from various sources, including biased data used for training and inherent algorithmic design flaws (Bishnu, 2024). Mitigating biases requires a comprehensive approach involving diverse and representative datasets,

rigorous testing, and continuous monitoring to detect and rectify biased outcomes (Jobin et al., 2019). Ethical guidelines and standards play a crucial role in the responsible use of AI in cybersecurity, emphasising human oversight, privacy protection, and alignment with societal values (Ho et al., 2019).To achieve trustworthy AI in healthcare, transparency in algorithm development and testing is vital to identify and address biases that could lead to harm (Nadarzynski et al., 2019). The ethical imperative in AI extends to various sectors, with biased algorithms perpetuating discrimination in areas like hiring, lending, and criminal justice (Yang et al., 2023). Ensuring fairness in AI systems involves mitigating biases and discrimination across different demographic groups (Jobin et al., 2019). Trustworthy AI in healthcare necessitates reliability, safety, transparency, and adherence to ethical principles (Babajide Tolulope Familoni, 2024). Protecting personal privacy is a critical ethical concern as AI becomes more prevalent, highlighting the need for responsible AI deployment (Fehr et al., 2024). Ethical considerations in AI-enhanced medical decision support systems underscore the continuous refinement of ethical guidelines to tackle emerging challenges (Quinn & Thompson, 2024). Ethical deployment of AI in various domains, including conservation, requires data practices that respect privacy, adhere to ethical standards, and avoid harmful biases. By implementing comprehensive mitigation strategies, organisations can develop AI-driven cybersecurity solutions that are effective, ethical, and contribute to a more secure digital environment.

Discussion

Integration of AI and Hikmah in Cybersecurity Practices

The integration of AI with the concept of *hikmah*, encompassing wisdom and ethical judgment, into cybersecurity practices necessitates a meticulous and strategic approach. One crucial strategy involves developing transparent AI systems that enable stakeholders to comprehend decision-making processes, ensuring fairness and equity. This transparency can be achieved through the incorporation of explainable AI (XAI) techniques, providing clear insights into AI-driven decisions (Capuano et al., 2022b). Furthermore, embedding ethical guidelines into AI development is essential, emphasising principles such as fairness, accountability, and user privacy. Continuous monitoring and evaluation processes are vital to ensuring that AI systems remain aligned with ethical standards as they evolve (Sadeghi et al., 2023). The fusion of AI and *hikmah* offers benefits such as improved threat detection, adaptive security controls, and enhanced user trust, but it also presents challenges.

These challenges include addressing biases in AI algorithms, managing the complexity of ethical decision-making, and ensuring resilience against adversarial attacks (Hamon et al., 2024). Overcoming these hurdles requires interdisciplinary collaboration involving ethics, AI research, and cybersecurity (Adewale Daniel Sontan & Segun Victor Samuel, 2024c). Ethical considerations play a significant role in AI integration across various domains. It is crucial to use AI for the common good, avoid harm, respect values like fairness and privacy, and uphold accountability (Albahri & AlAmoodi, 2023). The ethical implications of AI deployment in healthcare, education, business, and other sectors underscore the need for responsible AI practices and adherence to ethical standards (Babajide Tolulope Familoni, 2024). As AI continues to evolve and permeate different aspects of society, addressing ethical dilemmas, ensuring transparency, fairness, and accountability in AI development and deployment becomes increasingly crucial. The synergy between AI and *hikmah* in cybersecurity demands a meticulous approach that prioritises transparency, ethical guidelines, and continuous monitoring. By addressing ethical challenges, promoting fairness, and fostering interdisciplinary collaboration, the integration of AI and *hikmah* can lead to enhanced cybersecurity practices that align with ethical standards.

Future Research Directions

The integration of artificial intelligence (AI) in cybersecurity holds significant promise for enhancing security measures, but to fully leverage this potential, it is crucial to address key research gaps. One critical area highlighted by (Quinn & Thompson, 2024), is a necessity for robust frameworks for ethical AI in cybersecurity. These frameworks are essential to establish standardised guidelines and best practices that ensure AI applications in cybersecurity adhere to ethical standards and human values.

Neupane et al. (2022) emphasises the importance of developing advanced techniques to detect and mitigate biases in AI algorithms, as biases can compromise the fairness and effectiveness of cybersecurity measures. Additionally, Shahana et al. (2024d) point out the value of investigating the intersection of AI and human-computer interaction to optimise user experiences with AI-driven security systems.

Moreover, Abimbola Oluwatoyin Adegbite et al. (2023b) suggests that exploring the application of AI in addressing emerging cybersecurity

challenges, such as securing the Internet of Things (IoT) and critical infrastructure, is a promising area of research. By identifying and addressing these research gaps, scholars and practitioners can drive innovation in cybersecurity, ensuring that the integration of AI enhances technical defenses while upholding ethical standards and human values.

Conclusion

As cyber threats grow increasingly complex and pervasive, traditional cybersecurity measures alone are insufficient to safeguard critical digital infrastructures. AI presents a powerful tool to address these evolving threats, with capabilities in predictive analytics, threat detection, and adaptive response. However, without an ethical framework, AI's effectiveness in cybersecurity may be undermined by risks related to transparency, accountability, and trust.

The concept of *hikmah* offers a unique approach to AI in cybersecurity, emphasising ethical principles that prioritise fairness, transparency, and societal responsibility. By guiding AI-driven systems with *hikmah*, cybersecurity practices can better balance technical resilience with ethical decision-making. This approach ensures that AI not only strengthens defenses but also aligns with core human values, building trust and reliability in automated security processes. Through the integration of *hikmah*, AI systems are better equipped to make ethically sound decisions, such as prioritising sensitive data protection or making fair judgments in threat response.

Findings suggest that *hikmah*-driven AI contributes to cyber resilience by fostering a security culture rooted in ethical practices. Organisations adopting this approach can enhance both their operational continuity and their commitment to societal trust and transparency. Future research should focus on developing standardised ethical frameworks for implementing *hikmah* in AI cybersecurity, as well as exploring its applications across various industries, including finance, healthcare, and critical infrastructure. This work holds the potential to establish a more secure and ethically responsible digital landscape, ensuring that AI-driven cybersecurity solutions benefit both organisations and the public at large.

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Chapter 10

Advancing Cybersecurity Through Proactive Cyber Threat Intelligence

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Abstract
In the context of *hikmah*, the application of artificial intelligence (AI) can significantly enhance our defence against the increasingly severe and frequent cyberattacks of today. The dynamic, elusive, resilient, and complex nature of new-generation threats makes it challenging for traditional security systems based on heuristics and signatures to keep up. By incorporating AI, organisations can adopt a proactive approach, collecting and disseminating real-time cyber threat information with greater precision and efficiency. Cyber Threat Intelligence (CTI) mining, a rapidly growing field, leverages AI to find, process, and evaluate crucial data regarding cyber risks. However, many businesses still primarily focus on fundamental use cases, such as integrating intrusion prevention systems, security information and event management, and threat data feeds with existing network and firewall systems. This article surveys and investigates various data sources related to CTI mining and explores the potential paths for future research in this area, emphasising the role of AI guided by *hikmah* principles in enhancing cybersecurity. The findings indicate that AI-guided CTI mining, when aligned with *hikmah* principles, can create a more ethically robust cybersecurity framework. Future work should investigate the long-term impacts of such an integration on threat detection and mitigation across various sectors.

Keywords: cybersecurity, threat intelligence, proactive defence, cyber threats

Introduction

The interconnectedness of people, processes, and technology in today's threat landscape highlights the challenges of preventing security breaches and cyberattacks. Cybercriminals have refined their strategies, methods, and procedures (TTPs) to the extent that detecting, investigating, and mitigating these threats has become increasingly difficult. Strong security measures are more crucial than ever as cyberattacks grow in frequency and severity. The dynamic, elusive, resilient, and complex nature of modern attacks renders traditional security systems based on heuristics and signatures inadequate. Organisations are seeking innovative solutions, with real-time cyber threat intelligence (CTI) being a pivotal element. The burgeoning field of CTI mining is essential for identifying, processing, and assessing critical cyber threat information.

This paper aims to demonstrate the role of AI-guided CTI mining in enhancing cybersecurity, examine the application of *hikmah* principles in ethical AI development and explore how proactive intelligence strategies under *hikmah* can improve digital defences. To effectively address emerging challenges, modern businesses must not only anticipate and respond to threats but also stay ahead of them. The limitations of traditional security approaches necessitate a shift to proactive strategies that can either prevent attacks or, at the very least, respond swiftly to minimise damage. Integrating intrusion prevention systems, security information and event management, and threat data feeds with existing network and firewall systems is a priority for many enterprises.

In this context, researchers are exploring how Artificial Intelligence (AI) can enhance cybersecurity. Fraudsters are also leveraging AI to conduct increasingly sophisticated cyberattacks while evading detection. However, by applying AI guided by *hikmah* principles—wisdom, discernment, and ethical consideration—our work focuses on how AI-based cybersecurity solutions can effectively reduce or eliminate data breaches and better protect against attackers.

The term *Hikmah* refers to a principle of wisdom that emphasises ethical discernment and responsible action. In the context of AI-driven cybersecurity, *hikmah* can guide the ethical use of data, prioritising respect for privacy and accountability in cybersecurity practices. Integrating *hikmah* means ensuring that AI algorithms in cybersecurity not only detect and

respond to threats but do so within an ethical framework, balancing effectiveness with ethical considerations.

Data mining tools offer an organised way to identify threats, vulnerabilities, and system weaknesses as well as track the actions and patterns of intruders. Data mining techniques can be used to identify passive attack signatures such as sniffing, phishing, eavesdropping, and scanning open network ports. Data mining and artificial intelligence approaches can be used to detect active attack signatures such as ransomware, malware, and denial of service attacks. A machine learning methodology may be used in an intrusion prevention system to detect vulnerabilities, record attack footprints on a particular network, and identify strategies and tactics utilised by intruders.

The concept of intelligence has numerous definitions and interpretations. According to Breakspear (2012), intelligence is the capacity to "forecast change in time to do something about it," which includes having the insight and foresight to recognise the elements of change that could pose a threat. The primary goal of intelligence production is to comprehend the enemy. Finding the adversary's aims, capabilities, constraints, tactics, objectives, strategies, and weaknesses is part of this strategy. Figure 1 shows how to build a Cyber Threat Intelligence platform in cybersecurity.

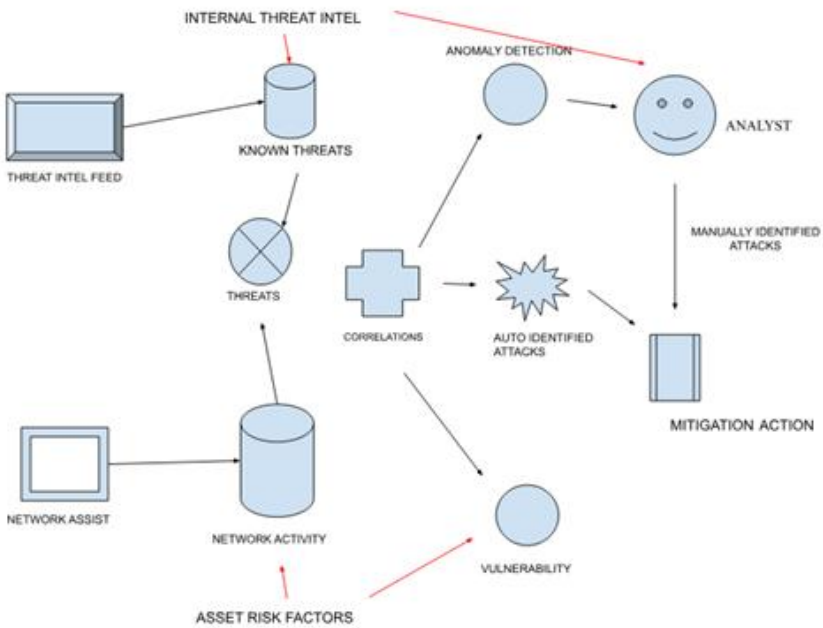

Figure 1: Build of Cyber Threat Intelligence

Figure 1 shows that data collection, analysis, and interpretation are all part of cyber threat intelligence, which aims to identify and lessen possible cyber threats. By offering relevant information and actionable insights, it supports proactive defence against cyberattacks.

In summary, a move toward Cyber Threat Intelligence (CTI) mining is important given the growing panorama of cyber threats. The importance of CTI in thwarting contemporary dangers is highlighted by this examination of surveys and research. The article highlights the necessity for continuous research and innovation in CTI mining to proactively handle the dynamic nature of cyber risks and protect against increasingly complex assaults in the future, particularly as enterprises concentrate on fundamental use cases.

The subsequent sections of this paper are structured as follows. Section 1 provides an overview of our research focus on the mining techniques with advantages, key features and potential application. Section 2 delves into the critical components of proactive defense strategies. In Section 3, we explore the framework for proactive cyber threat intelligence. Section 4 provides insights into our chosen methodology. Literature reviews of papers related to research are discussed in section 5. Finally, Section 6 concludes this paper with recommendations for further exploration in the realm of proactive cyber threat intelligence mining.

This study aligns with the book's theme by exploring how *hikmah* principles can shape ethical AI use in cybersecurity, creating a framework where technical efficiency meets ethical wisdom. This integration could influence the future of AI in cybersecurity, guiding it towards ethical stewardship in protecting digital ecosystems.

Overview - The Mining Techniques with Advantages, Key Features and Potential Applications

In response to the ever-changing landscape of cyber threats, our research project, titled "Advancing Cybersecurity Through Proactive Cyber Threat Intelligence Mining," aims to strengthen organisational defenses by applying proactive cyber threat intelligence (CTI) mining techniques strategically. Acknowledging the need to shift from reactive to proactive cybersecurity measures, our focus lies in extracting valuable insights from diverse sources like cybersecurity reports, hacker forums, and online articles. We employ

advanced text mining, natural language processing (NLP), and machine learning (ML) techniques for this purpose. Our primary objective is to contribute to bolstering organisational cybersecurity by staying ahead of emerging threats and cultivating a proactive security stance. The study incorporates various methods such as social media analysis, deep neural networks, graph convolutional networks, ontology mapping, classification models, trigger-enhanced systems, and threat hunting strategies. Looking forward, we envision predicting potential attacks and integrating AI into cybersecurity for more robust security strategies. Table 1 illustrates the mining techniques relation between Law and Ethics.

Table 1: Mining techniques with advantages, key features and potential applications.

Mining Technique	Key Features	Advantages	Potential Applications
Machine Learning	- Automated pattern recognition - Predictive modelling - Behavioural analysis	- Adaptability to evolving threats - Ability to handle large datasets - Continuous learning capabilities	- Anomaly detection - Classification of threat types - Malware detection
Data Clustering	- Grouping similar data points - Unsupervised learning - Anomaly detection	- Scalability - Robust to noisy data - Reduced dimensionality	- Identifying patterns in network traffic - Grouping related cyber incidents - Identifying commonalities in attacks
Network Graph Analysis	- Visualisation of relationships - Node and edge analysis - Community detection	- Identification of network patterns - Detection of unusual connections - Insight into network structure	- Tracking lateral movement of threats - Identifying command and control nodes - Analysing social engineering attacks
Natural Language Processing	- Text analysis and interpretation - Sentiment analysis	- Extraction of context and intent	- Analysing unstructured threat data

Mining Technique	Key Features	Advantages	Potential Applications
	- Named entity recognition	- Understanding language nuances - Parsing threat intelligence reports	- Identifying social engineering tactics - Monitoring online forums for threats

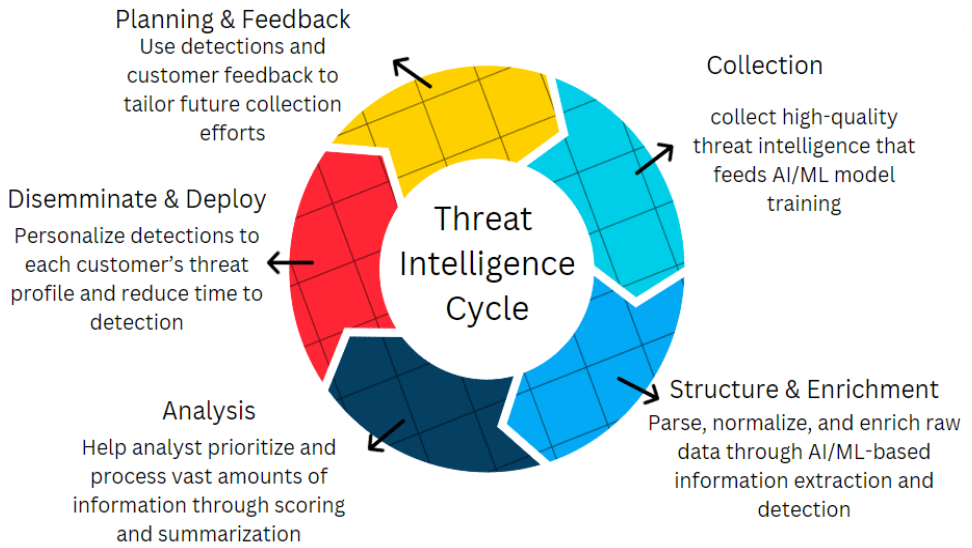

Figure 2: The threat intelligence cycle

The analysis stage involves processing collected data to extract actionable insights, supporting proactive cybersecurity measures. Figure 2 is the cycle of threat intelligence, consisting of loops for feedback, analysis, distribution, and collection. The analysis stage involves processing collected data to extract actionable insights, supporting proactive cybersecurity measures. It entails obtaining information on cyberthreats, evaluating it to extract insights, disseminating pertinent data, and continuously adjusting tactics to account for new and emerging threats.

Types of Cyber Threats

Cyber threats, ranging from malware and phishing to DDoS attacks, pose significant dangers to our data, networks, and computer systems. Malicious software, or malware, takes various forms such as ransomware, spyware,

Trojans, worms, and viruses, with the goal of causing disruption, harm, or gaining unauthorised access to valuable data. Phishing involves deceptive tactics aimed at acquiring sensitive information through fake messages, emails, or websites, often disguised as trustworthy sources. DDoS attacks, on the other hand, seek to overwhelm systems, networks, or websites, causing slowdowns or rendering them unresponsive to legitimate users.

Traditional security measures struggle to keep up with the increasing volume and speed of cyber threats. Targeted attacks, focused on specific entities, use stealthy and persistent methods to remain undetected within systems for extended periods. Social engineering techniques, like phishing, exploit human weaknesses, surpassing the capabilities of technological security measures.
The ever-evolving cyber threat landscape introduces new vectors, including supply chain intrusions, cloud security threats, and vulnerabilities in the Internet of Things. Addressing these challenges effectively requires a proactive and adaptive cybersecurity strategy, integrating machine learning, behavioural analysis, advanced threat intelligence, and real-time monitoring.

Role of Threat Intelligence in Cybersecurity
The term "threat intelligence" refers to the insights derived from analysing and understanding potential cyber threats, encompassing the strategies, tactics, and procedures (TTPs) employed by threat actors. To identify and assess potential cybersecurity threats, organisations gather, analyse, and interpret data. Threat intelligence equips organisations with vital information to anticipate, prevent, and respond effectively to cyber threats.

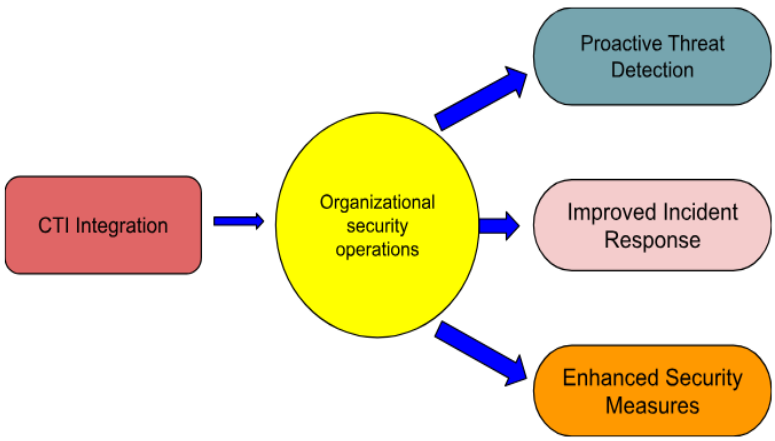

Figure 3: Illustrating the benefits of CTI integration

Figure 3 shows that the effectiveness of proactive cybersecurity protection hinges on three pivotal strategies: integration, customisation, and staying abreast of the field of cyber threat intelligence (CTI). When expertly interwoven, these strategies empower organisations to bolster their defences against the constant influx of new and emerging cyber threats. By embracing the dynamic nature of CTI and seamlessly integrating it into their operational frameworks, organisations can proactively avert potential risks and navigate the intricate cybersecurity landscape.

Facilitated by early threat detection, proactive defence enables organisations to implement preventive security measures before potential threats materialise. This approach effectively mitigates risks by implementing security measures in advance.

Risk assessment aids organisations in prioritising security activities and utilising resources more efficiently by evaluating the likelihood and severity of individual threats. Timely and accurate threat intelligence improves incident response capabilities, facilitating faster and more efficient containment and cleanup.

Informed decision-making, driven by a profound awareness of the threat landscape, empowers organisations to make knowledgeable decisions about security investments, resource allocation, and response methods. This information assists practitioners, policymakers, and security experts in crafting response plans, allocating resources, and determining security expenditures.

In conclusion, timely and dependable threat intelligence is indispensable for proactive security plans, enabling businesses to anticipate, identify, and counteract cyber threats effectively. It supports a proactive and flexible approach to cybersecurity, allowing businesses to adapt to evolving risks and minimise the impact of any potential attacks.

Frameworks For Proactive Cyber Threat Intelligence

Various models and frameworks for proactive cyber threat intelligence encompass a variety of strategies to anticipate, identify, and counteract cyber risks. Platforms like OpenCTI, for instance, serve as examples of Open-Source Threat Intelligence Platforms. They provide centralised environments

that collect, evaluate, and share threat intelligence data, fostering communication and information exchange among security professionals.

Machine learning and deep learning models play a vital role in extracting valuable insights from cyber threat intelligence data. Sophisticated models leverage these techniques to improve precision, scalability, and practicality in threat intelligence extraction.
The Diamond Model of Intrusion Analysis offers a systematic approach to evaluating cyber threats by focusing on the connections between adversaries, infrastructure, capabilities, and victim targeting. This model supports proactive threat intelligence by recognising and understanding the actions of threat actors.

The Cyber Kill Chain model, developed by Lockheed Martin, outlines the various stages of a cyberattack, from reconnaissance to exfiltration. It assists organisations in anticipating and neutralising potential risks at each stage of an attack's lifecycle.

The STIX/TAXII framework empowers organisations engaged in information-sharing communities to contribute to and benefit from shared threat intelligence. This framework proves particularly advantageous for agile firms that prioritise quick decision-making and adaptability in response to evolving cyber threats, aligning with the OODA Loop concept, also known as the Agile Organisation.

In conclusion, the effectiveness of these models and frameworks for proactive cyber threat intelligence is shaped by the corporate context, threat landscape, and strategic priorities of each organisation. Organisations are encouraged to assess and select frameworks that align with their unique requirements, available resources, and cybersecurity goals.

Machine Learning Applications in Threat Intelligence
As machine learning gains importance in the field of cyber threat analysis and prediction, its role becomes increasingly crucial. These algorithms excel at handling vast amounts of data, recognising patterns, and making predictions based on historical and real-time information. In proactive threat intelligence, they are commonly used for tasks like categorising malware, detecting anomalies, and conducting predictive analytics.

A major advantage of incorporating machine learning lies in its ability to identify complex patterns within large datasets, allowing the detection of subtle indicators of potential cyber threats. The adaptability of machine learning models is also notable, enabling them to adjust and learn from fresh data, making them effective in identifying evolving and previously unknown threats.

Automation is another key benefit, facilitating the automated analysis of extensive volumes of threat intelligence data. This, in turn, allows human analysts to focus on more intricate tasks. Moreover, behavioural analysis by machine learning algorithms enhances the understanding of cyber threats, enabling the identification of new and evolving attack strategies. Scalability is inherent in machine learning, making it well-suited for processing and evaluating massive amounts of threat intelligence data in contemporary cybersecurity contexts.

However, integrating machine learning into proactive threat intelligence is not without its challenges. The quantity and quality of data pose significant hurdles, requiring high-quality, labelled training data that may be scarce for businesses with limited prior threat data. Adversarial attacks represent another obstacle, as threat actors may attempt to manipulate machine learning models to evade detection systems.

In summary, while the integration of machine learning into proactive threat intelligence brings numerous benefits, addressing challenges related to data quality, adversarial attacks, interpretability, and resource requirements is essential. Organisations must carefully evaluate these factors and allocate the necessary resources and expertise to effectively leverage machine learning for preemptive cyber threat intelligence.

Ethical and Legal Considerations

In the realm of proactive cybersecurity, the ethical and legal dimensions of data collection emerge as crucial considerations, especially with regard to privacy. Taking a proactive stance on threat intelligence involves sifting through data from various sources, raising concerns about the confidentiality of individuals and entities under surveillance. The careful handling of information, like personally identifiable information (PII), becomes crucial to prevent privacy breaches and stay in line with data protection laws.

Prioritising compliance with regulations takes a central role, encompassing key frameworks such as the General Data Protection Regulation (GDPR) in the EU and the California Consumer Privacy Act (CCPA) in the US. Industries subject to specific regulations, like healthcare and finance, must similarly adhere to sector-specific rules governing data privacy.

Thoughtful sharing of threat intelligence involves navigating ethical and legal guidelines when sharing data externally, whether with law enforcement or industry peers, to prevent misuse for objectionable purposes like retaliatory cyberattacks or unauthorised surveillance. The ethical considerations extend to the utilisation of dark web data, urging organisations to exercise caution and ensure that information is sourced and used with moral and legal integrity, aligning with ethical norms and regulatory constraints.

Addressing these complexities necessitates privacy impact assessments, robust data governance, and compliance frameworks, all supported by the expertise of legal and compliance specialists. Cultivating a corporate culture that advocates for the ethical and responsible use of threat intelligence is crucial to consistently uphold privacy considerations and regulatory obligations.

Critical Components of Proactive Defence Strategies

Detecting cyber threats early is fundamental to effective cybersecurity. Taking a proactive approach in defence strategies is essential for minimising the risks associated with these threats. Using methods like data mining for early identification of potential cyber threats is a key element in staying ahead of evolving attack methods and lessening the impact of cyberattacks.

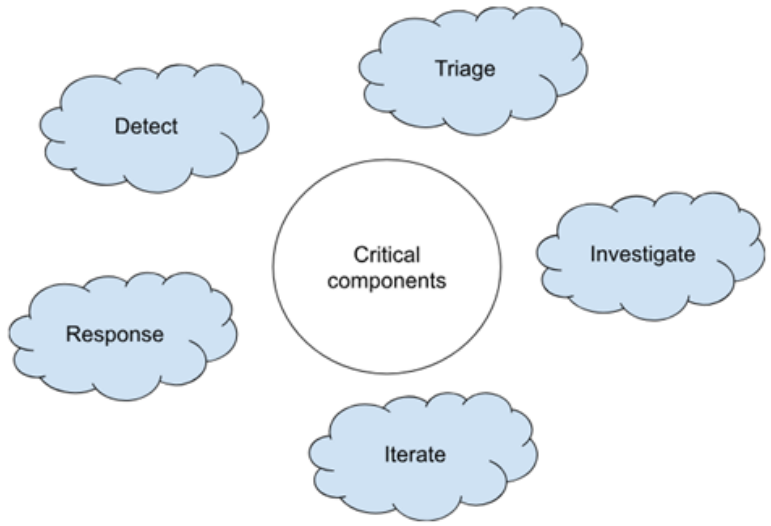

Figure 4: Illustrating the critical components

Figure 4 explains that proactive steps are part of proactive defensive techniques, which aim to protect against potential threats. Continuous threat intelligence collection, thorough vulnerability assessments, early detection systems, quick reaction plans, and dynamic risk adaptation are essential elements. When taken as a whole, these components improve an organisation's capacity to successfully anticipate, stop, and mitigate possible cyber threats.

In this proactive defence strategy, the role of threat intelligence is pivotal. Drawn from evidence-based knowledge, threat intelligence is instrumental in predicting, preventing, and defending against cyber threats. Analysing Tactics, Techniques, and Procedures (TTP) from threat reports provides valuable insights into attack patterns, enhancing the capabilities to detect and mitigate threats effectively.

Continuous monitoring and the sharing of threat intelligence are highlighted to adapt to the ever-changing threat landscape. The collaboration between Cybersecurity Red and Blue Teams, facilitated by threat intelligence sharing, attack profiling, and forecasting, contributes to advanced threat hunting and defence strategies.

To intelligently detect malware, organisations employ sophisticated data mining techniques, including classification algorithms such as SVM,

regression, decision trees, graph mining, KNN algorithms, and artificial neural networks. Hybrid detection approaches, combining anomaly- and signature-based methods, enhance overall threat detection capabilities. Clustering methods and dimensionality reduction techniques, such as hierarchical clustering, address cybersecurity challenges by simplifying complexity and improving efficiency.

The proactive defence strategy also involves the evaluation of real-world performance. This includes realistic assessments of the effectiveness of cybersecurity models and their ability to support decision-making. Collaborating with cybersecurity practitioners ensures continuous improvement, making the strategy more responsive and suitable for industrial cybersecurity specialists.

In summary, the proactive defence strategy outlined adopts a comprehensive approach to cybersecurity. By incorporating early detection, leveraging threat intelligence, maintaining continuous monitoring, utilising advanced data mining techniques, and fostering collaborative efforts, organisations can establish a robust defence against potential cyber threats. This proactive stance not only assists in staying ahead of cyber adversaries but also allows for a more resilient and adaptive cybersecurity posture.

Utilisation of Advanced Mining Techniques

In the field of enhancing cybersecurity, it's crucial to employ advanced mining techniques, such as deep learning, natural language processing (NLP), and knowledge graph construction. These methods play a vital role in extracting essential insights from cyber threat intelligence (CTI) data, aiming to strengthen the precision, scalability, and generalisability of CTI extraction for fortified preventive defence strategies.

Moreover, these sophisticated mining techniques contribute significantly to establishing robust security approaches by foreseeing potential cyber threats and dynamically updating the CTI knowledge graph to align with emerging risks. Investigating the correlation between model scores and responses to recommendations becomes an important aspect to enhance their effectiveness.

Predictive analytics, a proactive method for identifying vulnerabilities and predicting cyber threats through data mining and machine learning, is

pivotal. Concurrently, anomaly detection, driven by advanced mining algorithms, reveals irregularities and patterns in network data that may indicate potential cyberattacks or security lapses.

Additionally, pattern recognition utilises sophisticated mining algorithms to identify complex patterns in cybersecurity data, facilitating early threat detection and the creation of efficient defence strategies. The integration of data mining and machine learning into the analysis of extensive cybersecurity data is crucial for leveraging advanced mining techniques to bolster cybersecurity.

These techniques contribute to enhancing threat detection, response, and mitigation efforts, ensuring a proactive approach against the ever-evolving landscape of cyber threats.

Challenges, Open Issues, and Avenues

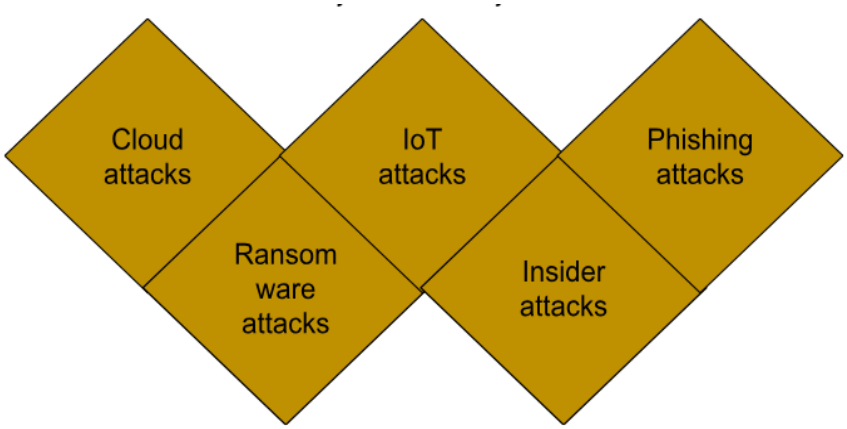

Figure 5: Illustrating the 5 main issues considered in cybersecurity

According to Figure 5, the world of technology expands, so do the top cybersecurity threats to our online security. It can be daunting to contemplate how to protect your company from cyber threats, but it does not have to be insurmountable. There are several difficulties in the ever-growing field of cybersecurity related to different threat vectors. Cloud attacks highlight the need for strong defences by taking advantage of holes in off-site service platforms. Ransomware is a serious issue since it requires money in order to access data. IoT threats put data integrity and operational disruption at risk by focusing on adaptable but frequently insecure devices.

Social engineering is used in phishing campaigns to obtain private information. Insider threats highlight the danger from within, as demonstrated by a Yahoo case study. Thorough cybersecurity procedures, such as thorough training and compliance controls, are necessary to protect against these various and ever-changing threats.

The world of improving cybersecurity is filled with numerous challenges, issues yet to be resolved, and promising areas for further exploration. One critical concern is establishing benchmark datasets to underpin robust cybersecurity measures. Creating these datasets, drawn from a diverse array of threat reports, is essential for thoroughly assessing Tactics, Techniques, and Procedures (TTP) extraction methods. They serve as a cornerstone for training machine learning models, enabling a better understanding and prediction of undisclosed patterns in cyberattack behaviour.
At the same time, there's a pressing need to delve into textual feature selection. This involves considering features like Named Entity Recognition (NER), patterns of verb and noun co-occurrence, and the use of regular expressions highlighting specific Indicators of Compromise (IoCs). Integrating these features into machine learning models not only enhances TTP extraction but also contributes to the broader field of cybersecurity.

Fine-tuning hyperparameters is a critical factor for improving the classification performance of machine learning models. Optimising hyperparameters for each classifier addresses the intricacies of cyber threat environments and deals with the extensive volumes of data involved in scaling up the performance of data mining methods. In the realm of cybersecurity, the challenge of multi-label classification takes centre stage. Recognising that a single sentence may be linked to multiple TTPs leads to exploring the application of multi-label classification for TTP extraction. This nuanced approach aligns with the evolving nature of cyber threats, providing a more sophisticated understanding of potential risks.

Furthermore, closely examining the benefits of incorporating specific textual features is of great interest. Through rigorous assessment and identifying optimal features using selection and ranking techniques, ongoing efforts to refine cybersecurity intelligence mining solutions gain traction.

Adversarial attacks pose a continual threat to cybersecurity systems. Evaluating the resilience of data mining-based cybersecurity systems against

evasion strategies and adversarial attacks is crucial. This involves not just fortifying systems against potential breaches but also ensuring adaptability to emerging threats in real-time. As we navigate through these challenges and unresolved issues, the importance of collaboration across disciplines becomes evident. Bringing together cybersecurity experts, data scientists, and domain specialists fosters a holistic approach to addressing the complexities of the cybersecurity landscape. Ethical considerations, legal frameworks, and responsible practices are integral elements in this collaborative effort.

As the field progresses, ongoing research becomes crucial. The dynamic nature of cyber threats demands adaptive and innovative solutions. By addressing these challenges and exploring avenues for further research, the enhancement of cybersecurity is poised to anticipate, detect, and mitigate cyber threats effectively, fortifying the resilience of our digital ecosystems.

Methodology

As cyberattacks become more frequent and severe, strong security measures are more important than ever. Due to the dynamic, evasive, resilient, and complex nature of modern attacks, traditional security systems based on heuristics and signatures are inadequate.

The emerging field of CTI mining is important for identifying, processing, and evaluating critical information about cyber threats. That is why in this article, we thoroughly analyse surveys and research about CTI mining from various data sources. The article will also highlight the necessity for continuous research and innovation in CTI mining to seek its possible path in the future. Qualitative research was used as the research methodology for this article. The reason is that the opinions and thoughts of researchers who had done their studies related to Cyber Threat Intelligence (CTI) were the main focus. We want to understand what conclusion they derived from their research and why the researchers came to said conclusion.

To achieve this objective, all the data contained in this article must be collected from various articles and journals with topics related to CTI. The data was gained through secondary data collection methods with an emphasis on external sources, which are the Internet. Moreover, the articles and journals used were published between 2019 and 2023 to make sure that there is no outdated information.

After data has been collected, it needs to be analysed before being used as a reference in the article. There are three methods, which are paraphrasing, summarising and quotation. A paraphrase explains a statement by using your own words and sentence structure, while a summary explains a statement using your words, but typically condenses a larger statement into a shorter explanation. On the other hand, a quotation reproduces a statement word-for-word as it appears in its source. These methods will be shown throughout the article to explain, emphasise or serve as proof for the statement related to it.

Machine learning techniques, such as feature reduction, regression analysis, unsupervised learning, and deep learning, are effective in extracting insights and patterns of security incidents to prevent cyberattacks. Traditional security solutions may not meet modern cyber business needs, necessitating the use of machine learning techniques in cybersecurity. The last example is paraphrasing, data mining and artificial intelligence approaches can be used to detect active attack signatures such as ransomware, malware, and denial of service attacks was based on the document emphasises the significance of threat intelligence in cybersecurity and proposes the use of artificial intelligence techniques for recognising and preventing cyber threats. It highlights the importance of data mining techniques such as A/B testing, association, and Naïve Bayesian classification for early detection of threat conditions.

Literature Overview

This literature overview provides a brief summary of at least 15 papers published from 2018 onward key sources on the advancing cybersecurity through proactive cyber threat intelligence mining. Table 2 shows several literature reviews of this work.

Table 2: Survey of cyber threat intelligence mining

Articles	Key Findings / Arguments	Supporting Evidence/ Sample Characteristics/ Methods	Strength / Limitations	Significance / Implications
Desai (2021)	Desai's study advances CTI extraction using deep learning models, highlighting RoBERTa-BiGRU-CRF's performance for entity extraction, demonstrating improved efficiency in handling complex CTI data. The suggested method showed encouraging outcomes in resolving the difficulties related to entity and connection extraction from CTI data, giving security experts faster and more precise insights to help them make judgments.	The experimental data, comparisons with cutting-edge models, and statistical significance testing used in model evaluation provide evidence for the conclusions. With a final F1 score of 0.86, the RoBERTa-BiGRU-CRF model outperformed the top-performing baseline model by 7%. Explanatory artificial intelligence (XAI) methods were also applied to offer further insights into the model's decision-making process.	The study's strength is how it tackles the difficulties of CTI data extraction by utilising deep learning and sophisticated natural language processing techniques. The experimental results demonstrated a significant improvement in the accuracy, scalability, and generalisability of CTI extraction using the suggested joint extraction technique. The study also emphasised the suggested technique's possible influence in the field of cyber threat intelligence.	The study has significant implications for cyber threat intelligence researchers, practitioners, policymakers, and security experts. The results offer insightful information that can be used to create useful tools and techniques for CTI data analysis and decision-making.
Motlhabi (2022)	The article is emerging cyber risks cannot be adequately managed by traditional cybersecurity systems. Malware comes in many forms and can impact	Cybersecurity uses a variety of machine learning methods, such as association rule mining, dimensionality reduction, and supervised learning. Experiments and	The strength is that utilising machine learning methods and algorithms offers a more adaptable and effective cybersecurity strategy. Confidential data is better protected	The results point to the necessity of more sophisticated and flexible security measures in order to counter new types of cyberattacks. The creation of

Articles	Key Findings / Arguments	Supporting Evidence/ Sample Characteristics/ Methods	Strength / Limitations	Significance / Implications
	any system that has computational logic. To solve cybersecurity challenges, hybrid detection techniques and anomaly-based detection techniques are suggested.	studies have been carried out to assess how well machine learning models work in cybersecurity.	when machine learning and fully homomorphic encryption (FHE) are used together.	more automated and secure cybersecurity solutions may be impacted by the fusion of machine learning and encryption techniques.
Ampel (2020)	The research applied data mining techniques for malware detection, applying static and dynamic analytic methodologies, and implementing different data mining algorithms for threat analysis and detection in cybersecurity. The study also highlights the difficulties brought about by the rise in internet usage and the demand for effective and clever methods for early cyberattack	The sample characteristics include the usage of various data mining algorithms for malware identification, including genetic algorithms, KNN, SVM, and graph mining. The study also addresses network vulnerability, cyber threats, and their various forms, emphasising how crucial it is to comprehend and deal with these problems.	The strength of the research lies in its focus on exploring key aspects of cybersecurity and the application of descriptive research to study data mining techniques for malware detection.	The discovery is significant because it has the potential to improve cybersecurity measures by aiding in the development of effective and intelligent methods for early cyberattack identification.

Articles	Key Findings / Arguments	Supporting Evidence/ Sample Characteristics/ Methods	Strength / Limitations	Significance / Implications
	identification.			
Rahman (2022)	The author leverages Twitter data with the MITRE ATT&CK framework to identify and profile emerging threats, showcasing how real-time social media can be instrumental in threat prediction. Rahman leverages Twitter data with the MITRE ATT&CK framework to identify and profile emerging threats, showcasing how real-time social media can be instrumental in threat prediction.	The use of machine learning (ML) and natural language processing (NLP) to identify threat names, the application of MITRE ATT&CK methodologies to identify threat strategies, and the timely generation of alerts for emerging or novel threats are some of the evidences supporting these conclusions.	The framework's strengths are its capacity to recognise and categorise cyberthreats using the constantly-evolving information from MITRE ATT&CK, its effective alert generation for cyber threat analysis, and its use of machine learning algorithms to categorise tweets.	As seen by the successful discovery of attacks like the PetitPotam example, the relevance of this work resides in its ability to improve cybersecurity defensive methods by enabling early detection and prevention of cyber threats.
Marinho (2022)	In order to improve cyberattack characterisation, detection, and mitigation, the comparison study concentrated on TTP extraction techniques from threat reports. The chosen studies assessed	The proof came from the chosen studies that used threat reports and the MITRE ATT&CK framework to classify and extract TTP. In order to extract TTP from textual artifacts, the studies used	The methodical comparison of TTP extraction strategies, which sheds light on the efficacy of various approaches for extracting cyberthreat data, is where the strength lies. A standardised dataset from the	The work is important because it can help cybersecurity practitioners and researchers choose the best TTP extraction techniques for threat intelligence analysis. The

Articles	Key Findings / Arguments	Supporting Evidence/ Sample Characteristics/ Methods	Strength / Limitations	Significance / Implications
	their performance using a range of classifiers and used a variety of approaches, including LSI, TFIDF, and BM25 for TTP extraction.	NLP and ML algorithms. Precision and other metrics were used to assess the performance.	MITRE ATT&CK architecture was used to guarantee uniformity and comparability amongst the investigations.	results make a significant contribution to the development of cyberthreat intelligence extraction and its use in improving cybersecurity protocols.
Ahmad (2024)	The study focuses on the application of artificial intelligence and data mining techniques to cybersecurity threat detection and prevention, as well as the importance of threat intelligence in cybersecurity. It highlights the difficulties that businesses confront as a result of people using more and more Internet-connected devices—devices that are open to cyberattacks.	The paper provides evidence for the significance of threat intelligence in cybersecurity, the shortcomings of current methodologies, and the necessity of advanced data mining and artificial intelligence tools to improve cybersecurity data veracity and threat detection. The application of different data mining techniques, including prediction, classification, and clustering, to threat detection is also covered.	The study offers a convincing justification for applying artificial intelligence methods to threat intelligence detection. It also discusses the difficulties that different businesses have managing large and varied datasets, as well as the necessity of sophisticated systems to compile and correlate these datasets for long-term security.	The study's importance comes from its focus on threat intelligence and how data mining and artificial intelligence may improve cybersecurity. In order to effectively gather threat intelligence, it emphasises the necessity of efficient sharing of threat data and information as well as common protocols and standard formats.

Articles	Key Findings / Arguments	Supporting Evidence/ Sample Characteristics/ Methods	Strength / Limitations	Significance / Implications
Gupta (2019)	In order to increase generality, the study suggests using learnt representation from professionally labelled exploits to categorise hacker forum exploits using a Deep Transfer Learning for Exploit Labeling (DTL-EL) framework. In hacker forum literature, DTL-EL performs better than other well-known models, attaining high performance in accuracy, F1-score, precision, and recall.	Eleven well-known hacker forums provided the data, which had 101,175 exploits in total for both datasets. The suggested DTL-EL framework enhances hacker forum exploit source code labelling performance by utilising carefully examined exploits with detailed information.	The study's shortcomings are not stated clearly. The requirement for additional testing and validation in various hacker forum environments as well as the DTL-EL framework's applicability to various hacker datasets kinds are possible drawbacks, though.	The research automates the gathering and classification of hacker forum exploit source code, thereby filling research gaps and offering useful insights for proactive Cyber Threat Intelligence (CTI). The DTL-EL methodology can be applied to various hacker datasets to find patterns in the disclosure of personally identifiable information, cybersecurity tutorials, and other related subjects.
Rahman (2020)	A technique for assessing Cyber Threat Intelligence (CTI) systems and standards is presented in this document to strengthen cybersecurity safeguards. It highlights the need to assess platforms and	An extensive assessment of Threat Intelligence (TI) platforms and standards is given in this document. It describes the standards and platforms for CTI standards and evaluation and chooses well-	The strength of the research lies in its comprehensive evaluation of TI standards and platforms. It also addresses the need for a methodology to evaluate CTI standards and platforms, contributing to the understanding and improvement of	One of the research gaps in the analysis of available CTI systems and tools is filled by this study, among its implications. The enhancement of cybersecurity protocols and the comprehensive

Articles	Key Findings / Arguments	Supporting Evidence/ Sample Characteristics/ Methods	Strength / Limitations	Significance / Implications
	makes an argument for the need to close the research gap in the analysis of CTI systems and tools.	known platforms for more study, including MISP, CIF, CRITs, OpenCTI, and Anomali STAXX.	cybersecurity measures.	comprehension of the cybersecurity terrain are potential benefits.
De Melo (2022)	One of the research's primary conclusions highlights the diverse character of the area by identifying recurrent study issues in fintech cybersecurity. Research papers' global citations are analysed to show their importance and impact in the field of cybersecurity in the fintech mobile app industry. Thematic mapping is a useful tool for visualising the evolution and relative importance of different issues within a subject of study.	These conclusions are backed by a thorough examination of global citations for a selected group of research articles, which highlights the publications' importance and impact in the field of cybersecurity in the fintech mobile app ecosystem. A visual depiction of the relative importance and development of different subjects within the field of study is provided by thematic mapping. Analysis of the characteristics of the dataset utilised in the study, such as its length, place of origin, textual	The strength of the research lies in its comprehensive approach to understanding cybersecurity challenges and solutions in the fintech mobile app ecosystem. The use of bibliometric analysis, thematic mapping, and examination of worldwide citations adds depth and credibility to the findings.	The study is important because it clarifies the complex and varied nature of cybersecurity challenges and solutions in the context of financial technology and mobile applications. It offers practitioners, researchers, fintech companies, regulators, and cybersecurity experts insightful information that improves understanding of the changing trends, issues, and opportunities in this fast-paced market.

Articles	Key Findings / Arguments	Supporting Evidence/ Sample Characteristics/ Methods	Strength / Limitations	Significance / Implications
		content, and authorship details.		
Ampel (2020)	The creation of the INTIME framework, which combines technologies for Threat Intelligence Mining and Extraction, and the application of a CTI Extraction Solution that goes beyond conventional rule-based matching are two of the document's primary conclusions.	The thorough explanation of the framework's architecture, modules, and components, together with the particular strategies and tactics applied for CTI extraction and administration, provides support for these conclusions.	The document's strength is its thorough explanation of the INTIME framework, including its many modules such as Data Analysis, Data Management, and Sharing, as well as how to employ open-source software to put it into practice. The document also offers insights into the assessment of the framework's constituent parts, demonstrating viability and performance via proof-of-concept analyses.	The results have implications for the development of CTI extraction, management, and sharing procedures as well as for the framework's incorporation of deep learning and machine learning approaches. The utilisation of threat intelligence services for CTI sharing and the significance of structured data collecting are both highlighted in the document, both of which advance cybersecurity procedures generally.
Desai (2021)	The research about the surge in cyberattacks in South Africa, the necessity of stakeholder cooperation and	Data about cyberattacks in South Africa in 2019 and details on the CEI (Cybersecurity Exposure Index)	The document's strength is its emphasis on creating a platform for exchanging context-aware threat intelligence	The document's ability to handle the growing cyber dangers in South Africa and the larger SADC region is what

Articles	Key Findings / Arguments	Supporting Evidence/ Sample Characteristics/ Methods	Strength / Limitations	Significance / Implications
	information sharing, and the possible advantages of converting unprocessed Indicators of Compromise into cyber threat intelligence are some of the main conclusions.	rating are among the evidence provided in the publication. It also covers how to identify and counteract cyber threats by using IoCs, STIX, and threat intelligence platforms.	in order to enhance cybersecurity. It also offers insights into how the NIST architecture works and how situational awareness is achieved through sharing threat intelligence.	makes it significant. By enhancing threat intelligence sharing, decreasing data duplication, and improving vulnerability detection and remediation, the suggested platform could make the cyber environment safer.
Sahrom (2018)	The research aims to extract knowledge from unstructured Turkish economy news articles using text mining techniques. Tokenisation, downcasing, stemming, stopword elimination, and synonym expansion are all part of document processing. Cosine similarity is used for similarity analysis, and several data mining algorithms are	The evidence is based on the analysis of 543 unstructured Turkish economy news articles from ten newspapers.The study employs linguistic techniques and text mining procedures to identify significant patterns in unstructured data.	The limitations of the research are not explicitly mentioned in the provided text. The representativeness of the sample, the generalisability of the results, and the accuracy of the text mining algorithms are possible drawbacks, though.	The implications of the research include the potential for improved analysis and understanding of unstructured economic news data. The results could have an impact on the creation of text mining methods for news article analysis that are more successful. The findings might also have an impact on data mining and natural language processing as a whole.

Articles	Key Findings / Arguments	Supporting Evidence/ Sample Characteristics/ Methods	Strength / Limitations	Significance / Implications
	used in cybersecurity.			
Motlhabi (2022)	The claims made in this study are based on a review of the literature on cyber threat intelligence (CTI). It goes over the conclusions and important discoveries from a number of studies on threat intelligence sharing platforms, threat analysis techniques, and the application of natural language processing (NLP) based tools for CTI mining.	References to particular research, including those carried out by Sauerwein et al., Tuma et al., Xiong et al., and Bridges et al., are included in the paper's evidence. These studies include empirical data as well as insights into the difficulties, strategies, and techniques involved with extracting CTI from Twitter feeds, unstructured text reports, and other sources.	The study's limitations are highlighted by the restrictions, including the possibility of incompleteness in the search procedure, the arbitrary application of inclusion and exclusion standards, and the arbitrary character of the search and documentation of study results. Furthermore, the subjective character of the search method may limit the generality of the results.	The language that is presented does not specifically state the study's implications. However, the consequences could include the need for more thorough search procedures, uniform inclusion and exclusion criteria, and the need for additional research to address the limitations noted in the literature review, depending on the findings and limitations stated.
Koloveas (2021)	Among the document's main conclusions are the dearth of scholarly works that address Cyber Threat Intelligence (CTI) and the necessity of a precise definition,	The document's research methodology comprised a comprehensive analysis of the literature on cyber threat intelligence (CTI). The definition, problems, and	The paper offers a thorough examination of all English-language works published since 2010, guaranteeing a thorough examination of pertinent sources. In addition to	The results indicate that more investigation and advancement are required to fully realise the potential of CTI adoption. To turn threat data

Articles	Key Findings / Arguments	Supporting Evidence/ Sample Characteristics/ Methods	Strength / Limitations	Significance / Implications
	guidelines, and system for exchanging threat intelligence. It also draws attention to the difficulties with CTI sharing platforms and data quality, as well as the opportunities for businesses to use threat sharing platforms and recruit skilled threat data analysts.	difficulties of CTI were the main topics of the writers' focused literature review, which they carried out utilising keyword searches. The information collection procedure was explained, along with the search strategy and selection criteria. The authors compared, contrasted, and summarised the material from software vulnerabilities, whitepapers, and public information sharing sites using a narrative synthesis technique.	addressing the need for a precise definition of CTI, it highlights issues with data quality and CTI sharing platforms, offering insightful information for further study and advancement in the area.	into actionable intelligence, organisations can gain by putting in place threat sharing systems and employing trained threat data analysts. The difficulties with data quality and CTI sharing platforms that have been found emphasise how critical it is to resolve these problems in order to use CTI effectively.
Sun (2023)	A taxonomy for categorising CTI mining studies according to their goals is presented in the paper. It covers the difficulties faced in CTI mining research and provides a	The examples of research that used Indicators of Compromise (IOCs) to identify reliable intelligence sources and monitor new cyberthreats are given in the article. It talks	The paper notes that certain studies have assumed and this may not always be the case that the text format of CTI reports adheres to a fairly straightforward pattern. It draws attention to how common	The paper highlights the value of broadening the viewpoints of CTI communities and other researchers. It also addresses potential areas for future research,

Articles	Key Findings / Arguments	Supporting Evidence/ Sample Characteristics/ Methods	Strength / Limitations	Significance / Implications
	thorough analysis of the most recent findings. The paper provides a concise overview of a six-step process that uses CTI mining to turn cybersecurity-related data into evidence-based knowledge through observation, comprehension, and projection for proactive cybersecurity protection.	about the necessity for domain-specific contextual processing and the intricate syntactic and semantic structure of CTI reports. The development of ground truth datasets in the cybersecurity sector and the application of natural language processing (NLP) to enhance comprehension of the cybersecurity context are mentioned.	technical phrases are and how improper punctuation might affect how attacks are interpreted and extracted from CTI data.	including quality assessment and mining CTI from aggregated data sources to maximise the impact of CTI. In order to guarantee accuracy and dependability, the results point to the necessity of methodical, evidence-based techniques for evaluating the caliber of CTI and its sources.

Conclusion

This paper uniquely contributes to the field by illustrating how *hikmah* principles can guide ethical AI applications in cybersecurity. This framework not only enhances defence mechanisms but does so while upholding ethical values, setting a precedent for responsible AI use in sensitive sectors like cybersecurity.

The dynamic nature of cybersecurity threats demands a move towards preemptive defensive tactics, of which Cyber Threat Intelligence (CTI) mining is becoming an important element. The strategies used by contemporary cybercriminals to circumvent conventional security measures have evolved, making it more difficult to recognise, investigate, and eliminate risks. Because

of this, businesses are relying more and more on real-time CTI to foresee and address new issues. To extract patterns and insights from security events and avoid cyberattacks, the study highlights the significance of incorporating machine learning approaches, such as feature reduction, regression analysis, unsupervised learning, and deep learning. The study also emphasises how important artificial intelligence and data mining methods are for detecting and preventing cyberattacks. According to the study's thorough assessment of CTI standards and platforms, STIX has the most comprehensive architecture and capacity. This emphasises the necessity of ongoing research and development in the field of CTI mining. The results highlight the requirement of maintaining up-to-date CTI formats and standards to handle the quick changes in the field and highlight how important it is that CTI be both high-quality and applicable.

To guarantee proactive cybersecurity protection, the study's conclusion promotes integration, customisation, and keeping up with the area of cyber threat intelligence. In an era of cyber danger, protecting digital assets and ensuring operational resilience may be achieved by embracing the dynamism of CTI and incorporating it into operational paradigms. The paper highlights the potential influence of artificial intelligence and data mining techniques in enhancing the veracity of cybersecurity data, suggesting that these methods are the answer to the requirement for the effective exchange of threat data and information.

Acknowledgement

We would like to sincerely thank the Computer Network course for its essential assistance with our study, "Advancing Cybersecurity Through Proactive Cyber Threat Intelligence Mining." We now have a deeper understanding of blockchain technologies, IoT security, and cybersecurity thanks to the knowledge this course has taught.

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Chapter 11

Exploring Blockchain Technology and *Hikmah* for Securing the Internet of Things (IoT)

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Abstract
The rapidly expanding Internet of Things (IoT) ecosystem, characterised by interconnected devices and continuous data exchange, faces significant security challenges. Traditional security measures often fall short in mitigating the intricate risks associated with these extensive networks. This article investigates the potential of blockchain technology, renowned for its security and transparency, to fortify the IoT landscape. Through a comprehensive analysis of blockchain's core benefits, we demonstrate its capacity to enhance data security, ensure robust authentication and authorisation, deliver unparalleled transparency, and foster distributed trust. These features not only contribute to a more secure and resilient IoT environment but also embody *hikmah* (wisdom) by offering substantial benefits to the ummah. The decentralised nature of blockchain resonates with the principles of equity and justice, providing a secure and reliable technological framework that supports communal welfare and safeguards data integrity.

Keyword: Blockchain, Internet of Things, Security, capability, *hikmah*

Introduction

Several strategies can be employed to link *hikmah* (wisdom) to IoT application development. Incorporating ethical design is paramount, ensuring that IoT applications prioritise data privacy and security to protect users' information and foster trust. This approach aligns with *hikmah* by promoting fairness and justice. Developing community-centric solutions that address the specific needs of the ummah (community) further embodies *hikmah*, as these applications can improve healthcare, enhance educational opportunities, and streamline public services, thereby benefiting communal welfare. Utilising blockchain technology enhances transparency and accountability in IoT applications, ensuring data is securely managed and accessible, which aligns with the values of honesty and integrity central to *hikmah*. Designing IoT systems that are scalable to meet growing demands while maintaining their ethical and communal focus supports sustainable development and responsible innovation, reflecting the wisdom in balancing progress with moral considerations. Lastly, educating users about the benefits and safe use of IoT technologies empowers the ummah with knowledge, leading to more informed and beneficial use of technology, thus promoting wisdom through awareness and understanding. By integrating these strategies, IoT applications can be developed to advance technology while ensuring they are beneficial, ethical, and just.

The rapid expansion of the Internet of Things (IoT) is creating a network of billions of networked devices in several industries, including healthcare, smart cities, industrial automation, and environmental monitoring (Abdul-Qawy, 2015; Mehmood et al., 2017). The widespread interconnectedness enables unparalleled prospects for increased efficiency, automation, and insights derived from data. Nevertheless, within the enthusiasm lies a potential problem - the fundamental weaknesses of the IoT environment provide substantial security obstacles, endangering both personal privacy and essential infrastructure (Matta & Pant, 2019; *Sensors | Free Full-Text | Blockchain—Internet of Things Applications: Opportunities and Challenges for Industry 4.0 and Society 5.0*, n.d.).

The decentralised and heterogeneous nature of IoT networks provides an ideal environment for malevolent actors. Devices that are not secured generally lack strong authentication and authorisation procedures, which makes them vulnerable to unauthorised access and modification of data (Ali et al., 2019). The dependence on centralised servers leads to the existence of

vulnerable points, whereas isolated data storage obstructs effective forensic analysis and identification of weaknesses (Raghavendra et al., 2022). In addition, the large amount and high speed at which data is produced by IoT devices might overpower conventional security measures, resulting in areas of vulnerability and potential risks (Anand et al., 2020).

To address these challenges, this article explores the potential of blockchain technology to enhance the security of IoT networks. Blockchain, known for its inherent security, transparency, and decentralised nature, offers solutions that can mitigate the vulnerabilities of IoT systems. In this context, *hikmah* (wisdom) embodies ethical use, security, and fairness in technology applications. Blockchain's transparency and decentralisation align with *hikmah* by ensuring fairness and protecting community data. Blockchain's structure avoids misuse, promoting justice and communal welfare. Implementing blockchain in IoT thus reflects wisdom, protecting user data while enhancing ethical and community-centred practices. Also, its alignment with principles of equity and justice provides a secure and trustworthy technological framework that enhances communal welfare and protects against misuse of data. This integration represents a significant step towards a safer, more ethical, and transparent digital future for all.

Traditional centralised security paradigms encounter difficulties in dealing with the vast size and dynamic nature of the IoT world. Introducing blockchain, an innovative form of distributed ledger technology that has arisen as a potentially transformative force in strengthening security for the Internet of Things (IoT) (Bikos & Kumar, 2022; Wang et al., 2022). By incorporating fundamental ideas derived from cryptocurrencies such as Bitcoin, blockchain technology has a distinct array of characteristics that have great potential in safeguarding the complex network of the Internet of Things (IoT) (Gadekallu et al., 2022).

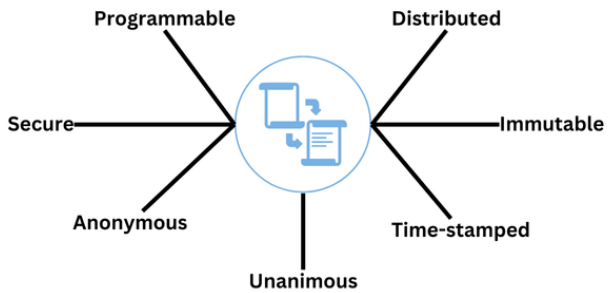

Figure 1: Properties of Distributed Ledger Technology

Blockchain can be understood as a secure digital ledger, where information is recorded and stored across multiple devices, making it almost impossible to alter without detection. This decentralised setup reduces reliance on a single control point, ensuring data remains trustworthy and secure across various IoT devices (Politou et al., 2021). This obviates the necessity for centralised servers, cultivating a trustless milieu wherein devices can securely interact without middlemen. The inherent decentralisation of the system reduces the risks that come with having single points of failure, hence improving the overall resilience of the system (Khan et al., 2023). Moreover, the unchangeability of data on the blockchain precludes unauthorised alterations, guaranteeing the integrity and traceability of data (Alotaibi, 2019).

The inherent transparency of blockchain enables effective collaboration in security monitoring and detection of anomalies. Every transaction is subject to public auditing, allowing for ongoing investigation of potential threats and prompt response to incidents (Alkadi et al., 2020). Furthermore, blockchain technology enables the creation of safe and unalterable smart contracts, which automate access control and authorised actions inside the Internet of Things (IoT) ecosystem (Badshah et al. (2022).

Through using the distinctive functionalities of blockchain, we may picture a forthcoming era when Internet of Things (IoT) devices function inside a secure and decentralised environment, effortlessly transferring data while ensuring the protection of personal information and essential infrastructure. This paper explores the technical foundations of blockchain and its ability to tackle the complex security issues of the Internet of Things (IoT) environment. We examine the distinct advantages and constraints of technology in several areas of application, demonstrating real-world implementations and current research endeavours. As we explore the ever-changing landscape of the Internet of Things (IoT), including blockchain technology as a fundamental security measure is crucial for fully realising its capabilities and guaranteeing a protected and reliable future for interconnected devices.

Benefits of Blockchain in IoT

Conventional security solutions, which are often centralised and isolated, face difficulties in keeping up with the ever-changing and widely spread

nature of the Internet of Things (IoT). As a result, they are vulnerable to data breaches, unauthorised access, and manipulation of devices.
Figure 2 indicates the process of crypto hashing to ensure immutability in blockchain.

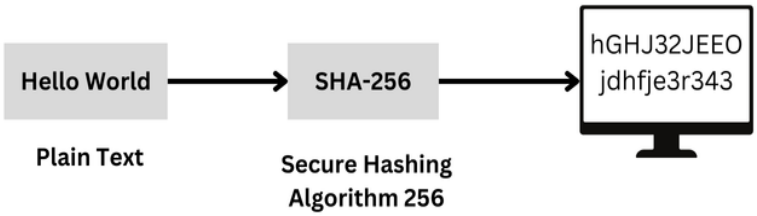

Figure 2: Process of crypto hashing

Blockchain technology is a disruptive force that is revolutionising numerous sectors by prioritising security and transparency. The fundamental principles of decentralisation, immutability, cryptographic hashing, and distributed consensus that underlie it provide a compelling solution to address the complex security concerns that IoT is facing.

The fundamental basis of blockchain's security is rooted in its immutability. The blockchain's distributed ledger permanently records data that has been carefully encrypted and cryptographically encoded. The tamper-proof repository ensures that any attempt to modify data would require the recalculation of all subsequent blocks, which is a computationally infeasible task (Nawari & Ravindran, 2019). The inherent security measures protect the authenticity of data produced by IoT devices, preventing malicious tampering and unauthorised access to data (Makhdoom et al., 2018).

In addition, the decentralisation of blockchain reduces the vulnerability of traditional centralised systems, which is the presence of single points of failure. Data is not limited to susceptible servers; instead, it is dispersed among a network of nodes, guaranteeing resistance against deliberate attacks. Despite the compromising of several nodes, the remaining ones maintain the network's integrity and ensure the veracity of the data (Homoliak et al., 2021).

Blockchain enhances secure communication by employing cryptographic methods. Public-key cryptography ensures the secure encryption of data during transmission between devices and the blockchain, thereby protecting

it from unauthorised access. The implementation of many layers of defence greatly diminishes the likelihood of data breaches and unauthorised data manipulation inside the IoT ecosystem.

Blockchain enables advanced authentication and authorisation systems for networked devices. Digital signatures serve as distinctive identifiers, validating specific devices and guaranteeing that only authorised participants engage with the network. Smart contracts are code scripts recorded on the blockchain that automate permissioned activities and reduce human error, hence simplifying device interactions and access control (Khan et al., 2021). Each transaction and interaction inside the blockchain network is scrupulously documented and linked in chronological order, forming an immutable audit trail. The exceptional level of transparency provided enables stakeholders to have an unmatched understanding of the origin of data, the detection of abnormalities, and the investigation of security events. Tracing data back to its source enhances the ability to detect and respond to threats in a proactive manner, hence strengthening the overall security of the IoT ecosystem (Hassija et al., 2019).

Blockchain creates a decentralised ecosystem, eliminating the requirement for a central authority and promoting trustlessness. Network participants collaborate to verify transactions and make choices, creating a decentralised system of trust and reducing dependence on potentially susceptible intermediaries. By doing so, it removes a main objective for potential attackers and promotes the development of a stronger and more resistant system. Despite the compromise of certain nodes, the remaining nodes persist in their operation, thereby averting system-wide disruptions and guaranteeing uninterrupted data transmission (Shahidehpour, 2021).

Challenges and Limitations of Blockchain in IoT

Blockchain technologies are garnering considerable attention due to their potential uses in the Internet of Things (IoT). Nevertheless, the integration of difficulties and constraints arises in IoT systems. The scalability of blockchain is a significant challenge in IoT due to the sheer volume of data generated by IoT devices. Processing vast amounts of information can lead to delays and high energy consumption. Lightweight blockchain methods are under development to address these issues, including alternative consensus algorithms like Proof-of-Stake and off-chain processing. These solutions aim to reduce energy demands while enhancing processing speed to support the

large-scale needs of IoT applications (Zikria et al., 2021). Figure 3 shows the challenges of blockchain and IoT that we will need to face.

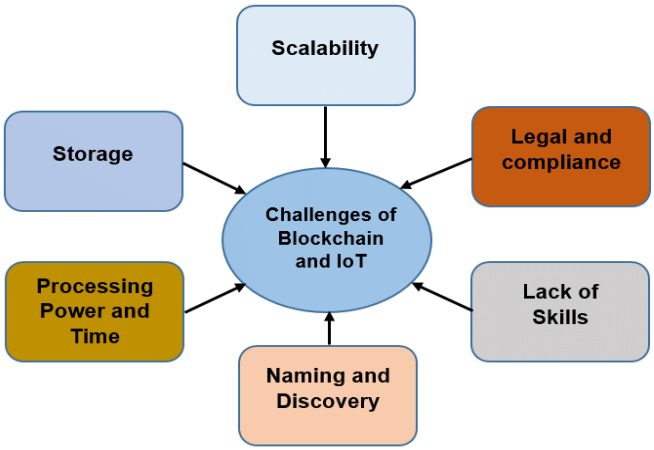

Figure 3: Challenges of Blockchain and IoT

Additionally, the limitations of IoT devices in terms of computational power and storage capacity pose a significant issue. Integrating the Blockchain into devices can result in heightened energy usage and diminished overall efficiency. Scientists are investigating lightweight algorithms and agreements that are off-chain in order to mitigate these constraints on resources and enhance the suitability of blockchain for Internet of Things (IoT) applications (Stefanescu et al., 2022).

Security and privacy are significant areas of concern. Blockchain is renowned for its immutability and transparency. However, the public nature of the ledger might potentially expose sensitive information related to the Internet of Things (IoT). Maintaining data privacy while ensuring the decentralisation of blockchain is a significant difficulty. The security concerns related to blockchain in IoT are exacerbated by weaknesses in smart contracts and potential attacks on the underlying cryptographic techniques (Hassan et al., 2019).

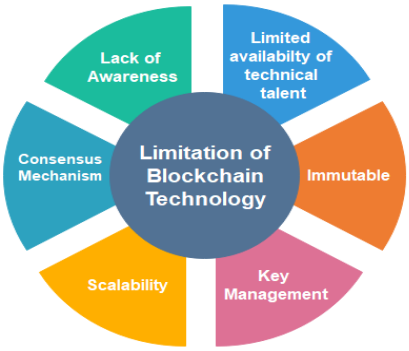

Figure 4: Limitations of Blockchain Technology

Interoperability is a significant constraint as it becomes challenging to achieve seamless communication and collaboration among diverse blockchain implementations due to the multitude of IoT devices, protocols, and standards. Efforts are currently being made to standardise and improve the compatibility of blockchain-based Internet of Things (IoT) systems (Lohachab et al., 2021).

In summary, the successful use of blockchain technology in the Internet of Things (IoT) is contingent upon addressing scalability, resource limitations, interoperability, as well as security and privacy concerns. These factors are crucial for the efficient adoption of blockchain in the intricate and ever-changing IoT landscape.

Future Directions

The amalgamation of blockchain technology and the Internet of Things (IoT) holds considerable potential for the future, although it is impeded by scaling obstacles. Within this particular setting, the literature emphasises the significance of resolving concerns related to transaction output and latency. Researchers are currently investigating new methods, such as unique consensus algorithms and off-chain strategies, to improve scalability and simplify the integration of blockchain with IoT devices. This literature study provides a thorough analysis of the existing situation, offering insights into the intricacies and suggesting directions for future research in developing scalable and efficient blockchain solutions for IoT environments.

The incorporation of blockchain technology into IoT devices poses various issues, specifically on scalability. These problems encompass transaction throughput and latency, which might impede the smooth functioning of IoT

devices inside a blockchain network. The consensus process is essential for facilitating decentralised peer-to-peer trade without the need for any intermediary (Alam et al., 2024). In addition, the ample storage capacity of current blockchains and the computing prowess of consensus algorithms are crucial factors to be taken into account for the seamless integration of blockchain technology with Internet of Things (IoT) devices (Berdik et al., 2021). Furthermore, the capacity of blockchain technology to decentralise and enhance the security of Internet of Things (IoT) connections has been acknowledged.

The proposal introduces a cutting-edge Internet of Things (IoT) service platform that utilises consortium blockchain technology. It emphasises the importance of scalable, lightweight protocols and off-chain data storage to enhance the scalability of blockchain technology (Nasir et al., 2022). Numerous academic endeavours have focused on tackling these difficulties related to scalability. Novel consensus algorithms like CBCIoT have been suggested to meet the particular demands of blockchain-based IoT applications, highlighting the importance of cautious consideration prior to implementing blockchain in the IoT domain.

Figure 5 illustrates the disparity in phases of BCIoT nodes, which is essential for validating the consensus algorithm of the Remote Management System (RMS) used on Warid sites to combat fuel theft.

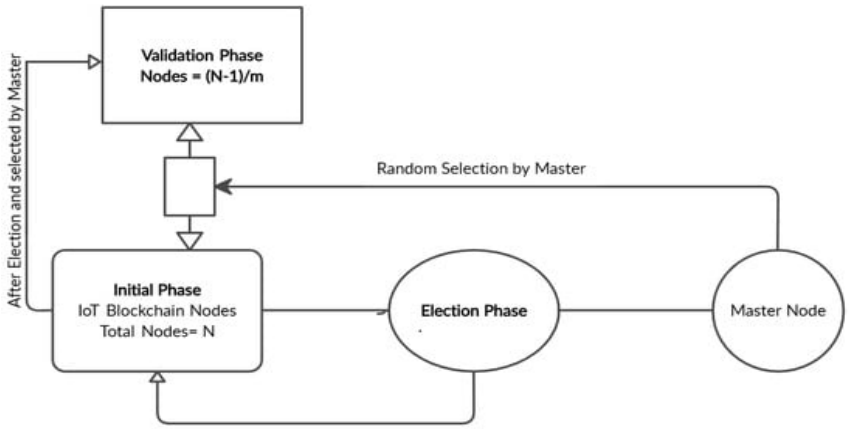

Figure 5: Phases of BCIoT Nodes

It is imperative to carefully select a pertinent dataset obtained throughout the deployment process. The dataset must possess a narrow focus on remote

sensing and fuel management in order to guarantee the algorithm's precision and efficiency. Multiple sources offer significant insights into the gathering and application of remote sensing datasets, which are crucial for testing data-driven algorithms in the domains of computer vision and artificial intelligence (Zhang & Zhang, 2022). Furthermore, a comprehensive analysis has been carried out to offer a deeper understanding of the incorporation of blockchain technology with the Internet of Things. This analysis has revealed valuable information regarding the possible areas of future research in this field (Rejeb et al., 2024). Furthermore, a study examining the incorporation of blockchain technology with the Internet of Things (IoT) has emphasised the necessity of improving performance and overcoming obstacles in order to simplify individuals' everyday routines and boost their engagement with their environment (Abdelmaboud et al., 2022).

In addition, the rapid increase in the number of IoT devices and the introduction of 5G mobile connections have made it necessary to create effective Byzantine consensus mechanisms for IoT blockchains. These methods rely on reputation and are designed to handle the large volume of data transactions generated by the IoT network (*Efficient Byzantine Consensus Mechanism Based on Reputation in IoT Blockchain*, n.d.). Furthermore, researchers have suggested employing lightweight storage frameworks and layer-based IoT blockchain frameworks to address scaling issues in IoT systems, while simultaneously enhancing performance and security (Qing et al., 2023). The significance of rectifying technical deficiencies in blockchain and creating specialised lightweight consensus algorithms for IoT applications is emphasised by these endeavours (Mahmood & Dabagh, 2022).

Ultimately, the fusion of blockchain technology and Internet of Things (IoT) devices offers potential advantages as well as obstacles. Although it is necessary to resolve scalability concerns regarding transaction throughput and latency, the exploration of innovative consensus algorithms, off-chain solutions, and lightweight protocols presents encouraging prospects for future investigation in this field. The significance of investigating novel methods to improve scalability and performance in blockchain-based IoT systems is highlighted by the potential of blockchain to decentralise and secure IoT communications.

The amalgamation of blockchain technology with the Internet of Things (IoT) has resulted in a multitude of practical implementations, presenting a revolutionary capacity across many fields. The applications encompass a wide range of areas, including smart city systems, supply chain management, healthcare, smart homes, and industrial IoT deployments. Nevertheless, the integration of blockchain technology in the Internet of Things (IoT) is not devoid of obstacles. The literature offers significant insights about the application scenarios, difficulties, and knowledge gained from real-world implementations of blockchain in IoT settings.

Multiple studies have emphasised the various applications of blockchain in the Internet of Things (IoT), particularly in smart city systems. It is considered one of the most highly anticipated technologies for enhancing decentralisation and security in IoT (Yang et al., 2022). Furthermore, the integration of Blockchain with IoT can effectively address the issues posed by IoT, hence enhancing government services through digitalisation (Bataineh et al., 2022). The practical examples displayed here illustrate the adaptability of blockchain technology in meeting the trust, security, and transparency needs of IoT implementations. Nevertheless, the actual application of blockchain technology in the Internet of Things (IoT) has uncovered difficulties pertaining to scalability, consensus methods, data security, and performance (Trivedi et al., 2023). It demonstrates that offering further understanding of the obstacles could yield beneficial outcomes for utilising modified IoT blockchains in the industrial sector (Misra et al., 2021). The effectiveness of blockchain becomes a significant challenge when managing the large number of devices introduced by IoT applications (Wei et al., 2020). Furthermore, the need for resources to solve proof-of-work (PoW), the extended time it takes to confirm transactions, and the limited ability to handle large volumes of transactions have been recognised as major obstacles (Saleminezhadl et al., 2021).

The practical experiences highlight the importance of efficient consensus processes, lightweight cryptography, and scalable connection solutions specifically designed for IoT contexts (Lee et al., 2019). Furthermore, the assessment of big data processing performance for IoT-blockchain systems has emphasised the significance of transferring demanding blockchain processing jobs to compute nodes, while simultaneously ensuring the stability of data nodes (Parmar, 2023). Moreover, the incorporation of blockchain technology with the Internet of Things (IoT) to safeguard privacy

and provide secure communication has been acknowledged as a crucial domain for the fourth industrial revolution (Industry 4.0) and the fifth societal revolution (Society 5.0) (Anagnostakis et al., 2021). The research highlights the potential of blockchain in tackling specific difficulties of the Internet of Things (IoT), such as ensuring data confidentiality, integrity, and authentication. However, it also acknowledges that implementing consensus methods on IoT devices with limited resources might be computationally complex (Alamri et al., 2019). Furthermore, the implementation of deep-blockchain operation in the underlying processes of the IoT ecosystem has been recognised as a distinct problem, necessitating a high level of clarity and effective coordination.

Ultimately, the literature analysis offers a thorough comprehension of the practical applications, difficulties in execution, and insights gained from the integration of blockchain technology in Internet of Things (IoT) settings. Although blockchain presents potential answers for trust, security, and transparency in IoT applications, it is essential to prioritise the resolution of scalability, consensus processes, and performance issues to ensure the successful integration of blockchain with IoT. Promising avenues for further investigation involve the creation of effective, lightweight, and adaptable blockchain solutions designed specifically for various IoT applications. These solutions should guarantee the smooth and secure functioning of IoT devices within a blockchain network.

Ethical and legal considerations

To incorporate blockchain technology into the Internet of Things (IoT) ecosystem, it is crucial to tackle ethical and legal concerns in order to provide a secure, fair, and lawful digital environment. From an ethical standpoint, the utmost importance is placed on privacy and data protection. This entails obtaining explicit user consent before gathering, retaining, and manipulating data, as well as implementing privacy-by-design principles to limit data collection. Additionally, employing methods like anonymisation and encryption safeguards user identities. Both transparency and accountability are of equal importance. Blockchain technology may be used to ensure transparency by providing explicit information about how data is used and managed. Additionally, strong accountability procedures should be in place to immediately address any instances of data misuse.

Equity and accessibility are crucial ethical factors as well. Designing

blockchain-IoT systems that are inclusive and accessible to all users, irrespective of technological proficiency, socio-economic status, or geographical location, is of utmost importance in order to prevent digital divides. Furthermore, it is crucial to guarantee that data is not utilised for discriminatory activities or inequitable treatment. Ensuring user trust and data integrity requires prioritising security and resilience. This entails implementing robust security policies to defend against cyber threats and establishing means for data recovery and system continuity.

Legally, adherence to data protection regulations, such as the General Data Protection Regulation (GDPR) and other applicable local legislation, is obligatory. It is crucial to uphold intellectual property rights for blockchain and IoT devices. It is important to assess the legality of smart contracts to ensure that they are acknowledged and may be enforced within relevant legal frameworks, while also having explicit conditions to prevent legal conflicts. It is crucial to establish explicit definitions of liability and accountability, specifying the obligations of developers, service providers, and users in case of failures or breaches. Additionally, efficient processes for resolving disputes should be put in place.

Transferring data across borders presents extra-legal complexities, necessitating adherence to international data transfer regulations and upholding data sovereignty principles to guarantee lawful data management across different countries.

From an ethical standpoint, it is important to emphasise the compatibility of blockchain technology with wisdom (*hikmah*) and its advantages for the community (*ummah*). The decentralised structure of blockchain fosters equity, justice, and communal welfare by guaranteeing data integrity and avoiding misuse. It also cultivates a sense of common duty and protection for all community members. This ethical framework improves the ability of the digital ecosystem to withstand and recover from challenges, while also increasing its reliability and credibility.

By prudently addressing these ethical and legal factors, stakeholders may guarantee that the integration of blockchain with IoT not only improves security and transparency but also fosters a just, legal, and ethical digital future for everyone.

Discussion

The Internet of Things (IoT) holds the potential for a linked future, but as more devices get integrated into our lives, there are underlying weaknesses that need to be addressed. Ensuring the security of this collection of sensors and devices requires a revolutionary method, and blockchain technology, the master of unchangeable data, provides an intriguing option. However, fully harnessing its capabilities necessitates skillfully coordinating a deliberate sequence of recommendations:

Scalability presents a notable obstacle. Existing blockchain implementations can be readily inundated by the overwhelming amount of data generated by the Internet of Things (IoT). It is imperative to give higher importance to conducting research on alternative consensus methods, such as Proof-of-Stake, and hybrid systems that utilise technologies like fog computing to handle data in proximity to its origin. Standardisation is crucial in ensuring smooth integration across various IoT ecosystems. By defining industry-wide protocols, compatibility may be achieved. The blockchain symphony can only echo throughout the extensive array of interconnected devices at that moment.

Conventional blockchain techniques, such as Proof-of-Work, consume a significant amount of energy, which contradicts the goal of achieving sustainability on the globe. Examine energy-conserving options such as Proof-of-Stake and explore innovative approaches, such as utilising renewable energy sources to fuel blockchain networks. Ensure that the security of the blockchain does not compromise environmental sustainability.

Mass adoption hinges on the crucial aspect of user-friendliness. Sophisticated blockchain infrastructure necessitates user-friendly interfaces and efficient onboarding processes. Strong developer assistance and extensive documentation are essential tools that enable designers to construct secure and interesting IoT apps using blockchain technology. Ensure that technology is available to all, rather than being limited to a select group of technologically proficient individuals.

Establishing regulatory frameworks and implementing clear policies are crucial for fostering confidence and resolving legal ambiguities associated with this progressive technology. Effective cooperation among researchers,

policymakers, and industry practitioners is crucial in orchestrating responsible development, guaranteeing that blockchain technology delivers on its commitment to a secure and reliable future. Facilitate the convergence of the legal and technological domains in this digital composition.

In addition to ensuring the current state of affairs, research must also explore future possibilities. Explore emerging use cases in fields such as decentralised identity management and safe autonomous systems. Allow the potential of the blockchain to extend beyond conventional security measures and flourish as a harmonious ensemble of innovative opportunities.

Continuous review is crucial as we adopt blockchain technology. It is imperative to evaluate the societal ramifications of this groundbreaking technology, taking into account ethical implications, privacy issues, and future economic upheavals. Regardless of the amount of information or document, the mathematical hash function generates a hash code of equal length for each block. Therefore, every effort to modify a block of information would result in the generation of an entirely different hash value.

Kravitz and Cooper (2017) introduced a framework for constructing permissioned blockchain ecosystems that incorporate identity and attribute management for both users and devices. Identities, along with their corresponding characteristics, surpass any individual gadget or collection of devices. The suggested structure is intriguing, but there is presently no existing implementation.

Conclusion

The complex network of interconnected devices in the Internet of Things necessitates a fundamental change in security measures. Blockchain technology, characterised by its steadfast dedication to decentralisation, immutability, and secure communication, emerges as a compelling frontrunner in this endeavour. Blockchain enhances data integrity, authenticity, transparency, and trust, hence creating a more secure and resilient future for the interconnected globe. As research and development advance, the mutually beneficial connection between blockchain and IoT security is set to transform the digital environment, allowing us to confidently utilise the complete capabilities of the interconnected world with the highest level of trust and security.

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Chapter 12

Navigating Morality in Gaming: Ethical Design and Behavioral Prediction in Violent Video Games

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Abstract
With over 90% of video games rated E10+, Teen, and Mature depicting some form of violent imagery, concerns about the potential impact on aggressive behaviour remain highly relevant. The inability of players to distinguish in-game violence from real-world actions can lead to moral panic, indicative of a broader cultural issue. From a game design perspective, it is essential to create games that are entertaining, realistic, and rewarding, allowing players to engage in actions without real-world moral consequences. Game designers shape the game world through rules that guide player behaviour within set constraints. Ethical game design should consider the moral implications of in-game actions, challenging players to make decisions based on their morals and learn from the consequences. This paper reviews the application of AI to predict the behaviour of violent video gamers confronted with moral challenges in video games, and how it can change the course of the story based on the players' morality demonstrated throughout the game. The insights gained will help game designers to consider developing ethical yet engaging games, while enhancing the moral awareness of players and contributing to societal well-being.

Keywords: Ethical game design, AI predictive model, morality in gaming, violent video games

Introduction

Video games, which were once created as children's entertainment, have now found a need to address the older, mature gamers. Since the first creation of interactive video games in the 1950s, despite the crash of the

industry in the 80s, video games continue to bloom and slowly shifting to a more experiential type (Hoffin & DeVos, 2020).
When the first of the Mortal Kombat series was released in 1992, the reception came with backlash from the media due to the extreme violence featured in the game. One of the fighting techniques used in the game, the finishing move, allows the player to defeat the opponent through brutal maiming, humiliation or defilement.

On 1st December 1993, Senator Joseph Lieberman held a hearing on video games after the launch of Mortal Kombat, claiming that the game "glorifies violence and teaches children to enjoy inflicting the most gruesome forms of cruelty imaginable". This has led to the establishment of the Entertainment Software Rating Board (ESRB) to rate video games based on content (Crossley, 2014).

Doom became the first violent video game blamed due to the Columbine Shooting in April 1999. The perpetrators were found to be enjoying playing this type of video game (Campbell, 2018), hence it was believed that they were influenced by it. However, this belief was stemmed from a moral panic, a perception that occurs when the people's fears of an object or activity make them over assessing the actual threat posed to society by that object or activity (Markey & Ferguson, 2017), which gave birth to the plethora of research on topics related to violence in video games.

Violent Video Games

Violent video games usually involve physical aggression, combat, or harm to characters or players, often displaying intense or vivid portrayals of violence (Violent Video Games - (Social Psychology) - Vocab, Definition, Explanations | Fiveable, 2024). Why do people enjoy playing violent video games? The answer might be relevant to what Sicart (2009) wrote in his book, The Ethics of Computer Games, where he mentioned that "a game gives us the possibility of engaging without risk in ethical decision making in which we would otherwise never engage". This is also supported by Zhang et al. (2009) where they mentioned that through video games, gamers get to play their favorite role, create a new persona that is completely different than who they are in the real world, and more importantly, the rewards given after fighting and killing the enemies, or after committing any other violent acts in the games. Douglas Gentile, a professor at Iowa State University stated that "violent games tap into a primal instinct", making it more exciting and

challenging caused by an adrenaline rush ("Video Game Violence: Why Do We like It, and What's It Doing to Us?," n.d.), as well as the opportunities it offers to fulfil our psychological needs (Knight, 2022).

According to Barclay (2018), more than 90% of games rated E10+, Teen, or Mature will contain some type of violent imagery. Even the E-rated games, which are suitable for all ages as labelled by ESRB, do not shy away from including minimal violence in them. A study conducted by Thompson (2001) reported that 35 of 55 E-rated games deliberately involved violence, and worse, 33 games chose to reward the violence committed or make violence a requirement to advance in the game.

Clayborn and Garrison (2015) stated that there is a debate about whether playing violent video games directly or indirectly influences violent behaviour, or if there is no correlation between them at all. Greitemeyer (2019) reported that violent game play does increase a player's aggression, as well as contagion, where it can also affect other individuals in the player's network. This is further supported by Zhang, Cao and Tian (2020), where the result of their study revealed that a brief exposure to a violent video game in children can increase aggressiveness in cognition and behaviour. Similarly, Ly (2022) stated that in general, regular exposure to the brutal content in video games will become a norm, thus making the gamers insensitive to sensitive topics.

Despite the pro arguments that linked violent games and aggressive behaviour, various studies indicated otherwise. In fact, some believe that playing violent video games can lead to a positive effect. For example, according to Kersten & Greitemeyer (2021), habitual violent video gamers often find themselves in a better mood after gaming, thus reducing aggressive behaviour. Kühn et al. (2018) investigated the effects of long-term violent video gameplay on aggression with adult gamers and reported that they found no relevant negative effects in response to violent video game playing. In another similar study to find a relation between violent game engagement and observable variability in adolescents' aggressive behaviour, the same result was reported (Przybylski & Weinstein, 2019).

Whether violent video games increase or reduce the effects of aggression, the fact that they will continue to populate the video game market is enough to push game designers to consistently consider ethical game design. We

believe that, even as pure entertainment, with appropriate moral challenges presented either to move the plot forward or to serve as a reward or punishment, players of violent video games will be constantly reminded of the consequences of their actions. Therefore, in this paper, we explore previous work on the incorporation of ethical values in violent video games and how AI can be used to navigate players' morality during gameplay. The terms "player" and "gamer" will be used interchangeably throughout this paper.

Ethical Game Design

The concept of teaching through video games has been used successfully in serious games. For example, a role-playing war game simulation can be used to educate military and evaluate their knowledge on ethics and laws of war (Veziridis, Karampelas, & Lekea, 2017), or game-based learning that uses ethical reasoning to teach children on road safety (P C, Khwaja, Murthy, & Dasgupta, 2019).

The significance of ethical design in general is that, if software systems are designed without taking into account any ethical considerations at the early stage, it can negatively affect the quality of life and interfere with human rights i.e. undermining the individuals' and society's values and causing ethical issues (Razieh Alidoosti et al., 2023).

There are many ways ethical considerations can be incorporated into the design of video games. For instance, there is a potential to promote ethical reasoning and reflection in players through video games, though designing such games might prove to be a challenge (Christiansen, 2017). One of the challenges addressed by the author is the classification of action as good or evil, as this is normally dictated by one's own opinion about in-game actions, which might lead to moral disengagement. In other words, the game allows the players to perform actions that are normally not justifiable in the real world because the game environment defines its own morals and ethics, thus leading to the possibility of committing unethical behaviour within the game. Another example of an ethical consideration is also presented by Mori & Miyake (2022) in the context of dialogue used by the non-player characters (NPCs). The authors argued that it is necessary to consider the ethical hierarchy when designing the dialog system, which are i) the ethics of individual NPCs; ii) the ethics of NPCs are tied to the world of the digital game and not necessarily have to coincide with the ethics of the real world; and iii)

the designer must consider the relevance of the overall content incorporated into the dialog system based on the ethics of the contemporary era when the content is released.

As presented in the above examples, the ethical considerations are very much related to affective computing, which can be integrated into affective game loops. Melhart et al. (2023) addressed the concern about the ethical challenges of applying AI in video games within this context. The authors discussed the ethical dimensions of game AI based on i) elicitation, where the core issue would be in terms of ownership and autonomy over one's own emotions.; ii) sensing – the capture and processing of the triggered emotions where the issues are related to the trade-off between privacy and control, and malicious action in games; iii) affect detection – with the issues of transparency related to the processing and prediction of certain aspects of affect; and iv) adaptation – where the amount of ownership these players have over these affective models is unclear.

Still within the realm of ethical design, Church (2022) stated that based on a study conducted on the demographics, it is not just the young people who play video games, thus it is wise to consider cultural heritage when it comes to game industry, as well as conducting a regular ethical review of the industry. From the review conducted, the author proposed a design of the code of ethics for computer game production based on the following key principles: i) ethical content and ethical consumers; ii) ethical monetisation; iii) respect for collaborative property rights; iv) cultural rights; and v) indigenous property rights.

From what we can gather thus far, violence has become one of the appealing elements to video gamers. In terms of ethical considerations, different researchers tend to lean towards a certain aspect of ethics. It is nearly impossible to include all ethical considerations in a single video game. Therefore, for this purpose, we narrow down further our focus to look for a way to turn the appeal of violence into an opportunity by challenging the players' ethics when presented with moral dilemmas influenced by their in-game behaviour.

Predicting Gamer Behaviour

AI in gaming goes all the way back, as early as the 1970s. These can be experienced in video games such as Space Invaders that used stored patterns

for random movement of aliens, or Pac-Man with its AI pattern to its maze as well as AI-enabled ghosts having different personalities (Evolution of AI in Video Game Design: Historical Journey, n.d.).

As the AI technology evolves, we witness a new era of game development with the integration of different AI models. Tian (2024) wrote an overview on the AI applications in video games, particularly in the context of i) AI algorithms used such as reinforcement learning, imitation learning, Finite State Machine, Fuzzy State Machine and Genetic Algorithm; and ii) the optimisation of player experience and game content through AI, which include detecting rendered image glitches, game balancing, emotion detection, more intellective NPCs, and interaction with human using Natural Language Processing.

One of the ways to increase players' experience is through analysing their behaviours or skills. For instance, when they face a challenge during the game, it will be more enjoyable if the challenge is set according to their own level of skills (Massoudi & Fassihi, 2013). The authors demonstrated this through the use of fuzzy logic to measure the player's skill level and have an adaptive AI system to match that level of skill.

de Lima et al. (2022) also took the same adaptive AI approach that utilises the player's fear in real time to create virtual reality horror games. The authors implemented an Artificial Neural Network for the classification function and adopted the Fast Artificial Neural Network (FANN) library for model development.

Some games allow players to purchase or choose a profusion of items within the game in order to progress and maximise their game experience. Taking advantage of the recorded data on the players' purchasing preferences, Bertens et al. (2018) presented two models of item recommenders implemented using Extremely Randomised Trees and Deep Neural Networks, where players can automatically get personalised recommendations while playing.

Incorporating Moral Challenges in Games

The next question is, how does predicting gamers' behaviour play a role in instilling the ethical virtue in violent video gamers? This concept of incorporating ethical values is not new. Zagal (2009) discussed a few notable

video games that provided elements for encouraging ethical reasoning and reflection through the incorporation of moral dilemmas such as *Ultima IV*, *Manhunt*, and *Fire Emblem: Radiant Dawn*.

According to Shafer (2012), though there is a strong relationship between morally activated/disengaged reasoning and moral choice, in terms of enjoyment, it is pretty much equal between those who made good or evil choices. Based on his findings, he concluded that many players will apply their moral sanctions in making a moral choice when presented with reprehensible behaviour, instead of disengagement.

The idea of morality in video games is further supported by Kjeldgaard-Christiansen (2020), where the author believes that the true potential of video games within the context of ethics can be elevated by designing moral dilemmas and decisions that require players to reflect on their own values and ethical principles.

Fallout 3 is an excellent example of a game that presents players with moral dilemmas in decision-making. In this game, players must choose whether to fulfil Harold's request to end his misery—being rooted in one spot for eternity—or to spare his life, as Harold is considered a deity by the Treeminders, and killing him would cause these people to lose their god (Bethesda Game Studios, 2008). Either choice players make leads to consequences.

A series of branching narratives can present moral dilemmas and decision-making in video games by incorporating various moral challenges. The use of Machine Learning with branching narrative storytelling is nothing new. For example, Netflix released Bandersnatch, an interactive story where a recommendation is made based on the users' viewing behaviour (Riedl, 2019). Another model that has been used for this purpose is Recurrent Neural Network, where the model predicts the players' behaviour to decide the best route/conflict for them to ensure that the enjoyment and the game experience can be increased (Thue et al., 2007).

By utilising this concept, game designers can incorporate moral challenges as part of the decisions that players must make. Based on their moral preferences in making decisions during the game, players' ethical orientations can be profiled (Alfieri et al., 2022), and the game will adapt to

the player's behaviour, using it to influence the progression of the story. After all, the rise and fall based on decision-making, and how it alters the course of the game, are important for engaging a player's mind (Fullerton, 2019). The use of Islamic ethical values, such as respect for life, compassion and mercy, accountability and responsibility, and respect for dignity, can also serve as guidelines for game design, encouraging non-violent solutions whenever possible and rewarding players with positive outcomes if they manage to restrain themselves and act with wisdom.

Conclusion

This paper has outlined the enjoyment gained from playing violent video games and the necessity for game designers to consider ethical game design in their development, given the fact that most games nowadays contain some type of violent imagery. The application of ethics in video games is also slightly discussed. We have learned that there are many aspects of ethical considerations and different types of ethics implemented based on the objective of the video games.

We focus on navigating the morality of the players through a set of moral challenges, and we explore the use of AI in changing the course of the game based on the moral decisions made by the players. Quoting Hanussek (2021) where the author stated that "Video games have to be used for what they are best at, namely, engaging people effectively", and therefore, following this line of thinking, we ought to utilise the player's engagement in violent video games by presenting them with moral dilemmas based on their in-game behaviors. As reviewed previously, this might influence the players to use their virtue ethics when making a moral decision. Therefore, violent video games should not be viewed as a disease that plagues society; instead, take it as an opportunity to instil ethical values into players.

Moving forward, predictions for AI in gaming include more automated and intelligent iterations of games, highly intelligent human-like AI characters, and a more realistic environment through the use of virtual reality (Tian, 2024). With these possibilities, we can also project trends in gaming ethics. For example, with intelligent human-like AI, players might need to be morally aware of how they interact with virtual beings since these characters appear more "alive" than before, prompting careful thought about empathy and ethical treatment toward in-game characters. In terms of intelligent game-building, an adaptive ethical system could be implemented to challenge

players' ethical principles based on the moral decisions they make throughout the game. Finally, in virtual reality settings, games that are focused on real-world issues, such as climate change, poverty, or social justice, could allow players to explore these issues to foster awareness and understanding, thereby providing them with valuable ethical experiences.

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Chapter 13

Reducing Suicidal Risk Using Artificial Intelligence

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Abstract
This chapter explores how social media analysis can be used to identify and lessen suicidal behaviour with artificial intelligence (AI) and machine learning. Social media such as Facebook, Twitter, and Reddit have been widely used, and thus, AI may be able to spot linguistic patterns in user posts that are related to suicidal thoughts. AI, as represented by deep learning models, can identify people who are at risk in conjunction with natural language processing (NLP). The chapter also discusses the moral issues that arise when applying AI to such delicate activities, highlighting the significance of accuracy, privacy, and consent. Moreover, it harmonises technological endeavours with the Islamic precept of *hikmah*, which promotes discernment, mercy, and the conservation of life. This chapter aims to contribute to the reduction of suicide rates and the promotion of mental well-being in a digitally linked society by highlighting the possibilities and constraints of AI-driven suicide prevention through a thorough analysis of existing literature and practical applications.

Keywords: Suicide Risk, AI, Machine Learning, Natural Language Processing

Introduction

In a time when technology is everywhere in our lives, artificial intelligence (AI) has enormous promise for resolving pressing societal problems. Suicide prevention is one such critical issue. Suicide is a devastating and avoidable cause of death that has a profound effect on people's lives, families, and communities (Elmahjub, 2023). This chapter examines the creative use of AI and machine learning to recognise and lessen suicidal behaviour, especially through social media activity monitoring. Friends, family, and mental health experts can then be informed by the notifications, allowing for prompt support and action.

The rapid rise of social media such as Facebook, Twitter, and Reddit has changed how individuals share their ideas and opinions and interact with one another. Among the enormous amounts of content produced every day, there are both overt and covert indications of unhappiness that could point to a suicide risk (Nazwar, 2023). By observing warning indicators and offering prompt solutions, artificial intelligence (AI) is revolutionising attempts to prevent suicide. AI-powered solutions can identify at-risk individuals and link them to vital resources by evaluating data from social media, medical records, and crisis hotlines. Through improved early detection and individualised support, this technology opens up new life-saving opportunities. With AI utilising machine learning algorithms, it is possible to identify these signs and provide prompt assistance and intervention (Lejeune et al., 2022).

We will explore particular machine learning techniques that use text analysis from social media posts to forecast suicidal thoughts. Among these are natural language processing (NLP) approaches, which are able to identify emotional cues and linguistic patterns suggestive of suicide ideation. AI systems have the ability to recognise these tendencies and automatically send notifications to the user's social network, allowing friends and family to step in and provide help (Berrouiguet et al., 2019; Castillo-Sánchez et al., 2020).

Moreover, this methodology is consistent with the Islamic philosophical notion of *hikmah*, which prioritises knowledge, empathy, and the conservation of life. In Islam, suicide is regarded as haram, and it is morally required to avoid it. By utilising AI to protect vulnerable people, we not only respect these moral precepts but also advance the more general objective of lowering suicide rates and enhancing mental health and well-being (Ziaee, 2011).

This chapter will cover how AI helps to reduce suicidal risks and helps in protecting the moral issues raised, and practical case studies that illustrate their usefulness. We hope to demonstrate the significant influence AI-driven interventions can have on suicide prevention through this investigation, ultimately promoting a more secure and caring digital society.

Literature Review

This literature review aims to provide a comprehensive evaluation and summary of the substantial amount of research conducted on AI-based suicide detection. Here, we highlighted the effectiveness, limitations, and potential applications of AI-based methods in suicide detection by analysing the most recent advancements and approaches employed in this area. The analysis's findings will contribute to scholarly knowledge while also advising politicians, mental health professionals, and AI developers on the potential benefits and challenges of utilising AI in suicide prevention programs and create a great impact on helping people following Islamic rules by not committing suicide.

Table 1. Research Problems Align with our Topic

No.	Authors	Research Problems	Main techniques applied
1	de Andrade et al. (2018)	Ethics and Artificial Intelligence: Suicide Prevention on Facebook	DeepText and linear regression in random forest classifiers
2	Fabra et al. (2020)	Detecting Suicide Risk Through Twitter	Kniem clustering, for classification LSTM neural network. Suggested Random Forest classifier
3	Alotaibi et al. (2020)	A Big Data Analytics Tool for Healthcare Symptoms and Diseases Detection Using Twitter, Apache Spark, and Machine Learning	Naive Bayes, Logistic regression
4	O'dea et al. (2015)	Detecting suicidality on Twitter	SVM with TFIDF no-filter
5	Luo et al. (2020)	Exploring temporal suicidal behaviour patterns on social media: Insight from Twitter analytics.	Initially, latent subjects were deduced from the dataset of suicidal tweets. Secondly, the ideal structure for latent topics was demonstrated, providing insight into the important semantics of suicide-related tweets. Non-negative Matrix Factorisation topic modelling was used

No.	Authors	Research Problems	Main techniques applied
6	Berrouiguet et al. (2019)	Combining mobile-health (mHealth) and artificial intelligence (AI) methods to avoid suicide attempts: the Smartcrises study protocol	Utilise the two main categories of models that have been tried out in the past for suicide prediction: 1) explanatory or generative models, and 2) predictive or discriminative models. And many prediction signatures can be found.
7	Cheng et al. (2017)	Assessing Suicide Risk and Emotional Distress in Chinese Social Media: A Text Mining and Machine Learning Study	Develop algorithms that automatically classify Weibo users into two groups: those at risk of suicide and those experiencing emotional distress. And the algorithms were developed by utilising SVM
8	Coppersmith et al. (2018)	Natural Language Processing of Social Media as Screening for Suicide Risk	Use both supervised and unsupervised learning techniques to keep the model from becoming too close to the training set. GloVe embeddings that are pretrained and assessed the categorisation performance between user pairs using a 10-fold cross-validation method
9	Chatterjeea et al. (2022)	Suicide ideation detection from online social media: A multi-modal feature-based technique	The Tf-Idf vectoriser from the Scikit-learn Python module is used to extract unigrams and bigrams. The suicidal ideation categorisation task is solved using four classical learning methods. In the process of developing the model, several classifiers were used, including XGBoost, Random Forest, Support Vector Machine, and Logistic Regression.

No.	Authors	Research Problems	Main techniques applied
10	Ji et al. (2018)	Supervised Learning for Suicidal Ideation Detection in Online User Content	First, several features were extracted, including statistics, word-based features (such as pronouns and suicidal words), TF-IDF, semantics, and grammatical structure. Along with topic features retrieved by LDA as unsupervised features, the authors also used dispersed features by training neural networks to incorporate words into vector representations.
11	Aldhyani et al. (2022)	Detecting and Analyzing Suicidal Ideation on Social Media Using Deep Learning and Machine Learning Models	In the first experiment, they used supervised ML (XGBoost) and hybrid DL (CNN–BiLSTM) to learn word embeddings taken from post content using TF-IDF and Word2Vec. This allowed them to construct a SIDS that can be used to categorise social media postings as suicidal or non-suicidal. They also employed numerical features that were extracted using LIWC-22 in the second trial.

The relationship between AI and mental health has received a lot of scholarly attention lately, especially when it comes to suicide prevention. Scholars have investigated diverse approaches to use artificial intelligence's capacity to identify and alleviate suicidal thoughts via social media scrutiny (Parsapoor et al, 2023)

AI and Mental Health

An AI-powered technology called MindWatch was created to help mental health practitioners with targeted psychoeducation and early symptom detection. With the use of sophisticated language models such as ALBERT and Bio-Clinical BERT, which have been optimised using Reddit data, it is able to identify suicidal ideation with over 92% accuracy, precision, and recall. In this job, ALBERT performed better than other models, like as OpenAI GPT-3.5. The Llama 2 model offers low-inconclusiveness tailored content for

psychoeducation. This application, which adapts material to each user's needs and advances automated depressive condition identification, shows how AI may improve mental health support (Bhaumik et al., 2023).

Suicide Detection with Machine Learning

Recent studies have explored various machine learning techniques for classifying health-related tweets and detecting suicidal thoughts on social media (World Health Organization, 2021). Alotaibi et al. (2020) found that Naive Bayes with Trigram feature extraction achieved the highest accuracy (78.2%) for classifying health-related tweets, while Logistic Regression with HashingTF excelled in both accuracy (86.7%) and F1-score (85.6%) for second-level classification (Alotaibi et al., 2020). Aldhyani et al. (2022) demonstrated that LSTM deep learning models outperformed SVM in identifying suicidal ideation on social media, achieving high accuracy (0.91) and F1-score (0.92). Ji et al. (2018) highlighted Random Forest's effectiveness in categorising suicidal thoughts on the SuicideWatch subreddit, using various feature combinations and machine learning algorithms (Aldhyani et al., 2022). O'dea et al. (2015) showed that SVM with TFIDF features was most effective in categorising tweets about suicide, emphasising the potential for improved performance with more data. Despite successes, limitations such as handling sarcasm and addressing ethical concerns remain (O'dea et al., 2015).

Numerous machine learning methods, each with unique benefits and drawbacks, have been used to prevent suicide. In terms of accuracy, speed, and real-world applicability, sophisticated models such as deep learning and natural language processing (NLP) provide greater accuracy and versatility, but they necessitate substantial computer resources and continuous upkeep. Although simpler models, such as SVMs or decision trees, may be less accurate, they may be implemented more quickly and are more practical in settings with limited resources. For practical applications, hybrid approaches frequently combine the advantages of several different approaches in a balanced manner (Aldhyani et al., 2022; O'dea et al., 2015; World Health Organization, 2021).

NLP Techniques

The implementation and experimentation that were done in the first pilot study to test the approach given in the work are the most significant features in the article written by Fabra et al. (2020). 3,051 context-sensitive Tweets

were obtained via the Amazon Web Services architecture and annotated with the help of the Indico API. As a result, five different emotions were felt: surprise, delight, fear, anger, and sadness. TensorFlow was used to create the LSTM neural network, and 100 iterations were used to train it. With an impressive accuracy rate for the test data and a small number of false positives and negatives, the training results are extremely encouraging (Fabra et al., 2020).

Ethical Considerations

The article by de Andrade et al. (2018) demonstrates the mapping of abstract philosophical and ethical issues to particular, tangible product decisions. It offers a case study illustration of how these procedures for ethical reviews function in an actual business environment, using AI and suicide prevention as a tangible product driven by a particular technology (de Andrade et al., 2018).

AI in Real-World Applications

An article by de Andrade et al. (2018) says that Facebook uses its platform to provide tools and assistance to people who are contemplating suicide. They work with groups like Crisis Text Line and Lifeline to use AI to identify suicidal messages and link people to resources. Facebook's Privacy Program attempts to address these difficult ethical issues by striking a balance between privacy and safety. In the face of imprecise solutions, Facebook solicits feedback from a range of sources and collaborates with specialists to improve its strategy. This case study encourages other businesses to increase transparency in tackling ethical concerns in technology and provides an example of how ethical considerations influence product decisions (de Andrade et al., 2018). Other than that, Reddit and Facebook, for example, have partnered with mental health organisations to incorporate AI-based suicide prevention tools. After evaluating these tools' efficacy, discovered that, despite their potential, there are serious issues with scalability, accuracy, and user acceptability (D'Hotman & Loh, 2020).

By spotting the warning signals and getting assistance, it is frequently avoidable. The potential and constraints of AI, particularly machine learning and deep learning, for mood analysis to identify early indicators of depression and reduce suicide risk, are discussed in this communication (Zohuri & Zadeh, 2020).

Summary of Literature Review

A growing body of research on the use of AI in suicide prevention has revealed how machine learning and natural language processing may be used to scan social media data for indicators of suicidal thinking. The viability of employing AI to identify mental health trends has been demonstrated by foundational research, and particular techniques are being developed to improve the precision and dependability of suicide prediction. Through the use of linguistic patterns, techniques including sentiment analysis, SVM, RNN, and logistic regression have been shown to be successful in identifying people who pose a risk. The use of these technologies must, however, handle important ethical issues, especially those pertaining to privacy and the possible consequences of inaccurate forecasts. Although there are still obstacles to overcome, real-world applications are demonstrating promise in reducing the risk of suicide by intervening early. In general, literature emphasises how crucial it is to keep up the research and exercise ethical caution when creating and utilising AI-driven suicide prevention technologies.

Existing Techniques

Table 2: Existing Techniques

No	Techniques
1	DeepText and linear regression in random forest classifiers (de Andrade et al., 2018)
2	Kniem clustering For classification LSTM neural network Suggested Random Forest classifier (Fabra et al., 2020)
3	Naive Bayes, Logistic regression (Alotaibi et al., 2020)
4	SVM with TFIDF no-filter (O'dea, 2015)
5	NMF (Non-negative Matrix Factorisation) topic modelling (Luo et al., 2020)
6	Used Nonparametric Bayesian (NPB) techniques (Berrouiguet et al., 2019)
7	The support vector machine (SVM) was utilised to develop algorithms (Cheng et al., 2017)
8	Both supervised and unsupervised learning techniques with GloVe embeddings that are pretrained, and finally 10-fold cross-validation method (Coppersmith et al., 2018)
9	The Tf-Idf vectoriser from the Scikit-learn Python module. Then classifiers: XGBoost, Random Forest, Support Vector Machine, and Logistic Regression (Chatterjee et al, 2022)
10	Several features were extracted Applied TF-IDF Features Retriever: LDA as unsupervised features To incorporate words into vector representations: Neural Networks (Ji et al., 2018)

No	Techniques
11	To Embed post words: TF-IDF and Word2Vec. Learn embedded words by: supervised ML (XGBoost) and hybrid DL (CNN–BiLSTM) (Aldhyani et al., 2022)

Best Accuracy Rates of Different Models

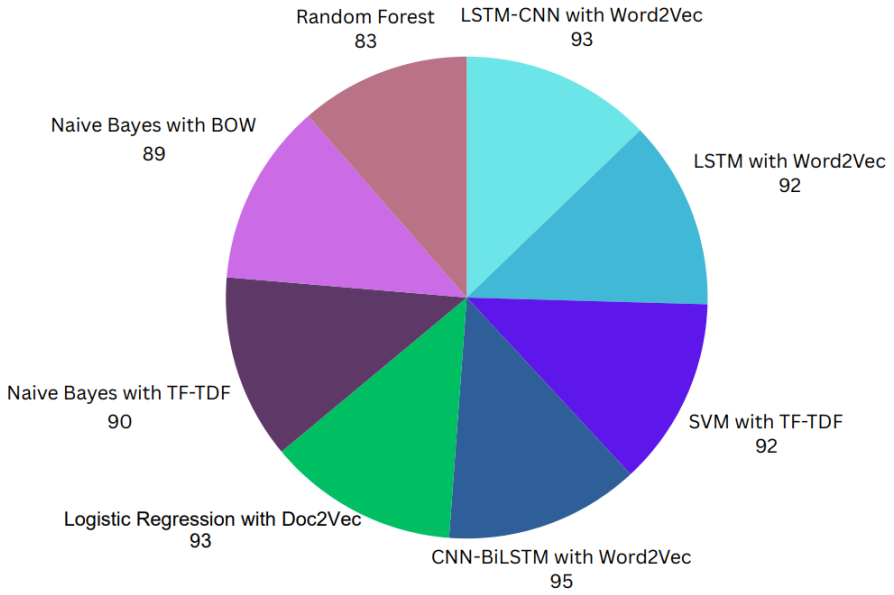

Figure 1: Best Accuracy Rate of Different Models (Aldhyani et al., 2022)

After reviewing all the reference papers, we tried to find out the best accuracy rate achieved by models and select the first 8 models that showed the best results, which are respectively CNN-BiLSTM with Word2Vec, Logistic regression with Doc2vec, LSTM-CNN with Word2Vec, LSTM with Word2Vec, SVM with TF-TDF, Naïve-Bayes with TF-TDF, Naïve-Bayes with BOW and Random Forest with an accuracy rate of respectively 95%, 93%, 93%, 92%, 92%, 90%, 89% and 83% as shown in Figure 1.

Conversational Agents in the Clinical Management of Suicide

Conversational agents are NLP-based computer programs that directly engage with people in simulated conversation by providing human-like responses via a text- or voice-based interface. This is an emerging AI method for "therapy". The delivery of psychological interventions, including social therapy, cognitive behavioural therapy, and trauma therapy, has been incorporating conversational technology more and more. The program adapts to the discourse that is offered, allowing for the delivery of

interventions that are customised to a patient's emotional state and therapeutic needs. Similar, albeit in development, technologies are being added to smartphones so that voice assistants can identify and address customer concerns about mental health (Fonseka et al., 2019).

Additionally, conversational bots are being included in suicide treatment as virtual counsellors and clinical training simulated patients. Conversational agents can be trained to perform a variety of tasks within direct patient care, such as gathering data on the patient's clinical status, offering psychoeducation, recommending supports, and administering patient-tailored psychotherapies. For the purpose of managing suicide, several conversational agents have been created and integrated into web and mobile platforms, as shown in Figure 2.

Program name	Description	Reference
ELIZA	Responds to mental health issues utilizing Rogerian psychotherapy concepts.	www.maswerk.at/elizabot/
Woebot	Provides personalized cognitive-behavioral therapy (CBT) tools, including mood tracking and psychoeducation, to help users gain insight into themselves.	https://woebot.io/
Wysa	Emotional-support treatments, such as CBT, DBT, meditation, yoga, and breathing exercises, are used to assist people regulate their emotions and cognitive processes.	www.wysa.io/
Ellie	Assesses psychological discomfort in veterans through reading facial expressions, body language, and emotional clues, including sadness, anxiety, and PTSD.	http://ict.usc.edu/prototypes/simsensei/
SPARX-R	Personalized avatars guide patients through a fantasy game to provide cognitive behavioral therapy. The approach aims to reduce depression and address suicide behavior as a secondary goal.	www.sparx.org.nz

Figure 2: Example Conversational Agents (Fonseka et al., 2019)

AI has demonstrated its ability to save lives by being successfully used in several global programs to lower the risk of suicide in the real world. For example, currently, Facebook's AI-based suicide detection tools are handling thousands of users who are connected with helplines or emergency services, especially in societies or regions where it's hard to get mental health support. Rather than Facebook, more such services are serving to detect suicidal thoughts, such as "Crisis Text Line, VA REACH VET Program, MindStrong Health, Koko AI Platform, Samaritans Rader (UK)", etc. These AI systems are regularly helping people in the real world to prevent suicide.

Conclusion

This chapter has examined, using the lenses of machine learning and NLP, the exciting nexus between AI and suicide prevention. AI provides a potent tool for early intervention and support due to its capacity to evaluate enormous volumes of social media data and recognise linguistic patterns suggestive of suicidal thinking. By using these tools to notify loved ones, friends, and mental health specialists when someone is in danger, we may be able to save lives (Fonseka et al., 2019).

The effectiveness of certain machine learning models, such as logistic regression, SVM, RNN, and CNN, is highlighted by our analysis of the literature. When paired with cutting-edge NLP methods such as sentiment analysis and topic modelling, these models have demonstrated remarkable efficacy in accurately identifying suicide posts (Ji et al., 2018).

However, there are important ethical questions that are also raised by the use of AI in this delicate field. The appropriate application of AI in suicide prevention depends critically on protecting user privacy, getting informed consent, and reducing the possibility of false positives and negatives. To promote trust and efficacy as we incorporate new technologies into practical applications, it is critical to address these ethical issues.

An ethical framework that is meaningful is created when AI-driven suicide prevention is in line with the teachings of *hikmah*, which prioritise compassion, wisdom, and the preservation of life. This alignment guarantees that technical breakthroughs are applied for the greater good, thereby improving mental health and well-being, in addition to aiding in the observance of moral imperatives (Elmahjub, 2023).

In conclusion, even though AI offers a revolutionary chance to lower suicide rates, care and ethical consideration must be taken at every step. To fully realise AI's promise to build a safer, more supportive digital environment for everyone, further study, collaboration between technologists and mental health specialists, and adherence to Islamic ethical norms are essential.

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Chapter 14

An Islamic Ethical Approach to Artificial Intelligence Governance

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Abstract
Artificial intelligence (AI) is rapidly transforming societies, underscoring the need for ethical and responsible governance rooted in Islamic principles. This study introduces a comprehensive AI governance framework inspired by fundamental Islamic values, emphasising accountability, transparency, fairness, trust (*Amanah*), justice (*Adl*), responsibility (*Muhtam*), explainability (*Mubin*), and ethical leadership (*Khalifah*). The framework demonstrates practical applicability through Retrieval-Augmented Generation (RAG) systems for large language models (LLMs). RAG enhances accuracy and relevance by dynamically retrieving external knowledge during inference, making it a promising tool for aligning AI outputs with Islamic values. By operationalising these principles, RAG systems can support ethical, trustworthy, and socially beneficial applications in fields such as education, healthcare, financial services, and environmental governance. This value-driven paradigm offers a foundation for responsible AI development, providing a unique perspective for scholars and practitioners to explore further. It is intended as a catalyst for scholars and practitioners to discuss and investigate this novel viewpoint further.

Keywords: AI, Framework, Islamic, Responsible

Introduction

Artificial intelligence (AI) is a branch of computer science that aims to create intelligent machines that can perform tasks that normally require human intelligence, such as visual perception, speech recognition, decision-making, and language translation. They take in data to learn and predict or decide

without being explicitly programmed on any rules, with algorithms and statistical models, and techniques from machine learning.

AI applications range across industry sectors, namely healthcare, finance, transport, and education. AI has the power to change a lot of sectors and to make life better for many people in a lot of ways, yet it also creates ethical and social issues, including bias, privacy issues, and job losses.

The accelerated adoption of artificial intelligence (AI) has garnered spirited debates over its ethical implications and governance. While most frameworks found in literature today are largely concerned with technical and legal elements, this study provides a fresh approach that anchors AI with the adoption of Islamic principles. Using basic Islamic values such as *Amanah* (trust), *Adl* (justice), and *Mubin* (clear understanding), the goal is to fill a critical void by proposing an Islamic-infused AI governance framework. This not only ensures responsible and ethical AI system development, but it also provides a distinct feature that complements and improves contemporary secular Western paradigms.

Existing models in recent studies generally focus on the technological and legal aspects of AI governance, frequently overlooking the broader societal and ethical implications (Mohadi & Tarshany, 2023). While significant efforts have been made to establish ethical frameworks for AI development, such as those outlined by Paraman and Anamalah (2023) and the governance structures investigated by Birkstedt, Minkkinen, Tandon, and Mäntymäki (2023), these frameworks primarily operate in a secular Western context. This paper presents an AI governance framework based on *Maqāṣid al-Shari'ah*, which includes the overarching aims of Islamic law and essential Islamic values. By embracing these essential concepts, we hope to create a complete approach that protects human dignity, promotes societal welfare, and ensures the responsible use of AI.

Recent Developments

Since artificial intelligence (AI) is growing so quickly, there have been intense debates on the need for strong governance and ethical frameworks. There have been numerous efforts to build guardrails for AI deployment by introducing ethical principles to ensure the safety of AI usage. Current research frequently ignores the larger social and ethical ramifications of artificial intelligence in favour of concentrating primarily on the technological

and legal aspects of the field. Accountability, openness, justice, trust, responsibility, explainability, bias reduction, and alignment with society's well-being are some of the major topics that have emerged from the field of AI ethics and governance.

There have been suggestions for an AI governance framework that consists of rules, guidelines, and best practices to direct the moral advancement, application, and utilisation of AI technology. The development of generative AI has made it necessary to define parameters that guarantee adherence to legal requirements, ethical norms, intellectual property protection, and privacy issues. By encouraging openness, responsibility, explainability, and equity, an AI governance framework guarantees responsible AI development. The framework is essential for increasing users' and stakeholders' trust and confidence in AI systems; it is not just about complying with regulations. Explainability, accountability, safety, security, transparency, fairness and inclusivity, reproducibility, robustness, and data governance are among the values that support AI governance, according to a recent article published by Wood (2024).

Effective AI governance, according to the author, is crucial for the ethical and responsible application of AI technology in a variety of industries because it promotes credibility, strengthens data transparency and compliance, and facilitates data-driven decision-making.

A pioneering legislation called the EU AI Act was created to strike a balance between AI advancement and social and ethical protections. Taking a risk-based approach, it classifies AI systems according to how dangerous they could be and applies laws that are specific to each category. Building solid risk management frameworks that give priority to explainability, accountability, and transparency at every stage of the AI lifecycle, especially for high-risk applications, is a fundamental tenet. The coverage of areas listed under this act is depicted in Figure 1. To promote responsible innovation, the Act establishes "innovation sandboxes," which are regulated spaces where artificial intelligence (AI) solutions can be created and evaluated under regulatory supervision.

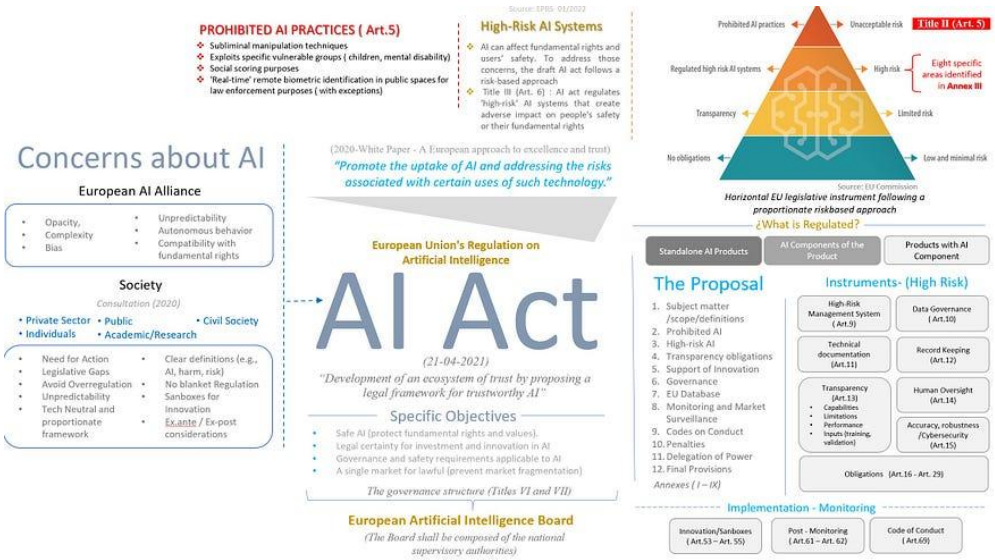

Figure 1: Details on the EU AI Act (Neuwirth, 2022)

This act is an important framework created to guarantee that AI is trustworthy and safe. It gives firms operating throughout the EU clear legal requirements while protecting the basic rights and health and safety of their inhabitants. The Act tackles greater societal hazards that AI systems can bring about, such as inequity, in addition to protecting individuals.

The EU establishes a new benchmark for moral AI governance by placing a high priority on accountability, openness, and justice (Chirinos, 2024). This approach is likely to impact AI policy globally, pushing the sector toward more responsible practices even though there are still obstacles to overcome.

In academia, several frameworks for ethical AI governance have been proposed in response to the growing recognition that unchecked technological development could lead to dangerous or potentially harmful AI outcomes (Xue & Pang, 2022; Díaz-Rodríguez et al., 2023). These frameworks aim to ensure that AI advancements are guided by ethical principles, safeguarding against risks that could arise from the rapid evolution of AI technologies.

Díaz-Rodríguez et al. (2023) emphasise that integrating ethical principles with regulatory requirements is crucial for developing trustworthy AI systems. To create AI that is reliable, safe, and beneficial to society, it's essential to incorporate both moral values and legal frameworks. Ethical principles serve as a moral compass, guiding developers to design AI that respects human rights, minimises biases, and prioritises the common good. Meanwhile, regulatory requirements ensure that AI systems comply with legal obligations, such as data protection, consumer rights, and safety standards. By merging these elements, organisations can build AI systems that not only fulfil legal requirements but also contribute positively to society. This concept of a trustworthy AI is depicted in Figure 2 shown below.

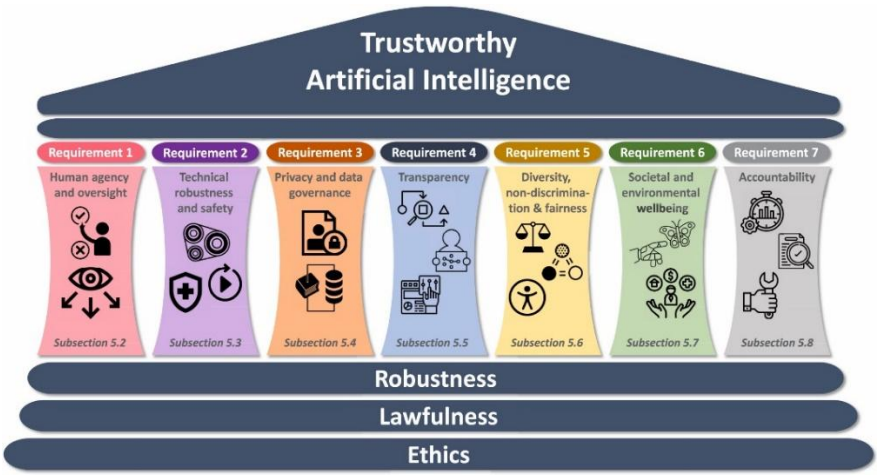

Figure 2: Trustworthy Artificial Intelligence (Díaz-Rodríguez et al., 2023)

Another similar framework, with a significant focus on ethical issues, risk management, and regulatory compliance, also examines similar qualities to offer a systematic way to managing and overseeing the development and deployment of AI technology within organisations (*AI Adoption Requires Strong Governance Through Ethical and Risk Management Frameworks, Says Info-Tech Research Group*, 2022). Three fundamental parts of the framework include defining roles and duties inside the governance structure, creating an operating model that is in line with organisational goals, and putting strong model governance procedures for AI and machine learning systems into practice. An overview of this framework is shown in Figure 3.

Figure 3: Info-Tech Research Group's Guide to Enhancing AI Governance in Organisations (CNW Group/Info-Tech Research Group)

Additionally, this framework encompasses a set of policies, procedures, and technological tools designed to support governance activities, along with continuous monitoring mechanisms to identify and mitigate potential risks. The framework is underpinned by six fundamental ethical principles—trustworthiness, accountability, responsibility, transparency, explainability, and fairness—that guide the ethical development and deployment of AI systems, ensuring they are reliable, ethically sound, and free from discriminatory biases. This framework serves as a basis to be adapted into the proposed Islamic AI governance framework by adding an important component or Islamic governance namely Leadership (Khālifah).

While initiatives like the EU AI Act and other frameworks have made significant progress in addressing the ethical, legal, and technological aspects of AI, a notable gap remains. These frameworks are largely grounded in Western legal and ethical paradigms, often neglecting the broader sociocultural implications of AI. Given the increasing complexity and potential impact of AI systems, there is a pressing need for a more comprehensive approach that goes beyond these limitations. Building on the insights gained from existing frameworks, this study aims to offer a new perspective on AI governance by incorporating Islamic principles into AI development and

governance, thereby addressing the ethical and societal challenges posed by this transformative technology.

Proposed Framework

Building upon the insights gained from existing AI governance frameworks, this study proposes an innovative framework rooted in Islamic principles. To address the growing complexities and ethical challenges posed by artificial intelligence, we introduce the Islamic AI Governance Framework shown in Figure 4. This framework is anchored in eight core values: *Akhlaq* (ethical), *Muhtam* (Responsible), *Amanah* (Trustworthy), Adil (Fair), *Khalifah* (Leadership), Hisab (Accountable), *Mubin* (Explainable), and Sahih (Transparent). By integrating these Islamic principles, we aim to establish a comprehensive and morally grounded approach to AI development and deployment.

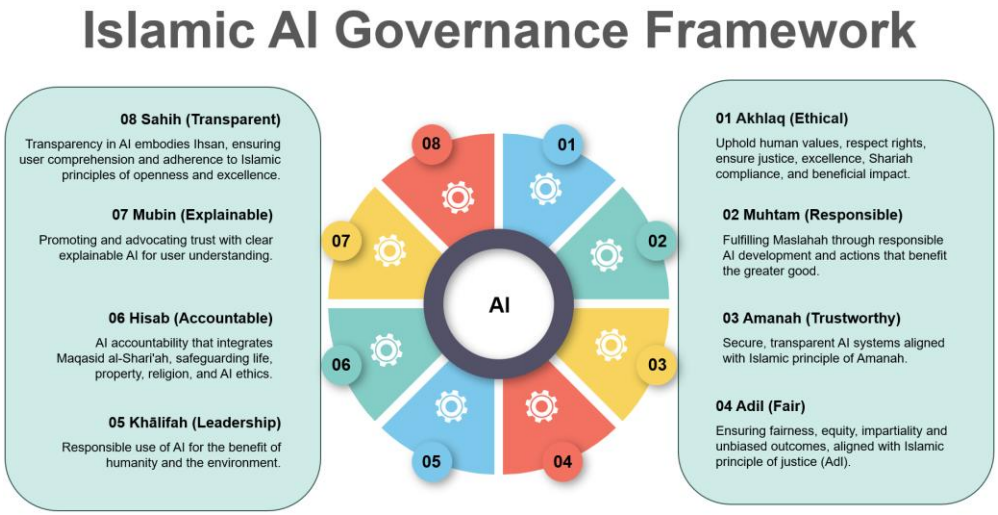

Figure 4: Proposed Islamic AI Governance Framework

Each of these principles is designed to ensure that AI technologies are developed and implemented in a manner that respects human dignity, upholds justice, and promotes the greater good, while also being transparent, explainable, and accountable. This framework aims to guide organisations in creating AI systems that are not only technically robust but also ethically sound, fostering trust and ensuring that AI serves the best interests of society as a whole we will now look at each of these core values and their role in ensuring the incorporation of Islamic principle into AI Governance.

01 *Akhlaq* (Ethical)

We begin with the first core value: Islamic moral standards, or *Akhlaq*. *Akhlaq* represents fundamental principles that guide individuals' actions and decisions, serving as the foundation for a just society. These principles are closely linked to the concept of justice (*Adl*), which embodies justice and fairness (Rahim, 2020). In the context of AI governance, *Akhlaq* ensures that systems are developed and implemented in a manner that upholds Islamic ethical standards, including accountability, transparency, and the protection of human rights (Birkstedt, Minkkinen, Tandon, & Mäntymäki, 2023). According to these guidelines, AI must be created with the idea of advancing the common good and being consistent with the overarching objectives of *maqasid al-shari'ah*. Islamic ethics is relevant not only for character development but also because it answers the pressing need for a moral compass in contemporary Muslim society and offers a strong basis for moral judgment - a critical component of responsible AI.

02 *Muhtam* (Responsible)

Islam holds that every deed and decision must be made with the notion of accountability, or muhtam, in mind. It's the conviction that each person is responsible for their deeds and will be held accountable for them. This idea is strongly related to the Islamic governance concept of accountability (*mas'ul*), which maintains that decision-makers and leaders bear responsibility for the welfare and prosperity of their communities (Ayaz & Mansoori, 2017). Within the framework of AI governance, the principle of accountability mandates that both AI system creators and users have responsibility for the moral and societal consequences resulting from their activities. *Muhtam*, or responsible AI, is a critical concept in Islamic ethics and governance frameworks for AI (Al-Shami, 2020).

03 *Amanah* (Trustworthy)

Another core principle in Islam is *amanah* (trustworthiness). This describes the moral qualities of accountability and trust that every Muslim should uphold in their day-to-day existence. It is a crucial characteristic that keeps one from being perceived as a thoroughly depraved party (Shuhari et al., 2019). *Amanah* is vital in guaranteeing the dependability and credibility of AI systems within the framework of AI governance. It is imperative to make sure that decisions made by AI systems are reasonable, fair, and moral since they have the potential to impact people's lives. As a result, *Amanah* is a crucial part of responsible AI governance, and it is crucial to make sure that AI

systems are developed and put into use in a way that respects accountability and reliability.

04 *Adil* (Fair)

Islam views *adil* (fair) as a basic virtue that highlights the value of equity, impartiality, fairness, and unbiased results. This virtue is strongly related to the Islamic concept of justice (*Adl)*, which stipulates that everyone must be treated fairly and without bias (Tavakoli, Sahraian, & Ebrahimi Kooshali, 2024). *Adil* mandates that AI systems be developed and applied fairly and equally in the framework of AI governance, making sure that they do not reinforce or worsen already-existing biases and inequities. This entails guaranteeing that AI systems are created with the greater good and the flourishing of humans in mind, and that they are open, responsible, and subject to ethical and legal scrutiny.

05 *Khālifah* (Leadership)

One of the core concepts that is an important trait in Islam is *Khālifah* (leadership), which describes the function of a leader in pointing a group of people, organisation or a country in the correct direction (Ihsan, Maha, Himam, & Fauziah, 2023). Leadership is essential in the context of AI governance to guarantee that AI systems are created and applied in an ethical, responsible, and beneficial way. The proposed Islamic AI governance framework identifies several crucial elements of Islamic leadership, such as upholding human values, respecting rights, ensuring justice, excellence, *Shariah* compliance, and positive impact; fulfilling *maslahah* (benefit) through responsible AI development and actions; and guaranteeing fairness, equity, impartiality, and unbiased outcomes. These guidelines can be used to make sure AI systems are developed and used in a way that upholds Islamic beliefs and principles.

06 *Hisab* (Accountable)

Accountability (*hisab*) in Islam is a fundamental concept that requires individuals to be responsible for their actions and decisions (Rashid, 2020). This principle is closely linked to AI governance, as AI systems are designed to make decisions that can have significant impacts on people's lives. As such, it is important to ensure that AI systems are designed and used in a way that is accountable and transparent, and that individuals are held responsible for the consequences of their actions. This can be achieved through the development of ethical guidelines for AI governance, as well as through the

establishment of accountability mechanisms to ensure that AI systems are used in a way that is consistent with Islamic principles. Ultimately, accountability is a key component of good governance in Islam, and it is essential that AI governance is designed with this principle in mind.

07 *Mubin* (Explainable)

The development and management of artificial intelligence (AI) are intimately related to the Islamic notion of *Mubin*, or explainable. *Mubin* refers to the capacity to give concise, intelligible justifications for its choices and acts (Al-Qur'an, 2023). This guarantees that users can trust and comprehend the decisions made by AI systems, which is significant in the context of AI governance. Furthermore, it contributes to the transparency and accountability of AI systems, two key tenets of Islamic governance. The Islamic notion of *Amanah* (Trustworthiness), which mandates that AI systems be dependable, secure, and trustworthy, is closely related to the idea of *Mubin*. As a result, creating *Mubin*-compliant AI systems is crucial to Islamic and responsible AI governance.

08 *Sahih* (Transparent)

Another principle of Islamic good governance, *Sahih* (Transparent), highlights the significance of transparency in all spheres of life, including AI governance. The Quran (Quran, Al-Baqarah, Beginning of the *Ayat*, 2:282) refers to transparency when it says that all transactions must be documented to prevent injustice (Waluya & Mulauddin, 2020). Transparency is essential to the governance of AI to guarantee that AI systems are developed and used in an ethical, equitable, and responsible manner. This entails making sure AI systems are visible and easy for users to understand, as well as sharing information about their tactics, results, and impact. Encouraging openness in the governance of AI ensures that the technology is applied for the good of people and the environment while also fostering confidence in it.

Throughout this section, we review the eight basic principles of *Akhlaq*, *Muhtam*, *Amanah*, *Adil*, *Khalifah*, *Hisab*, *Mubin*, and *Sahih* that form the basis of the proposed Islamic AI governance framework. Incorporating Islamic principles in governing the implementation of AI requires a thorough examination of the value of each principle. The discussion highlighted the importance of these principles in creating and using AI systems in an ethical, responsible and consistent manner with Islamic teachings. The proposed framework is intended to be used to create AI systems that are transparent,

fair, accountable, trustworthy, and socially valuable by combining these concepts. Ultimately, this framework will provide a strong foundation for understanding the successful integration of Islamic values in AI governance.

Applications

Although this framework is suitable for all AI development that accommodates Islamic principles, it has a particular applicability in Result Augment Retrieval for Large Language Models (LLMs). RAG is an improved framework that combines LLMs with an information retrieval system, intending to generate quality performance in terms of producing valid and contextually relevant outputs. While traditional LLMs depend solely on pre-trained knowledge, RAG dynamically retrieves external knowledge from structured or unstructured databases during inference. This lets the model answer queries that require domain-specific information or current information that is generally absent in its training data. Mao et al. (2024) discuss the in-domain adaptation of Retrieval-Augmented Generation through self-alignment.

RAG frameworks significantly reduced the problem of hallucination and increased factual accuracies. In several areas, RAG frameworks significantly reduced the problem of hallucination and increased factual accuracies (Njeh, Nakouri, & Jaafar, 2024). This is the modular and scalable way to enhance all the LLM capabilities, exploiting the latest retrieval methods and generative pre-training improvements in design. Having a transparent information flow from learning to AI output makes this application one of the better examples where the proposed framework can be utilised effectively. Recent studies, such as those by Zhao et al. (2024) and Siriwardhana et al. (2023), have demonstrated the effectiveness of RAG in various applications, including AI-driven customer support and interactive AI systems.

The proposed framework serves as a baseline for assessing and applying Retrieval-Augmented Generation (RAG) systems following Islamic ethical norms. RAG, a technique that retrieves knowledge from external sources and integrates it into generative outputs, stands out as a prime candidate for applying the eight principles outlined in the framework. This section demonstrates how RAG can operationalise these principles in its design, deployment, and usage, ensuring alignment with Islamic values.

In the context of retrieval-augmented generation (RAG), ethical considerations are critical. These systems must adhere to concepts such as *Akhlaq* (Ethics), which guarantee human dignity, respect for rights, and useful, non-harmful use. For example, a RAG-powered educational system can be configured to filter and retrieve content that adheres to Islamic standards while avoiding dangerous, inappropriate, or deceptive material. This can be accomplished by ethical rules and content validation procedures that reject banned content, such as misleading information or data that promotes harm, in line with the larger AI ethics debate on cultural diversity and harm-free activities (Resnik & Hosseini, 2024).

Taking into account the concept of *Muhtam*, or Responsible AI, we use AI as a means to achieve *Maslahah* (the greater good); a society, humanity, and the rest of the environment must come first. As an example, the retrieval of accurate, evidence-based knowledge for medical professionals can also support responsible decision-making and improve patient outcomes when using a RAG system in healthcare. Developers have suggested policy implementation to prioritise among sources peer-reviewed, ethically appropriate, and high-quality sources during retrieval, enhancing patient safety and decision-making (Obermeyer et al., 2019). Also, Trustworthiness (*Amanah*) and Fairness (*Adil*) are important attributes that contribute to transparency in source selection mechanisms for both governance and fair algorithms that will assure reliability, safety, and unbiased outputs and provide trust from users while also mitigating biases (Freiesleben et al., 2024; Mehrabi et al., 2021).

Khalifah (Leadership) and *Hisab* (accountability) are two important moral principles for RAG systems. As stewards of technology, RAG systems must promote sustainable and socially beneficial outcomes in harmony with Islamic value at such a point as possible. An example here would be environmental governance, where an RAG system may seek out and access practices on sustainability drawn from both global and Islamic environmental policies. Ethical frameworks should be incorporated in the design of RAG systems, prioritising long-term societal and ecological benefit over short-term gain, as noted by research advocating responsible AI leadership (Rolnick et al., 2019).

Accountability, in this regard, refers to having mechanisms that track, explain, and justify the retrieval and generation process. For instance, a RAG-based

legal advisory system could maintain logs of its sources and decision-making pathways by which its *Shari'ah*-compliant recommendations are derived, thus ensuring the possibility of auditing the process by stakeholders. Enabling such features as robust tracking, explainability, and user feedback loops can further fortify these RAG systems to be answerable to users and regulatory bodies (Floridi and Cowls, 2019).

The principles of *Mubin* (Explainable) and *Sahih* (Transparent) further improve trust and transparency in RAG systems. Explainability is a major ingredient in building user trust and making transparent how content is retrieved and generated. For instance, a RAG system for Quranic or Hadith interpretation might explain the sources and rationale behind its responses, helping the user weigh the authenticity and relevance of the content retrieved. Explainability algorithms and user interfaces should give clear, short justification with respect to all outputs, along with the source retrieved (Gilpin et al., 2018).

Transparency means that RAG systems are functioning in an open way consistent with the Islamic principles of *ihsan* (excellence) and *shafaa* (openness). In research, for example, a RAG-based AI would be able to disclose fully which sources it retrieves, making distinctions between credible academic references and sources of lesser value. That will ensure greater integrity and trustworthiness for the system (Wachter et al., 2017).

From the preceding paragraphs, it can be seen that the proposed framework offers a robust method for ensuring Retrieval-Augmented Generation (RAG) systems comply with Islamic ethical principles as one of its example applications. RAG can eventually be set up according to the eight major components of *Akhlaq* (Ethics), *Muhtam* (Responsible), *Amanah* (Trustworthy), *Adil* (Fair), *Khalifah* (Leadership), *Hisab* (Accountable), *Mubin* (Explainable), and *Sahih* (Transparent). RAG will filter-retrieve information that is generally complementary towards human dignity and diversity through guidelines and content validation mechanisms.

It can be used as an educational tool, a healthcare system, a financial advisory for green governance in society, towards a better future. Source transparency, ethical filters, accountability-through-logs-and-feedback, and algorithms for explainability ensure the reliability, safety, and fairness of RAG output for users but also bring user confidence in upholding Islamic values.

Conclusion

As artificial intelligence is developing at an amazing pace, there is a need for a very strong ethical governance framework. Thus, the present research brings forth a new vision of AI governance inspired by Islamic principles as a significant complement to existing approaches. The Islamic AI Governance Framework, thus, steers understanding of fundamental principles such as *Amanah* (trust), *Adl* (justice), and *Mubin* (clear understanding) for an ethical framework compatible with contemporary, secular Western models and considers *Maqāṣid al-Shari'ah*, whereby the focus is on human dignity, societal wellbeing, and responsible use of AI.

Promising to ensure systems of AI are designed and used in adherence to Islamic principles and for the common good, the framework incorporates such concepts as *Akhlaq* (ethics), *Muhtam* (responsibility), *Khilafah* (leadership), *Hisab* (accountability), and *Sahih* (transparency). It lays particular emphasis on explainability, accountability, transparency, and fairness in order to build confidence between human users and AI systems.
One possible real-world application can be seen through the perspective of Retrieval-Augmented Generation (RAG) systems for large-language models (LLMs). RAG dynamically retrieves external knowledge during inference in order to enhance the accuracy and contextual relevance of outputs while ameliorating the problems of hallucinations and bias. Thus, the integration of this dimension of AI allows it to be consistent with the Islamic ethical principles, proving its capability to fulfil the valorisation of human dignity while advancing societal harmony and the common good.

This value mechanism would be an integrated approach to the governance of AI, incorporating Islamic values as catalysts for more than scholars and practitioners could have imagined. It is a possible road to the morality of the AI and the technological future.

Future Work

This study lays the groundwork for integrating Islamic principles into AI governance and opens several avenues for future research. First, comprehensive empirical research is required to assess the practical applicability of the suggested framework in many organisational contexts, including the development of comprehensive policies and resources for its implementation. Second, by comparing current AI governance frameworks with one another, it may be possible to find areas of overlap and convergence

that could lead to the creation of a more thorough and broadly applicable strategy. Third, implementing the framework in specific technology fields such as healthcare, banking, and self-driving systems would provide vital insights into its practical applicability and impact. Finally, interacting with policymakers and industry stakeholders is critical for promoting framework adoption and developing supportive policies and regulations. Pursuing these research directions will help to improve our understanding of Islamic-based AI governance and lead to the creation of ethical and responsible AI systems.

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Chapter 15

Conclusion: Integrating *Hikmah* and Artificial Intelligence for a Better Future

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Introduction

Artificial Intelligence (AI) is reshaping our world in ways we couldn't have imagined. The integration of AI with the concept of *Hikmah* (wisdom) presents a transformative opportunity to align technological advancements with ethical, spiritual, and moral principles. But while AI has the power to solve big problems, it also raises important questions about fairness, ethics, and responsibility.

This book explored how combining AI with *Hikmah* (wisdom) can guide the use of technology in ways that benefit humanity while staying true to moral and spiritual values.

Each chapter has demonstrated how *hikmah* can guide AI to achieve transparency, equity, and resilience in diverse domains such as cybersecurity, education, healthcare, governance, and even the design of virtual environments.

This concluding chapter sums up the key ideas from each chapter and reflects on how AI and *hikmah* can create a better future.

Summaries of the Chapters

Chapter 1: Allah's Wisdom in Creating the Universe as a Source of Inspiration in Artificial Intelligence

This chapter reflected on the divine wisdom in creation as a source of inspiration for designing ethical AI systems. Lessons from nature and the Quranic worldview were applied to AI development.

Chapter 2: Islam and Epistemology of Knowledge and Technology

Focusing on the Islamic epistemology of knowledge, this chapter emphasised the importance of balancing reason, revelation, and ethics in guiding technological advancements.

Chapter 3: Islamic Ethics in AI Through a Faith-Based Approach

The chapter proposed a faith-based ethical framework for AI, ensuring that systems operate within Islamic ethical boundaries, fostering trust, and reducing harm.

Chapter 4: The Role of Wisdom in Guiding Ethical Decision-Making Within AI Systems

This chapter explored how *hikmah* can guide AI ethical decision-making, balancing technical accuracy with moral judgment to address complex ethical dilemmas.

Chapter 5: Towards a Wisdom-Based Artificial Intelligence in Education

The authors advocated for embedding *hikmah* in AI-driven education systems, fostering personalised learning experiences while upholding ethical principles like equity, fairness, and spiritual growth.

Chapter 6: Exploring the Potential of Generative Artificial Intelligence in Enhancing Academic Integrity

Generative AI technologies were examined for their potential to uphold academic integrity. When guided by *hikmah*, AI can help detect plagiarism and promote ethical academic practices.

Chapter 7: Empowering Muslim Elderly in Malaysia with AI

This chapter highlighted the role of AI in enhancing the well-being and spiritual fulfilment of the elderly in Muslim communities through personalised and ethical applications.

Chapter 8: Leveraging AI for Growth in Muslim Startups: A *Hikmah*-Centred Approach

This chapter emphasised how Muslim startups can harness AI to innovate and grow sustainably. A *hikmah*-centred approach ensures

that startups align business goals with ethical and community-oriented values.

Chapter 9: Enhancing Cyber Resilience Through the *Hikmah* of Artificial Intelligence

This chapter explored how AI can strengthen cybersecurity by integrating ethical principles like transparency and fairness. A *hikmah*-guided AI framework can enhance cyber resilience, enabling systems to withstand and recover from attacks while prioritising human values.

Chapter 10: Advancing Cybersecurity Through Proactive Cyber Threat Intelligence Mining

The authors demonstrated how Cyber Threat Intelligence (CTI), guided by AI, can detect and mitigate evolving cyber threats. Aligning CTI with *hikmah* ensures proactive cybersecurity strategies that are ethical and value-driven.

Chapter 11: Exploring Blockchain Technology and *Hikmah* for Securing IoT

This chapter highlighted the synergy between blockchain technology and *hikmah* in addressing IoT vulnerabilities. By combining transparency and wisdom, blockchain secures IoT networks and protects user privacy.

Chapter 12: Navigating Morality in Gaming: Ethical Design in Violent Video Games

By integrating *hikmah*, game designers can promote ethical gaming environments, reducing harm while fostering positive behaviour through AI.

Chapter 13: Reducing Suicidal Risk Using AI

This chapter explored the use of AI to detect and reduce suicidal tendencies, emphasising ethical considerations and respecting individual privacy and dignity.

Chapter 14: An Islamic Ethical Approach to AI Governance

The authors presented an Islamic ethical governance framework for AI, addressing challenges such as bias, accountability, and transparency in AI policy and practice.

Conclusion

Through these efforts, the concept of *hikmah*-driven AI can set a global standard for aligning technological progress with the timeless principles of wisdom, compassion, and accountability.

The journey through this book shows that combining AI with *hikmah* can lead to technology that is not only powerful but also ethical and compassionate. *Hikmah* reminds us that technology should serve humanity, not harm it. It teaches us to balance innovation with moral and spiritual values.

Moving forward, developers, policymakers, and educators must work together to ensure AI systems are guided by wisdom. By doing this, we can create a future where technology supports fairness, kindness, and justice. This is the promise of AI when shaped by *hikmah*: a tool for building a better, more harmonious world for everyone.

Glossary

Accountability in AI: The responsibility to ensure that AI decisions can be traced back to developers or organisations.

Adaptive Security: Real-time adjustment of security systems to counter evolving cyber threats.

Artificial Intelligence (AI): Technology enabling machines to mimic human cognitive functions like learning and reasoning.

Blockchain: A distributed and secure ledger system used to record transactions and ensure data integrity.

Cyber Resilience: The capacity to prepare for, respond to, and recover from cyberattacks while maintaining operations.

Cyber Threat Intelligence (CTI): Information about potential or existing cyber threats used to prevent attacks.

Cybersecurity: Practices and technologies designed to protect systems, networks, and data from cyber threats.

Data Mining: Extracting patterns, trends, and insights from large datasets using statistical and computational techniques.

Deep Learning: A type of machine learning using neural networks to process vast amounts of complex data.

Digital Ethics: Principles guiding the responsible use of technology, including AI, to protect human rights and privacy.

Ethical AI: AI designed to align with human values, emphasising fairness, accountability, and transparency.

Ethical Decision-Making: The process of choosing actions that align with moral and ethical principles.

Faith-Based AI Ethics: Ethical guidelines for AI based on religious or spiritual teachings and values.

Generative AI: AI that creates new content, such as text, images, or music, by learning patterns from existing data.

***Hikmah*:** Wisdom or sound judgment integrating ethical, moral, and spiritual principles in decision-making.

Human-Centred AI: AI systems designed to prioritise human values, dignity, and welfare in their operation and impact.

IoT (Internet of Things): A system of interconnected devices that collect and share data over the internet.

Islamic Epistemology: The study of knowledge from an Islamic perspective, focusing on the harmony between divine revelation and human reason.

Machine Learning (ML): A subset of AI that allows machines to improve performance by learning from data.

Natural Language Processing (NLP): AI focused on enabling machines to process, understand, and respond to human language.

Phishing: A cyberattack technique where fake messages deceive individuals into revealing sensitive information.

Predictive Analytics: Using AI to analyse data and predict future trends or behaviours.

Threat Detection: Identifying and mitigating potential cyber threats in real-time.

***Ulul Albab*:** Quranic term for those endowed with intellect/wisdom, emphasising the use of knowledge in ethical ways.

Wisdom-Based AI: An AI framework guided by ethical, moral, and spiritual principles to promote human well-being.

Zero-Day Exploit: A cyberattack that exploits a software vulnerability before developers can address it.

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