

ARTIFICIAL INTELLIGENCE IN HAJJ GUIDANCE: TECHNOLOGY-BASED LEARNING, ADAPTIVE AND IMMERSIVE LEARNING INNOVATION

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ABSTRAK

This article examines the use of Artificial Intelligence (AI) in Hajj guidance as a technology-based learning innovation. The background of this research is the need to improve the effectiveness and efficiency of the Hajj guidance process, which has been carried out conventionally. The research uses a descriptive-qualitative approach using literature studies and interviews with educational technology practitioners and Hajj guidance instructors. The results indicate that AI can be used to present interactive simulations, a Hajj fiqh Q&A chatbot, an automated assessment system, and personalized material based on pilgrim profiles. The use of this technology has the potential to improve pilgrims' understanding of the Hajj ritual while enriching the learning experience with a more adaptive and inclusive approach. This article recommends the development of a Sharia-based AI platform as part of the digital transformation of Hajj administration..

Keywords : Artificial Intelligence, Hajj Rituals, Educational Technology, Digital Innovation, *Adaptive Learning*

INTRODUCTION

Hajj guidance is a crucial stage in preparing pilgrims for the Hajj. This activity aims to equip prospective pilgrims with a thorough understanding of the rituals, from the pillars and obligatory to the sunnah (sunnah) of the Hajj, so they can perform the ritual correctly and devoutly. However, the current guidance methods for Hajj guidance are still dominated by conventional approaches such as face-to-face lectures and manual simulations. This approach often faces various obstacles, such as time constraints, limited space,

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and large numbers of participants, which reduce the effectiveness of the learning.

Along with the development of digital technology and the era of industrial transformation 4.0, Artificial Intelligence (AI) technology is starting to gain attention as an innovative solution in various fields, including education and religious learning. AI offers the ability to deliver a more personalized, adaptive, and interactive learning experience by utilizing intelligent algorithms, chatbots, and data-driven learning systems. In the context of Hajj guidance, AI integration has the potential to overcome the limitations of conventional methods by providing flexible learning access, accessible anytime and anywhere, and able to adapt materials to the needs of individual pilgrims.

Furthermore, AI technology can support professional training and certification for Hajj and Umrah guides, a crucial factor in improving the quality of manasik guidance. A standardized certification program supported by digital technology enables guides to acquire greater competence and consistently provide services to pilgrims. This is particularly relevant given the complexity of the Hajj pilgrimage, which requires in-depth understanding and strong communication skills.

The use of other supporting technologies, such as Virtual Reality (VR) and Augmented Reality (AR), is also increasingly developing as immersive learning media capable of realistically simulating the atmosphere and rituals of the Hajj pilgrimage. These simulations not only enhance pilgrims' understanding but also build mental and spiritual preparedness before

departure. Studies show that VR- and AR-based learning can improve information retention and learning motivation compared to traditional methods. (Supriyatmoko, 2025)

This article aims to examine how AI and other digital technologies can be implemented in Hajj guidance as a technology-based learning innovation. The discussion focuses on various AI applications that support the Hajj learning process, such as digital assistants, multilingual chatbots, VR simulations, and management and monitoring systems that increase the effectiveness and efficiency of guidance. Thus, it is hoped that this technological integration can significantly contribute to improving the quality of Hajj learning, expanding access, and better preparing pilgrims for their pilgrimage in the Holy Land.

THEORETICAL BASIS

Artificial Intelligence (AI) in Education

AI is a computer system that can perform tasks that typically require human intelligence. In education, AI is used for adaptive learning, educational chatbots, and even virtual tutors.

AI can provide digital assistants, chatbots, and adaptive learning systems that can tailor material to individual needs. (Haidar Triari, 2024). AI also enables monitoring of learning activities and provides automatic feedback. (Haidar Triari, 2024).

Artificial Intelligence (AI) in education is a technological innovation that is bringing significant changes to the way learning is conducted. AI is a

computer system designed to mimic human cognitive abilities, such as learning, reasoning, and problem-solving. In the educational context, AI serves not only as a tool but also as an intelligent agent capable of significantly improving the quality and effectiveness of learning.

One of the main applications of AI in education is adaptive learning. Adaptive learning systems use AI algorithms to analyze data from student interactions with learning materials, then adjust the content, difficulty level, and delivery method to suit individual student needs and abilities. This ensures each student receives a personalized learning experience tailored to their learning style, which can improve motivation and overall learning outcomes. For example, if a student is struggling to grasp a concept, the system will provide additional material or simpler exercises before moving on to more complex material.

Furthermore, AI is also used in the form of educational chatbots, computer programs that can interact with students naturally using human language. These chatbots function as digital assistants, answering questions, providing explanations, and assisting students in their learning anytime and anywhere. Chatbots are particularly helpful in distance learning, as students can receive instant assistance without having to wait for a teacher or tutor.

Furthermore, AI also provides virtual tutors capable of monitoring students' learning activities in real time. These virtual tutors can collect data on how students learn, such as time spent on a material, error patterns, and level of understanding. Based on this data, virtual tutors provide automated, constructive feedback, such as offering study tips, correcting errors, or

suggesting more effective learning strategies. This enables the learning process to be more responsive and dynamic, and helps students overcome learning difficulties independently.

According to Haidar Triari (2024), AI's ability to deliver digital assistants, chatbots, and adaptive learning systems represents a significant breakthrough in modern education. With AI technology, education is no longer one-way and uniform, but rather more inclusive, personalized, and interactive. AI opens up new opportunities for developing learning methods that can reach a wide range of students with varying needs, while also assisting educators in managing the teaching and learning process more efficiently and effectively.

Overall, the integration of AI in education has broad positive impacts, from improving the quality of learning, reducing disparities in access to education, to enhancing student motivation and learning outcomes. However, AI implementation also requires attention to ethical aspects, data privacy, and infrastructure readiness to ensure optimal and responsible use of this technology.

Virtual Reality and Augmented Reality

VR and AR technologies provide a more immersive and interactive learning experience. Users can simulate virtual worship services, significantly improving their understanding and preparedness.

Augmented Reality (AR) technology allows the addition of synthetic images into real environments. Unlike Virtual Reality (VR) technology, which completely immerses users in a synthetic environment, AR allows users to see

3D virtual objects added to the real environment. AR and VR are part of the virtual reality continuum, hereinafter referred to as mixed reality (MR). MR environments combine the real world and virtual objects in the same real-time display. This technology can enhance users' perception and interaction with the real world, especially with AR. Augmented reality is a technology that adds something to the real world, such as sound, video, graphics, images, and other things processed by a computer. It can also be said that augmented reality brings something virtual into the real world in real time. (Supriyatmoko, 2025)

Basically, augmented reality has three main components, the first is a tracking system, the second is a graphic system that depicts virtual images in the appropriate place based on the information provided by the tracking system, and the third is a display system that combines the real world with virtual images and sends the results to the user.

The augmented reality marker detection process goes through several stages, broadly speaking there are three main parts, namely (Vitono, Nasution, & Anra, 2016) which are shown in Figure 2.3:

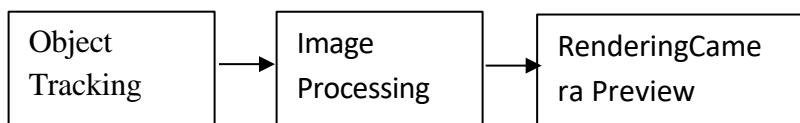


Figure 1. Augmented Reality Flow

a. Object Tracking

The process of capturing image data of an object used as a marker, the user must point the camera at the marker. Object tracking is the initial process in

AR technology that functions to detect and capture image data from an object used as a marker. This marker is usually an image or special pattern that is recognized by the system. The user must point the device's camera (smartphone, tablet, or computer camera) at the marker so that the system can detect and identify the object correctly. This process is very important because the marker serves as a reference point for the AR system to accurately place virtual objects in the real world. In the marker-based tracking method, the marker is usually a 2D pattern with high contrast, such as a black and white square image with thick borders, which facilitates the detection process by the camera.

b. Image Processing

After the marker is detected, the next stage is image processing, which is the process of matching the image captured during the object tracking stage with the marker image database already in the system. This process is carried out in real time so that the system can immediately recognize the marker and determine its position and orientation relative to the camera. Image processing involves several stages such as converting the image to grayscale, binarization (thresholding), and pattern matching to ensure the detected marker matches the pre-programmed target. The speed and accuracy of this process are crucial for the smooth AR experience experienced by the user. After the marker is detected, the next stage is image processing, which is the process of matching the image captured during the object tracking stage with the marker image database already in the system. This process is carried out in real time so that the system can immediately recognize the marker and determine its position

and orientation relative to the camera. Image processing involves several stages such as converting the image to grayscale, binarization (thresholding), and pattern matching to ensure the detected marker matches the pre-programmed target. The speed and accuracy of this process are crucial for the smooth AR experience experienced by the user.

c. Rendering Camera Preview

Rendering is the final process that combines image processing data with the virtual object to be displayed. The system retrieves relevant 3D object data, text, images, or videos and precisely places them over the detected markers. These virtual objects are then displayed in real-time on the user's device screen, making it appear as if they actually exist in the real world. The rendering process requires calculating the object's position, orientation, and scale to match the camera's perspective, resulting in an immersive and realistic visual experience. Rendering is the final process that combines image processing data with the virtual object to be displayed. The system retrieves relevant 3D object data, text, images, or videos and precisely places them over the detected markers. These virtual objects are then displayed in real-time on the user's device screen, making it appear as if they actually exist in the real world. The rendering process requires calculating the object's position, orientation, and scale to match the camera's perspective, resulting in an immersive and realistic visual experience.

Development and Application of Augmented Reality Technology

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AR technology has developed rapidly and is applied in various fields, including:

Interior Design and Architecture: AR makes it possible

a. Image Processing

The process of matching the results of image data capture during object tracking with the images on the target markers in the system. This process is carried out in real time throughout the system.

b. Rendering Camera Preview

The process of calling up image/text/video information data from the image processing process and combining the added information (rendering) so that the 3D object will appear above the marker and be displayed on the user's device screen.

The development of augmented reality technology has developed in various fields, such as interior design, architecture and construction, advertising, business, tourism, education, health, and others.

Augmented Reality

In augmented reality, there are two methods that have been developed, namely:

a. Marker-Based Tracking

Marker-based tracking is a method where the system uses markers to detect, identify, and then calculate objects. Marker-based tracking uses a 2D object marker (Marker) with a pattern, which the computer then reads through a

camera. This marker is typically a black and white rectangular illustration with a thick black border and a white background.

b. Markerless

Markerless is a Marker with an object whose location is not determined so that the object displayed can change position. Markerless makes real objects as markers or can also be said to utilize the environment itself as its marker. Identification is done by using information such as location coordinates, orientation, and movement. The advantage of using the markerless method is that there is no need for a special marker automatically when the user scans an object using the camera. The difference with marker-based is that during the tracking process, markerless calculates the position and orientation of the camera and the real world without any provisions, but uses natural features such as axes and angle/texture detection from the image or object.

Hajj Guidance

This guidance is a learning process regarding the procedures of the Hajj pilgrimage, from Islamic jurisprudence theory and ritual practice to social etiquette. The goal is for pilgrims to understand and be able to perform the pilgrimage correctly.

Manasik guidance is a crucial aspect of prospective Hajj pilgrims' preparation, aiming to enhance their readiness and spiritual strength to achieve perfect worship. According to psychological theory, thorough mental and spiritual preparation can help individuals overcome challenges and improve focus

during the Hajj. This aligns with the psychological concept of habit formation, where familiarizing oneself with rituals and contemplation can strengthen one's commitment to performing the pilgrimage with full awareness and a sense of responsibility.

1. The Purpose of Hajj Guidance

- a. Increasing the congregation's understanding of the pillars, obligations and sunnah of Hajj.
- b. Cultivating physical, mental and spiritual readiness to perform the Hajj pilgrimage.
- c. Equipping pilgrims with technical skills while in the Holy Land.
- d. Instilling the value of *istitho'ah* (ability) comprehensively: spiritual, financial, and health.
- e. Instilling the principles of patience, order and togetherness in the Hajj.

Guidance consists of 8-10 meetings, covering the following aspects:

Table 1. Hajj Guidance Meeting Themes

Meeting	Main Theme	Sub-Material
1	Hajj Orientation	The meaning of Hajj, history, law and types of Hajj
2	Istitha'ah & Intention of Hajj	The concept of <i>istitha'ah</i> (physical, financial, spiritual), procedures for intention
3	Pillars & Obligations of Hajj	Explanation and differences between the pillars, obligations and sunnah of the Hajj

4	Practical Rituals	The practice of tawaf, sa'i, tahallul, ihram, wukuf, and stoning
5	Contemporary Hajj Fiqh	Modern fiqh issues, fiqh taysir (convenience), and practical solutions
6	Manners and Ethics in the Holy Land	Ethics among pilgrims, local culture of Saudi Arabia
7	Hajj Health	Health istitha'ah, stamina management, disease prevention
8	Hajj Travel and Logistics	Departure procedures, transportation, accommodation, congregation cooperatives
9	Complete Simulation of Manasik	Dress rehearsal for the Hajj pilgrimage: a miniature Hajj pilgrimage in an open field
10	Spiritual Evaluation and Strengthening	Q&A, motivational strengthening, spiritual provision

Technology-Based Learning Innovation

This innovation includes the use of software, applications, VR/AR simulations, and artificial intelligence systems that can improve the effectiveness and efficiency of the learning process. (Supriyatmoko, 2025) Technology-based learning innovation has become one of the main drivers of educational transformation in today's digital era. This innovation includes various applications of advanced technologies such as educational software, interactive

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learning applications, Virtual Reality (VR) and Augmented Reality (AR)-based simulations, and artificial intelligence (AI) systems designed to improve the effectiveness and efficiency of the learning process (Supriyatmoko, 2025).

Educational Software and Applications

Modern learning software and applications enable interactive and adaptive delivery of materials. These applications not only present content in text or video format, but also integrate interactive quizzes, practice exercises, and automated feedback to help students better understand the material. With features like progress tracking and personalized content, these applications can tailor learning to each student's needs and abilities, thereby increasing motivation and learning outcomes.

Virtual Reality (VR) and Augmented Reality (AR) Simulations

VR and AR simulations provide immersive and realistic learning experiences. VR allows students to enter a virtual environment that mimics the real world, allowing them to practice directly without the risks and limitations of physical activity. For example, in learning Hajj rituals, VR can simulate the atmosphere in the Holy Land so prospective pilgrims can practice virtually before their departure. Meanwhile, AR adds digital elements to the real environment through devices such as smartphones or smart glasses, allowing students to see 3D objects and additional information directly around them. This technology is highly effective in enhancing understanding of complex concepts and enriching the learning experience.

Artificial Intelligence (AI) System

AI in learning acts as an intelligent assistant capable of providing a personalized and adaptive learning experience. With advanced data analysis capabilities, AI can monitor students' learning activities in real time, identify difficulties they face, and recommend appropriate learning materials or strategies. Furthermore, AI is also used in the form of educational chatbots that are ready to help students answer questions at any time, as well as virtual tutors that provide automated guidance and feedback. This not only improves learning effectiveness but also helps teachers manage their classes and focus on more complex aspects of teaching.

Effectiveness and Efficiency of Learning

This technology integration significantly improves learning effectiveness by making the learning process more engaging, interactive, and tailored to individual needs. Furthermore, learning efficiency is increased because technology allows flexible access to materials anytime and anywhere, reducing reliance on conventional learning methods, which often require significant time and resources. Thus, technology-based learning innovations not only support improvements in education quality but also expand access to education for diverse segments of society.

This research uses a descriptive-qualitative approach. Data were obtained through a literature review of current literature and interviews with three Islamic education app developers and two certified Hajj guides. Thematic analysis was conducted, emphasizing the benefits, challenges, and opportunities of utilizing AI in Hajj manasik guidance and the development of AI-, VR-, and AR-based Hajj learning apps. Data were collected from

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scientific journals, app development reports, and trial results on prospective
Hajj pilgrims.

RESULTS AND DISCUSSION

AI Innovation in Hajj Ritual Learning

Digital Assistants and Chatbots: Applications like MeccaBot AI, developed by ITS, provide an AI-based digital assistant ready to assist pilgrims 24/7. Its main features include prayer guides (text, audio, and video), Q&A sessions about worship, location navigation, a digital Quran, instant prayers, and even intelligent souvenir shopping. All of these features are available in multiple languages, making it easier for pilgrims from various backgrounds.

Multilingual Robots in the Holy Land Robots like Manara 2 at the Grand Mosque can provide instant religious guidance in more than 11 languages, helping worshippers understand the procedures of worship and answering questions in real-time.

An AI Crowd Monitoring and Management System is used to monitor congregational density through smart cameras and facial recognition. AI algorithms analyze crowd data to regulate movement, prevent congestion, and improve safety during worship services.

AI Transportation and Logistics Optimization manages dynamic transportation schedules, intelligent bus routes, and integrates ride-sharing services to ensure efficient and seamless movement of pilgrims between locations. This is crucial considering that millions of pilgrims must move simultaneously in a short time.

Immersive Technologies: Virtual Reality (VR) and Augmented Reality (AR)

Interactive Hajj Ritual Simulation: The use of VR allows prospective pilgrims to practice Hajj rituals virtually, providing an immersive experience that mimics real-life conditions in the Holy Land. Studies show that learning with VR improves pilgrims' comprehension, information retention, and confidence compared to conventional methods. **Gamification-Based Education Platforms** like Virtual Hajj Ritual combine AI, VR, and gamification to make learning more engaging and accessible to a wide range of audiences, including school students.

Table 2. Functions and Impacts of AI on Hajj Ritual Learning

AI & Technology Innovation	Main Function	Impact on Hajj Ritual Learning
MeccaBot AI	Digital assistant, prayer guide, Q&A, navigation	Learning is more personal, accessible, and interactive
Tower Robot 2	Multilingual guidance, real-time information	Reducing language barriers, rapid response at places of worship
VR Hajj Rituals	Ritual simulation, interactive exercises	Improving the understanding and readiness of the congregation
AI Crowd Management	Crowd monitoring, flow prediction	Improve safety and comfort during worship

Benefit

24/7 Information Access

With AI technology and digital platforms, Hajj pilgrims can access guidance, learning materials, and support anytime and anywhere, regardless of time or location. This is crucial, given that conventional Hajj guidance schedules are often limited and inflexible. This 24-hour access allows pilgrims to study independently at their own pace, increasing the effectiveness and convenience of the learning process.

Personal and Adaptive Learning

One of the advantages of AI is its ability to analyze individual needs and characteristics. AI-based learning systems can adapt the material, difficulty level, and delivery method to suit each student's abilities and needs. For example, AI can provide additional practice for material not yet mastered or accelerate learning for students who already understand basic concepts. This approach increases learning effectiveness and minimizes boredom or fatigue.

Efficiency and Safety

During the Hajj pilgrimage, which involves millions of pilgrims, logistics and crowd management are crucial to avoid accidents and congestion. AI technology can be used to monitor pilgrim density in real time through smart cameras and sensors, and optimize pilgrim movement routes. This system helps officials make quick and accurate decisions to regulate the flow of

pilgrims, thereby enhancing safety and comfort during the pilgrimage.

Immersive Experience

VR and AR technologies offer a more realistic and immersive learning experience than traditional teaching methods. With VR, pilgrims can virtually simulate the Hajj pilgrimage, resembling the atmosphere in the Holy Land, helping them better understand the steps of the pilgrimage and build mental preparedness. AR allows for interactive visualization of objects and instructions accessible through mobile devices, making learning more engaging and easier to understand.

The following is a table of the benefits of using AI technology in Hajj guidance:

Table 3. Benefits of Using AI Technology in Hajj Guidance

No.	Benefit	Explanation
1	24/7 Information Access	With AI and digital platforms, congregants can access guidance and learning materials anytime and anywhere. This overcomes the time and location constraints of conventional guidance, enabling flexible and effective self-directed learning.
2	Personal and Adaptive Learning	AI can analyze individual needs and adjust the material, difficulty level, and delivery method. Those who haven't yet mastered the material can receive additional practice, while those who have

		already grasped it can progress more quickly. This increases effectiveness and minimizes boredom.
3	Efficiency and Safety	AI can help monitor congregation density in real time using smart sensors and cameras. This technology supports rapid decision-making by officials to manage the flow of worshippers, improve safety, and reduce the risk of congestion or accidents during worship services.
4	Immersive Experience	VR and AR technology enable virtual simulations of the Hajj pilgrimage, providing a learning experience that mimics real-life conditions in the Holy Land. AR facilitates interactive visualization of objects and instructions, enhancing pilgrims' understanding and mental readiness in a fun and accessible way.

Challenge

Technology Gap

Not all pilgrims have the same level of digital literacy. Some pilgrims, especially those from older ages or remote areas, may be unfamiliar with or even struggle to use digital technologies such as AI, VR, or AR applications. This can hinder the widespread adoption of these technologies, necessitating specialized training and mentoring programs to ensure all pilgrims can utilize them optimally.

Infrastructure Limitations

Stable internet access and hardware such as a smartphone or computer are essential requirements for using digital technology. In some areas, particularly

rural areas or developing countries, telecommunications infrastructure remains inadequate. This limits access for pilgrims to technology-based manasik guidance applications, leading to disparities in the quality of learning.

Local Content Development

For AI-, VR-, and AR-based learning technologies to be accepted and effective, the content presented must be tailored to the congregation's language, culture, and local context. Developing inclusive and relevant content is crucial to avoid misunderstandings and ensure proper understanding. Furthermore, content must be regularly updated to comply with the latest regulations and worship procedures.

By understanding these benefits and challenges, the development and implementation of technology in Hajj guidance can be designed more maturely and inclusively, so that it can provide maximum positive impact for Hajj pilgrims in the future.

The following is a table of challenges in using AI technology in Hajj guidance:

Table 4. Challenges of Using AI Technology in Hajj Guidance

No.	Challenge	Explanation
1	Technology Gap	Not all pilgrims have adequate digital literacy. Elderly groups or pilgrims from remote areas often experience difficulties using technologies such as AI, VR, and AR. This requires training and mentoring programs to ensure optimal technology access.

2	Infrastructure Limitations	Stable internet access and devices like smartphones or computers remain a challenge in many areas, particularly rural areas. Inadequate infrastructure prevents some pilgrims from accessing technology-based manasik guidance services, creating disparities in the quality of learning.
3	Local Content Development	Digital content must be adapted to the local language, culture, and context to ensure it is easily understood by the congregation. Irrelevant or non-contextual content risks misunderstanding. Furthermore, regular updates are necessary to keep up with current regulations and worship procedures.

Artificial Intelligence (AI) is playing a transformative role in revolutionizing the Hajj pilgrimage. As millions of Muslims from around the world gather annually to fulfill this sacred obligation, the Saudi Arabian government has increasingly integrated AI technologies to improve safety, efficiency, and the overall spiritual journey of pilgrims. This integration not only enhances logistical operations but also personalizes the Hajj experience in ways never seen before. Here's how AI is being implemented:

1. Crowd Management and Safety

Managing the movement of millions of people in a confined space presents a monumental challenge. AI-powered systems, such as Baseer, use computer vision and machine learning to analyze real-time video feeds and track crowd

density and movement within the Grand Mosque. These tools help authorities detect potential bottlenecks and risky overcrowding situations. In addition, predictive analytics based on historical and current data allow for early warnings and strategic interventions to maintain crowd flow and prevent stampedes or accidents.

2. Personalized Guidance and Spiritual Support

To aid pilgrims in performing the rituals correctly and meaningfully, AI tools have been developed to provide personalized support. The Smart Enrichment Assistant delivers real-time updates, multilingual spiritual guidance, and ritual navigation tips. Similarly, AI-based platforms such as Digital Mutawwif offer visual guides, supplications, and ritual counters for Tawaf and Sa'i. Multilingual robots like Manara 2 are deployed to interact with pilgrims, offering instant religious instructions in various languages. Smart apps further assist pilgrims by offering maps, schedules, and personalized reminders to ensure a fulfilling experience.

3. Efficient Logistics and Operations

The Hajj pilgrimage also requires extensive logistical coordination. The Makkah Route Initiative, powered by AI and biometric technology, simplifies immigration procedures even before pilgrims arrive in Saudi Arabia. AI is also employed in the healthcare sector to manage patient records, assist in diagnostics, and support emergency responses during the pilgrimage. Resource management — including transportation, accommodation, and healthcare services — has become more efficient and responsive with the help of AI

algorithms that anticipate needs and optimize supply chains.

4. Enhancing the Spiritual Journey

AI is not just improving physical logistics; it also enriches the inner spiritual experience. AI-powered apps can deliver personalized Islamic content, supplications, and reminders based on each pilgrim's schedule and preferences. By providing access to a comprehensive digital library of Islamic knowledge, AI enables pilgrims to explore the deeper meanings of rituals, Hadith, and Qur'anic verses relevant to the pilgrimage. This ensures a more contemplative and spiritually engaging experience.

5. Safety and Security Monitoring

AI-enhanced surveillance systems play a crucial role in maintaining security during Hajj. These systems monitor key areas for any suspicious activity, crowd surges, or emergencies, enabling rapid response by security personnel. AI tools also assist in managing lost-and-found services and tracking missing persons, contributing to overall safety.

6. Addressing Ethical and Practical Challenges

Despite its benefits, the use of AI in Hajj presents several challenges. Ensuring the accuracy and authenticity of religious information provided by AI tools is essential. Developers must work closely with Islamic scholars to prevent the spread of misinformation or misinterpretation. Additionally, concerns about data privacy and the security of personal information must be addressed, especially when handling biometric data. Lastly, the integration of AI should complement, not replace, human religious guidance. The wisdom and empathy of human scholars remain irreplaceable in addressing individual spiritual

concerns.

The 2025 Hajj pilgrimage showcases how AI can significantly elevate the experience of one of Islam's most important religious duties. From crowd control to personalized spiritual guidance, AI has proven to be a vital tool in making Hajj safer, more organized, and spiritually rewarding. As technology continues to evolve, the careful and ethical use of AI in religious contexts will be key to preserving the sanctity and purpose of the pilgrimage.

The Benefits of Technological Innovation in Hajj Guidance

In the digital era, the integration of Artificial Intelligence (AI) and immersive learning (using technologies such as Virtual Reality and Augmented Reality) into the Hajj guidance process presents a range of significant benefits. These benefits are not merely technical in nature but also deeply impact the spiritual experience and readiness of prospective pilgrims. These advantages can be grouped into the following key dimensions:

1. Enhancing Visual and Cognitive Understanding

AI-powered learning systems can deliver content that is rich in data, interactive visuals, and narrative explanations. When pilgrims use 3D simulations that replicate real environments such as the Grand Mosque (Masjid al-Haram), Mina, Arafat, and Muzdalifah, they are able to visually and experientially understand the process of performing the rituals. This improves both conceptual and procedural knowledge (Bloom, 1956).

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VR allows pilgrims to see and experience the correct sequence of tawaf, including the direction of movement, the location of Hajar Aswad (Black Stone), and Maqam Ibrahim.

AI can also provide context-aware voice/text-based explanations at each location within the simulation (e.g., during the wuquf at Arafat).

According to the Cognitive Load Theory (Sweller, 1988), dynamic visualizations help reduce cognitive overload and improve information retention. Immersive learning enables smoother information processing, especially for elderly pilgrims or those with limited literacy.

2. Improving Time Efficiency in Training

AI enables learning to become modular and adaptive, allowing each pilgrim to study based on their own time, pace, and capacity. In traditional manasik (Hajj guidance), sessions are often delivered en masse and limited by time, location, and teaching personnel. AI provides 24/7 accessibility to learning materials.

AI systems offer short interactive modules (10–15 minutes each) accessible via mobile phones.

Automated reminders help pilgrims manage their learning schedule, keeping them engaged and on track.

The concept of Self-Paced Learning, introduced by Knowles (1984) in *Andragogy*, emphasizes that adult learners benefit from flexible, non-coercive learning environments. AI allows self-regulated, efficient learning that suits

each individual's needs.

3. Reducing Technical Errors in Ritual Practice

One of the main challenges during Hajj is the lack of technical knowledge among pilgrims, such as the direction of tawaf, proper stoning of the jamarat, or where to stand during wuquf. Mistakes in ritual practice can affect the validity of the pilgrimage. Through AI and immersive training, such errors can be minimized since pilgrims have already practiced the rituals in near-realistic simulations.

AI detects incorrect gestures during simulated tawaf and provides real-time feedback such as: “You are moving in the wrong direction,” or “Your stone-throwing position is inaccurate.”

Experiential Learning Theory (Kolb, 1984) highlights the value of learning through direct experience. Immersive technology replicates real-life ritual scenarios, fostering deeper understanding and reducing potential errors during actual Hajj.

4. Increasing Learner Engagement and Motivation

Active participation is critical to successful religious education. AI and immersive platforms allow learners to become active agents, not just passive recipients of instruction. When participants explore virtual environments or respond to AI-generated quizzes, their cognitive and emotional engagement

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increases.

Pilgrims use VR headsets to engage in scenarios such as “getting lost in Mina” and are tasked to solve it using AI guidance.

Reward systems (points, badges) are incorporated to encourage continued participation and foster internal motivation.

In Constructivist Learning Theory (Vygotsky, 1978), learners construct knowledge through active interaction with their environment. Immersive technology offers the interactive space necessary for deep learning and internalization.

The benefits of AI and immersive technology in Hajj guidance go beyond technical innovation. They address fundamental aspects of religious education: effectiveness, personalization, and spiritual depth. These tools improve visual understanding, save time, minimize errors, and enhance learner engagement. As a result, Hajj training becomes more inclusive and impactful—aligning with the ultimate goals of the pilgrimage: to form devout, disciplined, and spiritually conscious Muslims.

CONCLUSION

The integration of Artificial Intelligence (AI) into Hajj guidance is a strategic step in digitizing religious learning. This technology not only addresses the challenge of effectiveness but also creates a more inclusive and personalized learning experience. Moving forward, the development of a Sharia-compliant AI-based Hajj platform should be a priority in the digital transformation policy for Hajj services. This technology provides a more interactive, immersive, and adaptive learning experience tailored to individual needs. The main challenges

are gaps in digital literacy and infrastructure, but the benefits are far greater in a modern learning context. The application of Artificial Intelligence (AI), Virtual Reality (VR), and Augmented Reality (AR)-based technology in Hajj guidance offers various advantages, but is not without challenges. The main challenge includes the technology gap among pilgrims, especially the elderly and those from remote areas with low digital literacy. Furthermore, limited infrastructure, such as internet access and digital devices, poses a significant obstacle to the equitable use of this technology. Furthermore, the development of local content tailored to the language, culture, and context of pilgrims is also crucial for effective and inclusive learning with this technology.

Therefore, the implementation of technology in Hajj guidance must be strategically designed, taking into account training, infrastructure provision, and local content adaptation. Collaborative efforts between the government, Hajj organizers, technology developers, and religious leaders are necessary to ensure optimal use of technology to enhance the quality of worship and the spiritual experience of pilgrims.

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