



JOURNAL OF INFORMATION SYSTEM AND TECHNOLOGY MANAGEMENT (JISTM)

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DIGITAL TECHNOLOGIES IN ASTRONOMICAL HADITH STUDIES: TOWARD AN INTEGRATIVE FRAMEWORK

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Article Info:

Article history:

Received date: 20.07.2026

Revised date: 30.07.2026

Accepted date: 23.08.2025

Published date: 20.09.2026

To cite this document:

Hoque, M., Ibrahim, M. N. A., Ibrahim, N., Amin, M. Z. M., & Ellias, M. S. (2026). Digital Technologies In Astronomical Hadith Studies: Toward An Integrative Framework. *Journal of Information System and Technology Management*, 11 (44), 462-469.

Abstract:

Astronomical Hadith Studies is a sub-discipline of hadith studies that deals with the analysis of prophetic traditions pertaining to celestial matters such as the sighting of the moon, the timing of the five daily prayers, the direction of *qiblah*, the occurrence of solar and lunar eclipses, the movement of seasons and other celestial bodies mentioned in hadith texts. Historically, the methods employed in Astronomical Hadith Studies have included classical hadith verification, juridical analysis, and astronomical observation. With the advancement of digital technologies, there are several ways in which Astronomical Hadith Studies could be improved and expanded for both educational purposes and practical applications. Although digital technologies have increasingly been applied to Islamic studies and astronomical computation, limited research has examined their systematic integration, particularly within the field of Astronomical Hadith Studies. Therefore, main objective of this paper is suggesting an integrative approach to studying astronomical hadith. Using a qualitative conceptual literature-review approach, the study examines scholarly literature on Hadith sciences, Islamic astronomy, digital Islamic scholarship, and emerging astronomical technologies. The paper concludes with the need to develop an integrative approach to

maximise the potential of digital technologies while preserving the core principles of the study of hadith and Islamic astronomy.

DOI: 10.35631/JISTM.1144027 **Keyword:**

Astronomy, Framework, Hadith, Integration, Islam



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Introduction

Hadith, as the second primary source of Islamic knowledge after the Qur'an, plays a crucial role in guiding various aspects of Muslim life (Hoque, Yusoff, Toure, & Mohamed, 2019), including the understanding of natural and celestial phenomena. Among these, astronomical elements such as lunar observation, timekeeping, and celestial events are frequently referenced in prophetic traditions, particularly in relation to acts of worship like fasting, pilgrimage, and prayer timings (Hoque et al, 2023). Historically, Muslim scholars relied on direct observation (*ru'yah*) and traditional interpretive methods to understand such narrations. However, the rapid advancement of modern science and technology has introduced new tools that significantly enhance the precision and scope of astronomical analysis.

Astronomy has always held an essential place in Islamic intellectual tradition, serving both theological and practical functions. It provides the scientific basis for determining the Islamic lunar calendar and aligning religious practices with observable celestial patterns (Rasheed et al., 2025). In contemporary contexts, the integration of astronomy with digital technologies—such as computational models, machine learning algorithms, and astronomical simulation software—has transformed how lunar visibility and celestial phenomena are studied. For instance, recent studies demonstrate that machine learning can accurately predict crescent moon visibility, contributing to the harmonization of Islamic calendar determinations across regions (Loucif et al., 2024).

Despite these advancements, a gap remains between classical Hadith interpretation and modern technological applications. Traditional approaches emphasize textual authenticity and jurisprudential frameworks, while contemporary methods prioritize empirical accuracy and data-driven analysis. This divergence often leads to debates, particularly in issues such as moon sighting for Ramadan, where discrepancies persist across Muslim communities (Rahman, 2023).

Therefore, this study seeks to explore how modern technological tools can be effectively integrated with Hadith studies to enhance the understanding of astronomical narrations. By bridging *Naqli* (revealed knowledge) and *Aqli* (scientific knowledge), this research aims to contribute to a more holistic and methodologically sound approach in contemporary Islamic scholarship.

Relationship Between Hadith and Astronomy in Islamic Civilization

The relationship between Hadith and astronomy occupies a significant place in Islamic civilization, reflecting the integration of religious teachings with scientific observation. Hadith is the record of the sayings, actions and approvals of Prophet Muhammad (PBUH), serves as a primary source of guidance for Muslims after the Qur'an. Many prophetic traditions talk about celestial stuff and give practical instructions for religious duties connected to looking at the stars and planets. The study of astronomy (*ilm al-falak*) was not only done for scientific purposes but also as a means of understanding religious teachings (King, 2005). In Islam, many acts of worship are related to astronomy. For example, figuring out daily prayer times depends entirely on where the sun is sitting. Another example is the timing of the month of Ramadan, which begins and ends based on the sighting of the new moon (*hilāl*). The Prophet Muhammad (PBUH) instructed his followers to start fasting when they see the crescent moon and to stop fasting when they see it again (Al-Bukhari, 2002). Thus, the timing of religious observances is based on astronomical observations. In addition, there are Hadiths that discuss the phenomenon of eclipses. Eclipses are seen as signs from Allah and Muslims are encouraged to reflect on them and perform prayers during eclipses (Muslim, 2006). Instead, the Hadiths encourage observation and reflection on eclipses rather than superstition.

This practical purpose led to the growth of astronomical knowledge in the Islamic tradition. Muslim scholars realized that they needed to understand the movement of heavenly bodies to determine prayer times, *qiblah* direction, and Islamic lunar calendar accurately. Thus, astronomers, mathematicians, and religious scholars worked together to create new methods of observation and tools for scientific measurement. During the golden age of Islam, astronomers like al-Battānī, al-Bīrūnī, and Naṣīr al-Dīn al-Ṭūsī advanced astronomical science to serve the Hadith-related requirements of the Islamic community (Saliba, 1994). The impact of Hadith on the development of astronomy can also be seen in the building of observatories and the creation of astronomical tables. The resulting astronomical knowledge allowed for more accurate calculation of prayer times, visibility of the moon, and orientation towards *qiblah*. In his paper, Saliba (1994) states that the advancement of astronomy in Islam was strongly related to the practical demands of the Muslim community, namely determining prayer times, *qiblah* direction, and the Islamic lunar calendar. In addition, the need for collective prayer and the maintenance of a consistent lunar calendar in the Islamic community led to the continuous improvement of astronomical knowledge and practices in the Muslim world (Hoque, 2018). Moreover, Hadith also stimulated the intellectual pursuit of the natural world. In a Many hadiths Prophet Muhammad (PBUH) invites Muslims to reflect upon the signs of Allah in the universe, including the heavens, stars, sun, and moon. Such a belief system created a scientific environment where learning about celestial bodies was not at odds with the religious life of the community. Instead of treating science and religion as separate fields, Muslim scholars tended to see astronomy to understand the divine plan and fulfil religious duties more efficiently (Guessoum, 2011). Technology has changed how astronomy can be used with Hadith in today's world. With the tools such as satellites, astronomy software, sky digital simulation, and AI, moon sighting, prayer time determination, and *qiblah* calculation have become easier and more

accurate. Despite the positive impacts, scientists claim technology is a double-edged sword until it is controlled and aligned with Islamic law and Hadith (Hoque & Mohd Amin, 2025). It means the relationship between Hadith and astronomy is still important today with the balance of religious tradition and scientific advances. To conclude, this relationship shows the other side of empirical studies and revelation in Islamic history Prophetic sayings not only served to direct religious practice but also stimulated scientific research and contributed to the growth of astronomy as one of the key sciences of the Islamic civilization.

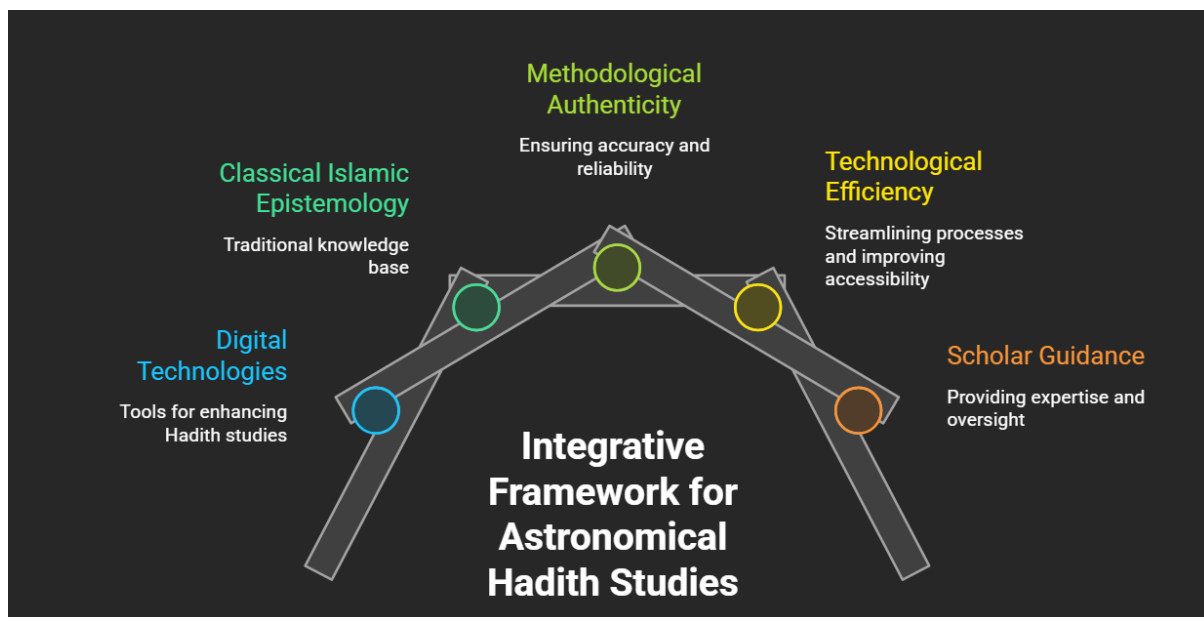
Necessity of an Integrative Framework

Due to the fast development of digital technologies, methods to study, analyse, and distribute religious knowledge have been changed. Digital Hadith databases, artificial intelligence (AI), natural language processing (NLP), geographical information system (GIS), satellite navigation, and astronomical simulation software are examples of the digital technologies used in the field of Astronomical Hadith Studies. The use of digital technologies increases the speed of accessing and analysing data and applying them to practical issues such as prayer times, moon sighting, and *qiblah* direction. But, at the same time, it raises many methodological, epistemological, and ethical questions which must be addressed by an integrative framework (Bunt, 2022). The main reason why an integrative framework is required is to protect the authenticity and reliability of Hadith studies. The classical sciences of Hadith have developed a system of studying Hadith based on *isnād* criticism, *matn* analysis, narrator evaluation, and contextual understanding. While digital technologies can help to make Hadith studies more accessible and facilitate some aspects of the analysis process, it cannot provide the necessary knowledge about the historical context, legal implications, and theological perspectives of Hadith. So, if we depend only on digital technologies without the help of scholars, there will be a possibility of misinterpreting Hadith and using weak narrations. Therefore, the integrative framework must ensure that the use of digital technologies complements the traditional approaches of Hadith studies, and does not replace them (Azmi & Badia, 2012). Another issue that requires the integrative framework is the growing complexity of astronomical issues. The technological advancements provide precise information on the calculation of prayer times, *qiblah* direction, and moon visibility. However, these results must be understood from the point of view of Islamic law and Hadith studies. For example, there is a difference among scholars on whether to rely on the calculation of moon visibility or the actual sighting of the moon. This difference indicates the need to combine astronomy with Hadith and fiqh in a structured way (King, 2005). The integrative framework can help to bridge the gap between these different disciplines by bringing together the perspectives of Hadith scholars, astronomers, jurists, and technologists. The integrative framework is also required to deal with the ethical and pedagogical challenges raised by the advent of digital technologies. Digital media has made Islamic religious knowledge more accessible to the public. At the same time, it has led to an increase in the number of unverified Hadith, false interpretations, and AI-generated content on the internet. Without guidelines and proper checks, it will become difficult for users to identify authentic religious sources (Campbell & Tsuria, 2022). The integrative framework can provide standards for verifying digital Hadith, academic review, and responsible use of technology. Finally, the integrative framework is needed to provide an interdisciplinary model for Astronomical Hadith Studies that combines traditional Islamic sciences and modern technological fields. Islamic civilization was able to achieve great progress in science and technology when scholars combined their religious knowledge with scientific research. Today, it is necessary to develop a similar approach that uses digital technologies to support the goals of Islamic scholarship (Guessoum, 2011).

Therefore, the proposed framework must be integrative in nature, incorporating both traditional and modern approaches to achieve its objectives. The proposed framework should seek to integrate the strengths of the Hadith sciences and modern technologies to enhance the quality of research, improve the learning experience, increase the application of research in Islamic astronomy and maintain the integrity of scholarship in Astronomical Hadith Studies.

Proposed Integrative Framework:

With the increasing advancement of digital technologies, it is necessary to develop new ways of doing Astronomical Hadith Studies. For example, technologies may be used to enhance the astronomical terminology. However, the use of such technologies in Astronomical Hadith Studies needs to be done in a way that does not compromise the methodological principles of the science. Therefore, this study proposes an integrative framework for Astronomical Hadith Studies called Technology-Assisted, Scholar-Guided Astronomical Hadith Studies that aims to blend the classical Islamic methodology and modern digital technology (Bunt, 2022). The technology should serve as a means, not an end, to produce Islamic knowledge. In classical methodology of Hadith, authenticity is determined using several tests, such as *isnād* criticism, *ilm al-rijāl*, and *matn* analysis. This could help to preserve the integrity and the context of the custom (Azmi & Badia, 2012). Thus, while current digital tools AI, NLP, large databases of Hadith present possibilities for the study of Hadith. Figure below shows the idea of Integrative Framework.



Integrative Framework.

The framework is set in place on the understanding that the assessment of authenticity and relevance must nonetheless still be ultimately the domain of human Hadith scholars, and technology is only to be employed as an aid. The two layers of this framework are a technological layer and a scholarly layer. The technological layer comprises digital databases of Hadith texts; AI systems to process; GIS software and astronomy software; smartphone apps to calculate *qiblah* and prayer times. This layer supports massive data handling along with retrieval and computation of astronomical variables. For example, GIS or spatial technology can determine the *qiblah* at any point on earth. At the same time, one can use astronomy software to calculate whether the new moon is visible or not anywhere on earth (King, 2005).

The academic layer negotiates the interpretation of data, authentication, and contextualization. Experts examine technological yield to ensure it meets the standards of hadiths according to scholars. They can also resolve disputes about the compatibility of Hadith and astronomical calculations.

Additionally, they monitor the technology to avoid the uncritical acceptance of its results (Guessoum, 2011). Another important component of the proposed framework is the integration process, which consists of five stages: data collection, digitization, astronomical mapping, authentication, and application in education and daily life. Data collection entails the gathering of information about Hadith and astronomy from authorized databases. Digitization is the use of AI and NLP to analyse the gathered data. Astronomical mapping refers to the alignment of the astronomical details mentioned in Hadith with modern scientific equivalents. Authentication requires an expert to verify that the outputs of the process meet the standards of classical methodology. Application entails using the authenticated data in educational settings and everyday practice.

Finally, the framework includes ethics to tackle the issues arising from AI-generated religious materials. With the emergence of multiple digital sources of religious knowledge, there is an increased likelihood of false information being produced. For instance, individuals may come across interpretations of Hadith on the internet without referring to reliable sources or consulting scholars. Hence, the framework proposes a set of ethical guidelines, including transparency in sourcing, accountability of outcomes, and mandatory scholarly endorsement prior to the distribution of digital content (Campbell & Tsuria, 2022).

In addition, the proposed framework advocates collaboration among various experts, including Hadith scholars, astronomers, data scientists, software engineers and universities. Islamic astronomy grew because of this sort of cooperation. Judicial and scientific collaborations address issues involving religion, science, and society. If this cross-discipline cooperation transported to digital space, it would lead to innovative products without losing authenticity. Additionally, this will eventually lead to the production of standardized digital tools for the needs of Islam. To sum up, the proposed framework, Technology-Assisted, Scholar-Guided Astronomical Hadith Studies, provides a modern digital technology-using avenue to classical Islamic scholarship. By joining scholarly oversight with the benefits of technological advancements, the system ensures the rigor and advancement of the Astronomical Hadith Studies. This hybrid approach enhances the efficiency of research and education while safeguarding the epistemology of Hadith sciences from an epistemological standpoint.

Conclusion

In conclusion, the increasing relevance of digital technologies to Astronomical Hadith Studies was examined in this study together with the model of combination of classical Islamic scholarship with digital technologies. It turns out that the Astronomical Hadith Studies become interdisciplinary by virtue of its dependence on both religious texts as well as the study of astronomical observations. In the past, it made use of traditional hadith sciences, such as criticism of *isnād* and *matn* and *fiqh* as well as classical astronomical sciences for the calculation of timings of prayer, the determination of direction of the *qiblah* and the sighting of the moon. Digital technologies impact this process by supplying researchers and practitioners with new resources. All these technologies made it possible to process vast amounts of Hadith texts, create visual representations of the phenomena, and carry out

international cooperation between researchers and teachers. Nonetheless, using such technologies creates questions about authenticity, creativity, and excessive reliance on technology. To address these concerns, this study presented a framework for Technology-Assisted, Scholar-Guided Astronomical Hadith Studies. This approach posits that digital technologies and the authority of classical scholars work together. Digital technologies provide the means for organizing and presenting data, but the final word on interpretation and verification must remain with the classically trained Hadith scholar. The epistemological principles of Hadith sciences are thereby maintained in the face of technological challenges. In conclusion, Astronomical Hadith Studies in the digital age must avoid the choice of either tradition or technology. Rather, it must seek an integrative solution that combines the rigor of traditional approaches with the possibilities of digital innovation. The framework developed in this study provides a model for achieving greater accuracy, efficiency, and impact in Astronomical Hadith Studies, while at the same time retaining the legitimacy and credibility of the discipline in the modern world.

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- Acknowledgements:** The authors would like to express their sincere gratitude to Universiti Sains Islam Malaysia and Jabatan Mufti Sarawak for providing support for publishing this paper under grant Number USIM/JMNS/FPQS/LUAR-K/46424. Special appreciation is extended to colleagues and peers who contributed valuable insights and constructive feedback, which greatly enhanced the quality of this paper.
- Funding Statement:** This paper received financial support from Research and Innovation management center (RIMC) USIM. The funding body had no role in the design of the study, data collection, analysis, interpretation of results, or the decision to publish this manuscript
- Conflict of Interest Statement:** The authors declare that there is no conflict of interest regarding the publication of this paper. All authors have contributed to this work and approved the final version of the manuscript for submission to the International Journal of Information System and Technology Management (JISTM).
- Ethics Statement:** This study did not involve any human participants, animals, or sensitive data requiring ethical approval. The authors confirm that the research was conducted in accordance with accepted academic integrity and ethical publishing standards.
- Author Contribution Statement:** All authors contributed significantly to the development of this manuscript. The first and fourth authors were responsible for the conceptualization, methodology, literature review, and overall supervision of the study. The second and third and fifth authors were responsible for data collection, analysis, and critical revision of the manuscript. All authors read and approved the final version of the manuscript prior to submission
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