

THE APPLICATION OF DIGITAL TECHNOLOGIES IN THE INTERPRETATION OF HADITH ON QIBLAH: OPPORTUNITIES AND CHALLENGES

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Abstract	<i>The interpretation of Hadith concerning Qiblah has historically occupied a significant place in Islamic scholarship, particularly in relation to ritual worship, mosque orientation, navigation, and the determination of the direction of prayer. Classical scholars relied on textual analysis, jurisprudential reasoning, astronomical observation, and geographical estimation to understand and apply Prophetic traditions related to Qiblah. In the contemporary era, rapid advancements in digital technologies have introduced new possibilities for enhancing the interpretation and practical implementation of these Hadith. This article examines the application of digital technologies in the interpretation of Hadith on Qiblah by analysing both the opportunities and challenges associated with this transformation. Using a qualitative library-based research approach, the study reviews classical Islamic sources alongside recent literature on digital humanities, Islamic studies, geospatial systems, and artificial intelligence. The findings indicate that technologies such as Geographic Information Systems (GIS), Global Positioning Systems (GPS), satellite imagery, mobile prayer applications, digital Hadith databases, machine learning, and augmented reality have significantly improved the accessibility, precision, and contextual understanding of Qiblah-related traditions. These tools enable accurate directional calculations, multilingual dissemination of Hadith sources, comparative jurisprudential analysis, and user-friendly guidance for Muslims worldwide. However, several challenges remain, including methodological overreliance on automation, inaccuracies in poorly designed applications, differences among juristic schools, data reliability concerns, limited scholarly supervision, and ethical issues related to algorithmic bias and religious authority. The study argues that digital technologies should complement rather than replace traditional scholarly methodologies grounded in the Qur'an, Sunnah, and established fiqh principles. A balanced integration between revealed knowledge (naqli) and rational-technological tools ('aqli) is therefore essential. The article concludes that when responsibly developed and guided by qualified scholars, digital</i>
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<i>technologies can strengthen contemporary understanding of Hadith on Qiblah while preserving the authenticity and integrity of Islamic knowledge traditions.</i> Keywords: <i>Hadith, Qiblah, Digital, Technology, Islam.</i>
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INTRODUCTION

The determination of *Qiblah*, the direction Muslims face during ṣalāh (prayer), is one of the most significant practical issues in Islamic ritual life. Rooted in the Qur'ānic command to turn toward al-Masjid al-Ḥarām (Qur'an 2:144), the concept of Qiblah has historically required both religious obedience and scientific reasoning. The Prophet Muhammad (PBUH) also provided guidance through Hadith regarding facing the Ka'bah, he said, "When you stand for prayer, perform ablution thoroughly, then face the Qibla and say "Allahu Akbar" (Allah is Greatest) (Al-Bukhari: 6667 & Muslim: 397).

The Prophet Muhammad (PBUH) also emphasized the importance of exerting effort when the direction is uncertain and of facilitating acts of worship during travel. Consequently, Muslim scholars traditionally combined textual evidence, jurisprudential reasoning, astronomy, geography, and mathematics to determine the most accurate direction from different parts of the world. In distant regions such as Southeast Asia, even minor directional deviations may create substantial geographic displacement from Makkah, highlighting the importance of precision (Umar et al., 2025).

In recent years, digital transformation has significantly changed how Muslims access and apply Qiblah-related knowledge. Technologies such as the Global Positioning System (GPS), Geographic Information Systems (GIS), smartphone sensors, satellite mapping, and augmented reality applications now enable real-time Qiblah determination with unprecedented convenience. Studies have shown that digital tools can improve accessibility and efficiency, especially for travellers and Muslims living in non-Muslim-majority countries where mosques or traditional guidance may be limited (Hasan et al., 2025).

At the same time, the growing dependence on mobile applications and automated systems raises important methodological and religious concerns. Several studies have found inconsistencies among smartphone compass applications due to magnetic interference, calibration errors, inaccurate coding, and environmental limitations. Some users may rely entirely on software outputs without understanding the *fiqh* principles of *ijtihād* (reasonable effort) or the contextual flexibility recognized in Islamic law (Husein et al., 2021).

Furthermore, the rapid expansion of digital Hadith resources has created broader debates regarding authenticity verification, scholarly authority, and ethical use of technology in Islamic studies (Akbar et al., 2024). Therefore, examining the application of digital technologies in the interpretation of Hadith on Qiblah is both timely and necessary. This article explores how modern technologies contribute to understanding Prophetic guidance on Qiblah while also identifying the challenges associated with overreliance on automation, data reliability, and limited scholarly supervision.

By integrating *naqli* (revealed sources) and *'aqli* (rational-scientific tools) approaches, the study argues that digital technologies should complement not replace traditional Islamic scholarship in ensuring accurate and meaningful Qiblah determination (Mahtir & Ridwan, 2020).

CONCEPT OF QIBLAH IN ISLAMIC TRADITION

The concept of Qiblah occupies a central place in Islamic ritual, theology, and communal identity. It refers to the sacred direction toward which Muslims turn during prayer and several other acts of worship. Beyond its legal and physical dimensions, the Qiblah symbolizes unity, obedience to divine command, and spiritual orientation toward Allah. Throughout Islamic history, scholars have examined Qiblah through the lenses of Qur'anic exegesis, Hadith interpretation, jurisprudence, astronomy, and geography.

In the contemporary period, renewed scholarly attention has highlighted both the symbolic meaning and technical determination of Qiblah in increasingly globalized Muslim societies (Ridwan et al., 2025).

DEFINITION OF QIBLAH

Linguistically, the Arabic word *qiblah* derives from the root *q-b-l*, which conveys the meaning of facing, confronting, or directing oneself toward something (Mutmainnah, 2017). Technically, in Islamic jurisprudence, Qiblah refers to the direction of the Ka'bah in Makkah, Saudi Arabia, which Muslims face during ṣalāh (ritual prayer). It also guides the orientation of mosques, graves, and certain ritual practices such as animal slaughter.

Thus, Qiblah is not merely a geographic bearing but a sacred axis linking Muslims globally to the House of Allah established by Prophet Ibrahim and Prophet Ismail (Ridwan et al., 2025). The significance of Qiblah lies in its function as a visible expression of unity among Muslims despite differences in language, ethnicity, and location. Five times daily, believers across continents orient themselves toward one focal point, reflecting the collective discipline of the ummah.

Contemporary researchers note that the legal requirement of facing the Qiblah also encouraged the historical development of astronomy, cartography, mathematics, and navigation within Islamic civilization (Abdullah, 2025).

QUR'ANIC DISCOURSE ON QIBLAH

The Qur'an establishes the theological and legal foundation of Qiblah. The most explicit reference appears in Sūrat al-Baqarah (2:144): *"So, turn your face toward al-Masjid al-Haram. Wherever you are, turn your faces toward it."* This verse formalized the direction of prayer toward the Ka'bah after an earlier phase in which Muslims prayed toward Jerusalem.

The change of Qiblah represented a decisive moment in the formation of Muslim identity and religious independence (Mutmainnah, 2017). Additional verses in Sūrat al-Baqarah (2:142–150) address criticism from opponents and emphasize that east and west belong to Allah, while He guides whom He wills. These passages indicate that sacred direction is not about limiting Allah to space, but about obedience, order, and communal discipline. Scholars interpret the transition from Jerusalem to Makkah as both a test of faith and a reaffirmation of the Abrahamic legacy centered on the Ka'bah (Hamid, 2016).

The Qur'anic discourse also recognizes practical flexibility. Muslims are instructed to face the Qiblah "wherever you are," implying the need for human effort in determining direction according to available means. This principle later became the basis for juristic rulings allowing *ijtihād* (reasonable effort) when certainty is difficult to attain, especially during travel or in remote lands (Budiwati et al., 2022).

HADITH ON QIBLAH

The Hadith literature elaborates the Qur'anic commands and provides practical guidance regarding Qiblah. Numerous narrations describe the Prophet Muhammad (PBUH) praying toward the Ka'bah in Madinah after revelation of the change in direction. Reports also mention the construction of mosques with attention to Qiblah orientation, demonstrating the practical importance of correct alignment in communal worship.

One well-known narration states: *"What is between the east and the west is Qiblah."* This Hadith, reported in Sunan al-Tirmidhī (342), was interpreted by scholars as applying to people north or south of Makkah, such as residents of Madinah. It indicates that precise mathematical alignment is not always required for those far from the Ka'bah; rather, facing the general direction fulfills the obligation when exact certainty is unavailable (Jalil & Hosen, 2020).

Other Hadith demonstrate flexibility during travel. The Prophet (PBUH) was reported to pray voluntary prayers on his mount while facing whichever direction it turned during journeys. Jurists used such narrations to distinguish between obligatory and

supererogatory prayers and to formulate concessions under difficult circumstances. This illustrates that Islamic law balances ideal orientation with practical ease (Faid et al., 2022).

Hadith also laid the foundation for later scientific inquiry. Because Muslims sought to fulfill Prophetic guidance accurately, scholars developed methods using the sun, stars, shadows, compasses, and eventually spherical trigonometry to determine Qiblah from distant lands. In Southeast Asia, for example, historical scholars combined jurisprudence with astronomy to refine mosque orientation and public worship practices (Ridwan et al., 2025).

In conclusion, according to Islamic faith, Qiblah is far more than a physical direction. It is a symbol of unity, continuity with the Abrahamic heritage, and submission to divine command. The Qur'an established its legal basis through the command to face al-Masjid al-Haram, while the Hadith provided practical interpretations that balanced accuracy with ease. Across centuries, the concept of Qiblah inspired scholarly developments in law and science, making it one of the clearest examples of harmony between revelation and reason in Islamic civilization.

DIGITAL TECHNOLOGIES IN QIBLAH INTERPRETATION

The interpretation and determination of Qiblah, the direction of the Ka'bah in Makkah toward which Muslims face during prayer, has historically combined religious guidance with scientific reasoning. Classical Muslim scholars employed celestial observation, geometry, and geographical knowledge to identify accurate prayer orientation. In the contemporary era, rapid technological development has transformed Qiblah determination through digital tools that offer faster calculations, real-time positioning, and broader accessibility.

These technologies have become especially important for Muslims living in non-Muslim-majority countries, travelers, and communities lacking traditional astronomical expertise. However, while digital innovation increases convenience, it also raises concerns regarding accuracy, methodology, and overdependence on automated systems.

GEOGRAPHIC INFORMATION SYSTEMS (GIS)

One of the most influential tools in modern Qiblah studies is the Geographic Information System (GIS). GIS integrates spatial data, mapping software, and coordinate systems to calculate the shortest great-circle route from any location on Earth to the Ka'bah. Through GIS platforms such as ArcGIS and Google Earth, users can determine mosque orientation, verify prayer hall alignment, and assess deviations in existing buildings.

Scholars have found GIS particularly useful for urban planning, mosque construction, and re-evaluating historical Qiblah alignments (Budiwati et al., 2022). GIS also enables visualization of global Qiblah lines, making it an effective educational tool for demonstrating how Muslims from different continents face a single sacred point.

GLOBAL POSITIONING SYSTEM (GPS)

The Global Positioning System (GPS) has further enhanced Qiblah determination by enabling precise real-time location tracking. GPS-enabled devices use satellite signals to calculate latitude and longitude, which are then combined with spherical trigonometric formulas to determine the azimuth angle toward Makkah. Modern smartphones, watches, and navigation devices commonly rely on GPS for Qiblah applications.

Recent studies examining mosque alignment through GPS methods reported higher consistency compared with traditional manual estimation, especially in remote regions where landmarks are unreliable (Hidayatullah et al., 2026). GPS is especially beneficial for travelers who need immediate directional guidance in unfamiliar environments.

SATELLITE IMAGING AND MAPPING

Satellite imaging and digital mapping technologies have revolutionized Qiblah verification through highly detailed aerial imagery. Platforms such as Google Maps and Google Earth

allow users to inspect building orientation, compare compass readings with true north, and manually trace lines toward the Ka'bah. Satellite tools are widely used by mosque committees and Islamic authorities to audit prayer spaces before construction or renovation.

These systems reduce human error by integrating accurate geodetic coordinates with visual context. Researchers note that combining satellite imagery with GIS significantly improves Qiblah precision in densely built urban environments where magnetic compasses may be unreliable (Abdullah, 2025).

MOBILE PRAYER APPLICATIONS

Among the most widely used technologies are mobile prayer applications. Thousands of smartphone apps now combine Qiblah direction, prayer times, adhān notifications, Qur'an access, and Islamic calendars in a single interface. Their popularity stems from portability, ease of use, and immediate access. For many Muslims, especially younger generations, these apps have become the primary method for locating the Qiblah.

Nevertheless, recent studies reveal significant variation in app accuracy due to differences in algorithms, calibration quality, and sensor dependence. Some applications rely heavily on magnetic compasses, which are easily disturbed by metal objects, electronic devices, or poor device calibration (Umar et al., 2025). Therefore, users are advised to verify app results when possible.

DIGITAL HADITH DATABASES

Beyond directional tools, digital Hadith databases contribute to the interpretation of Qiblah by providing rapid access to Prophetic narrations on prayer direction, travel concessions, mosque orientation, and jurisprudential principles. Databases such as Shamela, Sunnah.com, Maktaba al-Shamilah, and institutional repositories allow scholars and students to search keywords, compare narrations, and trace legal discussions across schools of thought.

This digitization has accelerated comparative fiqh research and enabled multilingual dissemination of Qiblah-related Hadith. Instead of relying solely on printed collections, researchers can now cross-reference texts within seconds (Akbar et al., 2024). Contemporary Hadith scholars observe that digital archives improve accessibility but still require traditional expertise in authenticity criticism and contextual interpretation.

ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

The emergence of Artificial Intelligence (AI) and Machine Learning (ML) offers new possibilities for Qiblah interpretation. AI systems can analyze geographic coordinates instantly, optimize route calculations, and personalize guidance according to user context. Machine learning can also improve app performance by correcting sensor drift, recognizing common calibration errors, and adapting compass readings based on environmental interference.

In Islamic studies, AI can organize Hadith corpora, cluster related narrations, and assist multilingual translation of Qiblah texts. However, scholars caution that AI-generated outputs may contain errors, oversimplify juristic differences, or reproduce biased datasets if not supervised by qualified experts (Muttaqin, 2023). Thus, AI should function as a support tool rather than a replacement for scholarly reasoning.

AUGMENTED REALITY / SMART COMPASS TOOLS

Another innovative development is Augmented Reality (AR) and smart compass technology. AR-based applications use a smartphone camera to overlay directional arrows onto the real-world environment, allowing users to visually "see" the Qiblah direction on-screen. This feature is particularly helpful indoors, in hotels, airports, or unfamiliar public spaces.

Smart compass systems combine magnetometers, accelerometers, gyroscopes, and GPS to provide smoother directional guidance than conventional compasses (Hasan et al.,

2025). Some advanced tools also integrate solar-shadow methods to verify true north. Studies on AR-based Qiblah applications show high usability but note limitations in mountainous terrain, weak sensor performance, and indoor interference.

In conclusion, Digital technologies have profoundly transformed Qiblah interpretation by increasing precision, accessibility, and global usability. GIS, GPS, satellite imaging, mobile applications, digital Hadith databases, AI, and AR tools now enable Muslims to determine prayer direction more efficiently than ever before. Nevertheless, technological convenience must be accompanied by verification, ethical design, and scholarly oversight.

When integrated responsibly, these innovations strengthen rather than replace the rich intellectual tradition through which Muslims have historically understood and practiced the obligation of facing the Qiblah.

OPPORTUNITIES OF DIGITAL TECHNOLOGIES IN QIBLAH INTERPRETATION

The determination of Qiblah, the direction of the Ka'bah in Makkah toward which Muslims face during prayer, has always required a combination of religious knowledge and scientific reasoning. Classical Muslim scholars used astronomical observation, geography, and mathematical calculations to determine accurate orientation from various regions of the world.

In the modern era, digital technologies have created new opportunities that significantly enhance the interpretation and practical application of Qiblah-related guidance. Tools such as Geographic Information Systems (GIS), Global Positioning Systems (GPS), satellite mapping, mobile applications, digital Hadith databases, and artificial intelligence have made Qiblah determination more accurate, accessible, and educationally valuable. These innovations demonstrate how technology can support Islamic practice while preserving the objectives of Shari'ah.

IMPROVED ACCURACY OF QIBLAH DIRECTION

One of the most significant opportunities offered by digital technologies is the improved accuracy of Qiblah direction. Traditional methods based on rough compass readings or local assumptions often resulted in directional deviations, especially in regions far from Makkah. Modern GIS and GPS technologies now calculate the great-circle route from any location to the Ka'bah using precise coordinates and geodetic formulas.

Studies evaluating smartphone and satellite-based Qiblah tools found that calibrated digital systems provide higher precision than many manual methods (Umar et al., 2025). Similarly, Google Earth and GIS-based models have been used successfully to verify mosque alignments and correct previously inaccurate orientations (Budiwati et al., 2022). This accuracy is particularly important in Southeast Asia, where small angular errors may lead to substantial geographic displacement from Makkah.

GLOBAL ACCESSIBILITY FOR MUSLIMS

Digital technology has also enhanced global accessibility for Muslims living in diverse environments. In earlier times, determining Qiblah in non-Muslim-majority countries or remote regions could be difficult due to limited access to scholars or mosques. Today, a smartphone with internet access can instantly provide reliable Qiblah guidance. This convenience benefits travelers, students abroad, refugees, airline passengers, and Muslim minorities worldwide.

Researchers note that mobile Islamic applications have become essential tools for maintaining religious practice in transnational contexts (Ismail et al., 2024). Through multilingual interfaces and simplified navigation, digital Qiblah services reduce barriers to worship and strengthen the continuity of Islamic identity regardless of location.

FASTER INTERPRETATION AND DATA RETRIEVAL

Another major advantage is faster interpretation and data retrieval. Historically, scholars and students needed to consult multiple printed sources to study rulings on Qiblah, prayer

direction, travel concessions, and juristic disagreements. Today, digital libraries and searchable databases allow immediate retrieval of relevant Hadith, fiqh opinions, and astronomical calculations.

Platforms such as al-Maktabah al-Shāmilah, Sunnah.com, and online repositories enable users to locate narrations by keywords, compare variants, and review scholarly commentary in seconds. According to Akbar et al. (2024), the digitization of Hadith sources has transformed research efficiency by enabling faster access to classical texts and broader dissemination of Islamic knowledge. This speed benefits both academic researchers and ordinary Muslims seeking guidance.

COMPARATIVE STUDY OF HADITH SOURCES

Digital databases also create opportunities for the comparative study of Hadith sources related to Qiblah. Classical jurists often differed in interpreting narrations concerning approximate direction, prayer during travel, or obligations when certainty is unavailable. Modern software now allows scholars to compare chains of transmission, textual variants, legal commentaries, and school-based interpretations across multiple collections.

This strengthens methodological transparency and supports evidence-based legal analysis. Researchers in contemporary Hadith studies observe that digital humanities tools help organize complex textual traditions while preserving access to original sources (Abdulrahman, 2024). As a result, scholars can better contextualize Qiblah narrations within broader jurisprudential debates.

USER-FRIENDLY EDUCATIONAL TOOLS

Digital technologies have further generated user-friendly educational tools for learning about Qiblah. Interactive maps, animated tutorials, smart compass applications, and augmented reality (AR) interfaces make complex astronomical concepts understandable to non-specialists. Users can visually observe how the Earth's curvature affects prayer direction or how great-circle routes differ from flat-map assumptions.

Such educational tools are particularly effective for younger generations accustomed to digital learning environments. Hasan et al. (2025) found that AR-based Qiblah applications significantly improved user engagement and comprehension compared with static compass systems. These innovations transform Qiblah determination from a purely technical task into an opportunity for religious education and scientific literacy.

INTEGRATION OF ASTRONOMY AND ISLAMIC KNOWLEDGE

Perhaps the most important opportunity is the integration of astronomy and Islamic knowledge (Hoque et al., 2025). The study of Qiblah historically stimulated Muslim contributions to trigonometry, navigation, observatories, and celestial science. Contemporary digital systems continue this legacy by connecting Islamic ritual needs with modern astronomy, geodesy, and spatial science.

Satellite data, solar-shadow simulations, and mathematical modeling now support more precise implementation of Prophetic guidance. Scholars argue that this relationship reflects the harmony between *naqli* (revealed knowledge) and *'aqli* (rational inquiry), where scientific tools serve religious objectives rather than compete with them (Faid et al., 2022). This integration also provides a strong model for broader Islamization of contemporary science and technology.

BROADER SOCIAL AND INSTITUTIONAL BENEFITS

Digital opportunities in Qiblah interpretation extend beyond individuals to institutions. Mosque committees use digital surveying tools before construction, Islamic schools employ apps for teaching students, and national religious authorities use standardized software to issue guidance. Universities increasingly integrate GIS and falak (Islamic astronomy) software into curricula, helping train a new generation of scholars capable of combining classical knowledge with technological competence (Zaki & Hidayatullah, 2025).

This institutional adoption strengthens consistency and professionalism in public religious services. In Conclusion, the Digital technologies have opened unprecedented opportunities in Qiblah interpretation by improving accuracy, expanding global accessibility, accelerating information retrieval, enabling comparative Hadith studies, enhancing educational engagement, and integrating astronomy with Islamic scholarship.

These developments demonstrate that technological innovation can serve the practical and intellectual needs of Muslim communities when guided responsibly. While human expertise and scholarly oversight remain essential, digital tools offer powerful means to preserve and advance the Islamic tradition of precise and meaningful Qiblah determination.

CHALLENGES OF DIGITAL TECHNOLOGIES IN QIBLAH DIRECTION

Despite the rapid advancement of digital tools in determining the Qiblah direction, several significant challenges remain that affect accuracy, reliability, and religious confidence. These challenges arise from technical limitations, methodological inconsistencies, and broader ethical and epistemological concerns in the integration of technology with Islamic practice. While technologies such as GPS, GIS, artificial intelligence (AI), and mobile applications have improved accessibility, their limitations highlight the need for careful scholarly oversight and methodological balance.

INACCURATE OR UNVERIFIED APPS

One of the most widely reported challenges is the existence of inaccurate or unverified Qiblah applications. Although thousands of mobile apps are available, not all undergo proper scientific or religious validation. Many rely on simplified algorithms or outdated geographic data, leading to inconsistent results. Studies show that numerous Qiblah apps in both Android and iOS platforms have never been formally tested for accuracy, raising concerns about reliability for religious practice (Zaki & Hidayatullah, 2024).

This problem is worsened by the widespread use of apps that depend heavily on device sensors without calibration verification, which can mislead users in prayer direction determination (Ismail et al., 2024).

OVERDEPENDENCE ON TECHNOLOGY

Another major challenge is overdependence on digital technology. Many users rely entirely on smartphone apps without understanding the underlying principles of Qiblah determination, such as basic astronomy or fiqh guidelines. This creates a passive reliance where users trust technology blindly, even when it may be inaccurate. Research highlights that such dependence weakens critical religious awareness and reduces personal effort (*ijtihad*) in verifying direction (Umar et al., 2025). In some cases, users may continue following incorrect readings simply because they trust digital outputs more than traditional methods like maps or compasses.

LACK OF SCHOLARLY SUPERVISION

The lack of scholarly supervision in app development and digital Qiblah systems is another critical issue. Many applications are designed by software developers without consultation from qualified Islamic jurists or astronomers. As a result, the integration between fiqh principles and computational models is often weak or incomplete. Scholars emphasize that religious tools should be developed collaboratively to ensure both scientific accuracy and Shariah compliance (Akbar et al., 2024). Without such oversight, there is a risk of misinterpretation of Hadith and misuse of religious authority in digital platforms.

JURISTIC DIVERSITY AND STANDARDIZATION ISSUES

Islamic jurisprudence recognizes diversity in Qiblah determination methods, which creates challenges for standardization. Different schools of thought allow varying degrees of deviation depending on distance, geographical constraints, and certainty levels. Digital

systems, however, often present a single fixed direction without acknowledging these juristic differences.

This lack of flexibility may create confusion among users and lead to disputes regarding “correct” Qiblah orientation. Researchers note that the absence of global standardization in Qiblah algorithms remains a persistent challenge in Islamic digital tools (Hasan et al., 2025).

TECHNICAL ERRORS IN SENSORS AND GPS

Digital Qiblah tools rely heavily on sensors such as magnetometers, accelerometers, and GPS systems, all of which are vulnerable to technical errors. Magnetic interference from electronic devices, metal structures, and even phone cases can distort compass readings. Similarly, GPS signals may be inaccurate in indoor environments, urban areas with tall buildings, or remote locations with weak satellite coverage.

Studies confirm that smartphone compass readings can vary significantly depending on calibration and environmental conditions, sometimes producing directional errors of several degrees (Faid et al., 2022). Such inaccuracies may affect prayer orientation if users do not cross-check results.

ALGORITHMIC BIAS AND ETHICAL CONCERNS

The use of AI and algorithm-based Qiblah systems introduces concerns about algorithmic bias and ethical reliability. AI systems depend on training data, which may not always reflect accurate geospatial or religious interpretations. If poorly designed, these systems may prioritize computational efficiency over juristic accuracy. Additionally, ethical questions arise regarding whether automated systems should be trusted in matters of worship.

Scholars argue that without ethical frameworks grounded in Islamic principles, digital tools may unintentionally distort religious understanding or oversimplify complex jurisprudential debates (Hasan et al., 2025).

WEAK UNDERSTANDING OF HADITH CONTEXT

A final challenge is the weak understanding of Hadith context among general users of digital tools. Many applications provide Qiblah directions without explaining the Prophetic traditions behind them or the jurisprudential principles governing uncertainty. As a result, users may treat digital outputs as absolute religious rulings rather than interpretive tools based on scholarly reasoning.

This disconnect reduces awareness of key Hadith principles such as ease (*taysir*), effort (*ijtihad*), and flexibility in cases of uncertainty. Scholars emphasize that Hadith should be understood within its broader legal and historical context rather than reduced to technical outputs (Ridwan et al., 2025). In summary, while digital technologies have greatly improved the ease and accessibility of Qiblah determination, they also introduce serious challenges related to accuracy, user behavior, scholarly oversight, and ethical integrity.

Inaccurate applications, overreliance on devices, lack of juristic supervision, technical sensor limitations, algorithmic bias, and weak Hadith contextualization all highlight the need for a balanced approach. The effective solution lies in integrating technological innovation with traditional Islamic scholarship, ensuring that digital tools serve as supportive instruments rather than replacements for religious knowledge and expertise.

RECOMMENDATIONS

The increasing use of digital technologies in determining the Qiblah direction presents both significant opportunities and notable challenges. To ensure that these technologies serve the needs of Muslim communities accurately and responsibly, several key recommendations are proposed. These recommendations focus on improving reliability, enhancing scholarly engagement, strengthening user awareness, and promoting global cooperation in the development and use of Qiblah-related digital tools.

CERTIFICATION SYSTEM FOR ISLAMIC APPS

A structured certification system for Islamic applications is essential to ensure accuracy, reliability, and Shariah compliance. At present, many Qiblah apps are developed without formal evaluation, resulting in inconsistencies in directional accuracy and content quality. Establishing a certification body possibly under national Islamic authorities or international organizations would allow apps to be tested against standardized scientific and religious criteria.

This system should evaluate GPS accuracy, compass calibration methods, algorithm reliability, and adherence to established fiqh principles. Certified applications could display an official verification badge, helping users distinguish between reliable and unverified tools. Such a system would also encourage developers to improve quality and follow ethical design standards, ensuring that digital Islamic tools maintain credibility and public trust (Hasan et al., 2025).

INVOLVEMENT OF HADITH SCHOLARS IN SOFTWARE DESIGN

The involvement of qualified Hadith scholars and Islamic jurists in software development is crucial for ensuring that digital tools reflect authentic religious understanding. Many current applications are developed primarily by engineers or software companies without sufficient consultation with religious experts. This separation can lead to misinterpretation of Hadith, oversimplification of jurisprudential rulings, or omission of important contextual guidance.

By integrating Hadith scholars into interdisciplinary development teams, developers can ensure that Qiblah applications correctly reflect Prophetic traditions, juristic diversity, and methodological principles of Islamic law. Scholars can also guide the inclusion of explanatory content, ensuring that users understand the religious basis behind Qiblah determination rather than relying solely on automated outputs (Akbar et al., 2024). This collaboration strengthens both technological innovation and religious authenticity.

PERIODIC CALIBRATION OF QIBLAH TOOLS

Another important recommendation is the periodic calibration of Qiblah tools and applications. Digital Qiblah systems rely heavily on sensors such as magnetometers, accelerometers, GPS modules, and gyroscopes, all of which can lose accuracy over time due to environmental interference, software updates, or hardware degradation. Regular calibration procedures should be established to ensure consistent performance.

App developers should incorporate automatic calibration prompts, while users should be educated on how to recalibrate their devices when necessary. In addition, mosque authorities and Islamic institutions can conduct periodic verification of installed Qiblah indicators using reliable astronomical or GIS-based methods. This ensures that both individual users and communal prayer spaces maintain correct alignment (Umar et al., 2025).

PUBLIC EDUCATION ON PROPER USE

Enhancing public education on the correct use of Qiblah technologies is essential to prevent misuse and overreliance. Many users assume that smartphone applications provide absolute accuracy without understanding their limitations. Educational initiatives should be developed to explain how Qiblah direction is calculated, the role of GPS and magnetic sensors, and the possibility of minor deviations.

Islamic institutions, universities, and mosques should organize workshops, seminars, and online courses to raise awareness about both digital tools and traditional methods of Qiblah determination. Educational content should also emphasize key Hadith principles such as flexibility in cases of uncertainty and the importance of effort (*ijtihad*) in worship. Strengthening public understanding will promote responsible use of technology and reduce blind dependence on automated systems (Ismail et al., 2024).

INTERNATIONAL COOPERATION

Finally, there is a strong need for international cooperation in the development and standardization of Qiblah technologies. Because Muslims live in diverse geographical and cultural contexts, inconsistencies in Qiblah calculation methods often arise between different countries and institutions. Collaborative efforts among Islamic organizations, universities, astronomy centers, and technology companies can help establish unified standards for Qiblah determination.

International bodies such as the Organization of Islamic Cooperation (OIC) or global fiqh councils could play a leading role in coordinating research, sharing data, and setting technical guidelines. Cooperation would also encourage the development of open-source datasets and shared algorithms that improve transparency and reduce discrepancies across platforms. Such global collaboration ensures that technological advancements serve the entire Muslim ummah in a consistent and scientifically reliable manner (Faid et al., 2022).

In conclusion, improving the reliability and effectiveness of digital Qiblah technologies requires a comprehensive and integrated approach. Certification systems can ensure quality control, scholarly involvement guarantees religious authenticity, calibration maintains technical accuracy, public education promotes responsible use, and international cooperation supports global standardization. Together, these measures will help ensure that digital innovations in Qiblah determination remain accurate, trustworthy, and aligned with both scientific principles and Islamic teachings.

CONCLUSION

The study of digital technologies in Qiblah interpretation highlights a significant transformation in both the practice and understanding of determining the direction of the Ka'bah. Traditionally, Qiblah determination relied on Qur'anic guidance, Prophetic Hadith, astronomical observation, geographical knowledge, and juristic reasoning. Classical scholars developed sophisticated methods using celestial bodies, geometry, and environmental cues to ensure accurate orientation for prayer.

In contrast, the contemporary digital era has introduced advanced technological tools that have reshaped this practice in terms of speed, precision, and accessibility. Overall, the findings of this study show that technologies such as Geographic Information Systems (GIS), Global Positioning Systems (GPS), satellite mapping, mobile Qiblah applications, artificial intelligence, and augmented reality tools have greatly improved the accuracy and convenience of Qiblah determination.

These tools enable Muslims to locate the correct prayer direction instantly from almost any place on earth, making them especially valuable for travellers, urban populations, and Muslim minorities in non-Muslim-majority regions. In addition, digital Hadith databases and educational platforms have enhanced access to Prophetic traditions and classical Islamic knowledge, allowing users to better understand the religious foundations of Qiblah.

At the same time, the study identifies important limitations, including inaccuracies in some applications, lack of standardization, technical errors in sensors and GPS systems, and insufficient scholarly supervision. These challenges indicate that while digital tools are highly beneficial, they are not completely infallible and must be used with awareness of their limitations.

Issues such as overdependence on technology and weak understanding of the Hadith context further emphasize the need for balanced usage grounded in Islamic epistemology. When properly guided, digital technologies offer immense value to Islamic practice. They should be viewed as supportive instruments rather than replacements for traditional scholarly authority. By integrating scientific precision with fiqh principles, these technologies can enhance religious practice while maintaining authenticity.

The collaboration between Islamic scholars, astronomers, and technologists ensures that digital tools reflect both technical accuracy and Shariah compliance. This

integration strengthens the harmony between revealed knowledge (*naqli*) and rational-scientific methods (*aqli*), which has historically characterized Islamic intellectual tradition.

Looking toward the future, Qiblah studies are expected to become increasingly interdisciplinary and technologically advanced. Artificial intelligence, machine learning, cloud-based geospatial systems, and augmented reality are likely to further improve accuracy and user experience. These innovations may allow real-time correction of directional errors, personalized Qiblah guidance, and immersive educational experiences. However, future development must also prioritize ethical frameworks, scholarly validation, and global standardization to prevent inconsistency and misuse.

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