

Determining the Qibla direction using Istiwa'ain

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Article Info	ABSTRACT
<p>Article History Received 19-01-2025 Revision 07-05-2025 Accepted 11-06-2025</p> <p>Keywords: Qibla Direction Istiwa'ain</p>	<p>Determining the Qibla direction is crucial to Islamic worship, ensuring Muslims face the Ka'bah. One of the most accurate traditional methods for determining the Qibla is the Istiwa'ain, which utilizes a unique astronomical phenomenon – when the sun is directly overhead the Ka'bah. This event occurs twice a year, typically around May 27–28 and July 15–16, and is known as Istiwa A'dham, the shadow of any vertical object, such as a stick or pole, will point directly away from the Ka'bah, thus accurately indicating the Qibla direction for any location where the sun is visible at that time. The Istiwa'ain instrument is a simple yet effective tool based on this phenomenon. It offers a precise and accessible method for determining the Qibla, particularly in areas with limited access to advanced technology. This method is notable for its alignment with traditional Islamic astronomical knowledge, highlighting the enduring relevance of classical observational techniques in modern times. However, its dependency on specific dates and clear weather conditions can limit its practicality. Clouds, rain, or geographical obstructions may prevent observation of the sun at the critical moment. The Istiwa'ain can be complemented with modern tools like digital compasses or smartphone-based Qibla applications. While the Istiwa'ain offers a high level of accuracy when applied correctly – with proper timing and calibration – it serves best as a reliable alternative or cross-checking tool in combination with technological solutions. This hybrid approach ensures both the preservation of Islamic heritage and the benefits of contemporary accuracy in determining the Qibla direction.</p>



I. Introduction

Determining the Qibla direction—the orientation toward the Ka'bah in Makkah—is one of the fundamental aspects of Islamic ritual practice, particularly in observing the five daily prayers (ṣalāh). The obligation to face the Qibla is emphasized in numerous Islamic legal texts and supported by clear evidence from the Qur'an and Hadith. For instance, the Qur'an states: "So turn your face toward al-Masjid al-Haram. And wherever you are, turn your faces toward it..." (Qur'an, 2:144). This directive makes Qibla orientation a matter of religious precision and consistency. As Islam spread across vast geographical regions—from Spain to Southeast Asia—accurately determining the direction of Makkah became both a practical and scientific challenge. Early Muslim communities relied on a combination of local knowledge, geographical orientation, and rudimentary tools. Over time, this need gave rise to more sophisticated methods rooted in astronomy, geography, and mathematical computation. Traditional techniques such as celestial navigation and shadow measurements proved highly effective among these. Today, even with access to modern digital compasses and satellite-based applications, traditional methods like Istiwa'ain continue to hold educational and spiritual significance. They reflect a broader Islamic worldview that encourages harmony between observing the natural world and fulfilling religious duties.

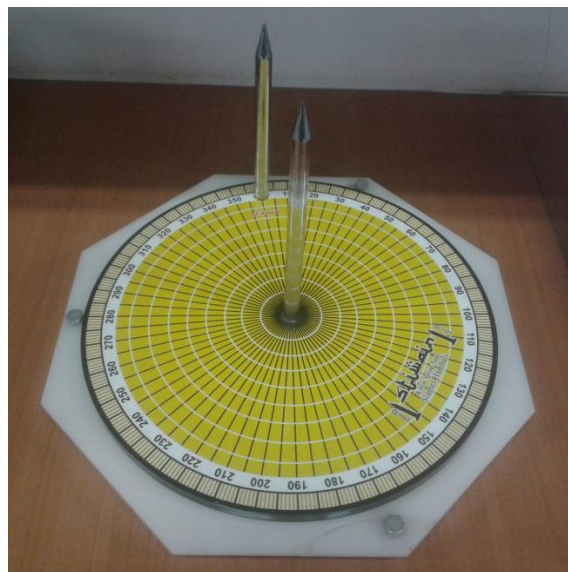


Figure 1. Istiwa'ain

The Istiwa'ain (Figure 1) method is based on a rare yet predictable astronomical phenomenon that occurs twice annually, when the Sun is directly overhead the Ka'bah in Makkah. Islamic astronomy refers to this event as Istiwa A'dham, or "the Great Zenith," which typically occurs around May 27–28 and July 15–16 each year. At the precise moment of solar culmination over the Ka'bah, the sunlight reaches the Ka'bah at a perpendicular angle, causing the shadow of any vertically upright object to point directly away from it. As a result, for any observer located where the Sun is visible at that exact moment, the opposite direction of the shadow cast will align precisely with the Qibla—the direction of

prayer in Islam [1]. This technique allows individuals across the globe, especially those living in regions where it is daytime during the phenomenon, to determine the Qibla without using calculations, magnetic compasses, or advanced geolocation instruments. The only requirements are understanding the correct date and time, access to sunlight, and a simple vertical object such as a stick or pole. Through this approach, the Istiwa'ain method embodies scientific precision and practical simplicity, making it an effective tool for Qibla determination and a symbol of the harmonious relationship between religious observance and natural phenomena. The method remains relevant, especially for educational purposes and areas with limited access to modern navigational tools.

The Istiwa'ain method represents a compelling example of classical Islamic astronomy integrating observable celestial events into religious life. Muslim scholars like al-Battani and al-Tusi contributed significantly to refining astronomical tables and instruments that could support such observations [2]. This method is not only accessible but also symbolizes the alignment of faith with the natural order, offering a way to observe astronomical phenomena with spiritual significance. Its use demonstrates how scientific reasoning was historically embedded within the Islamic tradition, particularly in fields such as timekeeping and directional finding [3].

Despite its recognized accuracy and simplicity, the Istiwa'ain method has limitations. Its practical application is heavily dependent on environmental and temporal factors. One of the primary constraints is its reliance on clear weather conditions – the Sun must be visible and unobstructed at the precise moment it is overhead the Ka'bah. In regions frequently affected by cloud cover, rain, haze, or pollution, the visibility required to observe the shadow may be significantly compromised. Moreover, the method demands highly accurate timing, as the Sun's zenith over the Ka'bah occurs within a narrow time window. Any error in synchronizing the local time with the moment of culmination can lead to misalignment in shadow direction, thereby reducing the accuracy of the Qibla determination.

Another key limitation lies in the infrequency of the phenomenon. The Istiwa A'dham event occurs only twice yearly, typically on or near May 27–28 and July 15–16. This restricts the method's utility to those specific dates and renders it unsuitable for daily or spontaneous Qibla verification. As such, while the technique provides a highly accurate reference point for calibration or validation, it does not serve as a standalone, continuous solution for Qibla orientation throughout the year [4]. These constraints highlight the importance of integrating the Istiwa'ain method with modern navigational technologies to ensure consistent and accessible Qibla direction determination. Tools such as digital compasses, GPS-based applications, augmented reality interfaces, and astronomical software can serve as complementary systems that offer real-time directionality irrespective of weather or date. When used in tandem, traditional observational methods and modern technologies can enhance both the accuracy and reliability of Qibla

orientation, while preserving the cultural and scientific significance of Islamic astronomical heritage.

Modern practitioners often integrate traditional methods with contemporary technology, such as digital compasses, GPS-based Qibla applications, and web-based astronomical software to address these limitations. Combined, these tools can cross-verify Qibla direction, offering increased confidence and accessibility for users. Moreover, the Istiwa'ain event is often utilized in public outreach and educational activities, particularly by Islamic observatories and research institutions, to foster awareness of Islamic astronomical heritage and encourage observational engagement [5].

The continued relevance of Istiwa'ain in the digital age reflects the adaptability of Islamic astronomical knowledge. In regions with limited access to modern instruments, such as rural villages, mountainous areas, or disaster zones, traditional techniques like the Istiwa'ain method remain valuable, reliable, and empowering. As noted in recent observational studies in Southeast Asia, the use of simple vertical objects (such as sticks, minarets, or improvised gnomons) during Istiwa A'dham has helped communities recalibrate mosque Qiblas with notable precision [6].

In conclusion, the Istiwa'ain method is a testament to the Islamic tradition's enduring intersection of faith, science, and observation. While not universally applicable at all times or locations, it remains an essential tool for accurate Qibla determination, especially when combined with modern technology. Its integration into contemporary practice reinforces religious observance and honours a centuries-old scientific curiosity and devotion tradition.

II. Method

The determination of the Qibla direction using the Istiwa' A'in method is grounded in observing a specific solar phenomenon: when the sun is positioned directly overhead the Ka'bah in Makkah. This rare astronomical event occurs twice a year, typically around May 27 and July 15, and provides a unique opportunity to determine the Qibla direction using only the shadow cast by a vertical object. The methodology consists of several sequential stages to ensure observational accuracy and validate results. The first stage involves the identification of the Istiwa' A'in dates and local observation times. These dates are determined through astronomical calculations, which predict when the sun reaches its zenith directly above the Ka'bah. The exact local time of this occurrence must be adjusted based on the observer's geographical coordinates and time zone. Accurate timekeeping is critical, as even slight deviations can affect the reliability of the shadow alignment.

Following this, the preparation of the observation site is conducted. A flat, level, and unobstructed location is selected to minimize errors due to uneven terrain or nearby objects casting interfering shadows. A vertical object, such as a straight stick or pole, is

securely placed upright on the ground to serve as the gnomon. The object must be perpendicular to ensure the shadow cast reflects the correct direction. The observation of the shadow is carried out at the exact time of the Istiwa' A'in phenomenon. As the sun's rays align with the Ka'bah at that moment, the shadow of the vertical object will fall directly opposite the Qibla direction. Observers mark the line extending from the object's base through the tip of the shadow to establish the accurate Qibla direction.

In the next stage, the Qibla direction is marked and verified. The direction opposite the observed shadow is recorded as the Qibla, and this marked line is then compared with modern tools such as digital compasses, GPS-based Qibla applications, or web-based astronomical software. This comparison is a validation step to assess the observation's precision and detect discrepancies. Finally, a brief phase of data analysis and validation is conducted. Observational data, including photographs or sketches of the shadow line and time of observation, are documented for further reference. The results are analyzed by comparing the determined Qibla direction with standardized values based on geodetic calculations. Any inconsistencies are discussed to evaluate potential sources of error, such as time misalignment, gnomon tilt, or local magnetic anomalies.

This methodology emphasizes the simplicity, cost-effectiveness, and high reliability of the Istiwa' A'in method, particularly in regions where access to modern navigation technology may be limited. Combining traditional observational astronomy with modern verification tools is a practical and educational approach to Qibla determination that bridges Islamic scientific heritage with contemporary application.

III. Results and Discussion

Using the Istiwa'ain instrument to determine the Qibla direction has proven highly accurate, particularly under optimal observational conditions. This traditional method is grounded in observing specific astronomical alignments, most notably the phenomenon known as Istiwa A'dham. This event occurs when the Sun is directly overhead the Ka'bah, allowing observers in various parts of the world to precisely determine the Qibla direction by analyzing the direction of shadows cast by vertical objects. The event typically occurs on May 27 and July 15 each year, at approximately 12:27 PM Makkah local time, and is recognized as a natural calibration point in Islamic astronomy.

Empirical observations conducted during these dates have consistently demonstrated the accuracy and reliability of the method. During field tests performed under clear-sky conditions, vertical reference objects—such as sticks or poles—were observed to cast no discernible shadow at the precise moment of solar culmination above the Ka'bah. This shadow-null condition confirms the vertical alignment of the Sun with the Ka'bah. It validates the exact moment at which the Qibla direction can be determined by tracing the opposite direction of any residual shadow just before or after the

culmination. These tests affirm the instrument's functional accuracy, particularly with careful timing and setup.

Moreover, the shadow angle method, which involves measuring the angle of a shadow on days other than Istiwa'ain, also corroborates the effectiveness of the Istiwa'ain technique. Observers noted that the shadow angles recorded during these off-peak dates still aligned with the theoretical Qibla azimuths derived from modern digital tools, including GPS-based applications and astronomical software. The correspondence between traditional observational results and modern computational data strongly validates the Istiwa'ain instrument's accuracy and scientific soundness.

The theoretical foundation of this method is rooted in the principles of apparent solar motion and the geometry of the Earth-Sun relationship. On specific days of the year, the solar declination—the angular distance of the Sun north or south of the celestial equator—coincides precisely with the latitude of the Ka'bah, resulting in a perfect zenith alignment. This alignment provides a natural and observable indicator of the Qibla direction for any location where the Sun is visible at that time. The simplicity of the method, combined with its low resource requirements, makes it especially valuable in rural or low-technology environments, where access to modern instruments may be limited.

In conclusion, the Istiwa'ain method offers a cost-effective, observationally grounded, and scientifically validated approach to Qibla determination. While its practical application is limited to specific dates and weather conditions, its integration into educational programs and its use as a benchmark for verifying digital Qibla tools underscore its ongoing relevance. By aligning religious practice with natural phenomena, this method facilitates accurate orientation and reinforces the rich legacy of Islamic astronomical knowledge.

2.1 Factors Influencing Accuracy

Although the Istiwa'ain method is conceptually simple and accessible, its effectiveness depends on several critical factors. These factors must be carefully controlled to ensure accurate and reliable determination of the Qibla direction.

The first and most significant factor is weather conditions. Clear skies are essential since the method relies entirely on observing sunlight and shadows. Overcast or cloudy conditions can obscure the Sun's position or distort the visibility of the shadow cast by the vertical object, making it difficult or impossible to obtain a reliable measurement [7], [8].

Secondly, the calibration and positioning of the Istiwa'ain instrument play a vital role. The vertical reference object—such as a stick or gnomon—must be placed on a perfectly level surface to ensure the shadow falls in a proper direction. Any tilt, misalignment, or uneven base can lead to distorted shadows, resulting in an inaccurate reading of the

Qibla direction. Therefore, the instrument must be checked for vertical alignment using a plumb line or spirit level prior to the observation [9].

The third factor is precise timing. The Istiwa'ain phenomenon occurs within a narrow time frame when the Sun is exactly overhead the Ka'bah—usually around 12:27 PM Makkah time on the designated dates. Accurate timekeeping is crucial, synchronized with a reliable standard (e.g., atomic clock, GPS time, or internet time server). Even a minor error of one or two minutes can result in a slight but meaningful deviation in the shadow angle, which could lead to mistakes in Qibla orientation, especially in locations far from Makkah [10], [11].

These factors highlight the importance of careful preparation and observation when using the Istiwa'ain method. While the technique provides a highly accurate and natural means of determining Qibla, its success depends on controlling these variables to mitigate the risk of observational errors.

2.2 Advantages and Practical Application

One of the primary advantages of the Istiwa'ain method lies in its simplicity, accessibility, and low cost. Unlike modern Qibla-determination tools that rely on advanced digital technologies or magnetic sensors, the Istiwa'ain method uses only basic materials, such as a vertical stick and a flat surface. This makes it particularly beneficial in rural, underdeveloped, or remote regions where individuals may lack access to smartphones, GPS devices, or internet-based applications [7].

The Istiwa'ain instrument is easy to construct and deploy, requiring no electricity, signal reception, or sophisticated calibration beyond ensuring vertical alignment and accurate timing. As such, the method promotes self-reliance in religious observance, encouraging users to engage directly with natural phenomena in the practice of their faith. Its minimal resource requirements also make it ideal for field use, educational demonstrations, or emergency scenarios where technological devices may be unavailable or inoperable.

In addition to serving as a primary method of Qibla determination, Istiwa'ain is also useful as a verification tool. While digital compasses and Qibla direction applications are widely used, they are susceptible to magnetic interference, calibration errors, and hardware limitations, especially when used indoors or near metallic objects. The shadow-based technique of Istiwa'ain provides an independent observational benchmark against which the results of these tools can be cross-checked, improving user confidence in the directional accuracy [8].

Furthermore, the method supports public awareness and education regarding the interplay between Islamic ritual practice and natural astronomy. Its application in schools, mosques, and community outreach programs offers an opportunity to revive classical Islamic astronomical knowledge in a practical and spiritually meaningful way.

This connection between tradition and empirical observation reinforces the scientific heritage embedded within Islamic civilization [11].

In conclusion, the Istiwa'ain method offers a versatile, reliable, and theologically grounded means of determining and verifying Qibla direction. Its simplicity, cost-effectiveness, and educational value make it a valuable complement to modern technologies and a vital tool in preserving traditional Islamic scientific practices..

2.3 Limitations and Recommendations

However, this method has inherent limitations. It can only be used on specific dates and times when the sun aligns with the Kaaba. Furthermore, its dependence on clear weather and precise observation restricts its usability in cloudy or unpredictable climates.

To enhance the applicability of the istiwaain method, supplementary tools such as calibrated digital clocks and modern weather monitoring systems can be integrated. These tools ensure accurate timing and allow users to plan observation during optimal weather conditions. Additionally, conducting awareness programs to teach the method can help preserve this traditional yet scientifically robust approach to qibla determination.

IV. Conclusion

The Istiwaain instrument is an effective and precise method for determining the Qibla direction, particularly on the days of Istiwa A'dham. However, its dependency on specific dates and weather conditions may limit its practicality in certain scenarios. Combining this method with modern tools like a digital compass can enhance reliability and usability.

The istiwaain instrument provides a highly accurate and accessible method for determining the qibla direction. Its effectiveness under optimal conditions underscores the significance of traditional Islamic astronomical knowledge, which remains relevant in modern times. With proper calibration and timing, this method remains a reliable alternative for qibla determination, particularly in areas with limited access to advanced technology.

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