

# An Artificial Intelligence ChatGPT-Based Approach for Qibla Identification: Implementation and Analysis

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**Abstract:** The integration of Artificial Intelligence (AI) into religious practices, particularly in determining the qibla direction, offers both opportunities and challenges. While AI tools such as ChatGPT provide high accuracy and efficiency, their acceptance among religious adherents remains uncertain due to concerns over tradition and religious principles. This study aims to evaluate the feasibility and accuracy of ChatGPT-4 in determining the qibla direction compared to traditional methods. A mixed-methods approach was employed, utilizing the principles of Spherical Trigonometry as the primary approach for qibla determination. The accuracy of AI-predicted qibla directions was verified through two different validation techniques: direct measurement using Mizwala for mosques located in Java and Google Earth for indirect validation in mosques outside Java. Statistical analysis, including mean error calculation and standard deviation, demonstrated ChatGPT-4's exceptionally low average deviation of  $0^{\circ}0'0.026''$ , confirming its potential as an effective and efficient alternative. However, qualitative insights from mosque administrators highlight concerns about AI's alignment with religious values and community trust. The study emphasizes that successful AI integration in religious practices requires a balance between preserving tradition and embracing innovation. These findings contribute to ongoing discussions on AI's role in religious contexts, advocating collaboration among religious scholars, technologists, and community leaders. Ultimately, this research successfully bridges the gap between traditional qibla determination methods and AI-based technology, ensuring that technological advancements remain aligned with religious principles.

**Keywords:** Artificial Intelligence; ChatGPT; Qibla; Spherical Trigonometry

**Abstrak:** Integrasi *Artificial Intelligence* (AI) dalam praktik keagamaan, khususnya dalam penentuan arah kiblat, menghadirkan peluang sekaligus tantangan. Meskipun AI seperti ChatGPT menawarkan akurasi dan efisiensi yang tinggi, penerimaannya di kalangan penganut agama masih menghadapi kendala karena pertimbangan tradisi dan prinsip keagamaan. Penelitian ini bertujuan untuk mengevaluasi kelayakan dan akurasi ChatGPT-4 dalam menentukan arah kiblat dibandingkan dengan metode tradisional. Pendekatan metode campuran diterapkan dengan menggunakan prinsip *Spherical*

*Trigonometry* sebagai pendekatan utama dalam menentukan arah kiblat. Akurasi prediksi arah kiblat yang dihasilkan oleh AI diverifikasi melalui dua teknik validasi yang berbeda: pengukuran langsung menggunakan Mizwala untuk masjid yang berlokasi di Jawa, serta validasi tidak langsung menggunakan Google Earth untuk masjid di luar Jawa. Analisis statistik, termasuk perhitungan rata-rata kesalahan dan deviasi standar, menunjukkan bahwa ChatGPT-4 memiliki deviasi rata-rata sangat rendah sebesar  $0^{\circ}0'.026''$ , yang menunjukkan potensinya sebagai alternatif yang efektif dan efisien. Namun, wawasan kualitatif dari pengelola masjid mengungkapkan kekhawatiran terkait kesesuaian AI dengan nilai-nilai keagamaan dan kepercayaan masyarakat. Penelitian ini menegaskan bahwa keberhasilan integrasi AI dalam praktik keagamaan memerlukan keseimbangan antara pelestarian tradisi dan inovasi. Temuan ini berkontribusi pada diskusi yang sedang berlangsung mengenai peran AI dalam praktik keagamaan, mendorong kolaborasi antara ulama, ahli teknologi, dan tokoh masyarakat. Pada akhirnya, penelitian ini berhasil menjembatani kesenjangan antara metode tradisional dalam penentuan arah kiblat dengan teknologi berbasis AI, memastikan bahwa kemajuan teknologi tetap selaras dengan prinsip keagamaan.

**Kata kunci:** *Artificial Intelligence; ChatGPT; Kiblat; Spherical Trigonometry*

## Introduction

Determining the qibla direction is of paramount importance in Islamic practices, particularly during prayers. Historically, Muslims relied on natural references such as the sun, stars, and compasses to ascertain the qibla direction.<sup>1</sup> However, with the advent of digital technology, various qibla determination applications have been developed to provide accurate results. Among the latest advancements, Artificial Intelligence (AI), particularly AI chat tools like ChatGPT, presents a transformative alternative by leveraging natural language processing (NLP) and machine learning capabilities.

Despite the existence of numerous qibla determination applications, such as mobile-based GPS apps and dedicated qibla compasses, the implementation of AI chat tools, specifically ChatGPT, in this domain remains underexplored. This study addresses the gap by assessing ChatGPT's potential to provide accurate qibla directions, offering a unique blend of interactive, user-friendly, and adaptable

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<sup>1</sup> Dhiauddin Tanjung, "Urgensi Kalibrasi Arah Kiblat Dalam Penyempurnaan Ibadah Salat," *Al-Manahij: Jurnal Kajian Hukum Islam* 11, no. 1 (February 22, 2017): 113–32, <https://doi.org/10.24090/MNH.V11I1.1273>.

solutions that conventional applications may lack. The increasing reliance on AI-driven solutions across various domains underscores the urgency of exploring their feasibility in religious applications, ensuring that Islamic practices can benefit from cutting-edge technology without compromising accuracy and authenticity.

Dr. Lance B. Eliot, a world-renowned expert on Artificial Intelligence (AI) and Machine Learning, elucidates the transformative potential of AI like ChatGPT in religious domains.<sup>2</sup> His insights provide a compelling argument for the utilization of AI in addressing challenges in Qibla direction identification. As AI continues to evolve, its integration could significantly streamline the process, enhancing accuracy and convenience for religious adherents.

Several qibla direction applications currently available primarily rely on GPS and compass sensors, which are susceptible to calibration errors, environmental interference, and hardware limitations. In contrast, ChatGPT, powered by AI and NLP, offers a versatile approach by processing diverse data sources, including geographical coordinates, astronomical data, and contextual understanding. ChatGPT can provide personalized and dynamic interactions, accommodating users with varying levels of technical knowledge and offering explanations beyond mere directional outputs.

The focus on using ChatGPT for qibla direction determination stems from its potential to revolutionize how Muslims access religious information. Traditional methods, while effective, often require manual effort and a certain level of astronomical knowledge. AI-based solutions, on the other hand, offer a seamless and intuitive solution that simplifies the process for a wider audience, including those unfamiliar with technical details. Furthermore, AI models like ChatGPT can integrate various datasets, such as astronomical calculations, geographic mapping, and real-time location services, making them a promising alternative for accurate and accessible qibla determination.

Several studies have explored the integration of technology into qibla determination, primarily focusing on mobile applications utilizing

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<sup>2</sup> "The Crucial Ways that Religion and Generative AI ChatGPT are Crossing Fateful Faithful Paths," accessed September 29, 2023, <https://www.forbes.com/sites/lanceeliot/2023/05/10/the-crucial-ways-that-religion-and-generative-ai-chatgpt-are-crossing-fateful-faithful-paths/?sh=32b1f29e35bb>.

GPS and astronomical algorithms. A study by Akhmad Husein et al. (2021) analyzed the effect of magnetic declination correction on the accuracy of compass sensors in Android phones for qibla determination. They found that without proper correction, compass sensors can deviate significantly from the true qibla direction due to interference from Earth's magnetic field, emphasizing the need for calibration to achieve accurate results. This study provides crucial insights into the limitations of current technological tools in qibla determination and highlights the importance of precise calibration techniques.<sup>3</sup>

Building upon this, Fajar Fathurahman's research on mobile application development for qibla direction guidance services training (2020) highlighted the importance of integrating blended learning models and interactive educational tools to improve the understanding of qibla direction calculations.<sup>4</sup> His follow-up study on learning innovation (2021) through computational thinking further emphasized the integration of science and technology in religious practices, offering insights into adaptive mobile-based learning methods. These studies underscore the role of technology in enhancing religious education and practice.<sup>5</sup>

Expanding the discussion further, a study by R. Muhsalling et al. (2021) explored the controversy of qibla direction determination in Kendari City, revealing that many mosques determined their qibla direction based on consensus rather than precise geographical methods. This finding underscores the need for technological solutions to ensure accuracy and standardization in qibla determination,

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<sup>3</sup> Akhmad Husein, Ahmad Izzuddin, and Muhammad Said Fadhel, "The Effect of Magnetic Declination Correction on Smartphones Compass Sensors in Determining Qibla Direction," *Al-Hilal: Journal of Islamic Astronomy* 3, no. 2 (October 31, 2021): 43–74, <https://doi.org/10.21580/AL-HILAL.2021.3.2.8309>.

<sup>4</sup> Fajar Fathurahman, "Innovative Development of Mobile Application for Qibla Direction Guidance Services Training," *Ilomata International Journal of Social Science* 1, no. 3 (July 31, 2020): 88–102, <https://doi.org/10.52728/IJSS.V1I3.122>.

<sup>5</sup> Fajar Fathurahman, "Learning Innovation of Qibla Direction with Mobile-Based App by Adapting Computational Thinking," *Jurnal Iqra' : Kajian Ilmu Pendidikan* 6, no. 1 (June 2, 2021): 211–24, <https://doi.org/10.25217/JI.V6I1.981>.

reinforcing the argument for AI-based applications.<sup>6</sup> Similarly, Sumaiyah Fitriani Dini and Edy Sutomo (2022) investigated the character and function of mosques in urban shopping centers, showing how mosque orientation is adapted to architectural constraints rather than strict qibla accuracy. This highlights the practical challenges faced in urban settings where space constraints may limit precise qibla alignment, further justifying the need for more accessible and reliable technological solutions.<sup>7</sup>

In the field of AI applications, Som Biswas (2023) analyzed the role of ChatGPT in computer programming, demonstrating its ability to provide accurate and contextually relevant responses across various domains. While his study focused on programming, it serves as a foundation for applying ChatGPT's capabilities in qibla determination by leveraging its machine learning capabilities for data interpretation and validation. This positions ChatGPT as a potential tool for providing real-time, interactive guidance for qibla direction determination.<sup>8</sup>

Existing research lacks a comprehensive analysis of how AI can dynamically process and respond to qibla-related queries. While various qibla applications have been developed, few studies have conducted empirical comparisons between AI-generated qibla directions and traditional methods such as spherical trigonometry and field measurements. Additionally, the perception and acceptance of AI-based solutions within the Muslim community remain underexplored. Addressing these gaps, this study aims to provide valuable insights into the feasibility, accuracy, and acceptance of using AI ChatGPT for qibla direction determination, thereby contributing to both the technological

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<sup>6</sup> R. Muhalling et al., "Controversy of the Qibla Direction Determination in Kendari City, Indonesia," *Utopía y Praxis Latinoamericana: Revista Internacional de Filosofía Iberoamericana y Teoría Social*, ISSN-e 1316-5216, No. Extra 2, 2021, Págs. 161-170, no. 2 (2021): 161–70, <https://doi.org/10.5281/zenodo.4678868>.

<sup>7</sup> Sumaiyah Fitriani Dini and Edy Sutomo, "Karakter dan Fungsi Masjid Di Pusat Perbelanjaan (Studi Kasus: Masjid Blok A Tanah Abang Jakarta Pusat)," *Jurnal Ilmiah Desain & Konstruksi* 21, no. 1 (June 19, 2022): 135–49, <https://doi.org/10.35760/DK.2022.V21I1.5963>.

<sup>8</sup> Som Biswas and Article History, "Role of ChatGPT in Computer Programming," *Mesopotamian Journal of Computer Science* 2023 (February 5, 2023): 9–15, <https://doi.org/10.58496/MJCSC/2023/002>.

and religious discourse.

This research uses a mixed-methods approach, blending both quantitative and qualitative techniques,<sup>9</sup> with a central emphasis on the utilization of the ChatGPT-4 artificial intelligence model for qibla direction identification. The quantitative aspect focuses on data collection from five selected mosques, utilizing precise geographical coordinates to train the ChatGPT-4 model and comparing its predictions with traditional methods such as Spherical Trigonometry. Statistical analysis, including deviation calculations and error measurements, is employed to quantify the accuracy of AI-generated results.

The research process involves training the ChatGPT-4 model with collected geographical coordinates and evaluating its predictive capabilities by comparing results with traditional verification methods. ChatGPT-4, as an advanced AI language model, does not solely rely on memorization but leverages deep learning, pattern recognition, and contextual understanding to provide responses.<sup>10</sup> It incorporates vast amounts of pre-trained data, including geographical algorithms and principles of qibla determination. Unlike earlier versions, ChatGPT-4 demonstrates improved accuracy, contextual comprehension, and flexibility in adapting to specific queries, enhancing its potential for qibla direction identification. Thus, in this study, ChatGPT-4's role is primarily in data synthesis and recommendation rather than direct computation or memorization of fixed values.

To validate the accuracy of ChatGPT-4's synthesized qibla direction data, a combination of direct and indirect measurement methods was employed. For mosques in Java, direct measurement was conducted using Mizwala, a widely trusted astronomical tool, due to its proven precision and accessibility. Meanwhile, for mosques outside Java, indirect measurement was conducted using Google Earth, which provided a reliable digital alternative for verifying geographical coordinates remotely. This dual approach ensures a robust framework

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<sup>9</sup> James P. Takona, "Research Design: Qualitative, Quantitative, and Mixed Methods Approaches / Sixth Edition," *Quality and Quantity* 58, no. 1 (February 1, 2024): 1011–13, <https://doi.org/10.1007/S11135-023-01798-2/METRICS>.

<sup>10</sup> "GPT-4 | OpenAI. GPT-4 Is OpenAI's Most Advanced System, Producing Safer and More Useful Responses," accessed August 15, 2024, [https://openai.com/index/gpt-4/?utm\\_source=chatgpt.com](https://openai.com/index/gpt-4/?utm_source=chatgpt.com).

that accounts for both direct and indirect validation methods, offering a balanced comparative analysis of AI-generated predictions.

On the qualitative side, exclusive interviews with mosque administrators provide valuable insights into the practical applications and acceptance of AI-based qibla determination. These interviews seek to understand the administrators' views and interpretations regarding the use of AI, particularly ChatGPT-4, in determining the qibla direction. In the subsequent phase of analysis, the outcomes from the direct measurements, Google Earth data, and ChatGPT-4 predictions are cross-examined to assess their precision and reliability. Complementing this, insights from the interviews with the mosque administrators are meticulously analyzed and synthesized with the quantitative data. The qualitative data is analyzed thematically to identify recurring patterns and perspectives, ensuring a nuanced understanding of the potentials and challenges tied to the application of AI models like ChatGPT-4 in this unique context.

By combining quantitative precision with qualitative insights, this study aims to provide a comprehensive evaluation of AI's role in qibla direction identification, balancing numerical accuracy with real-world applicability. The quantitative data obtained from ChatGPT-4 predictions and traditional methods are analyzed using statistical techniques such as mean error calculation and standard deviation to measure the accuracy of AI-generated results.<sup>11</sup> Comparative analysis is conducted to evaluate the differences and similarities between AI-predicted qibla directions and conventional calculations.

This study utilizes the Great Circle Method as the primary approach for determining the qibla direction, which is based on the principles of Spherical Trigonometry.<sup>12</sup> This method offers superior accuracy by accounting for the Earth's curvature, making it the most reliable technique for long-distance calculations and ensuring compliance with religious requirements.

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<sup>11</sup> Dong Kyu Lee, Junyong In, and Sangseok Lee, "Standard Deviation and Standard Error of the Mean KJA," *Korean J Anesthesiol* 68, no. 3 (2015): 220–23, <https://doi.org/10.4097/kjae.2015.68.3.220>.

<sup>12</sup> Sri Wahyuni et al., "Qibla Direction in Various Coordinates in Indonesia Using Spherical Trigonometry," *Al-Hisab: Journal of Islamic Astronomy* 1, no. 1 (March 1, 2024): 15–23, <https://jurnal.umsu.ac.id/index.php/alhisab/article/view/17229>.

For the qualitative data, thematic analysis is employed to identify recurring themes and perspectives among mosque administrators regarding the use of AI in religious contexts. This analysis is grounded in the Technology Acceptance Model (TAM),<sup>13</sup> which helps assess the perceived ease of use and usefulness of AI-driven qibla determination. The integration of both quantitative and qualitative findings enables a comprehensive understanding of the feasibility and reliability of AI applications in qibla direction identification.

The five mosques selected in this study were chosen based on their geographical and functional diversity to ensure comprehensive analysis. Darussalam Mosque, located in a residential area, represents local community needs and serves as a benchmark for household-scale qibla determination. Al-Aziz Mosque, situated within a Pondok Pesantren (Islamic boarding school), provides insight into qibla direction accuracy in an educational institution where religious practice is a daily routine. The Great Mosque of Jami', as a grand mosque in Java, was selected to assess qibla direction accuracy in a densely populated urban setting with significant foot traffic and diverse community interactions. The Great Mosque of Baitul Hikmah, a grand mosque in Kalimantan, represents religious activities in remote areas where traditional methods might differ. Lastly, the Great Mosque of Baiturrahman, a grand mosque in Aceh, Sumatera, was included to analyze regional variations and historical significance in qibla direction determination.

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<sup>13</sup> Dedy Setiawan, Jefri Marzal, and Lucky Enggrani Fitri, "Integrating Religiosity with Technology Acceptance Model (TAM) and Technology Organization Environment (TOE) Frameworks: A Study on ICT Adoption in Micro and Small Enterprises," *Pakistan Journal of Commerce and Social Sciences* 2024, no. 3 (2024): 651–75.



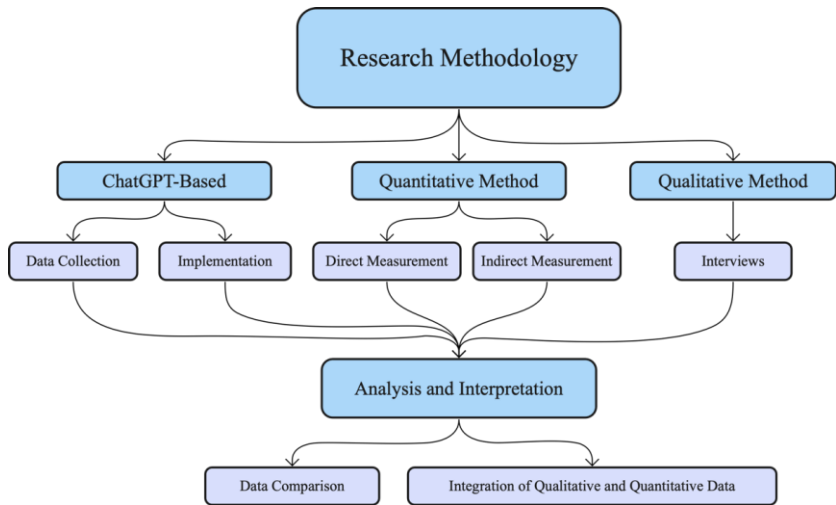


Figure 1. Research Methodology Chart

Determining Qibla Direction with AI ChatGPT

The process of determining the qibla direction using AI ChatGPT involves a series of steps that combine artificial intelligence with natural language processing technology. First, the user provides a prompt in the form of a question or request related to finding the qibla direction. For example, the user may ask, “How to determine the qibla direction?” or “What is the qibla direction from my current location?”

After receiving the user’s question, ChatGPT analyzes the question to understand the user’s intent. The system utilizes natural language processing, which has been trained on a vast dataset, including information about the qibla direction.<sup>14</sup>

Next, ChatGPT uses the geographical coordinates data provided by the user or accesses the user’s location data (if allowed) to calculate the azimuth angle that points towards the Kaaba in Mecca. This azimuth angle indicates the direction to face the qibla.

<sup>14</sup> Moatsum Alawida et al., “A Comprehensive Study of ChatGPT: Advancements, Limitations, and Ethical Considerations in Natural Language Processing and Cybersecurity,” *Information* 2023, Vol. 14, Page 462 14, no. 8 (August 16, 2023): 462, <https://doi.org/10.3390/INFO14080462>.

During the process of calculating the azimuth angle, ChatGPT employs programmed algorithms and data processing.<sup>15</sup> These algorithms analyze the user's geographical coordinates and reference data regarding the location of the Kaaba, including information about the changing positions of the sun relevant to determining the qibla direction.

In some cases, ChatGPT may also consider other factors that affect the determination of the qibla direction, such as the elevation of the location or the presence of specific objects around the user's location. This can help provide more accurate and location-specific answers. The process of determining the qibla direction by ChatGPT may also involve validation using traditional methods or trigonometric calculations. For example, the system can compare the ChatGPT predictions with sun or star guidance or use a compass to ensure the accuracy of the results.

After analyzing and validating the information, ChatGPT provides an answer to the user in the form of the azimuth angle that indicates the qibla direction to follow. For example, the system may provide an answer like *"The qibla direction from your location is approximately 292.52 degrees from the north."*

Below is a simulation of determining the qibla direction using ChatGPT-4 for five locations selected as research samples. The process begins by inputting geographical coordinates of each location into the ChatGPT-4 model:

1. Darussalam Mosque, Yogyakarta, with coordinates 7°50'42.25" South Latitude and 110°24'44.83" East Longitude,
2. Al-Aziz Mosque, Nganjuk, with coordinates 7°34'19.60" South Latitude and 112°3'59.04" East Longitude,
3. The Great Mosque of Jami', Malang, with coordinates 7°58'56.52" South Latitude and 112°37'46.39" East Longitude,
4. The Great Mosque of Baitul Hikmah, Kalimantan, with coordinates 2°9'3.04" North Latitude and 117°30'14.19" East Longitude,

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<sup>15</sup> Moatsum Alawida et al.

5. The Great Mosque of Baiturrahman, Aceh, with coordinates 5°33'12.86" North Latitude and 95°19'2.23" East Longitude.

The AI then processes these inputs to determine the azimuth angle pointing towards the Kaaba in Mecca.

ChatGPT 4

Share

Hello, can you help me determine the Qibla direction for the following locations:

1. Darussalam Mosque, Yogyakarta: 7°50'42.25" South Latitude, 110°24'44.83" East Longitude
2. Al-Aziz Mosque, Nganjuk: 7°34'19.60" South Latitude, 112°3'59.04" East Longitude
3. The Great Mosque of Jami', Malang: 7°58'56.52" South Latitude, 112°37'46.39" East Longitude
4. The Great Mosque of Baitul Hikmah, Kalimantan: 2°9'3.04" North Latitude, 117°30'14.19" East Longitude
5. The Great Mosque of Baiturrahman, Aceh: 5°33'12.86" North Latitude, 95°19'2.23" East Longitude.

To determine the Qibla direction, we typically need to calculate the direction from each location towards the Kaaba in Mecca, Saudi Arabia, which is approximately at 21.4225° North Latitude and 39.8262° East Longitude.

We can use the formula for the initial bearing between two points on a sphere:

$$\theta = \text{atan2}(\sin(\Delta\lambda) \cdot \cos(\phi_2), \cos(\phi_1) \cdot \sin(\phi_2) - \sin(\phi_1) \cdot \cos(\phi_2) \cdot \cos(\Delta\lambda))$$

where  $\lambda$  is longitude,  $\phi$  is latitude, and  $\Delta\lambda = \lambda_2 - \lambda_1$ .

Let's calculate the Qibla direction for each location using this formula.

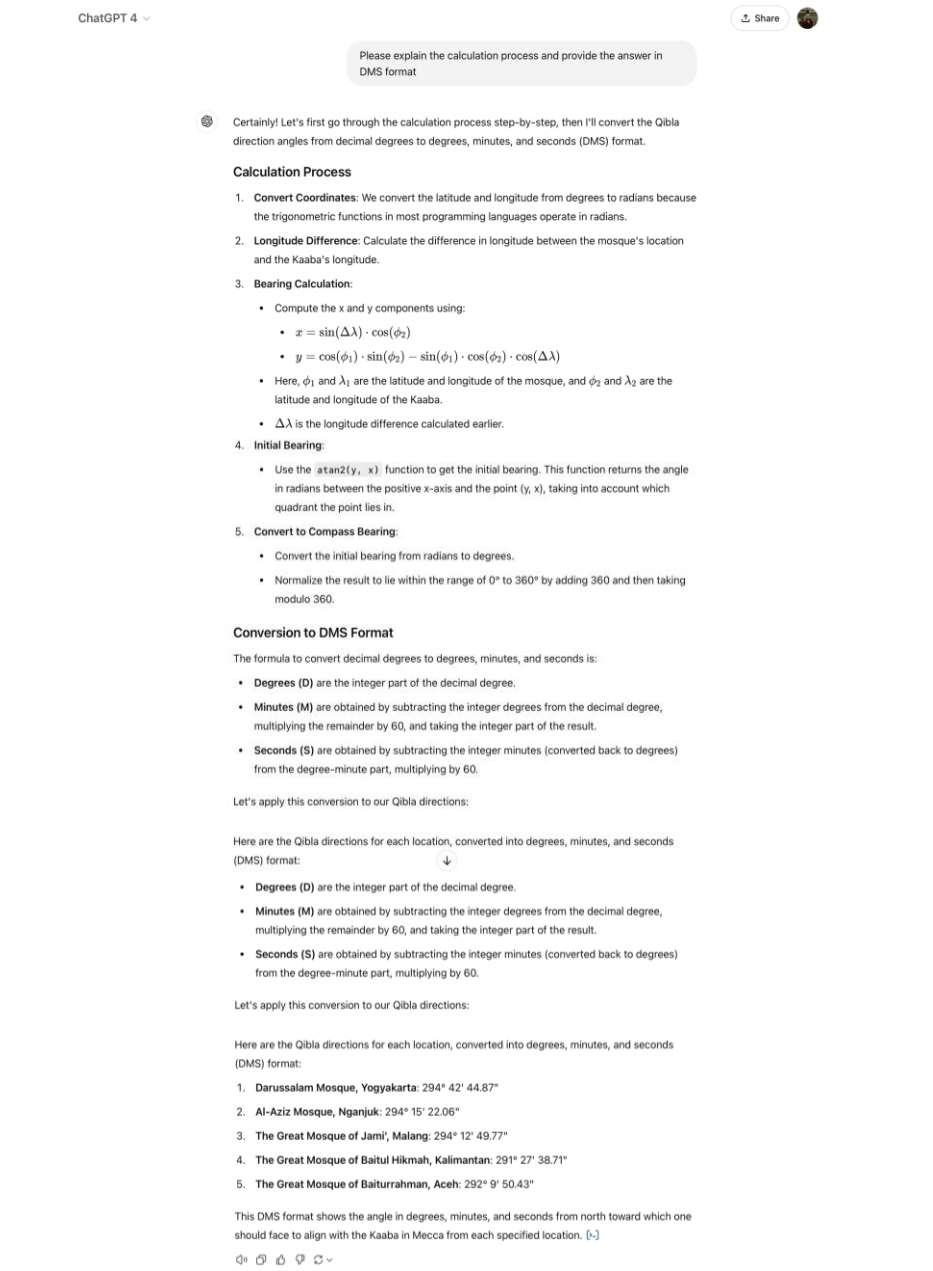
Here are the Qibla directions for each of the specified locations, calculated from north in degrees:

1. Darussalam Mosque, Yogyakarta: 294.71°
2. Al-Aziz Mosque, Nganjuk: 294.26°
3. The Great Mosque of Jami', Malang: 294.21°
4. The Great Mosque of Baitul Hikmah, Kalimantan: 291.46°
5. The Great Mosque of Baiturrahman, Aceh: 292.16°

These directions indicate the angle from north to which you should face to direct yourself towards the Kaaba in Mecca from each location. [5]

**Picture 1.** *This Screenshot Captures the Interaction Between Researcher and ChatGPT-4, Documented for Further Analysis. (source: researcher)*

To further verify the AI's understanding and calculation process, the prompt *"Please explain the calculation process and provide the answer in DMS format"* was given. ChatGPT-4 responded by outlining the steps involved in determining the qibla direction, which include Geographical Coordinate Analysis, Azimuth Calculation, Conversion to Degrees, Minutes, and Seconds (DMS) Format. By following these systematic steps, ChatGPT-4 generates a response with the qibla direction in DMS format for each of the five locations, providing an accessible and accurate reference for practical implementation.



**Picture 2.** *This Screenshot Captures the Follow-Up Interaction Between the Researcher and ChatGPT-4, Aimed at Verifying the AI's Understanding and Calculation Process. (source: researcher)*

To further explore the capabilities of ChatGPT-4 in determining the qibla direction, an additional prompt was issued: *"Can you apply different methods to calculate the Qibla direction, and how would the results compare?"* ChatGPT-4 responded by utilizing two different calculation approaches: the Great Circle Method and the Rhumb Line Method, offering valuable insights into their respective accuracies and applications.

The Great Circle Method, which had been previously applied in this study, calculates the shortest distance between two points on the Earth's surface, considering its spherical shape. This method is commonly used in astronomical and geodetic applications to determine precise directions. In contrast, the Rhumb Line Method, also known as the loxodrome, calculates a path of constant bearing relative to the Earth's meridians. Unlike the Great Circle Method, it does not provide the shortest path but maintains a steady directional angle, making it useful for navigation on Mercator projection maps.

ChatGPT 4 ▾

🔗 Share



Can you apply different methods to calculate the Qibla direction, and how would the results compare?



To demonstrate the application of different methods for calculating Qibla direction and compare the results, we can use the **Great Circle Method** which we previously applied and the **Rhumb Line Method**. These two methods will give us a good sense of how results can vary depending on the calculation technique used.

#### 1. Great Circle Method (Already Calculated)

We've already computed the Qibla directions using the Great Circle Method. Let's recall these directions for comparison.

#### 2. Rhumb Line Method

For the Rhumb Line calculation, we can use a different approach:

- The Rhumb Line, or loxodrome, is a path of constant bearing as seen on a Mercator projection. Unlike the great circle, it doesn't represent the shortest distance over the earth's surface but maintains a steady angle to the meridians.
- The formula for the rhumb line bearing between two points ( $\phi_1, \lambda_1$  to  $\phi_2, \lambda_2$ ) on the Earth is given as:



**Picture 3.** *This Screenshot Captures the Follow-Up Interaction Between the Researcher and ChatGPT-4, Aimed at Exploring the Application of Different Methods to Calculate the Qibla Direction. (source: researcher)*

The results highlight the advantage of using the Great Circle Method for qibla determination, particularly for long distances where precision is crucial. ChatGPT-4's ability to apply and compare these methods demonstrates its capability in assisting with geographical and astronomical calculations, providing valuable insights for both practical and scholarly applications. Based on the comparative analysis, this study affirms the Great Circle Method as the optimal choice for qibla determination. Its ability to accurately factor in the Earth's curvature makes it particularly suitable for long-distance calculations, ensuring both scientific precision and adherence to religious guidelines.

## Analysis of the Validity and Accuracy of AI ChatGPT's Calculations

### Darussalam Mosque, Yogyakarta

Darussalam Mosque, established in 2018, is located in the Royal Mansion residential area in Bintaran, Bantul, Yogyakarta. The mosque's qibla direction aligns with the architectural orientation of the housing complex, a decision not yet certified due to diverse opinions within the congregation about the necessity of precise qibla alignment.<sup>16</sup> This context sets the stage for understanding the community's relationship with religious practices and their openness to technological solutions.



**Picture 4.** *Darussalam Mosque, Yogyakarta (source: researcher)*

The insights for this study are enriched by an interview conducted on October 6, 2023, with Lutfi Nurfalaq, a 28-year-old administrator of Darussalam Mosque. His perspectives are instrumental in understanding the mosque's stance on technology's role in religious practices, especially in determining the qibla direction.

Lutfi's experiences during the COVID-19 pandemic highlight the practical challenges faced by the mosque in maintaining uniformity in prayer orientation. Instances of congregation members adjusting their prayer rows to align with their interpretation of the qibla direction underscore the need for a universally accepted reference point.

Lutfi's openness to using technology, like AI, for qibla

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<sup>16</sup> Results of the interview with Lutfi Nurfalaq, S.H. (Administrator of Darussalam Mosque) on October 6, 2023.

determination is conditional on the technology's accuracy, clarity, and positive reception among users. His interest in a potential AI tool like ChatGPT for this purpose reflects a growing trend of integrating modern technology into religious practices, provided it adheres to the community's cultural and social norms.

However, the hesitancy to change the mosque's qibla direction due to fears of reducing congregation numbers and disrupting community unity highlights a significant challenge. It shows the delicate balance between technological accuracy and social harmony that must be considered in the implementation of AI solutions in religious contexts.<sup>17</sup>

The case of Darussalam Mosque, as elucidated by Lutfi Nurfalaq, exemplifies the complexities involved in embracing technology in religious practices. It demonstrates the necessity for AI tools like ChatGPT to not only provide technically accurate solutions but also to be sensitive to and aligned with the cultural and communal dynamics of their users. This research, thus, not only investigates the technical capabilities of AI in determining the qibla direction but also sheds light on the socio-cultural dimensions that influence the acceptance and effectiveness of such technologies in religious settings.

The Darussalam Mosque, positioned at coordinates 7°50'42.25" South Latitude and 110°24'44.83" East Longitude, with a building orientation of 278°10'48", provides an intriguing case for determining the qibla direction. This process involves precise calculations to ensure accurate alignment towards the Kaaba in Mecca.

The first step involves calculating the qibla angle relative to the north. This is done using the formula:

$$\text{Cotan Q} = \frac{\tan 21^{\circ}25'21.04'' \cdot \cos -7^{\circ}50'42.25''}{\sin 70^{\circ}35'10.58''} - \sin -7^{\circ}50'42.25'' \cdot \cotan 70^{\circ}35'10.58''$$

Upon application of this formula, the Qibla Angle from the North is obtained as 65°17'15.1". To ascertain the qibla direction relative to the west, the qibla angle from the north is subtracted from 90 degrees. This calculation results in an angle that indicates the direction towards the Kaaba from the west.

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<sup>17</sup> Results of the interview with Lutfi Nurfalaq, S.H. (Administrator of Darussalam Mosque) on October 6, 2023.



Qibla Angle from the West  $\rightarrow 90^\circ - 65^\circ 17' 15.1'' = 24^\circ 42' 44.9''$

The azimuth, representing the true direction from the mosque's coordinates to the qibla, is calculated by adding the qibla angle from the west to 270 degrees.<sup>18</sup>

Qibla Azimuth  $\rightarrow 270^\circ + 24^\circ 42' 44.9'' = 294^\circ 42' 44.9''$

To ascertain the accuracy of the qibla direction for Darussalam Mosque, the researcher employed a methodical approach using a tool known as Mizwala. This device was strategically positioned in a flat, unobstructed area around the mosque to ensure optimal exposure to direct sunlight. In a specific setup, the qibla direction was determined based on input data consisting of the mosque's latitude and longitude coordinates, yielding a calculated qibla azimuth of  $294^\circ 42' 44.9''$ .

Mizwala serves as a verification tool by offering an empirical approach to cross-check the accuracy of the calculated qibla azimuth. It works by determining the qibla direction through solar azimuth calculations, aligning the observed sun's position with the theoretical qibla azimuth derived from manual computations. Additionally, Mizwala plays a crucial role in assessing any deviation in the mosque's orientation relative to the true qibla direction, providing valuable insights for realignment and corrective measures when needed.<sup>19</sup>

This validation process ensures that the calculated qibla azimuth of  $294^\circ 42' 44.9''$  is verified through direct observation, thereby enhancing the reliability of the overall qibla determination process. Mizwala was chosen over other traditional methods, such as Rashdul Qibla, due to its flexibility, as it can be utilized at any time of the day when sunlight is available, whereas Rashdul Qibla is limited to specific annual occurrences. Furthermore, Mizwala's capability to conduct on-

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<sup>18</sup> The azimuth is the angle measured clockwise from the north to the qibla direction. For more details, see: F. Yunita Sari, A. Yusuf Ababil, U. Nafis, et. al., "Comparison of Spherical Trigonometry Method, Jean Meeus Algorithm and Google Qibla Finder in Determining of the Qibla Direction of Islamic Hospital." *Al-Hilal: Journal of Islamic Astronomy* 5, no. 2 (2023), 117-134. doi:<https://doi.org/10.21580/al-hilal.2023.5.2.17192>.

<sup>19</sup> This process was crucial in determining the precise direction towards the Kaaba, ensuring that the mosque's alignment adhered to religious guidelines. For more details, see: Anisah Budiwati, Muhammad Wahyu Firdaus, and Galih Cipto Raharjo, "Integration Method for Measuring Qibla Direction (Comparative Analysis of Google Earth and Mizwala)," *Indonesian Journal of Interdisciplinary Islamic Studies (IJIIIS)* 5, no. 3 (2022), 147-64, <https://doi.org/10.20885/ijiiis.vol.5.iss3.art2>.

site validation and accurately measure structural deviations makes it an effective and reliable tool for this study.



**Picture 5.** *Measuring the Qibla direction of Darussalam Mosque using Mizwala (source: researcher)*

### **Al-Aziz Mosque, Nganjuk**

Al-Aziz Mosque, associated with Pondok Pesantren an-Nahdhah, once invited the Nganjuk Department of Religious Affairs to ensure the accuracy of its qibla direction during its construction in 2020. Despite a slight deviation of about 4 degrees, the head of Pondok Pesantren, KH. Abdullah Sajjad, noted that adjustments over time are possible.<sup>20</sup>

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<sup>20</sup> Results of the interview with KH. Abdullah Sajjad (Head of Pondok Pesantren an-Nahdhah) on November 9, 2023.



**Picture 6.** *Al-Aziz Mosque, Nganjuk (source: researcher)*

Initially reluctant to involve external authorities for qibla determination, KH. Abdullah Sajjad referred to the Quranic verse, *Fawalli Wajbaka Syaṭra al-Masjid al-Harām* (QS. Al-Baqarah [2]: 144), emphasizing that for Indonesians, the concept of *Syaṭra* in determining the qibla is generally understood as facing Mecca, specifically the boundary of the Sacred Territory (*Hudūd al-Harām*). According to fiqh rulings, for those residing within *Hudūd al-Harām*, *al-Masjid al-Harām* serves as the qibla, whereas those within *al-Masjid al-Harām* take the Kaaba as their qibla. For people outside Saudi Arabia, including Indonesians, the qibla reference is directed towards *Hudūd al-Harām*.

While he agrees with using technology for determining the qibla direction in newly built mosques, KH. Abdullah Sajjad expressed reservations about adjusting prayer rows in older mosques. He fears that such adjustments could lead to the congregation's feet inadvertently leading the imam, potentially invalidating their prayers. Additionally, he worries about the creation of unused spaces due to the reorientation of prayer rows.

His approach resonates with the views of the Nahdlatul Ulama community, which adheres to the Quranic directive of facing towards *Dẓātu al-Qiblah* or *Jibatu al-Qiblah*. *Dẓātu al-Qiblah* means facing the Kaaba for those in *al-Masjid al-Harām*, while *Jibatu al-Qiblah* refers to

facing the *al-Masjid al-Harām* for those outside it and towards *Hudūd al-Harām* for those further away, including Indonesians. This interpretation underlines the community's calm approach to slight deviations in qibla direction.

KH. Abdullah Sajjad's insights offer a valuable perspective on balancing the technological advancements in determining the qibla direction with traditional and religious interpretations. His views highlight the importance of considering the practical implications and communal sensitivities when implementing new technologies in religious practices. This case study from al-Aziz mosque and Pondok Pesantren an-Nahdhah enriches the research narrative by illustrating the diverse approaches and understandings of qibla direction across different Islamic communities.<sup>21</sup>

Al-Aziz mosque, positioned at coordinates 7°34'19.60" South Latitude and 112°3'59.04" East Longitude, with a building orientation of 298°58'12", provides an intriguing case for determining the qibla direction. This process involves precise calculations to ensure accurate alignment towards the Kaaba in Mecca.

The first step involves calculating the qibla angle relative to the north. This is done using the formula:

$$\text{Cotan } Q = \frac{\tan 21^{\circ}25'21.04'' \cdot \cos -7^{\circ}34'19.60''}{\sin 72^{\circ}14'24.79''} - \sin -7^{\circ}34'19.60'' \cdot \cotan 72^{\circ}14'24.79''$$

Upon application of this formula, the Qibla Angle from the North is obtained as 65°44'37.92". To ascertain the qibla direction relative to the west, the qibla angle from the north is subtracted from 90 degrees. This calculation results in an angle that indicates the direction towards the Kaaba from the west.

$$\text{Qibla Angle from the West} \rightarrow 90^{\circ} - 65^{\circ}44'37.92'' = 24^{\circ}15'22.08''$$

The azimuth, representing the true direction from the mosque's coordinates to the qibla, is calculated by adding the qibla angle from the west to 270 degrees. The azimuth is the angle measured clockwise from the north to the qibla direction.

$$\text{Qibla Azimuth} \rightarrow 270^{\circ} + 24^{\circ}15'22.08'' = 294^{\circ}15'22.08''$$

To ensure the precision of qibla direction at Al-Aziz Mosque, the

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<sup>21</sup> Results of the interview with KH. Abdullah Sajjad (Head of Pondok Pesantren an-Nahdhah) on November 9, 2023.

researcher employed Mizwala, an astronomical instrument trusted for its practical application in qibla verification. Unlike conventional methods that depend on celestial events at specific times, Mizwala offers a convenient approach by utilizing real-time solar positioning, making it highly suitable for continuous monitoring and validation.<sup>22</sup>

The validation conducted using Mizwala at the site confirmed the accuracy of the qibla direction, yielding results that aligned precisely with the calculation derived from the principles of Spherical Trigonometry, which determined the qibla direction to be  $294^{\circ}15'22.08''$ . This congruence underscores the reliability of both traditional astronomical tools and theoretical calculations in ensuring the accurate orientation of the mosque toward the Kaaba.



**Picture 7.** *Measuring the Qibla direction of al-Aziz Mosque using Mizwala (source: researcher)*

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<sup>22</sup> The use of Mizwala in this context highlights the blend of traditional religious practices with modern technological tools to maintain the sanctity and accuracy of religious observances. For more details, see: A. Rakhmadi and H. Setiawan, "Pemanfaatan Instrumen Astronomi Klasik Mizwala dalam Pengukuran dan Pengakurasaan Arah Kiblat." *Maslahah Jurnal Pengabdian Masyarakat* 1, no. 2 (2020), p. 152-163. <https://doi.org/10.56114/maslahah.v1i2.69>; M. Maulidin and A. Abdullah, "Uji Komparasi Instrumen Arah Kiblat Antara Qibla Tracker dan Mizwala Qibla Finder." *AstroIslamica Journal of Islamic Astronomy* 1, no. 1 (2022), p. 73-96. <https://doi.org/10.47766/astroislamica.v1i1.899>.

### The Great Mosque of Jami', Malang

The Great Mosque of Jami', established in 1890, is a cultural heritage site in East Java. The mosque exhibits a blend of Javanese and Arab architectural styles, with its square structure, two-tiered tajug roof, and arched openings. The mosque's position within a cultural triangle, alongside Masjid Jami Pasuruan and Masjid Jami Surabaya Ampel, and its potential connection to Masjid Jami Gresik, further emphasizes its cultural and historical importance. The use of Arabic Pegon script in its inscriptions adds to its rich heritage.<sup>23</sup>



**Picture 8.** *The Great Mosque of Jami', Malang (source: researcher)*

During the interview on November 9, 2023, Imam H. M. Affan Salim provided insights into the mosque's method for qibla direction determination, which is rooted in both tradition and technology. This approach reflects a deep respect for historical practices while embracing modern advancements. The mosque utilizes traditional methods such as observing Raşdul Qibla, a specific time indicated by the Kudus Tower calendar, along with contemporary tools like compasses. This method aligns with the principle of *al-Muḥafazatu 'alā al-Qodim al-Şālih wa al-Akhdzu bi al-Jadid al-Aşlah* (preserving beneficial traditions and adopting superior modern practices).

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<sup>23</sup> Results of the interview with H. M. Affan Salim (the Imam of Jami' Great Mosque) on November 9, 2023.

This interview highlights the importance of qibla accuracy in Islamic jurisprudence and the allowance for using technology, seen as a gift from Allah, within the boundaries of Sharia. H. M. Affan Salim's openness to new technologies, including potentially ChatGPT for qibla determination, as long as they are proven accurate and adhere to traditional calculations, mirrors the research's exploration of AI's role in religious settings.

The case of The Great Mosque of Jami' Malang showcases a harmonious blend of tradition and technology in religious practice. It demonstrates the mosque's commitment to accuracy in qibla direction while respecting historical methods and cultural heritage. This example is particularly relevant to the research, illustrating how traditional methods and AI predictions, such as those from ChatGPT, can coexist and complement each other in religious contexts.<sup>24</sup>

The insights from H. M. Affan Salim enhance the research narrative by providing a real-world example of how mosques balance tradition and modernity in determining the qibla direction. This case study underscores the importance of accuracy, cultural sensitivity, and the adaptability of AI tools like ChatGPT to the needs and practices of religious communities. The integration of these insights contributes significantly to the research's objective of understanding the practical and cultural implications of employing AI in religious settings.

The Great Mosque of Jami' Malang, positioned at coordinates 7°58'56.52" South Latitude and 112°37'46.39" East Longitude, with a building orientation of 284°45', provides an intriguing case for determining the qibla direction. This process involves precise calculations to ensure accurate alignment towards the Kaaba in Mecca.

The first step involves calculating the qibla angle relative to the north. This is done using the formula:

$$\text{Cotan Q} = \frac{\tan 21^{\circ}25'21.04'' \cdot \cos -7^{\circ}58'56.52''}{\sin 72^{\circ}48'12.14''} - \sin -7^{\circ}58'56.52'' \cdot \cotan 72^{\circ}48'12.14''$$

Upon application of this formula, the Qibla Angle from the North is obtained as 65°47'10.21". To ascertain the qibla direction relative to the west, the qibla angle from the north is subtracted from

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<sup>24</sup> Results of the interview with H. M. Affan Salim (the Imam of Jami' Great Mosque) on November 9, 2023.

90 degrees. This calculation results in an angle that indicates the direction towards the Kaaba from the west.

$$\text{Qibla Angle from the West} \rightarrow 90^\circ - 65^\circ 47' 10.21'' = 24^\circ 12' 49.79''$$

The azimuth, representing the true direction from the mosque's coordinates to the qibla, is calculated by adding the qibla angle from the west to 270 degrees. The azimuth is the angle measured clockwise from the north to the qibla direction.

$$\text{Qibla Azimuth} \rightarrow 270^\circ + 24^\circ 12' 49.79'' = 294^\circ 12' 49.79''$$

To validate the qibla direction at the Great Mosque of Jami', the researcher utilized Mizwala, a well-established astronomical tool renowned for its accuracy in determining the qibla direction through solar positioning. Given the mosque's historical and cultural significance, ensuring the accuracy of its qibla orientation is crucial to preserving its spiritual and architectural integrity.

The validation process involved positioning the Mizwala in a carefully selected open area, ensuring minimal interference from surrounding structures that could affect sunlight exposure. The instrument was then used to observe the sun's azimuth at predetermined times, aligning it with the calculated qibla azimuth based on the mosque's coordinates. This approach enabled a thorough assessment of the mosque's alignment with the true qibla direction and provided insights into any potential deviations that may have occurred over the years due to structural modifications or environmental factors.<sup>25</sup>

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<sup>25</sup> This procedure was essential in pinpointing the exact direction to the Kaaba, confirming that the mosque's orientation complied with religious norms. Employing Mizwala in this scenario underscores the integration of conventional religious customs with contemporary technological instruments, preserving the integrity and precision of religious rites. For more details, see: S. Sutopo and Y. Amin, "Uji Akurasi Arah Kiblat Masjid Pondok Pesantren Sunan Drajat Kecamatan Paciran Kabupaten Lamongan dengan Metode Mizwala Qibla Finder." *JOSH: Journal of Sharia* 1, no. 1 (2022), p. 67-80. <https://doi.org/10.55352/josh.v1i1.471>.





**Picture 9.** *Measuring the Qibla direction of the Great Mosque of Jami' using Mizwala (source: researcher)*

## **The Great Mosque of Baitul Hikmah, Kalimantan**

The Great Mosque of Baitul Hikmah stands as the largest and most majestic mosque in the Berau Regency of East Kalimantan. Inaugurated in 2004, this mosque has since been a beacon of religious and cultural significance in the region. Following its inauguration, a significant addition was made in 2011 with the establishment of a library, a development proudly initiated by the Bupati (Regent) of Berau. But the mosque's offerings extend beyond spiritual guidance; it also houses a clinic providing free medical treatment for the underprivileged, funded by the Badan Amil Zakat Pusat (Central Zakat Management Body).

Since its establishment, the Great Mosque of Baitul Hikmah has emerged as a new landmark for Tanjung Redeb and the wider Berau Regency. Its grandeur is unmistakable, making a striking impression amidst the urban landscape of Tanjung Redeb. The mosque's architecture is a visual delight, with its dominant green color harmonizing with the lush, verdant forests that are characteristic of Berau's landscape. This architectural masterpiece is not just a place of

worship but a symbol of the region’s harmony with nature and its commitment to community welfare.<sup>26</sup>



**Picture 10.** *The Great Mosque of Baitul Hikmah, Kalimantan (source: masjidinfo.net)*

The Great Mosque of Baitul Hikmah, positioned at coordinates 2°9’3.04” North Latitude and 117°30’14.19” East Longitude, with a building orientation of 290°52’48”, provides an intriguing case for determining the qibla direction. This process involves precise calculations to ensure accurate alignment towards the Kaaba in Mecca.

The first step involves calculating the qibla angle relative to the north. This is done using the formula:

$$\text{Cotan } Q = \frac{\tan 21^{\circ}25'21.04'' \cdot \cos 2^{\circ}9'3.04''}{\sin 77^{\circ}40'39.94''} - \sin 2^{\circ}9'3.04'' \cdot \cotan 77^{\circ}40'39.94''$$

Upon application of this formula, the Qibla Angle from the North is obtained as 68°32’21.26”. To ascertain the qibla direction relative to the west, the qibla angle from the north is subtracted from 90 degrees. This calculation results in an angle that indicates the direction towards the Kaaba from the west.

Qibla Angle from the West →  $90^{\circ} - 68^{\circ}32'21.26'' = 21^{\circ}27'38.74''$

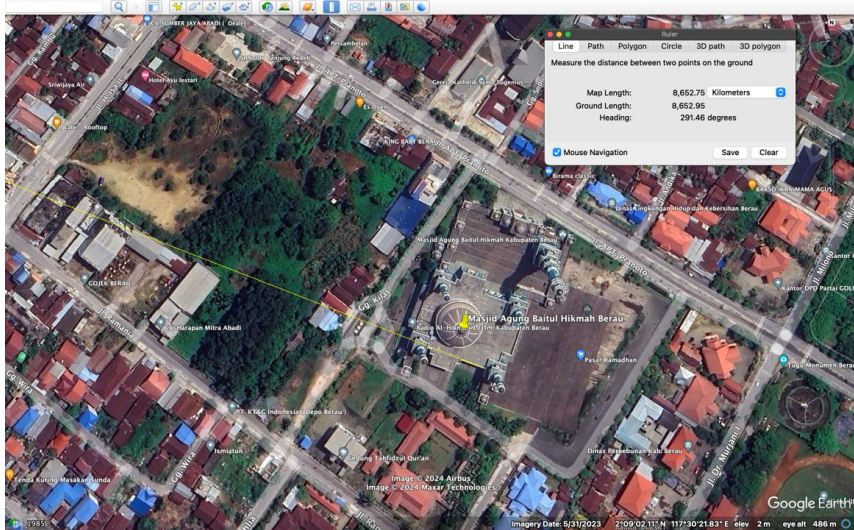
The azimuth, representing the true direction from the mosque’s coordinates to the qibla, is calculated by adding the qibla angle from the west to 270 degrees. The azimuth is the angle measured clockwise

<sup>26</sup> <https://www.masjidinfo.net/2017/10/masjid-agung-baitul-hikmah-tanjung-redep.html>, accessed January 21, 2024.

from the north to the qibla direction.

$$\text{Qibla Azimuth} \rightarrow 270^{\circ} + 21^{\circ}27'38.74'' = 291^{\circ}27'38.74''$$

Given the logistical challenges of conducting direct observations in remote regions, and the need for a reliable, accessible, and scalable verification method, the Great Mosque of Baitul Hikmah's qibla direction was verified using Google Earth, which provides a practical alternative to Mizwala by allowing remote validation without the necessity of on-site measurements.<sup>27</sup>



**Picture 11.** *Measuring the Qibla direction of the Great Mosque of Baitul Hikmah using Google Earth engine (source: Google Earth)*

The results obtained from Google Earth engine for the qibla direction of the mosque were found to be  $291.46^{\circ}$ . Remarkably, this measurement aligns perfectly with the calculations derived from Spherical Trigonometry, which indicated a qibla direction of

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<sup>27</sup> S. Wahyuni, S. Samsuddin and Ekawati Hamzah, “Qibla Direction Accuracy Analysis Based on Astronomy (Google Earth), Perspective of Islamic Law.” *Journal of Islam and Science* 9, no. 1 (2022). <https://doi.org/10.24252/jis.v9i1.30111>; By inputting the mosque’s latitude and longitude coordinates into Google Earth engine, researcher could accurately determine the mosque’s alignment with the Kaaba in Mecca. For more details, see: Riza Afrian Mustaqim. “Penggunaan Google Earth Sebagai Calibrator Arah Kiblat.” *Jurnal Justisia: Jurnal Ilmu Hukum, Perundang-undangan dan Pranata Sosial* 6, no. 2 (2021), p. 194. <https://doi.org/10.22373/justisia.v6i2.11537>.

291°27'38.74". When converted, this trigonometric calculation also equates to 291.46°. This validation underscores the reliability of satellite-based methods as an alternative when traditional instruments are not feasible.

## **The Great Mosque of Baiturrahman, Aceh**

The Great Mosque of Baiturrahman in Aceh is a historical and architectural marvel with a rich history dating back to the early 17th century. Built initially in 1612 during Sultan Iskandar Muda's reign, there are claims that its origins might trace back even earlier to 1292 under Sultan Alaidin Mahmudsyah. The original structure showcased typical Acehese architecture with a multi-tiered thatched roof. Originally, the mosque was characterized by a single dome and minaret. However, through the years, particularly in 1935, 1958, and 1982, additional domes and minarets were incorporated, culminating in its present structure that boasts seven domes and eight minarets, including the tallest in Banda Aceh.<sup>28</sup>

Today, the mosque stands as a symbol of pride for Banda Aceh, with its seven domes, eight minarets, and 32 pillars. It has become an iconic landmark, representing the "Veranda of Mecca" in Aceh. Remarkably, the mosque demonstrated its resilience by withstanding the devastating 2004 tsunami, emerging as a beacon of hope and endurance.

Over a century later, the Great Mosque of Baiturrahman continues to evolve, now appearing even more magnificent with recent additions and infrastructure enhancements. Its beauty and significance are not just in its physical presence but in its enduring place in the heart of Aceh's cultural and religious history.

The Great Mosque of Baiturrahman, positioned at coordinates 5°33'12.86" North Latitude and 95°19'2.23" East Longitude, with a building orientation of 290°3', provides an intriguing case for determining the qibla direction. This process involves precise calculations to ensure accurate alignment towards the Kaaba in Mecca.

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<sup>28</sup> Gunawan Tjahjono, *Indonesian Heritage-Architecture* (Singapore: Archipelago Press, 1998), p. 81-82.



**Picture 12.** *The Great Mosque of Baiturrahman, Aceh (source: researcher)*

The first step involves calculating the qibla angle relative to the north. This is done using the formula:

$$\text{Cotan } Q = \frac{\tan 21^{\circ}25'21.04'' \cdot \cos 5^{\circ}33'12.86''}{\sin 55^{\circ}29'27.98''} - \sin 5^{\circ}33'12.86'' \cdot \cotan 55^{\circ}29'27.98''$$

Upon application of this formula, the Qibla Angle from the North is obtained as  $67^{\circ}50'9.54''$ . To ascertain the qibla direction relative to the west, the qibla angle from the north is subtracted from 90 degrees. This calculation results in an angle that indicates the direction towards the Kaaba from the west.

$$\text{Qibla Angle from the West} \rightarrow 90^{\circ} - 67^{\circ}50'9.54'' = 22^{\circ}9'50.46''$$

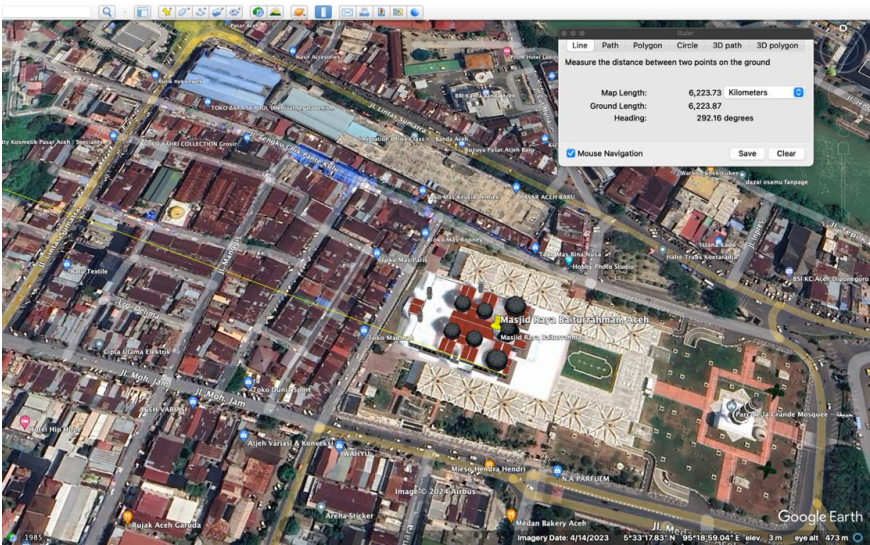
The azimuth, representing the true direction from the mosque's coordinates to the qibla, is calculated by adding the qibla angle from the west to 270 degrees. The azimuth is the angle measured clockwise from the north to the qibla direction.

$$\text{Qibla Azimuth} \rightarrow 270^{\circ} + 22^{\circ}9'50.46'' = 292^{\circ}9'50.46''$$

To ascertain the accuracy of the qibla direction for the Great Mosque of Baiturrahman, researcher employed a modern and precise method using Google Earth engine. This advanced tool allowed for a detailed and accurate assessment of the mosque's geographical



orientation without the need for physical devices on the ground.<sup>29</sup>



**Picture 13.** *Measuring the Qibla direction of the Great Mosque of Baiturrahman using Google Earth engine (source: Google Earth)*

The results obtained from Google Earth engine for the qibla direction of the mosque were found to be 292.16°. Remarkably, this measurement aligns perfectly with the calculations derived from Spherical Trigonometry, which indicated a qibla direction of 292°9’50.46”. When converted, this trigonometric calculation also equates to 292.16°. This congruence between the modern digital method and the traditional mathematical approach underscores the reliability and precision of both techniques in determining the qibla direction.

**Comparative Analysis and Interpretation**

The comparison of the Qibla Azimuth between the AI ChatGPT

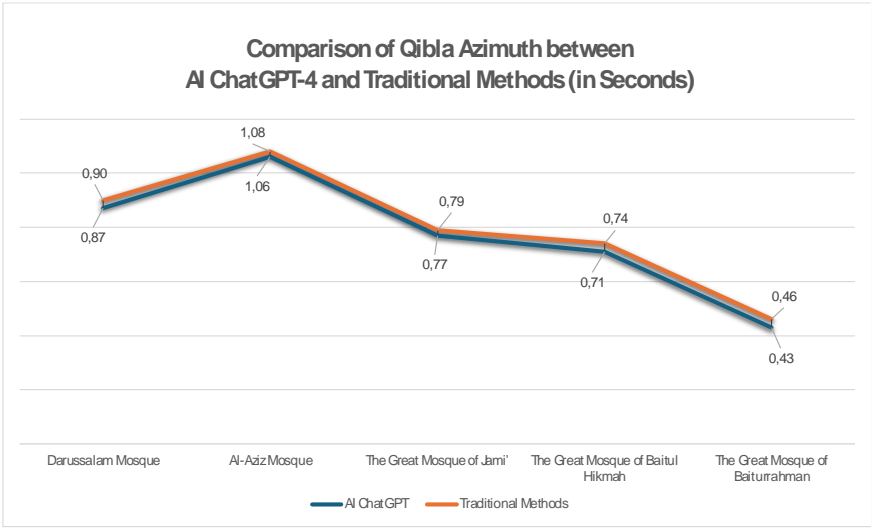
<sup>29</sup> By entering the mosque's geographical coordinates of latitude and longitude into Google Earth engine, the researchers were able to precisely ascertain the mosque's orientation towards the Kaaba in Mecca. For more details, see: R. Muhalling, Najmah ST., N. A. Huzaimah, and M. Idriz, “The Qibla Directional Accuracy Determination Analysis Using Spherical Trigonometric Method and Google Earth.” *NeuroQuantology* 20, no. 5 (2022), p. 107-114. <https://doi.org/10.14704/nq.2022.20.5.nq22153>.

model and traditional methods, which include Spherical Trigonometry calculations validated by Mizwala in three mosques and Google Earth data for two others, showed an average deviation of merely 0°0'0.026", reinforcing the research objective to assess ChatGPT's potential as a reliable alternative for qibla direction determination.

**Table 1. Comparison of Qibla Azimuth between AI ChatGPT-4 and Traditional Methods**

No.	Location	Qibla Azimuth		Deviation Angle
		AI ChatGPT	Traditional Methods	
1	Darussalam Mosque	294°42'44.87"	294°42'44.9"	0°0'0.03"
2	Al-Aziz Mosque	294°15'22.06"	294°15'22.08"	0°0'0.02"
3	The Great Mosque of Jami'	294°12'49.77"	294°12'49.79"	0°0'0.02"
4	The Great Mosque of Baitul Hikmah	291°27'38.71"	291°27'38.74"	0°0'0.03"
5	The Great Mosque of Baiturrahman	292°9'50.43"	292°9'50.46"	0°0'0.03"
Average Deviation				0°0'0.026"

This finding aligns with the study’s goal of exploring AI’s feasibility in religious applications and demonstrates that ChatGPT's accuracy can complement traditional verification methods effectively. This extremely small difference highlights the impressive accuracy of ChatGPT's predictions in determining the qibla direction using specific geographical coordinates.



**Figure 2.** *Comparison of Qibla Azimuth between AI ChatGPT-4 and Traditional Methods*

However, accuracy alone is not the sole determinant in the adoption of AI-based methods in religious contexts. The findings suggest that while AI offers precision, social and cultural acceptance remains paramount. Mosque administrators and congregants exhibit a preference for traditional methods due to their perceived authenticity and alignment with long-standing religious practices. The study demonstrates that the integration of AI tools like ChatGPT should be accompanied by efforts to build trust and ensure alignment with religious values.

The research findings emphasize the need for a balanced approach that combines technological advancements with sensitivity to religious traditions. Insights from mosque administrators, such as Lutfi Nurfalaq from Darussalam Mosque, highlight the importance of community acceptance and trust in AI-based solutions. Similarly, KH. Abdullah Sajjad from Al-Aziz Mosque expressed concerns regarding adjustments in older mosques, emphasizing the potential disruptions in prayer arrangements and community dynamics. These perspectives reinforce the notion that technological accuracy must be complemented by social acceptance to ensure meaningful integration into religious practices. While AI-based methods can enhance efficiency and accessibility, their successful adoption requires clear



communication, education, and endorsement from religious authorities.

In conclusion, this study highlights the nuanced relationship between technology and religion, where the technical capabilities of AI, such as high accuracy, must be contextualized within the broader framework of religious and cultural considerations. Traditional methods, despite their time-consuming nature, retain their significance in ensuring communal cohesion and spiritual integrity. The research thus contributes to the ongoing dialogue on the role of AI in religious practice, advocating for a collaborative approach that respects tradition while embracing innovation. This aligns with the study's introduction, which underscores the importance of cultural acceptance in the adoption of AI tools for qibla determination. The findings reinforce that while AI offers technological convenience and accuracy, its successful integration requires alignment with religious values and community trust.

## Conclusion

This research effectively achieved its objectives by employing a mixed-methods approach to assess the accuracy and feasibility of the ChatGPT-4 AI model in determining the qibla direction, in comparison with traditional Spherical Trigonometry methods. The study validated that the ChatGPT-4 model, when provided with precise geographical coordinates, yielded qibla predictions with an exceptionally low average deviation of  $0^{\circ}0'0.026''$ , closely aligning with traditional calculations. The results were substantiated through direct measurements using Mizwala in three mosques located in Java and indirect verification using Google Earth for two mosques outside Java, demonstrating the reliability of AI-based calculations.

Beyond numerical accuracy, the research underscores the importance of community acceptance and cultural considerations in adopting AI for religious practices. While AI tools offer convenience and precision, their successful implementation requires alignment with religious values and community trust. Traditional methods such as Mizwala and Rashdul Qibla remain indispensable due to their cultural significance, with AI serving as a complementary resource rather than a replacement.

Furthermore, the study contributes to the broader discourse on

the interaction between technology and religion, emphasizing the need for further exploration into how AI can be integrated in ways that uphold religious integrity. The findings advocate for collaborative efforts between religious scholars, technologists, and community leaders to facilitate AI adoption without compromising spiritual authenticity. Ultimately, this research successfully bridges the gap between traditional qibla determination methods and modern AI-based solutions, highlighting the potential of AI to enhance religious observances while maintaining cultural authenticity.

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