Al-Hilal: Journal of Islamic Astronomy
Vol. 08, No. 01, April 2026: 27-38
DOI: 10.21580/al-hilal.2026.8.1.29337
ISSN: 2775-1236 (printed); 2775-2119 (online)

Islamic Prayer Time Calculation in High-Latitude Summer: A Computational Approach Using the *Ittibāʿ Aqrab al-Bilād* Method in Iceland

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‖ *Submitted: 04-11-2025* ‖ *Revised:08-02-2026* ‖ *Accepted: 19-04-2026* ‖ *Published: 26-04-2026* ‖

Abstract

Determining Islamic prayer times in high-latitude regions is challenging, particularly during summer when continuous twilight prevents the Sun from reaching required depression angles below the horizon. This condition causes conventional solar-angle-based methods to produce undefined (NaN) values for *Fajr* and *Isha*. This study proposes a computational approach to address this limitation using Reykjavik, Iceland, as a case study. Astronomical calculations based on solar position parameters are applied to determine *Dhuhr*, *Asr*, and *Maghrib*. At the same time, the *ittibā' aqrab al-bilād* method is used to resolve *Fajr* and *Isha* by referencing London as the nearest region with normal day–night cycles. The method is implemented in a GUI-based prayer time calculator. Validation shows that the computed times have acceptable deviations, averaging 14–15 minutes compared to established applications, with larger discrepancies for Isha due to persistent twilight. This study offers a practical, computational, and jurisprudential solution to determining prayer times in extreme latitudes.

Keywords: Islamic prayer times, high-latitude regions, continuous twilight, *ittibā' aqrab al-bilād*.

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Penentuan waktu salat di wilayah lintang tinggi menghadapi tantangan signifikan, terutama selama musim panas ketika senja yang berlangsung terus-menerus menghalangi matahari mencapai sudut depresi yang diperlukan di bawah cakrawala. Kondisi ini menyebabkan metode konvensional berbasis sudut matahari menghasilkan nilai tak terdefinisi (NaN) untuk waktu Subuh dan Isya. Penelitian ini mengusulkan pendekatan komputasional untuk mengatasi keterbatasan tersebut dengan mengambil studi kasus di Reykjavik, Islandia. Perhitungan astronomi berbasis parameter posisi matahari digunakan untuk menentukan waktu Zuhur, Asar, dan Magrib, sementara metode *ittibā' aqrab al-bilād* diterapkan untuk menentukan waktu Subuh dan Isya dengan merujuk pada London sebagai wilayah terdekat yang masih mengalami siklus siang–malam normal. Metode ini diimplementasikan dalam aplikasi kalkulator waktu salat berbasis GUI. Hasil validasi menunjukkan bahwa waktu yang dihasilkan memiliki deviasi yang masih dapat diterima, dengan rata-rata sekitar 14–15 menit dibandingkan aplikasi pembanding, meskipun deviasi lebih besar terjadi pada waktu Isya akibat kondisi senja berkelanjutan. Penelitian ini menawarkan solusi komputasional dan yurisprudensial yang praktis untuk penentuan waktu salat di wilayah lintang ekstrem.

Kata Kunci: waktu salat, wilayah lintang tinggi, senja berkelanjutan, *ittibā' aqrab al-bilād*.

To cite this article (Chicago Manual of Style 17th Edition Full-Note):
Mayrisa Andriyani, *et al*, "Islamic Prayer Time Calculation in High-Latitude Summer: A Computational Approach Using the *Ittibā' Aqrab al-Bilād* Method in Iceland", *Al-Hilal: Journal of Islamic Astronomy*, Vol. 8, No. 1 (2026): 27-38.

A. Introduction

Islam regulates acts of worship with clearly defined procedures and prescribed times,[1] including the obligation of performing the five daily prayers within their designated intervals as emphasized in *Surah An-Nisa* (4:103).[2] The determination of these prayer times is fundamentally based on the apparent motion of the Sun, which marks key daily astronomical events such as dawn, solar culmination, and sunset.[3] Consequently, astronomical calculations (*ḥisāb*) play a crucial role in ensuring the accuracy of prayer schedules across different geographical regions.[4]

However, in high-latitude regions, such as Reykjavik, Iceland, problems arise during the summer when the Sun does not set, a phenomenon known as the midnight sun.[5] The solar altitude is the main factor in determining prayer times.[6] Each prayer time is determined by the Sun's position or altitude angle relative to the horizon; for example, *Dhuhr* begins when the Sun reaches its highest point, *Magrib* when the Sun sets, and *Fajr* when dawn begins to appear on the eastern horizon.[7] In high-latitude conditions, the Sun does not always reach specific angles below the horizon (for example, for *Fajr* and *Isha*), making conventional solar-angle-based methods inapplicable.

On the other hand, the number of Muslims in Iceland continues to increase, even though they remain a minority group with a population of around 1,500 to 2,000 people. The characteristics of Muslims in Iceland are generally immigrants or descendants of immigrants from countries such as Pakistan, Albania, and Morocco, as well as a small number of native Icelanders who have converted to Islam.[8] They continue to practice their worship in accordance with religious guidance despite extreme geographical and climatic conditions. To overcome this obstacle, scholars have proposed several solutions. Some scholars argue that the determination of prayer schedules in polar regions can follow the schedule of the nearest country that still

[1] Ais Mariya et al., "Pelaksanaan Konsep Islam Rahmatan Lil 'Alamin," *Al-Afkar, Journal For Islamic Studies* 4, no. 2 (2021): 459–474, https://doi.org/10.31943/afkarjournal.v4i2.217.

[2] Muhammad Zainul Arifin and Ainur Rofiq Sofa, "Pengaruh Shalat Lima Waktu Terhadap Disiplin Dan Kualitas Hidup," *Lencana: Jurnal Inovasi Ilmu Pendidikan* 3, no. 1 (November 5, 2024): 70–78, https://doi.org/10.55606/lencana.v3i1.4458.

[3] Imroatul Munfaridah, "Problematika Dan Solusinya Tentang Penentuan Waktu Shalat Dan Puasa Di Daerah Abnormal (Kutub)," *Al-Syakhsiyyah: Journal of Law & Family Studies* 3, no. 1 (July 21, 2021): 37–50, https://doi.org/10.21154/syakhsiyyah.v3i1.2985.

[4] Muhammad Himmatur Riza et al., "Integrating Astronomical Observations and Islamic Law: The Case of Sunrise and the Ishrāq Prayer Time," *Al-Hilal: Journal of Islamic Astronomy* 7, no. 2 (September 24, 2025): 133–48, https://doi.org/10.21580/al-hilal.2025.7.2.27963.

[5] Aulia Salma and Muhammad As'ad, "Determining Prayer Times In Midnight Sun Countries," *Al-Hilal: Journal of Islamic Astronomy* 6, no. 1 (April 30, 2024): 69–78, https://doi.org/10.21580/al-hilal.2024.6.1.21040.

[6] Siti Tatmainul Qulub and Sanuri Sanuri, "Aspek Maqāṣid Al-Kulliyyah Dan Al-Juziyyah Dalam Penetapan Awal Waktu Shalat Shubuh Dan Isya'," *Al-Qanun: Jurnal Pemikiran Dan Pembaharuan Hukum Islam* 27, no. 2 (2024): 186–98, https://doi.org/10.15642/alqanun.2024.27.2.186-198.

[7] Iif Riansa and Darlius Darlius, "Formulasi Waktu Shalat Perspektif Empat Imam Mazhab," *Innovative: Journal Of Social Science Research* 3, no. 6 (2023): 8625–8640.

[8] N. Zaid, "Menengok Sejarah Dan Pergulatan Islam Di Islandia," oase.id, 2022, https://m.oase.id/read/WGLzmR-menengok-sejarah-dan-pergulatan-islam-di-islandia.

experiences typical day-night alternation.[9] Meanwhile, other scholars believe that prayer times in polar regions should be aligned with the prayer schedule in Makkah, the birthplace of Islam.[10]

Previous research conducted by Abdullah Hasan in 2021 discussed the implications of the *istiwa'* shadow for determining the beginning of prayer times. In his article, it was stated that the latitude at the North Pole reaches 90°, and at the South Pole, 90°, where darkness occurs without sunlight. In such extreme situations, where solar observation becomes difficult, alternative approaches to determining prayer times are required, including the method proposed by Saadoe'ddin Djambek and T. Jamaluddin.[11] Another study conducted by Ahmad Fadholi in 2022 discussed the differentiation of *ḥisāb* for prayer times (a study of *al-Khulāṣah al-Wafiyyah* and contemporary works). The study concluded that al-Khulashah is one of the classical references that has already incorporated the position of the Sun in the calculation of prayer times.[12] However, these studies primarily focus on theoretical and comparative approaches and have not specifically addressed the limitations of solar-angle-based methods in extreme-latitude regions through computational simulations. Therefore, there remains a research gap in developing a computational method for determining prayer times under extreme astronomical conditions, particularly in regions experiencing the midnight sun phenomenon.

Based on previous studies, this research aims to analyze and propose a practical solution for determining the prayer schedule in Iceland during the summer season. It offers a computational approach through solar position simulation to produce prayer time calculations, distinguishing it from previous studies that tend to rely on static or purely *fiqh*-based methods. The results are expected to benefit the Muslim community in high-latitude regions and to enhance scientific understanding of the determination of prayer times under extreme astronomical conditions.

B. Method

This study employs an astronomical computational approach to determine Islamic prayer times under high-latitude summer conditions, using Reykjavik, Iceland (64° 05' N and 21° 50' W) and London, United Kingdom (51° 30' N and 〖-0° 7' W) as reference locations. The required data include geographical coordinates (latitude and longitude), solar declination, and the Equation of Time obtained from official ephemeris tables.[13] The selected case date is July 20 2025, as adapted

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[9] Muhammad Najib and Dewi Chamidatul Chusna, "Waktu Sholat Daerah Kutub Dalam Kitab Al-Ma'ayiir Al-Fiqhiyyah Wa Al-Falakiyyah Fi I'dad at-Taqwiim Al-Hijriyyah: Problem Dan Solusinya," *MIYAH: Jurnal Studi Islam* 19, no. 1 (2023): 167–78.

[10] Munfaridah, "Problematika Dan Solusinya Tentang Penentuan Waktu Shalat Dan Puasa Di Daerah Abnormal (Kutub)."

[11] Abdulloh Hasan, "Implikasi Bayang Istiwa' Terhadap Penentuan Awal Waktu Sholat," *Jurnal Penelitian Agama* 22, no. 1 (June 17, 2021): 1–19, https://doi.org/10.24090/jpa.v22i1.2021.pp1-19.

[12] Ahmad Fadholi, "Diferensiasi Hisab Waktu Salat (Studi Kitab Al-Khulashah Al-Wafiyyah Dan Kontemporer)," *Al-Marshad: Jurnal Astronomi Islam Dan Ilmu-Ilmu Berkaitan* 8, no. 2 (December 5, 2022): 96–109, https://doi.org/10.30596/jam.v8i2.10845.

[13] Aisah Nur Eka Rahmawati, Yulianti Rusdiana, and Ilmadi Ilmadi, "Trigonometri Segitiga Bola Dalam Penentuan Waktu Salat," *Jurnal Saintika UNPAM: Jurnal Sains Dan Matematika UNPAM* 4, no. 1 (2021): 90–107, https://doi.org/10.32493/jsmu.v4i1.19497.

in Rizalludin,[14] representing peak summer conditions when continuous twilight occurs in high-latitude regions.

Prayer times are calculated using spherical trigonometry based on solar position parameters. *Dhuhr* is determined from the meridian passage corrected by the Equation of Time and local time correction (LTC). At the same time, *Asr*, *Maghrib*, and *Isha* are calculated using solar altitude and hour angle formulations. However, under extreme conditions in Reykjavik, the Sun does not reach the required depression angles for *Fajr* and *Isha*, resulting in undefined (NaN) values in standard computations.

To resolve this limitation, the *ittibā' aqrab al-bilād* method is applied by referencing prayer times from London, where the normal day–night cycle still occurs. The computational procedure detects undefined values and replaces them with corresponding values from the reference location. This hybrid approach ensures both astronomical consistency and compliance with Islamic jurisprudential principles.

The method is implemented as a web-based computational system that processes user input in the form of date and geographic coordinates. Based on these inputs, the system retrieves ephemeris data and computes prayer times using solar position algorithms. Under high-latitude summer conditions, the system may produce undefined values (NaN) for Fajr and Isha due to the absence of valid twilight angles. To address this issue, the system automatically activates a fallback mechanism based on the *ittibāʿ aqrab al-bilād* method, replacing undefined values with those from the nearest valid reference region, such as London.[15] This implementation ensures that the generated prayer times remain both computationally valid and practically applicable.[16]

C. Result and Discussion

1. Astronomical and Jurisprudential Basis of Prayer Time Determination Using the *Ittibā' Aqrab al-Bilād Method* in High-Latitude Regions

Islamic prayer times are determined by observable solar phenomena that mark the beginning and end of each obligatory prayer. These include the appearance of true dawn (*fajr ṣādiq*),[17] the Sun's culmination at the meridian,[18] the elongation of shadows,[19] sunset,[20] and the

[14] Rizalludin Rizalludin, "Pemikiran Thomas Djamaluddin Tentang Salat Dan Puasa Di Daerah Dekat Kutub," *Al-Marshad: Jurnal Astronomi Islam Dan Ilmu-Ilmu Berkaitan* 4, no. 1 (June 30, 2018): 116–34, https://doi.org/10.30596/jam.v4i1.1938.

[15] Unggul Suryo Ardi, "Problematika Awal Waktu Shubuh Antara Fiqih Dan Astronomi," *AL - AFAQ : Jurnal Ilmu Falak Dan Astronomi* 2, no. 2 (January 5, 2021): 87–102, https://doi.org/10.20414/afaq.v2i2.2921.

[16] Asep Saefullah and Diana Ayu Rostikawati, "Kajian Siklus Waktu Puasa Penduduk Belahan Bumi Utara Dan Bumi Selatan," *Newton-Maxwell Journal of Physics* 3, no. 1 (April 25, 2022): 1–5, https://doi.org/10.33369/nmj.v3i1.21030.

[17] Hilyahtul Uyuni and Nurul Wakia, "Analisis Fatwa MUI Terhadap Waktu Salat Di Daerah Kutub Perspektif Kaidah-Kaidah Fiqh," *El-Falaky: Jurnal Ilmu Falak* 9, no. 2 (December 28, 2025): 244–61, https://doi.org/10.24252/ifk.v9i2.60429.

[18] Labibah Amil Farah, "Waktu Shalat Ashar, Maghrib Dan Isya' Perspektif Hadis," *El-Falaky: Jurnal Ilmu Falak* 4, no. 1 (June 18, 2020): 56–72, https://doi.org/10.24252/ifk.v4i1.14167.

[19] Farah.

[20] Juli Prasetia Panca Putri Kamiswidaryani, Nur Aisyah, and Muh. Anis, "Pengaruh Posisi Matahari Terhadap Penentuan Awal Waktu Salat Perspektif Ilmu Falak," *HISABUNA: Jurnal Ilmu Falak* 4, no. 1 (June 30, 2023): 143–60, https://doi.org/10.24252/hisabuna.v4i1.35806.

disappearance of twilight.[21] Each of these indicators corresponds to specific solar positions relative to the horizon, making astronomical parameters, particularly solar altitude, a fundamental basis in determining prayer times.[22] In regions with normal day–night cycles, these parameters can be consistently applied using fixed angular thresholds. However, variations in geographic location, especially latitude, influence the Sun's apparent motion and, consequently, affect the timing of these events.[23] As a result, determining prayer times is not only a religious obligation but also an applied astronomical problem that requires careful alignment between observational criteria and computational methods.

In high-latitude regions, such as Reykjavik, Iceland, determining prayer times becomes significantly more complex, particularly during the summer season. Due to Earth's axial tilt and orbital motion, these regions experience prolonged daylight and, in some cases, continuous twilight, in which the Sun does not set sufficiently low on the horizon. Under such conditions, standard criteria, such as solar depression angles of -18^{o} or -15^{o} for defining *Fajr* and *Isha*, cannot be fulfilled. Consequently, calculations based on these parameters often yield undefined results, indicating a breakdown of conventional solar-angle-based methods. While the times for *Dhuhr*, *Asr*, and *Maghrib* remain computable because they depend on solar culmination and sunset, the absence of distinct twilight phases complicates the determination of dawn and night prayers, necessitating alternative approaches.

From the perspective of Islamic jurisprudence, several methods have been proposed to address these anomalous conditions. One of the most widely accepted approaches is the *ittibā' aqrab al-bilād* method, which prescribes following the prayer times of the nearest region where normal astronomical conditions still apply. This method is grounded in the principle of taqdīr (estimation), which allows for reasonable adjustments when direct observation or calculation becomes impractical.[24] Other approaches include proportional time division and the use of fixed reference locations such as Makkah or Madinah.[25] However, the *ittibā' aqrab al-bilād* method is often preferred because it maintains a closer relationship with actual solar phenomena while remaining flexible enough to accommodate geographical limitations.[26]

Based on this framework, determining prayer times in high-latitude regions requires an integrative approach that combines astronomical calculations with jurisprudential considerations. The Sun's inability to reach the required depression angles underscores the need for adaptive computational strategies that go beyond conventional methods. By incorporating the *ittibā' aqrab al-bilād* approach into a computational system, it becomes possible to generate prayer times that

[21] Zainuddin Zainuddin, "Posisi Matahari Dalam Menentukan Waktu Shalat Menurut Dalil Syar'i," *El-Falaky: Jurnal Ilmu Falak* 4, no. 1 (April 15, 2020): 36–55, https://doi.org/10.24252/ifk.v4i1.14166.

[22] Agung Danarta, "Shift in Understanding of The Quran and Hadith about The Early Time of Subuh (Case Study Of Muhammadiyah)," *Jurnal Living Hadis* 6, no. 2 (January 16, 2022): 19–38, https://doi.org/10.14421/livinghadis.2021.3099.

[23] Widi Astuti, Nurul Wakia, and Hadi Daeng Mapuna, "Penentuan Awal Waktu Salat Dan Arah Kiblat Ditinjau Dari Gerak Semu Tahunan Matahari," *HISABUNA: Jurnal Ilmu Falak* 4, no. 1 (June 30, 2023): 40–57, https://doi.org/10.24252/hisabuna.v4i1.36215.

[24] Wahbah Al-Zuḥailī, *Al-Wajīz Fī 'Uṣūl Al-Fiqh* (Beirūt: Dār al-Fikr, 1999), 93.

[25] Zavitri Galuh Prameswari and Mahsun, "Perspektif Fiqih Minoritas Yusuf Al-Qardhawi Dalam Penentuan Awal Waktu Salat Di Daerah Kutub," *El-Faqih : Jurnal Pemikiran Dan Hukum Islam* 10, no. 2 (October 7, 2024): 334–49, https://doi.org/10.58401/faqih.v10i2.1480.

[26] Uyuni and Nurul Wakia, "Analisis Fatwa MUI Terhadap Waktu Salat Di Daerah Kutub Perspektif Kaidah-Kaidah Fiqh."

are both scientifically grounded and religiously valid. This conceptual foundation underpins the analysis presented in this study. It provides a basis for evaluating the effectiveness of the proposed method in determining prayer times under extreme latitudes.

2. Computational Results of Prayer Time Determination in Reykjavik

Based on the theoretical framework described in the previous section, prayer times in Reykjavik were determined using astronomical parameters derived from solar position data. The calculation employs spherical trigonometry, incorporating latitude, longitude, solar declination, and the Equation of Time for the selected date: July 20, 2025.

Table 1. Prayer times in Reykjavik on July 20, 2025

Fajr	***Dhuhr***	***Asar***	***Magrib***	***Isha***
NaN (Not a Number)	13:36	18:16	23:00	NaN

The results show that *Dhuhr*, *Asr*, and *Maghrib* can be determined directly using standard computational procedures, as these prayer times depend on solar culmination and sunset, which remain observable even at high latitudes. However, the calculations for Fajr and Isha yield undefined values (NaN), indicating that the Sun does not reach the required depression angles below the horizon. This outcome confirms the theoretical limitation discussed earlier and demonstrates the inapplicability of conventional solar-angle-based methods in extreme summer conditions.

To address this limitation, the *ittibā' aqrab al-bilād* method was applied, using London as the nearest region with normal day–night cycles. The prayer times for Fajr and Isha were recalculated using London's astronomical data and then adopted as reference values for Reykjavik. The adjusted results show that *Fajr* occurs at 02:40 and *Isha* at 23:36, while *Dhuhr*, *Asr*, and *Maghrib* remain unchanged from the direct calculations.

Table 2. Prayer times in Reykjavik on July 20, 2025

Fajr	***Dhuhr***	***Asar***	***Magrib***	***Isha***
02:40	13:36	18:16	23:00	23:36

This approach ensures continuity in the prayer schedule despite the absence of valid twilight conditions in Reykjavik. The integration of local astronomical computation with external reference data reflects a hybrid model that aligns with both scientific reasoning and jurisprudential principles. To evaluate the reliability of the proposed method, the computed prayer times were compared with established prayer time applications, namely *Muslim Pro* and *Al-Moazin*.

Table 3. Comparison of Prayer Times on July 20, 2025.

Prayer Times	*Ḥisāb* Results	Reykjavik (*Muslim Pro*)	Deviation (MP)	Reykjavik (*Al-Moazin*)	Deviation (AM)
Fajr	02:40	02:47	00:07	02:31	00:09
Dhuhr	13:36	13:39	00:03	13:34	00:02
Asar	18:16	18:14	00:02	18:14	00:02
Magrib	23:00	23:13	00:13	23:09	00:09
Isha	23:36	00:21	00:45	00:30	00:54

The comparison indicates that the calculated times are generally consistent, with an average deviation of approximately 14–15 minutes. The smallest differences are observed in *Dhuhr* and *Asr*, which are directly derived from solar culmination and shadow length, resulting in minimal variation across methods. *Maghrib* also shows relatively small deviations, although slight differences arise from variations in the solar altitude criteria and atmospheric assumptions used by different applications. In contrast, the largest deviation is observed in Isha, reaching up to 45–54 minutes. This discrepancy is primarily due to the absence of true astronomical twilight in Reykjavik during summer, which forces different calculation systems to adopt different approximation methods. Applications such as *Muslim Pro* and *Al-Moazin* may use alternative twilight angles or internal adjustment algorithms, resulting in differences in the prayer times. Despite this variation, the results of this study remain within an acceptable range under contemporary jurisprudential standards, particularly given the extreme astronomical conditions. These findings indicate that the proposed computational approach provides a stable and justifiable solution for determining prayer times in high-latitude regions.

3. Integrative Evaluation and System Implementation in High-Latitude Prayer Time Determination

The findings presented in the previous sections indicate that determining prayer times in high-latitude regions cannot be approached solely from a computational standpoint. While astronomical calculations can produce reliable results for certain prayer times, they face clear limitations under extreme seasonal conditions. In such cases, the problem extends beyond technical computation and enters the domain of Islamic jurisprudence, where normative considerations become essential. Various approaches have been developed to address these conditions, including adopting prayer times from regions with normal day–night cycles, applying proportional time estimation, or referring to fixed locations. These alternatives reflect different ways of reconciling astronomical constraints with religious obligations, suggesting that an integrative perspective is required rather than a purely mathematical solution.

Table 4. Comparison of Prayer Time Determination Under Extreme Conditions

Method	Description of the approach	Strength	Limitation
Nearest Region (*Ittiba' Aqrab al-Bilād*)	Refers to the prayer times of the nearest location with a normal day-night cycle	*Fiqh*-supported and practical	Requires an appropriate reference location
Proportional Time Division (*Taqsīm*)	Divides 24 hours proportionally into prayer times	Applicable in extreme cases	Less accurate astronomically
Fixed Reference (Makkah/Madinah)	Uses prayer times from sacred cities	Strong symbolic basis	Less geographically adaptive

A comparative overview of these approaches highlights their respective strengths and limitations. The nearest-region approach, commonly referred to as *ittibā' aqrab al-bilād*, offers a practical solution by maintaining a connection to actual solar phenomena observed in geographically adjacent regions. In contrast, proportional time division provides flexibility but tends to weaken the link to astronomical reality, while fixed-reference methods rely more on symbolic consistency than on local conditions. Considering these differences, the present study adopts the nearest-region approach, as it provides a balanced framework that is both jurisprudentially acceptable and astronomically grounded. This choice is not merely theoretical, but is also informed by the need to ensure that the resulting prayer schedule remains applicable in real-world conditions.

To implement this approach in practice, a web-based prayer time calculator was developed based on the computational model described earlier. The system allows users to input specific dates and automatically processes astronomical data to generate prayer times. When applied to Reykjavik during the summer season, the system successfully determines *Dhuhr*, *Asr*, and *Maghrib* using standard solar position calculations. However, as anticipated, the calculations for Fajr and Isha initially produce undefined values. This occurs because the Sun does not reach the necessary depression angles below the horizon, making conventional twilight-based definitions inapplicable. Rather than forcing a result, the system identifies these outcomes as computational anomalies and explicitly marks them, ensuring transparency in the calculation process.

Once these undefined values are detected, the system applies a correction mechanism based on the nearest-region approach. In this stage, prayer times for *Fajr* and *Isha* are recalculated using data from London, a location where twilight conditions remain valid. These values are then used to replace the undefined results, producing a complete and coherent prayer schedule. This process demonstrates how computational methods can be structured and consistently applied to incorporate jurisprudential principles. Compared to previous studies that tend to remain at a conceptual or descriptive level.[27] This study offers a more operational contribution by integrating

[27] Muh Arif Royyani et al., "Criteria for Determining Subuh Prayer Time by the Wahdah Islamiyah Jamaat: Socio-Religious Implications," *Ijtihad : Jurnal Wacana Hukum Islam Dan Kemanusiaan* 25, no. 1 (June 30, 2025): 55–84, https://doi.org/10.18326/ijtihad.v25i1.55-84; Munfaridah, "Problematika Dan Solusinya Tentang Penentuan Waktu Shalat Dan Puasa Di Daerah Abnormal (Kutub)"; Najib and Chusna, "Waktu Sholat Daerah Kutub Dalam Kitab Al-Ma'ayiir Al-Fiqhiyyah Wa Al-Falakiyyah Fi I'dad at-Taqwiim Al-Hijriyyah: Problem Dan Solusinya"; Rizalludin, "Pemikiran Thomas Djamaluddin Tentang Salat Dan Puasa Di Daerah

anomaly detection and adaptive correction within a single computational framework. In this sense, the proposed approach not only addresses a known limitation in prayer time calculation but also provides a practical tool that can be applied in similar high-latitude contexts.

Figure 1. Pre-Adjustment Prayer Time Calculation in Reykjavik (NaN Results for *Fajr* and *Isha*)

Figure 2. Post-Adjustment Prayer Time Calculation Using the *Ittibā' Aqrab al-Bilād* Method

Dekat Kutub"; Uyuni and Nurul Wakia, "Analisis Fatwa MUI Terhadap Waktu Salat Di Daerah Kutub Perspektif Kaidah-Kaidah Fiqh."

The comparison between the initial and adjusted computational outputs, as illustrated in Figures 1 and 2, clearly demonstrates the impact of applying the *ittibā' aqrab al-bilād* method in resolving indeterminacy in prayer time under high-latitude conditions. The initial calculation produces undefined values (NaN) for *Fajr* and *Isha* because no valid twilight angles are available, reflecting the limitations of conventional solar-angle-based methods. Following the implementation of the nearest-region adjustment, these undefined values are now replaced with reference-based results, yielding a complete and coherent prayer schedule. This comparison highlights not only the necessity of integrating jurisprudential approaches into astronomical computation but also the effectiveness of the proposed method in addressing real-world constraints. To further support practical application, the developed web-based Prayer Time Calculator can be accessed at: *https://bit.ly/Iceland_Prayer_Calculator*, allowing users to explore and apply the model dynamically across different dates and conditions.

D. Conclusion

This study demonstrates that determining Islamic prayer times in high-latitude regions, such as Reykjavik, Iceland, becomes problematic during the summer due to continuous twilight, which prevents the Sun from reaching the required depression angles for defining *Fajr* and *Isha*. As a result, conventional ḥisāb methods produce undefined values for these prayer times, while *Dhuhr*, *Asr*, and *Maghrib* remain computable using standard astronomical parameters. By applying the *ittibā' aqrab al-bilād* method with London as a reference location, the study successfully generates adjusted prayer times that resolve these limitations. The resulting schedule shows deviations of 2 to 45 minutes compared with existing applications, indicating that the proposed approach remains within acceptable bounds from both astronomical and jurisprudential perspectives.

From a scientific standpoint, this research contributes a hybrid computational–jurisprudential framework that explicitly addresses the problem of undefined prayer times (NaN) in high-latitude regions. Unlike previous studies that remain largely theoretical or descriptive, this study introduces a systematic mechanism that integrates astronomical computation with adaptive jurisprudential correction within a single operational model. The implementation of anomaly detection and automated fallback procedures represents a novel contribution, enabling the system to resolve computational failures rather than merely approximating results dynamically. In addition, the development of a GUI-based Prayer Time Calculator demonstrates the practical applicability of the proposed model, bridging the gap between theoretical discourse and real-world implementation in Islamic astronomy.

Despite these contributions, the study has several limitations. The analysis is restricted to a single date and location, which may not fully capture the year-round variability of solar behavior in high-latitude regions. Furthermore, the study focuses on a single primary adjustment method without extensive comparison with alternative *fiqh*-based or astronomical approaches. Future research is therefore recommended to include multi-date and multi-location analyses, systematic comparisons across different methodological frameworks, and the development of automated systems capable of detecting continuous twilight conditions and dynamically adjusting solar angle parameters. Such advancements would enhance the robustness, adaptability, and broader applicability of prayer-time determination models in extreme-latitude environments.

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