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THE TRANSFORMATION OF *RUKYAH AL-HILAL*: INTEGRATING DIGITAL IMAGING TECHNOLOGY IN ISLAMIC MOON SIGHTING PRACTICES

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ABSTRACT

Rukyah is a method used to ascertain the start of the Islamic month by observing the sight of the new moon. The purpose of this study is to examine the transformation of traditional *rukyah al-hilāl* practices with the integration of modern technological tools, specifically digital imaging and telescopes. By analysing classical and contemporary Islamic scholarly perspectives, this research seeks to evaluate how these technological advancements impact the process of moon sighting, which is central to determining the Islamic calendar. The methodology employed in this study is qualitative, utilising a comparative analysis of classical juristic texts from scholars. Data was collected through literature review and analysis of relevant fatwas and scholarly discussions on the permissibility and effectiveness of technological aids in *rukyah al-hilāl*. The results indicate a clear transformation in the acceptance of technology, with contemporary scholars endorsing the use of telescopes and digital imaging to enhance the accuracy and reliability of moon sighting. While classical scholars acknowledged the use of basic visual aids, they emphasised the importance of direct visual observation. This study is original in its comprehensive examination of how Islamic jurisprudence is adapting to modern technological developments in moon sighting, an area that has not been extensively studied. The implications of this research are significant for Islamic legal institutions, as it provides a framework for integrating technology into religious practices while maintaining alignment with the principles of Islamic jurisprudence. It also highlights the potential for further advancements in the field, paving the way for future discussions on the intersection of faith and science.

Introduction

The development of modern astronomical techniques has transformed *rukyah al-hilāl* practices. Over the last century, *rukyah al-hilāl* has evolved with the integration of advanced optical devices like telescopes and digital cameras. These tools allow people to view the moon's phases without directly observing the sky, as was done traditionally. In the past decade, modern instrumentation such as CCD and CMOS cameras has been used to convert light into digital signals, enabling easier distribution and sharper images of the *hilāl* (Minnett et al., 2019). This innovation has not only made the observation more accessible but has also increased the precision of lunar sightings, allowing the moon's position to be documented with greater accuracy (Mustaqim, 2020). These advancements are reshaping how Muslims observe the moon and determine Islamic months (Hazrazil & Lewa, 2021). This modernisation in *rukyah al-hilāl* reflects how technology has integrated with religious practices, making the observation process more efficient.

The literature shows various approaches to *rukyah al-hilāl* and its legal implications. Several scholars have examined the role of digital and optical technologies in *hilāl* observation, noting both the scientific advancements and the debates surrounding their use. While modern methods improve visibility, they sometimes raise concerns about compatibility with traditional practices. Legault (2013) discusses astronomical photography techniques that assist in *rukyah al-hilāl*, although these methods have not completely resolved issues like equipment limitations and legal disputes. Similarly, Ruskanda (1994) outlines several alternative technologies, such as infrared devices and radar, which offer more precise results but cannot entirely overcome challenges like weather disturbances. Raharto (2004) emphasises the use of optical telescopes to increase objectivity in *rukyah al-hilāl*, although the *shafak* light interference remains an issue (Thomas Djamaluddin et al., 2010). The literature highlights both the advancements and challenges of using modern technology for *hilāl* observation, especially in balancing scientific objectivity with Islamic legal principles.

This research aims to contribute to establishing solid visibility criteria for *rukyah al-hilāl*. The study seeks to create a scientific foundation for determining the new moon's visibility by using advanced technologies in lunar observation. By doing so, it hopes to bridge the gap between modern science and traditional Islamic practices. Modern digital imaging techniques allow for precise recording and analysis of the moon's phases, improving the reliability of *rukyah al-hilāl*. For example, the International Crescent Observation Project provides global data for new moon visibility, offering a comprehensive database for analysis (Khaera et al., 2022). By applying these methods, the study expects to enhance the accuracy of lunar sightings, minimising errors caused by human observation limitations. The research is designed to enhance the reliability and validity of new moon observations through the integration of scientific and religious methodologies.

The use of modern technology in *rukyah al-hilāl* is essential for improving accuracy, despite *fiqh* debates (Wijaya & Muzammil, 2021). Although some argue that traditional naked-eye observation is more aligned with the practices of the Prophet Muhammad, the advancements in technology offer undeniable benefits. The ability to accurately measure the moon's position and phases through modern instrumentation is a significant step forward. The introduction of telescopic and digital imaging technologies has allowed for more objective and consistent lunar observations, addressing issues like visibility difficulties and environmental disturbances. However, the debate persists as some Islamic scholars question the appropriateness of these methods, given that they differ from traditional *rukyah al-hilāl* (Endarto, 2005). Despite this, the increasing precision and widespread use of technology suggest that its integration is both practical and necessary. While debates about the use of technology in *rukyah al-hilāl* continue, the benefits in accuracy and objectivity make modern methods a valuable tool for contemporary Islamic practices.

Literature Review

Meaning of *Rukyah al-Hilāl*

When discussing *"rukyah"* (sighting), we delve into deep linguistic roots (Ahmad Warson Munawwir, 1997). The word itself, derived from the Arabic verb *"ra'â"*, means to see, but it has layers! Whether we refer to seeing with our eyes, understanding with our minds, or even spotting the moon (*hilāl*), it all connects back to this root (Manzûr, n.d.). Essentially, *"rukyah"* plays a significant role in both religious practices and science, particularly when it comes to the observation of the moon for the Islamic calendar (Muhdlor, 1998). Researchers have examined the meanings of *"rukyah"* and *"ra'â"* in different contexts. From ancient scholars like Ahmad Warson Munawwir to modern dictionaries, *"ra'â"* is all about sight. And whether it's literal (seeing with your eyes) or metaphorical (like understanding or guessing), it has been the subject of extensive linguistic analysis (Masroerie, 2011). Notably, *"rukyah"* also has a specific use – observing the moon, especially for the start of months in the Islamic calendar (Ma'luf, 1989).

The meanings of *"ra'â"* have evolved, with more scholars contributing to defining its nuances. It is fascinating to see how this word has shifted from just physical sight to intellectual insight, reflecting how people rely on more than just their eyes (Tono Saksono, 2007). Researchers like Tono Saksono point out that, in modern times, *"rukyah"* involves not just looking with the naked eye—it incorporates science and tools, significantly changing the practice.

Moving on to the practical side of *"rukyah",* scholars like Muhyiddin Khazin have highlighted its application in astronomy and religious practice. Observing the moon with tools like telescopes adds precision; yet historically, *rukyah al-hilāl* (moon sighting) was done by the naked eye. Early Islamic scholars worked diligently to develop astronomical tables, turning *rukyah* into a bridge between science and faith.

While there is a wealth of research on *rukyah* and moon sighting, a gap exists in how modern technology is fully integrated into this practice. Most previous studies focus on historical and linguistic aspects, but few delve into the challenges of balancing traditional *rukyah* with tools like telescopes. This tension between the old-school approach and new technology is something that has not been explored sufficiently—and that's where new research can shine. Going forward, we should explore how modern tools can complement—not replace—traditional *rukyah* practices. Let's investigate the dynamics between faith-based observation and scientific advancements. How can they work together? This research aims to demonstrate that modern astronomical tools can enhance the reliability of *rukyah al-hilāl*, while respecting the spiritual significance of the practice.

Rukyah with Technology

The advancement of astronomical technology, particularly in observing the new moon (*rukyah al-hilāl*) (Raharto, 2004), has developed significantly since the introduction of telescopes in the 17th century. Telescopes, pioneered by Galileo Galilei, have become crucial in compensating for the limitations of the human eye in moon observations, enhancing the clarity and visibility of celestial objects. By focusing light through lenses and mirrors, modern telescopes facilitate a more precise understanding of the moon's position. This integration of technology into *rukyah al-hilāl* illustrate the continuous intersection between science and Islamic practices in determining the start of the Islamic lunar calendar.

Research has consistently explored the effectiveness of telescopic aids in moon sighting, focusing on the technical differences between astronomical and *rukyah*-specific telescopes. While both types of telescopes enhance visibility, *rukyah* telescopes utilise an alt-azimuth movement system, enabling them to track celestial objects both horizontally and vertically. The large diameters of their mirrors or lenses collect more light, thereby amplifying faint celestial objects like the *hilāl*. Despite these advancements, studies by Schaefer (1991) and others have shown that even with telescopes, the *hilāl* may not be visible if the angular distance between the sun and the moon is less than 7 degrees. This issue continues to challenge efforts to improve *rukyah* accuracy (Thomas Djamaluddin et al., 2010).

In recent years, the use of digital imaging technology has gained prominence in *rukyah al-hilāl*. This technology enhances the weak contrast between the moon and surrounding celestial light, such as the *shafak*. However, despite modern tools like telescopic photography and electronic detectors, significant challenges remain in capturing clear and objective images of the *hilāl*. Observers often struggle to differentiate between the *hilāl's* faint light and background illumination. While technological aids enhance the brightness of both the *hilāl* and the interfering light, the resulting contrast remains similar to observations made without equipment, raising questions about the empirical validity of *rukyah*.

As technological advancements continue, astronomers have begun utilising software and digital tools to process *rukyah* data, addressing some of the limitations of traditional telescopic observations. Digital imaging techniques and astronomy software can increase the visibility of the *hilāl*, especially when its light is faint (Bruin, 1977). These instruments enable researchers to enhance the contrast of *hilāl* images, overcoming the limitations of manual observation and helping to detect the moon even at low angular distances between the sun and moon. Such methods have the potential to bring greater objectivity and precision to *rukyah* practices, as highlighted by Legault (Legault, 2013), making them valuable additions to traditional techniques.

Despite these advancements, gaps remain in the literature regarding the accuracy and reliability of *rukyah al-hilāl* using modern technological aids (Purwanto, 1992). For instance, while telescopic and digital imaging methods have improved contrast and visibility, they still grapple with issues related to light interference and subjective interpretation of the *hilāl's* appearance. Furthermore, empirical evidence obtained through *rukyah*, even with advanced tools, remains questionable due to the lack of objective data. This reveals a gap in research—how to fully integrate digital and telescopic technologies to produce verifiable, repeatable results in moon sighting. Addressing these gaps would significantly contribute to both Islamic jurisprudence and scientific observation methods.

Future research should aim to further refine the integration of digital imaging and telescopic technologies in *rukyah al-hilāl*, focusing on increasing the empirical reliability of observations. One promising avenue is enhancing computer-assisted astronomy tools to better distinguish between hilal light and surrounding interference. Additionally, studies could explore standardising these tools across different regions, ensuring that *rukyah* practices become more objective and universally accepted. By addressing these technological and methodological challenges, new research can bridge the gap between traditional Islamic practices and modern scientific advancements, offering a more reliable approach to determining the beginning of the Islamic lunar months.

Methodology

In this study, the research design is exploratory and qualitative, focusing on the application of digital imaging technology in the observation of the new moon (*rukyah al-hilāl*). The aim is to explore how modern technology, particularly digital imaging, can enhance the accuracy of moon sighting, a critical component of the Islamic calendar. This approach is well-suited for investigating the emerging intersection between technology and traditional *rukyah* practices. The exploratory nature of the study allows for a flexible examination of how technological advancements might address limitations in traditional methods while contributing to the ongoing scholarly debate about their compatibility with Islamic law. Data collection for this research combines both primary and secondary sources to gain a comprehensive understanding of the topic (Syatar et al., 2023). Primary data is gathered through field experiments, where digital imaging technology is directly applied to the observation of the new moon. These field experiments are supplemented by secondary data, such as existing literature, related documents, and prior studies on *rukyah* practices and technological interventions. By integrating direct observation with content from scholarly and legal texts, the study aims to gather rich, multi-faceted data that supports an in-depth analysis of the role and effectiveness of digital imaging technology in the *rukyah al-hilāl* process.

Data analysis is conducted through content analysis, a qualitative technique that allows for an in-depth examination of both the field data and the collected literature. This method helps identify key themes and patterns related to the accuracy, feasibility, and legal implications of using digital imaging technology for moon sighting. By carefully analysing how the data aligns with or diverges from traditional *rukyah* practices, the study offers insights into the potential for this technology to be integrated into Islamic

jurisprudence. The findings will be critically evaluated to assess the extent to which technological tools can enhance or transform traditional moon sighting methods.

Rukyah with Digital Imaging Technology

Digital imaging technology in *rukyah al-hilāl* and image processing using computer devices have often been employed by astronomers to enhance weak contrast or detect objects from very dim celestial bodies. This step can help overcome the limitations of *rukyah* telescopes. *Rukyah* to determine the position and existence of the new moon can be processed with various digital instruments such as astronomy software, thereby increasing the validity of *rukyah* and eliminating doubts.

Information on celestial objects, in this case, the new moon, is conveyed by a messenger called a photon. Information couriers start from the surface of the Moon, which is illuminated by sunlight, propagate through space between the Moon and Earth, penetrate the turbulence of the Earth's atmosphere, and enter through hardware in the form of cameras, telescopes, mountings, and other equipment that ultimately produce an image. The new moonlight information obtained, besides relying on *rukyah* tools, also depends on the percentage of new moonlight illumination. Interference from *syafak* light can dim the moonlight, making it even invisible.

The light may be dim and not visible due to atmospheric turbulence or imperfections in the optical apparatus. Sighted with the naked eye and not supported by the tools, it is difficult to recognise the moon. Therefore, the use of digital imaging technology is important to process the image of the *hilāl* to increase the contrast of the moonlight that is dim, thin, and not visible to the naked eye. Here are the stages of digital imaging technology in *rukyah al-hilāl*:

Firstly, setting up the hardware before *rukyah al-hilāl* involves the main equipment, i.e. telescopes, tripods, mountings, and digital cameras recommended as the EOS type 60Da DSLR dedicated to astronomical photography. Other hardware as supporting equipment includes a webcam, laptop, and solar filter. Prior to the process, the telescopic recording must be adjusted precisely because the moon to be recorded is a dim and thin object that cannot necessarily be observed using the naked eye. Telescopic adjustments are made at least before sunset by pointing the telescope towards the sun that has been mounted. The telescope is then directed by positioning the sun right in the middle of the eyepiece's point of view while regulating its focus as accurately as possible. It is recommended to use a tube in which there are several fins with a particular configuration placed in front of the objective lens to reduce the angle of light, thus minimising sunlight and increasing the contrast of the moonlight. Once the hardware is installed and functioning, it must be ensured that the main object in *rukyah al-hilāl* has been identified in the frame image or video recording, even if it is not visible to the naked eye.

Secondly, preparing the software to process the video recordings obtained through the hardware is essential. The purpose of processing video recordings with software is to extract as much information as possible from the *hilāl* light as a celestial object that may be concealed due to atmospheric turbulence and the limited capability of the tools used. Digital imaging technology plays a significant role in the processing of *hilāl* images. This technology involves software that can be utilised to maximise the processing of *rukyah* data. Through the framework of digital imaging technology, the dim light contrast can be increased, making it easier to see with the naked eye.

The software used for processing *hilāl* images has several types, including free or open-source options, provided they possess comprehensive menu features, such as the software IRIS version 5.59, which has a high revision frequency. Data sighting with such software can be reached by following these steps: First, create a directory file or folder that facilitates the grouping and storage of recorded video files and frame images. This can be done through the steps: Click "*File*" – select "*Settings*" – click "*Working Path*", which will direct you to the intended folder as a workplace and storage media. Secondly, convert recorded videos into image frames. This step serves to break down video recording files that have an AVI extension into images. This can be accomplished by: Click "*File*" – Select "*AVI Conversion*" – Click on *Select,* which will automatically direct you to the directory of files containing the video recordings. After selecting the video record, click "*Open*" on the "*exported image type*", and select "*black & white*". In the Panchro band output file name, set the naming system and numbering by typing the name, e.g. (analysis-). The sign (-) is used to separate the name from the numbering in the frame image conversion result.

Next, click on *"convert",* then an instruction appears providing information about how many frames the video recording will be broken into, the estimated time required, file size, and storage capacity needed. After clicking "*Yes*"*,* the conversion of the video recording to frame images will commence. The duration of the conversion process depends on the capacity of the video file being converted. The larger the video recording capacity, the more frames it generates. Thirdly, perform a frame image buildup of multiple frame images into one. This step is called *"stacking",* which combines the image frames of the *hilāl* into one. The steps taken involve clicking "*Processing-selecting*". Add a sequence, where the input generic name is typed according to the initial naming (analysis-) and filling in the number of image frames that will be stacked without exceeding the total number of image frames from the conversion result. For example, only 200 frame images will be stacked. Next, select "*median*"*,* which serves to make the moon visible in the frame image in parallel with the frames, then next click "*OK*" and the build process of the 200 frame images will commence. The next step is to save the stacked frame image by clicking "*Next file-Select Save*"*,* then in the file name write the desired file name, for example (resultant analysis). On the "*Save as type*"*,* select BMP type to obtain the *hilāl* image frame with high resolution.

The image resulting from the conversion of the video recording to the frame image may not be visible to the naked eye, but it is confirmed that the *hilāl* is present in the frame. To identify the *hilāl* in the frame, the contrast of the moon must be determined by the wavelength of the light. This step serves to identify the strongest source; after which, the light is eliminated, producing a considerable source of photon waves. This can be proved by creating a plot of the *hilāl* light configuration on the resulting stacked image frame. This can be done using GIMP software version 2.10.12, which can provide preliminary information as a configuration point of the most powerful light source, click *"Stage"*, open and select the image frame file to be processed. Next, click on *"colours"* and select *"levels",* then the display *"adjust colour levels"* appears on the input level menu, showing the visible wavelengths of light at a point. This step serves to enhance or strengthen the image of the chosen *hilāl* to achieve good quality results from *stacking* by utilising a menu of antidotes in the form of contrast enhancement.

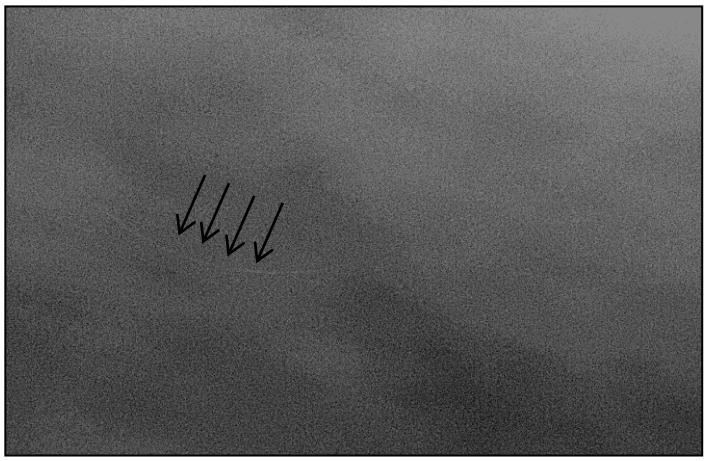

Figure 1. Visible Image of Crescent after Image Enhancement of Digital Imaging Technology

This step aims to eliminate any interference, such as dew, dust particles, and dirt attached to the telescope or camera lens. As for the *hilāl* image that has the presence of ghost images or images that disrupt contrast light, they cannot be processed. Thus, the image of a possible *hilāl* can be treated if it meets the clean criteria of the disorder. In addition, this stage also serves to increase the contrast value with the cursor step on the input levels menu to the wavelength point. Then click "*ok*, *file"*, and "*export as"* to save the image frame. The result of this image analysis shows that the intersecting light, as the main issue disrupting *rukyah al-hilāl*, can be eliminated, as evidenced by being visible to the naked eye.

Discussion

Islamic Law on the Use of Rukyah Technology

The findings of this study suggest that the use of digital imaging technology in *rukyah al-hilāl* can be accepted and justified within Islamic law (Niedermeier, 2020), as it facilitates the observation of the new moon, a crucial element in determining the Islamic calendar. This aligns with the *ushul fiqh* principle that the legality of using tools is determined by their purpose (Rachmadhani et al., 2024), meaning that if the goal (*rukyah*) is obligatory, then the tools used to achieve that goal become obligatory as well. Therefore, the use of digital imaging tools such as CCD technology is permissible because it serves the lawful and religiously important task of moon sighting.

In analysing this with the Qur'an, the principle of observation for determining religious duties is reflected in the Qur'anic verse:

Translation: "So whoever sights the new moon, let him fast".

(Surah Al-Baqarah, 2:185)

This highlights the importance of seeing the moon to mark the beginning of Ramadan, thus reinforcing the necessity of moon sighting. The use of technological aids like digital imaging serves the same purpose, helping Muslims fulfil this Qur'anic obligation more accurately (Khaleel, 2016). Moreover, the principle of *wasīlah*, or the means to a lawful end, finds its foundation in Islamic law and supports the use of technological intermediaries that help achieve religious goals, provided they align with the objectives laid out in the Qur'an.

Furthermore, the Prophet Muhammad (PBUH) stated:

> Translation: "Do not fast until you see the new moon, and do not break your fast until you see it".
>
> (Sahih al-Bukhari, Hadith No. 1909)

This hadith highlights the importance of visually confirming the new moon. It supports the view that any method—traditional or technological—that facilitates moon sighting is permissible within the framework of Islamic law. The use of digital imaging enhances this process, allowing for a more precise observation of the new moon, which could reduce disputes over moon sightings and foster unity among Muslim communities, as it aligns with the broader purpose of Islamic law (Mehmood & Md Hashim, 2021).

This is particularly significant in terms of its impact on the unity of Muslim communities and the reduction of dissent regarding the start of Islamic months. By allowing governments to adopt digital imaging technology for moon sighting, as suggested by the *fiqh* principle *"The government's decision is binding and eliminates dissent"*, a more standardised and accepted method of *rukyah al-hilāl* can be implemented. This would reduce disputes within communities over conflicting moon sightings and create a more uniform approach to determining the Islamic calendar, especially for critical months such as Ramadan and Dhul-Hijjah.

A *fiqh* response to the development of the use of technological tools in *rukyah al-hilāl* is important to formulate. This is in line with the *ushul fiqh* rule that the legal status of the use of the equipment is the same as the legal status of the destination, i.e. the *wasilah* or intermediary has the law in accordance with the destination law. Specifically, since *rukyah* is mandatory*, the tools and equipment used in rukyah al-hilāl* also become mandatory. This is in line with the principles of *fiqh*, "*Intermediaries have the law in accordance with the law's purpose* (Ibn Qayyim, n.d.)".

Based on the rules of *ushul fiqh* and the arguments above, the results of *rukyah al-hilāl* that rely on the visibility of the new moon through digital imaging with CCD technology or software can be accepted and justified by Islamic law, because the main purpose of using these tools is to facilitate *rukyah al-hilāl* as a guide in determining the beginning of the Islamic month, especially the beginning of Ramadan, the beginning of Shawwal, and Dhul-Hijjah. To bind all Muslims, especially those in a particular country, the results of *rukyah al-hilāl* that rely on the visibility of the new moon through digital imaging with CCD

technology or data processing using software must be determined by the government, as the government's decision binds all Muslims and eliminates dissent. As mentioned in the rules of fiqh, "*the government's decision is binding (must be obeyed) and eliminates dissent"* (ʻAzzām, 2013).

Image processing only helps to strengthen or increase contrast by stacking some of the recorded images. Initially in the form of a video that is broken down into a large number of image frames to produce one image that shows a clear *hilal* image. Based on the aforementioned *fiqh* rules, *rukyah al-hilāl* results that rely on digital imaging can be accepted and justified, because the main purpose of using the *rukyah* aids is to facilitate *rukyah al-hilāl* as a guide in determining the beginning of the Islamic month.

While digital imaging technology offers improved accuracy in moon sighting, it remains dependent on weather conditions and human interpretation of the images. Additionally, the availability of such advanced technology is not uniform across all Muslim communities, particularly in less developed regions. Therefore, reliance on digital imaging alone may not be feasible for all, and traditional *rukyah* methods will still hold importance in areas where access to technology is limited.

Future research should explore the integration of digital imaging technology with traditional *rukyah* practices, particularly in diverse geographic and socioeconomic contexts. Investigating how different regions can adopt these technologies, as well as the potential for creating global standards for moon sighting, could enhance the effectiveness of *rukyah al-hilāl*. Additionally, further studies could assess the role of artificial intelligence in automating the moon sighting process and examine how such innovations align with Islamic legal principles, potentially leading to even greater accuracy and accessibility.

Scholars' Opinions on the Use of Rukyah Technology

The majority of responses from scholars regarding the use of technology in *rukyah al-hilāl* can be classified into two perspectives: classical and contemporary scholars. Classical scholars like Ahmad Ibn Hajar al-Haitami, Abdul Hamid as-Syarwani, and Muhammad Bakhit al-Muti'i accepted the use of technology in *rukyah*, although they emphasised the preference for using the naked eye. Al-Haitami allowed tools that reflect light, such as telescopes, while as-Syarwani permitted instruments that enlarge small objects for better visibility. Al-Muti'i endorsed magnifying binoculars for distant objects, supporting technological aids to enhance *rukyah*. In contrast, contemporary scholars, such as Thomas Djamaluddin, advocate for the use of technology to ensure that the object observed is indeed the new moon. The use of technological tools increases accuracy and provides visual evidence, which can be presented in courts, further reinforcing the legitimacy of using technology in *rukyah al-hilāl* practices.

Table 1. Scholar Opinions on Technology in *Rukyah al-Hilāl*

Scholar	Category	Opinion on Technology in *Rukyah al-Hilāl*	Rationale or Condition
Ahmad Ibn Hajar al-Haitami	Classical	Permitted (reflect light)	Tools can clarify light for better visibility
Abdul Hamid as-Syarwani	Classical	Allowed (enlarging and clarifying objects)	Prefers no tools, but permits aids to bring distant objects closer
Muhammad Bakhit al-Muti'i	Classical	Allowed (magnifying binoculars)	Supports the use of binoculars for seeing distant objects
Thomas Djamaluddin	Contemporary	Strongly Recommended	Ensures accuracy and eliminates doubt regarding moon identification
Hanafiah Scholars	Classical	Determined by large group (clear sky)	One just witnesses if the sky is cloudy
Malikiah Scholars	Classical	Determined by two just people (no doubt in sight)	Ramadan and Shawwal must be based on two witnesses when *al-hilāl* is visible
Shafi'ite Scholars	Classical	Determined by one just person (even if there are obstacles)	One witness can determine the start of Ramadan and Shawwal in difficult conditions
Hanabilah Scholars	Classical	Determined by one just person for Ramadan; two for Shawwal	Similar to Malikiah, requires two witnesses for Shawwal

The scholars' opinions, both classical and contemporary, show a general acceptance of technology in *rukyah al-hilāl*, with conditions based on the purpose and function of the tools used. Classical scholars acknowledge the permissibility of tools that assist in moon sighting, albeit with a preference for the naked eye. Contemporary scholars emphasise the necessity of technology for more accurate and reliable sightings, highlighting that visual aids strengthen the credibility of the process and ensure that the object identified is indeed the new moon. These views collectively suggest a strong alignment between technological advances and Islamic legal principles regarding *rukyah al-hilāl* (Alfitri, 2020).

The majority of classical scholars, such as Ahmad Ibn Hajar al-Haitami, Abdul Hamid as-Syarwani, and Muhammad Bakhit al-Muti'i, accept the use of technology in *rukyah al-hilāl*, albeit with a preference for the naked eye. Al-Haitami argues that using aids like glass, which reflects light, is permissible if it clarifies the new moon's light. As-Syarwani supports the view that *rukyah al-hilāl* is best performed without auxiliary tools but acknowledges that aids like water or magnification devices are permissible. Al-Muti'i also permits tools like binoculars that magnify small or distant objects, even citing instances where such tools were used to confirm a sighting. These scholars maintain that technological aids can complement the naked eye in enhancing visibility but emphasise that direct observation remains the ideal method in Islamic jurisprudence.

Contemporary scholars such as Thomas Djamaluddin extend the permissibility of technological tools in *rukyah al-hilāl* further, stressing that they are necessary for ensuring accuracy. According to Djamaluddin, using tools like telescopes not only strengthens the observer's confidence in identifying the new moon but also provides more verifiable evidence, such as imagery that can be presented in court. He asserts that *rukyah* with technological aids offers more reliable evidence compared to relying solely on the observer's memory and verbal testimony. This perspective reflects a shift in contemporary Islamic thought, where technological tools are seen as crucial for the precise and indisputable confirmation of the new moon's sighting.

Historically, *rukyah al-hilāl* has been a practice in Muslim communities across the archipelago since the advent of Islam, with believers gathering on hills or beaches to observe the *hilal* on the 29th day of Sha'ban and Ramadan (Anwar, 2016). If the *hilal* is sighted, it marks the start of the new month; but if not, the month continues for 30 days. Various *fiqh* schools have differing requirements for validating these sightings. Hanafiah scholars, for instance, allow for the testimony of one just person in cloudy conditions, while Malikiah and Hanabilah scholars generally require two just witnesses for determining the start of Shawwal. These differences highlight the variability in jurisprudential approaches across regions and time (Tabran & Talli, 2021).

The results show that while classical scholars leaned towards manual observation for *rukyah al-hilāl*, the development of modern technology has shifted scholarly opinion towards accepting technological aids. This acceptance has significant implications for Islamic practices today, as technology can reduce human error, enhance precision, and provide physical evidence of the moon's sighting. In legal and religious contexts, using telescopes and other tools could standardise the *rukyah* process and lead to more consistent results, thereby reducing disputes over moon sightings across different Muslim regions. This development bridges traditional Islamic practices with modern scientific advancements, ensuring both religious observance and accuracy.

A limitation of this study is its focus on scholarly opinions without a comprehensive exploration of how these technological tools are practically implemented across different Islamic communities. While the study highlights the acceptance of technology (Mufid et al., 2020), it does not investigate how effective or widespread the use of such tools is in actual *rukyah al-hilāl* practices (Nisa' & Ulinnuha, 2021). Furthermore, the study primarily centres on the opinions of classical and contemporary scholars but does not address how local cultural traditions may influence the adoption of technology in *rukyah* practices. These gaps highlight the need for further empirical research to assess the real-world application of these rulings.

Future research could expand on the practical integration of technological aids in *rukyah al-hilāl* by studying the practices of different regions and their compliance with both classical and contemporary scholarly opinions. Investigating the effectiveness of tools like telescopes and digital imaging technology in accurately detecting the *hilal* could offer insights into improving the process. Additionally, comparative

studies between countries that adopt modern technology in *rukyah* and those that rely on traditional methods would provide a more nuanced understanding of the challenges and benefits of technological advancement in Islamic jurisprudence. This research could also explore the potential for a standardised global practice for determining Islamic months based on technological innovation.

Conclusion

This study reveals that while telescopes and other visual aids are widely accepted in *rukyah al-hilāl* practices, they are not without limitations. The challenge of detecting the new moon's light against the brightness of the evening sky, particularly the *shafak* light, prevents telescopes from fully solving the problem. The research highlights that more advanced technology, such as digital imaging and data processing, is necessary to enhance the visibility of the *hilāl*. This method allows for the adjustment of contrast in the *hilāl*'s light, making it more visible to the naked eye and offering a scientifically supported means of *rukyah*. The strength of this research lies in its focus on integrating modern technology with traditional *rukyah* practices. By introducing digital imaging techniques as a tool to enhance the accuracy of *hilāl* sightings, the study bridges the gap between empirical science and Islamic jurisprudence. It offers a valuable perspective on how new technological tools can help validate *rukyah* practices, reducing reliance on testimonies alone and providing more robust empirical evidence. The study also highlights how digital image processing could address current challenges, making the *rukyah* process more reliable and scientifically grounded.

However, this study has certain limitations. It primarily discusses the theoretical application of digital imaging technology in *rukyah al-hilāl* without providing empirical case studies or real-world examples of its effectiveness. Additionally, the research focuses more on the technical aspects of *rukyah* rather than fully exploring the practical challenges faced by various Muslim communities in implementing these technological tools. Further research could benefit from field studies and a broader analysis of how different environments and atmospheric conditions might affect the use of these technologies.

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