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The Urgency and Contribution of Information Technology in Verifying The Beginning of Shubuh Time and Hilal Height Determine the Beginning of the Hijri Month

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Abstract

The sun's altitude of -20° as a reference for determining the beginning of shubuh time used by the Ministry of Religious Affairs is questionable. Meanwhile, in terms of hilal height as one of the criteria for determining the beginning of the Hijri month, the Ministry of Religion has also undergone adjustments and changes in 2022. The new criteria of MABIMS mention criteria in the form of a hilal height of 3° and an elongation angle of 6.4°. This research answers two formulations of problems, first, the urgency of information technology in determining the criteria for the beginning of dawn and the criteria for determining the beginning of the Hijri month in Indonesia. Second, the extent of the contribution of information technology in determining the criteria for dawn and the criteria for determining the beginning of the Hijri month in Indonesia. Analytical descriptive methods with fiqh and scientific approaches are used to answer both formulations of the problem. The study produced two findings. First, according to Islamic law, the presence of digital-based information technology is considered legal to be used and utilized to provide certainty and trust in Islamic legal products. Secondly, technology has made a major contribution in verifying dawn criteria and establishing new criteria of MABIMS.

Keywords:*Digital Technology, Verification, The Beginning Of Shubuh Time, Hilal Height*

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A. Introduction

The height of the sun -20^o as a reference for determining the beginning of dawn time used by the Ministry of Religious Affairs is questionable. This question arose after Muhammadiyah in the Meeting of Hisab and Jurisprudence Experts from Muhammadiyah organized by Tarjih and Tajdid Council of Muhammadiyah Central Board in Yogyakarta on August 23, 2016, mentioned that the beginning of shubuh time in Indonesia was too soon.[1] Finally, in 2021, Muhammadiyah in the Tarjih Muhammadiyah National Conference changed the provisions for the height of the sun at dawn to -18^o[2]. This causes a difference in prayer time of about 8 minutes between the Ministry of Religious Affairs' version of the dawn prayer time schedule and Muhammadiyah.

Almost the same upheaval also occurred on the issue of determining the beginning of the lunar month. The height of the *hilal* as one of the criteria for determining the beginning of the Hijri month (especially Ramadan, Shawwal, and Zulhijjah) is also being questioned. In 2022, the Ministry of Religious Affairs made adjustments and changes by implementing the new MABIMS criteria. This new MABIMS criterion mentions criteria in the form of *hilal* height of 3^o and elongation angle of 6.4^o.[3]–[5] The establishment of this new criterion is actually the result of an agreement between MABIMS member countries (Forum of Ministers of Religious Affairs of Brunei Darussalam, Indonesia, Malaysia, and Singapore) during Muzakarah Rukyat and Takwim Islam on 2-4 August 2016 to change the old criteria (2, 3, 8) with new criteria (3, 6.4)[6].

The establishment of new MABIMS criteria turned out to be questioned by many experts and astronomy activists in Indonesia. Because so far in Indonesia the height of *hilal* 2^o is believed to have been seen by observers in Indonesia, especially from the Nahdlatul Ulama Falakiyah Institute. This new criterion also makes the gap between the Government and Muhammadiyah even greater.[7] So far, Muhammadiyah uses the criteria of *wujudul hilal* as a guideline for determining the beginning of the Hijri month.[8] The *hilal* requirement in the criteria of *wujudul hilal* is that there has been *ijtima' qabl al-ghurub* (ijtima' which occurs before sunset) and the position of the moon is positive above the horizon of *mar'i*, even though it is only 1 minute or less[9].

The problems that occur related to worship really require the existence of information technology as one of the *wasilah* (intermediaries) to obtain evidentiary data related to the existence of dawn Sadiq as a determinant of the beginning of the time of *shubuh* and the

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existence of *hilal* determining the beginning of the month of Kamariyah.

For this reason, this study answers two formulations of the problem, first, the urgency of information technology in determining the criteria for the beginning of dawn and the criteria for determining the beginning of the lunar month in Indonesia. Second, the extent of the contribution of information technology in determining the dawn criteria and the criteria for determining the beginning of the lunar month in Indonesia.

B. Methods

The analytical descriptive method is used to answer both problem statements. The fiqh approach and scientific approach used in this study describe the urgency and contribution of information technology in determining the criteria for the beginning of dawn and the criteria for determining the beginning of the lunar month in Indonesia.

C. Resultsand Discussion

Results

The Urgency and Contribution of Information Technology in Determining the Early Dawn Criteria and the Criteria for Determining the Beginning of the Hijri Month in Indonesia

According to Islamic law, the presence of digital-based information technology is considered legitimate to be used and utilized. Although there are differences of opinion on the validity of the use of tools to determine worship rituals, the majority of opinions consider it important to use assistive devices (technology). The presence of technology is considered important and legitimate to be used to provide certainty and confidence in Islamic legal products.

This is seen from the rules of fiqh, that the guideline for the validity of a worship is confidence in the executor of worship and the worship is actually carried out on time. In addition, the ability to use tools in performing *rukyatul hilal* is also based on the Rules of Fiqh:

لـ لمو سائـ ل حكم الم قا صد

Meaning: "The will/intermediary has a law in accordance with the law of its purpose"

Based on the arguments above, the use of SQM and SOOF in observing dawn Sadiq is very important to provide legal certainty and confidence in carrying out *shubuh* prayers and fasting. Likewise, the use of CCD in *rukyatul hilal* to ensure that the *hilal* can be seen and the beginning of the Hijri month can be established is very urgent, acceptable, and justified in Islamic law, because the main

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purpose of using the tool is to facilitate *rukyatul hilal* as a guideline in determining the beginning of the Hijri month, especially the beginning of Ramadan, Shawwal and Zulhijjah.

Technology has made a major contribution in verifying the criteria of dawn Sadiq determining the beginning of dawn time and capturing *hilal* imagery as a guideline establishing new criteria of MABIMS (criteria for the beginning of the Hijri month). Verification of the dawn light of Sadiq is carried out by utilizing technology in the form of SQM *(Sky Quality Meter)* and SOOF (Dawn Observation Automation System) which is able to detect the beginning of the appearance of very soft dawn Sadiq light on the eastern horizon. Meanwhile, in capturing *hilal* images as a guideline for determining new MABIMS criteria, technology presents a digital image processing system with a tool called CCD (Charge Couple Device) which is able to help clarify and record *hilal* images. With continuous study, technology can help resolve the problem of dissent related to the implementation of Muslim worship, especially the beginning of the time of *shubuh* and the beginning of the Hijri month.

Disscussion

1. Characteristics of the Dawn Sadiq Determining the Beginning of Shubuh Time in Islamic Literature

Fajr prayer time begins with the rising of the dawn of Sadiq and ends when the sun rises.[10] The dawn of Sadiq comes after the dawn of Kadzib, as mentioned in the books of jurisprudence. In this case, the appearance of the dawn of Sadiq after the dawn of Kadzib becomes the main condition for the obligation to perform the *shubuh* prayer and the commencement of fasting. For this reason, it is very important to know the signs of the dawn of Sadiq.

In the Qur'anic verse, the explanation of the dawn of Sadiq and the dawn of Kadzib is found in Sura Al-Baqarah verse 187, as follows:

ۗوْا حَتّٰى يَتَبَيَّنَ لَكُمُ الْخَيْطُ الْاَبْيَضُ مِنَ الْخَيْطِ الْاَسْوَدِ مِنَ الْفَجْرِۖ كُلُوْا وَاشْرَبُ...

It means: "Eat and drink until it is clear to you (the difference) between the white thread and the black thread, which is dawn".

Based on the understanding of the word *of al-khait and min al-fajr*, the interpreters states that the beginning of the appearance of the dawn rays on the eastern horizon, although soft and thin like thread and still weak rays, can already be categorized as the dawn of Sadiq which has legal implications for the prohibition of eating and the legalization of dawn prayers

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(Al-Zamakhshari, Ibn Taymiyah, al-Alusy, Muqatil, al-Mawardy, al-Baghawiy, an-Naysabury).

In the hadiths, it is also mentioned that there are two kinds of dawn, namely: first, the dawn which looks like a wolf's tail. This dawn does not allow prayer (*shubuh*) and does not forbid eating (for those who want to fast). Second, the dawn that stretches across the horizon. This dawn justifies prayer (*shubuh*) and forbids eating (for those who want to fast).[11]In the time of Prophet Muhammad SAW, it was quite easy to see the light of dawn Kadzib. Indications are that the use of the word *hadza* to designate the whiteness of dawn Kadzib and the Prophet could easily describe the shape of dawn.[12]

The first dawn is called the dawn of Kadzib, which is a light that soars upwards like a wolf's tail that appears earlier than the dawn of Sadiq on the horizon. This first dawn in astronomy is called the zodiacal light. This zodiac light is caused by the scattering or reflection of sunlight by interplanetary dust scattered in the ecliptic plane and countless others. This zodiac light appears in the sky across the zodiac series (the series of constellations that the sun seems to pass through).[13] The phenomenon of dawn Kadzib (lie) is not the basis for worship. While the second dawn is called the dawn of Sadiq. This dawn is defined as a white light that stretches across the eastern horizon. This white light began to spread very quickly and then was completely bright.[14]

From the various literature above, it can be concluded that the characteristics of the early dawn of Sadiq light in Islamic literature are: 1) The light of the dawn of Sadiq at the beginning of sunrise is soft white and elongated like a thread on the eastern horizon. 2) The conditions and atmosphere at the beginning of the dawn of Sadiq are still in a state of *ghalas* (dark) so a person cannot recognize the person beside him. 3) The dawn of Sadiq rises after the dawn of Kadzib which is also white in color but the direction of the light rises upwards like a wolf's tail. 4) The condition of brightness of the sky in the time of the Prophet Muhammad SAW was considered very dark because at that time it was quite easy to see the dawn of Kadzib before the dawn of Sadiq.[12]

2. Hilal Criteria for the Beginning of the Month of Kamariah

The beginning of the month of Kamariyah is determined based on a hadith which reads:

صُومُوا لِرُؤْيَتِهِ وَأَفْطِرُوا لِرُؤْيَتِهِ فَإِنْ غُمِّيَ عَلَيْكُمْ الشَّهْرُ فَعُدُّوا ثَلَاثِينَ

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It means: "Fasting when you see it (*hilal*), and breakfasting when you see it, if the moon is cloudy, then count thirty (expand to 30 days)".[15]

The word *rukyat* in the hadith according to the Arabic dictionary comes from the word: *ra'a – yaro – ru'yatan* which literally means seeing, understanding, guessing, and thinking.[16] The word *ra'a* or *rukyat* is defined by the meaning رصبا, see. Some interpret, seeing must be with objects (*maf'ul bih*) in the form of concrete objects, or can be seen by the eyes of the head. So seeing what is meant is the vision of the eyes of the head (*rukyat* / observation). This opinion is used by groups who use *rukyat* with their eyes, which is to see directly the existence of *hilal* with their eyes on the 29th at sunset as a guideline for determining the beginning of the Hijri month. This opinion was used by Nahdhatul Ulama' which was later called *rukyatul hilal bil fi'li*. *Rukyat* can also be interpreted as *adroka* / *'alima* i.e. understanding and seeing with the mind (by counting / *hisab*). There are also those who interpret *dzonna* / *hasiba* i.e. surmise sure / opinion / see with the heart.[7], [17], [18]

The second and third opinions were used by groups that used *hisab* guidelines or calculated the presence of *hilal* already above the horizon at sunset on the 29th of the Hijri month. This opinion is used by Muhammadiyah (*hisab wujudul hilal*) they argue that hisab is an alternative system for determining the beginning of the month of Kamariah.

From the meaning of the hadith above, broadly speaking there are two methods in determining the beginning of the Hijri month, namely the *rukyat* method and the *hisab* method.[19] The *rukyat* method is done by looking at the *hilal* directly. The determination of the beginning of the month by this method is done after the sighting of *hilalba'dal-ghurub* (crescent after sunset) on the 29th of the Hijri month. If the *hilal* is not visible, then *istikmal* is done (completing the number of months to 30 days).[20] The pure *rukyat* method does not take into account the *hisab* and *hilal* height at all in the determination of the beginning of the month. The principle of this *rukyat* method is that as long as the *hilal* is visible (regardless of its height above the horizon), and the viewer testifies and is sworn, then the next day is set as the beginning of the following month. Although the implementation of this *rukyat* method in practice uses the help of *hisab*, determining the beginning of the month still relies on *rukyatul hilal* (the appearance of the moon) or using *istikmal*. *Hisab* is only a tool, not a basis for determination.

The *hisab* method is carried out by taking into account the existence of a young moon (*wujudul hilal*) which is known through the calculation of *hisab*. This method does not take

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into account*rukyah* at all. Provided that the calculation of the *hilalba'dal-ghurub* is above the horizon, regardless of its height (not taking into account whether it is possible to see it or not), then the next day can be set as the beginning of the next month. In setting the beginning of the month, this method usually also takes into account the length of time between conjunction (*ijtima'*, the meeting of the sun and moon) until sunset. Usually, the length of time is required to be more than six hours.[21]

Hilal as an object of the method of determining the beginning of the lunar chamber (*rukyat* and *hisab*) in an astronomical perspective can be interpreted as crescent visibility (the possibility of *hilal* can be seen / *imkanurrukyat*). This *hilal* visibility is the result of combining the *hisab* and *rukyat* methods to obtain an astronomical interpretation of the jurisprudence postulates used. But keep in mind that the astronomy used to determine the beginning of the lunar month is a new month, not just a new moon. However, the criteria used are based more on the visibility of thenew crescent moon or *hilal* than the conjunction itself.[22]

3. Ulema Opinion on the Use of Information Technology in Assisting the Implementation of Worship

The implementation of worship related to direction (position) and time, cannot be separated from the application of science (Islamic astronomy) and the use of information technology. This is because pinions in addressing the use of information technology in assisting the implementation of worship, as follows:

a. Scholars who accept the use of technology

One of the uses of technology in assisting the implementation of worship is the use of telescopes or other aids in *rukyatul hilal*. In this regard, Abdul Hamid bin al-Husayn al-Daghistani ash-Sharwani in the book *Hawashii Tuhfatul Muhtaj bi Sharhil Minhaj* explains that *rukyatul hilal* is mainly done without the use of tools, but it is also permissible to use tools such as water, *ballur* (white objects such as glass), something that brings the far one closer, and that enlarges the small in view (such as a telescope).[23]

Muhammad Bukhit al-Muti'i in the book *Irsadu Ahli al-Millati Ila Itsbaati al-Ahillah*. Al-Muthi'i argues that the testimony of a person who sees the *hilal* even though he sees it with binoculars is acceptable because what is seen through the medium of the instrument is the *hilal*itself and its function is only to help see distant or small objects that are impossible to see without the tool. According to him, *rukyat* with binoculars is the same as *rukyat* with eyes, as

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is using glasses to read.[24]

Not only Middle Eastern scholars but Nusantara scholars also fatwa on the ability to use tools in *rukyatul hilal*. Sheikh Muhammad Manshur ibn Abdul Hamid ibn Muhammad better known as Guru Manshur Betawi, for example, in his book that specifically discusses the issue of *rukyatul hilal* entitled *Mizan al-I'tidal fi Takmilati Jawab as-Su'al fi Mas'alati Ikhtilafi al-Matali'i wa Ru'yat al-Hilal,* states: "As for looking at the moon with a magnifying glass is the same as looking directly with the eyes of the head, without any difference"Muhammad Manshur ibn Abdul Hamid ibn Muhammad, Mizan al-I'tidal fi Takmilati Jawab as-Su'al fi Mas'alati Ikhtilafi al-Matali'i wa Ru'yat al-Hilal (Jombang: Ma'had al-'Aziziyah al-Islami)..

b. Scholars who reject the use of technology

In terms of the use of information technology to assist the implementation of *rukyatul hilal*, Ahmad Ibn Hajar al-Haitami in the book *Hamisy Hawashii Tuhfatul Muhtaj bi Sharhil Minhaj* asserts that *rukyatul hilal* is done after sunset and without the use of intermediaries such as glass or mirrors قطس اوبال ةأرم وحن.[26] The implementation of *rukyatul hilal* like this uses the *rukyah bil fi'li* method with the naked eye, because it refuses to use tools (*nazarah*) that can reflect light.

In responding to this development, almost all scholars stated the permissibility of using modern technology that helps facilitate the process of *rukyatul hilal*, especially in terms of enlarging and bringing closer (*al-muqarrib*) views. Shaykh Muhammad ibn 'Uthaymeen (r), as recorded in *al-Fataawaash-Shar'iyyah fi al-Masail al-Ashriyyah Min Fataawa Ulama al-Balad al-Haram* stated that the *rukyatul hilal* decree in any way must be accepted and made a handle[27].

The results of the MABIMS Falak Expert Meeting in Yogyakarta on October 8-10, 2019 also approved the use of technology which includes the Charge Couple Device(CCD) in *rukyatul hilal*, and the use of CCD does not violate the method of shari'a law because it is only as *a wasilah* (intermediary) to facilitate *rukyatul hilal* whose provisions stick to several things, namely: after conjunctionand at sunset.[28], [29]

4. Use of Information Technology in Determining Dawn Criteria and Criteria for Determining the Beginning of the Hijri Month in Indonesia

a. Use of Information Technology in the Determination of Dawn Criteria

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In the Qur'an, hadith, and books of jurisprudence, it is mentioned that the beginning of the shubuh time is marked by the rising of the dawn of Sadiq. The characteristics of the dawn of Sadiq that are different from the dawn of Kadzib have also been described in detail in the hadith. However, in practice identifying the dawn of Sadiq is not easy. So soft is the light of dawn, that it is very difficult to identify the limit of the beginning of the dawn light of Sadiq begins to stretch on the horizon. The spread of the dawn of Sadiq is not like the light of a lamp that has just been turned on, where the light will be immediately visible.[30] The appearance of the dawn light of Sadiq is relatively subtle and slow so that the naked eye cannot judge when it starts, we only realize when it gets brighter[31].

The results of dawn observation with ordinary eyes depend on the physical and mental readiness of the observer and the results will be subjective.[32] Observation of objects that are long enough will easily cause saturation, resulting in an optical illusion, especially when physical conditions are less fit. This will be very different from observation using tools. By using the observation tool will not experience saturation as long as the power supply runs smoothly and there are no *system errors*[31].

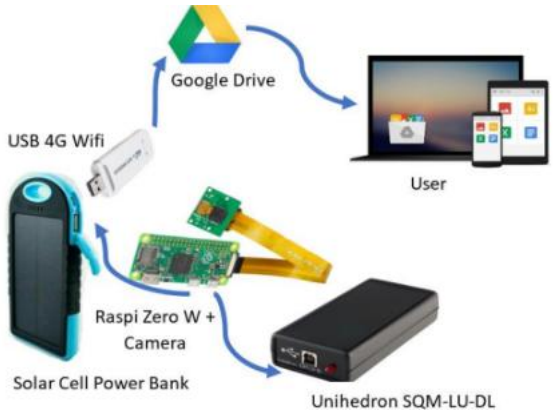

Figure 1. Use of SQM LU-DL for dawn observation of Sadiq

To obtain objective dawn observations, auxiliary tools are needed. Since the dawn of Sadiq is a phenomenon of light change, the right tool used to identify it is SQM (Sky Quality Meter) as seen in Figure 1. With SQM, the incoming light spectrum will be processed and output in the form of data. The photometric magnitude of the brightness of the sky will be displayed in MPSAS units, magnitude per arcsecond, the brighter the magnitude the lower the MPSAS value. When the sky is dark enough, the magnitude value can reach 21.5 and will

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drop when the skylight gets brighter. At the moment of bright light, the magnitude value is 0 (zero)[33].

The data generated by SQM will immediately be read in the form of data and will be stored in SQM's internal memory if the type of SQM used already has memory to store the data logger. SQM Unihedron type SQM-LU-DL is an example of a type of SQM that already has memory, so it can be used without having to be connected to a computer. Enough with a battery power supply, this tool can be used to record sky brightness data. The results of the SQM data logger can be analyzed according to the desired analysis method and can be converted in the form of curves so that it is easy to analyze[31].

Figure 2. SOOF interior

In addition to SQM, a tool called the Dawn Observation Automation System (SOOF) is now being developed. SOOF is an SQM-based instrument for dawn observation. This tool consists of SQM LU-DL, Raspberry Pi pocket computer, Raspi Camera, and Mifi (mobile wifi) as seen in Figure 2. This tool was developed by M. Basthoni with Abdul Muid Zahid. The heart of this tool is SQM as a sense of light reading. This SQM is integrated with the Raspberry minicomputer which functions to process data from SQM into a graph automatically and stored in Rapsberry's internal memory. In addition to SQM data, this tool is also equipped with a raspi camera for timelapse shooting so that it can be compared later with SQM result data for analysis[34]. Figure 3 shows the photos of SOOF in Banyuwangi.

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Figure 3. Photos of SOOF in Banyuwangi

Supported by Mifi (mobile Wi-Fi) and internet data packages, this device can be accessed from anywhere to capture data, graphs, and images generated, making it easier for users without having to observe dawn in the field every day. By using the Team Viewer application, VNC, and Anydesk users can access it from wherever they are. This tool is like a mini dawn observation station that can be placed anywhere as long as there is internet access plus packages[31].

b. Use of Information Technology in Determining the Criteria for the Beginning of the Hijri Month in Indonesia

Rukyatul hilal as proof of the *hilal* visibility criterion (*imkannurrukyat* / hilal can be seen) which has now changed from the MABIMS criterion to the new MABIMS criterion needs to be implemented more intensively. If previously, proving *rukyatul hilal* was only by oath, then in this modern era it is necessary to record *hilal* images that can prove the criteria of *hilal* that can be seen. For this reason, it is necessary to use technology that can capture, record, and process *hilal* images.

Currently, a telescope tool has been developed that is connected to a CCD camera (Charge Couple Device) which then the results are processed on a computer to obtain *hilal* images as seen in Figure 4. If previously the vision of the moon could be assisted by optical magnifying devices such as telescopes, then CCD not only helps direct vision, but also records it and clarifies it through technological engineering with light settings, the use of sensors, and so on[35].

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Figure 4. Operationalization of telescopes in *rukyatul hilal*

CCD or Charge Couple Device is a surveillance recording device that is the latest technological development that can be used in science, especially to determine the beginning of the Hijri month with the *rukyatul hilal* method as seen in Figure 5. CCD also serves to overcome natural phenomena in the form of air pollution, damage to the atmosphere and ozone, etc., which increasingly obstruct and obscure the view of seeing the *hilal*. In addition, the use of the latest CCD technology can also bridge various falakiyyah methods such as *hisab* and *rukyat*, making it more possible for the unity of Muslims[35].

Figure 5. The use of CCD in *rukyatul hilal*

When viewed again, the function of the telescope can only help the eye see celestial objects with very minimal light, especially *hilal*, magnifying celestial objects that are very far away where the eye is very difficult to see. But if the telescope is assisted by imagerecording technology instruments, its function increases, helping to clarify the image while recording to become evidence that the moon can be seen. With the addition ofCCDand Image Processing, it

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is clearer that the *hilal* image obtained by the instruments used by *rukyatul hilal* with telescopes connected to CCD and image processing systems is a testament that coincides and corresponds to today[35].

D. Conclusion

The study produced two findings or conclusions. First, in terms of urgency, according to Islamic law, the presence of digital-based information technology is considered legitimate to use and utilize. Although there are differences of opinion on the validity of the use of tools to determine worship rituals, the majority of opinions consider it important to use assistive devices (technology). The presence of technology is considered important to provide certainty and confidence in Islamic legal products.

Second, technology has made a major contribution to efforts to verify the criteria for the beginning of dawn time and establish new criteria for MABIMS. Verification of the dawn light of Sadiq is carried out by utilizing technology in the form of SQM(Sky Quality Meter)and SOOF (Dawn Observation Automation System) which is able to detect the beginning of the appearance of very soft dawn Shadiq light on the eastern horizon. Meanwhile, in capturing *hilal* images as a guideline for determining new MABIMS criteria, technology presents a digital image processing system with a tool called CCD (Charge Couple Device) which is able to help clarify and record *hilal* images. With continuous study, technology can help resolve the problem of dissent related to the implementation of Muslim worship, especially at the beginning of the time of Shubuh and the beginning of the Hijri month.

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