CHAPTER IV

AN ANALYZING OF THE IMPLEMENTATION OF CRESCENT OBSERVATION AT BAITUL HILAL TELUK KEMANG AND ITS CONTRIBUTIONS ON CRESCENT OBSERVATION ACTIVITY IN MALAYSIA

A. The Implementation of Crescent Observation at Baitul Hilal Teluk Kemang Malaysia

Rukyat al-hilal or crescent observation is an activity or effort to sight the new Moon or crescent in the west of sky (horizon) shortly after Sunset before the beginning of the month, especially in determining the beginning of Ramadhan, Shawwal and Zulhijah.[1]

The crescent observation also becomes a challenging activity and requires considerable skill. Astronomical factors such as the physical of crescent, the refraction of the Sun, sky brightness and atmospheric extinction rates and non-astronomers as the human eye sensitivity, accuracy of mathematical calculations, observation instruments, telescope tracking, truly support the success during obsevation.

Baitul Hilal Teluk Kemang is one of the centers in implementing the crescent observation activity in Malaysia. It is located in Teluk Kemang, Port

[1] Muhyiddin Khazin, *Ilmu Falak dalam Teori dan Praktek*, Yogyakarta : Buana Pustaka, ed. III, 2008, p.173. The definition of the new Moon in astronomy is well known as "crescent", it is part of the Moon that appears brighter from Earth because of the reflection of sunlight after sunset. See : Muhyiddin Khazin, *Kamus Ilmu Falak*, Yogyakarta : Buana Pustaka, 2005, p. 30.

Dickson Negeri Sembilan Malaysia, a cape that has a broad horizon and a beautiful coastline of Malaya, at coordinate latitude North 2° 26' 44'' and longitude East 101°51'21'' with altitude about 25 meters above the sea surface.[2]

Up to now, Baitul Hilal Teluk Kemang also become one of the most frequently crescent observation's place in crescent sighting for the beginning of Ramadhan, Shawwal and Zulhijah in Malaysia, so far recorded, among others, on: Shawwal 1392/1972, Shawwal 1393/1973, Ramadhan 1394/1974, Shawwal 1396 / 1976, Shawwal 1401/1981, Shawwal 1404/1984, Shawwal 1422/2001.[3]

The success of Baitul Hilal Teluk Kemang in crescent sighting for determining the beginning of lunar month can be strong evidence and proof that the location of Baitul Hilal Teluk Kemang is in very strategic place for implementation of crescent observation in Southeast Asia.[4]

Morever, their success in presenting data to crescent observations record is inseparable from the good implementation of method of crescent observation which it's thrive and develop well until now.

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[2] Ahmad Zaki bin Haji Hamzah, *Kompleks Baitul Hilal Teluk Kemang Port Dickson Negeri Sembilan Darul Khusus*, tt. p.2

[3] http://www.majlisraja-raja.gov, accessed on Wednesday, March, 12th 2014, at 16.00 WIB

[4] http://www.majlisraja-raja.gov.my/index.php/bm/sejarah/rekod-cerapan-hilal#section=p1, accessed on Wednesday, March, 12th 2014, at 16.00 WIB

The implementation method of crescent observation at Baitul Hilal Teluk Kemang, in general, is as follows:[5]

a) Selecting Place of Observation and Preparing the Observed Requirement Data

There are some basic provisions relating to the election of crescent observation's place in Malaysia, the selected places for crescent observation must be by the sea or high ground that allows the horizon can be seen clearly at the time of Sunset. The conditions of natural geographical and weather for crescent observation's place is also must be considered. But the most important, it is necessary to get official endorsement from the Malaysia government, to make a legal place for crescent observation.[6]

Therefore, the recommended crescent observation place in Malaysia must obtain a confirmation and legal endorsement from the conference of Rulers of Malaysia, so that the Land Surveyor will help provide sites of crescent observation places, including providing a reference datum and coordinate monitoring stations. This indicates that the place is used as the implementation of the crescent observation is not in any place, such as the sea, towers and other high-lying ground, but the

[5] Baharuddin Zainal, *Ilmu Falak*, Selangor : Darul Ehsan, 2004, p. 143-147 and Interview with Ahmad Zaki Hamzah, the manager of Baitul Hilal Teluk Kemang, via electronic mail on March 20th 2014.

[6] Interview with Nazhatultulshima Ahmad, the practitioner of Islamic astronomy at Baitul Hilal Teluk Kemang, Space Physics Laboratory, University of Malaya, on September 26th 2013.

places that are worth in terms of geographical, meteorological as well a recommendation from the Malaysia government.[7]

The place that used to be crescent observation place must also consider the aspect of geographical, meteorological and climatological, They are directly influence on the process of crescent observation activity.

The geographical aspect related with the visual conditioan (from horizon), accomodation, easy transportation and the development and progress of the region. Meteorological aspect closely related to weather condition, whether the venue has a relatively good weather for the implementation of crescent observation, and climatological aspect is more related to how the climate condition of the place.[8]

According to Baharudin Zainal, the good crescent observation place have to meet the characteristics of a good observation site. Some of the characteristics are:

1. Apparent horizon (*mar'i*) from the west, at the azimuth of 240 degrees to 300 degrees,must be clearly visible. If this can not be met, especially in the states on the east coast of Malaysia, be sure to restrictions or barrier around horizon should be minimal.

[7] Jabatan Kemajuan Islam Malaysia (JAKIM), *Kaedah Penentuan Awal Hijrah*, Kuala Lumpur : Percetakan Nasional Malaysia Berhad, 2001, p. 23.

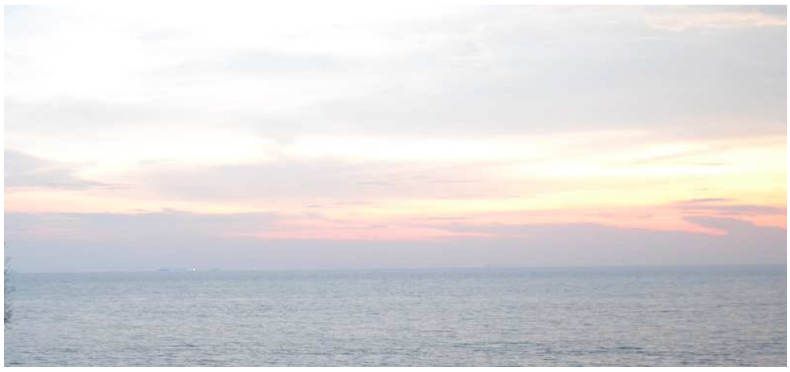
[8] Interview with Thomas Djamaluddin, astronomy researcher of LAPAN (Lembaga Penerbangan dan Antariksa Nasional) on March, 10th 2014 via Facebook.

2. The selected area should be away from municipalities and industry to prevent the harmful effects of atmospheric pollution and light scattering
3. There are basic facilities like electricity, water and connected to an adequate driveway and transportation access.[9]

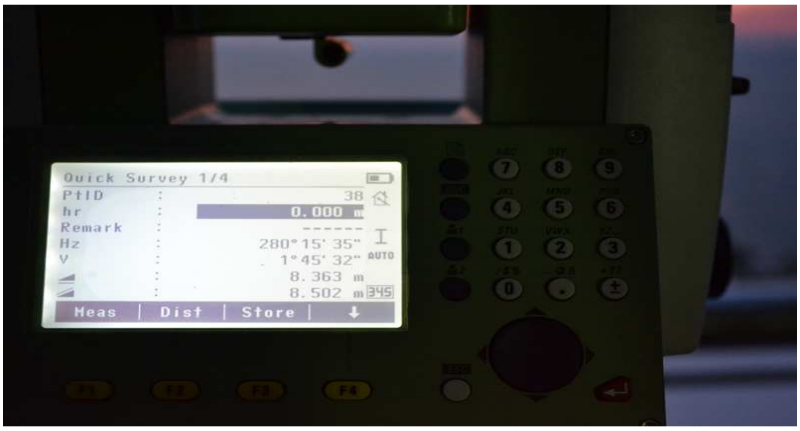
As the first's statement which explained by Baharudin Zainal about the crescent observation place that azimuth of Sun around 240 degrees to 300 degrees must be clearly visible and the restrictions or barrier around horizon should be minimal. Here is the conditional horizon with azimuth of Sun around 240 degrees to 300 degrees:

Picture.4.1
The theodolite shows around 240 degrees of Sun azimuth before Sunset on October, 4, 2013 at Baitul Hilal Teluk Kemang

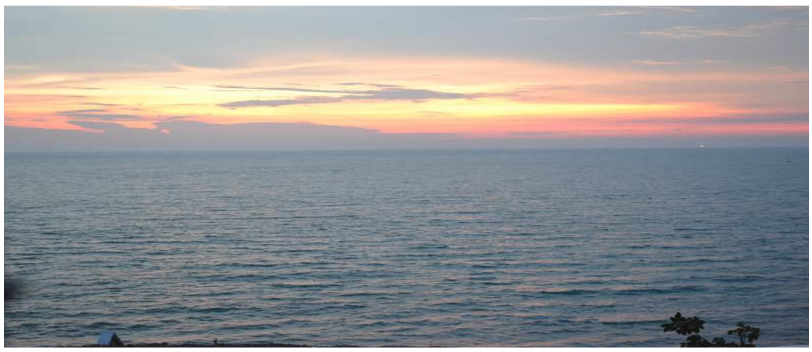
[9] Baharrudin Zainal, *Ilmu Falak Teori, Praktik dan Hitungan*, Kuala Trengganu : Yayasan Islam Trengganu, 2003, p.174.



Picture.4.2
The horizon image around 240 degrees of Sun azimuth before Sunset on October, 4, 2013 at Baitul Hilal Teluk Kemang



Picture.4.3
The theodolite shows around 280 degrees of Sun azimuth before Sunset on October, 4, 2013 at Baitul Hilal Teluk Kemang



Picture.4.4
The horizon image around 280 degrees of Sun azimuth before Sunset on October, 4, 2013 at Baitul Hilal Teluk Kemang

Ahmad Zaki, manager at Baitul Hilal Teluk Kemang, strengthen that Baitul Hilal Teluk Kemang has special privileges for crescent observation activities in Malaysia, which has a broad horizon line without having hindrance, and it's located at a fairly strategic position in Southeast Asia.[10]

In terms of venues and facilities, Baitul Hilal Teluk Kemang is in fairly populous and strategic place, because it is one of object of domestic tourism in Port Dickson Negeri Sembilan which easily accessible by means of transportation.

In the foccuss of observation data for crescent observation activity, the observation data needed to prepare as basis for knowing the position, form and coordinate of the observed crescent. The should be known coordinates is the equatorial coordinates and the local horizon for the required observation time, the right ascension, *istiwā'* angle, azimuth and altitude of the Moon and Sun. The visibility parameter is also needed to find its traces and removes the opportunities of the crescent visibility above horizon.[11]

Other important parameter visibility is to know the magnitude of the light of the Moon in the light phase of the new Moon, or the width of the size, age of the new Moon, and the time on the horizon, the use of the

[10] Interview with Ahmad Zaki bin Hamzah, the manager at Baitul Hilal Teluk Kemang,Baitul Hilal Teluk Kemang, on October 5th 2013.

[11] Interview with Dato Zambri bin Zainuddin, the supervisor of Baitul Hilal Teluk Kemang, Space Physics Laboratory, University of Malaya, on September 24th 2013.

right time is also very necessary. All of this data can be calculated self or accessed from several websites.[12]

In the implementation of crescent observation, Baitul Hilal Teluk Kemang using Moon Calculator 6.0 (Moon Calc) to obtain the value for the relevant parameter of the altitude (height) of the new Moon above the horizon, elongation (Moon-Sun distance curve) and the age of the new Moon.[13]

Moon Calc is a computer program (DOS-based) which was developed by Dr.Monzur Ahmed, it provides the information about the Moon which include: position, age, phase, orientation, appearance and visibility for any time and from any location in the world. In addition, the program also provides the number of calendar days julian data, declination, time and direction of the rising and setting of the Sun and the Moon, the interval time between the rising and setting of the Sun and the Moon, the date. Conjunctions of time for the new Moon to predicted probability of a particular location in crescent sighting activity.[14]

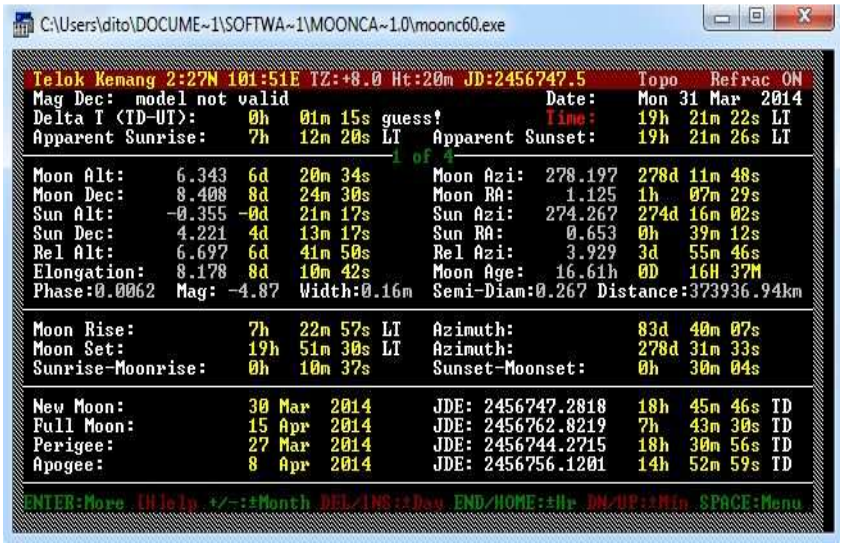
Moon Calc can also indicates the position of the Moon between the map and the position of the Moon at the local sky conditions both for appearance on a computer screen or for printing purposes (print). Also given the option to choose and toposentris geocentric coordinates, Sunset

[12] *Ibid.*

[13] Interview with Nazhatulshima Ahmad, the researcher of Baitul Hilal Teluk Kemang, Space Physics Laboratory, University of Malaya, on September 25th 2013.

[14] Tono Saksono, *Mengkompromikan Rukyat dan Hisab*, Jakarta : Amythas, 2007,p. 173-174.

geometrically, and the correction for refraction if necessary. The program has a database containing the coordinates of the atlas 1,000 cities in the world complete with latitude and longitude.[15]



Picture 4.5

The use of Moon Calc Application to find the observation data for crescent observation activity on March, 31st, 2014 at Baitul Hilal Teluk Kemang

In addition, the equalization time between the clock or watch of researchers, computers and observational tool is very important aspect which support the success in the crescent observation activity In this case, the crescent observer at Baitul Hilal Teluk Kemang convert time to UTC

[15] *Ibid.*

and SIRIM provision as the national standards development agency, include providing the standard time in Malaysia.[16]

b) The Observation Equipment

As far as my observation, the tools of crescent observation at Baitul Hilal Teluk Kemang is divided into three classification namely, *finding tool*, *clearing tool* and *capturing tool*.

Finding tools is the tools that help the observer to find the position of new Moon which has been predicted by astronomical calculations, the finding tools such as GPS (global positioning system)[17], Hilal Map and many others.

Clearing tools help the observer to clarify the observed object, the clearing tools such as theodolite[18], telescope[19], *rubu' mujayyab*[20], etc. The last is capturing tools, which help the observer to record the observed object, that's new Moon or crescent.

Using the right equipment is important during the crescent observation activity. In all the official place of crescent observation in Malaysia, the main equipment used for crescent sighting was a theodolite.

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[16] Interview with Joko Satria Ardianto, the researcher of Baitul Hilal Teluk Kemang, Space Physics Laboratory, University of Malaya, on September 24th 2013.

[17] GPS is aspace-based satellite navigation system that provides location and time information in all weather conditions, anywhere on or near the Earth where there is an unobstructed line of sight to four or more GPS satellites.

[18] Theodolite is a precission instrument for measuring both horizontal and vertical angles, as used in triangulation networks.

[19] A telescope is an instrument that aids in the observation of remote objects by collecting electromagnetic radiation (such as visible light).

[20] *Rubu' Mujayyab* well known as Sinus Quadrant as an ancienct Calculator in Muslim World.Widely use in daily life, such as clock, calculator, mimar.

This tool is able to accurately determine the position of the new Moon. most of the theodolite has a field of view between 1.3° to 1.6°, while the optical magnification of 26 to 32 times. A complete set of theodolite for the purpose of crescent sighting and crescent observation should have lighting equipment and insulation of the Sun. All observers must be skilled in the use of theodolite, especially to set up and prepare them during observation. Because of field of view of theodolite is exactly narrow, and the focus is very dangerous mismatch problem, so the brightness of the dawn-twilight are changing gradually and the different contrastof crescent light.[21]

Besides using modern instruments, a crescent observation can also be done by using traditional methods such as the use of *rubu' mujayyab*. The observers can also try to track the position of the new Moon by comparing the angle between the Moon and the Sun, or compare the new Moon with the planet Venus which often are on the horizon near the Sunset. However, the existence of the new Moon phase light is less than 1%, than it will be hardly visible without optical aid.[22]

The use of modern equipment in the crescent observation activity is not a new effort from traditional equipment such as *rubu' mujayyab*. The use of modern equipment such as theodolite and tracking telescope observations due to the crescent observations is a complicated research

[21] Baharuddin Zainal, *Ilmu Falak*, Selangor : Dawama, 2004, p.144.
[22] *Ibid*,.p. 146.

and need to reach scientific value. The more modern equipment such as tracking telescope also requires the more complicated alignment process.[23]

Since the last decade, Baitul Hilal Teluk Kemang Malaysia collaborated with Physics and space Laboratory of University Malaya using SLR cameras to record images of the new Moon and crescent with the purpose of scientific research on the Moon at Baitul Hilal Teluk Kemang Malaysia. Typically, SLR camera is mounted on a telescope MEADE LX 200 12 inch or refractor Borg 101ED telescope (the secondary telescope).[24]

Picture. 4.6

The observer ready to set up telescope before observation at Baitul Hilal

As time and technology development, film-based SLR camera was replaced with digital-based DSLR camera. The Results imaging of film-based SLR camera takes a long time to be processed and more difficult

[23] Interview with Joko Satria Ardianto, the researcher of Baitul Hilal Teluk Kemang, Space Physics Laboratory, University of Malaya, on September 24th 2013.

[24] Mohd. Zambri Zainuddin, and friends, *Pensabitan Hilal Menerusi Teknik Pengimejan*, in Dimensi Penyelidikan Astronomi Islam, Kuala Lumpur : Jabatan Fiqh dan Usul Universiti Malaya, tt, p. 97.

analyzed of data. With DSLR imaging capabilities, it simplifies the work of editing and post-imaging-taking and image analysis can be done at the same time, especially when used to observe the crescent while the crescent observation.[25]

DSLR or Digital Single Lens Reflex is a digital camera combining the optics and the mechanisms of a single-lens reflex camera with a digital imaging sensor, as opposed to photographic film. The reflex design scheme is the primary difference between a DSLR and other digital cameras. In the reflex design, light travels through the lens, then to a mirror that alternates to send the image to either the viewfinder or the image sensor. The alternative would be to have a viewfinder with its own lens, hence the term "single lens" for this design. By using only one lens, the view finder presents an image that will not perceptibly differ from what is captured by the camera's sensor.[26]

The main difference between SLR camera with a digital SLR camera is a medium sensitive detectors of light in which the SLR using 35 mm film and digital SLR cameras (DSLR) uses digital technology detectors. Developments in digital technology growth rapidly when device Double Charge, "Charge Couple Device" (CCD) was introduced in 1969 by Willard S. Boyle and George E. Smith of Bell Laboratories. Long before, the public has been aware and familiar use of imaging equipment based on a photographic plate or film detector. Unlike film-based detector

[25] *Ibid*., p. 96.
[26] *Ibid*., p. 96-97.

or photographic plate, CCD sensor technology has several advantages such as information storage, towing line, correlation and optical detector (Buil,1991).[27]

For astronomical use, atronomer and observer use CCD as a device to measure how much light falls on each pixel. The output is a digital image, consisting of a matrix of numbers, one per pixel, each number being related to the amount of light that falls on that pixel. Of course, one of the beauties of the CCD is that the image, coming out in a digital form, is readily manipulated, measured, and analyzed by computer. Research astronomers spend far more time sitting in front of computers than anywhere near telescopes.[28]

CCD optical detector has started a revolution in astronomical observation due to its ability to fit the high optical detector even in dim objects. Nowadays, CCD technology is used extensively in astronomical imaging equipment such as high-resolution cameras and video-CCD.[29] So far, Complimentary Metal-Oxide Semi-conductor (CMOS), which became the main detector for commercial cameras like the DSLR or compact-camera.

CCD (charge coupled device) and CMOS (complementary metal oxide semiconductor) image sensors are two different technologies for capturing images digitally. Each has unique strengths and weaknesses, giving advantages in different applications. Neither is categorically

[27] *Ibid*., p.97.
[28] *Ibid*.
[29] *Ibid*.

superior to the other. CCD and CMOS sensor technology have differences, especially in terms of image quality, the noise, and the efficiency of the battery. The CMOS sensor was rated as outperforming its CCD predecessor for depiction of cortical bone and root apices; the CCD detector was only rated superior for depiction of root canal space. No significant difference was found between the two detectors in perceived depiction of proximal dental caries, gingival soft tissues, periodontal ligament space or endodontic instruments. Combining rating scores from each of the tasks, CMOS and CCD detectors had a similar proportion of image ratings of excellent, acceptable and poor.[30]

Because of DSLR cameras using digital detectors so there are some advantages as comparison between DSLR and SLR cameras such as a high resolution image quality, wide range of shutter speed, the simplicity of camera operation, the quality of lens, simple post-procedure imaging, and some DSLR cameras can do video recording.[31]

c) Psychological Preparation

Besides the observed data needs, observers must also have the discipline. Every efforts and thought to be devoted solely to sight the crescent.The observer's psychology becomes an important thing to describe the real condition of the observation. The observer not only must

[30] *Ibid.*
[31] *Ibid.*, p.97.

be healthy (eyes), being not myopic and blind, but also must be honest and careful.[32]

Therefore each observer who are assigned to observe the crescent must be specialized person, they will first be trained and training to be capable enough for the implementation of crescent observation and get recommendations from national government.[33]

The training subject for candidate observer provided, among others, on the ability to operate the tools of crescent observation either telescope and theodolite, the calculation of determination the beginning of lunar month, to simulate the position of the new Moon as it dipped position also includes the factors supporting the success crescent observation activity.[34]

d) Record of Observation Results

Each proceeds data of crescent visibility should be recorded to ensure the visibility of the data can be analyzed. For this purpose, we ought to make sure assistant or observer always be near the equipment. This not only meant to help the observer, but more importantly, confirm the new Moon on the horizon. When one of the observers were able to see the new Moon, or see something that can be regarded as a new Moon, confirmation should be made with a few others. If crescent visibility made

[32] Baharuddin Zainal, *op.cit.*, p.147.
[33] Interview with Joko Satria Ardianto, the researcher of Baitul Hilal Teluk Kemang, Space Physics Laboratory, University of Malaya, on September 24th 2013.
[34] Baharudin Zainal, *op.cit.*, p. 145.

by theodolite and telescope, record the values azimuth, altitude and time of observation are the pictures and cloud formations to ensure the validity of the observed results.[35]

As has been explained that the imaging techniques done on the implementation of crescent observation at Baitul Hilal Teluk Kemang use a primary telescope, Meade SCT 12inch f/6.3 (Motorized Mount) with Canon DSLR, and secondary telescope, telescope Borg 101mm, Nikon DSLR,Computer or notebook with its imaging software.

Telescope / Camera	DIAMETER TELESCOPE	
	Meade 12’ (f/6.3)	Borg 101mm
Nikon DSLR D90	32.7’ x 49.2’	79.3’ x 118.9’
Canon DSLR EOS	26.8’ x 40.3’	96.6’ x 145.2’

* The width of field of view (FOV) the average data of Sun and Moon ~ 30 x 30 arkaminit

The above data show wide differences in the camera field of view imaging equipment used and compared with the average size of the Sun/ Moon. The basic knowledge of the broad field of vision will help observers expect the existence of the new Moon in the field of view of the camera. The orientation of the telescope is less accurate sometimes cause the new Moon was not at the center of the view (the center of the view finder).[36]

[35] *Ibid.*, 147.
[36] Mohd.Zambri Zainuddin, and friends, *op.cit.*,p. 99.

(1) Basic Techniques for Imaging

Before the imaging process, the camera calibration should be done first. The remaining time on the camera must be adjusted by reference to the SIRIM.[37] The role of imaging as it can be an important reference when the new Moon or crescent was first visible. By knowing the time, we know more precisely the position of the new Moon with the help of specific software.[38]

In principle, the crescent imaging technique using a DSLR camera is not much different with the SLR imaging techniques. Observers should be more sensitive and highly skilled in operating the camera in rapid time. Observers also should be able to determine the number of shutter speed and ISO the camera as possible at almost the same time. As usual, the recorded image of the new Moon at the first time will have some adjustments (technical adjustments) before observers are satisfied with the result image. Some technical adjustments should be carried out such as focus correction; correction to the exact position of the new Moon in the center of the camera view (center of viewfinder); shutter speed to suit the brightness of the sky background rate, and so forth.

In addition to the technical coordination at the camera and telescope, the visibility of the crescent is surely take high priority. The crescent visibility may exist but is very short, especially when age is less than 15 hours of the new Moon, the Moon and the Sun angle curve is less

[37] The national standards development agency of Malaysia
[38] *Ibid.,* p. 100.

than the limit Danjon (7°), or the height of the new Moon on the horizon less than 2°.[39]

The observer also requires good concentration and a conducive environment while performing the observation activity. All of this is its own challenges in getting a clear image and high quality of the crescent image.[40]

(2) Digital Imaging Revolution

While this technology DSLR camera equipped with an image which is displayed directly on the screen of the camera. With the facility, monitoring and tracking of the new Moon can be done simultaneously. Previously, the existence of the new Moon by using camera can only be done by an observer at one time before the new Moon image captured. Also, some DSLR cameras like the Canon brand camera software offers free to consumers which can be connected directly via USB-connection to control imaging can be performed by using a laptop computer.

Other companies have also introduced a new imaging technique in which an image editing can be done by a skilled observer. There are some cases, where the new Moon can be detected early during the editing process is done by directly detected by the naked eye. This activity is complex and requires high skills, but important for monitoring and tracking the physical existence of the crescent.[41]

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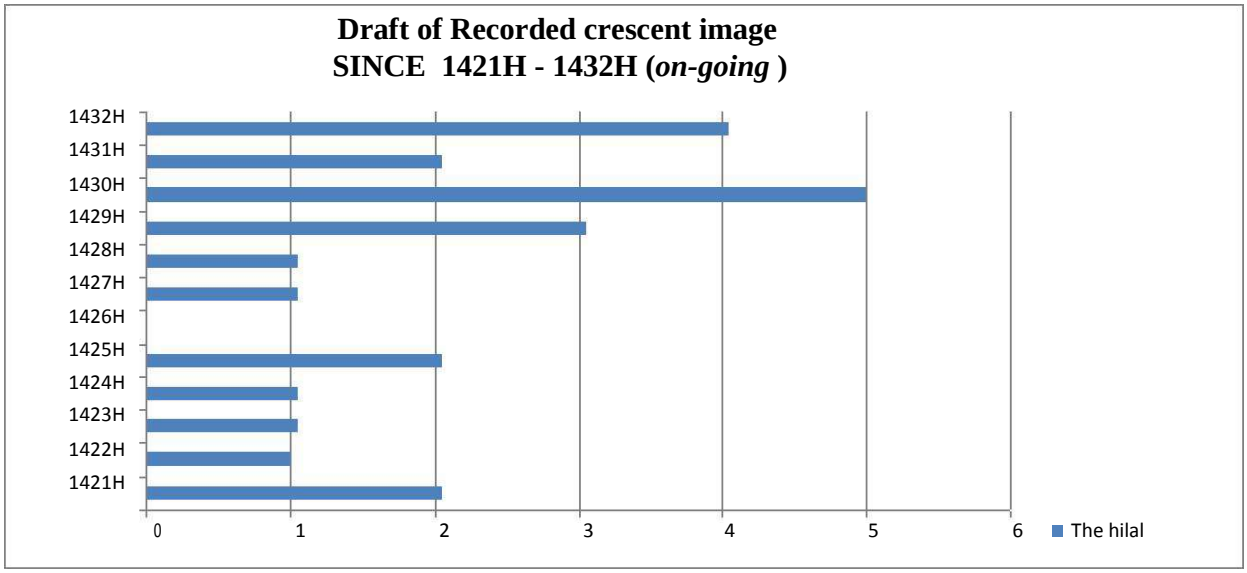
[39] *Ibid.*
[40] *Ibid.*
[41] *Ibid.,* p. 100.

(3) The Imaging Records

The crescent observation and its imaging depends on the setup of complete equipment and afternoon weather while observations. Afternoon weathers such as cloud cover rates on the horizon, scattering the Sunlight and the sky brightness is a factor that is difficult to predict to give success in the implementation of crescent observation.

Based on a record 120 crescent imaging session since 2000 to the present by using film SLR cameras or digital SLR, Space Physics Laboratory and Baitul Hilal Teluk Kemang has acquired 23 images of the crescent.[42]



The data shows that the imaging crescent growing up since the DSLR camera was introduced in 2005. The Youngest crescentwas recorded in the age of 16:09 hours on July 12th, 2010. The crescent apart

[42]*Ibid.*, p. 101.

were recorded using a DSLR camera, it was recorded on video and observed using a telescope (although the visibility is less than one minute).[43]

By controlling the contrast and brightness of the image, scattering Sunlight intensity can be reduced in the range of balanced until the existence of the new Moon can be detected early. However, there are also at least three crescent images observations confirmed to exist after the session ended. The images of the crescent on March 27, 2009, December 6, 2010, and 4 April 2011 is a crescent images which can be detected after post-processing is done (a few days after that).[44]

However, the crescent's obersvers of Baitul Hilal Teluk Kemang realize that the lunar visibility is so sensitive to the atmospheric condition, so that the use some modern astronomical equipment, such as telescope and DSLR camera. The scientific and technology aspects of lunar crescent visibility do not have a strong focus, due to concentration to the social impacts than find the youngest moon age. The modern equipment really support the succes of Baitul Hilal Teluk Kemang in sighting crescent so far record it and analyze that data in the future.

So far, Baitul Hilal Teluk Kemang will be never succed in crescent sighting and reach many awards of International Crescent Observaton Project (ICOP) for having an image of the youngest lunar crescent so far for having some important crescent observation data without using those

[43] *Ibid.*, p. 101-102.
[44] *Ibid.*

modern astronomical equipment.

As described data above, the implementation of crescent observation is really not easy. There are several important factors that support the success of crescent observation. According to Mohammad Zambri, there are many factors that affect the visibility of the crescent. It can be divided into two main factors, ie factors scientific/ astronomical and non-astronomical factors.[45]

1) The arc of light (elongation, meaning separation of the Moon from the Sun)
2) The arc of vision (the altitude the of Moon from the Sun)
3) The Moon altitude above the local horizon
4) The width of the crescent
5) The age of the crescent
6) Moon's intervals after Sunset
7) Distance of the Moon from the Earth
8) Distance of the Earth from the Sun
9) Latitude and longitude of the observer.

To explain the visibility of the new crescent Moon in simple terms, we shall try not using technical terms, so any ordinary Muslim can understand what is involved in the visibility. The Moon revolves around the Earth and completes its cycle in 29 to 30 days. That is why the crescent Moon

[45] Mohd Zambri bin Zainuddin, *Hilal dan Faktor-Faktor yang Mempengaruhi Kenampakan*, a material subject in lecturing Islamic Astronomy for Islamic astronomy student in University Malaya.

appears after 29 or 30 days. What makes this thin crescent luminous is the light from the Sun falling on the Moon's surface reflected to the Earth. Just consider that the Moon comes exactly between the Earth and the Sun in its cycle and at that moment the Sunlight falling on the Moon cannot come to the Earth as it is reflected back to the Sun. This instant of time is called the "Birth of New Moon" and it occurs roughly every 29 or 30 days.

This instant of time can occur at any time in the 24 hour period of the clock, not just at Sunset, which means that the cycle of the Moon is 29 days and some hours, but always less than 30 days. As the time passes, the Moon continues to revolve around the Earth, and when it moves away from the position of "birth of new Moon" there comes a time when the Sunlight coming to the Moon is now reflected towards the Earth, and we see the crescent. So, the most important factor for the visibility is that the Moon has moved enough from the position of "birth of new Moon". The second most important factor is whether the Moon is above the horizon or not. Due to the curvature of the Earth, the Moon may be above horizon in some countries and below the horizon in other countries. There are additional important factors for visibility like the distance of the Moon from Earth, and distance of Earth from the Sun. The Moon revolves around the Earth in an elliptical orbit, and that places the Moon at different distances from the Earth at different times in its orbit. Similar is the situation of the Earth around the Sun. The Earth too

revolves around the Sun in an elliptical orbit, and that places the Earth at different distances from the Sun at different times in its orbit. [46]

These important factors for visibility can be calculated with great precision and accuracy, thanks to modern science and to computers. We have collected observations of sighting or non-sighting for more than 160 years from different locations on Earth in different months and calculated all the factors that affect visibility and have derived an algorithm (relationship of different factors) that match the visibility or non-visibility.[47]

So far, Mohammad Odeh (2006) ever established a new criteria for crescent visibility that suggested the crescent's width as a good parameter to describe the actual crescent brightness, in contrast to the age of the Moon, as it is the arc of vision to include the effect of atmospheric extinction and hence estimate the apparent crescent brightness. So that, the crescent Moon's width is proven as the best parameter to support other parameters which are, elongation brightness and Moon altitude.[48]

Crescent width (W) is the width of the lit area of the Moon measured along the Moon's diameter. The Moon can be computed when arc of light that defined as the apparent geocentric angular distance (in degrees) between Sun-Moon centers or known as Lunar elongation. Significantly, better

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[46] *Ibid*.

[47] http://www.makkahcalendar.org/en/hilalSighting.php, accessed onWednesday, March12 th2014, at 06.00 WIB

[48] Khadijah Ismail and friends, *Moon's Width for crescent visibility*, in Dimensi Penyelidikan Astronomi Islam, Kuala Lumpur : Jabatan Fiqh dan Usul Universiti Malaya, tt, p. 135.

parameter is the ARCL, since the width of the lunar crescent increases with the Moon's elongation from the Sun. It is not perfect however, since for the same ARCL, the width of the crescent is maximum when the Moon is at perigee and minimum at apogee. The best parameter to incorporate the Moon intrinsic brightness, thus, is directly the width (W) of the crescent.Regarding to the second parameter, ARCV gives directly the angular distance of the Moon above the horizon and should be used in conjunction with *W.*[49]

Mohd Zambri Zainuddin, ever said that the lowest Moon's width and elongation in Malaysia are :

a. The lowest width : 0.05
b. The lowest elongation : 4.51°[50]

Furthermore, there was a non-scientific factors which also have an impact for the success of crescent activity. In general, non-scientific factors / external is very difficult to control , and depending on the situation when the observations. Non-scientific factors include as follows[51]:

1) Atmospheric pollution
2) Humidity of the air
3) The height of the observed location
4) Physical and psychological observer

[49] *Ibid*., 135-137
[50] *Ibid.*, 154-155
[51] Mohd Zambri bin Zainuddin, *Hilal dan Faktor-Faktor yang Mempengaruhi Kenampakan*, Universiti Malaya.

For example, if the weather is cloudy or rainy days it seems to be an observer only pray to hope that the weather improved. Atmospheric pollution is more to the haze that may have come from the neighboring countries to open burning. The humidity is due to the cold weather conditions. Height location also plays an important role. If our locations are in high areas as far as possible through the clouds will be much easier to see the new Moon. Finally, the physical and psychological conditions are also very important for observers to observe the new Moon's energy needs, with the sharpness of the eye of the observer. Observers will need to focus one hundred percent while observing the new Moon because sometimes the new Moon appears only a few seconds to a minute then cloud. Observers must be on hand throughout the observation session until the Moon sets.[52]

So that, we know that the implementation of crescent observation activity at Baitul Hilal Teluk Kemang Malaysia is effective in the term of crescent observation activity. As Baitul Hilal Teluk Kemang is placed in a strategic and suitable place for crescent observation activity and supported by some observers of Malaya university who officially certified by the goverment, so far Baitul Hilal Teluk Kemang also helped by some advance astronomical equipment for implementing the crescent observation activity.

[52] *Ibid.*

B. The Contribution of Baitul Hilal Teluk Kemang in the Implementation of Crescent Observation in Malaysia

According to Ahmad Zaki bin Hamzah, the manager of Baitul Hilal Teluk Kemang Malaysia, the contribution of Baitul Hilal Teluk Kemang in the implementation of crescent observation in Malaysia is surely divided into two main aspects, firstly, conducting astronomical acitivity to support the development of study of astronomy in Malaysia. Secondly, providing astronomical data which can be researched and analyzed by other astronomer.[53]

Baitul Hilal Teluk Malaysia surely gives the real contribution on development of study of astronomy by conducting many astronomical agenda. There so many activities, such as conducting astronomical course on how to sight the crescent and other object in the universe, conducting a course on how to have good astronomical calculation for determining the lunar month and presenting a museum of astronomy which give much information about history and development of study of astronomy. All of the agenda is presented to entire student and society who want to know and study more about astronomy, not only from Malaysia but also for entire society in the world.

Baitul Hilal Teluk Kemang also consistent in the implementation of crescent observation since 1972, as Teluk Kemang was officially appointed to

[53] Interview with Ahmad Zaki Hamzah, the manager of Baitul Hilal Teluk Kemang, via electronic mail on March 20 th 2014.

be the crescent observation in Malaysia. Baitul Hilal Teluk Kemang also has significant contribution in providing astronomical data to researched and analyzed by other astronomers.

Since the last decade, Baitul Hilal Teluk Kemang as its mission of name to sight the crescent, always conduct the crescent activity to determine the beginning of lunar month. Especially for determination of Ramadhan, Shawwal and Zulhijah, Baitul Hilal Teluk Kemang Malaysia collaborated with physics and space laboratory of University Malaya, Astronomical unit for Islamic development department of Malaysia, Astronomical unit for Islamic development department of Negeri Sembilan, and department of surveying and mapping of Malaysia (JUPEM) conducted the crescent observation together in order to sight the crescent for futher information in determining the beginning of lunar month in Malaysia.[54]

Baitul Hilal Teluk Kemang uses various of astronomical equipments, as like as theodolite, scientific calculator, telescope by using SLR and DSLR cameras to record images of the new Moon and crescent with the purpose of scientific research on the Moon at Baitul Hilal Teluk Kemang Malaysia.Typically, SLR camera is mounted on a telescope MEADE LX 200 12 inch or refractor Borg 101ED telescope (the secondary telescope).[55]

As time and technology development, film-based SLR camera was replaced with digital-based DSLR camera. The Results imaging of film-based SLR camera takes a long time to be processed and more difficult analyzed of

[54] *Ibid.*
[55] *Ibid,.*

data.With DSLR imaging capabilities, it simplifies the work of editing and post-imaging-taking and image analysis can be done at the same time, especially when used to observe the crescent while the crescent observation.

Observatory Baitul Hilal Teluk Kemang commonly become the first and center of researchers science or astronomy for its success in the record of crescent sighting for determining the beginning of lunar month, that's also become the highest record crescent sighting of lunar month in the history of the observatory throughout Malaysia.[56]

Especially During 2000 to 2012 there were 183 crescent observation was carried out at Baitul Hilal Teluk Kemang. A total of 56 crescent observations had managed to record the visibility of the new Moon (the Moon's visible on the 29th day) and a young crescent Moon (the Moon's visible on the 30th).From the mentioned number, only 7 (seven) timesof crescent observation that recorded successfully,on 29th of Rabi al-Awal 1421 (02/07/2000), 29th Rajab 1422 (17/10/2001), 29th Jamadi al-Akhir 1423 (09.08.2002),29th Jamadi al-Awal 1427 (26.06.2006), 29th Rajab 1431 (12/07/2010), 29th Zulhijah 1431 (06.12.2010) and 29th Muharram 1433 (25.12.2012). All of complete data and information well informedand share in the *attachment* list.

[56] See : Jabatan Kemajuan Islam Malaysia (JAKIM), *Kaedah Penentuan Awal Hijrah*, Kuala Lumpur : National printing for Malaysia Berhad, 2001, p.8. And http://www.majlisraja-raja.gov.my/index.php/bm/sejarah/rekod-cerapan-hilal#section=p1, accessed on Monday, January, 06th 2014, at 21.00 WIB.

By the end of Zulhijah 1433H, some photos of the new Moon (crescent) has successfully captured using the camera SLR/ SLR-Digital, and more digital camera (Nikon Coolpix), are 25 photos of the new Moon has successfully recorded. The youngest new Moon which recorded with a Digital SLR camera is the new Moon of Sha'ban 1431H (July 12 nd, 2010) aged 16:16 hour. Based on ICOP (International Crescent Observation Project) for ordinary imaging, this is become the youngest new Moon that can berecorded by using an ordinary imaging.[57]

Picture.4.7

The youngest crescent based on ICOP standard on ordinary imaging,

image by Baitul Hilal Teluk Kemang Malaysia[58]

[57] Universiti Malaya and team, Laporan Kajian Cerapan Hilal dan Pembiasan Cahaya di Ufuk Tahun 2000-2012 M or 1420-1433 H, p. 23.

[58] ICOP (International Crescent Observation Project) provide five categories of crescent record award, that can be recorded by Naked Eye Observations, Optical Aid Observations, Daylight Observations, Ordinary Imaging and CCD Imaging.

The astronomical data which taken from crescent observation activity is written in a compilation report (book) *Laporan Kajian Cerapan Hilal dan Pembiasan cahaya di Ufuk* which it must be reported to Malaysia government in every last period of observation. As far as my analysis of the data, there are many mistaken in writing and providing data, such as in written data of different point of Moon and Sun altitude (ΔAlt**)** of April, 06th 2000, the written data is 5.98, the right it must be 21.83, so in December, 06th 2010 the written data is 1,78, the right it must be 7,36. So far in July, 02nd 2000, the written data is 5,65 but the correct one is 7,88.[59]

So far, by analyzing the crscent observation data, Baitul Hilal Teluk Kemang foccuses on the research of the new Moon (crescent) for every month of lunar month for 20 years starting from 2000 to 2020, in collaboration with the Physics and space Laboratory of University Malaya, Astronomical unit for Islamic development department of Malaysia, Astronomical unit for Islamic development department of Negeri Sembilan, and department of surveying and mapping of Malaysia (JUPEM), they incentive to do research on the new Moon in each month in the beginning of lunar month, it was intended to formulate a criteria of *Imkān ar-rukyah* which can be more established in the future.

It seem to be a proof that Baitul Hilal Teluk Kemang now becomes one of the most success observation crescent place in sighting and recording

[59] The writer's analysis using the comparasion data in Moon Calc programme.

the visibility of new Moon and surely give the great influence on the history of the crescent observation in Malaysia.