

The Use of Technology to Live Webcast the Crescent Moon Observations

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Abstract

This paper will describe the use of observatory data to easily identify the precise location of the crescent moon for any given location/month and how to live webcast the observations to the whole world. The method uses a low-cost webcam, a small telescope and a free account on a live interactive broadcast website. Using real-life graphics from “hands-on” sessions, it will explain how to easily configure each component for a successful moon sighting experience. Finally, the acceptances (or non-acceptances) of such technologies by the Shariah scholars for their decision making process to begin the Islamic lunar month is also discussed.

1. Introduction

To look for the crescent moon on the 29th day of each lunar month is the Sunnah (tradition) of Prophet Muhammad (peace be upon him). The attempt to sight the crescent moon every month by a group of Muslims have been considered by the Muslim Jurists (Fuqahaa) as a communal obligation (Fardh-e-Kifaayah), based on the verses of the Holy Quran (2:189/9:36). When the crescent moon was sighted, the Prophet Muhammad (peace be upon him) used to recite a supplication (duaa), which makes looking for the moon a form of worship (Ibadah).

Observations in the UK over past few years (since 2006) have suggested that it is possible to sight the crescent moon above the UK horizon for a few months in a year when the crescent moon is in the Northern Hemisphere. However, adverse weather conditions can reduce the chances of a successful sighting. Therefore, it is important to have a large numbers of groups of people making the attempt from different parts of the country so that if most of the country is cloudy, at least one group may make a successful sighting. In order to co-ordinate the above crescent moon observation attempts in the UK on a regular basis as well as to send out reminders and observation reports, and to discuss the relevant issues, the Islamic Crescent Observation for the UK (ICOUK) group was set up in 2008. At the same time a national group of Muslim scholars in UK (Wifaqul Ulama) came into existence, which also encouraged local moon sighting efforts throughout UK to educate and minimise the confusions created from news of foreign moon sighting reports.

Since, adverse weather conditions can affect the reliable sighting of the crescent moon throughout the UK, an evidence based approach is needed to share accurate moon sighting news so that Muslims scholars can make rapid decisions for the start of each lunar

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months without undue hardships. It is also necessary to remove the scepticism in the minds of some Muslims that the moon can not be sighted at all in the UK. This paper combines the “hands-on” moon sighting experiences of the author over the past 2 years, and the use of technology to support rapid and accurate moon sighting decisions by the Muslim scholars for the validity of Islamic worship (Ibadah). It also explains how to use astronomical data to accurately locate the position of the moon with a telescope and then how to webcast the observations at low-cost to a wider audience.

2. Choice of Equipment

To photograph the brighter astronomical objects like the crescent moon and share the images fairly quickly usually requires cooled-chip astronomical CCD cameras, which are fairly expensive (over 600 GBP) and hence outside the budget of most casual observers. Therefore, it was necessary to find a low-cost alternative solution. Literature reviews suggested the use of CCD sensor based webcams (instead of CMOS types) as they are more sensitive to low-light conditions. The Philips SPC900NC webcam (Figure 1) was chosen as it uses the same Sony ICX098BQ CCD sensor as the Toucam Pro II webcam (with 1/4” type chip) and it was the original favourite choice for astronomers (costing less than 50 GBP) with good quantum efficiency (high light sensitivity) and low noise. This webcam could easily be connected to a telescope (with an eyepiece adapter/ UV-IR blocking filter) and to a PC via a USB cable to show streaming video of the crescent moon on the screen in real time. Note that the above Sony CCD chip is also used in the Celestron NexImage Solar System Imager (Digital Eyepiece) [8] available from most telescope suppliers, but at a much higher cost than a webcam.



Figure 1 –Philips SPC900NC Webcam

Having chosen the CCD sensor based webcam imaging device, it was then necessary to match it with a small refractor telescope to optimise the image resolution that the CCD chip can deliver. This matching process requires the focal length of the telescope to be determined. A theoretical calculation method is shown by Frank Brandl [3], but a much quicker/visual method was provided by Ron Wadaski’s CCD calculator program [1]. This

program shows the Field of View (FOV) of the entire moon for a given telescope and CCD chip and suggested a refractor telescope with a 350 mm f/5 focal length would be ideal to observe the entire moon with some space round it (e.g. Meade ETX-70). Initial tests carried out with a loan Meade ETX-70 telescope showed the results were favourable (see YouTube video, [7]), although the automatic features of GOTO controller was not required to find the moon. However, since this telescope was obsolete, the smallest f/5 focal length refractor telescope available on the market was a 400 mm type. Hence, a new a Skywatcher Startravel 80 EQ1 (Figure 2) that was readily available from most UK suppliers (129 GBP) was used for subsequent webcam imaging observations.



Figure 2 – Sky Watcher Startravel-80 (EQ1) telescope

Since the youngest crescent moon usually appears very low and dim on the western horizon, most observations are needed to be carried out from high locations (away from light pollution of the inner cities) where mains power and wireless broadband signals are generally not available. Therefore, a laptop PC (with mobile broadband dongle for webcasting) and battery-pack/antenna were also necessary to compliment the “mobile observatory” kit.

3. Configuration of Equipment

It is most important to familiarise oneself with both the webcam configuration software and the telescope settings during daylight hours before taking them to the observation site. The Philips SPC900NC webcam comes bundled with the VLounge control software, which is fairly easy to use and the default/automatic settings are sufficient for online video-chatting requirements, but the webcam lens needs to be adjusted to bring the target into focus. However, for astronomical use, the webcam lens cover needs to be removed carefully and replaced with the matching threaded eyepiece adapter. The next step is to

place the webcam into the eyepiece of the telescope, point it to a distance target, un-tick the automatic check-box and use manual settings to optimise the webcam image for the given lighting/environmental conditions by adjusting the appropriate gain and shutter-speed slide-bars (Figure 3).

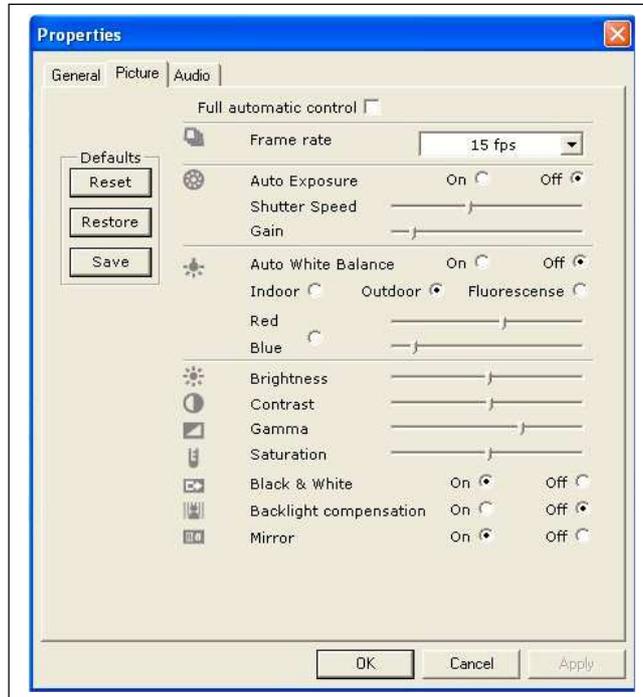


Figure 3 – VLounge software settings for Webcam

Note that any incorrect software settings of the gain/shutter-speed may render a visible image to the human eye, invisible to the webcam. Therefore, it is important to calibrate the webcam settings to match the human eye observation. Once the above configurations are satisfactory, they can be taken to the observation site and the same configurations need to be repeated after aligning the equatorial-mount telescope to the direction North. For best observation results, it is recommended to arrive at the target location about an hour before the expected observation time, so the telescope can adjust to the ambient temperature.

If the laptop PC battery is not sufficient to last the whole duration of the observation, it is important to have a spare battery. An alternative option is to use a 12v power pack available from most motor shops (with a low-cost mains inverter), which can be re-charged from mains supply after each observation session.

To live webcast the observation to the Internet, it is also necessary to choose a location with a good 3G mobile broadband signal coverage. If the signals are too weak, then an external antenna for the broadband card needs to be considered. For modern laptop PCs with ExpressCard slots, the Huawei E870 data card modems available from most mobile phone suppliers do provide external antenna options (up to 7.2 Mbs speed). However, if the observation location is within the reach of a wireless broadband signal (802.11g), then installing a broadband Access Point/Repeater with a directional/Yagi antenna may provide the highest speed of Internet connectivity (up to 54 Mbs speed).

4. Locating the Crescent Moon and Capturing the Image

Once the equatorial-mount of the telescope has been aligned to the North, the Alt-Azi controls may be adjusted to point the telescope on the correct portion of the western horizon, where the crescent moon is expected to become visible (after sunset). The lunar positional data (i.e. Azimuth and Altitude) for a given location and time can be obtained from the Moon Ephemeris of Accurate Times 5.2 program on ICOP website² or from the HM Nautical Almanac Office website³. An example data-sheet given in Appendix A is the Moon's Position for York on 15 April 2010, when the age was about 30 hours and it was easily visible to the naked eye on the UK horizon (Figure 4).



Figure 4 – Crescent Moon of 15 April 2010 (UK)

Using similar lunar positional data, members of York Astronomical Society⁴ (YAS) have been successful in sighting (and photographing) the earliest crescent moon in previous months. The youngest crescent moon sighted with a telescope by YAS was 17 hours old on 25 April 2009 (from 1000 ft above sea level, 1-hr after sunset), as posted on ICOP website (Jumadal-I 1430 AH).

Once the crescent moon becomes visible through the telescope, live video can be displayed on the laptop PC screen via the VLounge program of the webcam or by other similar program from a Digital Eyepiece (e.g. Celestron NexImage).

5. Live Webcast

Many commercial companies are now using webcasting technology to live broadcast their video contents to limited audience using their own dedicated servers. However, like

² <http://www.icoproject.org>

³ <http://websurf.hmnao.com>

⁴ <http://www.yorkastro.org.uk>

YouTube is used for recorded video, Ustream⁵ is used for live interactive "one-to-many" broadcast that enables anyone (with an Internet connection and a camera) to webcast to an audience of unlimited size. A Ustream account can be created fairly quickly (with a userid/password credentials) and once the webcam has been tested and shown to work satisfactorily with the telescope, live observations can be broadcast to Internet without much difficulty. It is also possible to embed the video in other websites, but Ustream forces the visitors to refer them back to their own website. However, a similar live webcast service is provided by Zaplive⁶, which allows the embedding of the video on the host websites without forcing the visitors back to their own website.

Members of York Astronomical Society have been successful in live webcasting and online chatting from Zaplive with worldwide viewers without any problems. The above webcast videos have also been embedded on the ICOP website⁷ and many ICOP members gained first-hand knowledge of the webcast technology since February 2010 (Safar 1431 AH). It should be noted that cloudy skies are very common in the UK throughout the year. As a result, the first day's crescent moon is not always possible to be sighted. However, on 15 April 2010 it was easily sighted and live webcast (Figure 5).

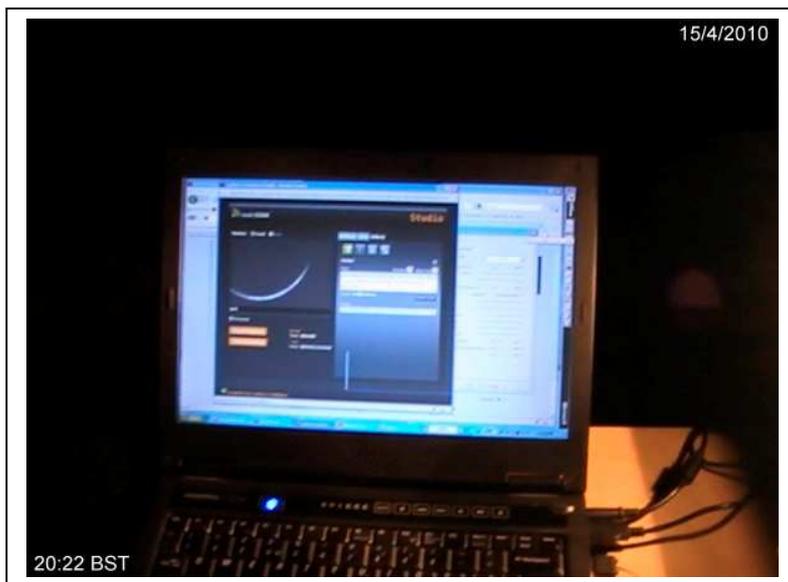


Figure 5 – Live Webcast of Crescent Moon

6. Views of Shariah Scholars on Webcast Technology

The use of a telescope to look for the moon was not available at the time of Prophet Muhammad (peace be up on him) as it is a more recent inventions since the 16th century. Therefore, some Muslims still believe that it is only permissible to sight the crescent moon by the naked eye, although they do accept that telescopes can be used initially to locate the crescent moon [10, 11]. However, many Muslim Jurists (Fuqaha) have discussed this issue

⁵ <http://www.ustream.tv>

⁶ <http://www.zaplive.tv>

⁷ <http://www.icoproject.org/live.html>

in recent years and some senior scholars have agreed that it is permissible to sight the crescent moon by telescopes only, including the present Saudi Ministry of Justice. Recent communications with the members of Saudi Hilal Committees revealed that many members of the Saudi Justice Ministry have also used telescopes (located at various Hilal Observatories) in Saudi Arabia and they are happy to accept any sighting claims from telescopes only [12,13]. There is also a Fatwah (Legal Ruling) from one of the senior Mufti of Saudi Arabia, Shaykh Saleh Ibn Uthaymeen, that it is permissible to use only telescopes to sight the crescent moon [14].

Since the webcam fitted to a telescope acts as a digital eyepiece only (in visible-light wavelength) to a human observer, it is inferred to be permissible by the Saudi Hilal Committees. Similarly, some senior Hanafi Madhab (school of thought) scholars like Shaykh Muhammad Bakhit al-Muti'i and Mufti Rasheed Ahmed Ludhyaanwi, have also stated that it is permissible to use telescopes only for moon sighting (Ahsanul Fataawaa Vol. 4). Many UK scholars, such as Mufti Yusuf Sacha of Batley Hilal Committee also support this opinion. It should be understood that for the purpose of accepting the witness statement by the authority, it is the direct sighting by the naked eye or telescope that may be accepted from the actual observation site. Any sighting claims from webcast (i.e. relayed information via the Internet), may not be accepted by the authority.

7. Summary and Conclusions

The use of astronomical data to accurately locate the crescent moon was demonstrated. The webcast technology can be used to sight the crescent moon by either naked eye only (after locating the moon by telescope if necessary) or by telescope only. It was shown that low-cost equipment could be used to live webcast the observation results to a wider audience fairly easily using existing technologies, which were also acceptable to Shariah scholars (when accompanied by direct observation witness statements).

It is suggested that the above webcast technologies should be adopted by Muslims worldwide to assist Shariah scholars make accurate monthly moon sighting decisions throughout the year as commanded by Allah in the Holy Quran (2:189/9:36).

It should be pointed out that the above webcast used a 1/4" type CCD chip webcam, which was sufficient to detect a thin crescent moon visible to the naked eye. It is possible that if the crescent moon is extremely thin then it may be outside the resolution of the 1/4" CCD chip to detect the image and hence it may not be visible to the webcam, even though it may be visible to a telescope. In such a case, the solution would be to replace the webcam with a higher resolution CCD chip (e.g. 1/2" type) available from most telescope suppliers.

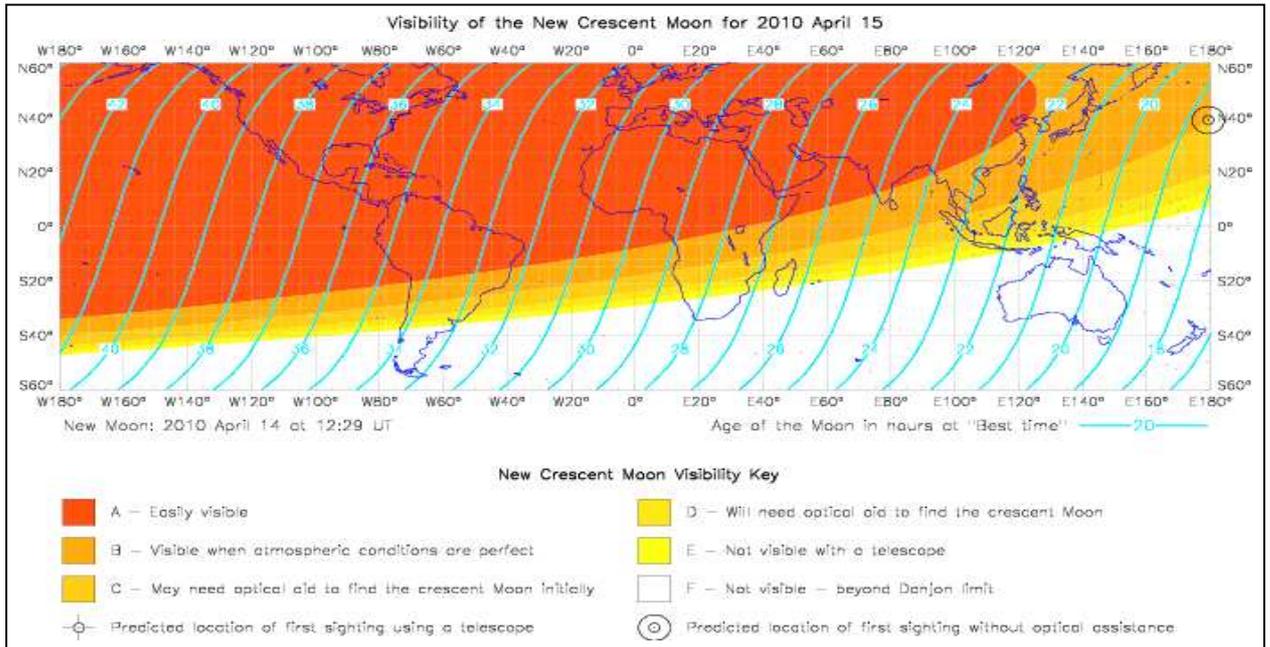
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10. Appendix A

A1. Global Predicted Crescent Visibility Map for 15 April 2010



<http://www.crescentmoonwatch.org/assets/F2010Apr15.png>

A2. Visibility Predictions for the New Crescent Moon

York																						
Longitude		W001 05																				
Latitude		N53 58																				
Times are in GMT																						
New Moon Birth Date						Sun		Moon at Sunset					Moon Lag		BEST							
Code						Set	Az	Age	Alt	Az	DAZ	Mag	El	Set	Time	TIME						
year	mth	day	h	m	d	mth	day	h	m	o	h	m	o	o	o	o	h	m	m	h	m	
2010	Apr	14	12	29	Wed																	
		0	Wed	Apr	14	19	04	288	6	35	4	290	-2	-4.0	6	19	39	35	19	20	F	
		1	Thur	Apr	15	19	06	288	30	37	13	283	5	-5.1	16	20	57	111	19	55	A	

A Easily visible
F Not visible, below the Danjon limit

A3. Moon's Position for York (Longitude W001 05, Latitude N53 58)

Year	m	d	h	m	Refraction	Azimuth	Altitude	Parallax
2010	4	15	19	30	0.09	288.00	10.16	0.93
2010	4	15	19	40	0.10	289.89	8.84	0.93
2010	4	15	19	50	0.12	291.77	7.55	0.93
2010	4	15	20	0	0.14	293.67	6.28	0.94
2010	4	15	20	10	0.17	295.57	5.03	0.94
2010	4	15	20	20	0.21	297.48	3.83	0.94
2010	4	15	20	30	0.28	299.40	2.66	0.94
2010	4	15	20	40	0.38	301.33	1.56	0.94
2010	4	15	20	50	0.57	303.28	0.57	0.94

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