The Application of Sky Quality Meter at Twilight for Islamic Prayer Time

Nur Nafhatun Md Shariff, Amran Muhammad, Mohd Zambri Zainuddin, and Zety Sharizat Hamidi

Abstract—**The aim of this study is to detect elusive light that indicate the prayer time (Isha'). Therefore, we focused on optical sky brightness at dusk from May 2007 through April 2008 intermittently. The measurements of twilight sky brightness were covered at one (1) site covering; West coast of Peninsular Malaysia. The measurements were done by applying Sky Quality Meter (SQM) which covered between 400-700 nm in accordance of human eyes and SQM range. Results showed that there are clear indications of light changes when Sun at certain degree below horizon that visible by plateau form in twilight sky brightness dependences versus solar zenith angle. It is clarified that the yearly averages of solar depression by observation are best correlated within the range of 17.3o – 19.5o for Isha'.**

Index Terms—**Twilight; prayer time; sky quality meter.**

I. Introduction

Early studies done by astronomers such as Ibn Muadh, al-Biruni, al-Qayini, Ibn Yunus etc.[1], [2]. Ibn al-Shaṭir adopted various value for each prayer times such as 17^o for Isha' due to their asymmetry property [3]. There are many efforts made on sky twilight measurement using a photometer and a CCD camera, yet they are not specific on prayer times determination [4]- [6]. In this paper, we show that elusive light can be detected i.e. *shafaq al-abyaḍ* [7]. The elusive light is detected when Sun dip below horizon. The important of knowing angle of elusive light solely for determination of two prayer times i.e. Isha' and Subh. Based on that, we investigated Isha' prayer time using Sky Quality Meter (SQM).

II. Instrument Performance

In order to understand the measurements, it was tested and characterized by checking the acceptance angle, linearity and spectral responsivity [8] by running photoelectric effects experiments[7]. A trough is formed on the graph as evidence of SQM characteristic to behave when certain colours (wavelength) strike on its sensor. Both values have a high correlation and clearly when twilight colours (lower wavelength colours) hit the sensor, it consistently gives high readings – see Fig. 1. The obtained response curve of SQM multiplying the spectral responsivity of the TAOS TSL237 photodiode by the transmittance of the Hoya CM-500 filter.

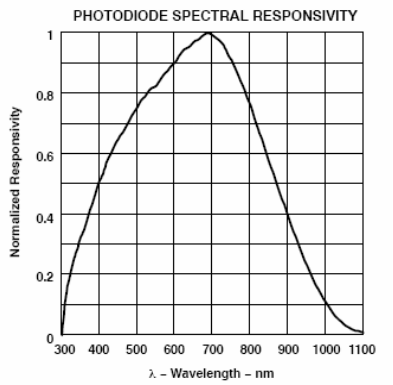

Fig. 1. Spectral response of SQM.

III. Experimental Procedures

The brightness of twilight sky observations were carried out from May 2007 until April 2008 intermittently in accordance of photometric night. We choose one (1) site in Malaysia with certain qualities, i) best obstruction-free horizon and ii) the least light-pollution surrounding. It was carried out in the city peripheral Port Klang (Selangor). We took appropriate measure for every phase i.e. pre-observation, observation and post-observation [7]. The measurements were covered between 400-700 nm in accordance of human eyes and SQM range. Data were taken in two minutes interval.

IV. Result and Discussion

For Isha', receipt of light is measured in terms of increase in magnitude values (decreasing of light) and fluctuate between 17.3^o-19.5^o. By plotting the magnitude values against time, a characteristic growth curve can be observed. The curve is divided into three (3) phases. The first phase is slow growth which means there was still bright light even the Sun just set. In the second phase shows a minimum of two gradual acclivities is increase at the certain rate. The gradual acclivity demonstrates receipt of light when the Sun is at certain degrees below horizon (6^o and 12^o). The third stage is the stationary phase when growth stops and no increase in magnitude values for a period of time and this prove the beginning of Isha' is indicated by a formed plateau – see Fig. 2 as interpreted from Table I.

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Nur Nafhatun Md Shariff, Amran Muhammad, and Mohd Zambri Zainuddin are with Faculty of Science, University of Malaya (UM) (e-mail: nur.nafhatun.ms@gmail.com).

Zety Sharizat Hamidi is with Faculty of Applied Science, MARA University of Technology (UiTM)

TABLE I: LIGHT DETECTION OF ISHA' AT PORT KLANG, 5 APRIL 2008

Time	SQM	Altitude of Sun
19:10	8.22	2.461
19:12	8.55	1.978
19:14	8.73	1.495
19:18	9.12	1.012
19:22	9.69	0.529
19:24	9.98	0.046
19:26	10.47	-0.956
19:28	10.48	-1.456
19:30	11.24	-1.955
19:32	11.73	-2.454
19:34	12.21	-3.753
19:36	12.65	-4.786
19:38	12.76	-5.752
19:40	14.55	-6.236
19:44	15.44	-6.789
19:46	15.81	-7.686
19:48	16.25	-8.169
19:50	16.66	-8.653
19:52	17.23	-9.136
19:56	17.96	-9.619
19:58	17.99	-10.586
20:00	18.23	-11.553
20:02	18.46	-12.553
20:04	18.55	-13.003
20:06	18.69	-13.487
20:08	18.95	-13.97
20:10	19.11	-14.454
2012	19.12	-14.938
20:14	19.13	-15.422
20:16	19.13	-15.906
20:18	19.23	-16.39
20:20	19.5	-16.874
20:22	19.48	-17.358
20:24	19.36	-17.842
20:26	20.32	-17.927
20:28	20.33	-18.326
20:32	20.32	-18.81
20:34	20.3	-19.03
20:36	20.28	-19.294
20:38	20.23	-19.778
20:40	20.22	-20.262
20:44	20.23	-20.746
20:46	20.21	-21.23
20:48	20.23	-21.714
20:52	20.24	-22.682
20:54	20.22	-23.166
20:56	20.23	-23.65
20:58	20.21	-24.134
21:00	20.2	-25.393

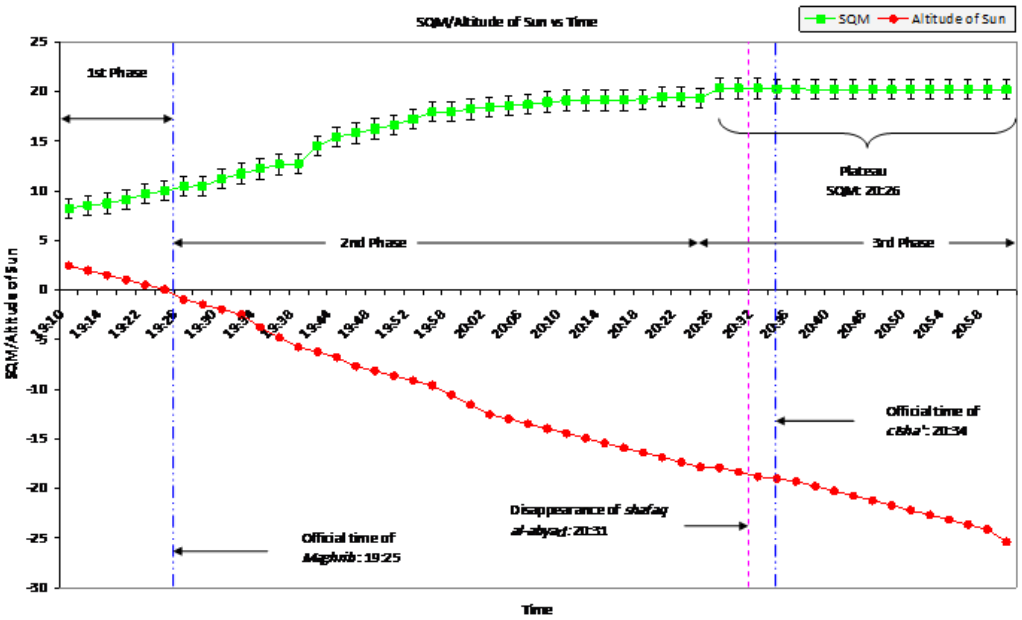

Fig. 2. Ligh de ec io of sh' Po K g, 5 Ap i 2008 .

V. CONCLUSION

From the evidence, SQM is able to assist the process of determining the beginning of Isha'. It is plausible that the value of twilight angle is fluctuating between for Isha' according what is given by the instrument.

VI. ACKNOWLEDGEMENT

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