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Astronomical Analysis: Viral Video of the Sun Rising from the North in Jeneponto

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ABSTRACT

This study aims to conduct an astronomical analysis of the viral video of the Sunrise from the north on Thursday, June 17, 2021, in Jeneponto Regency, South Sulawesi, Indonesia. The video shows a man testifying to the Sun's position in the north and associating this phenomenon as one of the signs of the Day of Judgment. It attracts much attention to become a trending topic, both of social, national, and international media. This research is descriptive with a qualitative approach using library research methods and content analysis of location, calculations, and images. Primary data was obtained through the interview, while secondary data came from related articles and books. Data collection techniques used documentations and relevant data or theories to the research question. Furthermore, the collected data were analyzed inductively and comparatively. Location analysis was carried out using the Google Maps application, and it was found that the coordinates of MAN Binamu Jeneponto were at 5.67o South (S) and 119.73 East (E). Through calculation analysis, it is known that day the Sun rose in Jeneponto at 06.08 WITA with an azimuth of 66° 35' 23". The comparative analysis between the video displays and google maps was then applied and found that the north direction shown in the video was not the actual one. The confirmation process concluded that the Sun did not rise from the north but the east (towards the northeast). The misunderstanding of Qiblah leading the west causes the observer's misidentification of the Sun's position.

Keywords: Astronomy; the Sun's position; falak; viral.

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INTRODUCTION

On Thursday, June 17, 2021, a video circulated saying that the Sun rises from the north (Berita Satu, 2021). In the video, which has a duration of 3 minutes 22 seconds, a man can be heard testifying about the Sun's position at MAN Binamu Jeneponto, which he thinks the Sun is in the north. According to the man who works as a teacher, the video was taken on Thursday, June 17, 2021, at 08.00 WITA. He made a video because he thought the Sun's position at that time was strange: rising in the north or being in the north. During the observer time, he confirmed the correct position of the Sun in the north, mentioning his position in the south and a mosque in the east. His complete statement in the video with a typical Makassar accent is as follows.

> Peace be upon you, and Allah's mercy and blessings. I only want to report from the location of MAN Binamu, something extraordinary has happened, where the Sun is in a position in the north, well, this morning, "apakah inne karaeng." What day is it today? This day is Thursday, June 17 where we are together with friends at MAN Jeneponto. Witnessing directly with the head's eyes happened an oddity. I say this is odd because I have never seen one before where the custom in the morning the Sun rises in the east. Nevertheless, now just before eight o'clock, it turns out that the Sun is in the north position. It does not usually happen like that. Once again, I want to convey that we think the Sun's position is strange because we have never seen this Sunrise before. Well, I guess so. Well, this looks a little weird. Because usually, the Sun in the morning is in the east position. However, now I notice the Sun is in the north.
>
> It is in the north. Now the Sun is in the north. This morning, with our friends at MAN Jeneponto, we are standing in the south position, and this time the Sun is in the north; this is a fact indeed. There is a mosque here, right? This is the east position. So what I am recording is the east position. Moreover, the Sun has risen in the north since two hours ago, or it seems to be in the north.

This video is interesting because it does not only show the Sun rising but also it regards with religious belief, Islam. As in one hadith narrated by Bukhari, Muslim, Abu Dawud, An-Nasa'i, Ibn Majah, and Ahmad, the apocalypse will not occur before the Sun rises from the west. The Observer assumes that if the Sun has risen from the north, the Sun may rise from the west when the apocalypse occurs. His complete statement is as follows:

> So this is if we are believers, as Muslims. We usually hear warnings from the Prophet Muhammad SAW. One sign of the apocalypse comes when the Sun rises in the west and set in the east. The situation we see this morning is a sign that someday the Sun will rise in the west because it is now in the north. Well, I think that is enough reports from me who saw this incident

firsthand. Hopefully, this can be useful. At least it will be a warning for all of us that the apocalypse will tak place and, now, there are signs.

This video was going viral on social media for a few days. It is widespread in various WhatsApp application groups and posted by netizens on Facebook, Instagram, and Twitter. National mainstream media such as Kompas, CNN, Tempo, Republika, Okezone, Kumparan, Detik, Tribun Timur did not miss to preach. Not only domestically, but this video is also viral to foreign countries, even becoming the top news in Malaysia (Adm, 2021c; Aida, 2021; Fea, 2021; Hafizah, 2021; Hariyadi, 2021; Mappiwali, 2021; Nai, 2021; Sumardi, 2021).

The content of this video raises questions about the truth of the Sun rising from the north. This event may be accurate, but it is possible for the misunderstanding of observers regarding the phenomenon. The hint of identification error in terms of Qibla direction when referring to a mosque as a direction parameter. It is pretty reasonable to refer to the previous research`s results, which proves that errors in determining the direction of the mosque's Qibla occur in many areas in South Sulawesi (Alamsyah, 2016; Jusran, 2019; Yusuf, 2014). Therefore, it is considered essential to conduct an astronomical analysis of the viral video of the Sunrise from the north in Jeneponto. This research is expected to reveal the truth of the video and build a correct public understanding of the phenomenon: the Sunrise and the Qibla direction.

RESEARCH METHODS

This research is classified into descriptive research with a qualitative approach (Hamdi & Ismaryati, 2019). The method uses content analysis and literature study (Jonathan, 2006), where the data come from videos, articles, research, and related references (Creswell, 2015). The content analysis method is carried out on video content, both location, calculations, and images, to test information regarding the Sunrise from the north (Schreier, 2012). The primary data used as data sources were obtained from direct interviews with one of the teachers of MAN Binamu Jeneponto, who was at the location when this incident took place, and recognize well the ins and outs of the school. Secondary data is sourced from relevant articles and books. Documenting and searching relevant data or theories to the research question are the selected data collection techniques. The data of location, calculations, and images that have been obtained are then analyzed inductively and comparatively to support the author's astronomical ideas (Haryanto, 2017).

RESULTS AND DISCUSSION

Determination of the Position of the Sun

The Earth and the Sun motion

The Earth has two motions, rotation, and revolution. Rotation means the Earth was spinning around the axe. It will take 24 hours and causes the exchange of day and night. The Earth that faces the Sun experiences the day phase, while another experiences the night phase (Peltier, 2007).

The Earth's revolution is the movement of the Earth around the Sun which takes 365.2425 days (Trurnit, 1995). The duration of the Earth's revolution is the basis for calculating the S\syamsiah/solar/gregorian calendar. There is an excess of 0.2425 from 365 days, making the Gregorian calendar known as a leap year (Rusdin, 2017). The leap year is one day more than the length of the normal year. If, in general, the total number of days in one year is 365 days, in a leap year, it will become 366 days. The current additional day takes effect in February, changing from 28 to 29 days. If 0.2425 is multiplied by four, the accumulation will approach one day. Therefore, a leap year will generally repeat itself every four years (AlModarresi & White, 2004).

An international agreement states that a leap year occurs when a year is divisible by four but not 100. For example, 1976.2472 and 2020 are the leap years because those are divisible by four, but not 100. On the other hand, 2020 is divisible by four, 505 (this is divisible by 100 because of resulting an integer), but if it is divided by 100, the result is 20.2 (it is not divisible by 100 because it is a fraction). However, even if the year is divisible by 100 and 400, it is still a leap year. Thus, 1700, 1800, and 1900 do not leap years, but 1600, 2000, and 2400 are vice versa (Dolven, 2017).

The Earth's rotation around the Sun forms a flat plane, called the ecliptic plane, as shown in figure 1 (Polyakhova et al., 2015). The ecliptic plane is not parallel or coincides with the Earth's equator but forms an angle of 23.5 degrees so that the Earth's axis is also not perpendicular to the ecliptic plane (forming an angle of 63.5 degrees). It means that sometimes the northern hemisphere is closer to the Sun (summer in the north and winter in the south) and sometimes vice versa. Seasons' change occurs to the tilt of the Earth's axis and the movement of the Earth around the Sun (Raisal & Rakhmadi, 2020).

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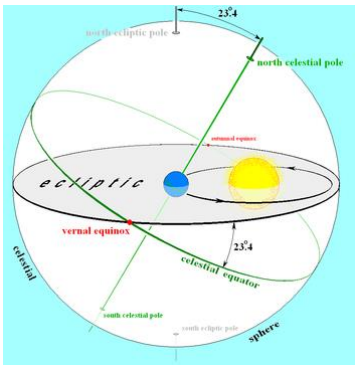

Figure 1. The plane of the Ecliptic in a Spherical Coordinates System

The apparent motions of the Sun

The Earth's rotation will cause the apparent daily motion of the Sun. Initially, the Sun rises from the east, reaches the peak, and sets in the west. Sunrise from the east is caused by the direction of the Earth's rotation counterclockwise when viewed from above the north pole (Rohman, 2016).

The revolution of the Earth and the 23.5 degrees tilt of the equator with the ecliptic plane will suggest that the Sun moves north and south as far as 23.5 degrees from the equator, which is better known as the annual apparent motion of the Sun. The Sun seen from the Earth is not continuously at the equator but changes position periodically from -23.5 degrees (south) to 23.5 degrees (north), and vice versa. When the Sun is at its northernmost point, called the northern solstice, it occurs on June 21. As for its southernmost point, it is called the southern solstice (December 21). The Sun is at the equator in March and September, known as the March and September equinox (Meeus, 1998).

Coordinate system

The representation of the object's position on the Earth's surface as a shape resembling a sphere, expressed by latitude and longitude, is known as geographic coordinates. Latitude represents the angle of north and south positions, where the zero point is on the equator. The plane created from the equator is termed the reference plane. The longitude represents a circular angle from west to east where the city of Greenwich is the zero degree point (Morison, 2013).

Likewise, the position of celestial bodies, according to spherical astronomy, when viewed from the Earth, is also represented by coordinates depending on the reference plane (Anugraha, 2012). If the reference plane is the ecliptic plane, it is called the ecliptic coordinate system. In ecliptic coordinates, the position of an object is expressed by the ecliptic latitude and ecliptic longitude. If the reference plane is the equator, the position of a celestial body is expressed by declination (similar to latitude) and right ascension (similar to longitude). As the name implies, this is called the equatorial coordinate system. When humans are in a place, they

will see their surroundings within certain limits of vision. The limit of human view on the Earth's surface is the horizon. The coordinate system built on this basis is called the horizon coordinate system, where the latitude is termed the altitude while the longitude is termed the azimuth (Dialynas et al., 2013).

Calculation of Sun position

The Sun is one of the celestial bodies. Therefore, its positions are also expressed through the latitude and longitude of the ecliptic, declination, right ascension, altitude, and azimuth. By considering the Earth as a sphere, experts have been able to derive accurate formulas for determining the position of celestial bodies. If the ecliptic coordinates are known, the declination and right ascension can be found (Anugraha, 2012). The coordinate transformation formula follows the geocentric ecliptic (λ, β) to the geocentric equator (α, δ) (Meeus, 1998).

$\lambda = \text{lambda}, \beta = \text{beta}$

$\alpha = \text{alpha}, \delta = \text{delta}$

$\varepsilon = \text{epsilon}$

$$\tan(\alpha) = \frac{\sin(\lambda)\cos(\varepsilon) - \tan(\beta)\sin(\varepsilon)}{\cos(\lambda)}. \qquad (1)$$

$$\sin(\delta) = \sin(\beta)\cos(\varepsilon) + \sin(\lambda)\cos(\beta)\sin(\varepsilon). \qquad (2)$$

Furthermore, using variables in the geocentric coordinate system (alpha, delta) is transformed to horizon coordinates (h, A) is (Anugraha, 2012),

$$\sin(h) = \sin(\phi)\sin(\delta) + \cos(\phi)\cos(\delta)\cos(HA). \qquad (3)$$

$$\tan(As) = \frac{\sin(HA)}{\cos(H)\sin(\phi) - \tan(\delta)\cos(\phi)}. \qquad (4)$$

$$A = As - 180.$$

Altitude and azimuth in the horizon coordinate system can be known, then. The application of the coordinate transformation is used to find the altitude and azimuth of a celestial body. Meanwhile, to calculate the time of Sunrise, the formula derived from the spherical triangle equation (Karttunen et al., 2007) is utilized to obtain the hour angle formula (HA) as follows (Meeus, 1998):

$$HA = ACOS(COS(HA)) \qquad (5)$$

Where,

$$\mathrm{COS(HA)} = \frac{[SIN(h) - SIN(L)SIN(\Delta)]}{[\mathrm{COS(L)COS}(\Delta)]} \qquad (6)$$

As for the time of Sunrise, it can be sought by the equation,

$$Matahari\ terbit = Transit - (HA_{\ matahari\ terbit})/15 \qquad (7)$$

whereas it is known,

$$Transit = 12 + Z - B/15 - ET/60 \qquad (8)$$

Several variables affect the time of Sunrise, namely latitude and longitude coordinates (L, B), time zone (Z), equation of time (ET), the Sun's declination, and altitude of the Sun at Sunrise (h) (Anugraha, 2012).

The Sun position calculation accuracy

The Modern astronomical reckoning is very accurate for determining the position of celestial bodies because it has used a computational system or better known as the astronomical algorithm (Grena, 2008). At least three astronomical algorithms are commonly used to determine the Sun's position: the low accuracy, Meuss, and VSOP-87 algorithm. All three are accurate, but the most accurate one is the VSOP-87. The difference in accuracy is determined by the number of periodic terms used. The low accuracy algorithm only uses dozens to tens of periodic terms. The Meeus algorithm utilizes hundreds of periodic terms. VSOP-87 is the most accurate because it uses thousands of periodic terms (Anugraha, 2012). Azhari (2007) states that modern calculations are very similar to the realities in the field.

The occurrence of a lunar eclipse on May 26, 2021, can be used as an example. By astronomical reckoning, it is known that the total lunar eclipse in Makassar began at 19:11, reached a maximum at 19:19, and ended at 19:26 (in local time) (Adm, 2021a). When observing and taking pictures, it was found that it was confirmed that from the beginning to the end, the maximum eclipse occurred at the same time as previously predicted. Figure 2 below shows the maximum eclipse at 19.19 WITA.

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Figure 2. Maximum Phase of a Total Lunar Eclipse, May 26, 2021, at 19.19 WITA

It is in line with what was written by Baolin and Fiala (1992), Afifi (2019) and Maghfuri (2020) that eclipse events can be predicted accurately using modern algorithms for many years. The National Aeronautics and Space Administration is a credible institution that applies modern algorithms to calculate the Sun's position, well-recognized as NASA (Basthoni, 2020). NASA uses the VSOP-87 algorithm to calculate the Sun's position and ELP2000 to calculate the moon's position (Espenak, n.d.).

Astronomical Analysis of Viral Video of Sunrise from North in Jeneponto

Location analysis

The location analysis of the incident plays a very strategic role; this is the primary basis for further analysis so that the objectives of this research can be achieved. The content of the analysis is also quite broad, starting from geographical coordinates, government administrative areas, topology, climate, weather at the time of the incident, and local cultural and religious conditions.

In the viral video, it is stated that the shooting location was at MAN Binamu Jeneponto. By using the Google Maps application, it is known that the coordinates of MAN Binamu Jeneponto are at 5.67◦ South (S) and 119.73 East (E) or 5º 39'55.6 `` S, 119º 43` 43.6` E [14]. MAN Binamu is located in Jeneponto regency with coordinates of 5.23'12"-5.42'1.2 S and 119.29'12"-119.56'44.9" E [15] . In effect, the time zone in this area is eight hours ahead of Greenwich Mean Time (GMT + 8) or in Indonesia, -popularly known as Waktu Indonesia Tengah (WITA).

Jeneponto is one of the regencies at the western end of South Sulawesi Province, which is about 90 km from the city of Makassar. In the east, Jeneponto is bordered by Bantaeng Regency. Takalar Regency borders Jeneponto to the north and west, while Gowa Regency only borders the north. In the south, it is bordered

by the Flores Sea. Jeneponto consists of 11 districts, covering 114 villages and sub-districts. One of these sub-districts is Binamu, where MAN Binamu is located. Overall, Jeneponto Regency has an area of 749.79 sq km[1].

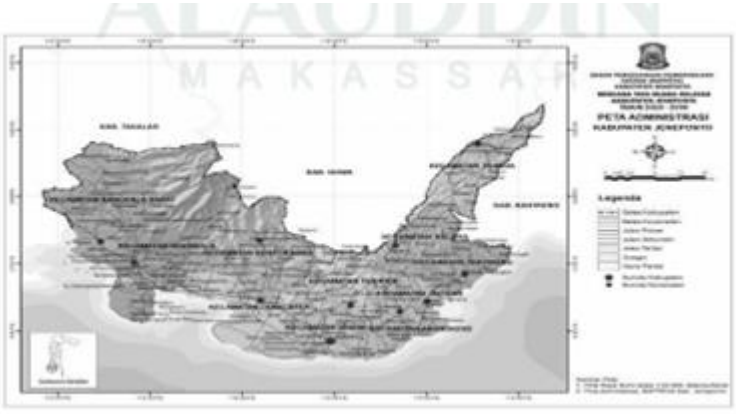

Figure 3. Map of Jeneponto Regency

Flat, undulating, rolling, hilly to mountainous area are topographic variations of Jeneponto. About 53.68% of Jeneponto Regency's area has a flat and wavy topography, with the slope in more than 15% of the entire region. The vast majority of the area is fields and gardens, whereas the drylands cover the rest (BPS, 2014).

The northern part of Jeneponto is comprised of highlands and hills with a level of 500 to 1400 meters above sea surface (stretching from west to east). On the other hand, the southern region is a lowland with only 0-100 meters above sea level. The plain area is in the middle (altitude of 100-500 meters above sea level) (BPS, 2014).

There are only two seasons in Jeneponto Regency, like other tropical areas, rainy and dry. Generally, November to April is the rainy season, and the rest priod is the dry season. The climate is classified as a dry area because of the distribution pattern and the low rainfall (BPS, 2014).

In the video, it is said that the shooting took place towards 8.00 am. The weather in Jeneponto at that time was sunny as the Sun could shine clearly. It was also reported by a credible weather website (IBM, 2021). It ranged from six in the morning to noon; the temperature was 22 - 32 (degrees), the humidity was 81%, and the wind speed was 4 kilometers per hour towards the north (Adm, 2021b).

(Firman, 2011) wrote that the Jeneponto community is unique because of the population's homogeneity in terms of religion and ethnicity. All residents are Muslims and ethnic groups of Makassar. It produces a conversational and accommodative interaction between Islam and culture; Islam brought specific values into the existing cultural identity of the Makassar tribal community, which later became local wisdom. This will lead to the understanding that the observer

connects the phenomenon with the apocalypse due to the local people's strong religion.

Calculation analysis

A calculation analysis is a primary key to testing the statement's truth for the Sunrise north in Jeneponto. Based on the information obtained from the video, two things can be analyzed: the sunrise moment and the Sun's position according to the time indicated in the video.

1. The Sunrise

The Sunrise is the position of the Sun when its entire plate has just passed the eastern horizon (Meeus, 1998). The horizon is the horizontal plane of the celestial sphere that passes through the center of the Earth and is perpendicular to the vertical plane of the Observer (Azhari, 2001). By knowing the coordinates and time zone of Jeneponto, the sunrise's time on June 17, 2021, can be calculated using the VSOP87 algorithm (Anugraha, 2012).

Table 1 Altitude, Declination, and Azimuth of the Sun at 06:08:08 WITA

Position	Degree: Minutes: Second (Arc)
Altitude	-00:50:01
Declination	+23:22:35
Azimuth	66:35:23

Based on calculations, it is known that the Sun rises at an altitude of -00:50:01, not 00:00:00. This result indicates that the Sun has not yet risen at that position because the upper disk has not yet reached the vertical plane of the observer; this shows how important to understand the two types of sun altitudes: apparent and true one. The former is the height visible to the Observer's eye, while the latter is the actual height of the Sun (Meeus, 1998). The altitude of -00:50:01 obtained by calculation is the actual altitude. Simultaneously, the observers somewhere will see the Sun's upper disk just under the horizon by the Sunrise's definition (apparent altitude) (Karttunen et al., 2007).

Both of the sunlight, refracted by the Earth's atmosphere, and the apparent radius of the Sun are the sources of such difference (Anugraha, 2012). The refraction is the bending of a wave when passing through two mediums with different refractive indexes. The effect of this makes the Sun's altitude always appear 34 arc minutes higher than it is (Karttunen et al., 2007). Meanwhile, the Sun's apparent radius is the distance between the center point and the boundary of the solar disk visible to observers on the Earth. The length of such an apparent radius is 16 arc minutes (Morison, 2013). If both are added up, it will come to 00:50:00. Therefore, when the Observer observes the Sun's upper disk strictly under

the horizon, the apparent solar altitude is 50 arc minutes lower than the horizon due to astronomical calculations.

More importantly, this result confirms that the Sun does not rise before 08.00 WITA, but at 06:08:08 WITA. The Sun rising from the north in the video can also be compared with the results of this calculation. The north azimuth is 0 degrees (Darajat et al., 2016), while the Sun's azimuth at Sunrise is 66:35:23 (66.6 degrees). This data asserts the Observer's error in identifying the sunrise position. At that time, it is 66.6 degrees from the north. Its position is clearly far from the north – even the northeast (45 degrees) is not reachable (Beers, 2017).

One particularly more interesting point highlighted from this fact is the public perception that the Sun always rises from the east (Pandian, 2019), where the east azimuth is 90 degrees (Beers, 2017). However, the calculations result using the VSOP87 algorithm reveals an azimuth difference between the sunrise position and the east, 23.4 degrees. This difference affirms that the Sun does not rise from the east but shifts towards the northeast by 23.4 degrees. In addition, it can also be known that the angle of the shift in the Sun's rising point is identical to the Sun's declination magnitude at that time, namely +23 o 22` 35 "or 23.4 degrees.

The relation between the sunrise azimuth and its declination can be confirmed by attesting to any other months in a year.

Table 2. Table of Rising Time, Declination, Azimuth, and Azimuth Difference of the Sun

	March 20, 2021	**September 23, 2021**	**December 21, 2021**
Sunrise time (WITA)	06:03:16	05:48:14	05:43:26
Deckination*	-00:11:25 (0.2)	-00:02:23 (0.04)	-23:26:06 (23.5)
Azimuth*	90:19:22	90:10:17	113:42:11
Sun Azimuth deviation From East*	00:19:22 (0.3)	00:10:17 (0.2)	23:42:11 (23.7)

* In units of Degrees: Minutes: Seconds

It seems that the Sun's declination tends to affect the sunrise azimuth. On March 20, 2021, when the Sun's declination is 0.2 degrees, its azimuth comes 0.3 degrees from the east, 0.1-degree derivation only. Similarly, for the Sun's declination of 23.5 degrees, the Sun's azimuth at Sunrise is in the direction of 23.7 degrees from the east. Thus, it is noticeable that the sunrise azimuth deviation from the east is influenced by the magnitude of the Sun's declination.

This declination of the Sun results in the apparent annual motion of the Sun. In March and September, the Sun's declination approaches zero degrees because, at

this time, the Sun is above the equator. On the other hand, in June and December, the Sun is north and south of the Earth, respectively, with the farthest point of 23.4 degrees (Rusdin, 2017). Hence, it can be understood that the Sun's declination in Jeneponto on June 17 deviated about 23.4 degrees from the east to the north/northeast due to the Sun's apparent annual motion, which was indeed at a point of 23.4 degrees to the north.

2. The position of the Sun at 08.00 WITA

The Observer informed that by 08.00 WITA, the Sun was in the north position. The truth of this statement will be analyzed by calculating the Sun's position before 08.00 WITA on the spot. Because there is a vocab for 'towards,' it is understood that it was not yet 8:00 am WITA. Therefore, in this calculation, a time close to, for example, 07.50 WITA is taken. By entering the coordinates of Jeneponto Regency, time zone, and time of observation, then applying the VSOP-87 algorithm.

Table 3 Altitude, Declination, and Azimuth of the Sun at 07:50:00 WITA

Position	Degrees: Minutes: Second
Altitude	+22:03:45
Declination	+23:22:43
Azimuth	61:56:07

Table 4 Comparison of the Sun position at 06:08:08 WITA with 07:50:00 WITA

Position at	06:08:08 WITA	07:50:00 WITA	Difference
Altitude*	-00:50:01	+22:03:45	+22:02:54
Declination*	+23:22:35	+23:22:43	00:00:08
Azimuth*	66:35:23	61:56:07	05:20:44

* In units of Degrees: Minutes: Seconds

It seem that there is a difference of 1 hour 41 minutes 52 seconds between Sunrise and observation time. Significant changes were seen in the altitude and azimuth within nearly two hours. The Sun's altitude increases by about 22 degrees, and its azimuth decreases by about 5 degrees. The altitude and the azimuth are horizon coordinate systems, which take the horizon of vision as the reference plane. Due to the Earth's rotation, the Sun's position from a specific horizon will also change as the Earth rotates on its axis. The first time a horizon on the Earth encounters the Sun is called sunrise. When the Sun is strictly at its highest point, named a transit, and the last time the Sun is seen from a specific horizon on Earth is sunset. Events from one transit to the next one; this is called a day that represents the Sun's daily motion (Meeus, 1998). Therefore, the altitude and azimuth as part

of the horizon coordinate system, their values will change as the Earth rotates on its axis. Both changes over time represent the apparent daily motion of the Sun.

The high Sun means that it will continue to rise in the morning until it reaches its peak and then sets. The reduced azimuth indicates the Sun is also moving towards the north (azimuth 0 degrees) to the west at Sunset (Beers, 2017); this is evident when further comparisons are made to the solar data culmination and Sunset.

Table 5. Data Comparison of the Position of the Sun at Rising, 07.50 WITA, Culmination, and Sunset on June 17, 2021

Position at (WITA)	06:08:08 (Rise)	07:50:00	12:02:00 (Culmination)	17:55:51 (Sunset)
Altitude*	-00:50:01	+22:03:45	+60:57:02	-00:49:55
Declination*	+23:22:35	+23:22:43	+23:23:03	+23:23:23
Azimuth*	66:35:23	61:56:07	359:59:58	293:25:27

*In units of Degrees: Minutes: Seconds

Like the definition of Sunrise, Sunset is also marked by its upper disk touching the horizon. Thus, the Sunset's apparent altitude is -00:50:00 (Meeus, 1998). Table 5 above shows the altitude -00:50:00 at Sunrise and -00:49:55 at Sunset. The results of these calculations are by the definition of Sunrise and Sunset. Meanwhile, +60:57:02 is the Sun's highest point on that day for the reference location of Jeneponto. It is clear that at that time, the Sun was not exactly on the top of Jeneponto city, with a margin of about 30 degrees from its vertical position. This fact is related to the Sun's declination at that time (+23:23:03), which was not the same as the latitude of Jeneponto (-05:39:55.6). If the declination and latitude of the city are the same, then the Sun will be at an altitude of +90:00:00. For the city of Jeneponto, the Sun will experience its great culmination on March 8, 2021, at 12:12:30 WITA, and October 6, 2021, at 11:49:51 WITA. Albeit not precisely east, the 66:35:23 azimuth still represents the east position for Sunrise, and 293:25:27 still represents the west at Sunset. The 00:00:00 or 360:00:00 azimuth is the north azimuth when the Sun is highest.

As a comparison, another day can be taken, for example, December 21, 2021, and then compared between the data on the Sun's position at sunrise, culmination, and sunset.

Table 6 Data Comparison of the Sun's Position at Rising, 07.50 WITA, Culmination, and Sunset on December 21, 2021

Position	05:45:26 WITA (Sunrise)	11:59:04 WITA (Culumination)	18:12:42 WITA (Sunset)
Altitude*	-00:50:08	+60:57:02	-00:49:55
Declination*	-23:26:06	-23:26:14	-23:26:13
Azimuth*	113:39:00	179:59:40	246:20:54

*In units of Degrees: Minutes: Seconds

The Sun's rising and setting at the same altitude, about 50 arc minutes, and the height at culmination is about 61 degrees. Here, the Sun's azimuth is in December, in contrast to June. If June tends to the north, then December will be vice versa. It starts with a rising azimuth 23.4 degrees greater than the east until it sets at 23.4 degrees less than a west azimuth. The difference in the direction of the Sun's azimuth is influenced by the Sun's declination, which is at the point – 23.4 degrees (south of the equator).

Based on this analysis, it can be concluded that the Sun rising from the east (slightly in the east), reaching a peak in the north/south (depending on the Sun's declination), and setting in the west (slightly to the west) is the daily motion of the Sun. Thus, the results of the calculation analysis refute the Observer's statement that the Sun's position is in the north at 08.00 in Jeneponto. At that time, the Sun was at an azimuth of 62 degrees in Jeneponto. This value differs only about 28 degrees from the east and 5 degrees from the rising position. The azimuth deviation of about 5 degrees from the rising position is a part of the apparent daily motion of the Sun.

3. Image Analysis

The location and calculations analyses have indeed succeeded in proving the misperception of the observer about Sunrise in the north but have not been able to explain the background driving it. Consequently, further analysis is needed to shed light on this issue. In this section, the author will perform an image analysis by comparing specific footage of the video with the image displays of the Google Map application.

By utilizing the google map application, the map of MAN Binamu Jeneponto can be seen as follows

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Figure 4. Map of MAN Binamu Jeneponto via Google Map with the cardinal directions

Because such application is equipped with a north direction (N, stands for *North* (English)), the cardinal directions in MAN Binamu can be constructed. In the picture above, it can be noticed the red arrows indicate the direction of north (U), east (T), south (S), and west (B).

On the other hand, by looking at the video carefully, several image pieces of the video are identical to the parts shown on the Google map.

Figure 5. The Sun, buildings, and trees at the 2nd second

Figure 6. Trees at 17th second

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Figure 7. Buildings and trees at 1:54

Figure 8. The wall of the mosque at 2:16

In the 2nd second (picture 5), you can see a picture of the Sun, trees, and one of the school buildings between the Observer and the Sun. Another tree image appears at 17th second (Figure 6) and 1:54 minutes (Figure 7), along with the buildings behind the observer. In picture 7 (2:16 minute), the observer shows the mosque he thinks is in the east. If the image is matched with the school map from google, the following image will be obtained.

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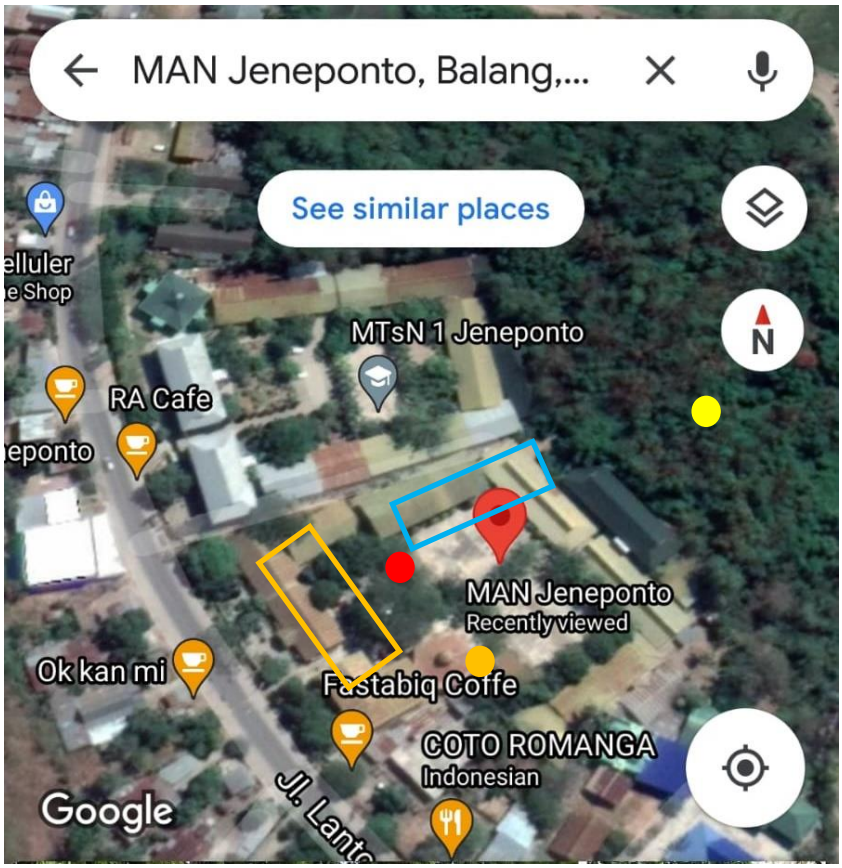

Figure 9. The suitability of the image in the video with the the Map of MAN Binamu Jeneponto with Google Map

The observer is on a red dot surrounded by trees, while a yellow circle symbolizes the Sun. The blue rectangle is a two-story building that appears at the second, between the observer and the Sun. The orange rectangle denotes a building positioned behind the observer. The mosque is concluded with an orange circle.

The observer tried to convince audiences that at that time, the Sun was really in the north position by stating that where they were standing was south and the mosque was in the east position. Departing from the critical statement, the description of the cardinal directions understood by the Observer is as follows,

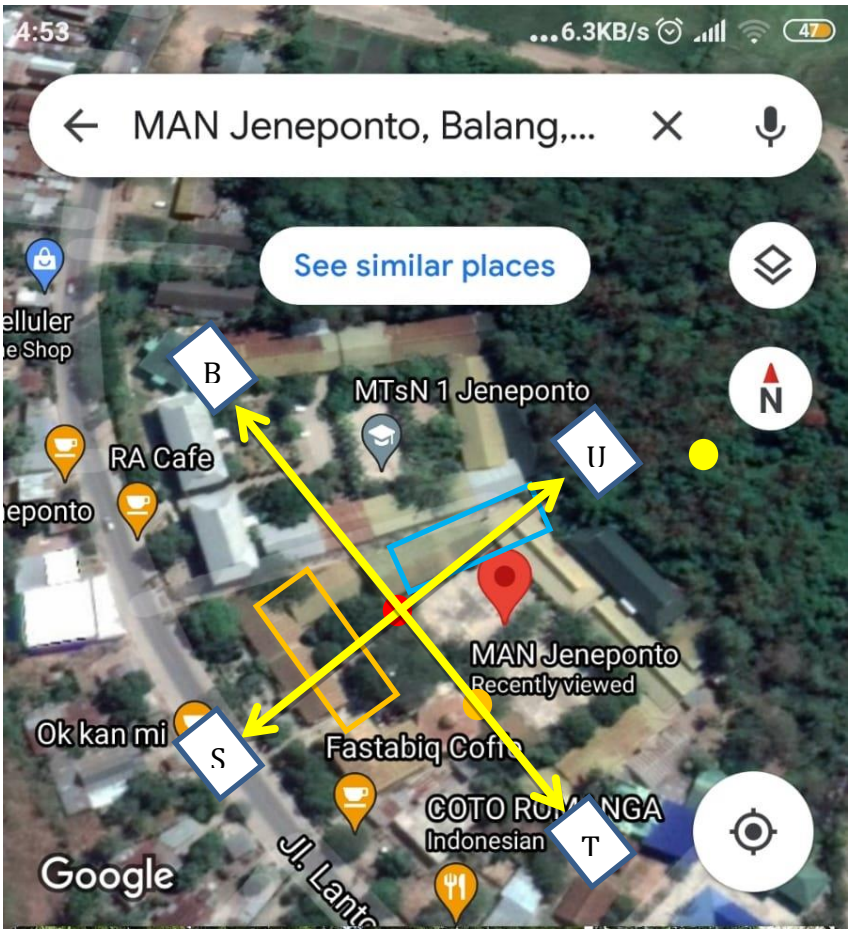

Figure 10. Map of MAN Binamu with the Observer's version about the cardinal directions

Suppose a comparison between the cardinal directions of the google map (red) and the observer's version (yellow) in Figure 11 is applied - it will be seen a clear difference in the direction perceived by the observer and the one presented on the google map.

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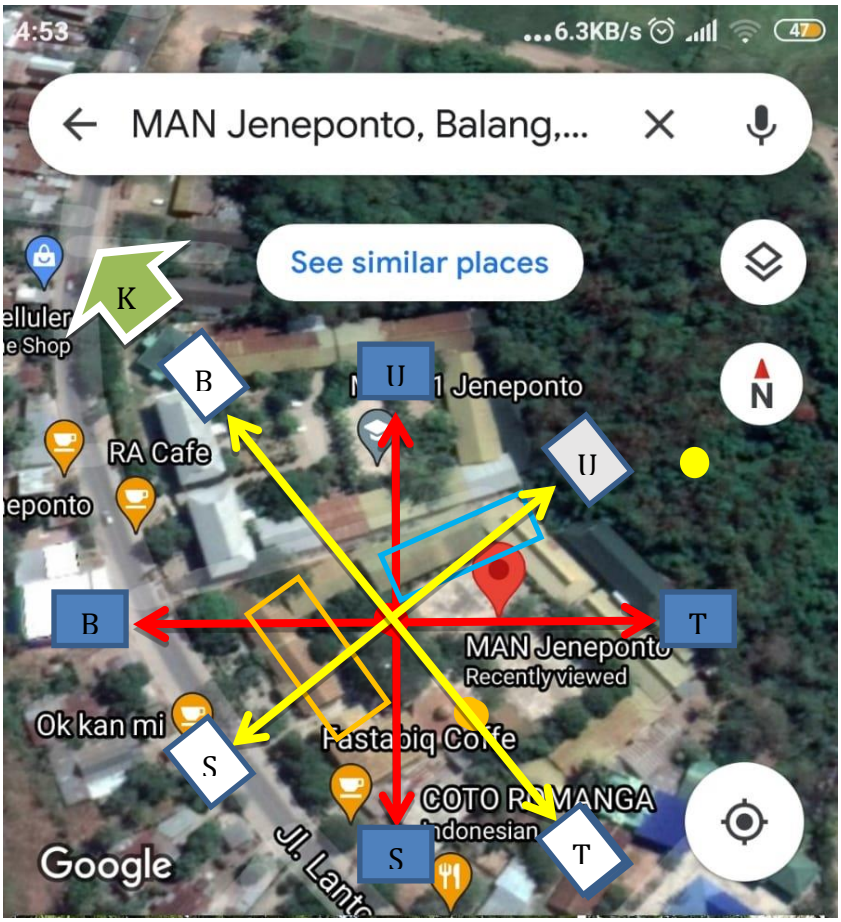

Figure 11. Comparison between the cardinal directions of the google map and the observer version

As Yu et al. (2019), Nabil et al. (2018), and Tafa (2018) conclude that google map is not necessarily accurate in determining position, so additional data is needed to test the accuracy of two different directions: the google map and observer. One of the vital clues is the existence of the mosque wall visible in the video. The author then interviewed a teacher at MAN Binamu named Sirajuddin, who knew precisely the condition of the school. One of the author's questions related to the visible walls of the mosque. He said the mosque wall shown in the video is the mosque's mihrab, where the imam stands to lead prayers. The Qibla direction is the same as the tree that appears right in front of the mosque wall (Interview with Sirajuddin, Jeneponto, June 18-19, 2021).

Referring to the information provided by Sirajuddin, it can be understood that the east direction stated in the video is not the actual east direction because the east is not opposed to the Qibla direction. According to (Wati, (2021), Jeneponto's Qibla direction is at an azimuth of 292 degrees (Q) from the north (U), as shown in the image below.

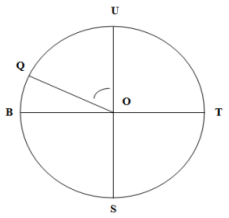

Figure 12. Qibla direction azimuth (Q) (Alamsyah, 2016)

If the Qibla is at 292-degrees azimuth, the opposite direction is obtained by subtracting 180 degrees to 112 degrees. The direction the Observer perceives to be east, as stated in the video. This azimuth value differs 22 degrees from the actual east, 90 degrees (Hambali, 2011). Thus, it can be noticeable that the actual east direction is the east which is depicted by the red arrow, not the direction of the one towards the mosque (yellow arrow towards the orange circle).

The analysis of this image also provides enlightenment that the observer incorrectly determined the east position, which resulted in the error in determining the west, south, and north positions. If it departs from the observer's eastern perception, he will define the east's left side in the north. If the Sun's position before 08.00 WITA is 61:56:07, it will be perceived as if the Sun is in the north. It is understood that the primary source of the observer's misperception regarding either the Sun`s north position by 08.00 WITA or the sunrise in the north because of an error in determining the east and west positions.

Suppose the observer understands that the east azimuth is opposite the Qibla direction, he also will think that the Qibla direction is towards the west of the Kaaba or the Kaaba is in the west. It is admittedly a society's common misconception. According to Muhammad Nur (Head of the Mosque, Hisab, Rukyat, and Sharia Development Section of the Ministry of Religion of South Sulawesi, South Sulawesi, May 6, 2021) and Abbas Fadhil (Chairman of the Hisab rukyat Badah Hisab Rukyat Commission, South Sulawesi, May 11, 2021), many people of South Sulawesi understand that the Qibla direction is in the west. It is evidenced by the number of deviations from the mosques` Qibla direction in various regions in South Sulawesi (Alamsyah, 2016; Jusran, 2019; Yusuf, 2014).

Not only ordinary people, but even the Indonesian Ulema Council (MUI) has also wrongly issued a fatwa that the Qibla is in the west (MUI, 2010). This fatwa was legalized in early February 2010 and published on March 22, 2010. Astronomers also raised their voices to straighten out the fatwa. The initial intention of this fatwa was to guide the people regarding the Qibla direction. However, the error in mentioning the Qibla direction creates a new polemic among people who question the praying validity in the case of facing the West (Nafi, 2015). Nafi added that there was a discourse in various media about the theme of the lawsuit related to the MUI fatwa of number 03 in 2010.

This polemic prompted the MUI fatwa commission to hold other assemblies involving astronomers. After holding four sessions, the MUI then updated the fatwa of no. 5 in 2010 that the Qibla was to the northwest (Khairraji, 2014). From this follow-up analysis, it is clear that the observer's error in determining the east and west positions was due to a misperception that the Qiblah was pointing to the west.[A0]

CONCLUSION

Several conclusions were obtained from location, calculations, and image analysis. First, MAN Binamu Jeneponto is located at coordinates 5° 39` 55.6 "S, 119° 43` 43.6` E with the time zone of GMT + 8, while Jeneponto city is situated in the range of 5°23' 12" - 5° 42' 1.2" S and 119° 29' 12" – 119° 56' 44.9" E. From the results of the calculation analysis, it was found that Thursday, June 17, 2021, in Jeneponto, the Sun did not rise from the north, but still the east (slightly to the northeast) with an azimuth of 66°35' 23". However, there is a deviation of 23.4 degrees from the east due to the apparent annual motion of the Sun. Likewise, at 08.00 WITA in the morning, the Sun is not in the north but is still in the east (slightly northeast) with a 61° 56' 07" azimuth. The 5° difference with the sunrise azimuth is driven by the Sun's apparent daily motion. Concerning the observer's error in deciding the north – south position, it is caused by his misconception in terms of positioning the west and the east. The Observer considers that Mecca leads in the true west (azimuth of 270°). However, the qibla's direction in Jeneponto is 292° from the north, or 22° from the west towards the northwest.

After conducting this research, the author suggests that astronomers/falak experts, preachers, and especially the ministry of religious affairs carry out more proactive socialization to enlighten the public that the qibla direction is not in the west, but towards the northwest (azimuth of 292°). Besides, the general public should be wiser in using social media by being more selective when sharing news.

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