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X-Blind Qibla Accuracy Test with Google Earth Standard

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Abstract

The problem related to the direction of the qibla is becoming more and more inclusive in the current era, considering that the suitability of the direction of the qibla is one of the prerequisites that must be met so that prayer can be considered valid according to sharia. In this Modern Era, there are Qibla directional instruments, both manual and digital-based such as Google Earth and Qibla compasses. In addition, there is also another innovation tool, namely X-Blind Qibla based on a modified compass with the addition of a buzzer. The author tries to examine the accuracy of the X-Blind Qibla with the standardization used, namely the Google Earth calibrator, based on a sample of mosques that have two typologies, namely the mosque that is right to the Qibla and the mosque that leads to the West. The research methodology stated in studying this problem is a qualitative method or field research. Based on the results of the study, it was found that the X-Blind Qibla deviated with an average value in the range of 1° 16' from the measurement results through Google Earth. The factors that affect the deviation are due to the effect of a large magnetic field, so that it has an impact on the movement of the compass magnetic needle. The value of the deviation is still understandable, if the reference in facing the qibla is the state of Saudi Arabia. This means that this tool can be applied in the practice of worship individually, even though it has not yet reached a high level of accuracy.

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A. Introduction

Qibla is the direction that unites all Muslims in prayer. Basically, it is mandatory for every Muslim to establish five prayers a day. The direction of the qibla is solely the direction in which a Muslim must face when he wants to perform prayers [1]. From a historical point of view, there are two orientations of the Qibla. The first is Jerusalem in Palestine, and the second is the Kaaba in the Al-Haram Mosque which is still used as a reference for the Qibla by Muslims [2]. Facing the qibla is part of the valid conditions for prayer, the meaning of which determines the validity of the prayer itself. So, if a person does not meet the valid conditions for the prayer, then his prayer is invalid or his actions are considered *null* (void) [3].

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In Indonesia, various people still consider the Qibla to be in the west. Of course, this cannot be claimed to be precise and right towards the Kaaba. Therefore, various qibla direction indicator devices have been developed that are available today. However, the reality is that not all circles easily determine the direction of the Qibla. For example, for the visually impaired, what if they want to perform prayers? Maybe for those who are normal they can still reach easily with various qibla directional tools. However, what about the visually impaired who cannot detect visually [4].

The determination of the position of the qibla, the time of prayer, and the identification of the beginning of the hijri month are fundamental aspects in the study of Islamic astronomy. These three elements play an important role in the practice of Muslim worship and require in-depth analysis for their application [5]. The determination of the direction of the Qibla is specifically focused on the position of the Kaaba to a certain geographical location on the Earth's surface. The process involves the use of geospatial data and astronomical methods to ensure its accuracy. Thanks to the advancement of technology and science in the modern era, humans can more efficiently determine the direction of the Qibla by utilizing tools such as digital compasses, theodolites, and *google earth [6]*.

In various research literature on aids intended for the visually impaired in knowing the direction of the Qibla, most of the devices designed using Arduino microcontroller-based technology consisting of various types, and equipped with ultrasonic sensors, *ohm speakers*, regulator modules and other components [7]. There are also those who design with infrared sensors *as an* additional component for detecting the direction of the qibla and the number of rak'ahs of prayer [8]. In addition, innovations have been designed with different concepts, but with the same function, namely innovations that develop rattan functions as qibla guidance sticks equipped with voice commands through earphones [9].

From some of the research results studied, it turns out that there are still not many qibla directional instruments that concentrate on the visually impaired. Therefore, the author is interested in studying a simpler and more practical innovation tool to manufacture and apply, namely, *X-Blind Qibla* which is elaborated with the use of compasses, *buzzers,* switches and batteries. *X-Blind Qibla* is one of the development tools in the field of astronomy aimed at those with visual limitations to help them find the position of the Qibla.

Considering the problems identified above, the author tested and analyzed an innovative tool called*X-Blind Qibla*. This product is specifically designed to make it easier for

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various groups, including individuals with visual disabilities, to determine the direction of the Qibla. The author researches how much accuracy the tool has in operation. For this reason, in testing the accuracy level of the tool, the author compares it with *the Qibla Direction Calibrator*, namely *Google Earth*. Google Earth is a software that is able to provide information about gesopasial data in the calculation of qibla direction data in various locations [10].In the context of this research, the author applies a qualitative method, which involves direct observation in the field to collect relevant data. The testing of the tool was carried out in several mosques that have two typologies, namely the orientation of the building facing west, and mosques whose qibla position is precise.

From the description of the problem above, there are several main topics of discussion that are studied, namely 1) How does *the X-Blind Qibla* and *Google Earth system work* in measuring the direction of the Qibla?, 2) What are the measurement results using *X-Blind Qibla* and *Google Earth*?, 3) How does the accuracy of *X-Blind Qibla*compare to the data generated by *Google Earth*?

B. Method

This scientific study is classified as qualitative research or field research. According to Sandu, et al. in their work *"Basics of Research Methodology"* as quoted by Rusandi that qualitative research was carried out because it focused on interpreting data obtained in the field [11].This study aims to describe the symbols and signs that are studied based on the actual representation [12]. In this study, the author tried to test the *X-Blind Qibla* tool in the field to find out the level of accuracy. In addition, the author also applies a *comparing*/comparison method to analyze the measurement results of the *X-Blind Qibla* tool with measurements made through *Google Earth* as standardization.

Regarding the research approach, the author uses an experimental approach, where the use of an instrument, namely *the X-Blind Qibla* as a test comparison object to prove the known hypothesis from the impression of practical experience [13]. The standards used based on Google Earth's Qibla direction measurement data with the intended sample are several mosques, first, whose building axis is right towards the Qibla, and second, facing West (which implements saf repair).

Meanwhile, the characteristics of this study are descriptive, which aims to examine the causal factors that are used as the basis for comparison related to objects observed in the field.

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Therefore, this study can be classified into descriptive-comparative research [14], in which the author implements a comparative methodology to analyze the measurement results of the *X-Blind Qibla* device with Qibla direction measurement data generated by *Google Earth*. The goal is to evaluate the level of precision or accuracy of the *X-Blind Qibla* tool. In this study, the author also describes the causal relationship that affects how much accuracy the tool is obtained.

Theoretical Framework

Instruments play a crucial role in the study of Islamic astronomy. The development of instruments is in line with the progress of a country, so that the existence of instruments reflects the progress of the country. The emergence of instruments in Islamic astronomy began with simple observations, which were then processed into computational and observational models, which eventually led to the concept of more complex instruments [15]. In astronomical practice, this computational model can be done using trigonometric theory, but in this case a computational tool is also needed, namely a scientific calculator [16].

1. Trigometri Segitiga Bola (*Spherical Trigonometry*)

Trigonometry is defined as a science that studies the measurement of angles and sides of triangles that can be used in the field of astronomy. In this context, trigonometry has a significant role, especially in the problem of finding the direction of the qibla where the calculation involves the method of scale and angle to produce accurate and accurate estimates. Mohammad Ilyas emphasized that the problem in determining the position of the qibla can be overcome with the concept of spherical trigonometry [17]. In Islamic astronomy, the type of trigonometric applied is *spherical trigonometry [18]*.

In the context of Islamic astronomy, the calculation method applied is known as the hisab method. Etymologically, the term "hisab" comes from the root word haasaba which means to calculate. Hisab science focuses on calculating the movement of the position of celestial objects, as well as being able to calculate the orientation of the Qibla. In the focus of calculating the position of the qibla, this method utilizes trigonometric formulas [19]. Meanwhile, to support this calculation process, a calculation tool is needed in the form of a scientific *calculator* equipped with degree mode (DEG) and degree units (°) [20].In determining the location of the qibla, in addition to using trigonometric formulas, a coordinate point of a place is also needed (South Latitude is rated negative (-), North Latitude is rated

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positive (+)).

The formula used is:

K = Ctg B = {Ctg b × Sin a − Sin c} – {Cos a × Ctg c}

a = 90° – LT b = 90° – LK c = λt – λk (BT - BK)

Information:

K: The direction is measured from the north point of the qibla to the west, or west to north, south to east, or east to south (depending on where it is located).

a : The bow of the Kaaba is calculated from the north point to its location (90°) and minus the latitude of the location.

b : The bow of the Kaaba is calculated from the north point to the position of the Kaaba (90°) and minus the latitude of the Kaaba.

c : The place arc is subtracted by the Kaaba arc [21].

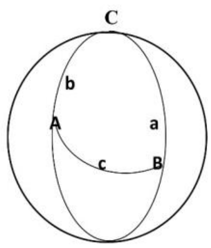

Figure 1 (triangle of the ball) [22]

C = North Pole

A = Letak Kakbah

B = Placement

a = North longitude distance to location

b = North Longitude Distance to Mecca

c = The distance of longitude from the Kaaba to the location

This theory is used by the author to evaluate the accuracy of the Qibla direction determination produced by the *X-Blind Qibla tool*, by referring to the geospatial data displayed in*Google Earth*. Through this approach, the author is able to identify the level of accuracy.

2. Magnetic Correction

The Earth's magnetic field is essentially influenced by internal sources, which come from the Earth's inner layers, as well as external sources such as solar radiation. The magnetic field can be analyzed based on strength and direction. The direction of the magnetic field is claimed to be a form of declination, which describes deviations from the geographical south,

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as well as inclination, which indicates storage from the horizontal plane. Accurate results require magnetic measurements, including daily variation correction and the use of the International Geomagnetic Reference Field (IGRF). Daily fluctuations refer to rapid changes and are related to the time and cycle of the moon. In this case, the IGRF correction is applied to the magnetic field measurement data to eliminate the influence of the Earth's main magnetic field. IGRF serves as a reference scale to determine the concentration of the earth's main magnetic field, so it can be applied as a reference to determine the magnetic strength at a certain location [23].

In this study, the author also reviewed the results of *X-blind Qibla measurements* based on magnetic declination values. Because, the basic component of this tool is a magnetic compass that always shows north and south directions. This is due to the influence of the Earth's magnetic field. The declination of this magnetic compass is constantly changing depending on the geographical location and time. Therefore, given the sensitivity of the compass to magnetic fluctuations, the use of this tool to measure the direction of the qibla requires great caution and precision [24].

To determine the true north, calculations are requiredwhich include magnetic correction. In Indonesia, magnetic fluctuations are observed in the range between -1 degree to 4.5 degrees, and the data can be reviewed through BMKG (Meteorology, Climatology, and Geophysics Agency) data [25]. This theory needs to be applied to obtain more coherent measurement results.

C. Results and Discussion

ConceptX-Blind *Qibla*

X-Blind Qibla is a tool designed in such a way to assist people with blindness in determining the direction of the Qibla when they want to carry out worship. The presence of this tool is certainly very important to be represented as a form of attention to those who have difficulties and limitations in visual activities, including carrying out prayers. The design of this innovation is designed by combining several components consisting of: analog compass and *buzzer bell* (main components), switches, batteries, and other complementary materials such as containers, cables, battery connectors, switch tenols, and acrylic. This innovation tool (*X-Blind Qibla*) was created by students and students of the Class of 2020 at *Sunan Kalijaga State Islamic University*, *Yogyakarta. The X-Blind Qibla* has also gone through stages of

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testing to determine the effectiveness of the tool. The test was carried out together with several Islamic astronomers.

Figure 2 Internal Device Design.

Figure 3 X-Blind Qibla *Products*

Here are the ways to use *X-Blind Qibla*, namely:

1. Activate *the X-Blind Qibla* by pressing the on/off switch button.
2. Move the tool by rotating it slowly until a sound appears. If the buzzer sensor sounds, then the compass has pointed north.
3. Next, feel the Qibla direction directions that have been provided at the top of the tool to find out the position of the Qibla direction.

Software Google Earth

*Google Earth*is an application that has various functions, including being able to display latitude and longitude coordinate points, altitude, distance measurements, angles, areas, circumference, and so on [26]. However, the image quality displayed in large cities is better than in small cities, and the resolution of satellite imagery is still low [27].One of the useful features of *Google Earth*is the *measure/ruler* which can display the distance between a certain location and the Kaaba in Mecca. The trick is that users of this application can draw a

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line from a certain location to the point where the Kaaba is located to find out the direction of the Qibla, so that it can be known whether the Qibla used is precise or not.

Qibla Direction Measurement Analysis Using*X-Blind Qibla*and Google *Earth*

In knowing the results of the *X-Blind Qibla measurement*, it is carried out using references to mosques around Yogyakarta that have/have not been certified, as well as those that have been considered accurate. In addition, as a comparison of the results of the tool (*X-Blind Qibla*), the author uses *the Google Earth machine* which is a calibrator of the direction of the Qibla in determining the accuracy and accuracy of the direction of the Qibla. The results of *X-Blind Qibla* and *Google Earth* measurements on several mosques are as follows:

1) Syuhada Mosque

a. Trigonometry Calculation

To find the azimuth data of the Qibla of the Syuhada Mosque based on the calculation of hisab (*Spherical Trigonometry*) is as follows:

Mosque latitude = -7°47'11.15" Mosque Oval = 110°22'9.36"

Latitude of the Kaaba = 21°25'21.14" Kakbah Longitude = 39°49'34.27"

A = 90° - (-7°47') = 97°47'
B = 90° - 21°25' = 68° 35'
C = 110°22' - 39°49' = 70°33'
K = COTAG B = (COTAG B X SIN A/ SIN C) - (COS A X COTAG C)

COTAG B = (COTAG 68° 35' × SIN 97°47'/ SIN 70°33') – (COS97°47' × COTAG 70°33')
= (0.393331316 × 0.99078727/ 0.94293243) – (- 0.13542736 × 0.35313677)
= 0.41213747923 – (- 0.04782438048)
= 0, 45996185971
B = 65° 17'57.74" (U →B)
K = 360° - 65° 17'57.74"
= 294˚42'2.26"

So, the azimuth of the qibla of the Syuhada Mosque is 294°42'2.26".

b. Correction of Earth's magnetic declination based on BMKG calculator

D = 0.649045 = 0˚ 38'56.56"

c. Measurement with *Google Earth*

Orientation of Mosque Buildings : 298.6 degrees

Azimuth Qiblat : 294.70 degrees

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Difference in Mosque Deviations : 4.1° (degrees) inclined to the West

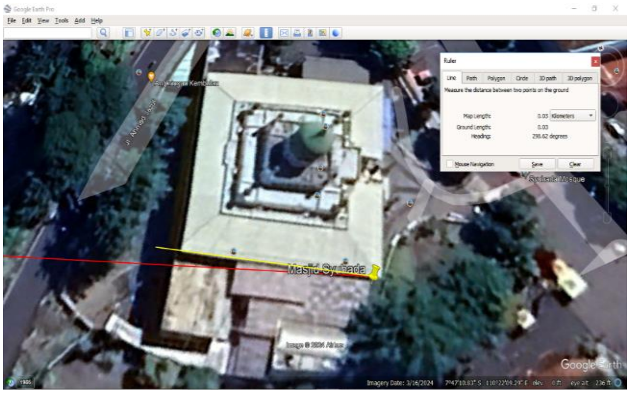

Figure 4. Displaying the position of the Qibla of the Syuhada Mosque with*the Google Earth feature*

Information:

- The red line is the connecting line from the location point to the Kaaba point, to show the actual position of the qibla.
- The yellow line is a line that shows the direction data of the mosque building.

d. Measuring with *X-Blind Qibla*

In implementing *X-Blind Qibla* in the martyrdom mosque, the author made several measurements on various sides of the mosque. The results obtained are that *the X-Blind Qibla* has a difference of 7.6° (degrees) inclined to the right (North) from the direction of the building/direction of the Qibla of the Syuhada Mosque where the direction of the qibla of the mosque has been right towards the Kaaba.

1. Mosque Donkey Koman

a. Trigonometry Calculation

The azimuth data of the qibla of the Gedhe Kauman Mosque based on the calculation of hisab (*Spherical Trigonometry*) is as follows:

Mosque latitude = -7°48'14.57" Mosque Oval = 110°21'44.42"
Latitude of the Kaaba = 21°25'21.14" Longitude of the Kaaba = 39°49'34.27"
A = 90° - (-7°48') = 97°48'
B = 90° - 21°25' = 68° 35'
C = 110°21' - 39°49' = 70°32'
K = COTAG B =(COTAG B X SIN A/ SIN C) - (COS A X COTAG C)

COTAG B = (COTAG 68° 35' × WITHOUT 97°48'/ WITHOUT 70°32') –

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(COS97°48' × COTAG 70°32')
= (0.393331316 × 0.99074784/ 0.94283553) – (- 0.135715572 × 0.35346397)
= 0.41216343333 – (- 0.04797056487)
= 0, 4601339972

B = 65° 17'28.44" (U →B)

K = 360° - 65° 17'28.44"
= 294°42'31.56"

So, the azimuth of the qibla of the Gedhe Kauman Mosque is 294°42'31.56".

b. Magnetic Declination Correction Based on BMKG Calculator

D = 0.649301 = 0˚ 38'57.48"

c. Measurement with *Google Earth*

Greatness Aara Kabalat (Kakba)	: 294.70 degrees
Direction of the mosque building	: 273.5 degrees
Difference in Mosque Deviations	: 21.2° (degrees) inclined to the North

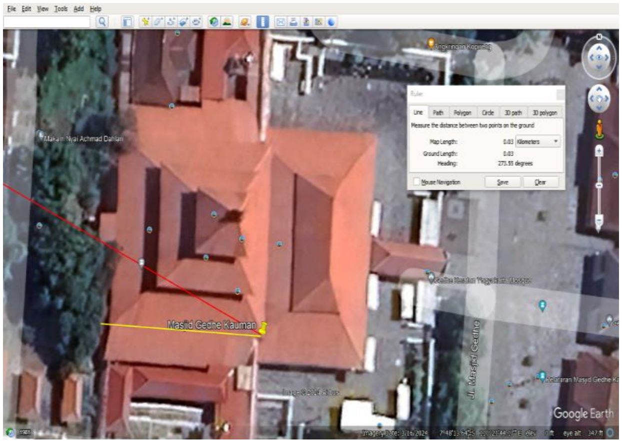

Figure 5. Displaying the position of the Qibla of the Kauman Mosque with *the Google Earth feature*

d. Measurement with *X-Blind Qibla*

As for measuring the direction of the qibla using *X-Blind Qibla*, the author conducted several tests on various sides of the mosque, both the inside and the left and right hallways of the mosque. The results obtained are that *the X-Blind Qibla* has a difference of 4.2° (degrees) from the position of the saf line in the direction of the Qibla of the Gedhe Kauman Mosque which has been changed, due to the orientation of the building facing West.

2) UGM Campus Mosque

a. Trigonometry Calculation

The azimuth data of the Qibla of the UGM Mosque based on the calculation of hisab (*Spherical Trigonometry*) is as follows:

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Mosque latitude = -7°46'24.79" Mosque Oval = 110°22'48.28"

Latitude of the Kaaba = 21°25'21.14" Kakbah Longitude = 39°49'34.27"

A = 90° - (-7°46') = 97°46'
B = 90° - 21°25' = 68° 35'
C = 110°22' - 39°49' = 70°33'
K = COTAG B = (COTAG B X SIN A/ SIN C) - (COS A X COTAG C)
COTAG B = (COTAG 68° 35' × SIN 97°46'/ SIN 70°33') – (COS97°46' × COTAG 70°33')
= (0.392231316 × 0.99082662/ 0.94293243) – (- 0.13513915 × 0.35313677)
= 0.41215384764 – (- 0.04772260293)
= 0, 45987645057
B = 65˚ 18'12.29" (U →B)
K = 360˚ - 65˚ 18'12.29"
= 294˚41'47.71"

So, the azimuth of the qibla of the UGM Yogyakarta Mosque is 294°41'47.71".

b. Magnetic Declination Correction Based on BMKG Calculator

D = 0.648195 = 0˚ 38'53.50"

c. Measurement with *Google Earth*

Greatness Aara Kabalat (Kakba) : 294.70 degrees

Direction of the mosque building : 294.8 degrees

Difference in Mosque Deviations : 0° slope (degrees).

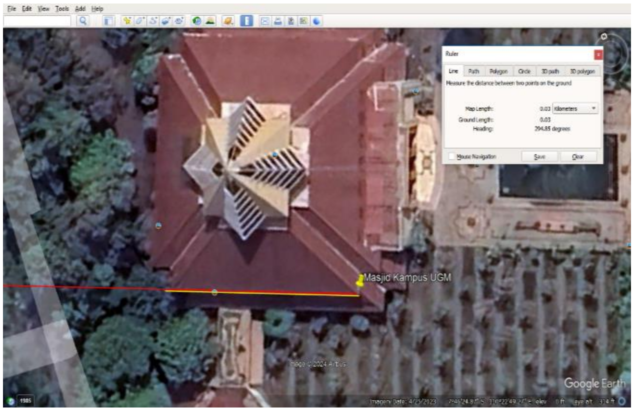

Figure 6. Displaying the position of the Qibla of the UGM Mosque with*the Google Earth feature*

d. Measurement with X-Blind Qibla

Measuring the direction of the qibla using *X-Blind Qibla*, the author conducted several trials on various sides of this mosque. The results obtained are that *the X-Blind Qibla* has a difference of 4.6° (degrees) from the direction of the UGM Campus Mosque building which is right towards the Kaaba.

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2. Religious Laboratory of UIN Sunan Kalijaga Mosque

   a. Trigonometry Calculation

   The azimuth data of the qibla of the UIN Sunan Kalijaga Mosque based on the calculation of hisab (*Spherical Trigonometry*) is as follows:

   Mosque latitude = -7°47'5.97" Mosque Oval = 110°23'40.96"

   Latitude of the Kaaba = 21°25'21.14" Kakbah Longitude = 39°49'34.27"

   A = 90˚ - (-7°47') = 97°47'
   B = 90° - 21°25' = 68° 35'
   C = 110°23' - 39°49' = 70°34'
   K = COTAG B =(COTAG B X SIN A/ SIN C) - (COS A X COTAG C)
   COTAG B = (COTAG 68° 35' × SIN 97°47'/ SIN 70°34') – (COS97°47' × COTAG 70°34')
   = (0.392231316 × 0.99078727/ 0.94302925) – (- 0.13542736 × 0.35280964)
   = 0.41209516543 – (- 0.04778007813)
   = 0, 45987524351
   B = 65˚ 18'12.49" (U →B)
   K = 360˚ - 65˚ 18'12.49"
   = 294˚41'47.51"

So, the azimuth of the qibla of the UIN Sunan Kalijaga Mosque Yogyakarta is 294°41'47.71".

   b. Magnetic Declination Correction Based on BMKG Calculator

   D = 0.648132 = 0˚ 38'53.28"

   c. Measurement with *Google Earth*

   Greatness Aara Kabalat (Kakba) : 294.70 degrees

   Direction of the mosque building : 294.7 degrees

   Difference in Mosque Deviations : 0° slope (degrees)

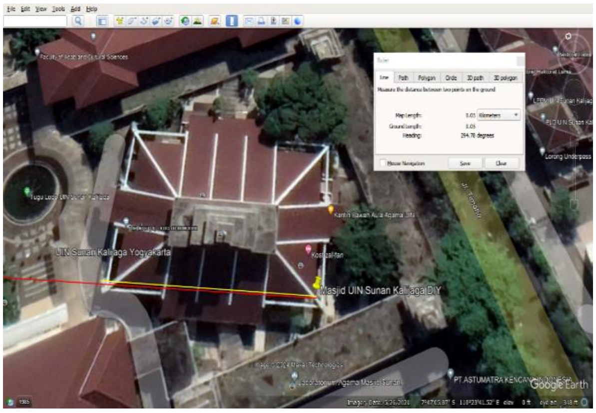

Figure 7. Displaying the posture of the UIN Sunan Kalijaga Mosque with*the Google Earth feature*

   d. Measurement with *X-Blind Qibla*

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Measuring the direction of the qibla using *X-Blind Qibla*, the author conducted several tests on various sides of the mosque such as the inside of the mosque, the left and right hallways of the mosque. The results obtained are that *the X-Blind Qibla* has a difference of 4.3 (degrees) from the direction of the UIN Sunan Kalijaga Mosque building which is considered to be precise towards the Kaaba.

3) Masjid al-Shiddiqi

a. Trigonometry Calculation

The azimuth data of the qibla of the Ash-shiddiiqi Mosque based on the calculation of hisab (*Spherical Trigonometry*) is as follows:

Mosque latitude = - 7°47'5.90" Mosque Oval = 110°23'22.42"

Latitude of the Kaaba = 21°25'21.14" Kakbah Longitude = 39°49'34.27"

A = 90˚ - (-7°47') = 97°47'
B = 90° - 21°25' = 68° 35'
C = 110°23' - 39°49' = 70°34'
K = COTAG B =(COTAG B X SIN A/ SIN C) - (COS A X COTAG C)
COTAG B = (COTAG 68° 35' × SIN 97°47'/ SIN 70°34') – (COS97°47' × COTAG 70°34')
= (0.392231316 × 0.99078727/ 0.94302925) – (- 0.13542736 × 0.35280964)
= 0.41209516543 – (- 0.04778007813)
= 0, 45987524351
B = 65˚ 18'12.49" (U →B)
K = 360˚ - 65˚ 18'12.49"
= 294˚41'47.51"

So, the azimuth of the Qibla of the Ash-shiddiiqi Mosque is 294°41'47.71".

b. Magnetic Declination Correction Based on BMKG Calculator

D = 0.648922= 0˚ 38'56.12"

c. Measurement with *Google Earth*

Greatness Aara Kabalat (Kakba) : 294.70 degrees

Direction of the mosque building : 295.5 degrees

Difference in Mosque deviations : 1.2° (degree) slope to the West

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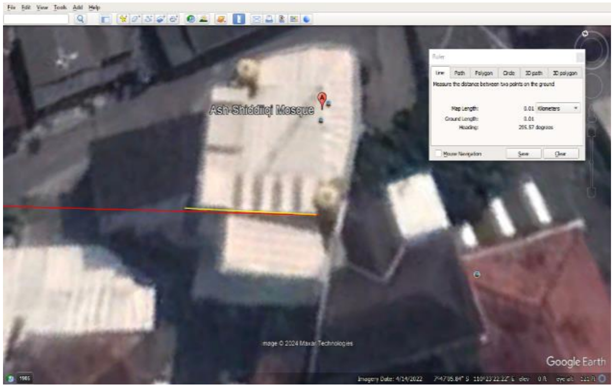

Figure 8. Displaying the position of the qibla of the Ash-Shiddiiqi Mosque with*the Google Earth feature*

d. Measurement with *X-Blind Qibla*

In the measurement of the direction of the qibla using *X-Blind Qibla*, the author tested and observed on various sides of the mosque, both the inner side and the right hallway, and the 2nd floor of the mosque. The results obtained show that *the X-Blind Qibla* has a difference of 4.75° (degrees) from the position of the direction of the mosque building that has been precisely oriented towards the qibla (kaaba).

4) Baiturrahman Mosque

a. Trigonometry Calculation

The azimuth data of the Qibla of the Baiturrahman Mosque based on the calculation of hisab (*Spherical Trigonometry*) is as follows:

Mosque latitude = - 7°47'4.59" Mosque Oval = 110°23'55.58"

Latitude of the Kaaba = 21°25'21.14" Kakbah Longitude = 39°49'34.27"

A = 90° - (-7°47') = 97°47'
B = 90° - 21°25' = 68° 35'
C = 110°23' - 39°49' = 70°34'
K = COTAG B =(COTAG B X SIN A/ SIN C) - (COS A X COTAG C)
COTAG B = (COTAG 68° 35' × SIN 97°47'/ SIN 70°34') – (COS97°47' × COTAG 70°34')
= (0.392231316 × 0.99078727/ 0.94302925) – (- 0.13542736 × 0.35280964)
= 0.41209516543 – (- 0.04778007813)
= 0, 45987524351
B = 65˚ 18'12.49" (U →B)
K = 360˚ - 65˚ 18'12.49"
= 294˚41'47.51"

So, the azimuth of the qibla of the Baiturrahman Mosque is 294°41'47.71".

b. Magnetic Declination Correction Based on BMKG Calculator

D = 0.649027= 0˚ 38'56.50"

c. Measurement with *Google Earth*

Azimutarah of the Qibla (Kaaba) : 294.70 degrees

Direction of the mosque building : 274.0 degrees

Mosque deviation difference : 20.7° (degrees) to the North

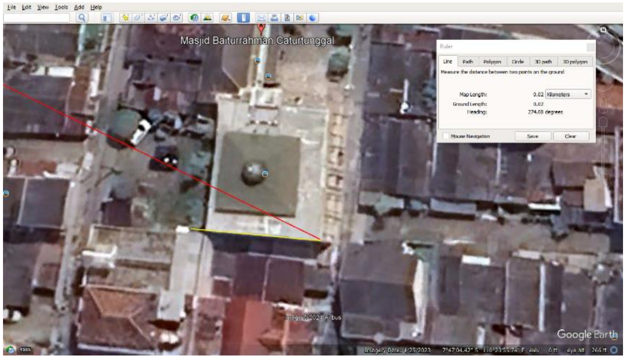

Figure 9. Displaying the position of the Qibla of the Baiturrahman Mosque with*the Google Earth feature*

d. Measurement with *X-Blind Qibla*

The results obtained from the measurement with *X-Blind Qibla* are that *X-Blind Qibla* has a difference of 5.75 (degrees) from the position of the shaf repair in the direction of the mosque qibla (saf lines), where the orientation of the direction of the mosque building is built facing the West.

Based on the explanation above, mosques in the Yogyakarta area have two types of typologies, namely:

1) Mosques that were built right facing the Qibla such as the Syuhada Mosque, UGM Mosque, UIN Sunan Kalijaga Mosque, and Ash-Shiddiiqi Mosque.
2) The mosque that was built faces west, so that it implements repairs/changes such as the Gedhe Kauman Mosque, and the Baiturrahman Mosque.

The Average of Deviation *X-Blind Qibla*:

$$\textbf{Average Deviation} = \frac{\textbf{Highest Deviation + Lowest Deviation}}{\textbf{Number of samples}}$$

$$= \frac{10° 52' - 3° 16'}{6}$$

$$= \frac{7° 36'}{6}$$

$$= 1° 16'$$

The following is an illustration of the deviation between the azimuth direction of the Qibla (Kaaba) and *the X-Blind Qibla* measuring instrument:

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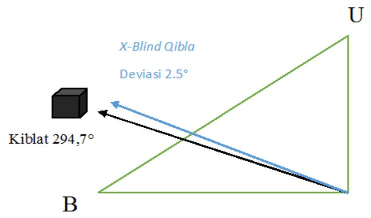

Figure 10. Illustration of the Qibla Direction Deviation Size on *X-Blind Qibla*

On the other hand, if the result of the deviation is viewed based on the following hadith narrated by Imam Malik, "*The Kaaba is the reference of the Qibla for those who are in the Al-Haram Mosque, and the Al-Haram Mosque is the Qibla for the people of Mecca, while Mecca is the Qibla for the Arab population, while Saudi Arabia is the Qibla for all Muslims around the world*," [28] So this hadith can be used as a comprehensive reference in determining the tolerance of the Qibla direction. Thus, if the tolerance limit is classified, it can be concluded that the qibla reference adopted by the people in various regions of Indonesia is facing Saudi Arabia.

There are a number of factors that affect the observed deviation in the instrument, namely: 1) Interference from the Earth's magnetic field, which is caused by the use of a compass in the *X-Blind Qibla working system*. 2) The consistency of the buzzer sound is still weak, due to the movement of the magnetic needle that has not worked properly. 3) *Human Error*, users are less careful in practicing tools.

Meanwhile, another factor that causes deviations in the field is such as the interference of magnetic fields around mosque buildings, for example from building materials. Therefore, to eliminate the influence of the magnetic field, the author uses the magnetic correction amount in the Yogyakarta area, which is 0° 38'.

D.Conclusion

Based on the results of observations and analyses that have been carried out related to the *X-Blind Qibla* Accuracy Test with *Google Earth Software standards* with references to the direction of the Qibla shown in various mosques, the author can draw the following conclusions:

1. *X-Blind Qibla* is a series of products that can be applied in finding the position of the Qibla. The update of the tool is based on a compass with the addition of supporting

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components such as electrical devices, and buzzers. In practice, this tool is still easily disturbed by the magnetic field around the place. Google *Earth* is a software that is able to display world maps, geographic data, and features that can display images in 3D. With this application, it can also measure the direction of the qibla of a location.

2. From the results of the *X-Blind Qibla accuracy test* with the standard measurement data through *Google Earth*, it was obtained that *the X-Blind Qibla* has an average deviation of 1°16' based on the samples of the mosques above. This result has also been subtracted by the amount of magnetic declination correction in the Yogyakarta area, which is 0° 38'. Based on these results, it is concluded that *the X-Blind Qibla*has not reached a high level of accuracy, due to several factors, namely:
   a. The interference of the Earth's magnetic field, due to *the compass-based* X-Blind Qibla.
   b. The consistency of the buzzer sound is weak, due to the movement of the magnetic needle that has not worked properly.
   c. *Human Error*, users are less thorough in practicing tools.

Meanwhile, the weakness of *Google Earth* is only in its satellite imagery where in the process of visualizing a building is not very clear, so it can affect the quality of the image. It can be seen in table 2 discussion of the concept of modulo 7. then $k_Y = 1$ H with zeller congruence then $k_Y = 15$ H with zeller congruence then $k_Y = 1$Because, so based on Table 2, the beginning of Ramadan 1445 H falls on Tuesday.Determination of the beginning of Ramadan in 1446 H with zeller congruence then $k_Y = 2$Because, so based on Table 2, the beginning of Ramadan 1446 H falls on Sunday.Determination of the beginning of Ramadan in 1447 H with zeller congruence then $k_Y = 2$Because, so based on Table 2, the beginning of Ramadan in 1447 H falls on Thursday. Determination of the beginning of Shawwal in 1443 H with zeller's congruence then $k_Y = 1$Because, so based on Table 2, the beginning of Shawwal in 1443 H falls on Tuesday.Determination of the beginning of Shawwal in 1444 H with zeller congruence$d = 1, m = 10, Y = 1444$ then $k_Y = 15$ H with zeller congruence then $k_Y = 1$Because, so based on Table 2, the beginning of Shawwal in 1445 H falls on Wednesday.Determination of the beginning of Shawwal in 1446 H with zeller congruence then $k_Y = 2$Because, so based on Table 2, the beginning of Shawwal in 1446 H falls on Monday.Determination of the beginning of Shawwal in 1447 H with zeller congruence then $k_Y = 2$Because, so based on Table 2, the beginning of Shawwal 1447 H falls on Friday.

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