

# 4<sup>th</sup> ICITB

## DESIGN OF DIGITAL PRAYER CLOCK BASED ON RASPBERRY PI 3

Setyawan, D.Y<sup>1</sup>, Rafiq, M<sup>2</sup>, Rosandy T<sup>3</sup>, Suratno<sup>4</sup>

<sup>1,2,3,4</sup> Institut Informatika dan Bisnis Darmajaya  
dodi@darmajaya.ac.id

---

### ABSTRACT

*Prayer is an obligation that must be carried out by every Muslim, at least five times a day a night is obliged to pray. The time was determined according to the Qur'an and the hadith of the Prophet. Every Muslim must know the prayer times precisely and specifically for the muezzin to proclaim the call to prayer. Determining prayer times is largely dependent on the position of the sun on the earth. This certainly makes it difficult to determine the exact prayer time, therefore it is necessary to build a system that is able to determine and display prayer times precisely based on raspberry pi3. Determination of prayer times is based on the position of longitude and latitude of the earth according to real time and altitude. Built using Lazarus programming language with free Pascal compiler. The system can determine and display prayer times precisely.*

**Keywords:** Prayer, digital, raspberry

---

### INTRODUCTION

One of the obligations of a Muslim is to pray as stated in QS. An Nisaa ': 103

إِنَّ الصَّلَاةَ كَانَتْ عَلَى الْمُؤْمِنِينَ كِتَابًا مَّوْقُوتًا

**Which mean:** *Indeed, prayer has been decreed upon the believers a decree of specified times.*

As also conveyed by the Prophet Shololohu alaihiwassalam in his hadith as follows

عَنْ أُمِّ فَرْوَةَ قَالَتْ سَأَلْتُ رَسُولَ اللَّهِ -صَلَّى اللَّهُ عَلَيْهِ وَسَلَّمَ- أَيُّ الْأَعْمَالِ أَفْضَلُ قَالَ « الصَّلَاةُ فِي أَوَّلِ وَقْتِهَا »

From Umm Farwah, he said, " The Apostle of Allah (peace\_be\_upon\_him) was asked: Which of the actions is best? He replied: Observing prayer early in its period." (HR. Abu Daud no. 426. Shaykh Al Albani said that this hadith was authentic).

There are devices that have been used to display prayer times such as seven segment and dot matrix LEDs, but they are still unable to display a more attractive feature. In other words, they look static.



Figure 1 digital prayer clock

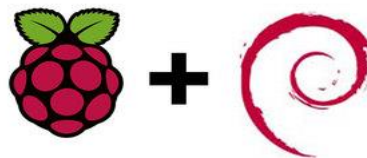
Besides being used as a prayer display, digital prayer hours can also be used to display the Qur'an and the hadiths of the Prophet Shololohu alaihi wassalam. This is very useful for the means of da'wah. On the contrary, seven segment and LED dot matrix devices have very limited memory capacity and appearance, and the display background also cannot change images.

### 1.1 Raspberry Pi 3



Figure 2 Raspberry Pi 3 Model B

The main device in making digital prayer hours is usually an ATmega328P microcontroller. It is a family of 8 bits microcontroller that has 131 instructions, 32 x 8 registers with speeds of more than 20 MIPS (Microprocessor without Interlocked Pipeline Stages) [1]. These microcontrollers are usually planted on Arduino boards and are widely used in various projects [2] [3]. As explained above, digital prayer clocks using seven segment devices and dot matrix LEDs based on the ATmega328P microcontroller have limitations in terms of memory and display. Therefore, the researchers tried to develop by designing a digital prayer clock based on Raspberry Pi3 to reduce and eliminate the shortcomings that existed at the digital prayer clocks based on the ATmega328P microcontroller. Raspberry Pi3 often abbreviated as Raspi, a SBC (single-board circuit) using the Raspbian operating system has a CPU of 1200 MHz quad-core ARM Cortex-A53 MicroSDHC storage capacity Memory slot 1 GB of Graphics RAM Broadcom VideoCore IV at high frequencies than previous versions running on 250 MHz. Raspberry Pi has two models, i.e model A and model B. In general Raspberry Pi Model B has a RAM storage capacity of 512 MB. The difference between models A and B lies in the storage module used. Model A uses 256MB of storage, while model B uses 512MB of storage. In addition, the B model is equipped with an Ethernet (for LAN) port that is not in the A model. The Raspberry Pi design is based on the Broadcom BCM2835 System-on-a-Chip, which has embedded the ARM1176JZF-S processor with 700 MHz, GPU VideoCore IV, and RAM of 256 MB (model B). Data storage is not designed to use or solid-state drives, but uses SD type storage cards to run the system and as a long-term storage medium [4]. There are many uses of Raspberry Pi, including as a web server [5] [6] for scheduling remote lighting control. There is a slight difference in the use of the Raspberry Pi, from the use of a timer, a remote control scheduling timer using a web timer while the digital prayer clock timer uses RTC (Real Time Clock) integrated into the Raspberry Pi board. Raspberry Pi uses Raspbian for Debian-based computer operating systems.



## **Raspbian**

Figure 3 Raspbian

### 1.2 Lazarus free pascal

There are many programming languages that can be integrated at Raspbian such as Python 2, GNU Emagces 23, Shonic Pi and Lazarus. Lazarus is one of the *free open source* programming languages and built using the *Lazarus Compnent Library* (LCL) framework written in Object Pascal. LCL is an abstraction for various graphic libraries used for *application interfaces*.

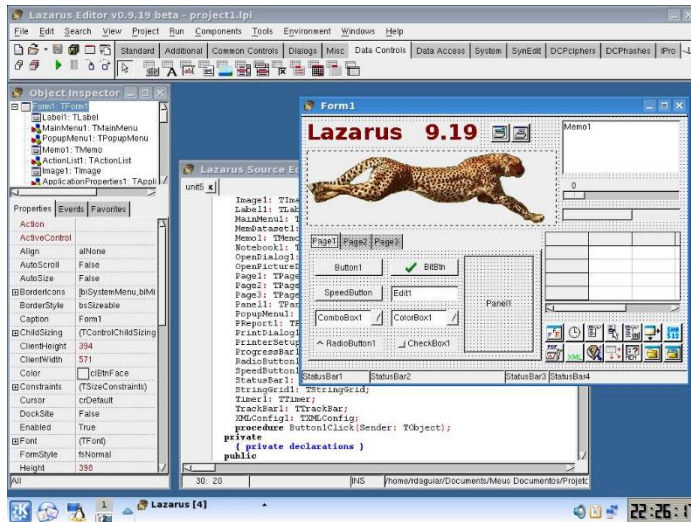


Figure 4 Lazarus free pascal

In this Lazarus free pascal the program code can be written only once but can be compiled in various Operating Systems, both on Windows, Ubuntu and Raspbian Operating Systems. Various applications can be built using this programming language [7]. In this time the researchers will use the Lazarus programming language to build a digital prayer clock.

## RESEARCH METHOD

The determination of prayer times

Before writing the program code in digital prayer hours, it must first be known how to determine the prayer times based on the position of the sun's angle to the earth or in other words the position or location of an area in longitude, latitude and height of the position of the sea surface. According to Ishmael [8] the beginning of entering prayer times can be determined from the position of the sun's angle to the area somewhere, where the beginning of the Zuhr prayer time is 0 °, the beginning of the Azar prayer time is determined by the formula

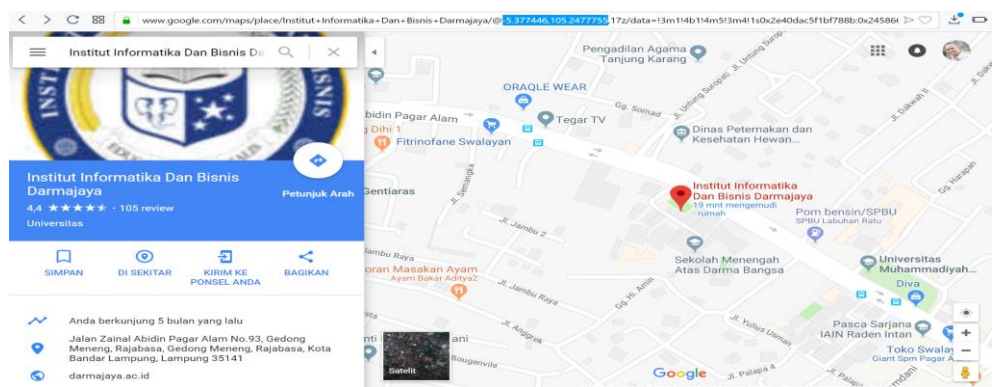
$$Z_{ashar} = \tan^{-1}(\tan abs(do - Lu) + 1)$$

Initially the Maghrib prayer time is  $91^\circ$  or  $-1^\circ$ , the initial prayer time is  $108^\circ$  or  $-18$  and the beginning of the Fajr prayer time is  $110^\circ$  or  $-20^\circ$ . In general, the sun height data for determining prayer times is influenced by the data in Egypt. The overall data on the method of determining the height of the sun is shown in Table 1 below

**Table 1 method of determining the height of the sun**

Method	Abbr.	Region Used
Muslim World League	MWL	Europe, Far East, parts of US
Islamic Society of North America	ISNA	North America (US and Canada)
Egyptian General Authority of Survey	Egypt	Africa, Syria, Lebanon, Malaysia
Umm al-Quran University, Makkah	Makkah	Arabian Peninsula
University of Islamic Sciences, Karachi	Karachi	Pakistan, Afghanistan, Bangladesh, India
Institute of Geophysics, University of Tehran	Tehran	Iran, Some Shia communities
Shia Ithna Ashari, Leva Research Institute, Qum	Jafari	Some Shia communities worldwide

As explained above, the determination of the initial prayer time is determined by the position of the angle of the sun towards the earth, the location of the position of the region on earth is determined by the latitude and longitude of a place. Then how to determine the latitude and longitude of a place? This can be obtained using Google Maps.

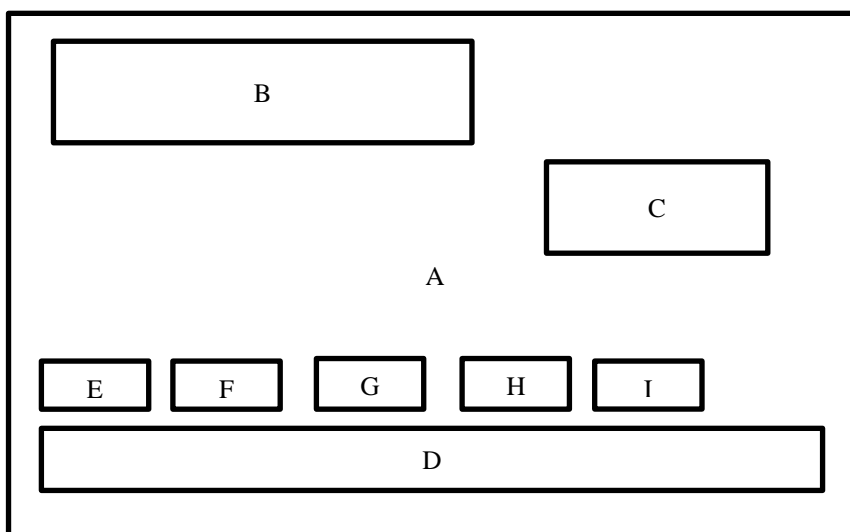


**Figure 5 How to obtain the longitude and latitude of a place**

By searching for a region or a place on Google Maps you can also get the longitude and latitude data of the region. After obtaining the data, it can then be used to determine the initial prayer time of an area. As shown in the picture above, the area of IBI Darmajaya is located at the longitude position of -5,377446 and latitude 105,2477755.

### 1.3 Program code frame

The digital clock display on the prayer times is very important to be made as good as possible and as beautiful as possible. The following is the frame design or the prayer time digital clock interface.



**Figure 6 Frame Interface design**

Captions:

- A. Background image (various mosque images that can change)
- B. Display of real time date and time
- C. Display countdown pauses iqomah
- D. Display of hadiths
- E. E up to I in a row at dawn, zuhr, asar, magrib and isha prayer times.

### 1.4 DS3231 RTC settings

Raspberry pi is not equipped with a RTC (Real Time Clock) along with a CMOS battery. Therefore, in Raspberry pi the time and date settings are done online. The time zone will be set automatically if the raspberry is connected to the internet. But this will be very difficult in using raspberries as a basis for digital prayer hours because they have to be online continuously. Therefore, it is necessary to manually integrate an RTC in this

case using RTC3231 into raspberry. The use of many DS3231 RTC integrated into the RTC Connection microcontroller with Raspberry pi 3 can be seen in Figure 7 as follows.

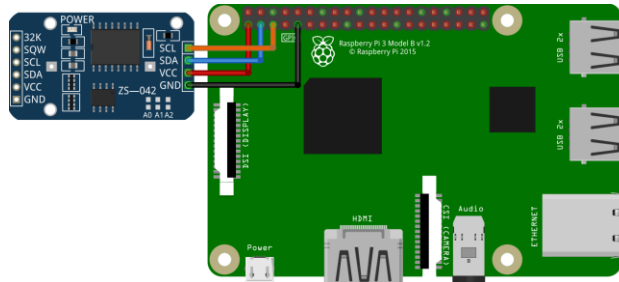


Figure 7 DS3231 RTC to Raspberry pi

After being connected, it is necessary to reset the timer, from the online timer to the offline timer. The steps are as follows:

1. Enter the raspberry terminal then run the raspi-config command,
2. After that the window will appear as follows,

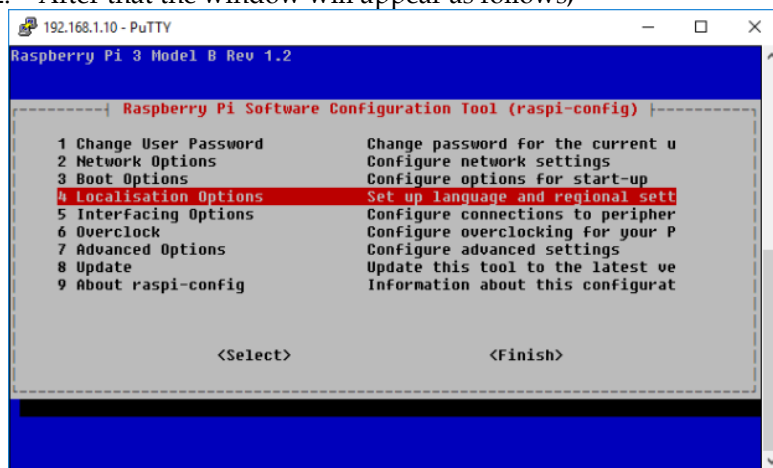


Figure 8 raspberry timer settings

3. Then select I2 Change Timezone
4. Select time zone in this case select the Jakarta area
5. Run the i2cdetect -y 1 command
6. Change the boot config using the nano / boot / config.txt command
7. Add to the last line dtoverlay = i2c-rtc, ds3231
8. Save and exit the window
9. Add the model by editing the file in the / etc / modules file by executing the command on the nano / etc / modules terminal
10. 8. Add to the last line rtc-ds3231 save and exit the window

11. 9. Edit the file in the nano / lib / eduv / hwclock-set and give a comment on the following line with the command
 

```
#if [ -e /run/systemd/system ] ; then
# exit 0
#fi
```

Raspberry pi has set its timer using DS3231 RTC no longer online. The next step is to adjust the local area clock real time with the following steps:

1. Run the date command on the Raspberry Pi terminal
2. Set the time according to the local real time clock
3. Run the hwclock -w command

### 1.5 Application startup settings

After successfully setting up RTC the next step is setting the application for digital prayer hours on application startup. This is done so that the application program will run when the operating system starts booting so that the user does not need to click on the application program. The steps for the application program to appear at startup are as follows.

1. Edit the file located in /etc/rc.local/
2. Add the address line of the digital prayer clock application
3. Save and exit
4. Re-start Raspberry Pi

### 1.6 Create database table

In addition to displaying prayer times, digital prayer hours can also display hadiths. These hadiths are stored in a database. The database used is DBFPlus, the following table is the place to store the hadiths.

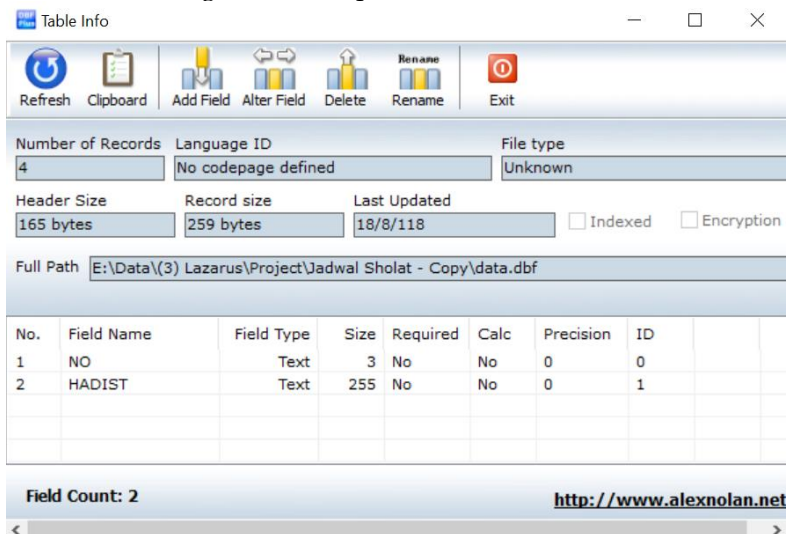


Figure 9 Database info table



## 2. Results and Discussion

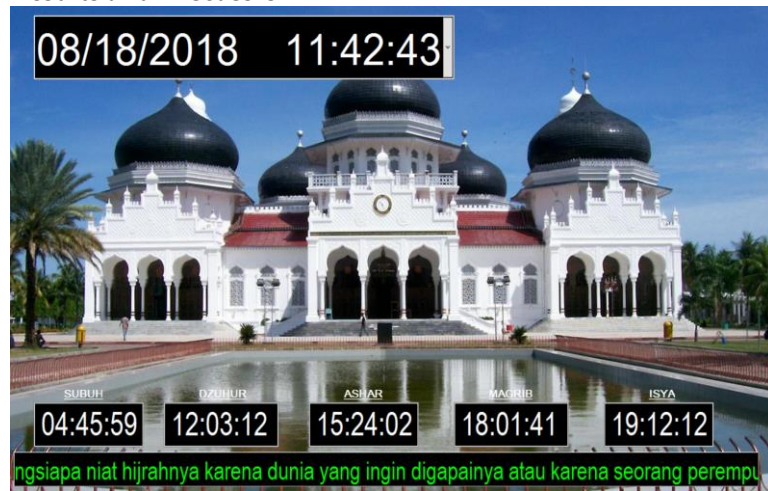


Figure 10 Results of the design of digital prayer hours

The components and program codes used in the above digital prayer hours application include:

1. TZVDateTimePicker,

Figure 11 ZVDateTimePicker

This component is used to display the date and time, this component must be placed or activated in the Timer component



Figure 12 Timer

Program code to enable TZVDateTimePicker to display the date and time in real time as follows:

```
procedure TForm1.Timer1Timer(Sender: TObject);  
var  
    waktu:String;  
begin  
    dtTanggal.Time := now;  
    dtTanggal.Date :=now;  
    ....  
    ....
```

Lies on event timer

2. Edit, this component is used to display prayer times, from morning prayers, to Islamic prayer. This component is also used to display the time lag between the call to prayer and iqomah, also used to display the hadiths.

**04:45:00**

**Figure 13 Component Edit**

The program code for displaying prayer times is as follows:

```
waktu := formatdatetime('hh:nn:ss', dtTanggal.Time);
hitung(dtTanggal.Date);
deg2min(subuh,jam,menit,detik);
edit1.Text := (lz(jam)+'.'+lz(menit)+'.'+lz(detik));
deg2min(zuhur,jam,menit,detik);
edit2.Text := (lz(jam)+'.'+lz(menit)+'.'+lz(detik));
deg2min(ashar,jam,menit,detik);
edit3.Text := (lz(jam)+'.'+lz(menit)+'.'+lz(detik));
deg2min(maghrib,jam,menit,detik);
edit4.Text := (lz(jam)+'.'+lz(menit)+'.'+lz(detik));
deg2min(isya,jam,menit,detik);
edit5.Text := (lz(jam)+'.'+lz(menit)+'.'+lz(detik));
```

The calculation function in the program code above is based on the calculation of the latitude and longitude coordinates of a particular region where the digital prayer hours will be used, the program code for the calculation function is as follows:

```
sh:=1;
Gd:=20;
Gn:=18;
H := 2;
B := (0-5.416570);
L := 105.262078;
TZ:= 7;
j :=Trunc(tgl-EncodeDate(YearOf(tgl),1,1));
beta:=2*pi*j/365;
D :=(180/pi)*(0.006918-
(0.399912*cos(beta))+(0.070257*sin(beta))-
(0.006758*cos(2*beta))+(0.000907*sin(2*beta))-
(0.002697*cos(3*beta))+(0.001480*sin(3*beta)));
T :=229.18*(0.000075+(0.001868*cos(beta))-
(0.032077*sin(beta))-(0.014615*cos(2*beta))-
(0.040849*sin(2*beta)));
R :=15*TZ;
Z :=12+((R-L)/15)-(T/60);
```

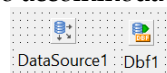
```

U :=(180/(15*pi))*arccos((sin((-0.8333-
0.0347*sign(H)*sqrt(abs(H)))*(pi/180))-
sin(D*(pi/180))*sin(B*(pi/180)))/(cos(D*(pi/180))*cos(B*
(pi/180))));
Vd:=(180/(15*pi))*arccos((-sin(Gd*(pi/180))-
sin(D*(pi/180))*sin(B*(pi/180)))/(cos(D*(pi/180))*cos(B*
(pi/180))));
Vn:=(180/(15*pi))*arccos((-sin(Gn*(pi/180))-
sin(D*(pi/180))*sin(B*(pi/180)))/(cos(D*(pi/180))*cos(B*
(pi/180))));
W
:=(180/(15*pi))*arccos((sin(arctan(1/(Sh+tan(abs(B-
D)*pi/180)))-
sin(D*pi/180)*sin(B*pi/180))/(cos(D*pi/180)*cos(B*pi/18
0)));
subuh :=Z-Vd;
terbit :=Z-U;
zuhur :=Z;
ashar :=Z+W;
maghrib:=Z+U;
isya :=Z+Vn;

```

the *sh* variable above is used for the solar height determination method, this variable is filled with a value of 1 as a value that represents the height of the sun in the Egyptian General Authority. Variables B and L are variables used to accommodate longitude and latitude data of an area that will use this digital prayer clock. B = 5.416570 and L = 105.262078 are the longitude and latitude of IBI Darmajaya campus.

2. Data source and dbf1 components are components that are used to connect application programs with existing data bases, the existing data base is used to accommodate the hadiths.



**Figure 14 Data source and DBF1**

Both of these components are activated and used in two procedures, the FormCreat procedure and the Timer procedure.

```

procedure TForm1.FormCreate(Sender: TObject);
begin
  dbf1.FilePathFull := Application.Location ;
  dbf1.TableName := 'data.dbf';
  dbf1.Active := true;
  ....
  ....

```

The activation of these components in the FormCreat procedure are aimed at connecting the database with the application when the application program runs for the first time when the operating system boots.

## CONCLUSION

The conclusion that can be drawn from this study is that it can successfully design and build a digital prayer clock based on Raspberry pi 3. This application can display prayer times precisely based on latitude and longitude of a place so that it can be used by every Muslim to determine prayer times in a timely manner. In addition, this digital prayer clock is able to display a more attractive interface compared to the digital prayer clock using either seven segment or LED matrix.

## REFERENCES

- Atmel-42735B-ATmega328/P\_Datasheet\_Complete-11/2016  
Michael M. (2012). *Arduino Cookbook*, USA, O'Reilly  
John D, et al.(2011). *Arduino Robotic*,New York, Spinger  
The official Raspberry Pi, *Beginner's Book*.(2012) , Inggris, official Raspberry  
Dias P.(2017).Pemanfaatan Raspberry Pi Sebagai Server Web Untuk Penjadwalan Kontrol Lampu Jarak Jauh, (2017).ISSN : 2085-3688; e-ISSN : 2460-0997, *Jurnal Infotel* Vol.9 No.1 Februari 2017  
Ignatius p dkk.(2014). Penggunaan Raspberry Pi Sebagai Web Server Pada Rumah Untuk Sistem Pengendali Lampu Jarak Jauh Dan Pemantauan Suhu, *Techné Jurnal Ilmiah Elektroteknika* Vol. 13 No. 1 April 2014 Hal 111 - 12  
Dodi dkk.(2017). *Interfacing Komputer dengan Visual Basic 6.0 Delphi 6.0 dan MSEGUI+MSEIDE*, 2017, Indonesia, Pustaka Media  
Ismail. (2015).Metode Penentuan Awal Waktu Salat Dalam Perspektif ILMU FALAK,*Jurnal Ilmiah ISLAM FUTURA* Vol. 14. No. 2, Februari 2015, 218-231