

## Home Automation based on Raspberry Pi

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**Abstract** – Every human being wants to feel safe and comfortable when traveling or leaving home empty. In addition to feeling safe and comfortable, homeowners also want electronic equipment at home can be controlled easily to reduce the waste of electricity and can know the condition of the house remotely. Therefore, a home automation system is needed which enables homeowners to travel to control the use of electronic devices at home and to know the state of the house, accessible wherever and whenever. With the existence of these problems then made the final task with the title Home Automation based Raspberry Pi. The purpose of this final task is to make Home Automation system with Raspberry Pi, LDR sensor, RTC and PIR sensors. This system is used to control lights and webcam automatically. The LDR sensor is used to get the light intensity to automate the lamp. RTC is used to get the current time on Raspberry Pi which then can be used to turn the lights on and off. The PIR sensor is used to read the human movement which then for the automation of the webcam in taking pictures of the state of the house. This system can also be controlled manually on a smartphone by using Telegram Bot inside Telegram app. The methodology used in designing this system is waterfall. The system is tested by creating a home model containing lights inside the house and outdoors. The results of testing with questionnaires conducted to 10 respondents obtained level of satisfaction of 79.2% which means Raspberry Pi Home-based system satisfactory.

**Keywords:** Home Automation, Raspberry Pi, LDR, RTC, PIR, Telegram Bot, Telegram.

### 1. Introduction

Population density in Indonesia is increasingly increasing, especially for those living in urban areas. This increase is directly proportional to the level of mobility of Indonesian society. The existence of a tradition for the people of Indonesia to carry out mudik during Lebaran and homecoming during the national holiday caused many empty houses. Leaving the house empty will not be without risk. Especially faced with the fact that the high crime in Indonesia. According to Central Java Police Chief Inspector General Pol. Condro Kirono, there was a significant decrease in the number of public security disruptions in Central Java, a 17.5% reduction in crime compared to 2015. During 2016 there were 12,574 criminal acts in Central Java. This number decreased compared to 2015, which is 15,245 cases. [1]

In addition to crime and criminality, the risk that can occur if the house left empty in the absence of electrical energy. This waste of electricity occurs due to the negligence of homeowners to turn off electronic devices while leaving home.

Some similar systems have been widely published and made in various forms, including Design of Light Control Using Mikrokontroler ATMega8535 Based Android via Bluetooth and Speech Recognition by Anggit Supriyanto (2013) [2], Design of Home Automation and Dynamic Control Panel by Fitrianto, Niko; Fahlevi (2015) [3], Smart Home Application Control of Web-based Electronic Household Peraltan Control by Masykur (2016) [4], Design of Room Security System Using Raspberry Pi by Krisnawan by Krisnawan (2013) [5], Design of Monitoring and Controlling of Electronic Devices in a Web-Based Room by Giant (2015) [6], Smart Home Automation with Raspberry Pi and Android Smartphone by Fernando (2014) [7], Implementation of Home Automation Using Single-Board Arduino with Android-based Controller by Subagio et al. (2015) [8]. The system has provided information on home automation with various controls such as web as well as homemade applications, but it is not secure enough. So a new, safer, easier and more convenient way to use in home automation is needed.

The above problem becomes the background to build Raspberry Pi Home Based Automation, which is

a system of automation on the lights and webcam at home that can be controlled automatically and manually by the home owner. hope with the existence of this system is the homeowner can reduce the waste of electricity consumption and feel safe and comfortable when leaving home.

**2. Research Methods**

In the preparation of this final task using the Waterfall method [9]. Waterfall method stages can be seen in Figure 1.

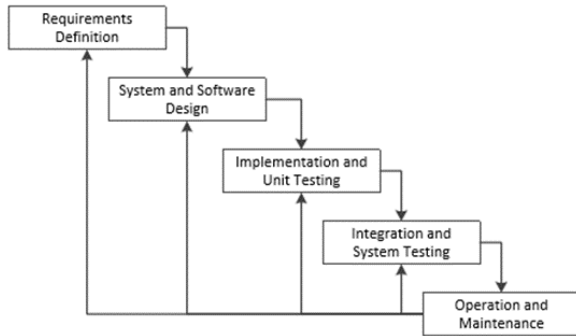


Figure 1 Waterfall Method Ian Sommerville

**2.1. Analysis**

**2.1.1. Home Automation**

Home Automation can be defined as "A part of The Internet of Things (IoT) that provides a way for all devices and equipment that we have to connect in a network that gives indirect or wireless control to all parts of the home and others" or "Usage one or more computers to control work in the house automatically or remotely. "so home automation can be defined as automation systems for work related to homes or buildings either scheduled or automated such as controlling electrical equipment, lighting or lights, security systems, or remotely through mobile devices and can be done from anywhere using an Internet connection owned.so that home automation can also be referred to as smart home (smart home) [10]

**2.1.2. Raspberry Pi 3 Model B**

RPi3 brings the same board and interface with RPi2 and RPi1 B + models, but on RPi3 an increase in SoC is used (10x faster than RPi1). In addition it is integrated with 802.11n wireless module and low power Bluetooth [11].

Telegram Messenger is a messaging app with focus on speed and security. Telegram is a cloud-based messenger with unlimited synchronization. Thus, it can access messages from multiple devices at once, including tablets and computers and share photos, videos and files (documents, zip, mp3, etc.) up to 1.5 GB each.and if you do not want to store data on

your device, you can still keep it in the cloud. It has an open API so developers can create their own Telegram apps.has an API Bot, a platform for developers that lets one make special tools easily for Telegram

**2.1.3. System Overview**

In general, the working principle of Raspberry Pi Home based automation system is using Raspberry Pi 3 Model B, internet connection, incandescent light, Logitech Webcam C270HD, and also Android Smartphone as data communication tool between User and Raspberry Pi in order to monitor and control lights and webcam .

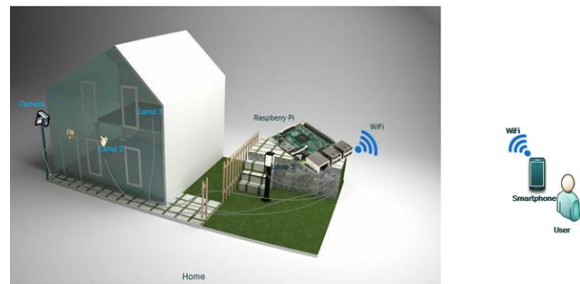


Figure 2 System Overview

**2.2. System Design**

System design is the stage to identify all system requirements.in the design of this system, use the use case diagram to provide a functional picture of the system shown in Figure 3.

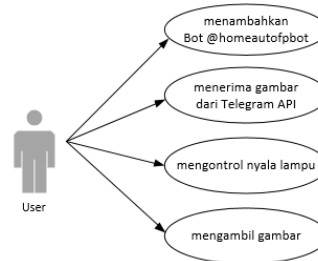


Figure 3 Use case diagram

**2.3. Designing the Application Interface**

The design of the interface is a stage to give an idea of the appearance of the application that will be used by the user.

**2.3.1. Initial Application Page Design**

Initial Page Design is shown in Figure 4.



Figure 4 Initial Page Design

This page will first appear when the application is run will contain the user's contacts from the user contact.on this page there is a search icon to find the Bot or the necessary channels and pencil icon to start a new message.

2.3.2. Search Page View

The search page view will appear when the search icon in the upper right corner of the previous page has been clicked.

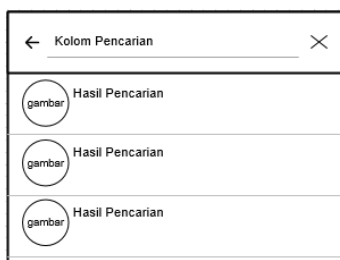


Figure 5 Search Page View

This page allows users to search for Bots, channels or a word from a previous conversation, depending on the needs of the user.

2.3.3. Menu Design

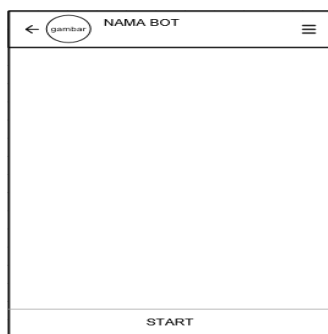


Figure 6 Main Page Views

At the beginning of this page is added will appear the start button, if clicked the user can start this system and choose the existing command in Bot @homeautofpbot.

2.4. Tool Design

In this section will be explained about the design of Raspberry Pi Home based tools.

2.4.1. Front View

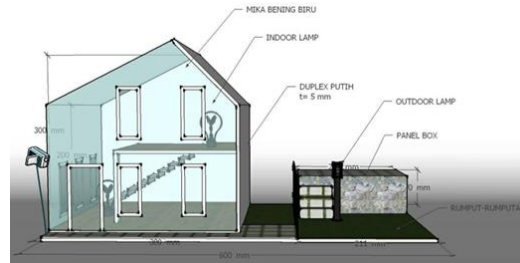


Figure 7 Front View

Seen in Figure 7, this model mockets are designed in such a compact manner that it is easy to use and easy to carry.it must be connected to an electric current for use.

2.4.2. Right Side Side Display

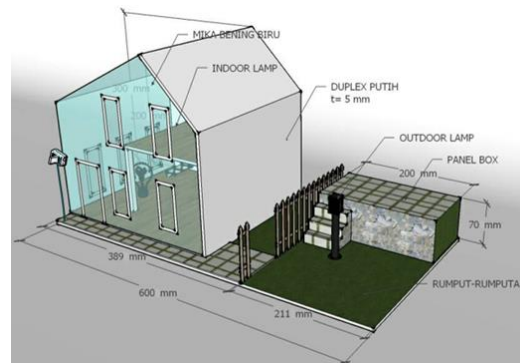


Figure 8 Right Side Side Display

On the right side of the Panel Box looks to be used to store Raspberry Pi and Outdoor Lamp that will light up on a predetermined timer and LDR sensors that have been placed around the lamp.

2.4.3. Left Side View

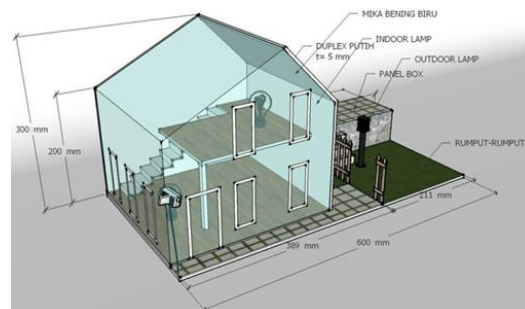


Figure 9 Left Side View

On the left side of the appliance there are 2 lamps 1 on the 1st and 1st floor are on the ground floor which will light up on a predetermined time, then in front of the

door there is a webcam that is useful for security and will work if the PIR sensor is placed near the door feel the movement, then webcam will capture the image and sent to the Bot user.

2.5. Testing

At the testing stage, three types of testing were done, namely hardware functionality testing, software functionality testing and user satisfaction level test using questionnaire.the functionality tests performed include sensor testing, application commands, and results.

3. Results And Discussions

3.1. Functionality Testing Results

Based on the test of system functionality that has been done, obtained the results shown in Table 1.

Table 1 Test Results Hardware and Software Functionality

No	Pengujian	Tujuan	Hasil
1	RTC DS1307 RT Test	As a time data source of seconds, minutes, hours, and days to set the condition of the lights 1 and 2 on or off.	Successful if lamp 1 and 2 can be on or off based on specified time.
2	PIR sensor testing	As a motion detector so that the camera captures the image.	Successfully if the webcam can already take pictures and can be sent on Telegram Messenger.
3	LDR sensor testing	As the light intensity reader to determine the lamp condition	Successful if lamp 3 can turn on or off automatically according to the specified threshold.
4	Testing the Start button	Requirements to be able to access the Bot	Successful if successful entry into the bot without error
5	Test command / lamp1on and / lamp1off	As a command to specify conditions on the first lamp.	Successful if the command / lamp1on can turn on the light and there is a reply 'light 1 flame' then / lamp1off can extinguish the light and there is a reply 'lamp 1 goes off'.
6	Test command / lamp2on and / lamp2off	As a command to specify conditions on the 2nd lamp.	Successful if the command / lamp2on can turn on the light and there is a reply 'lamp 2 flame' then /

			lamp2off can extinguish the light and there is a reply 'lamp 2 goes off'.
7	Testing commands / turnonall and / turnoffall	As a command to specify conditions on lamps 1 and 2.	The test indication is successful when the / turnonall command turns on the 1st and 2nd lights and there are replies 'all lights on' then / tumoffall can extinguish lamps 1 and 2 and there is a reply 'all the lights out'.
8	Test command / takepicture	As a command to take a picture.	The test indication is successful when the / takepicture command can control the webcam to take a picture and then the image will be sent in the bot.

Based on Table 1, it can be concluded that all aspects of functionality in Raspberry Pi Home Automation system has functioned well and in accordance with system design.

3.2. System Implementation

Implementation system is the stage of application design that has been done.

3.2.1. Bot Early View

Start Page is shown in Figure 10.

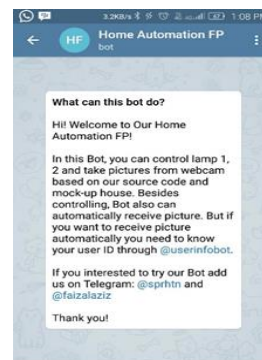


Figure 10 Bot Initial View

3.2.2. RT1 DS7 RTC Testing

In this test it can be said to be successful if the lights 1 and 2 can be on or off based on the time specified in the program code, in this experiment the

light is set to on Sunday, at 18:09 and then automatically turns off on Sunday at 18:11.

```

MonOn = datetime.time(hour=17,minute=0,second=0)
MonOff = datetime.time(hour=5,minute=30,second=0)
TueOn = datetime.time(hour=17,minute=0,second=0)
TueOff = datetime.time(hour=5,minute=30,second=0)
WedOn = datetime.time(hour=15,minute=40,second=0)
WedOff = datetime.time(hour=15,minute=41,second=0)
ThuOn = datetime.time(hour=12,minute=58,second=0)
ThuOff = datetime.time(hour=12,minute=59,second=0)
FriOn = datetime.time(hour=9,minute=57,second=0)
FriOff = datetime.time(hour=9,minute=58,second=0)
SatOn = datetime.time(hour=17,minute=0,second=0)
SatOff = datetime.time(hour=5,minute=30,second=0)
SunOn = datetime.time(hour=18,minute=9,second=0)
SunOff = datetime.time(hour=18,minute=11,second=0)
    
```

Figure 11 Program Setting Code Time



Figure 12 RTC IC Test Lights 1 and 2 Lit up

3.2.3. PIR Sensor Testing

Based on the test results, the sensor can detect a human movement with a maximum distance between the PIR sensor and the object is 5 meters. when it detects the presence of human lights on the webcam will light up, it indicates that the webcam takes the picture continued notification 'There is activity detected' then the image sent on Telegram.



Figure 13 Picture Sent on Telegram

3.2.4. LDR Sensor Testing

LDR sensor testing as a measure of outdoor light conditions to determine the data obtained from the

sensor. this test can be said to succeed if lamp 3 can turn on automatically based on threshold obtained.

Table 2 LDR Sensor Tests on Attachment 3

V <sub>in</sub> (V)	V <sub>out</sub> (V)	Range Pembacaan Nilai Ambang Batas	Kondisi Lampu
3.3	0.17	> 400	ON = 1
3.3	3.22	< 250	OFF = 0

3.2.5. Start Button Test

In this test it can be said to succeed if it can enter on Bot without any Error like Figure 10.

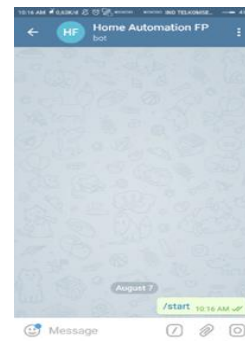


Figure 14 Successfully entered Bot

3.2.6. Test command /lamp1 on and /lamp1 off

In this test can be successful if the command / lamp1 on can turn on the light and there is a reply 'light 1 flame' then / lamp1off can extinguish the lights and there is a reply 'lamp 1 goes off'.

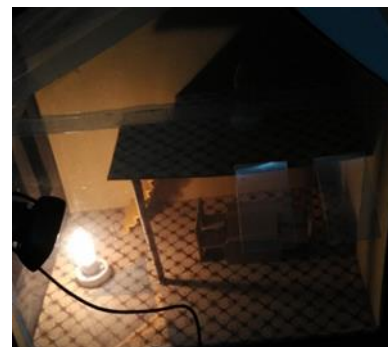


Figure 15 Command and Results of Lamp Condition 1

3.2.7. Test command /lamp2 on and /lamp2 off

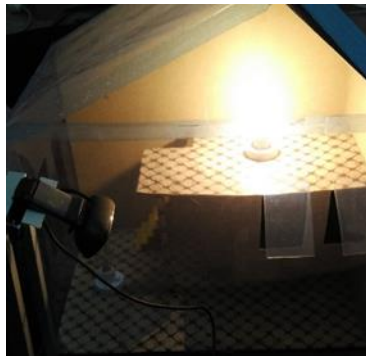


Figure 16 Commands and Results of Lamp Condition 2

3.2.8. Testing command / takepicture

In this test can be successful when the command / take picture can control the webcam to take pictures then the image will be sent in the bot along with notifications.



Figure 17 Command / take picture

3.3. Test Results User Satisfaction Level

Testing the level of user satisfaction is the stage to measure the level of user satisfaction with Raspberry Pi-based Home Automation. testing conducted on 10 respondents. in the testing process, respondents gave an assessment of the 5 questions shown in Table 3.

Table 3 Question List

No	Question Criteria
1	Apakah Anda setuju Home Automation Berbasis Raspberry Pi bermanfaat dengan baik?
2	Apakah Anda setuju fungsi <i>Telegram</i> dimanfaatkan sebagai antarmuka <i>Home Automation</i> Berbasis <i>Raspberry Pi</i> selain sebagai sosial media?
3	Apakah Anda setuju jika pengoperasian <i>Bot Telegram</i> sebagai alat kontrol lampu dan <i>webcam</i> mudah digunakan?
4	Apakah Anda setuju <i>Bot Telegram</i> berhasil untuk menyalakan dan mematikan lampu serta mengambil dan menerima gambar?

5	Apakah Anda desain alat <i>Home Automation</i> berbasis <i>Raspberry Pi</i> menarik dan <i>simple</i> ?
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1. Do you agree Home Automation Based on Raspberry Pi is well worth it?
2. Do you agree the *Telegram* function is used as a Raspberry Pi Home Ported interface other than as a social media?
3. Do you agree if *Telegram Bot* operation as a light and webcam control tool is easy to use?
4. Do you agree Bot *Telegram* managed to turn on and off the lights and take/receive pictures?
5. Do you agree that the design of Home Automation based on Raspberry Pi tools attractive and simple?

Assessment given is based on assessment indicators as in Table 4.

Table 4 Assessment Indicators

Predikat	Nilai
Sangat Setuju	5
Setuju	4
Cukup	3
Tidak Setuju	2
Sangat Tidak Setuju	1

Value Predicate

Strongly Agree 5

Agree 4

Simply 3

Disagree 2

Strongly Disagree 1

To determine the level of user satisfaction, the user satisfaction indicators shown in Table 5 are used.

Table 5 User Satisfaction Indicators

Kategori	Presentase
Sangat Memuaskan	81% - 100%
Memuaskan	61% - 80%
Cukup Memuaskan	41% - 60%
Tidak Memuaskan	21% - 40%
Sangat Tidak Memuaskan	0-20 %

Percentage Category

Very Satisfactory 81% - 100%

Satisfy 61% - 80%

Quite Satisfy 41% - 60%

Not Satisfactory 21% - 40%

Very Unsatisfactory 0-20%

Maximum satisfaction 25 (assessment indicator) = 10  
(users) = 250

User satisfaction percentage (%)

= (Total user satisfaction) / (Total user maximum  
satisfaction) x 100%

=  $198/250 \times 100\%$

= 79.2%

From the results of the above polls, obtained value of 79.2%.based on Table 5 can be categorized as satisfactory, so the application is as expected according to need.

#### 4. Conclusion

From the results of this final project, the following conclusions can be drawn:

Raspberry Pi Home Based Automation System run well.

Control of the lights and webcam automatically by using the LDR sensor, RTC DS1307 and PIR sensors as well as manual controls by using Telegram applications function well. From the results of testing with the questionnaire to the user was obtained that the level of user satisfaction is 79.2% of 10 respondents, which means Home Automation based on Raspberry Pi system is satisfactory.

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