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DEVELOPMENT OF MAC-BASED SMARTHOME ACCESS RIGHTS AUTHENTICATION (MEDIA ACCESS CONTROL) ADDRESS

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ABSTRACT

This study seeks to understand the purpose of using the ESP32 module as a control center in the electronic equipment control system on Smarthome and to ascertain the outcomes of the application design by utilizing Mac Address as Authentication Access rights to control electronic equipment. A methods for gathering data utilized literary analysis. In this study, access rights authentication was conducted on the software, and two hardware test, manual mode testing and automatic mode testing, were applied. Software testing was done by registering the user and Mac address of the device by the admin, then the data is stored in the firebase. In software testing, three smartphones were used whose MAC addresses were registered by the administrator. Each registered device was tried to log in ten times, and the success rate was 100%. In contrast, three devices' MAC addresses were not registered, and they were unable to log in ten times, with a 100% failure rate. Hardware testing is carried out by manual testing mode, in manual model testing the input from the controller application is in accordance with the prototype output, while automatic mode testing is carried out based on conditions at room temperature, namely in room conditions > 30 then the fan turns on automatically, the temperature room <30 the lights turn on automatically, so the automatic mode test has been matched to the output of the prototype. Based on the results of the study, a control system was produced with a MAC Address as an id and a user to login to an application called “Controller” which can be used to control electronic equipment in the house.

Keywords: Access Rights, MAC Address, Control, Prototype.

1. INTRODUCTION

The internet is an information and communication technology that provides opportunities to obtain information quickly, precisely and affordable (Sari, Ilyas, and Ifdil 2017). The internet is no longer just used to search for information; with the advancement of technology, it is now possible to access electronic equipment via an internet connection, such as lighting, fans, TVs, and other electronic devices. The Internet of Things is the name given to this technology (IoT). Based on intelligent sensors and smart devices that communicate with one another through the internet network, the "Internet of Things" is a scientific advancement that holds great promise for improving quality of life (Junaidi 2015).

Previous research related to smarthomes has been widely carried out because of the need for automation for convenience in regulating electrical equipment in the home. Danny Kurnianto et al (2016) conducted research related to smart home but this research only focuses on controlling room lights, fans, mosquito repellent devices and LCD displays using hardware in the form of Arduino Uno without utilizing Internet of Things (IoT) technology. Meanwhile, other research was carried out by Fyanka Ginanjar Aditya (2015) has implemented technology (IoT) but only focuses on the Arduino Uno-based client server system with the Android user interface. However, the server system uses a common gateway interface method or protocol, the result is that the smart home system can be accessed by multiclients. Meanwhile, on the other hand, this system is very weak and vulnerable to being controlled by users who are not verified by the system.

The results of previous research on the implementation of smarthomes are that there is no authentication system for access rights, so that the existing smarthome system can be controlled by unauthorized people. Several researchers then tried to combine the smart home system with a security system in the form of adding an RFID module as access rights. A system has been developed by Shihabul Milah (2018) considered to be still less concise considering the many additions to the module which of course consumes a lot of resources. For this reason, research on the development of access rights authentication on smart home devices using Wireless sensor network (WSN), is expected to complete the shortcomings of previous studies. Where the Wireless Sensor Network

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(WSN) is a system that performs sensing, computing and communication processes that provide the ability for administrators to measure, observe and react to events and phenomena in certain environments (Sugiarto 2010).

The module that is widely used in the development of the Internet of Things (IOT) and Wireless Sensor Network (WSN) is ESP32. This module has Wifii connectivity that can connect to networks, both local networks and the internet, in addition to wifii connectivity, the ESP32 is also equipped with bluetooth 4.0 low energy. In its application, the physical address (MAC Address) of the device is used as an id or user to login. In addition, by utilizing third-party applications such as Android studio, various remote control systems can be realized.

In this study, a smart home system designed with control of electronic equipment that has control access rights by utilizing ESP32 and MAC Address on the android smarthome wifii device as a special ID in the user identification process.

2. METHODS

2.1 System Architecture

The overall system architecture is shown in Figure 3.1 below. Where in Figure 3.1 can be seen the components that make up a smarthome system in this study. The component symbols used in this system architecture drawing are shapes that represent the actual tools.

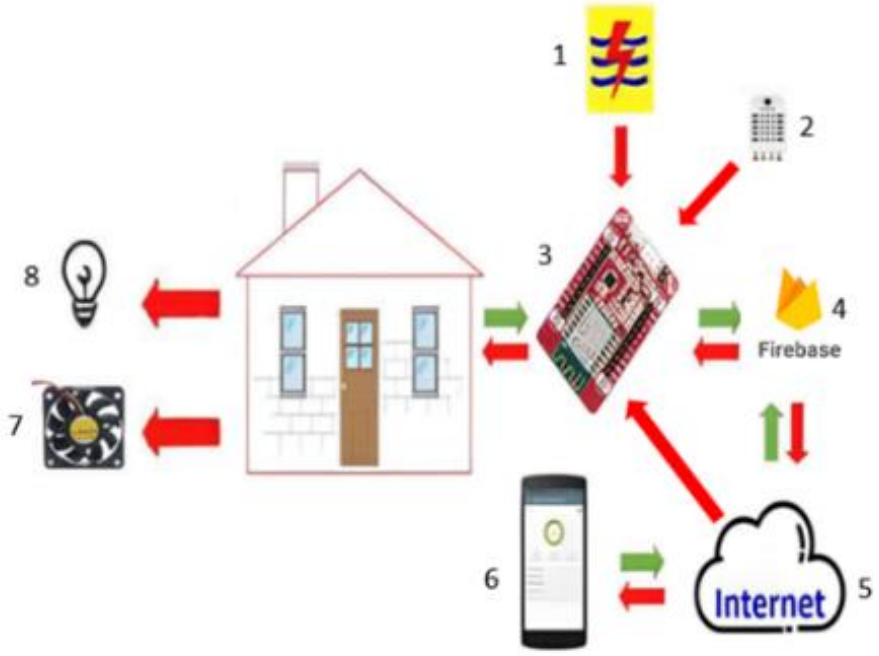

Figure 2.1 System architecture

Information:

1. Voltage source.
2. DHT 22
3. ESP 32
4. Firebase
5. Internet
6. Smartphone
7. Fan
8. Lamp.

In the picture above, it can be seen that the main system consists of a control system and media or tools to be controlled. While the secondary system consists of a PLN power source and internet connectivity. The way this system works as a whole is that the PLN electric current (voltage source) shown in no.1 will enter the home installation first through the ESP32 Control system shown in no.3, this ESP32 controls electronic equipment in the house when connected with the internet network shown in no.5, the electronic equipment in question is the fan and light shown in no. 7 and 8. So to control the electronic equipment, first the user name and Mac Address

of the device are registered by the admin. Data from registered users will be stored in the firebase shown in no.4. After the username and mac address are registered, the user has access rights to login to the user dashboard. The user name and Mac Address of the device used to login must match the existing data on firebase in order to login.

After successfully logging in, the user can control electronic equipment by pressing the ON/OFF button in the application. In the application there is also a manual mode and automatic mode, where in manual mode the user can control electronic equipment according to the button used, while the automatic mode is based on room temperature, the room temperature is detected using the DHT22 sensor shown in no.2, if the room temperature is at <30 then the light will turn on automatically and a notification "your light is on", and when the room temperature is >30 then the fan will turn on automatically and a notification "your fan is on".

a. System block diagram

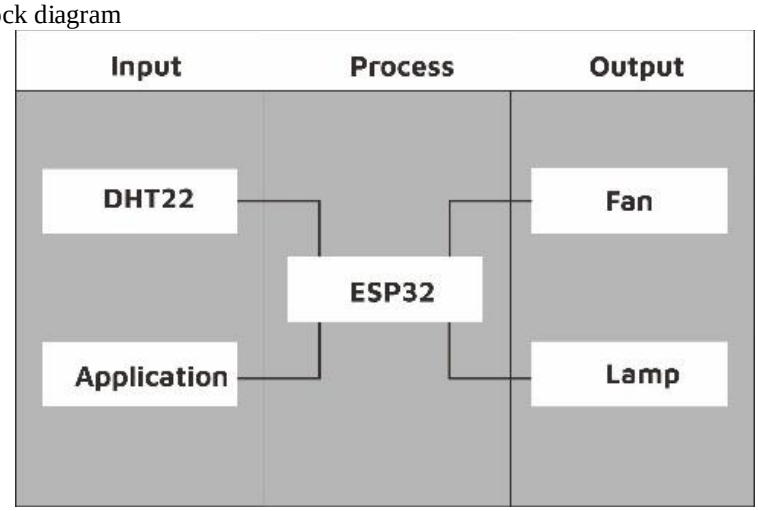

Figure 2.3 System block diagram

In Figure 2.3 it can be seen that the overall system is divided into three main blocks, namely input, process and output. In the input block there are two main components, namely, the DHT22 sensor and the application. While in the process block there is an ESP32 module as a control center. The output block consists of controlled electronic equipment, namely lights and fans.

b. Circuit Schematic

The image below briefly describes the circuit schematic design that will be used in the process of making a Smart Home control system with an ESP32 NodeMCU Module Using an Internet Of Things (IoT) Based Android Application. This circuit scheme serves to facilitate researchers in the process of identifying problems or modifying the system circuit blocks if needed. The circuit schematic in this design is made using the fritzing freeware application.

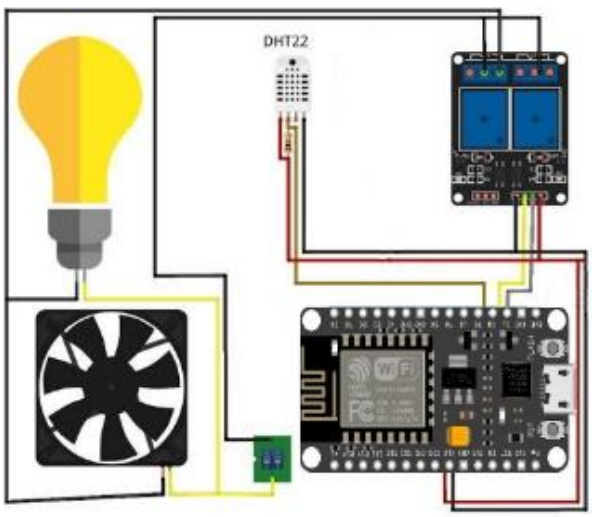

Figure 2.4 Circuit Schematic

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1.1 System Flowchart

The following flowchart image shows the work process of the system as a whole. This flowchart is used to make it easier for researchers to analyze the shortcomings of the system created and make modifications if needed. The following is an image of the flowchart system that was created.

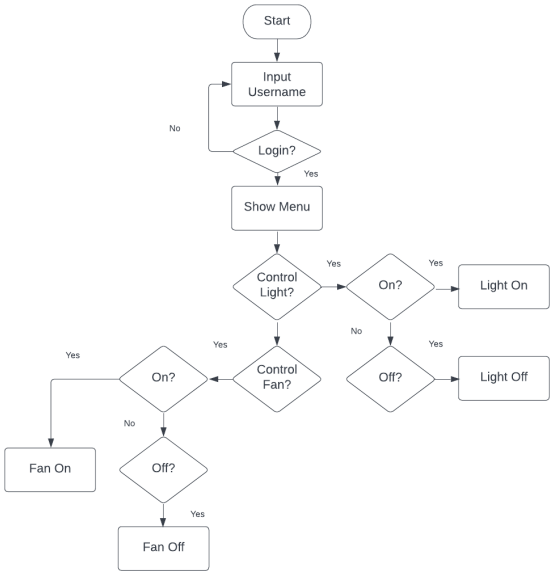

Figure 2.6 User Flowchart

Figure 2.6 shows a system flowchart where the first displayed is the condition menu, the conditions in question are the condition of the lights and the condition of the fan, on this user flowchart we can control two electronic equipment, namely lights and fans.

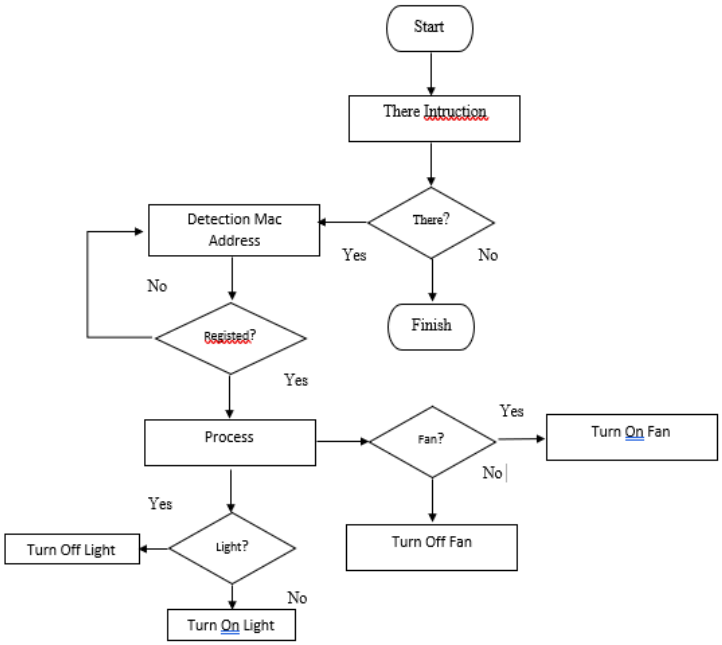

Figure 2.7 System Flowchart

Figure 2.7 shows the flowchart of the system, where to control electronic equipment a command will appear to control it, but before the command process is carried out first the system will detect the MAC Address, if the MAC Address is registered it can control electronic equipment, but if not then vice versa.

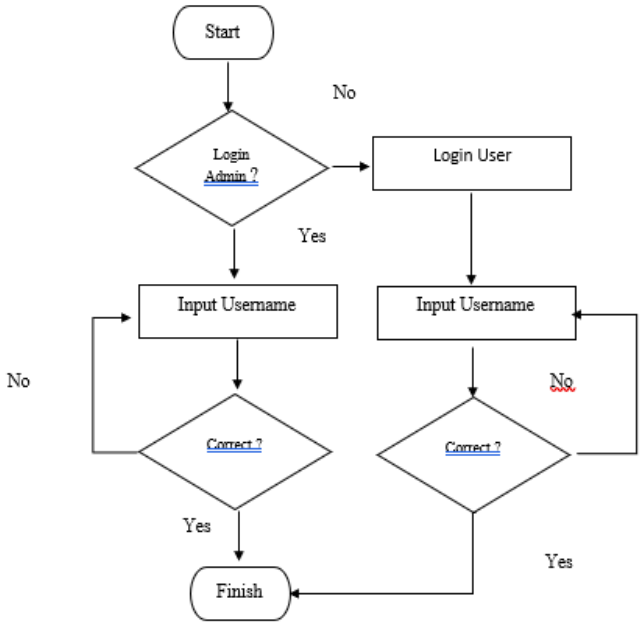

Figure 2.8 Authentication Flowchart

Figure 2.8 shows an authentication flowchart where to be able to login to the application first, the username used to login must match the username on Firebase, when the username does not match the name on Firebase, it means the user cannot login to the application.

1.2 Data analysis technique

In this study, the data analysis method used was descriptive. Descriptive data analysis technique is an analytical technique used to explain a data by describing it so that conclusions are obtained from a group of data (Mudassir, 2020). Analytical data is data obtained from the results of testing the development of Authentication of smart home access rights based on MAC addresses, functional systems, and access rights. This test then produces test data that supports the overall conclusion.

2. Results and Discussion

From the research results produce a system that has been built based on the design that has been made previously, as for the results as follows:

3.1. Software Testing

Testing on the software is done by registering the user name and MAC address of the device by the admin, after the user name and MAC address are registered, the device user can log in to control electronic equipment in the house.

Figure 3.1 User Login Display

Figure 3.1 shows the login display for the user, so we login using the username that has been registered by the admin.

Figure 3.2 User Dashboard Display

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Figure 3.2 shows the user dashboard display, on the user dashboard there is an ON or OFF button to turn on or turn off electronic equipment, besides that there are buttons for manual mode and automatic mode.

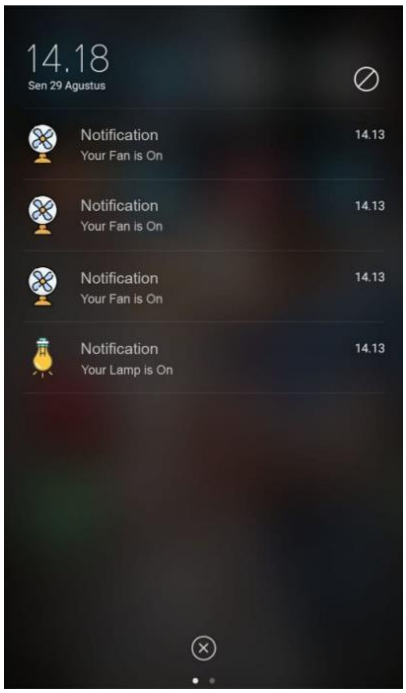

Figure 3.3 Automatic mode notification is on

In Figure 3.3 shows the automatic mode notification display, if the automatic mode is activated then the lights and fans will turn on automatically based on room temperature conditions, if the room temperature conditions are > 30°C then the lights will turn on automatically and a notification "Your fan is on" as well as with room temperature < 30°C then the lights will turn on automatically and a notification will appear "Your lights are on"

Figure 3.4 Manual Mode Notification On

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Figure 3.4 shows that the manual mode notification display is active, so when we give the fan on action, a notification will appear at the top of the “Your Fan is On” layer and vice versa.

3.2. Hardware Testing.

Hardware testing is carried out with two tests, namely manual mode testing and automatic mode testing.

Manual Mode Testing

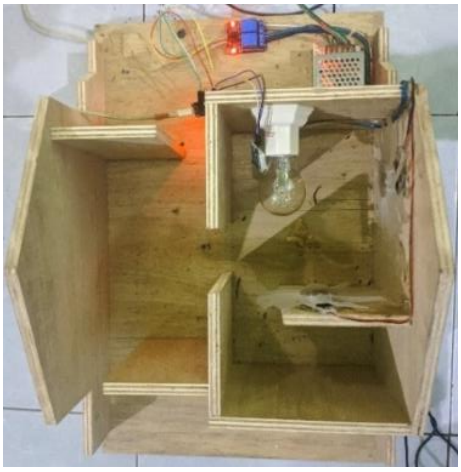

Figure 3.5 Manual Mode OFF

The controller shows the mode used is manual with the lights and fans off according to the application.

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Figure 3.6 Manual Mode ON

The controller shows the mode used is manual with the lights and fans on or on according to the application.

Figure 3.7 Manual Mode Lamp ON

The controller shows the mode used is manual with the light condition on and the fan off according to the application.

Figure 3.8 Fan Manual Mode

The controller shows the mode used is manual with the lights off and the fan active according to the application.

Figure 3.8 Auto Mode Lamp ON

The controller shows the mode used is Automatic with a temperature condition of 28.8 C, then the light is on and the fan is off.

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Figure 3.9 Fan Auto Mode

The controller shows the mode used is Automatic with a temperature condition of 30.4 C, then the light is off and the fan is on.

3.1 Registered Mac Address test results table

Mac Address	Test	Success	Failed
D0:c5:f3:27:62:21	10 x	10 x	0 x
F0:6d:78:77:97:83	10 x	10 x	0 x
54:2b:8d:f3:37:f3	10 x	10 x	0 x
Average ∑	30 x	30 x	0 x

(source: Data Processing Result , 2022)

$$\sum = \frac{Success}{Test} = 100\%$$

$$= \frac{30\,x}{30\,x} \text{ x } 100\% = 100\%$$

The results of the registered Mac Address experiment obtained a 100% success rate. The experiment was carried out 10 times logging in using a registered Mac Address with the same device and user. Registered Mac Address test table

Mac Address	Test	Success	Failed
E6:f2:a2:54:ff:ce	10 x	0 x	10 x
62:d3:67:f8:01:3e	10 x	0 x	10 x
12:b0:c5:39:d4:2b	10 x	0 x	10 x
Average ∑	30 x	0 x	10 x

(source: Data Processing Result , 2022)

$$\sum = \frac{Failed}{Test} = 100\%$$

$$= \frac{30\ x}{30\ x} \text{ x } 100\% = 100\%$$

The results of the Mac Address experiment are not registered, the failure rate or login failure is 100%. The experiment was carried out 10 times trying to login using a Mac Address that was not registered with the same device and user.

No	Component name	Input voltage	Output Voltage
1	Power supply	220 V	12 V
2	Lamp	220 V	-
3	Fan	12 V	-
4	Relay 1	220 V	220 V
5	Relay 2	12 V	12 V
6	ESP32	3,3 V	3,3 V
7	DHT22	3,3 V	-

(source: Data Processing Result , 2022)

Note:

Relay 1 = Controlling Lamp

Relay 2 = Controlling Fan

In table 4.5 the component test can be seen that the input voltage is 220 V and the output voltage is 12 V on the power supply, the input voltage from the lamp is 220V and the fan is 12 V, Relay 1 is to control the lights, Relay 2 is to control the ESP32 fan, the input and output voltages are 3,3 V, and DHT22 with a voltage of 3.3 V.

V-in 1 (Volt)	V-in 2 (Volt)	Gnd	Vcc	Relay	Lamp	Fan
0	0	3,2	3,1	Relay 1 OFF Relay 2 OFF	OFF	OFF
0	3,2	3,2	3,2	Relay 1 OFF Relay 2 ON	OFF	ON
3,2	0	3,2	3,2	Relay 1 ON Relay 1 OFF	ON	OFF
3,2	3,2	3,2	3,2	Relay 1 ON Relay 2 ON	ON	ON

(source: Data Processing Result , 2022)

In Table 4.6 are the results of the Relay test, which is produced if V in 1 and V in 2 have a value of 0 then relay 1 and relay 2 are OFF in the sense that the lights and fans are off, if v in 1 is 0 and v in 2 is 3, 2 then relay 1 is OFF status, relay 2 is ON status, in the sense that the light is on and the fan is off. Then if v in 1 is 3.2 v and v in 2 is 0 then relay 1 is ON and relay 2 is OFF, then the light is on and the fan is off, then if v in 1 and v in 2 are worth 3 ,2 v then relays 1 and 2 are ON, in the sense that the lights and fans are on.

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No	Temperature	Fan	Lamp	Description
1	35°C	ON	OFF	Success
2	34°C	ON	OFF	Success
3	33°C	ON	OFF	Success
4	32°C	ON	OFF	Success
5	31°C	ON	OFF	Success
6	30°C	ON	OFF	Success
7	29°C	OFF	ON	Success
8	28°C	OFF	ON	Success
9	27°C	OFF	ON	Success
10	26°C	OFF	ON	Success

(source: Data Processing Result , 2022)

Table 4.7 is a test of the DHT22 component, in this test it can be seen that the room temperature is above > 30 C the fan will turn on and the light will not turn on. While the temperature is < 30 C the fan does not turn on and the light is on. This indicates that the application controller is in accordance with the prototype output.

Fan	Lamp	Results
ON/OFF		
OFF	OFF	Fan and Lamp Off
ON	ON	Fan and Lamp On
OFF	ON	Fan Off and Lamp On
ON	OFF	Fan On and Lamp Off

(source: Data Processing Result , 2022)

The results of the manual mode test can be seen that the button input on the controller application is in accordance with the output in the prototype.

Fan	Lamp	Results
Temperature		
> 30 °C		Fan On and Lamp Off
< 30 °C		Lamp On dan Fan Off

(source: Data Processing Result , 2022)

Automatic mode testing, in this test it can be seen that the lights and fans are on based on predetermined conditions where the room temperature conditions > 30 the fan is on and the lights are off, while the room temperature is <30 the lights are on and the fan is off according to the output on the prototype.°C°C

3.3. Discussion

Smarthome application development is designed with an Authentication System with access rights based on the MAC address of the device. MAC address serves as an identifier registered by the admin. To log into the application in order to access or control the applications and tools that have been designed, the application is made in the form of an android-based application developed using android studio software with the dart programming language, application database management uses firebase to store data. In the application there are admins and users, in the admin section you can add or register the MAC address of the device, besides adding it

can also delete the registered MAC address. Then on the user side there is a button to control the lights and fans manually and automatically.

Based on the development of the Smarthome Access Rights Authentication System that has been made, software and hardware testing has been carried out. In testing the software, it is tested by trying to login using the user and Mac Address that has been registered by the admin. Meanwhile, in hardware testing, manual mode and automatic mode testing of the tools that have been made are tested.

Authentication testing of access rights is made to control electronic equipment in the house provided that the User and Mac Address of the device are first registered by the admin. After being registered by the admin, user data is stored in firebase. Then after the user is registered, the login will be successful if the username matches the data stored in firebase. Meanwhile, when the username does not match the data stored in firebase, a warning "Mac Address Unregistered" will appear. After successfully logging in, the user dashboard display will appear, on the user dashboard there are ON/OFF buttons for fans and lights, and manual/automatic modes in controlling electronic equipment. The manual mode in question is controlling the lights and fans based on the buttons on the application, whereas when the automatic mode is activated, it works based on room temperature. When the temperature is > 30 then the light will turn on automatically, while when the temperature is < 30 then the fan will rotate automatically.

At the testing stage, the application system is tested in terms of access rights authentication, by logging in with the registered MAC address and the unregistered MAC address. This test uses 6 mobile phone devices with different types, 3 Mac Address devices are listed and the other 3 are not registered. Of the 3 devices registered with the Mac Address, 10 attempts were made and successfully logged in and were able to control electronic equipment. Meanwhile, 3 other devices whose MAC addresses were not registered were also tried 10 times and could not log in and could not control electronic equipment. The test results are then described in Tables 4.3 and 4.4. After the process of authenticating access rights on the application, then testing the functionality of the features in the application, so after the user successfully logs in, the application features are used to control electronic equipment (lights and fans). The features in the application are in accordance with the output on the prototype. Described in tables 4.5 and 4.6.

In the needs analysis stage, the researcher examines the sources of literacy related to previous research. based on needs analysis in previous research, namely in terms of authentication of access rights on applications to control electronic equipment. The results of the needs analysis obtained, the needs of the application in terms of admin and user, namely the multiuser login menu, buttons controlling lights, controlling fans, manual and automatic mode buttons. The results of the needs analysis obtained are then designed in the form of a system block diagram, and the interface display of the application. While making system flows such as flowcharts using the 2019 version of Microsoft word. After the prototype design has been completed, then build the prototype that has been designed, then tested.

Based on the results of the development of MAC address-based smarthome access rights authentication that has been tested for authentication and functions, it can be concluded that the android-based controller application can control electronic equipment provided that the MAC Address has been registered by the admin.

3. CONCLUSION

Based on the results that have been carried out as follows, the following conclusions are obtained:

1. The results of the development in this study resulted in an Android-based smarthome control application by utilizing the MAC Address as an ID to log into the application in order to control electronic equipment in the house. The results of testing the application obtained a 100% success rate for logging into the application using 3 devices with each device being tested 10 times.
2. The device designed to work as expected by the researcher, based on the results of hardware testing, was tested in manual mode and automatic mode. The results of the manual mode are in accordance with the output on the prototype, while the automatic mode results are based on room temperature conditions, where the room temperature conditions are > 30 the fan is on and the lights are off, while the room temperature is <30 the lights are on and the fan is off according to the output on the prototype.℃℃

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