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SMART HOME APPS WITH VOICE USER INTERFACE

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Abstract

The development of the concept of Internet of Things (IoT) makes people excited about making devices that can control electrical devices remotely even when they are not at home. This system is known as a smart home. This smart home system controls electrical devices such as lights, fans, sockets and door locks through a smartphone application with the Android operating system that is connected to the internet. The Android application has a login security system so that not just anyone can control the device. To be able to control the device, a NodeMCU ESP-8266 microcontroller is needed which is already connected to the internet network as a data receiver through the Realtime Firebase database and a relay as a regulator of electric current from the plug to the device. Device control can use 2 modes, namely voice recognition mode and manual button mode. Voice recognition mode uses a special command code listed in the application in the Guide menu or guide. Every activity in controlling electrical devices will be recorded in the activity log and stored in Google Sheets, so that these activities can be monitored and can save electricity usage.

Keywords: smart home, application, voice user interface, iot, control system

1. INTRODUCTION

Technology is growing rapidly from year to year and has a very important role in aspects of everyday life for humans, including in the field of Internet of Things (IoT). IoT was discovered in 1999 by Kevin Ashton which was followed by the development of RFID or Radio-Frequency Identification. Basically IoT devices consist of sensors as data collection media, internet connections as communication media and servers as collectors of information received by sensors and for analysis (Efendi, 2018).

IoT is a term that emerged with the notion of accessing electronic devices through internet media (Wasista et al., 2019) . The core device in IoT is a microcontroller, which functions as processing and exchanging data between connected devices. Currently, microcontrollers used for IoT purposes continue to develop, one of the developments is the use of microcontrollers in smart homes that are controlled remotely through smartphone applications by exchanging data via the internet network.

From the survey that the researchers got, no smart home has been implemented around the researcher, especially by using Voice Recognition control. Even though the internet network and service providers for communication and data packages have been able to cover the research area, precisely in Paremono village. There are also quite a number of users who subscribe to communication and data services, but they are only used for work, school, social media, browsing and so on. Even many users are not familiar with the term IoT while the internet network can be used to help daily activities such as turning on and off electronic devices. Based on the description above, one of the uses in the IoT field is a smart home. A simple prototype design is needed that is able to control home devices. Because it is in the form of a prototype, the devices used are limited and the ones that are chosen are those with indispensable needs, such as lights, doors, fans and sockets.

The purpose of implementing this Smart Home Prototype is to be able to control a system in the form of lights, electricity and door locking so that users can see and manage it easily so that it fits the desired conditions (Prabowo 2018) . This smart home is intended for users with disabilities, the elderly, forgetful people and people who are always busy with their work. The number of studies on smart homes makes researchers competing in developing them. One of them is developing a smart home with a voice UI, where users use their voice as a command to control home devices through a smartphone application that is connected to the internet.

This smart home design with voice UI has both advantages and disadvantages. The advantage is being able to control home devices connected to the internet remotely via a smartphone application by voice. While the drawback is that if there is no internet network, then home devices cannot be controlled with a smartphone application .

The lack of optimal use of the internet, especially in the field of IoT in everyday life, causes the slow

development of technology around us and the wasted efficiency and effectiveness in utilizing time even though it can only be used for other activities, which is the main reason for conducting research entitled "Smart Home Applications with VOICE UI".

2. RELATED WORKS

This smart home research develops previous existing smart home research with the aim of making it easier for future research to collect and manage data. Here are some previous studies, research on Internet Of Things (IoT) Lamp Control System Using Mobile - Based Raspberry PI. This study discusses the lighting control system using a Raspberry PI microcontroller which is controlled via a smartphone application . This design controls 2 lamps that are connected to the DT Relay and Rasberry PI with a smartphone application as a controlling medium and is equipped with 2 lamp images that indicate the state of the lamp (Efendi, 2018).

The second research is about Designing a Smart Home System Prototype Based on the Internet Of Things. Research that discusses smart home design using NodeMCU as a microcontroller and equipped with several other devices, such as NodeMCU Base as an I/O port expander , servo motor as a rotor drive that is connected to a wire on the door lock, 4 channel relay as an electric current controller, infrared sensor as servo arm detection so that the door status information can be known, and the last is controlling it using a web browser (Prabowo, 2018).

The third research on Designing an IoT-Based Smarthome System Prototype with a Smartphone Using NodeMCU. This study discusses the design of a smarthome prototype like the second research. The difference is the components used, namely this research does not use infrared sensors but uses a power supply as a device that supplies electricity to the output load, the use of fan components, switches and control media is the Blynk application. When the NodeMCU is on, blynk will detect whether the NodeMCU is connected or not. If it is connected then blynk will provide information in the form of a display, if not then blynk will continue to try to connect NodeMCU (Sosa 2019) . The other components are the same, namely using the NodeMCU microcontroller as data processing and transfer, the use of a 4 channel relay as a regulator of electric current and a servo motor as a door or fence lock.

The research on Designing a Smart Home System Using NodeMCU Esp8266 Based on Telegram Messenger Communication. Research on smart home design with a system that has several features, such as controlling lights, detecting gas leaks, monitoring room temperature, and turning on the fan automatically which is controlled via the Telegram Messenger application (Purnawan & Rosita, 2019).

3. METHODS

The object of this research is the creation of an Android smartphone application to control a smart home using the voice method. In this device there are several tools used for its design, namely using a NodeMCU V3 microcontroller used as a control center, NodeMCU Base as an additional device from NodeMCU V3 to expand I/O ports , SG90 servo motor used to lock doors, relays function as connectors and breakers. electricity flow between connected devices, and an Android smartphone is used for the media controller.

This research uses literature research, surveying and observation, developing systems and conducting tests on systems. The development of this application has several stages, namely analyzing, system design, implementation, and testing.This research employed library research, surveys and field observations, system development and testing system. The application development stage included analysis, system design, implementation, and testing.

3.1. System Design

System design aims to determine the database according to system requirements. The system design is carried out to provide a general explanation to the user and the system design can be used by parties or researchers who will develop this system, as shown in Figure 1.

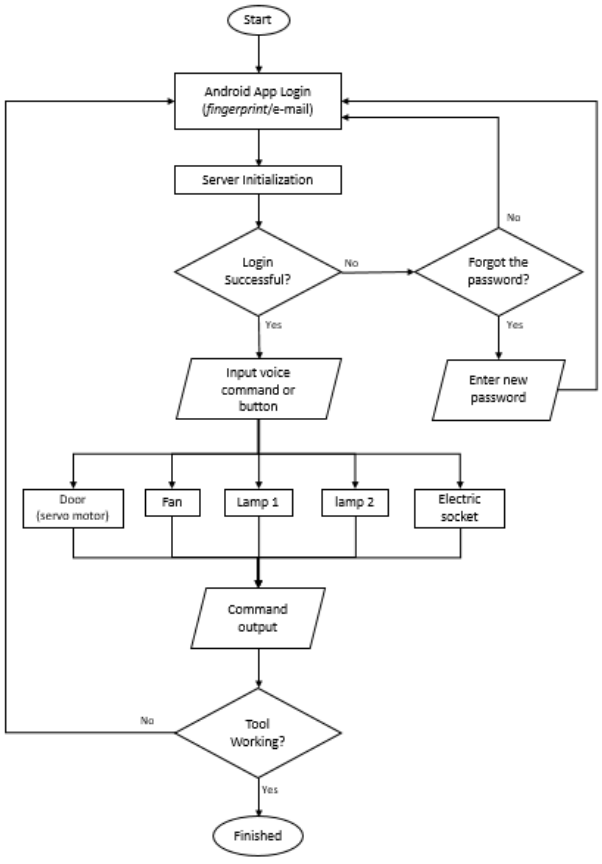

Figure 1. System Flow Chart

3.2. Smart Home Prototype Design

The smart home prototype design serves as a design form for hardware placement on the home prototype to be pasted. The following is an image of the smart home prototype design which can be seen in Figure 2.

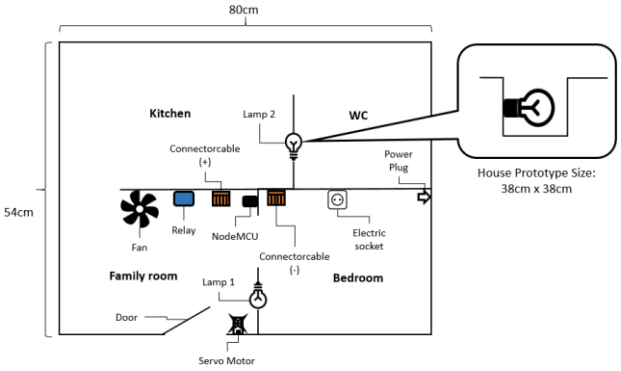

Figure 2. Smart Home Prototype Design

3.3. Hardware Design

Hardware design is a hardware design that will be used so that the hardware can form into a system that is interconnected and can be controlled. The following is a picture of the hardware design shown in Figure 3.

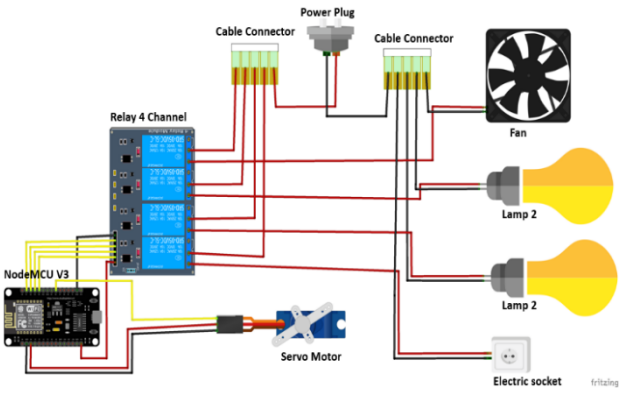

Figure 3 Hardware Design

3.4. Android Application Design

3.4.1. Login Page

The internet network plays an important role in connecting communication between Android and the NodeMCU microcontroller. Therefore, this application can only be used when the smartphone is connected to a good internet network. On the initial screen of the application there is an image of a fingerprint that is used to login with a fingerprint. In addition to using a fingerprint, users can use a registered email and password to login. There is a forgot password option to anticipate users who forget their login password. The login display image can be seen in Figure 4.

Figure 4. Login Display

3.4.2. Email Password Reset Page

On the reset email password page the user is required to write down the email that has been registered in the application. After writing the email correctly, tap the checkbox to activate the submit button and press submit. A message containing a password reset link will be sent to an email written by the user. The following is an image of resetting the email password shown in Figure 5.

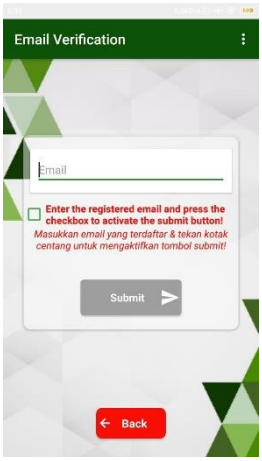

Figure 5. Reset Email Password

3.4.3. Home Page

The home page or Home displays several buttons such as log out, guide, add user, activity log, voice record button, button to switch to button control and about us. If the user presses the Use Button? then the second home screen will appear. The difference in the second display is that there is a Use Your Voice? to move to the first display and display several buttons to turn on and off devices such as lamp 1, lamp 2, socket, fan, door and all devices. The following is the display of the home/homepage which can be seen in Figure 6.

Figure 6. Home (Sound and Manual Buttons)

3.4.4. Guide Page

Guide page or guide contains voice command codes in two different languages, namely Indonesian and English. To switch pages from Indonesian to English, users need to press the English Language button and vice versa if they want to return to the Indonesian page. The back button is used to return to the home screen. The following is the display of the guide or guide (Indonesian and English) which can be seen in Figure 7.

Figure 7. Guide page

3.4.5. Add User Page

On the Sign Up or add user page contains 3 name forms, sign up and back buttons. The three forms must be filled in including the name, email and password form. After all the forms are filled, press the sign up button to add a new user. The back button is used to return to the home screen. The following is the display of Sign Up or add users which can be seen in Figure 8.

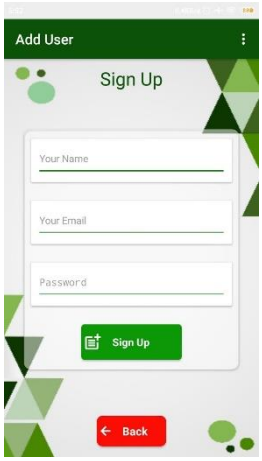

Figure 8. Add User

3.4.6. Log Page

On the log page contains a list of activities from the user when turning on and off the device accompanied by the time and date. There is a refresh button in the lower right corner that serves to refresh the activity list and the back button serves to return to the home view. The following is a log display that can be seen in Figure 9.

Figure 9. Log page

3.4.7. About Us Page

The about us page or about us displays the name, email and number of the researcher. If there are problems or problems with the application, users can contact the researcher. The back button is used to return to the home screen . The following is a display of About Us or about us can be seen in Figure 10.

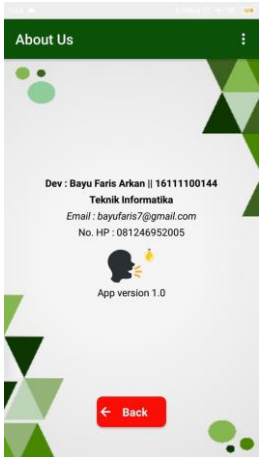

Figure 10. About Us

4. IMPLEMENTATION AND DISCUSSION

This implementation describes in detail about smart home applications with voice UI. The devices used are NodeMCU ESP-8266, mini fans, servo motors, lights, sockets and 4 CH relays. Making this tool aims to provide convenience in controlling or controlling electrical devices connected to WiFi using smartphone applications, especially Android, as shown in Figure 11.

4.1. System Circuit Building

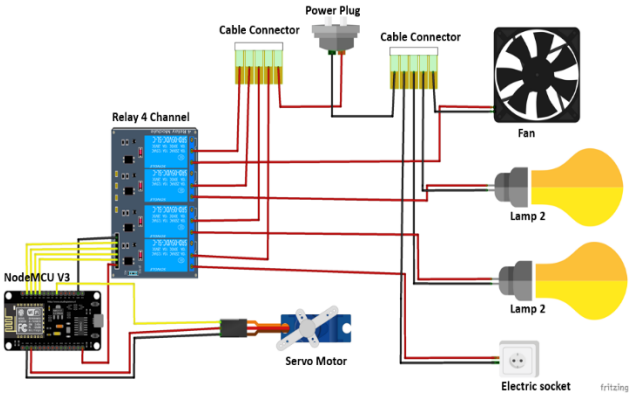

Figure 11. Circuit Tools

The form of implementation of the application is to form some source code into a smartphone application that is used to monitor or control IoT devices. The minimum Android version used to run the application is version 7.0 (Nougat) API 24. There are 2 methods displayed in the application, namely the voice method and the manual button method. Inside the application there is a button to record the user's Voice Recognition. If the Voice Recognition is in accordance with the guidelines in the application, the user can control 5 devices including controlling lamp 1, lamp 2, mini fan, socket and moving the servo motor to lock the door. In addition to the voice record button, there is a manual control button in anticipation if the user is experiencing sound disturbances or so on. The following are some display applications when run, such as the home button voice button and manual button can be seen in Figure 12 and the log display can be seen in Figure 13.

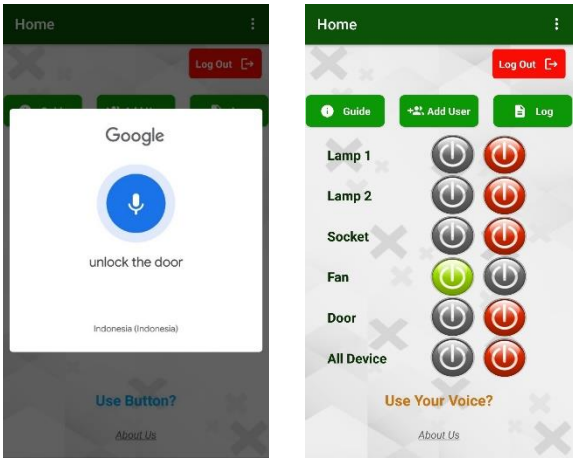

Figure 12. Home (Sound Buttons & Manual Buttons)

Figure 13. Log page

4.2. System Test Results

This servo motor test serves to measure the accuracy of the servo motor in moving the door lock. The test was carried out for 10 experiments, including by moving the servo motor for 5 times to lock the door and 5 times to unlock the door. The following are the results of the servo motor testing shown in Table 1.

Table 1. Servo Motor Testing

Command Input	From (degrees)	To (degrees)	Success Percentage	Test Results (degrees)
Lock	95	270°	98%	265°
Lock	95	270°	100%	270°
Lock	95	270°	96%	262°
Lock	95	270°	100%	270°
Lock	95	270°	100%	270°
Unlock	270°	95	94%	101°
Unlock	270°	95	94%	101°
Unlock	270°	95	94%	101°

In testing the application to devices with voice recognition mode, this is done using voice recognition mode which is then assessed for success and the speed at which the device can work. This test uses Telkomsel provider as the data sender to the database. The following table results from testing devices with voice recognition mode which can be seen in Table 2.

Table 2. Device Test with Voice Recognition Mode

Device Name	Voice Input	Device Output	Time (second)	Information
lamp 1	turn on	Light 1 On	1.25 seconds	Succeed
	turn off	Light 1 Off	1.06 seconds	Succeed
lamp 2	turn on	Light 2 On	1.32 seconds	Succeed
	turn off	Light 2 Off	1.98 seconds	Succeed
Electric socket	turn on	Stop Contact Live	1.75 seconds	Succeed
	turn off	Stop Contact Off	1.00 second	Succeed
Mini Fan	turn on	Live Fan	1.85 seconds	Succeed
	turn off	Fan Off	1.71 seconds	Succeed
Door	Lock	Door Locked (270º)	2.00 seconds	Succeed
	Unlock	Door Unlocked (95º)	2.19 seconds	Succeed

Device Testing with Manual Button Mode

In testing the application to a device with manual button mode, this is done using the manual button mode displayed on the application, then the success value and the speed of the device can work. The provider used is also the same as the voice recognition mode, namely Telkomsel. The following is a table of results from device testing with manual button mode which can be seen in Table 3.

Table 3. Device Testing with Manual Button Mode

Device Name	Key Input	Device Output	Time (second)	Information
lamp 1	ON	Light 1 On	1.58 seconds	Succeed
	OFF	Light 1 Off	1.71 seconds	Succeed
lamp 2	ON	Light 2 On	1.46 seconds	Succeed
	OFF	Light 2 Off	1.78 seconds	Succeed
Electric socket	ON	Stop Contact Live	1.39 seconds	Succeed
	OFF	Stop Contact Off	1.97 seconds	Succeed
Mini Fan	ON	Live Fan	1.12 seconds	Succeed
	OFF	Fan Off	1.39 seconds	Succeed
Door	ON	Door Locked (270º)	1.78 seconds	Succeed
	OFF	Door Unlocked (95º)	2.52 seconds	Succeed

4.3. Software Testing

Testing the voice recognition mode application is carried out to determine whether the application is functioning in controlling the device, namely by entering the user's voice command into the application. The following are the results of testing applications with voice recognition mode, which can be seen in Table 4.

Table 4. Application Testing with Voice Recognition Mode

Device Name	Voice Input	Command Function	Response
lamp 1	turn on	Turn on lamp number 1	Succeed
	turn off	Turning off light number 1	Succeed
lamp 2	turn on	Turn on light number 2	Succeed
	turn off	Turning off light number 2	Succeed
Electric socket	turn on	Turn on the socket	Succeed
	turn off	Turning off the socket	Succeed
Mini Fan	turn on	Turn on the mini fan	Succeed
	turn off	Turning off the mini fan	Succeed
Door	Lock	Lock the door	Succeed
	Unlock	Unlock the door	Succeed

4.4. Application Testing with Manual Button Mode

Manual button recognition mode is used to test the application to find out whether the application is successful or not in controlling the device by pressing the ON and OFF buttons in the application. The following results of application testing with manual button mode can be seen in Table 5.

Table 5. Application Testing with Button Recognition Mode

No	Device Name	Key Input	Command Function	Response
1	Lamp 1	ON	Turn on lamp number 1	Succeed
		OFF	Turning off light number 1	Succeed

No	Device Name	Key Input	Command Function	Response
2	lamp 2	ON	Turn on light number 2	Succeed
		OFF	Turning off light number 2	Succeed
3	Electric socket	ON	Turn on the socket	Succeed
		OFF	Turning off the socket	Succeed
4	Mini Fan	ON	Turn on the mini fan	Succeed
		OFF	Turning off the mini fan	Succeed
5	Door	ON	Lock the door	Succeed
		OFF	Unlock the door	Succeed

5. CONCLUSION

Based on the results of the system testing carried out, control using voice recognition and manual buttons can run properly according to instructions from the user and NodeMCU can also read data from the database so that the device can be controlled. The NodeMCU application and microcontroller require an internet network to be able to control the device. It takes an adapter or smartphone charger with a voltage rating of less than 12V and more than 5V to turn on the microcontroller and mini fan. Based on testing the servo motor can move the door lock at an angle of 95 to an angle of 270 and vice versa. This implementation describes in detail about smart home applications with voice UI. The devices used are NodeMCU ESP-8266, mini fans, servo motors, lights, sockets and 4 CH relays. Making this tool aims to provide convenience in controlling or controlling electrical devices connected to WiFi using smartphone applications, especially Android.

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