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Smart Home System With Radio Frequency Using Blynk Application

Abstract– *Over time, technology has been embedded in our daily lives and will develop more and more rapidly. Because everything can facilitate us in activities, especially in a house. But the problem arises how we manage and control electronic equipment efficiently and comfortably. In this study, an intelligent control system based on IoT (Internet of Things) technology has been suggested to solve the above problem, namely with a smart home control system based on IoT (Internet of Things) with a radio frequency of 433 MHz as a command to send and be forwarded to several receivers on each - each relay uses an IoT (Internet of Things) application, namely Blynk on a smartphone, it can also be controlled manually using a wireless button control and can be controlled remotely with a frequency of 433mhz. Through a series of control modules, such as switch modules, radio frequency control modules, you can directly control all kinds of household appliances. With smart phone can also communicate with smart center controller via wireless router via Wi-Fi interface. Because it has a radio frequency of 433 MHz as the bottom control layer, tools can be added to or removed from the control system very easily. And this control system functions as a switch that is connected to several receivers to each relay.*

Abstrak– Seiring berjalannya waktu, teknologi sudah melekat di kehidupan kita sehari – hari dan akan berkembang semakin maju dan pesat. Karena segala sesuatu bisa memudahkan kita dalam aktifitas terutama di dalam sebuah rumah. Tetapi timbul masalah bagaimana kita mengelola dan mengendalikan peralatan elektronika secara efisien dan nyaman. Pada penelitian ini sistem kontrol cerdas berbasis teknologi IoT (Internet of Things) telah disarankan untuk menyelesaikan masalah di atas yaitu dengan sistem kontrol smart home berbasis IoT (Internet of Things) dengan radio frekuensi 433 MHz sebagai perintah untuk mengirim dan diteruskan ke beberapa penerima pada masing – masing relay menggunakan aplikasi IoT (Internet of Things) yaitu Blynk pada smartphone, juga bisa di kontrol secara manual dengan menggunakan kontrol tombol tanpa kabel dan bisa dikendalikan dengan remote dengan frekuensi 433mhz . Melalui serangkaian modul kontrol, seperti modul sakelar, modul kontrol frekuensi radio, dapat mengontrol langsung semua jenis peralatan rumah tangga. Dengan ponsel pintar dapat juga berkomunikasi dengan pengontrol pusat pintar melalui router nirkabel melalui antarmuka Wi-Fi. Karena memiliki radio frekuensi 433 MHz sebagai lapisan kontrol bawah, alat dapat ditambahkan atau ditarik dari sistem kontrol dengan sangat mudah. Dan sistem kontrol ini berfungsi sebagai saklar yang terhubung pada bebrapa penerima ke masing – masing relay.

Kata Kunci– *IoT; Smart Home; Radio Frequency 433 MHz; Blynk; smart center controller*

I. Introduction

CONDITIONS for controlling electrical installations at home in the lives of most people are still relatively conventional, which is relatively only using the principle of close control (manual) or can be called a control that has not been able to be carried out at a distance [1, 2]. With the development of increasingly sophisticated technology so that it can make everything easier, one of the technological developments is the smart home system. This smart home system is a home control system that can provide comfort for homeowners to control electronic equipment remotely using a smartphone [3–6]. With this system, we can control and monitor the house, which doesn't have to be done on the spot anymore, but we can do it anywhere and anytime. Starting from controlling the lights, opening/closing the gate of the house, monitoring the state of the house, etc [7–9].

This smart home system is implemented to increase user convenience in controlling home appliances (lights, fans, air conditioners, etc.) either through wired or wireless communication [10–12]. Wired communication means that home appliances are physically connected to a server or control center, while wireless communication means equipment that is connected via a signal frequency medium to a server or control center. Some wireless devices such as Wireless LAN, Infrared,

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Bluetooth, are examples of wireless communication, which have different advantages [1, 2].

The monitoring system being studied basically requires basic modules such as a microcontroller and a radio frequency module (RF) [13–15]. On RF Module, This communication uses wireless transmission in which the RF signal travels based on a behavior called propagation characteristic. RF radiates from the antenna at the transmitting end and is received by the antenna at the receiving end. The actual data carrier is modulated at one end, transmitted over the air, and modulated at the other. The propagation characteristics of the RF signal are determined by the frequency, wavelength, and amplitude [16]. and with a 433Mhz radio frequency which is one of the cheapest and easy-to-use modules for all wireless projects. These modules can only be used in pairs and only simplex communication is possible. This means that the transmitter can only transmit information and the receiver can only receive it, so you can only send data from point A to B and not from B to A [17, 18].

In this final project, a smart home device with radio frequency was made using the Blynk application. This device is equipped with a radio frequency (RF) module to transmit sensor data, and can be used to control several rooms with different controllers but can also be controlled via a smartphone using the Blynk application [19, 20]. So in this study, the relay will be connected to a 433Mhz radio frequency receiver module, and some equipment products that use 433Mhz radio frequency as communication can be connected to a 433Mhz radio frequency receiver. In this study, the relay can also be controlled with a switch that is connected as a radio frequency sender of 433Mhz or can be controlled with a 433Mhz remote controller as a data sender to a receiver with a radio frequency of 433Mhz, namely a relay. And for device products that use 433Mhz RF such as sensors, sensor data can be monitored to the Blynk application.

II. Research Methods

The block diagram of the system design device shown in Picture 1. Requires several components. This device has tools to send data and tools to receive data. On the tool to send data there is a PIR sensor with a frequency of 433Mhz made by a brand that can be entered into data that can function as a motion detector and the movement will be sent to the data receiver and after that, the Blynk application will notify the data to the user, the door sensor has a frequency of 433Mhz made by a brand can be entered into data that functions as a detector when the door is open then the data is entered into the data receiver and after that, the Blynk application will notify the user of the data.

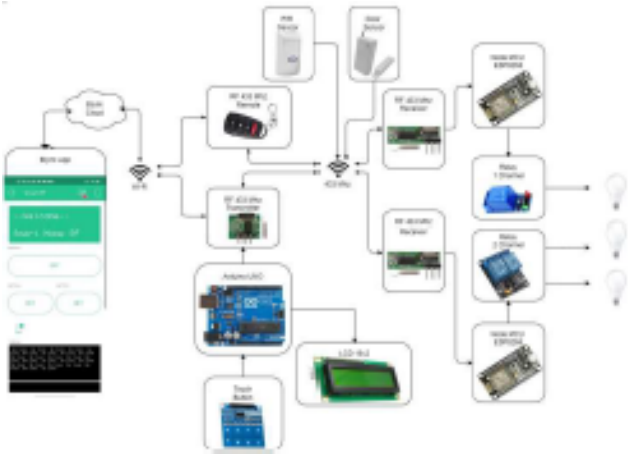


Figure 1: Block diagram block of device design system

There are 2 components for the controller, namely a handheld remote controller 433Mhz and a tool for touch control using a 433Mhz transmitter as a data sender from Arduino UNO as a microcontroller, Touch Button as a switch controller, and a 16x2 LCD as a display of buttons that have been touched. After the controller is connected to the 433Mhz signal and the data is sent, the receiver circuit will receive the data sent using the 433Mhz receiver component then the ESP8266 Node MCU as the microcontroller will process the data and notify the Blynk application to instruct the relay to be turned on or off so that the relay control on the lamp becomes wireless.

Figure 2: Flowchart

The block diagram of the system design device shown in Picture 1. Requires several components. This device has tools to send data and tools to receive data.

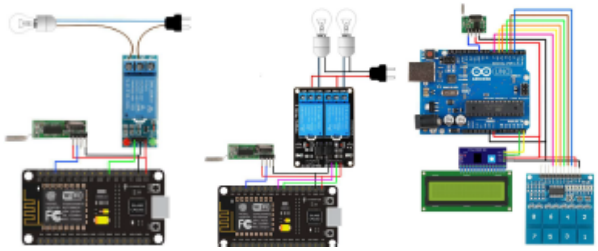
On the tool to send data there is a PIR sensor with a frequency of 433Mhz made by a brand that can be entered into data that can function as a motion detector and the movement will be sent to the data receiver and after that, the Blynk application will notify the data to the user, the door sensor has a frequency of 433Mhz made by a brand can be entered into data that functions as a detector when the door is open then the data is entered into the data receiver and after that, the Blynk application will notify the user of the data. There are 2 components for the controller, namely a handheld remote controller 433Mhz and a tool for touch control using a 433Mhz transmitter as a data sender from Arduino UNO as a microcontroller, Touch Button as a switch controller, and a 16x2 LCD as a display of buttons that have been touched. After the controller is connected to the 433Mhz signal and the data is sent, the receiver circuit will receive the data sent using the 433Mhz receiver component then the ESP8266 Node MCU as the microcontroller will process the data and notify the Blynk application to instruct the relay to be turned on or off so that the relay control on the lamp becomes wireless.

In the flowchart in Picture 2. It is explained that a smartphone must be connected to a Wi-Fi network to be connected to the Blynk application in order to receive / send commands. Followed by point A and point B, namely the PIR sensor 433Mhz and the door sensor 433Mhz to detect movement or detect an open door. Once detected, the 433Mhz PIR sensor and 433Mhz door sensor will send a notification to the Blynk app as a warning that something has been detected. After that switch to a controller system which has 3 branches, namely a controller with remote control, touch control, and Blynk control. Starting with the first remote control where when the relay 1 button is turned on, it will send a command to the receiver to activate relay 1 and oppositely when it is turned off, it will send a command to the receiver to turn off relay 1. If the relay 2 button is turned on it will send a command to the receiver to activate relay 2 and oppositely when it is turned off, it will send a command to the receiver to turn off relay 2.

The second controller is a touch control where the system is almost the same as a remote control, the difference is that this control has an additional button for relay 3 and every button touched the LCD will display the button that was touched. The third controller is control with the Blynk application where each button is a virtual button that can only be accessed with a smartphone. When virtual button 1 is activated, relay 1 on the receiver will be active, otherwise when it is turned off, relay 1 will turn off. For virtual 2 and virtual 3 button systems it is the same as for virtual 1 button systems. At point D it is a receiver for relay. So when the receiver has received a command from the transmitter and Blynk, the receiver will turn on or off the relay according to the command received and after that the receiver will connect to the Node MCU to send data to Blynk.

i. Electronic Devices Design

In the block diagram of Picture 3. There are 2 receivers that communicate with digital pin 2 on the Node MCU ESP 8266 with digital pin 7 on pin In relay 1 channel (a) and digital pins 5 and 6 on pins In1 and In2 relay 2 channel (b) as data receivers and each is connected to the microcontroller Node MCU ESP 8266 as a data processor as well as connecting data received by the Blynk application then the data will be processed by a 1 channel relay or a 2 channel relay, each of which has 2 NC (Normally Close) and NO (Normally Open) conditions, and this circuit will be assisted with 5 volts of power.



(a) (b) (c)

Figure 3: Wiring diagram (a) receiver relay 1 channel , (b) receiver relay 2 channel, and (c) controller touch button

In part (c) there is a touch control circuit with a transmitter as a data sender that can communicate with the Arduino UNO microcontroller via digital pin 10 which later when the button is touched, the microcontroller will process the data from the button and display the data to the LCD screen that has been connected to I2C communication (Inter Integrated circuit) will then send the data to the receiver that has been processed through the transmitter and this circuit will be assisted by 5 volts of power.

ii. Device Placement Design

In Picture 4. There is a plan for the placement of the device where the 433Mhz door sensor will be placed on the living room door, and receiver 2 is intended to

be a 2 channel relay receiver placed in the living room which can be connected to the living room and family room lights, so can be able to command the relay according to the command when there is a command from the Blynk application or from the 433Mhz frequency. The 433Mhz PIR sensor is placed in the living room, the touch control is placed in the family room so that you can control wirelessly on receiver 2 in the living room and also receiver 1 in the dining room, but touch controls can also be placed in other places as needed. Receiver 1 which is a 1 channel relay receiver is placed in the dining room which can be connected to the lights in the dining room. For the 433Mhz remote control it is not on the plan because the remote can be placed or taken anywhere because the remote is small and practical.

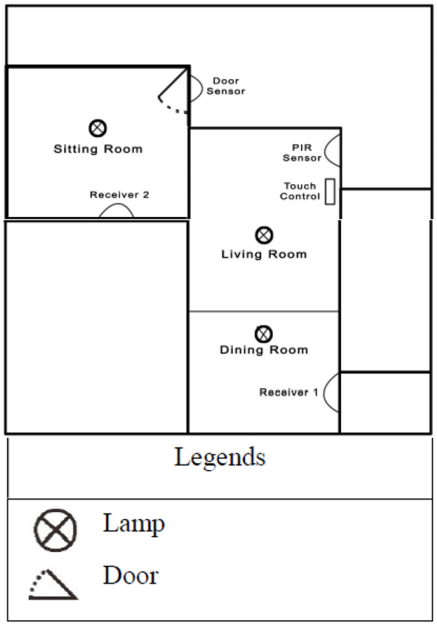
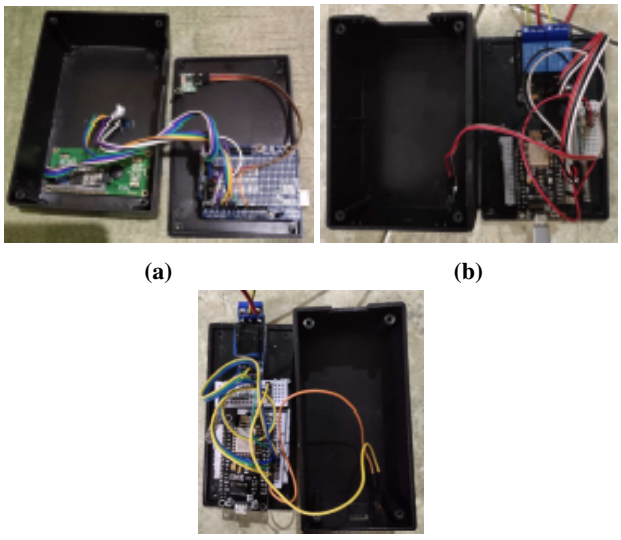


Figure 4: Device plan placement

III. Results and Discussion

i. Hardware Results

In hardware, the result will be 3 hardware. The first hardware is for a 1 channel relay receiver, the second hardware is for a 2 channel relay receiver, and the third hardware is for touch control devices. Can be seen in Picture 5. Based on Picture 5. On the hardware controller, the touch button (a) has a sensitive touchpad and a 16 x 2 LCD, while the inside is for the components of the controller and uses a box with a size of 14.5cm x 9.5cm x 5cm. In the picture part (b) is the hardware of a 1-channel receiver relay which is composed of a 2-channel relay, a 433Mhz receiver, an ESP8266 Node MCU microcontroller and uses a box with a size of 12cm x 6cm x 4cm. The image of part (c) is almost the same as that of part (b), the difference is that the image of part (c) uses a 1 channel relay and uses a box measuring 12.5cm x 8.5cm x 5cm.



(a) **(b)**

(c)

Figure 5: Touch button (a) controller hardware, (b) hardware receiver relay 2 channel, and (c) hardware receiver relay 1 channel

After that in Picture 6. The hardware will be placed according to the planned floor plan and each hardware such as hardware receiver 2 (a) will be given a voltage of 5 volts from the smartphone charger to make the device work, for hardware receiver 1 (b) will be given a voltage 5 volts from the smartphone charger and for the touch button hardware (c) 5 volts will be supplied from the smartphone charger, the door sensor hardware 433Mhz (d) is placed on the inside door of the living room, the PIR sensor hardware 433Mhz (e) is placed on the table in the living room which can detect when there is movement entering through the door.

ii. Touch button Controller Test Results

Gu In the test results of this touch button controller, the placement of the device is adjusted to the placement on the floor plan and can control receiver 2 and receiver 1 wirelessly because there is a 433Mhz transmitter in the device. For receiver 2, the 2 channel relay is connected to the living room lights and family room lights, where channel 1 is connected to the family room and channel 2 is connected to the living room. As for receiver 1, the 1 channel relay connected to the dining room lights will become the 3rd channel. All channels from receiver

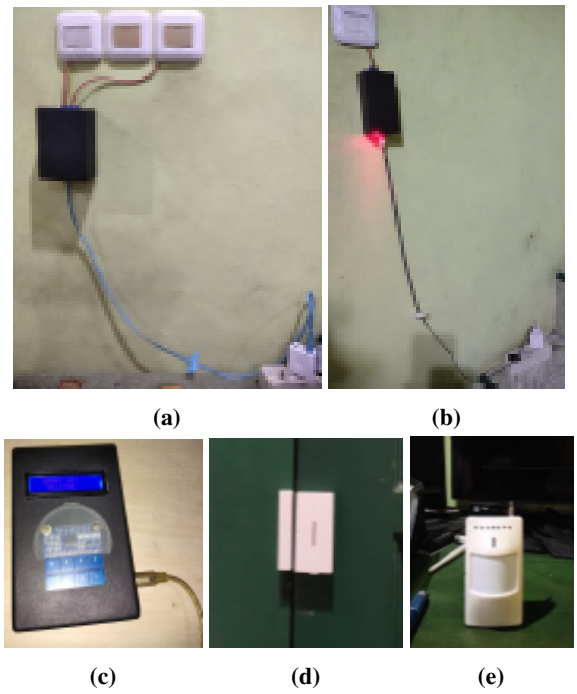


Figure 6: Hardware receiver: (a) receiver relay 2 channels in the living room, (b) hardware receiver 1 or receiver relay 1 channel in the dining room, (c) hardware controller touch buttons in the living room, (d) hardware door sensor 433Mhz in the living room (d), and (d) 433Mhz PIR sensor hardware in living room

2 and receiver 1 will also be connected to the Blynk application.

It can be seen in Table 1, that the controller has 6 touch buttons that can be used to control receiver 2 and receiver 1 which are 7.36 meters away from receiver 2 to the controller and 6.14 meters at a distance of receiver 1 to the controller. Each of these buttons shows that button 1 can activate channel 1 and Button 1 on Blynk, button 3 can activate channel 2 and Button 2 on Blynk, and button 5 can activate channel 3 and Button 3 on Blynk. While button 2 can turn off channel 1

Table 1: Touch button controller test results

No	$\mathcal{T}$	Range (m)		L			Button on Blynk		
		R_c2	R_c1	R_c2		R_c1	B_t1	B_t2	B_t3
				C_h1	C_h2	C_h4			
1	1	7,36	6,14	On	–	–	On	–	–
2	2			Off	–	–	Off	–	–
3	3			–	On	–	–	On	–
4	4			–	Off	–	–	Off	–
5	5			–	–	On	–	–	On
6	6			–	–	Off	–	–	Off

and Button 1 on Blynk, button 4 can turn off channel 2 and Button 2 on Blynk, and button 6 can turn off channel 3 and Button 3 on Blynk. Notations on table 1 are: $\mathcal{T}$ is touch button controller, R_c is receiver, L is lamp condition, C_h is channel, and B_t is button. The operation of the touch buttons can be seen in Picture 7.

Figure 7: The operation of the touch buttons controller

iii. Remote Control 433Mhz Test Results

For testing the 433Mhz remote controller can only control receiver 2 because this controller only has 4 buttons, namely button A, button B, button C, button D. And this test includes testing on distance, controlling lights, and the suitability of buttons on the Blynk application in Table 2 with notation: $\mathcal{R}$ is Remote 433Mhz Buttons, R_c is Receiver 2 Range (meter), L is lamp condition On receiver 2, $\mathcal{B}$ is button on blynk, C_h is channel, and B_t is button.

In Table 2. There are 5 distance tests to find out how far the 433Mhz remote controller can control receiver 2, namely at a distance of 0.5 meters, 1 meter, 1.5 meters, 2 meters, and 2.5 meters. And in controlling channel 1 and channel 2 lights can run smoothly so that the lights can be controlled properly without

Table 2: Remote control 433MHz test results

No	$\mathcal{R}$	R_c	L		$\mathcal{B}$	
			C_h1	C_h2	B_t1	B_t2
1	A	0,5	On		On	
	B		Off		Off	
	C			On		On
	D			Off		Off
2	A	1	On		On	
	B		Off		Off	
	C			On		On
	D			Off		Off
3	A	1,5	On		On	
	B		Off		Off	
	C			On		On
	D			Off		Off
4	A	2	On		On	
	B		Off		Off	
	C			On		On
	D			Off		Off
5	A	2,5	On		On	
	B		Off		Off	
	C			On		On
	D			Off		Off

any problems. The buttons of the remote can work well at any distance tested. So that sending data from the remote can be sent properly to the Blynk application.

iv. Controller Test Results On Blynk

The results of testing the controller on Blynk can be done by turning on / off the virtual button in the Blynk application. Then look at the conditions on the lights from receiver 2 channel 1 and channel 2 and receiver 1 channel 3 and the results can be seen in Table 3.

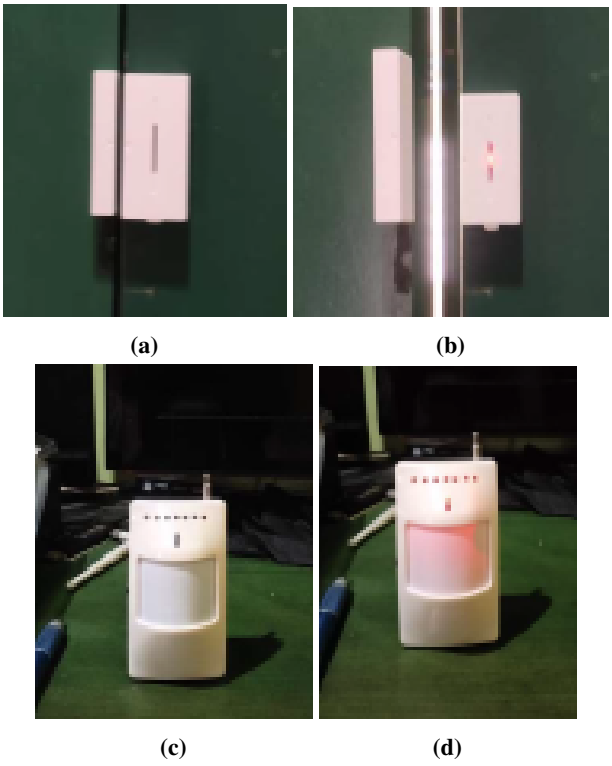
v. Test Results On Sensors

In this test, there are 2 sensors, namely the 433MHz door sensor and the 433MHz PIR sensor. The sensor will send data via a radio frequency signal to the receiver when there is movement and will be connected to the Blynk application to notify that there is movement via the LCD and notifications from the Blynk application.

On Picture 8. It is known that the 433Mhz door sensor will not turn on when the door is not open/closed (a) then when the door is about to open, the 433Mhz

Table 3: Remote control 433MHz test results

No	Blynk Buttons	Lamp conditions		
		Receiver 2		Receiver 1
		Channel 1	Channel 2	Channel 3
1		On	Off	Off
2		Off	On	Off
3		Off	Off	On
4		Off	Off	Off
5		On	On	On



(a) **(b)** **(c)** **(d)**

Figure 8: Door sensor display 433Mhz (a) on Blynk LCD, (b) notify 433Mhz door sensor, (c) 433Mhz PIR sensor display on Blynk LCD, (d) notify 433Mhz PIR sensor

Table 4: Sensor 433 Mhz type in test on door sensor and PIR sensor

No	Type	Condition	Notification on Blynk	
			Display	Notify
1	433Mhz door sensor	Open	On	On
		Close	–	–
2		2 m	On	On
3		2,7 m	On	On
4	433 Mhz PIR sensor	3,9 m	On	On
5		5,8 m	On	On
6		7 m	On	On

door sensor will turn on (b). For the 433Mhz PIR sensor when no motion is detected then the 433Mhz PIR sensor will not turn on (c) but if any motion is detected, the 433Mhz PIR sensor will turn on (d). In the sensor notification view in the Blynk application as shown in Picture 9.

For testing, the 433Mhz door sensor will be carried out with the door open and the door closed. After that test whether the 433Mhz door sensor will send a notification on the Blynk app. For testing the 433Mhz PIR sensor, a motion detection test will be carried out with a certain distance and a test for sending notifications to the Blynk application. In this test the results can be seen in Table 4.

IV. Conclusion

In this thesis, it can be concluded that smart home systems with radio frequency must use a radio frequency module and use a radio frequency transmitter component to send commands and a radio frequency receiver to receive and execute commands, to be able to control the lights, several devices are needed, namely a 2 channel 433Mhz relay receiver device with an ESP 8266 Node MCU microcontroller, a 1 channel 433Mhz relay receiver with an ESP 8266 Node MCU microcontroller, and a touch button controller with an Arduino UNO microcontroller which is connected to a 433Mhz transmitter. Then it can also be added several controllers such as a 433Mhz remote controller and can also be controlled with the Blynk application, 433Mhz devices such as PIR sensors and door sensors from other brands can be included in this smart home appliance system, for the test results of the touch button controller at the adjusted placement and distance the button can run smoothly in sending data to the receiver, namely the receiver which is connected to the relay and can be synchronized with the button on the Blynk application, in the remote control test, the buttons from the remote control can run smoothly in sending data to the receiver connected to the relay even though the distance is different and can be synchronized with the buttons on the Blynk application, and in testing the 433Mhz door sensor and 433Mhz PIR sensor when it detects motion, the sensor will send data to provide notification that something has been detected to the Blynk application.

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