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Smart Room Control and Monitoring System Based on Internet of Things

Bayu Andika[1], Oriza Candra[1]
[1]Department of Electrical Engineering, Faculty of Engineering, Universitas Negeri Padang, Padang, Indonesia

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ABSTRACT

In this modern era, the development of Internet of Things technology has opened up opportunities to create a smarter home environment that is easily accessible from anywhere. This research aims to create and develop a smart room system that utilises the Blynk platform and Google Assistant to efficiently control and monitor devices in the room. This system allows users to control electronic devices such as lights, fans, and other household appliances through the Blynk application, manual switches and provides voice-based control capabilities using Google Assistant. This system is designed using NodeMCU Esp8266 microcontroller as the main controller, which is connected to sensors and equipment that are controlled in this tool to monitor and control room conditions. The Blynk app is used as the user interface for real-time control, while integration with Google Assistant allows control via voice commands. Tests of the system that have been carried out both using Blynk, manual switches and Google Assistant show that the device can respond to commands quickly and provide accurate feedback on the status of the device and room conditions. With this system, users can improve comfort and energy efficiency in their homes, as well as enjoy the convenience of controlling devices through various media, both mobile applications and voice commands. The system also provides opportunities for further future development of an integrated smart room ecosystem.

Corresponding Author:

Bayu Andika
Department of Electrical Engineering, Faculty of Engineering, Universitas Negeri Padang
Kampus UNP Pusat, Jl. Prof. Hamka, Air Tawar, Padang 25131, Indonesia
Email: bayu08228501@gmail.com

1. INTRODUCTION

In today's modern era, there are many changes in the survival of society, both in terms of economy, science and technology that is obtained. Human life today is very dependent on technology. The factor of the existence of sophisticated technology that exists today is supported by the very rapid development of science and technology [1] - [2]. The development of increasingly sophisticated modern technology can be seen from the discovery of smart rooms, where smart rooms are a concept of indoor automation that uses the Internet of Things (IoT). Most of the smart devices that have been developed utilize the internet network to carry out data communication between devices or communication with users. The Internet of Things itself means a communication system between devices using the internet network. The implementation of IoT in a smart room system allows electronic equipment or physical objects in the house to be controlled and monitored directly [3] - [4]. Equipment that can be controlled in a smart room is usually like lights, fans and several other electronic objects. In general, lights and fans are controlled manually using a switch.

Turning on or off lights or fans using a switch will not cause problems such as forgetting to turn off lights and other equipment if the building only consists of a few rooms. However, the switch becomes less effective if the building consists of many rooms and can cause electricity waste [5]-[6]. Therefore, society needs a smart room or smart room to overcome the above problems because it can do the above work more

efficiently. The term "smart room" or "smart room" refers to a room with everything controlled simply and efficiently by its users and can be accessed via smartphone in real time from anywhere [7]-[8].

In this study, the ESP8266 module will be implemented as the brain to create a smart room that can be controlled via internet access in the process of controlling equipment in the smart room. ESP8266 is a microcontroller that is supported by WiFi technology as well as smartphones, so that both can be connected to an internet network [9]. Thus, the ESP8266 control process can be done using a smartphone via the internet network and is a development module for IoT [10]-[11]. This tool uses blynk as an interface and as a control and monitoring for smart rooms [12]-[13]. Blynk is perfect for interfacing with simple projects such as temperature monitoring or turning lights on and off remotely [14]-[15]. To read the temperature and humidity of the room using the DHT11 sensor, the DHT11 sensor is also set to automatically turn on the air conditioner when the temperature reaches above 35^{o}C and turn the air conditioner off again when the temperature is below 33^{o}C [16]. In addition, this tool can also be controlled with voice commands via Google Assistant to make it easier for us because we no longer need to move, and save more time [17]-[18]. However, it can also be controlled manually via a switch to turn on and off the controlled equipment if the internet connection is lost or dead.

2. METHOD

This study aims to design a smart room control and monitoring system based on the internet of things. The main goal is to allow users to control and monitor equipment such as lights and air conditioners only through smartphones and can be accessed in real time from anywhere as long as it is connected to the internet network through the blynk and google assistant applications. The control and monitoring system in this study will be explained through a block diagram. Smart room control and monitoring on this device uses NodeMCU Esp8266 as the brain of the smart room system and blynk as the interface. In addition, it can also be controlled using a manual switch and google assistant which is connected to the blynk server through an IFTTT intermediary. Figure 1 shows a block diagram of the IoT-based smart room control and monitoring system.

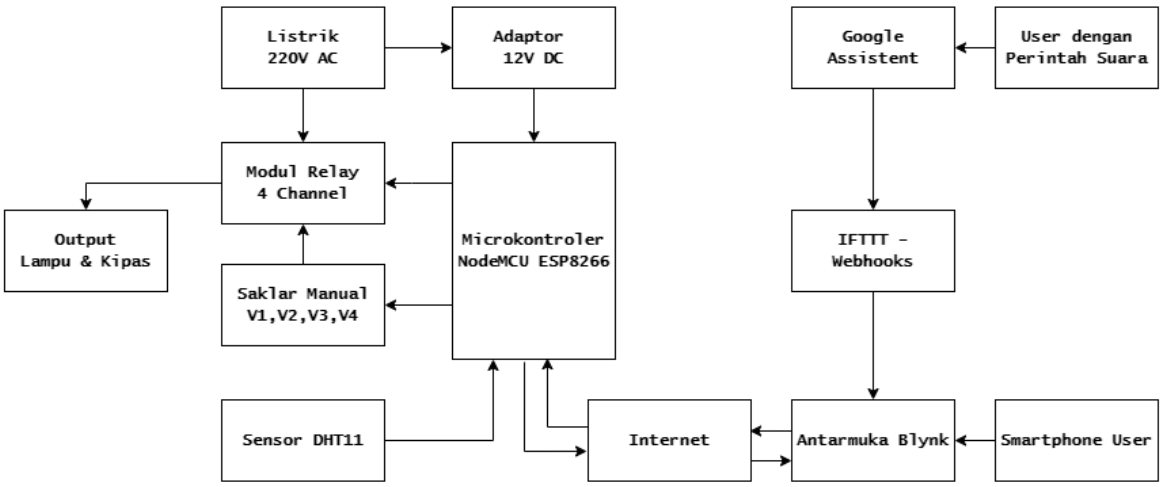


Figure 1. Diagram block of smart room control and monitoring system

Figure 1 shows the components used for the smart room control and monitoring system such as NodeMCU ESP8266, 12v dc adapter, 4 channel relay module, manual switch, DHT11 sensor, blynk for interface and google assistant for voice control. NodeMCU ESP8266 functions as the brain or data processing center, where data will be sent to blynk which is used as a smart home control and monitoring. In this system, it is controlled by commands to turn on and off devices including lights and air conditioners. Turning on lights and air conditioners can be done through the blynk application by pressing the button on the blynk interface screen, if you want to turn on the lights and air conditioners, you can also use voice commands from google assistant, and you can also press the manual switch. For temperature and humidity monitoring, the DHT11 sensor is used as a reader, but the temperature reading from the DHT11 sensor has also been set to turn on the air conditioner automatically if the temperature has reached 35^{o}C and turn off the air conditioner if the temperature is read below 33^{o}C.

Electronic design or hardware design is a design related to components that will be made in the tool assembly process. This design aims to make the process run easier and minimize the level of error because of the planning of system hardware that can be tested in advance whether it is running well or not. For the design of this tool has a circuit as in Figure 2.

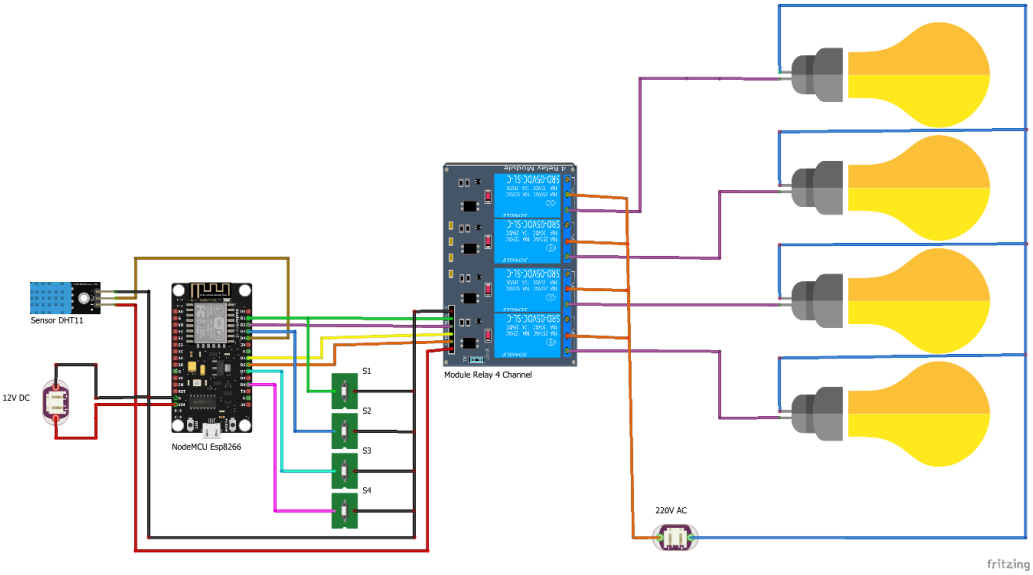


Figure 2. Circuit of smart room control and monitoring system

Mechanical design is a stage in making hardware. This design aims to reduce the level of error in making hardware so as to obtain optimal results. With the mechanical design, the system can be tested in real terms whether this tool can work well or not. The design of this tool can be seen in Figure 3.

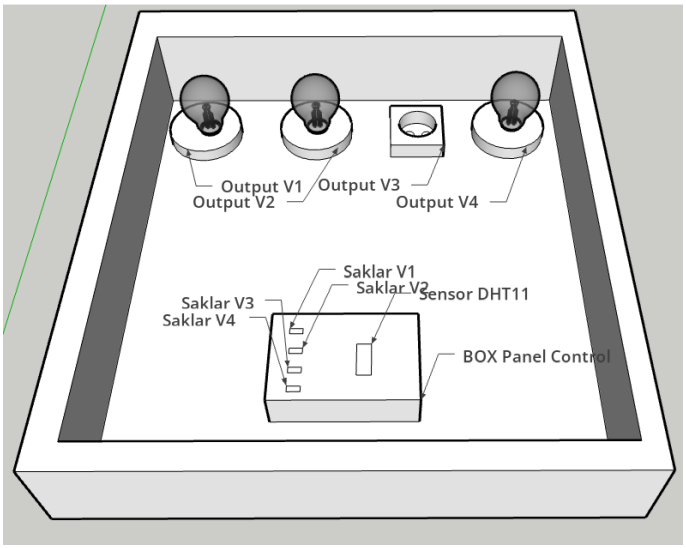


Figure 3. Prototype design of smart room control and monitoring system

The design and construction of a smart room control and monitoring system based on the internet of things will work with the NodeMCU ESP8266 microcontroller as the 'brain' that regulates and runs programs to process input signals into outputs that will be displayed and controlled in the blynk application. For how it works, the lights and air conditioners can be turned on and off by pressing the on or off button on the blynk interface, and you can also use the google assistant voice command to turn the circuit on and off in the system. However, the circuit can still be activated and deactivated via a manual switch. The DHT11 sensor,

which is a temperature and humidity sensor in the circuit, will read the temperature and humidity in the room, if the detected temperature is more than 35 ℃ then the air conditioner will turn on and display the temperature reading results in the blynk application and when the room temperature has returned to normal or below 33 ℃ then the air conditioner will turn off.

3. RESULTS AND DISCUSSION

The smart room control and monitoring system created in this study was tested with a miniature room that had been created in such a way as to match the existing room conditions. The control and monitoring system that was carried out can be seen on the blynk interface. Figure 4 shows the installation of the smart room control and monitoring system test tool based on the internet of things.

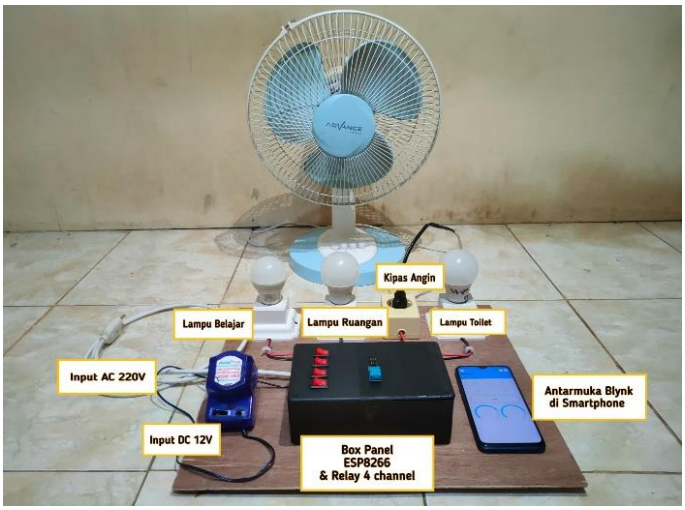
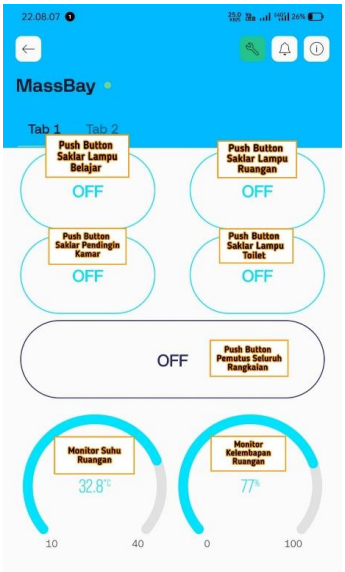
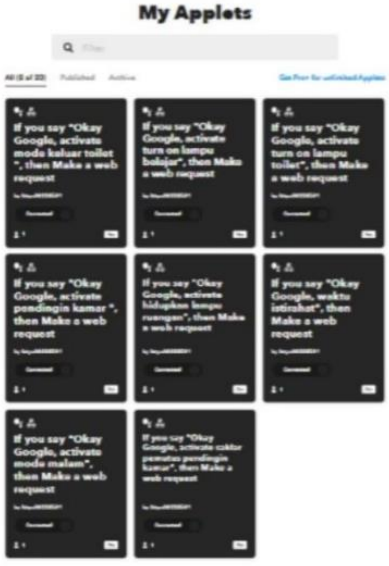


Figure 4. Hardware Installation of smart room control and monitoring system

Figure 5 shows the software design for smart room control using the blynk application, which consists of Figure 5(a) shows the interface of the blynk application accessed via a smartphone. Figure 5(b) shows the google assistant command in IFTTT.





(a) (b)

Figure 5. Software design, a) Blynk interface, b) Google Assistant commands in IFTTT

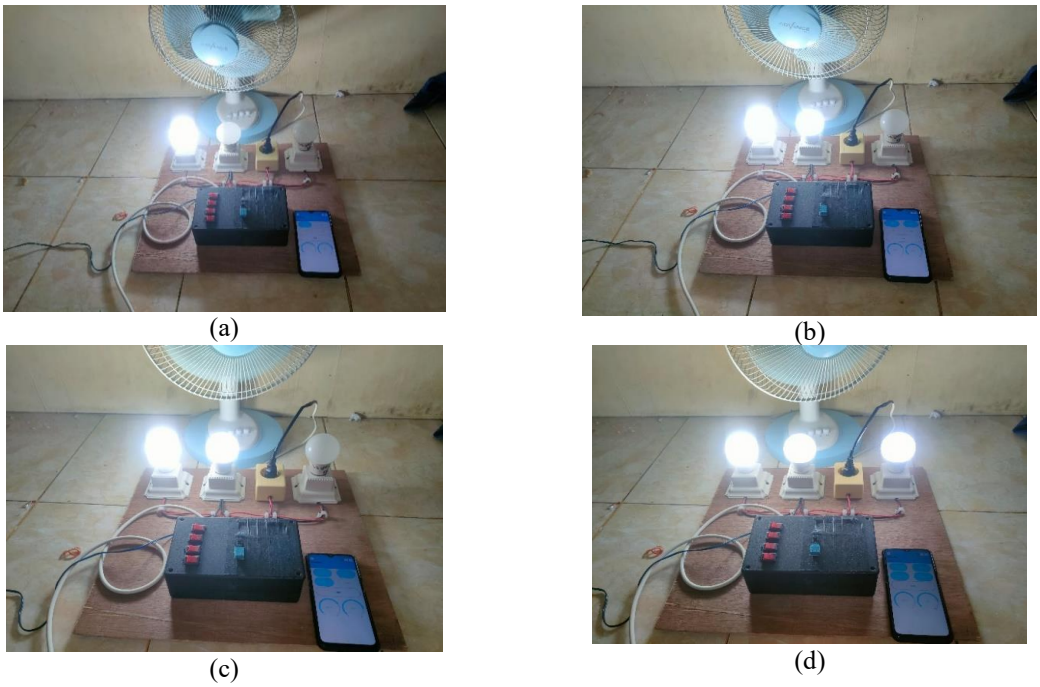
To activate the smart room circuit with a manual switch, you can do this by pressing switch v1 to turn the study lamp on and off, v2 to turn the room lamp on and off, v3 to turn the air conditioner on and off, v4 to turn the toilet lamp on and off. Figure 6(a) shows switches v2 and v4 on, figure 6(b) shows when all switches are on.



(a) (b)

Figure 6. Smart room circuit with manual switches. a) switches v2 and v4 On, b) all switches in the On condition.

Operation of the control and monitoring system circuit with blynk can be done on the blynk software that is connected to the internet and installed on a smartphone. Figure 7 shows the operation of the circuit using blynk software, figure 7(a) shows v1 active, figure 7(b) shows v2 active, figure 7(c) shows v3 active and figure 7(d) shows v4 active.



(a) (b)

(c) (d)

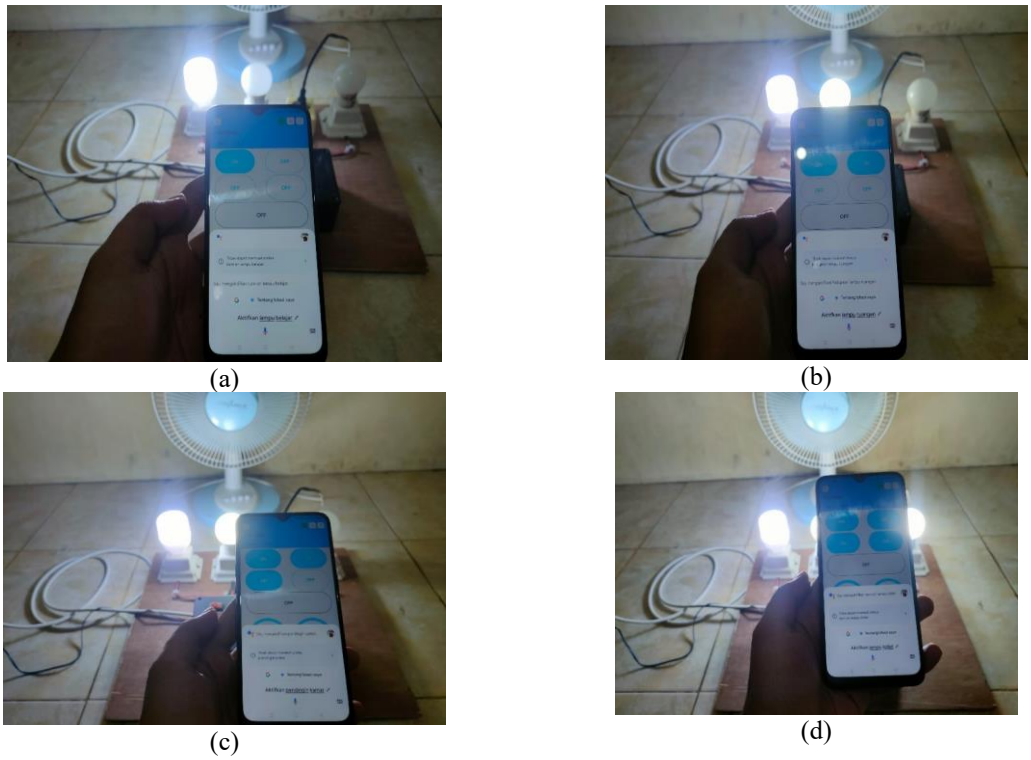
Figure 7. Operation of the control and monitoring system using blynk. a) v1 active, b) v2 active, c) v3 active, d) v4 active..

In the circuit there is a DHT11 sensor which functions as a temperature and humidity monitor, and regulates v3 to automatically activate the air conditioner with the active v3 set point at a temperature of 35°C and a notification will appear on blynk, and will automatically turn off at a temperature <33°C as shown in Figure 8 below.



Figure 8. Notification on blynk if the temperature is 35ºC

In this circuit, to activate the control and monitoring system, it is also done with voice commands on the Google Assistant that has been programmed in the IFTTT software so that controlling this circuit becomes easier. In IFTTT programming, switch v1 is called a study lamp, switch v2 is a room lamp, switch v3 is an air conditioner and switch v4 is a toilet lamp. Figure 9 shows the Google Assistant command with voice to activate the circuit, figure 9 (a) is the voice command "Activate the study lamp" to turn on relay v1, figure 9 (b) the voice command "Activate the room light" to turn on relay v2, figure 9 (c) the voice command "Activate the room cooler" to turn on relay v3 and figure 9 (d) the voice command "Activate the toilet light" to activate relay v4.

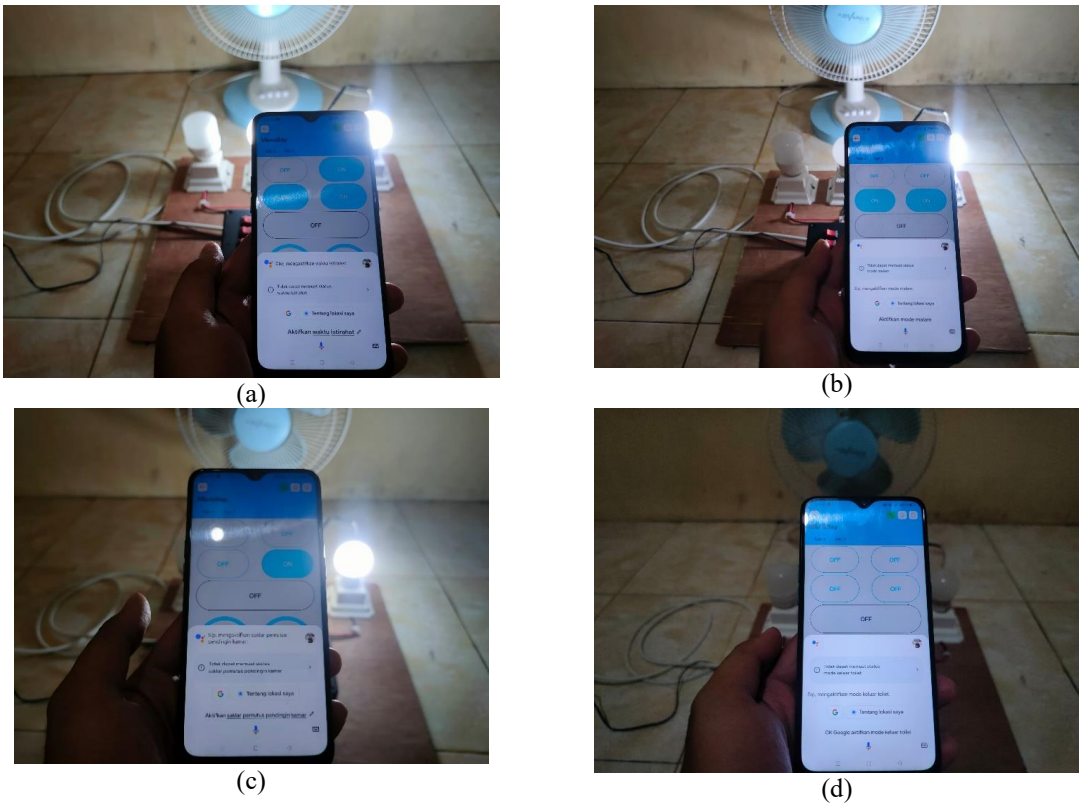


(a) (b)

(c) (d)

Figure 9. Activating the circuit with voice commands on Google Assistant, (a) activating v1, (b) activating v2, (c) activating v3 and (d) activating v4.

After testing the circuit with voice commands on Google Assistant, Figure 10 shows the voice command to deactivate the circuit with Google Assistant. Figure 10(a) voice command "Activate break time" to deactivate relay v1, Figure 10(b) voice command "Activate night mode" to deactivate relay v2, Figure 10(c) voice command "Activate room cooler switch" to deactivate v3 and Figure 10(d) voice command "Activate toilet exit mode" to deactivate relay v4.



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

Figure 10. Deactivating the circuit by voice command, (a) deactivating v1, (b) deactivating v2, (c) deactivating v3 and (d) deactivating v4.

Testing on IoT must use the same WiFi between blynk, MCU node and smartphone so that it can access the smart room control and monitoring system. All test results show that the design of the smart room control and monitoring system based on the internet of things has worked well according to the design. The control system centered on blynk and google assistant has been able to control the designed output. The monitoring system on the DHT11 sensor also managed to display the temperature and control the v3 relay according to the configured set point, and display humidity on the blynk interface.

4. CONCLUSION

This research proposes a design for a smart room control and monitoring system based on the internet of things. This research uses NodeMCU ESP8266 as the main processor for reading data from the sensors used and the configured relays. By implementing 4 outputs consisting of 3 lights and 1 fan as a room cooler, as well as a DHT11 sensor to monitor temperature and humidity and control the v3 relay automatically with a configured temperature set point. The test results show that the design for a smart room control and monitoring system based on the internet of things has successfully controlled and monitored the output and parameters on the sensor in real time with the appropriate values.

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