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Home Electrical Lighting System: Remotely Control and Power Monitoring

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Abstract: Life is becoming simpler and easier in many areas as a result of development of automation technologies. Automatic methods are increasingly becoming favorable over manual ones in today's society. With the fast rise in the number of internet users over the last decade, the internet has become an integral part of everyday life, and the Internet of Things (IoT) is the most recent and most promising internet technology. An expanding network of common objects ranging from industrial machines to consumer products that can exchange information and perform tasks while you are engaged in other activities is known as the Internet of Things. IoT enabled Wireless Home Automation System (WHAS) is a system that uses computers or mobile devices to control electrical lighting system automatically through the internet from any location in the world. A smart home is also referred to as an automated home when it is controlled remotely through the internet. Its purpose is to save electric power as well as human energy. The home automation electrical lighting system varies from previous systems in that it allows the user to control the system from any location in the globe by using an internet connection to connect to the system.

Keywords: IoT, Home Automation, NodeMCU, electrical lighting

1. Introduction

The Internet of Things (IoT) is a network of physical items or individuals referred to as "things" that are equipped with machines, electronics, networks, and sensors to capture and share data. The Internet of Things aims to expand internet access from mainstream devices such as laptops, cell phones, and tablets to comparatively simple devices such as toasters. Virtually everything becomes "smart" as a result of the Internet of Things, which uses data storage, AI algorithms, and networks to improve facets of our lives. This IoT guide for beginners discusses all of the fundamentals of the Internet of Things [1].

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Because of the convenience it offers, 21st-century homes would become increasingly self-controlled and automated, particularly when used in a private home. A home automation is a system that enables users to monitor and control electric lights. Wired networking is used in many modern, well-established home automation systems. [2] This is not a concern until the device is built ahead of time and implemented during the building's physical construction. However, the cost of development for current structures is very high.

Wireless networks, on the other hand, can be extremely beneficial to automation systems. Wireless technology such as Wi-Fi and cloud networks have advanced in recent years, and wireless services are now used every day and everywhere.

2. Materials and Methods

A block diagram is used to depict the system's architecture and structure. The project's design will be discussed. The block diagram for the project is shown in Figure 1.

The ESP32 has 39 digital pins, 34 of which are GPIO, and the rest are input-only. It contains 18 12-bit ADC channels and 2 8-bit DAC channels. It also has 16 PWM signal channels and 10 GPIO ports for capacitive touch. Thanks to multiplexing, the ESP32 may use any GPIO pin for PWM or other serial communication. The ESP32 includes three SPI, three UART, two I2C, two I2S, and CAN protocol support [3].

The eight-channel relay module features eight 5.0 V relays and associated switching and isolating components, making it easier to connect to a microcontroller or sensor. Each of the eight terminal blocks has six terminals and two relays. The terminals are screw-type, making connecting to the mains wire easier [4]. The module's eight 5.0 V relays activate when about 5.0 V is delivered across the coil. The relay's contacts are rated for 250.0 V AC, 30.0 V DC, and 10.0 A, respectively. Transistor switching transistors act as a buffer between high- and low-current inputs. They amplify the input signal to drive the coils that trigger the relays.

The switching transistors act as a buffer between the high-current relay coils and the low-current inputs. They accept input signals and magnify them to drive the coils, which trigger the relays. When the relay is turned off, the freewheeling diodes prevent voltage spikes across the transistors. The indicator LEDs glow when the coil of the corresponding relay is energized, indicating that the relay is operational [5]. An optocoupler adds a second layer of isolation between the switched load and the inputs. The isolation function may be disabled using the VCC selector jumper on the board. It has main voltage supply, ground, and input pins for easy connection with female jumper wires [6].

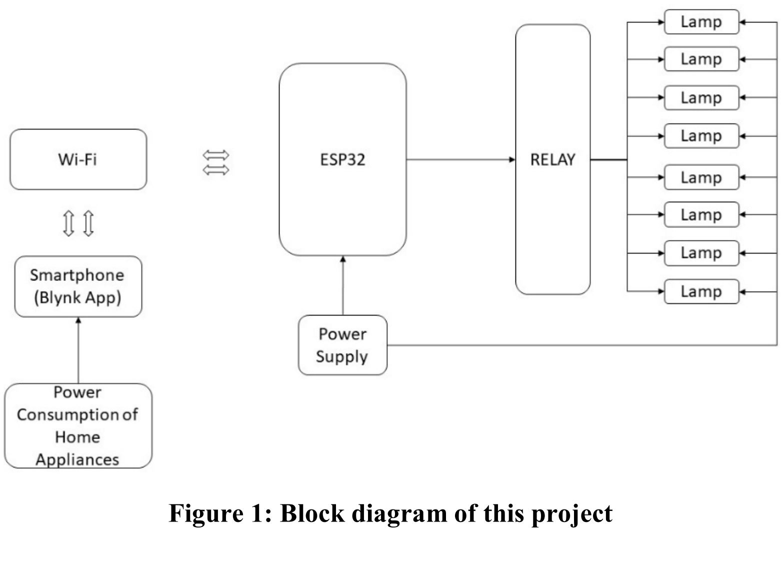

Figure 1: Block diagram of this project

2.1 Flow Chart

• System Flowchart

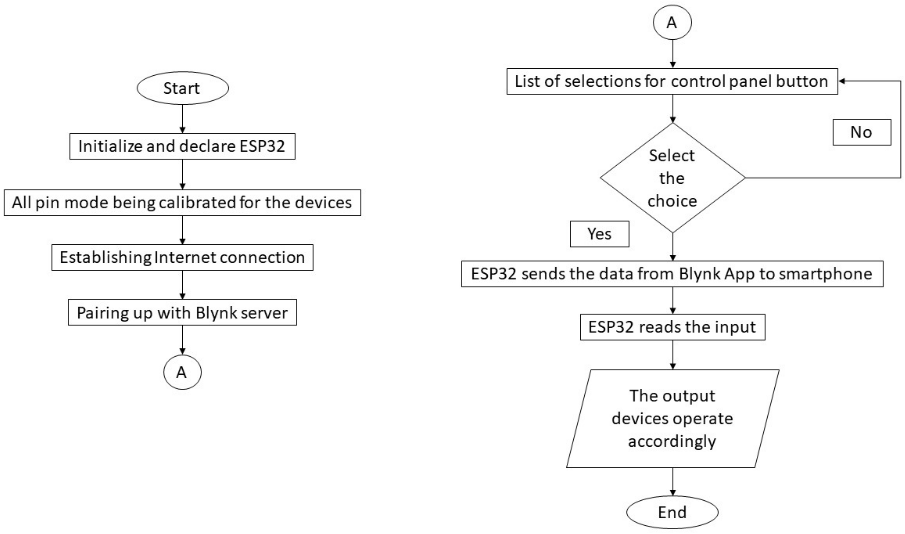

Figure 2: Showing System Flowchart in program

The flowchart in the Figure 2 shows the operation of the Home Automation System.

2.2 Hardware Development

Table 1 shows the list of components used for home automation prototype.

Table 1: List of Component

Item	Component	Description
1	NodeMCU	ESP32
2	Relay	8-channel relay
3	Light Bulb	5-Watt Operating power

2.2.1 Circuit Diagram

Figure 3 shown the circuit diagram of the hardware.

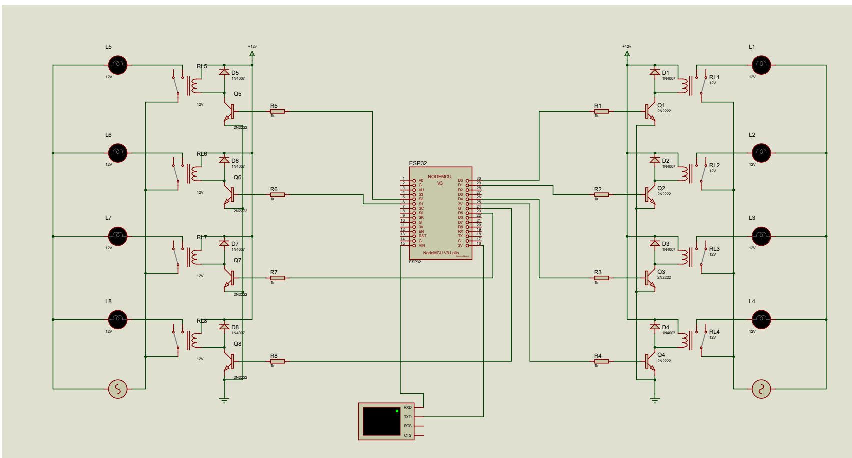

Figure 3: Circuit design of project in proteus

Using the Proteus program, we were able to design and create the project diagram for this project. The home automation system full circuit was completed, and the ESP32 was used as the microcontroller to control all the components of the home automation system, which was completed

2.3 Software Development

In this Blynk app, the three parts shown in Figure 4 can be used by the user. The first is the Blynk app builder, which lets you make apps for a project with a variety of widgets. For free, it can be used on both iOS and Android, and it can be used on both. Two more servers are called "Blynk servers," which are in charge of all communication between phones with Blynk apps and other hardware. Allow for the use of Blynk Clouds or the running of a Blynk server on a local network. Besides that, it can control a lot of things and can be started with the Arduino IDE, which is an open-source project. The third thing is the Blynk library, which helps the Blynk app communicate with the server and can handle all of the instructions from the Blynk app and the hardware that it connects to. As long as the user have a smartphone or tablet with Android software called Blynk, it can control electrical equipment at home from afar.

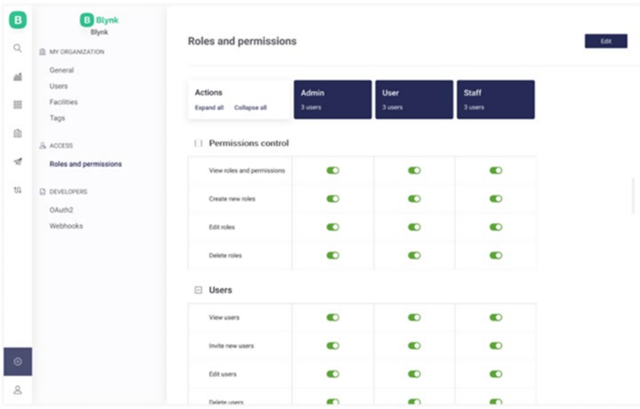

Figure 4: New Blynk IoT app

3. Results and Discussion

Figure 5 shows the connection between relay, load and supply. Relay consists of three terminals which are Normally Open (NO), Normally Close (NC), and Common (COM). Terminal is connected to supply while terminal NO is connected to load. The connection is repeated with other seven loads.

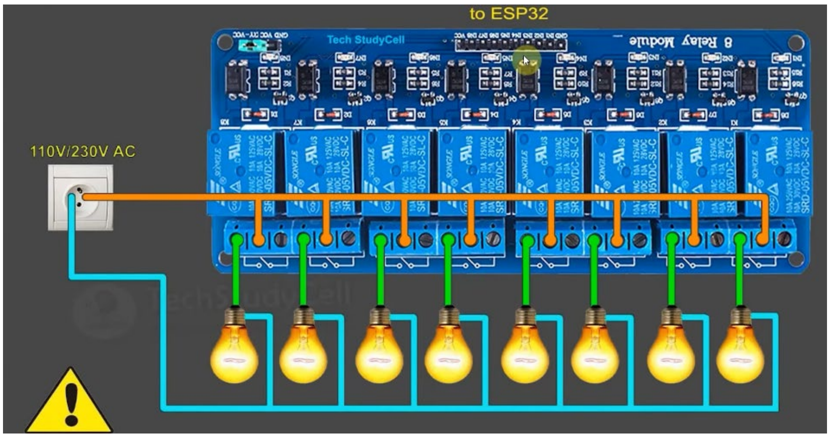

Figure 5: Connection of relay

Figure 6 shows the complete connection of the ESP32, relay and electrical appliances. The connection must be connected correctly so that the circuit can function, and the signal is received in order to make the electrical appliances well function.

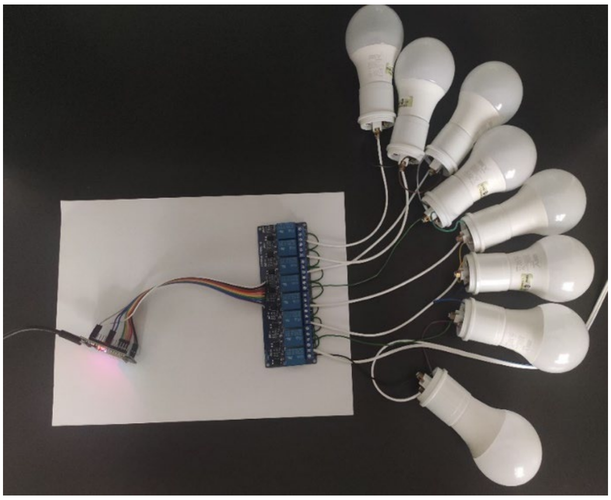

Figure 6: Complete connection of hardware

3.1 Blynk Application

Results from the ESP32, relay and the bulb can be shown in Figurer 7. The Blynk application is connected by using the home Wi-Fi and with user authority password that can be obtain from the user's email. So, only the user that have the authority password can connect with the home electrical lighting. This can be safety part of the Blynk application so that it will not easily be connected by anyone, only from the user that have the authority password. Blynk application also provided the power consumption used by each home appliances or light bulb in the household.

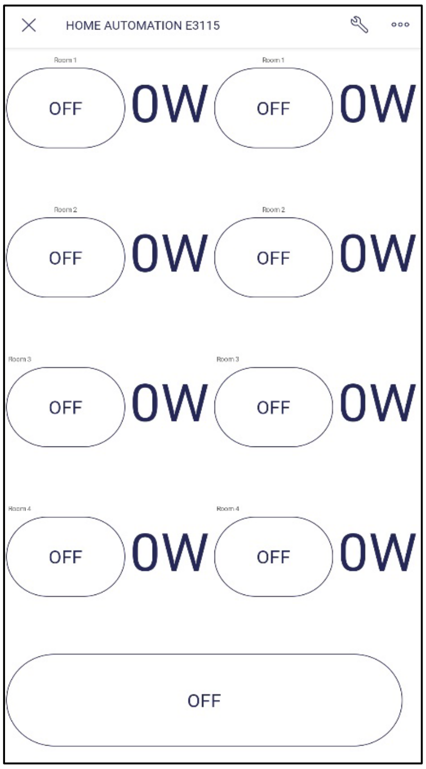

Figure 7: Main page of system application

3.2 System Result

After the circuit connection has successfully work, the process is proceeded with testing the functionality of the prototype connection. The hardware testing is conducted because to show that the hardware is working successfully.

Figure 8 depicts the testing conditions in Room 1, where the hardware is operational, and the electrical lighting are delivering the precise output that was expected from the hardware. Figure 9 shows the button and power usage for each light on the Blynk application, which allows the user to control and monitor the lights remotely.

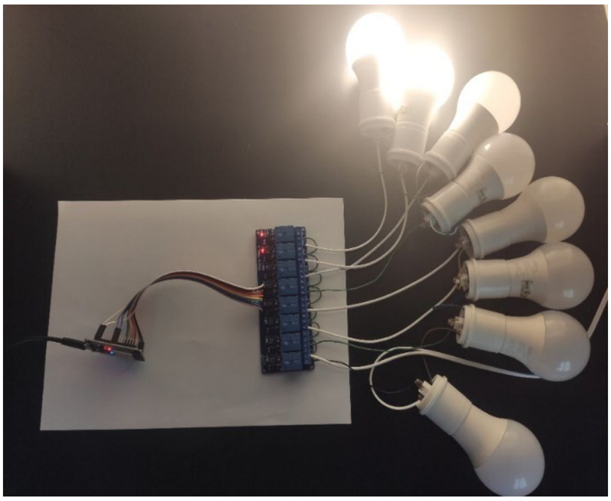

Figure 8: Room 1 bulb condition result

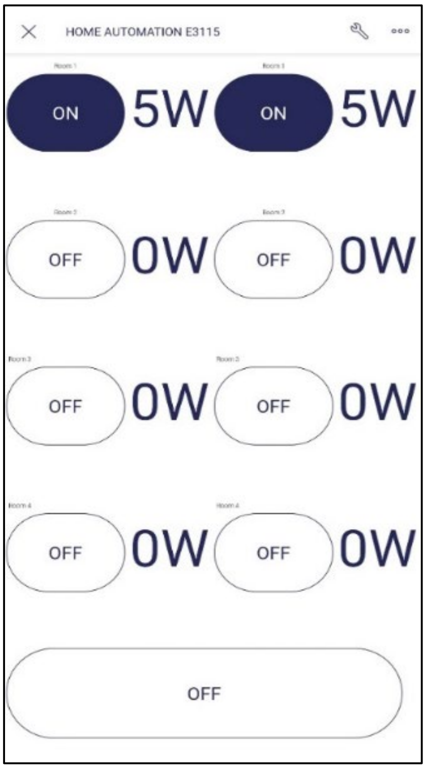

Figure 9: Room 1 status on Blynk app

The testing circumstances in Room 2 are shown in Figure 10, where the hardware is working, and the domestic appliances are producing the exact output anticipated of the hardware. Figure 11 illustrates the button and power consumption for each light on the Blynk application, which enables remote control and monitoring of the lights.

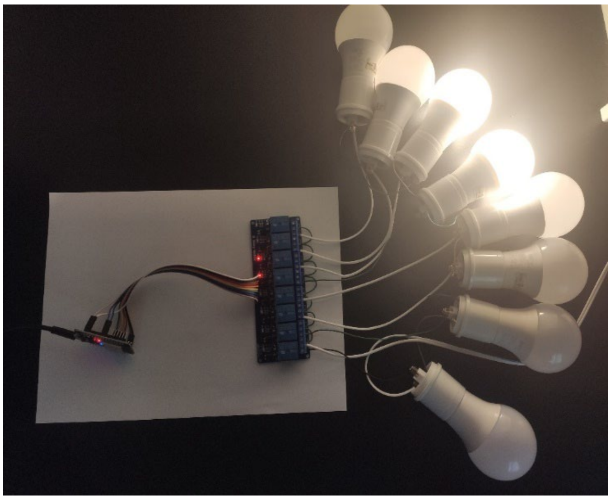

Figure 10: Room 2 bulb condition result

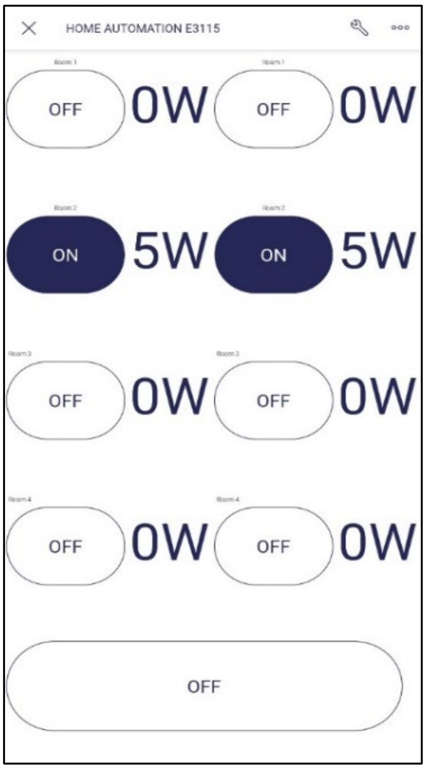

Figure 11: Room 2 status on Blynk app

Figure 12 depicts the testing conditions in Room 3, where the hardware is operating, and the home electrical lighting appliances are generating the precise output that the hardware is expected to provide. On the Blynk app, user can manage and monitor your lights from afar using the buttons and power usage shown in Figure 13.

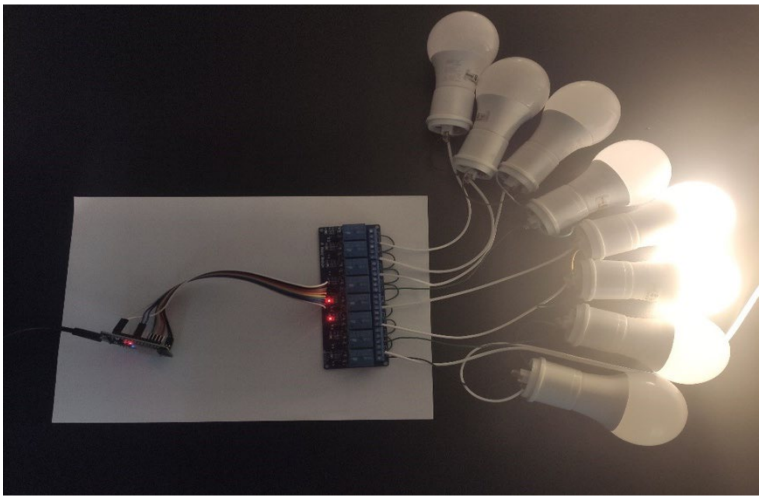

Figure 12: Room 3 bulb condition result

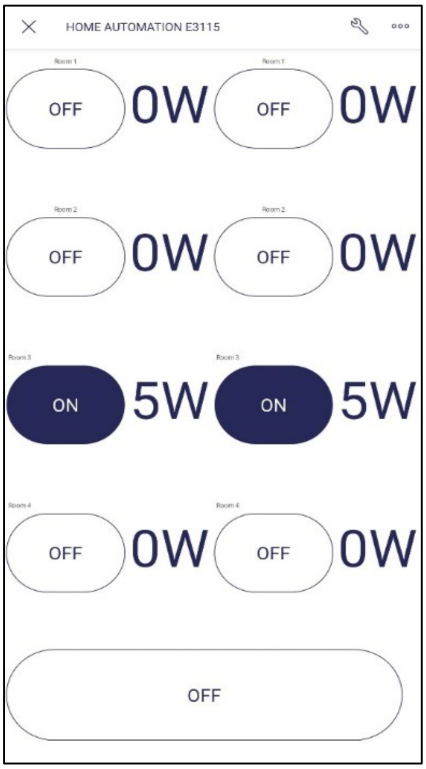

Figure 13: Status on Blynk app in Room 3

The testing settings in Room 4 are shown in Figure 14, where the hardware is working, and the home electrical lighting appliances are providing the exact output that the hardware is intended to provide. The Blynk app enables users to operate and monitor their lights remotely through the buttons and power use shown in Figure 15.

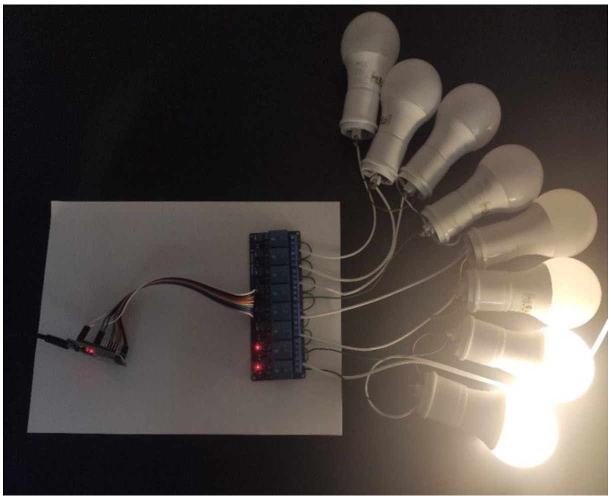

Figure 14: Room 4 bulb condition result

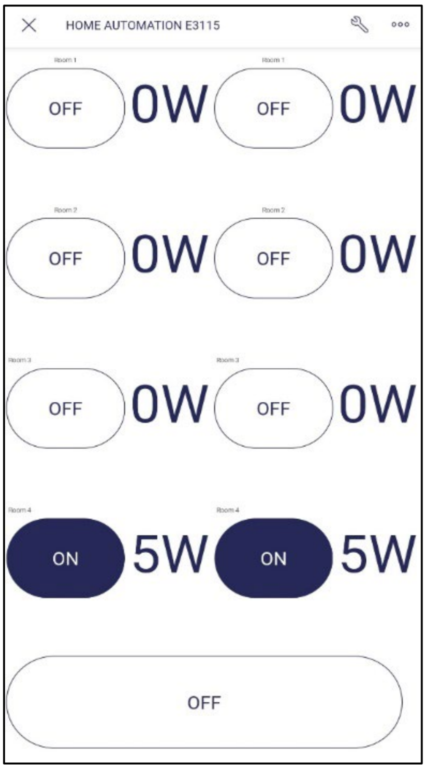

Figure 15: Status on Blynk app in Room 4

3.3 Tables

Table 2 below shows the data obtained from each testing:

Table 2: Hardware Testing result

Room	Bulb	Button	Condition
1	1	ON	Work
		OFF	Work
	2	ON	Work
		OFF	Work
2	1	ON	Work
		OFF	Work
	2	ON	Work

		OFF	Work
	1	ON	Work
		OFF	Work
3	2	ON	Work
		OFF	Work
	1	ON	Work
		OFF	Work
4	2	ON	Work
		OFF	Work

4. Conclusion

The project's overall development has been described in terms of software and hardware. The development enables users to manage electrical lighting appliances remotely using a smartphone application connected to a Wi-Fi network. Additionally, the microcontroller and smartphone application have been successfully programmed and coded. However, the coding was too complicated and required several troubleshooting attempts to ensure the circuit functioned properly. During the ESP32's flashing procedure, the coding failed due to an incorrect connection and a broken jumper wire. This procedure must be repeated many times before it eventually works. Apart from that, the project's aims were effectively accomplished and shown via experimentation.

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