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Smart Wifi Circuit Breaker

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Abstract: This abstract presents a Smart WiFi Circuit Breaker prototype designed for real-time monitoring of single-phase circuit breakers. The system aims to detect and address circuit trips caused by excessive electrical current flow, such as lightning strikes, to prevent potential hazards like fires and electrocutions. The prototype utilizes an ESP32 microcontroller connected to voltage and current sensors for data processing. When a trip is detected, the system automatically resets the circuit breaker using a servo motor and provides notifications to the user through a Blynk application. Real-time monitoring of voltage, current, and power is enabled via the Blynk app, allowing users to make informed decisions about energy usage and optimize power resources. The prototype has been successfully evaluated, providing valuable insights and contributing to the field of electronics. The abstract emphasizes the importance of user safety, remote monitoring capabilities, and the potential for efficient power management.

Keywords: Circuit Breaker Control, Monitoring System, Internet of Things (IoT).

1. Introduction

The tripping of a circuit breaker indicates that an excessive quantity of electrical current is attempting to pass through the circuit simultaneously, which is what caused the breaker to trip in the first place. If there is an excessive amount of electricity flowing through a circuit, it could result in a fire or an electrocution if the circuit contains electrical wiring or electrical devices. When a trip occurs, the system will immediately back up the power as well as rescue or protect the life of the electrical equipment, particularly electronic products that are susceptible to overload such as refrigerators, televisions, and laptops. The capabilities of the system need to include an automated reset and a notification to the user.

The ELCB is tripped when there is a lightning strike. The trip will be detected by the voltage sensor, and the information will be shown on the liquid-crystal display (LCD). Additionally, it comes with a

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Blynk application that, when an electrical trip occurs, will send a short message to the user. The user can benefit from the features of this prototype without having to physically interact with the Distribution Board or even be present in their own homes. However, if the problem is a persistent one, the ELCB will always trip, and the system will notify the user, until the switch is turned back on manually and the root of the issue is resolved. This will continue until the problem is fixed.

2. Methodology

The primary goals of this chapter are to put together the design of the smart wifi circuit breaker, which incorporates the MG995 servo motor as well as the ESP32 development board and to apply the IoT technology, which includes transmitting data to the online Blynk application platform and displaying data on a smartphone or tablet. Both of these goals will be accomplished through the completion of this chapter. By the time this chapter is over, both of these goals will have been completed successfully.

2.1 Project Flowchart

Before beginning work on this project, a flowchart would be an extremely helpful tool for allocating tasks and keeping track of time. Figure 1 shows the flowchart for the project.

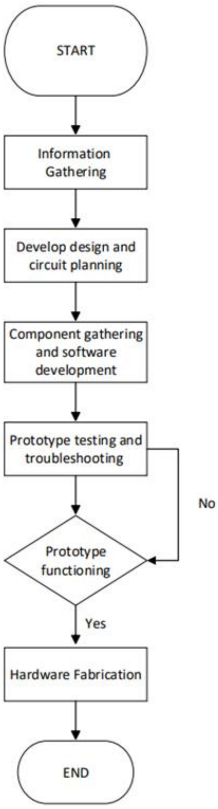

Figure 1: Project Flowcart

2.2 System Block Diagram

Figure 2 consists of Voltage Sensor ZMPT101B and Current sensor ACS712 as inputs connected to the ESP32 with a 5V power supply. When voltage sensor sends a signal to ESP32, it will process the data to activate the output such as Blynk Application, Servo Motor and LCD Display. When the voltage sensor detects voltage lower than 70V, then the servo motor will be trigged to pull the ELCB switch. The Servo motor will automatically flip back on the ELCB within three seconds. If the ELCB trip again, the servo will automatically pull the ELCB switch again with three seconds interval. The system will only attempt the reset count for a total of three times. After that, the LCD will indicate that an ELCB fault has occurred, and the Blynk application will notify the user that the ELCB has tripped four times. Finally, the LCD Display is to show the value of voltage, current, power, reset count and "ELCB Failed".Figure 2 shows the block diagram of ESP32.

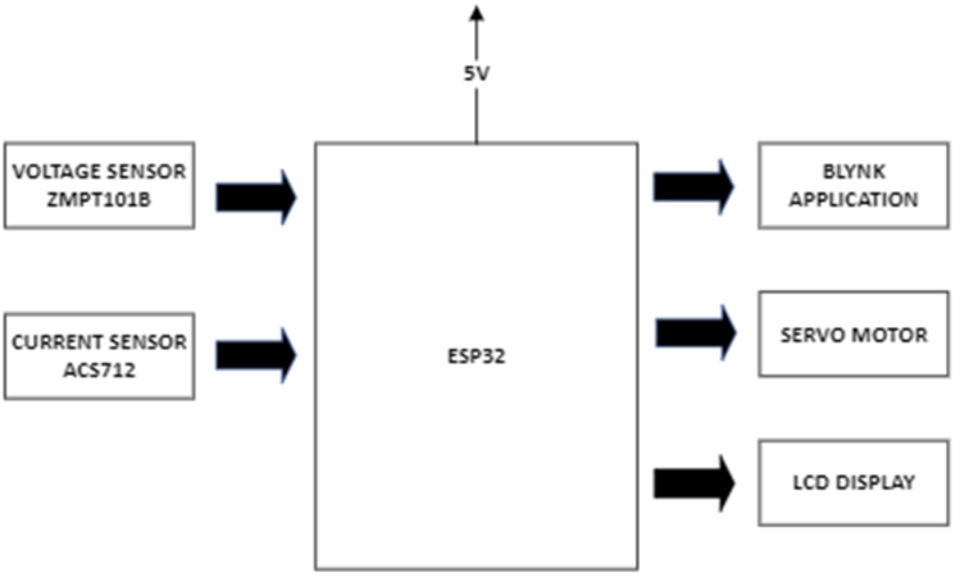

Figure 2: System Block Diagram

2.3 System Flowchart

The ESP32 will begin its operations by connecting to the WiFi networks that have been setup. After then, the system will check the voltage sensor in order to identify the condition of the ELCB. In order for the voltage sensor to detect a trip, the tripping value has been set to 70V. The servo motor will be activated to pull the ELCB switch in response to a trip being detected by the voltage sensor. In order to prevent any damage to the appliance, the system will only attempt the reset count for a total of 3 times. After that, the LCD will indicate that an ELCB fault has occurred, and the Blynk application will notify the user that the ELCB has tripped 4 times. In order to ensure that the user is aware that there must be an issue that is permanent and needs to be fixed before the ELCB may be turned back on, the user will see the message from Blynk application.

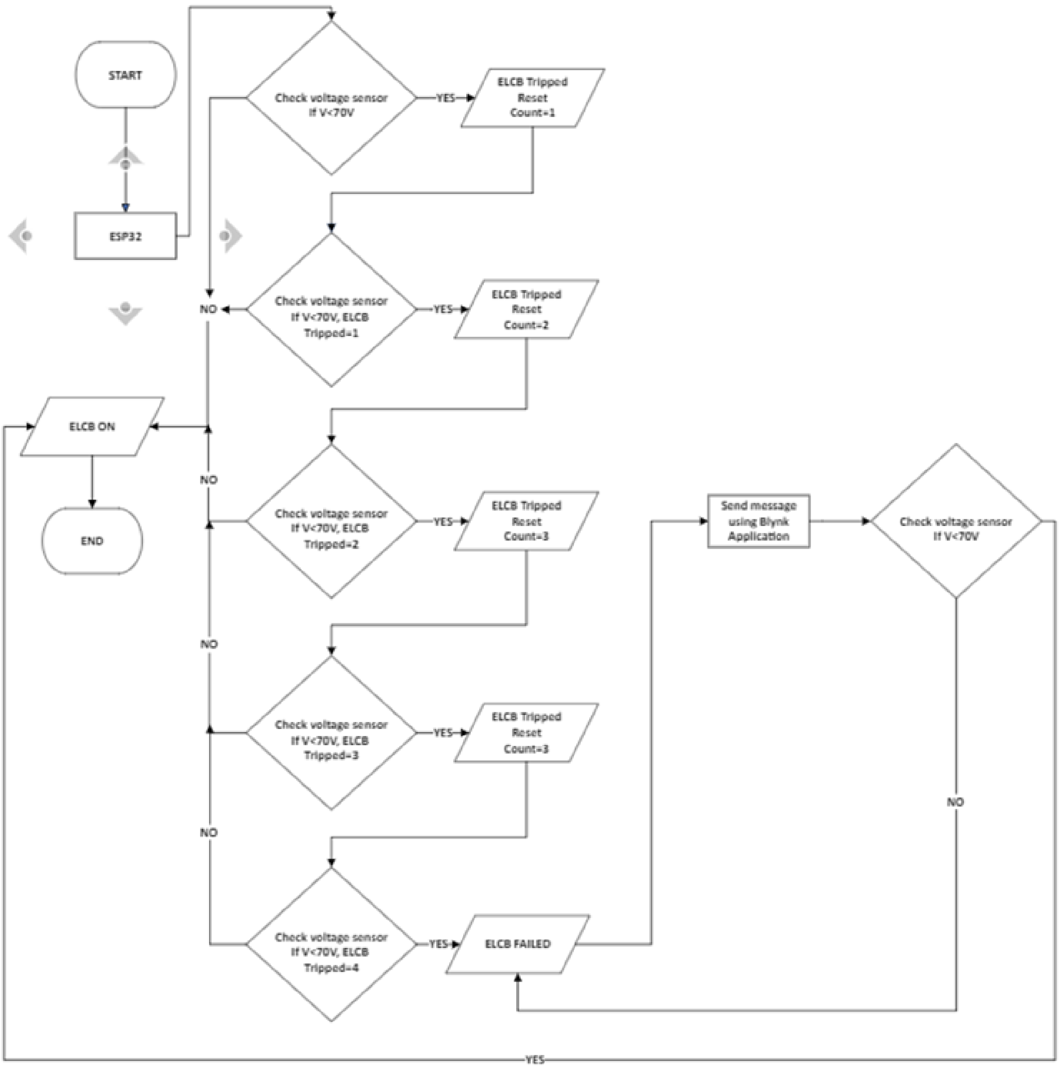

Figure 3: Flowchart of the system

2.4 Circuit Diagram

The circuit acts as a guide to follow when wiring the various electronic components. Figure 4 shows the circuit diagram of the system that designed by Fritzing.

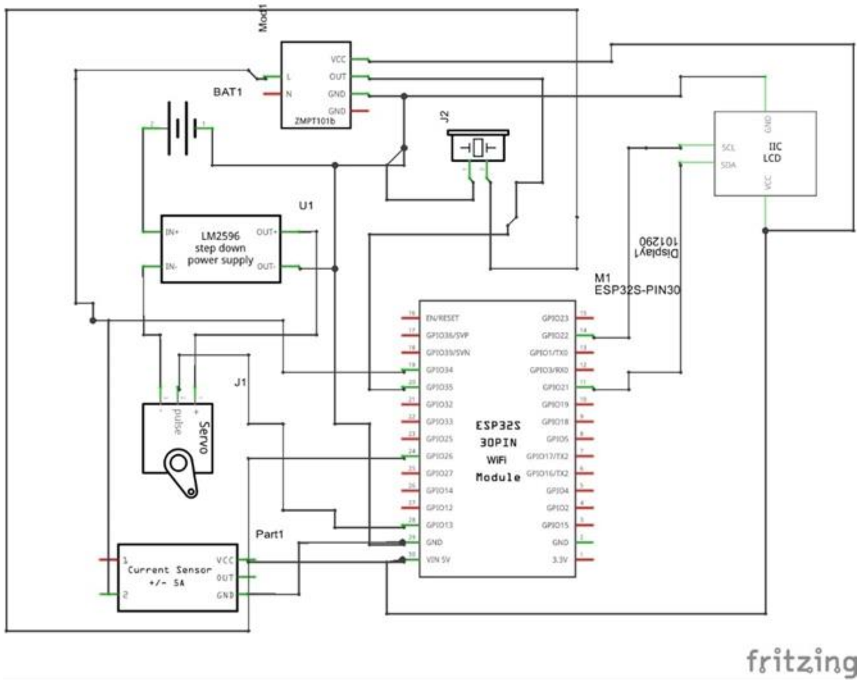

Figure 4: Circuit diagram design by Fritzing

3. Results and Discussion

In order to successfully finish the "Smart Wifi Circuit Breaker" project and ensure that the system continues to operate as intended, there are a number of issues that need to be resolved. In order to have a project that is flawless, one must begin with the phase of project selection and design and conduct an in-depth investigation. Therefore, having productive discussions is necessary in order to conclude projects on time. In situation that there is a problem or error, discussion with supervisor and expert is important to troubleshoot the problem. Throughout the process of developing this project, there have been discussions held in order to ensure that the most effective solution is produced for any problems that may arise.

3.1 Results and Discussion

To test if the real time monitoring is working properly, three loads have been put to check power output.

3.2 Three loads have been put to check power output.

The table 1 shows the electrical parameters and power usage of a Table Fan across a range of times. The voltage readings show a minor variation in the electrical potential provided to the fan, from 245.54V up to 246.63V. The amount of electrical current running through the fan appears to shift, with measurements ranging from 0.21A to 0.28A. Similar trends can be seen in the power usage values, which range from 50.95W to 68.94W. The data as a whole demonstrates the dynamic electrical behavior of the Table Fan, with voltage, current, and power consumption all showing fluctuations over the course of the recorded time intervals.

Table 1: Reading voltage, current and power of Table Fan

Load	Time	Voltage	Current	Power	Configuration
Table Fan	12:05 PM	246.31	0.28	68.94	
	12:06 PM	245.54	0.21	50.95	
	12:07 PM	246.62	0.21	52.71	
	12:08 PM	246.63	0.26	64.92	

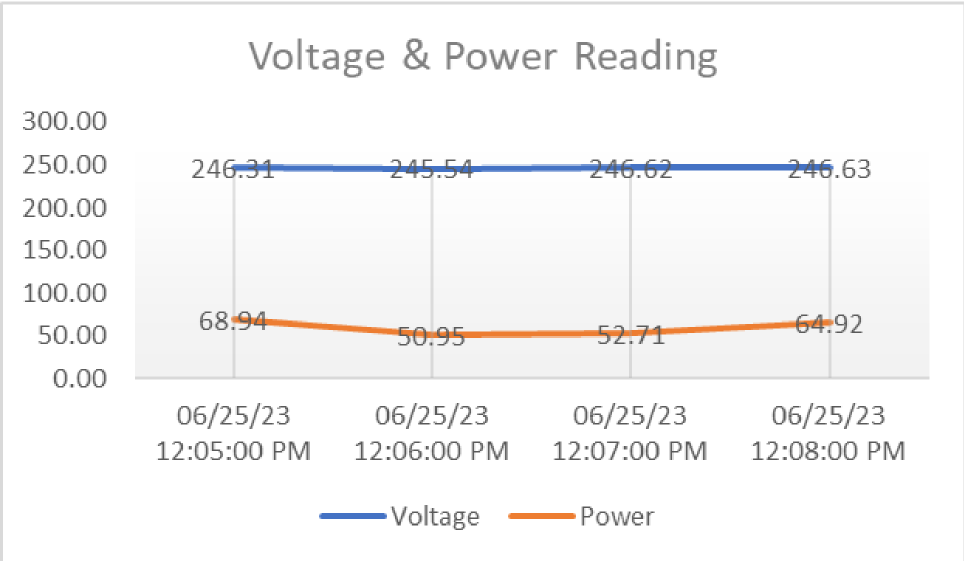

Figure 5: Voltage and Power graph

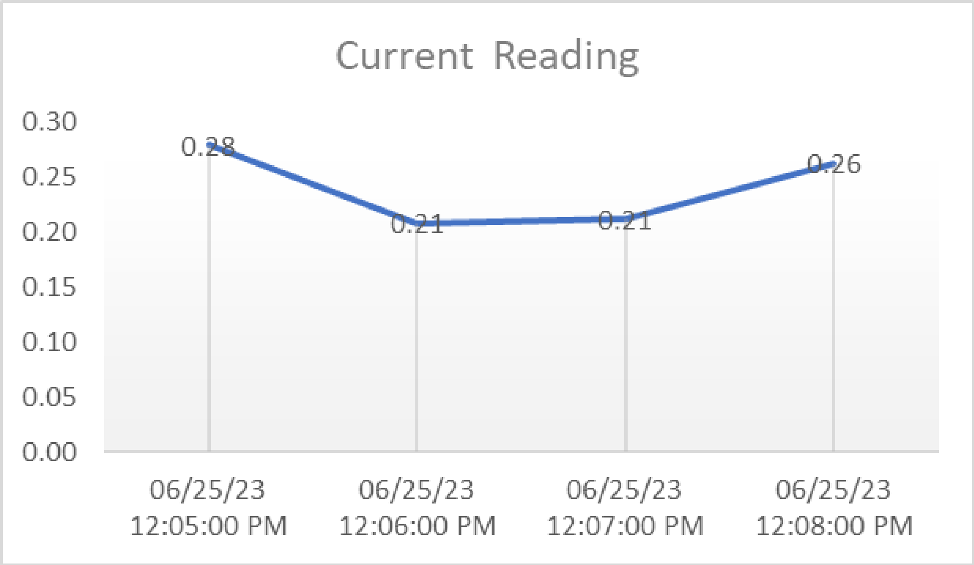

Figure 6: Current graph

The table 2 are readings taken from a Steam Iron at various times. Voltage measurements show a variation in the power supply to the iron, from a low of 235.34V to a high of 243.57V. There appears to have been fluctuations in the quantity of electricity flowing through the iron at the times measured, with values ranging from 3.12A to 3.27A. Energy consumption varies with use, from a low of 771.26W to a high of 805.17W. Overall, the data shows that the Steam Iron's electrical characteristics are dynamic, with voltage, current, and power usage all fluctuating across the recorded time intervals.

Table 2: Reading voltage, current and power of Steam Iron

Load	Time	Voltage	Current	Power	Configuration
Steam Iron	12:10 PM	242.14	3.12	771.26	
	12:11 PM	242.07	3.27	805.17	
	12:12 PM	235.34	3.24	797.56	
	12:13 PM	243.57	3.18	784.41	

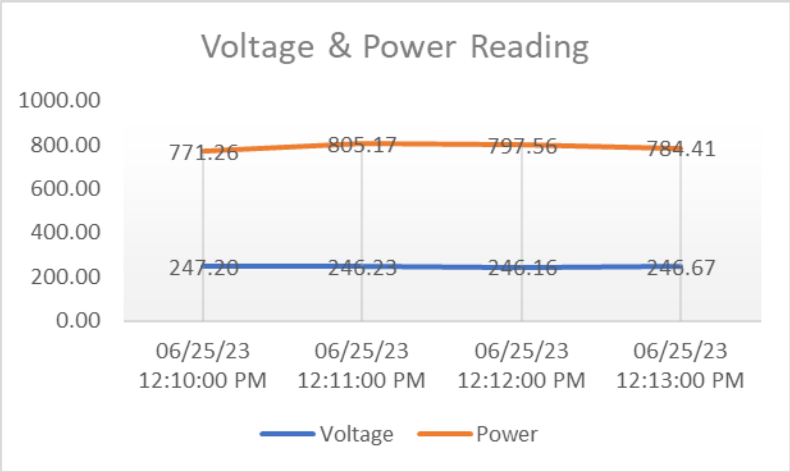

Figure 7: Voltage and Power graph

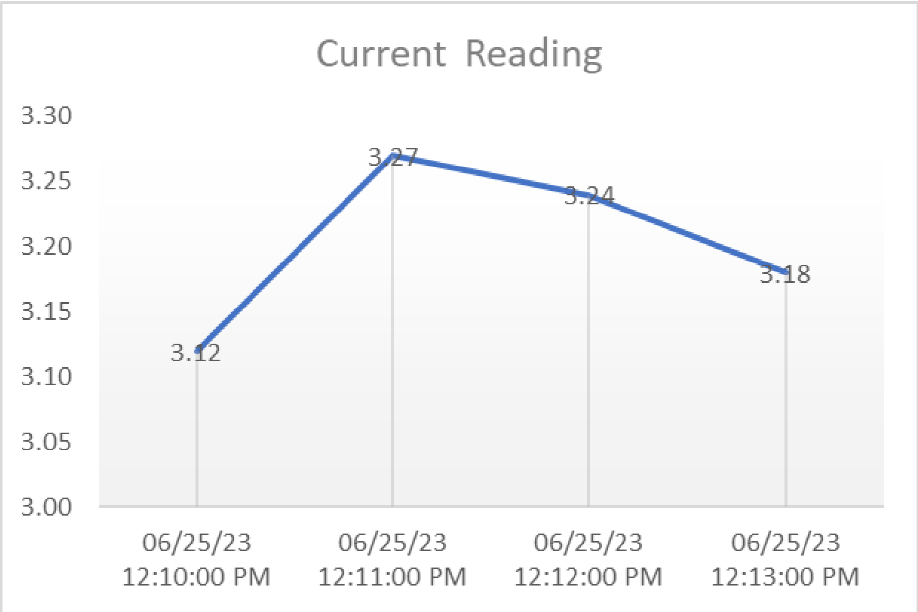

Figure 8: Current graph

Table 3 displays data from many measurements of a hair dryer taken at various times. The voltage readings show a minor change in the electrical potential provided to the hairdryer, from 239.78V to 241.71V. There appears to have been fluctuations in the electrical current going through the hairdryer at the times measured, with measurements ranging from 0.15A to 0.22A. Because of its variable energy needs, the hair dryer's power consumption varies from 37.05W to 52.35W. Overall, the data shows that the electrical characteristics of the Hairdryer are dynamic, with voltage, current, and power usage all fluctuating over the recorded time intervals.

Table 3 Reading voltage, current and power of Hairdryer

Load	Time	Voltage	Current	Power	Configuration
Hairdryer	12:15 PM	239.78	0.15	37.05	
	12:16 PM	240.30	0.18	41.76	
	12:17 PM	241.20	0.16	38.28	
	12:18 PM	241.71	0.22	52.35	

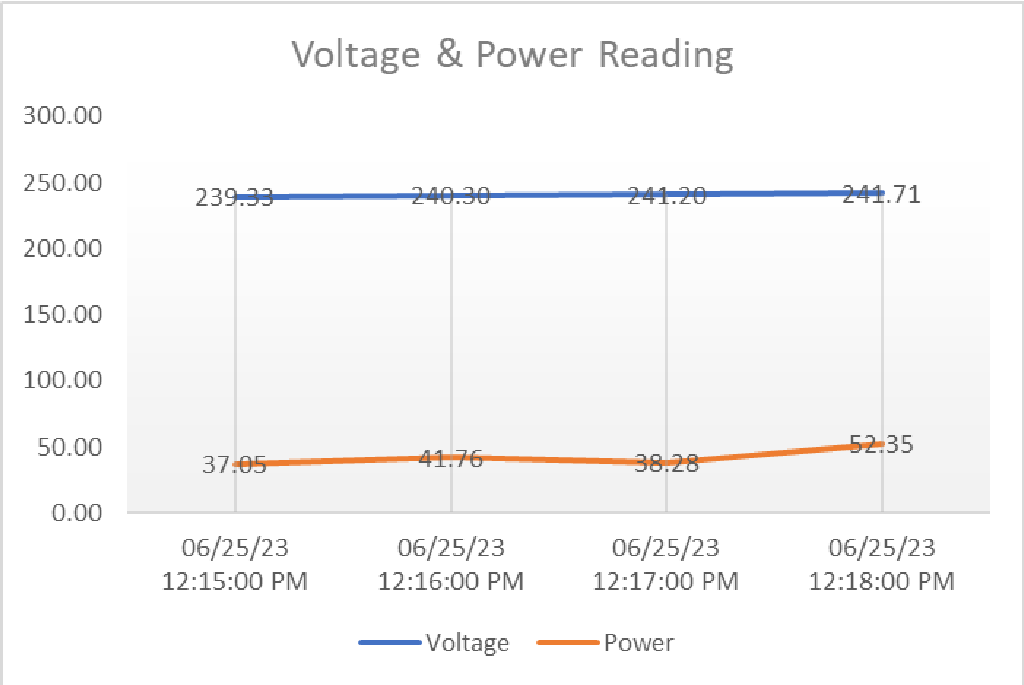

Figure 9: Voltage and Power graph

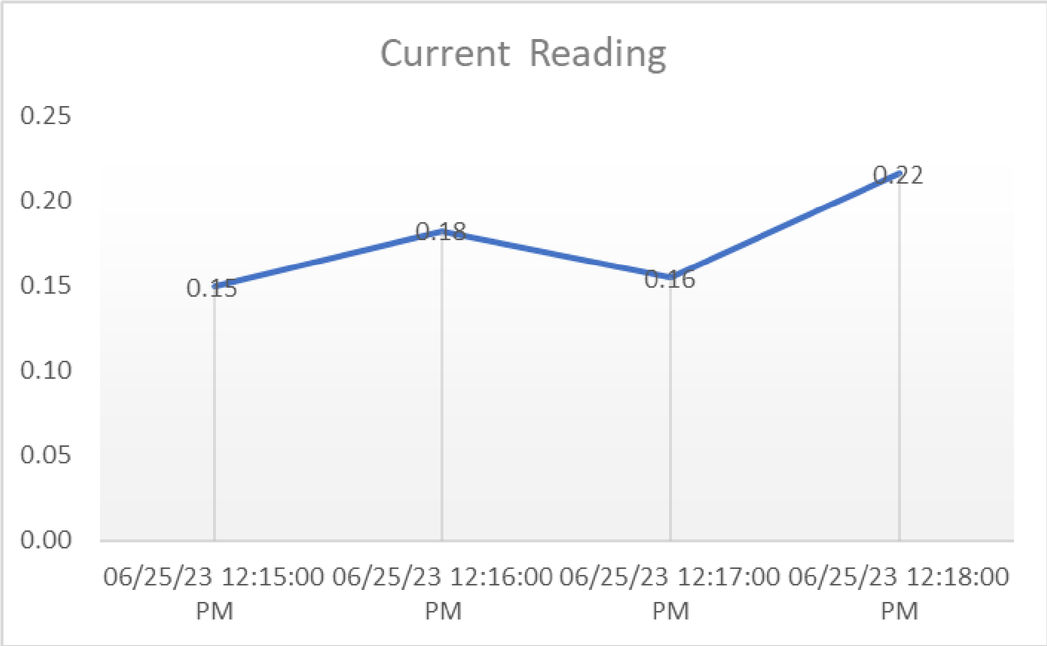

Figure 10: Current graph

4. Conclusion

In conclusion, the capability of monitoring the voltage, current, and power output of loads using the Blynk application on a smartphone gives ease as well as real-time insight into the electrical properties of the system. Users are able to keep informed of the performance and power consumption of their devices or equipment remotely thanks to this monitoring capabilities, which also enables them to make thoughtful decisions regarding the energy usage and efficiency of their electronic devices. Users are able to conveniently access and analyze critical electrical parameters by leveraging the Blynk application, which leads to improved control, optimization, and effective management of power resources.

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