AUTOMATIC ELECTRICAL LOAD CONTROL AND MONITORING SYSTEM

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Date of Submission: May,2026

DECLARATION

We hereby declare that this project **"Automatic Electrical Load Control and Monitoring System"** represents our work which has been done in the lab of the Department of Electrical and Electronic Engineering under the Faculty of Engineering of Sonargaon University in partial fulfillment of the requirements for the degree of Bachelor of Science in Electrical and Electronic Engineering, and has not been previously included in a thesis or dissertation submitted to this or any other institution for a degree, diploma or other qualifications. We have attempted to identify all the risks related to this research that may arise in conducting this research, obtained the relevant ethical and/or safety approval (where applicable), and acknowledged my obligations and the rights of the participants.

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APPROVAL OF ACCEPTANCE

The project entitled **"Automatic Electrical Load Control and Monitoring System"** submitted by **Asharful Hossain (EEE2203027013), Md. Tahibul Hassan (EEE2203027014), Md. Shahin Alam (EEE2203027056), Md. Mahadi Hasan (EEE2203027025), & Md. Shahidul Islam (EEE2201025002)** has been completed under my direction and is regarded as meeting the criteria for a partial **Bachelor of Science in Electrical and Electronic Engineering** degree in **May 2026.**

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Dedicated

To My Family, Honorable Teachers, and well-wishers.

ACKNOWLEDGEMENT

Firstly, we express our sincere thanks and gratitude to the almighty for his divine blessings which made it possible for us to complete this project successfully.

We are grateful and express our deepest gratitude to Md. Ashikur Rahman, Lecturer, Department of Electrical and Electronic Engineering, Sonargaon University. The deep knowledge and keen interest of our supervisor influenced me to carry out this project. infinite patience, scholarly guidance, constant encouragement, constant energetic supervision, constructive criticism, valuable suggestions at all levels made this project possible.

The successful completion of this thesis would not have been possible without his constant inspiration and constant guidance. Hence we are extremely pleased to acknowledge our profound gratitude and respect to the maintainer.

We would like to express our gratitude to our Head of Department, as this project was completed under the Head of Department of Electrical and Electronics Engineering, Sonargaon University, Bangladesh.

We would like to thank our entire course mates from Sonargaon University, who participated in this discussion while completing the course work.

The author is grateful to all the respected faculty members of the Department of Electrical and Electronics Engineering for their cooperation and vital assistance in the successful completion of the thesis work.

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LIST OF ACRONYMS AND ABBREVIATIONS

SCADA-Supervisory Control and Data Acquisition

RTU-Remote Terminal Unit

PCS -Process Control Systems

GSM-Global System for Mobile Communications

SVCMS -Smart Voltage and Current Monitoring System

IoT-Internet of Things

SAS-Substation Automation Systems

MTU-Master Terminal Unit

LAN- Local Area Network

EPRI-Electric Power Research Institute

IEDs -Intelligent Electronic Devices

PWM- Pulse With Modulation

SPI Pins-Serial Peripheral Interface

SCK-Serial Clock

TTL-Transistor Transistor Logic

ABSTRACT

This extension aims to collect more electrical data, including the buyers' control use and current, and deliver these real-time values across the network. This project also includes a relay that will switch the electrical circuits use load; when the electrical loads do not need to be used, the relay turns off the load. Substation mechanization has become a prerequisite for each utility firm as the dissemination arrangement has become more modern. It is crucial to understand the urgency that has occurred to advance the quality of power when the security, monitoring, and control of a control system is inadequate. With the help of the current sensor, this system can routinely update electrical characteristics in real time. Although a microcontroller is utilized in this project, we have used an ESP-8266 microcontroller for demonstration reasons because it is a prototype of the suggested concept. The controller must be able to connect to a Wi-Fi network and be able to interact with the computer quickly. When we turn on the control for our model, all of the sensors start to detect current and provide real-time data to the server and the user interface of the app. All current values are stored in Firebase data storage. If the issue continues for the specified amount of time, the relay separates the loads from the rest of the system. In the meantime, the comparison is carried out as already, and transfers are utilized to re-connect the loads to the rest of the framework when the issue settle.

CHAPTER 1
INTRODUCTION

1.1 Introduction

Electricity is a highly practical and useful kind of energy. It has a commensurately growing significance in our modern industrial society. The area unit for electric power systems was made up of extensive, complex, and extremely non-linear networks. The combination of these wattage systems offers operational advantages, enhanced accountability, and financial savings. They are among the most crucial elements of the infrastructure both domestically and globally, and their failure has a serious detrimental impact on security and the national economy. Electric power systems are composed of two subsystems: distribution and transmission systems. Transmission systems are principally in charge of transporting electricity from generators to consumers, whereas distribution systems serve as the last link between high-voltage transmission systems and consumer services. In other words, power is transferred from the distribution system to various customers via feeders, distributors, and service mains. Understanding the type of constraint that has developed is crucial to improving the quality of electricity with suitable solutions. Furthermore, inadequate management, supervision, and safety can cause a power system to become unstable. A monitoring system that can automatically detect, track, classify, and locate any electrical line restrictions is therefore required. This benefits the utility corporations as well as the end users.

1.2 Problem Statement

Our nation's load demand has grown in tandem with the complexity of the distribution network. Our power production expenses have gone up as a result of the increase in oil prices abroad, which has raised the cost of energy for consumers. If only we could see how much electricity is being used in our house right now. By promptly shutting down our superfluous loads, we may lower our expenses. By monitoring and controlling, we can automatically lower our power cost if we leave the house without shutting off the load. By avoiding waste, we may also contribute to the nation's image for having reliable power. The controller's responsibility is to dynamically monitor the loads' power consumption. The sensor node will decide whether to send this information to the sink immediately or after a certain amount of time. An increase in customer demand for power, which drives up the price of the electricity supplied to the client, triggers the alert. To employ a decent cure to improve the quality of power, it is necessary to comprehend it.

1.3 Objectives

The project's objectives are to

i. To control and monitor the loads.
ii. To calculate the room load automatically
iii. To develop an Android app for controlling and monitoring Loads.
iv. To develop the economy by providing reliable energy to the consumer load.

1.4 Necessity of Automation

i. In the textile business, automation refers to the tools and machines used to increase manufacturing efficiency. A higher-quality product, improved working conditions, and fewer hours of labor for the same amount of production are just a few benefits of automation.
ii. Automation, often known as automated control, is the process of operating machines and automobiles without human intervention by utilizing a range of control systems. Examples of this kind of machinery are industrial operations and boilers.
iii. Automation improves productivity and quality in an industrial context by reducing errors and waste, increasing security, and giving production processes greater flexibility. In the end, industrial automation improves safety, dependability, and profitability.

1.5 Advantages of Automation

i. **Reduced operational costs:** Robots can do jobs that would take three to five people to do. In addition to labor savings, automated tasks can save a significant amount of energy because they don't need to be heated as much. Robots improve part accuracy and speed up processes, which reduces waste in your company.

ii. **Improved workplace safety:** Automated cells have released people from harmful responsibilities. Your workers will appreciate that you protected them from the dangers of industrial labor.

iii. **Faster ROI:** Automation solutions that are tailored to your particular requirements and objectives soon pay for themselves through lower operational costs, shorter lead times, increased productivity, and other benefits.

1.6 Disadvantage of Automation

i. The topic of automation-induced job displacement has already been covered. Regardless of the potential social benefits of retraining displaced individuals for other employment, the person whose job has been replaced by a computer will almost always experience emotional hardship. In addition to losing their job, the person could have to relocate geographically. Having to relocate in order to find new job is another difficult circumstance.

ii. Automated equipment has some disadvantages, such as requiring a significant initial investment (the design, development, and installation of an automated system can cost millions of dollars), requiring more maintenance than a human-operated machine, and generally being less versatile.

1.7 Chapter Summary

The home load of three rooms must be controlled and monitored by automatic control and monitoring systems, which are also essential in both industry and our daily lives at home. We attempted to address each of these issues in this chapter.

CHAPTER 2
LITERATURE REVIEW

2.1 Introduction

Every day, the autonomous home control system is being improved. The automatic control system, which is more simple and easier to operate, keeps an eye on the room load. But this automatic method takes time to develop. In the early stages of development, power quality issues are rarely acknowledged. It is rather simple when it is initially developed. After that, the automated system is regularly enhanced. In this chapter, we will try to give a summary of the home automation system's history.

2.2 Fundamentals of Automation

Any work may be readily automated. Microcontrollers have made it possible for tasks that were previously completed by people to be completed automatically. Every element of modern life has changed as a result of the entire substitution of human labor by machines, which has enabled the automation of our everyday tasks. They place a high value on convenience, safety, energy efficiency, and the ability to remotely monitor and control their home. The system should have intelligent automation features and intuitive control interfaces to seamlessly integrate their lifestyle.

2.3 Literature Review

Nowadays, regardless matter how much electricity is utilized, many people would choose to use other kinds of technology rather than pay for it. Due to growing energy costs and demand, there are now many highly sophisticated ways to measure, regulate, and monitor an organization's energy savings. Reducing excessive power usage and informing consumers are the goals of the smart power consumption tracking and warning system suggested in this study. The amount of the unit's use would be communicated to the user. By the deadline, the total number of power units used and those still in the stable slab categories will be displayed. It aims to build a circuit that gives the user control over power consumption at an extra cost by increasing ingenious electrical energy-saving strategies. Any adjustment that is improved has a major effect on reducing the user's bill expenditures. The amount of electricity being consumed and the number of units left are communicated to the user. Users will get daily power use through SMS and web pages when the device is switched off. Big data analytics will provide quick, reliable insights that will help make better judgments by utilizing machine learning and predictive analytics. The resident data that has been collected is stored on the Big Data server. A Smart Energy Management System (SEMS) would help save expenses with growing energy demands. Big Data techniques and the Internet of Things (IoT) have been used to enhance power management by using energy utilization in homes, farms, and industries. [1]

This project develops an automated household utility power monitoring system and a real-time data logging system. This program makes use of the Arduino Uno Rev3 microcontroller board, which is designed to work with the ATmega328 microprocessor. It will be linked to a current transformer through the circuit for the voltage and current sensors in order to track these values. The SD/MMC shield module will record the raw data to an SD card so that it may be stored in the event of a power outage. The digital input will then be converted into raw data by the system so that it may be gathered. The system also includes a DS1307 serial RTC (Real-Time Clock) chip, which provides the date and real-time clock required for data recording. This will work as an evaluation criterion to ascertain the final technology's marketability, acceptance, and functionality. [2]

Using an Arduino Uno and Bluetooth, this article provided real-time power measurement and control of household electrical appliances. Furthermore, an Android application was used to display the real-time power usage of each item separately and to notify the user of the total payment amount. This technology records the total amount of electrical power consumed every hour in addition to measuring the total power used. The ideal billing amount is then determined using the load curve it generates, which is based on a two-part tariff. The main objective of this attempt was to reduce the maximum demand power used by the customer in order to lessen the total billing amount. The system generates a time window for all appliances with comparatively high power consumption capacity to be run after load curve estimation.

By making the average load curve almost horizontal, this lowers maximum demand. [3]

The demand for power has increased significantly over time. Reducing domestic energy use is one possible way to address the present energy problems. This has increased the need for accurate and reasonably priced power measurement methods. The purpose of providing such information is to optimize and reduce their power use. This study's smart energy meter is a component of a sophisticated, automated metering and billing system. A number of pre-programmed automated tasks (SMS) are provided to the meter reading system by the combination of the Arduino and GSM Short Message Service. Energy consumption in kWh, generated bills, and security services (line Cut/On) may all be sent via a GSM mobile network using the integrated controller and GSM modem in the proposed energy meter system. Power companies or other organizations can utilize this data to feed and integrate into their current energy management systems, enabling them to provide services to customers without the need for human labor. [4]

The use of automation to track power use data from home systems over the Internet (WEB) is discussed in this article. By removing the costs and errors associated with human labor, building automatic network access may ultimately lower the amount of physical labor needed to collect the units utilized from each residence. This solution doesn't require any hardware effort and is very easy to set up. The main components of this system are an Arduino board interface with voltage and current sensors, a general-purpose controller board with an Ethernet shield, and a WiFi router for wireless data transfer to the server for database storage of consumption figures. The administrator's ability to host web pages with database connectivity and automatically produce power invoices will allow customers to view and pay their bills online. [5]

Goals for 2016–2020 are outlined in the National Action Plan for Energy Efficiency. The European goal of energy efficiency is applicable to all of its member states. As the need for energy efficiency has increased throughout time, national and international laws have been created to promote this notion. The term "Internet of Things" (IoT) refers to the technological revolution in everyday devices that are connected to a worldwide network. In order to relate the need for energy consumption monitoring to the Internet of Things paradigm, they want to develop and implement an automated system called iPlug that enables the monitoring and management of electrical equipment connected to the Internet via Wi-Fi. This approach utilizes line voltage and current to determine how much electricity the connected device or devices consume. It consists of a smart plug that plugs into a standard socket. After then, the data is kept in a database. The plug also lets you change your status, check the state of the outlet, and access consumption statistics via two apps (a website and an iOS app). [6]

The demand for power has increased dramatically in recent years. Reducing household energy use at times of high demand is one possible way to solve this energy problem. To do this, the idea uses real-time pricing that adapts to demand. Accurate and cost-effective power measurement methods are needed. Giving customers access to their real-time power consumption data is the main objective of this effort, which intends to reduce peak generation through power monitoring. By making this information available to consumers, we hope to encourage them to shift their load to off-peak hours, which will reduce their power usage and electricity expenses. The project's theory, software, and hardware are briefly described. The voltage and current signals from the load are conditioned and stepped down before being sent to the Atmega328. We discuss the project's load circuit and signal conditioning circuit design and functioning. [7]

The main objective of a smart home is to ensure proper and effective use of power, aside from the communication and home automation aspects of the smart system. In order to improve the energy management capabilities of smart homes, this study proposes the design and implementation of an autonomous single-phase energy consumption management system. The system uses an Arduino microcontroller and the instantaneous power calculation technique to calculate the total power, voltage, current, and power factor consumption of the house. The paper also provides a fitting analysis of the voltage sensor using a polynomial curve. In the event that all of the relays fail, the system may automatically reconnect the loads, keep household loads below the predefined threshold of 2 KW, and sound a special alarm. This is in accordance with the system's experimental analysis. It also displays the voltage, current, power consumption, and current power factor of the loads. The system's maximum errors in voltage measurement (above 10 V AC) and current measurement, respectively, are 2.47% and 1.89% higher than those of a standard FLUKE meter. When properly installed, the system will significantly reduce the total energy consumption of the house, resulting in significant electricity bill savings. [8]

This study presents a home energy monitoring system with Ubidots Cloud Services notifications. This study used an Internet of Things (IoT) architecture to capture data on household energy use and send it to the IoT Cloud. The device attaches a sensor module (ACS712) to an Intel Edison microcontroller to measure the amount of power used at home. Power use data is collected and stored in Ubidots IoT Cloud Services. Customers have control over their energy use since they may monitor their daily energy usage at home. A data-gathering experiment is carried out to ascertain the amount of power used at home. The IoT dashboard may be accessed online by users to monitor their daily power use. After analyzing the collected power consumption data using event analytics, IoT Cloud notifies homeowners by email or Telegram that their electrical power usage has over their power consumption limit. This lessens the likelihood of power abuse.

2.4 Chapter Summary

We discuss many research articles on load-controlling and monitoring in this chapter. We attempt to provide a wide range of techniques that are either now in use or are being considered for use in substation load control and monitoring. This study paper aids in the effective completion of our assignment. Studying research papers taught us about the benefits and drawbacks of a wide range of topics pertaining to our project.

CHAPTER 3
DETAILS OF EQUIPMENT

3.1 Introduction

Several devices with predetermined nominal values are required to complete the project. You won't receive the intended outcomes if the device ratings don't match. As a result, we have talked about the many gadgets we employed for the project and their specs.

3.2 Hardware Setup

It is challenging to be fully informed on the project's hardware and software. The electronic parts have been positioned as optimally as feasible. The most crucial part of our project is the ESP-8266. We see this section as the core of the extension as it includes all of the computer program's information. This project also made use of a single-channel relay module and three current sensors. The load is started and stopped using the on/off switch. A lightbulb has also been employed as an output device. The ESP 8266 WiFi module is connected to the internet via the WiFi router.

Hardware elements

The project used many hardware and software components, which are described below:

- ESP-8266
- Power Supply
- Current Sensor
- Jumper Wire
- Single-channel relay module
- PCB Board
- On-off Switch
- Light
- Connecting Wire

3.2.1 Node MCU ESP 8266

NodeMCU could be a Espressif Frameworks Wi-Fi SOC (Framing on a Chip). The ESP8266-12E Wi-Fi module serves as its basis. It's a highly integrated semiconductor that provides a whole Web network in a small package. The Arduino IDE may be used to easily modify it over the USB harborage. With simple code, you may create a Wi-Fi connection similarly to how you would with an Arduino, define input and task legs as needed, and provide a web browser. It can be used to retrieve or send information, have a web garçon, or serve as a get-to-point or station. NodeMCU is an open-source, Lua-based firmware and development board specifically designed for Internet of Things (IoT) applications. It has firmware that manages grounding on the ESP-12 module and operates on the ESP8266 from Espressif Systems. It makes use of an ESP 8266mod Wi-Fi module. It is coupled to a microcontroller. It is often used to enhance the Web of Impacts (IoT). This WiFi module, which transmits all signals from the base station, looks a lot like the financial switch. Every piece of information should be stored in a standard database. For this reason, we used Firebase as the database. First and first, the WiFi module must process the supplied data or flag.For real-time observation, this data is stored on Firebase, which your phone will incontinently connect to.

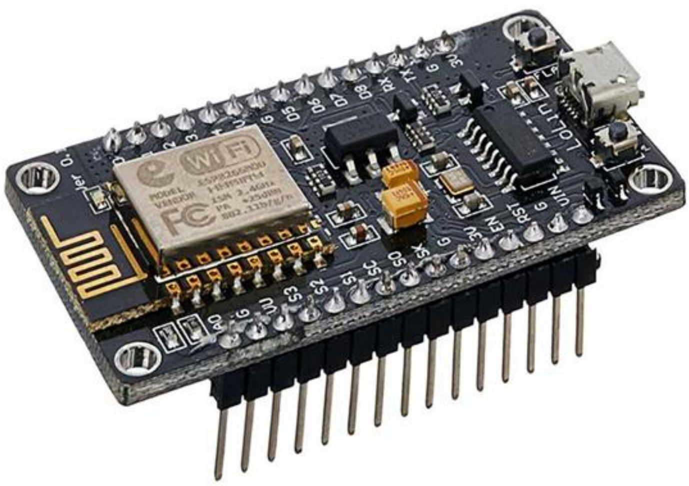


Figure 3.1: ESP 8266

3.2.1.1 Power

The Arduino can be powered by a surface control restriction or by figuring out USB participation. The control source is properly selected. An AC-to-DC connection can also provide external (non-USB) control. You may use the DC Control Jack, the barrel jack, to control your Arduino board. Most of the time, a separator connector is connected to the barrel jack. Although the sponsor recommends maintaining the board between 7 and 12 volts, it may be powered between 5 to 20 volts. The controllers may warm up at 12 volts, and they may not function at 7 volts. The legs of the control are

i. VIN: by and large the input voltage leg of the Arduino board is utilized to supply input constraints from an exterior control source. The voltage has to be interior the degree indicated.

ii. 5V: This adherence of the Arduino board is utilized as a controlled control drive voltage and it's utilized to supply the board as well as onboard components.

iii. 3.3V: This adhere of the board is utilized to supply a drive of 3.3 V which is made from a voltage controller on the board

iv. GND: Inside the ESP- 8266 pinout, you'll find 5 GND legs, which are all associated. The GND legs are utilized to close the electrical circuit and deliver a common clarification reference position each through your circuit. Persistently make past any mistrustfulness that all GNDs (of the Arduino, peripherals, and variables) are related and have a common ground.

3.2.1.2 Analog IN

Only one analog pin of the ESP 8266 is used with the Analog Digital Converter (ADC).

In addition to being used as analog inputs, these pins can also be used as digital inputs or outputs.

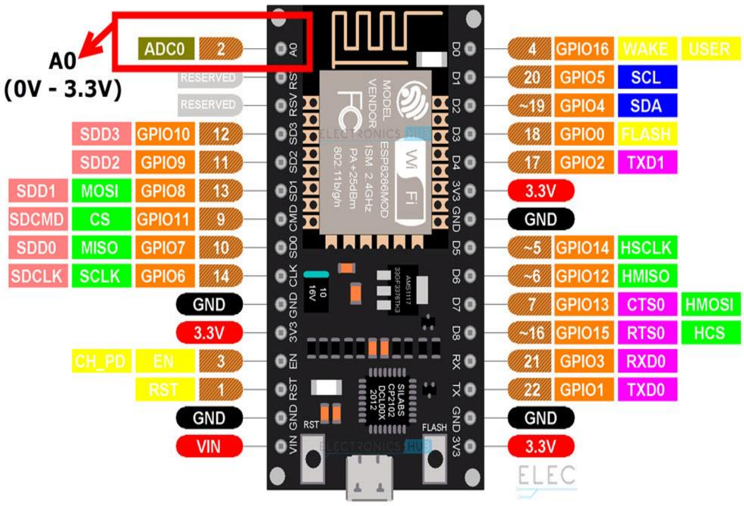
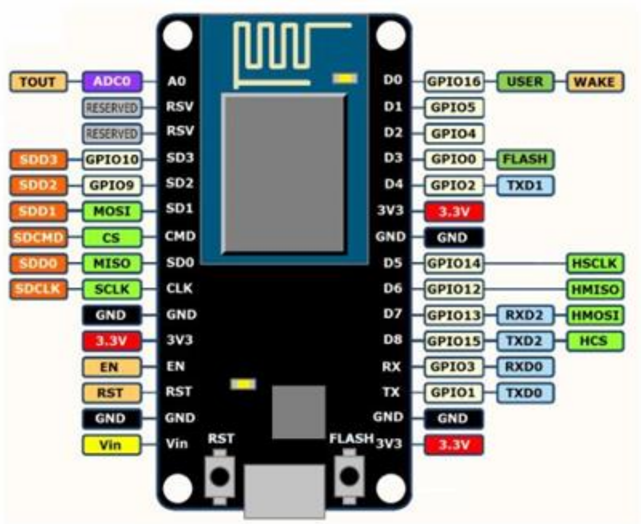


Figure 3.2: Pinout-Analog

3.2.1.3 Pinout – Digital Pins

Legs 0- 13 of the ESP 8266 serve as advanced input/ issue legs.

Leg 13 of the ESP 8266 is associated with the erected-in Driven.



Within the ESP 8266- legs have PWM capability.

Figure 3.3: Pinout - Digital Pins

It's critical to note that

- Each leg can allow/sink over to 40 mA most extreme. But the suggested current is 20 mA.
- The supreme most extreme current given (or sank) from all legs together is 200 mA.

3.2.1.4 Others Pins

i. **Pins:** These legs are too known as UART legs. It's utilized for communication between the Arduino board and a computer or other inclination. The transmitter Leg 1 and recipient Leg are utilized to transmit and concede the information resp.

ii. **Outside Hinder Pins:** This pin of the Arduino board is utilized to create the Outside barge and it's done by Legs 2 and 3.

iii. **PWM Legs:** The periodical legs of the board are utilized to change the computerized flag into an analog by changing the run of the palpitation. The Legs and 11 are utilized as a PWM leg.

iv. **SPI Legs:** This can be the periodical supplemental Interface leg, it's used to preserve SPI communication with the assistance of the SPI library. SPI legs incorporate.

v. **SS:** Leg 10 is utilized as a Slave Select.

vi. **MOSI**: Stick 11 is utilized as an Ace Out Slave In.

vii. **MISO:** Leg 12 is utilized as a Ace In Slave Out.

viii. **SCK:** Pin 13 is utilized as a periodical timepiece

ix. **LED Pin:** The board has an inbuilt Driven utilizing computerized leg- 13. The Driven shines as it were when the advanced leg gets to be tall.

x. **AREF Leg:** Typically an analog reference leg of the Arduino board. It's utilized to provide a reference voltage from an outside control drive.

3.2.1.5 Memory

Microcontroller	Family	Architecture	Flash	SRAM	EEPEROM
ESP 8266	AVR	Harvard	4 MB	64kb	1kb

Table 3.1 Memory of ESP-8266

3.2.1.6 Specifications:

- Voltage: 3.3V.
- Soft-AP and Wi-Fi Direct (P2P).
- Current use ranges from 10 µA to 170 mA.
- Flash memory attachable: up to 16MB (512K is standard).
- Processor clocked at 80–160MHz.
- RAM: 32K + 80K.
- The number of GPIOs is 17 (multiplexed with other operations).
- One input from analog to digital with a resolution of 1024 steps.
- +19.5dBm is the 802.11b mode output power.
- Support for 802.11: b/g/n.
- Five TCP connections can be active at once.

3.2.1.7 Working Principle

The stoner contributes source and destination points along a specified route. A number of stops will be made along the route. The ESP 8266 first receives the energy rating from the current sensor. Data is sent to the server using the Node MCUESP8266 module's built-in Wi-Fi networking functionality. On their client device, the user receives real-time data, which is updated continuously on the server. The anticipated time of arrival (ETA) is displayed to the user, accounting for traffic circumstances. The purpose of this little, highly integrated semiconductor is to provide full internet access. It may be programmed instantly over the USB connection using the Arduino IDE.

3.2.2 Single-Channel Relay

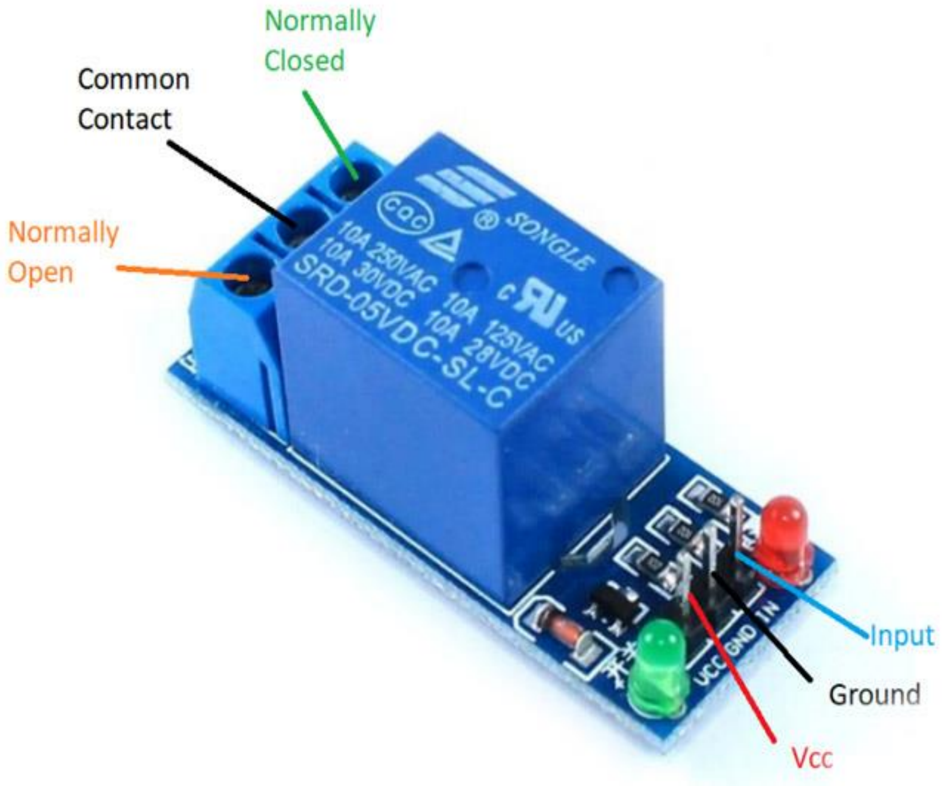


Figure 3.4: Single-Channel Relay module

An electromechanical device called a relay uses an electric current to open or close a switch's contacts. The single-channel relay module's parts facilitate switching and connecting while also acting as indicators to show whether the relay is operational or not. There is much more to it than a simple relay.

3.2.2.1 Module Specifications

Details of the Relay Module are provided below:

- Supply Voltage – 3.75V to 6V
- Quiescent current: 2mA
- Activation current: 2mA
- Maximum contact voltage of the relay – 250 AC or 30VDC
- Max. Current – 10A

3.2.2.2 Schematic diagram of Single relay module

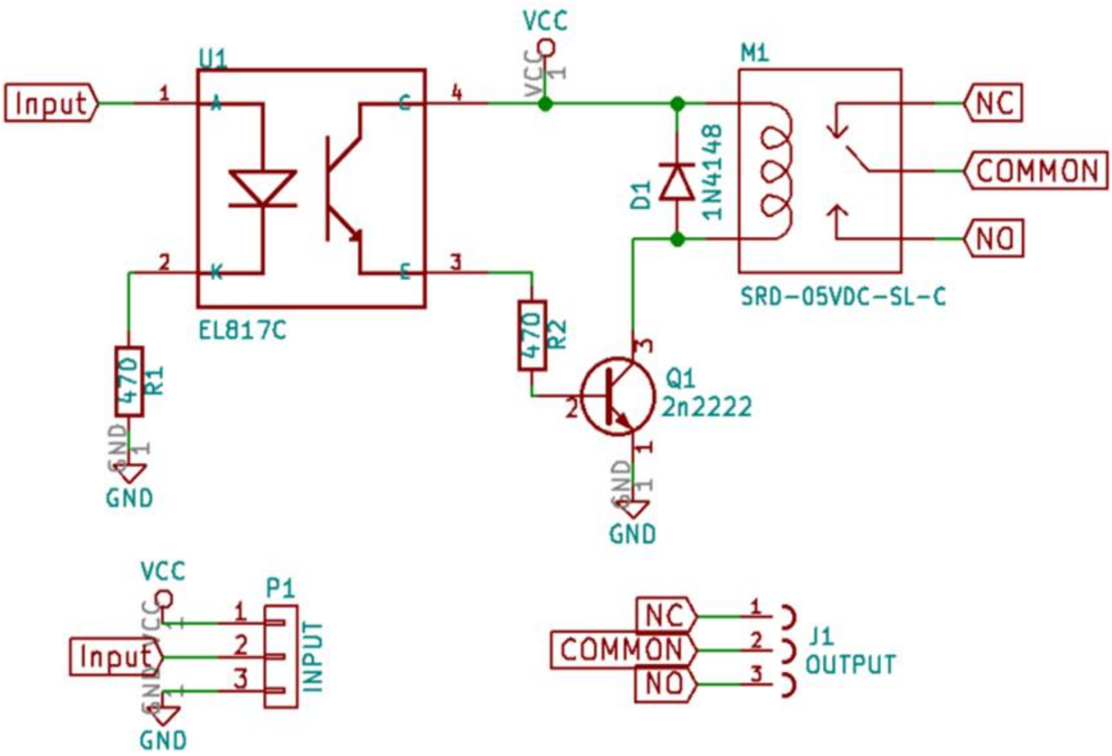


Figure 3.5: Schematic diagram of Single-channel relay module

3.2.2.3 Working Principle

The electromagnetic attraction hypothesis explains how it works. When electricity passes through the first circuit, the active electromagnet (brown) creates a magnetic field (blue). The second circuit is activated when this field presses against a red contact. A spring pushes the contact back to its initial position when the power is turned off, so shutting off the second circuit once more. The contacts in the second circuit of this "normally open" (NO) relay example are not connected by default; they only become active when a current flows through the magnet. Other relays only trip when the magnet is engaged, pushing or pulling the contacts apart, but the contacts are "normally closed" since a current runs through them by default and the relays are linked. The most common are frequently open relays. A relay connects two circuits by supplying current to an electromagnet, which attracts a metal switch and turns on the second output circuit. The output circuit's higher current is triggered by the input circuit's moderate current.

3.2.3 Current Sensor

A current sensor is a device that detects current and converts it into an output voltage that is proportional to the current passing through the channel under observation and can be easily measured. Sensors come in a wide variety, and each one is suitable for a certain current range and set of environmental conditions. The most popular kind of these sensors is a current-sensing resistor. It may be viewed as a current-to-voltage converter, where a resistor is added to the current channel to convert the current linearly to a voltage.

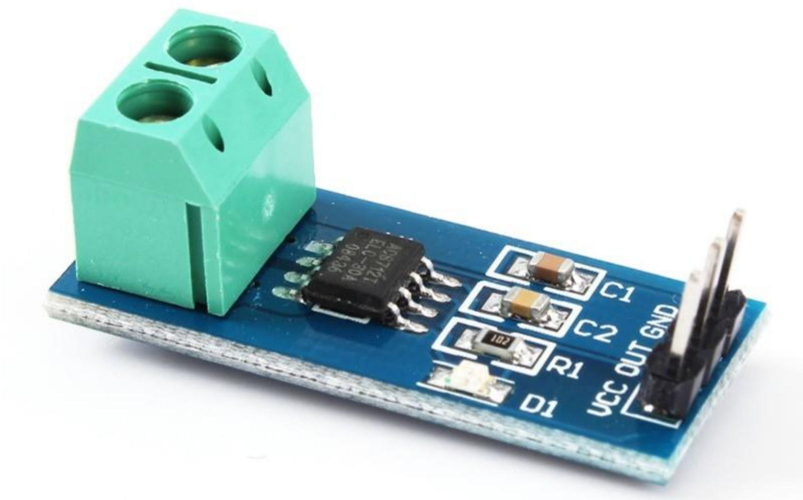


Figure 3.6: Current sensor

The technology used by the current sensor is important since different sensors may have distinct properties for different applications.Current sensors are based on either closed-loop or open-loop hall effect technology. In a closed-loop sensor, an actively driven coil generates a magnetic field opposite to the field produced by the recorded current.The hall sensor functions as a null-detecting device by generating an output signal proportionate to the current fed into the coil and the current being measured. An open-loop current sensor uses a Hall gadget to measure the magnetic flux generated by the primary current concentrated in a magnetic circuit. The output of the hall device is the signal that has been conditioned to provide an accurate depiction of the main current.

3.2.4 Connecting Wire

JST Wire is used to establish a connection between the devices. ESP-8266 module, relay module, and current sensor connection were done using this wire.

Figure 3.7: JST Connector

3.2.5 PCB Printed Board

Although "printed circuit board" is the most often used term, "printed wiring boards" or "printed wiring cards" are equally acceptable terms. Before the invention of PCBs, point-to-point wiring was a time-consuming method of building circuits. When wire insulation started to deteriorate and break, this resulted in fre quent failures at wire connections and short circuits. A simple printed circuit board consists of an insulating material that is flat and sturdy, with thin conducting components attached to one side. These electrical devices form squares, circles, and rectangles, among other geometric shapes. Different forms serve as component connection points, while long, thin rectangles serve as linkages.

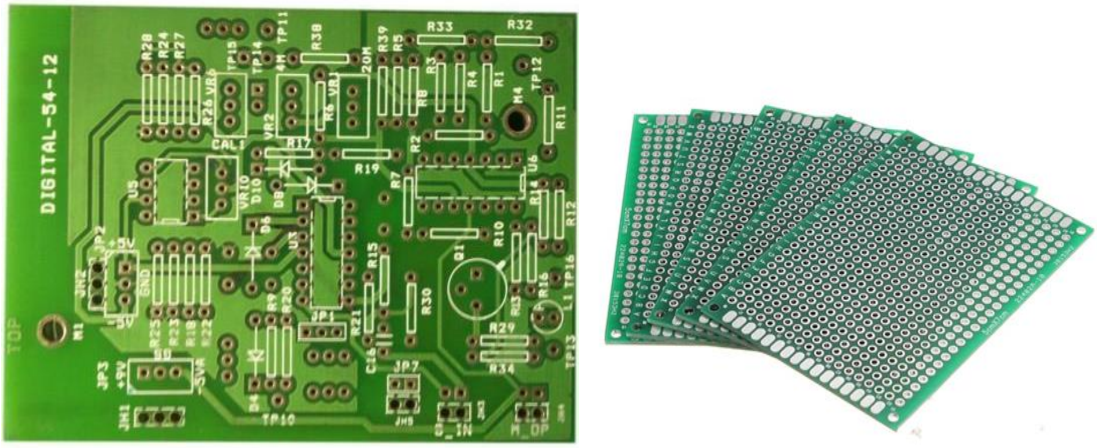


Figure 3.8: PCB Dot Varro Board

3.2.6 Power Supply

One of the most useful power sources for our project is the 5V power. To convert a 50V AC or 240V AC input into a 5V DC output, a combination of transformers, diodes, and transistors can be utilized. We used a capacitor to clean up the DC voltage. With current techno

logy, 5 volts is the ideal balance of speed, power consumption, and noise immunity. By using the same voltage to link circuits like sensors and other devices, the need for additional power supply may be reduced.

Figure 3.9: 5V DC Adopter

3.2.6.1 Working Principle

This is the main source of electricity for the project. All electronics need a 5 volt power supply to be activated. The GND site is connected to the power supply's positive side, while VCC, or 5 volts, is connected to its negative side. A USB connection is used to connect this portable power source. The power supply is suitable for our electric components due to its incredibly low current amp.

CHAPTER 4

HARDWARE USAGE

4.1 Introduction

This chapter covers the hardware implementation, which is the main focus of our project. The project would not be feasible without appropriate implementation. Thus, we outline our hardware implementation and project success in this chapter.

4.2 Flow Chart of The Project

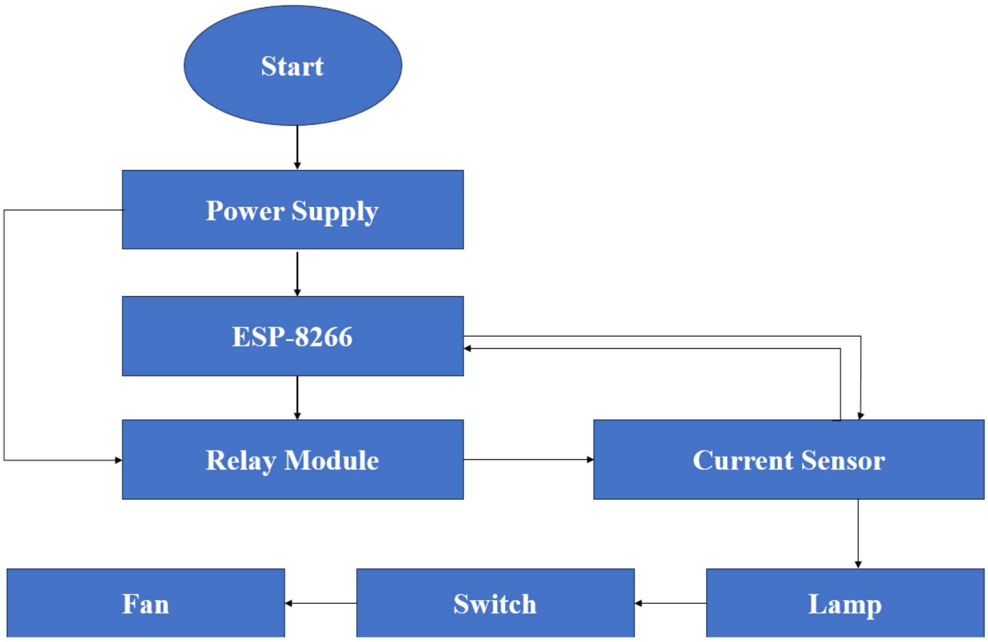


Figure 4.1: Flow Chart of the project

The flow chart shows that a relay module is used to regulate any loads, and the current sensor was used to determine the power. The ESP-8266 To send cloud storage, receive, send, and keep an eye on the signal. All of the load power utilizes data to save our database using an Internet of Things technology.

4.3 Block Diagram of the Project

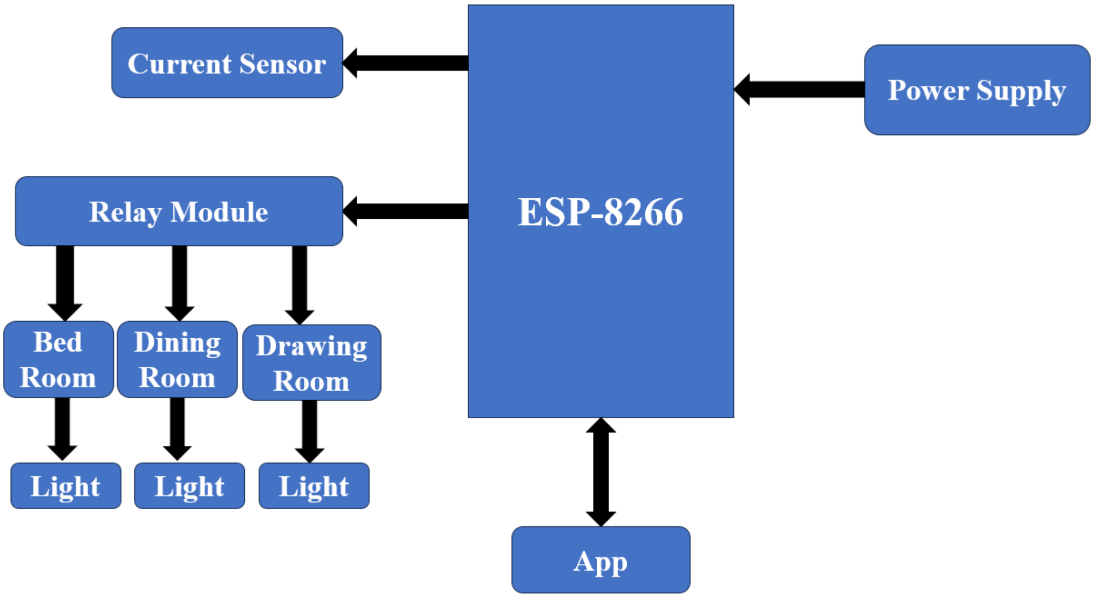


Figure 4.2: Block diagram of the project

The accompanying graphic shows the block diagram for our project. We can see several project components in this figure. These include the relay module, switchboard, light, power supply, switch, ESP-8266, and current sensor. The current sensor's value was recorded when the load was activated. The relay module is turned on in accordance with the ESP-8266's instructions. The microcontroller used the internet to connect to the Firebase database. As a result, the load is automatically turned on or off whenever and wherever it is needed. Power and current were measured while running. The user keeps an eye on his or her room load and may always observe the used load. Here is a brief overview of our project.

4.4 Circuit Diagram of our project

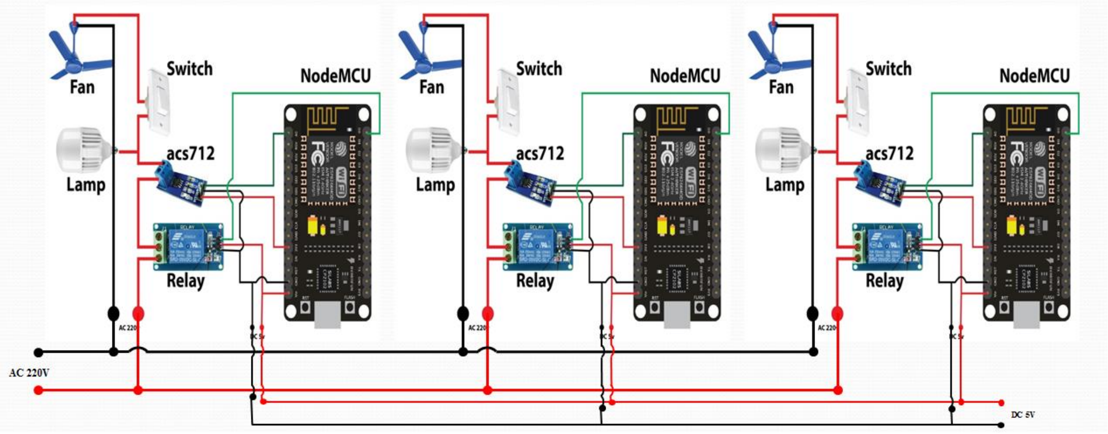


Figure 4.3: Circuit diagram of the project

A wire is connected between the relay module and the load in the circuit after the AC 220 V load is directly connected to the relay module's output side. 5 and 4.7 volts DC were produced from the remaining 220 volts AC.The ESP-8266 module is subjected to 5 volts DC. A current sensor was used to determine the light-taking power, and an ESP-8266 microcontroller was used to record the power. Additionally, the relay module runs AC 220 V. The relay receives signals from the Arduino and turns on when the load needs to be turned off automatically.

4.5.1 PCB Forming and Shaping

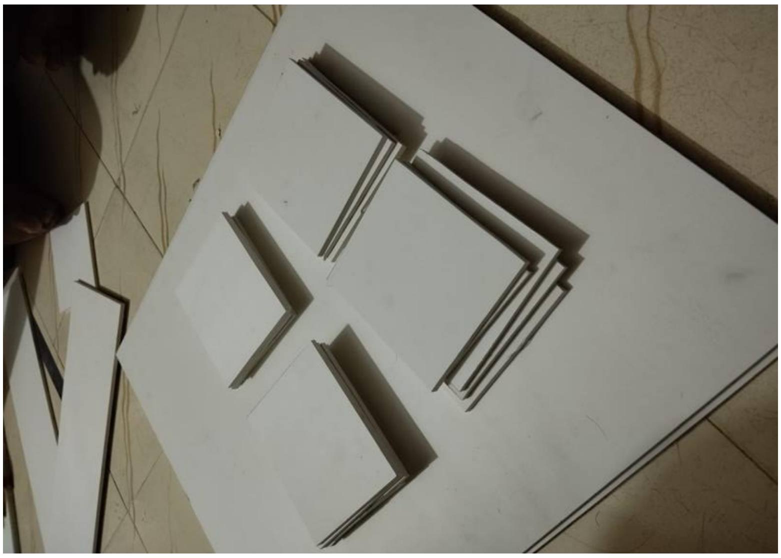


Figure 4.4: PCB Forming and Shaping

4.5.2 Hardware Setup

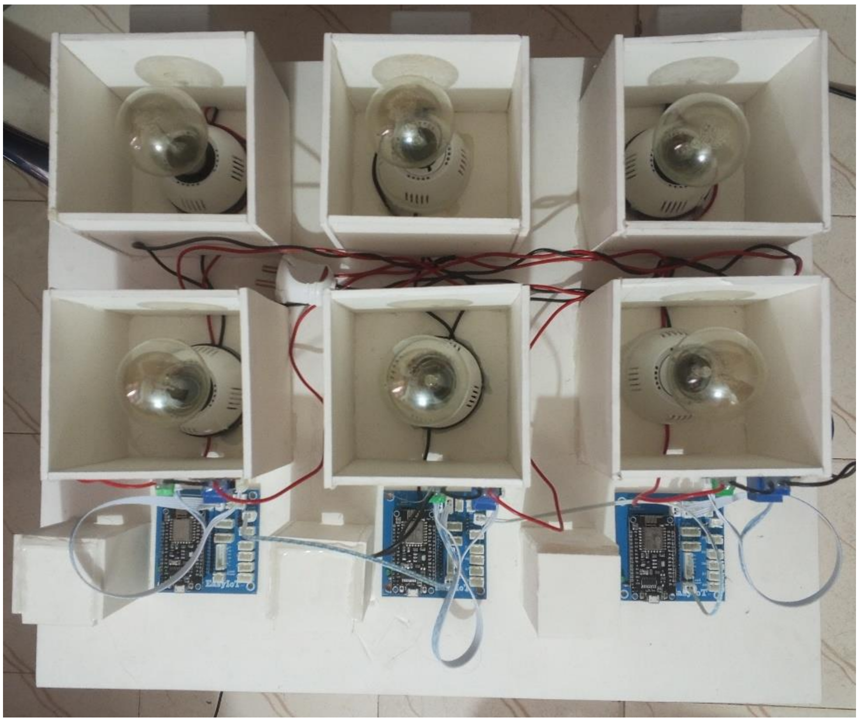


Figure 4.5: Final Hardware Setup

4.6 Project Prototype Design in AutoCAD

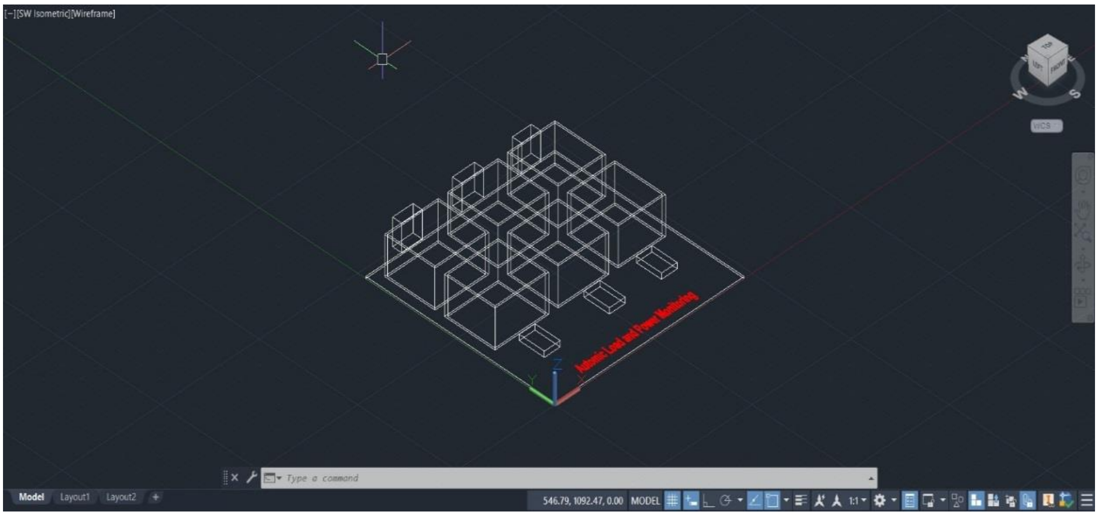


Figure 4.6: AutoCAD Drawing of this Project

CHAPTER 5
SOFTWARE AND APPS DEVELOPMENT

5.1 Software Development

Another crucial subject for this endeavor is software development. For this automated elevator monitoring system to work, the microcontroller has to be coded or programmed. The ESP-8266 is the microcontroller used in this project. The ESP-8266 controller was then controlled using the Arduino IDE. Using the App Controlled Lift mechanism, this step was flawlessly finished.

5.1.1 Software Arduino IDE

Let's take a closer look at the Arduino IDE's components after learning about them. You may do a number of actions, like creating and saving new files, by selecting the choices located near the top of the program screen. These button icons allow you to easily access some of the most frequently used functions. To check whether your code is error-free, click the verify button.

Figure 5.1: Arduino IDE

You may transfer your code from your laptop to your Arduino and have it execute on your board by selecting Upload. You may input your program through the window, and you can read more about it in the message sections. As we work with the IDE, we'll go into more depth regarding messages, but for now, just know that they alert you to errors in your code and offer details like the RAM usage of the Arduino. Examine the buttons in the code editor's top row in more detail. You may quickly access the activities in the code window using these buttons. These actions involve making a new file, opening an existing file, and saving it. They also include uploading and testing your code on the Arduino board. Let's first discuss what a sketch is, and then we'll use each of these buttons. were kept without a file extension and produced using a text editor. The editor allows you to search for and replace text as well as cut and paste. When exporting and saving, the message section highlights errors and offers feedback. The Arduino Software (IDE) sends information to the terminal, including detailed error warnings.

5.1.2 Programming Interface

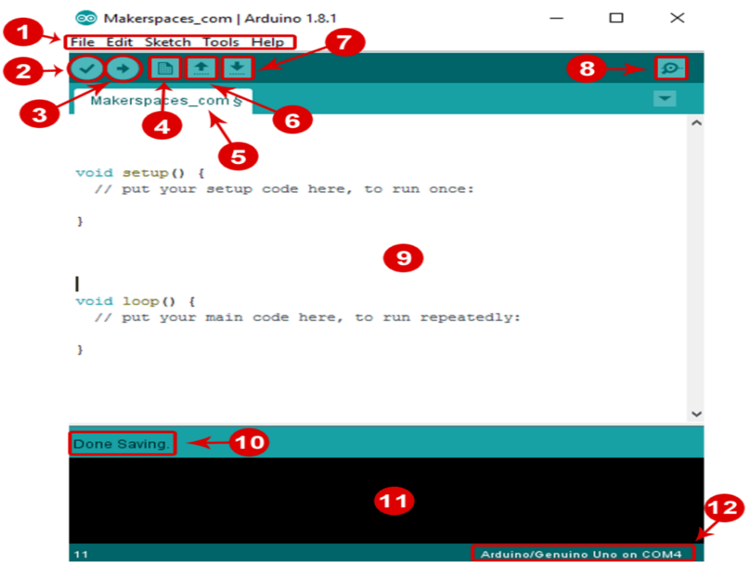


Figure 5.2: Sketch of Arduino IDE

Examine your surroundings and spend some time getting settled.

- Manu Bar: Provides you with the means to create and store Arduino sketches.
- Upload Button: Delivers the code to the attached board, in this example, the Arduino Uno. As the board uploads, the lights will flicker quickly.
- New Sketch: Brings up a new window with an empty drawing in it.
- Sketch Name: This is where the sketch's name appears once it has been saved.

- Open Existing Sketch: This lets you open a drawing that you've saved or one of the samples that are stored.
- Save Sketch: This preserves the drawing that is open at the moment.
- Serial Monitor: This will show the serial number of your Arduino when the board is attached.
- Coding Area: The sketch's code, which instructs the board on what to do, is composed in this section.
- Board and Serial Port: This indicates the board being utilized and the serial port to which it is attached.

You are now prepared to link your Arduino to your PC. Connect the USB cable's other end to the USB port on your computer and insert the first end into the ESP 8266. You must pick ESP 8266 under Tools, Board, then lastly once the board is linked.

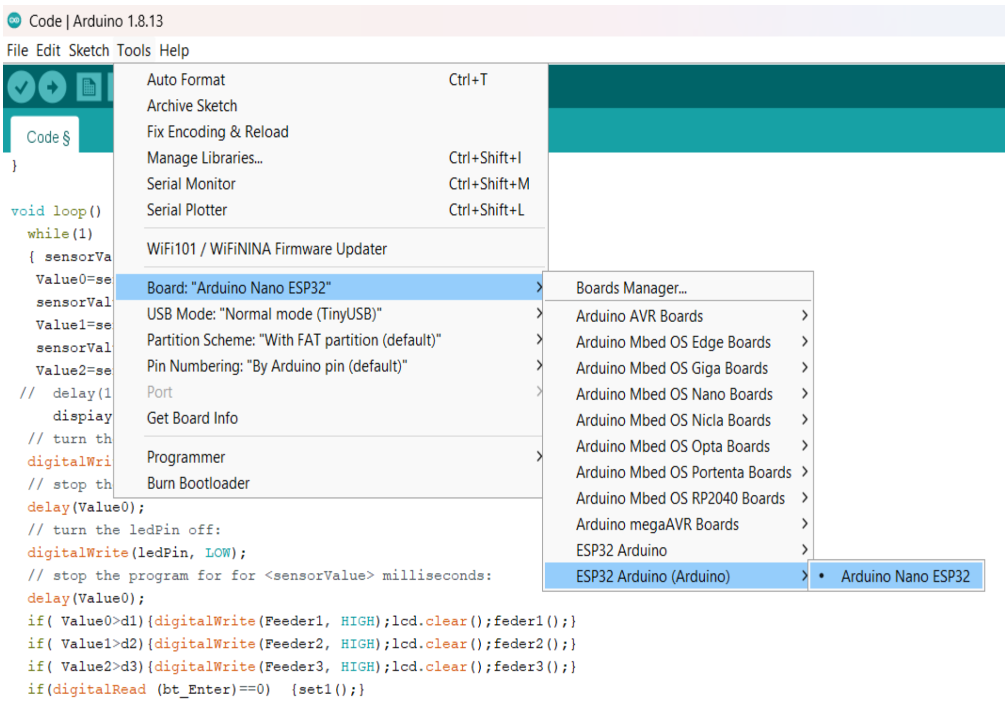


Figure 5.3 Arduino Board Selection

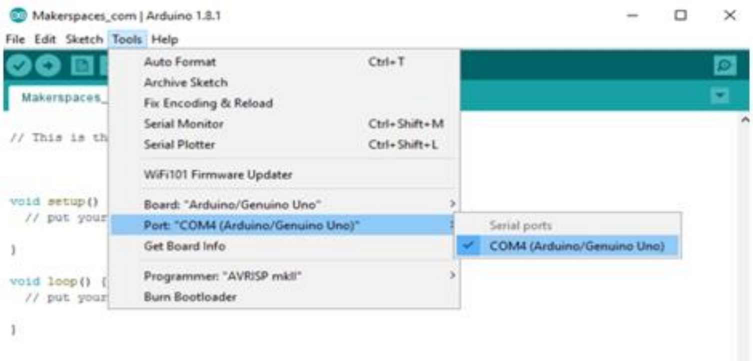


Figure 5.4 Arduino Port Selection

The Arduino needs to know which port on your PC you are currently utilizing. Go to Tools, then Port, and choose the port labeled Arduino to choose the port.

5.1.3 Arduino Variable Declaration and Library Include

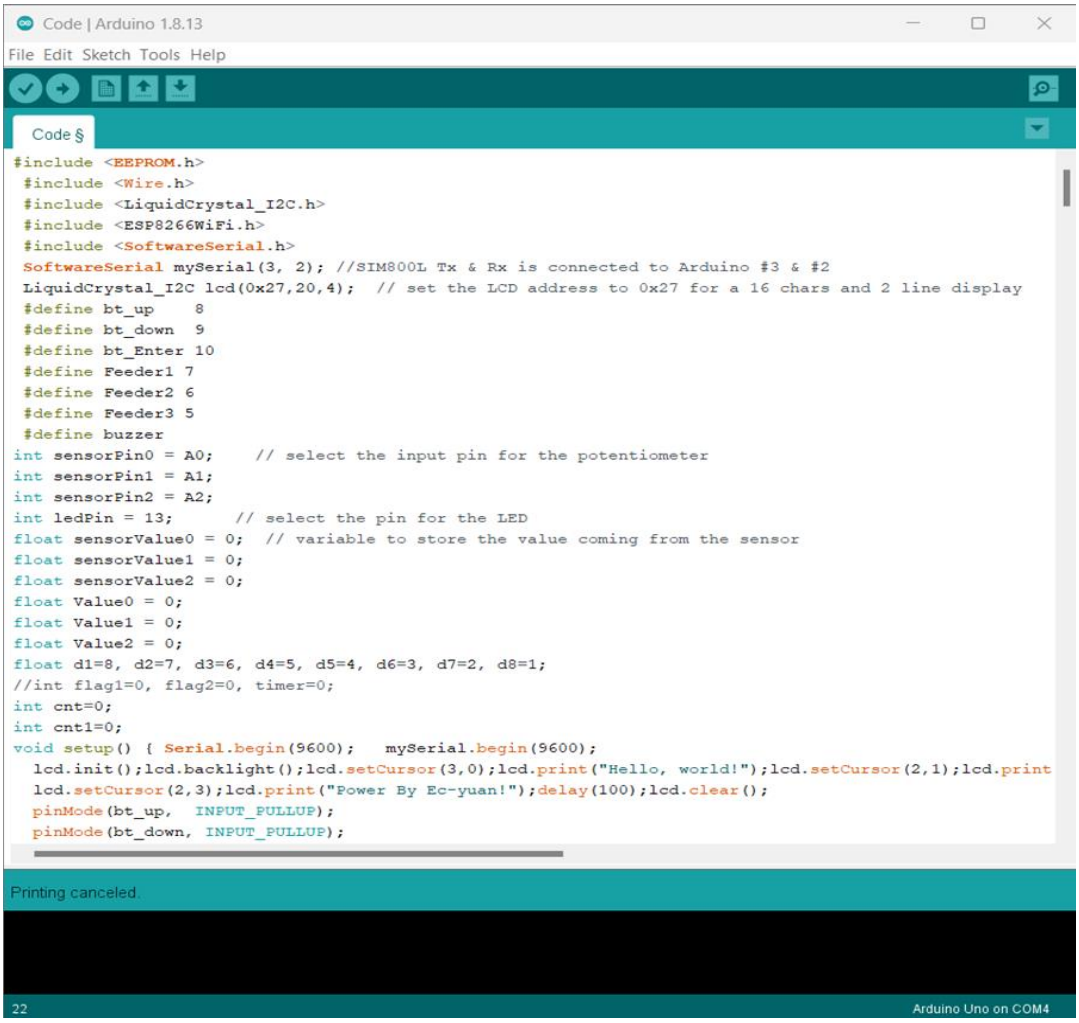


Figure 5.5: Arduino IDE screen Library Include and Void Setup

When coding, all of the libraries are first included in the Arduino IDE mane area. Different libraries are needed for different components since different components are used in different projects. We may choose any variable we wish to define as a variable after installing the required library. Here, we have added variables of the character, int, and string types.

5.1.4 Void Setup Function

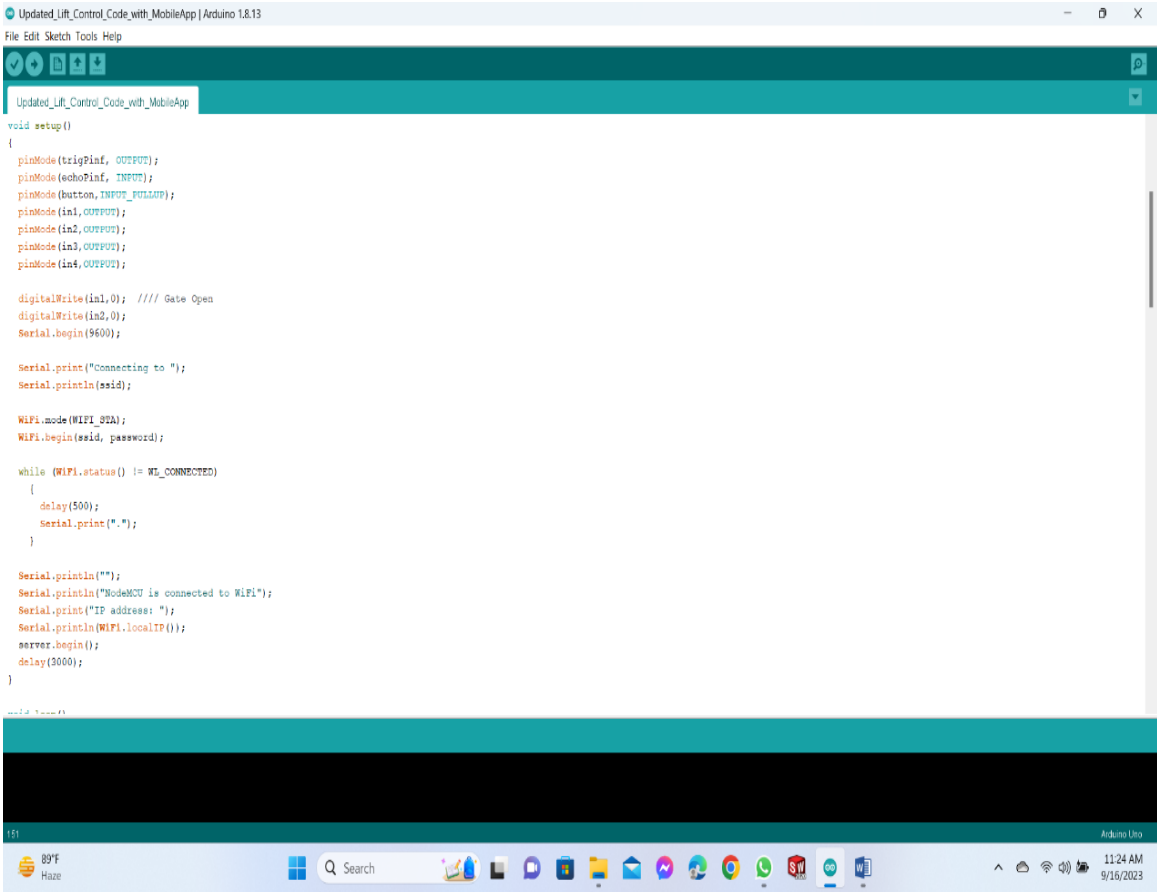


Figure 5.6: Void Setup Function

5.1.5 Void Loop Function

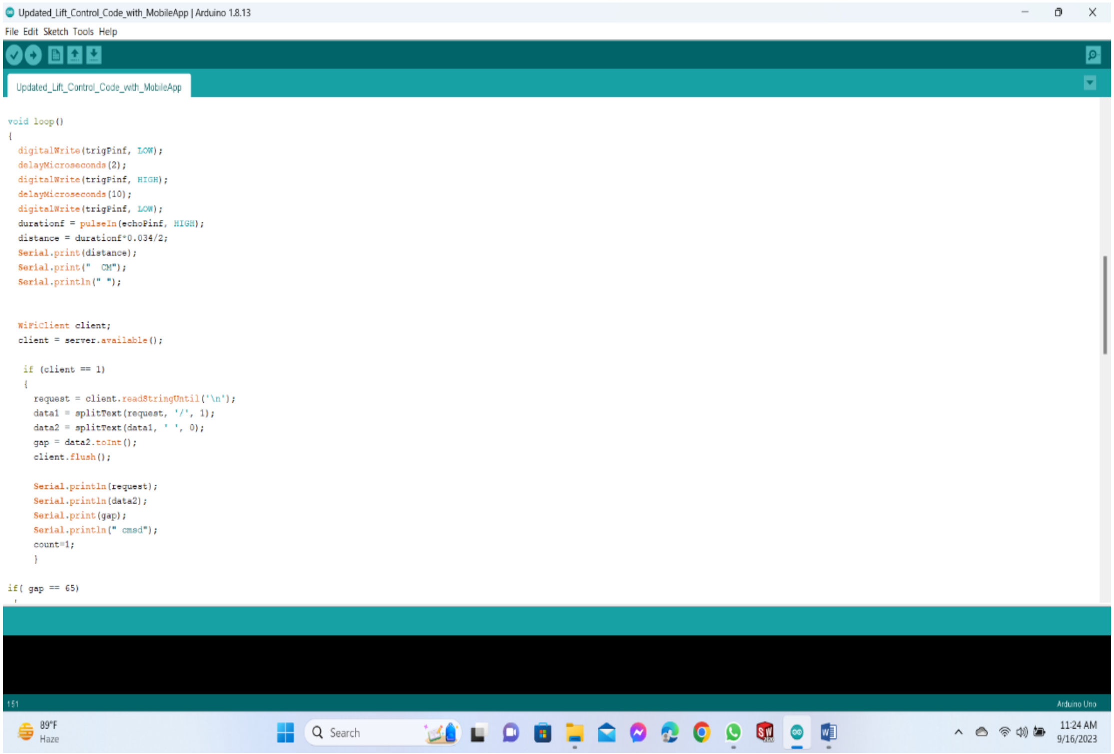


Figure 5.7: Void Loop Function

5.2 Internet of Things

The new paradigm known as the Internet of Things (IoT) has made living more technologically advanced than it was in the past. Smart homes, smart transportation, smart industries, smart libraries, smart pollution control, and strength saving are just a few of the advancements made possible by the Internet of Things. The use of IoT to decorate the time period has been the subject of several significant studies, research initiatives, and investigations. There are still many difficult situations and problems that need to be fixed before IoT may be used to its full potential. It is important to consider these difficult situations and problems from a range of IoT-related perspectives, including applications, difficult situations, enabling technology, social and environmental effects, etc. The item also highlights recent research and demonstrates how it adds to IoT-exclusive features. Additionally, the significance of vast amounts of data and how to assess them in the context of the Internet of Things have been discussed. This article may help readers and researchers better comprehend the Internet of Things and its potential applications in practical settings. IoT is gradually becoming an essential part of our lives that is evident everywhere. The

Internet of Things (IoT) is a collective creation that combines large systems, smart frameworks, and intelligent gadgets and sensors. Additionally, it makes use of quantum and nanotechnology to reach previously unachievable levels of storage, sensing, and processing speed. With the growing involvement of IoT devices and the technology in daily ordinary lives, a remarkable transformation may be observed.Another essential IoT component is a Smart Health Sensing device (SHSS). The SHSS supports human fitness by means of gadgets and a small intelligent system.To measure and track certain fitness difficulties, health condition, the amount of energy spent in the fitness facility, etc., these gadgets may be utilized both indoors and outdoors.Additionally, it is becoming used to identifying urgent fitness circumstances in hospitals and trauma centers. Because of this, it has changed the condition of science in general by making it possible through complex gadgets and modern technology. Furthermore, scholars and IoT developers are always trying to make elderly and disabled people's current attire better. The majority of people are using such devices and systems because they are highly strong in terms of improvement fees and easily available within a daily charge budget.

5.3 Firebase

5.3.1 Using Firebase Functionalities in an Android App

All of Firebase's features may be used by the Android application with just a few lines of code. Topics including databases, storage, and authentication have all been discussed in this section. To learn more about the capabilities, click the link to the Google Firebase handbook in the reference section. This is how to use a few of the features.

5.3.2 Verification

The user can generate a login ID by using the following code once Firebase and authentication dependencies have been added to the Android application.

```
FirebaseAuthauth=FirebaseAuth.getInstance();

Auth.signInWithEmailAndPassword(email,password).addOnCompleteListener(new
OnCompleteListener())

{
```

```
@override

Public Void Oncomplete (task Task)

{ if(task.isSuccessful()) {Firebaseuser User=task.getResult().getResult().getUser();

String email=User.getemail();

//…

}}
```

5.4 Developing Apps

We developed an application to monitor this project.It is an Android application.Using this application is simple. This app was developed using the MIT App Inventor framework.Anyone can develop completely working programs for Android and iOS tablets, as well as iPhones and Android phones, using its intuitive graphical programming environment.Block-based coding programs foster people's intelligence and inventiveness.The four parking spots shown in this app are as follows. It is now in final beta testing as of July 8, 2019.It enables non-programmers to develop apps for Android and iOS, two operating systems (OS). It is free and open-source software, with the source code licensed under a Creative Commons Attribution ShareAlike 3.0 Unported license and the rest of the application under an Apache License 2.0. Users can now create Android apps by dragging and dropping visual objects into a graphical user interface (GUI) that resembles the programming languages Scratch and StarLogo. Work is ongoing on an App-Inventor Companion, which would enable the app to run and debug on iOS devices.

Many different programming languages are used by App Inventor. A new programming language called "App Inventor Language" was developed by MIT App Inventor 2 blocks code. It has not yet been given a name.We're working on a textual version of this language called TAIL, or Textual App Inventor Language.

Many users will find this difficult to comprehend, yet the block code you see on your screen *is* your language's source code. When you save an. aia file (which is just a.zip file), the blocks are saved in an XML textual format that represents the same nested tree structure as the blocks on your screen. So, if you like to think of text as source code, this XML format is the App Inventor program's source code.

5.4.1 MIT App Inventor

A drag-and-drop interactive programming tool called MIT App Inventor may be used to create fully working Android mobile applications. App Inventor promotes a new type of private cell computing that allows people to design, create, and use—in my view—significant cell generation solutions for their daily lives in many circumstances. App Inventor promotes universal virtual literacy by allowing developers to concentrate on making informed programming decisions rather than coding language syntax thanks to its simple programming paradigm and progressive development features. Since it was moved from Google to MIT, certain improvements have been made, and research projects have started.

5.4.2 Drag and Drop Setup of the App

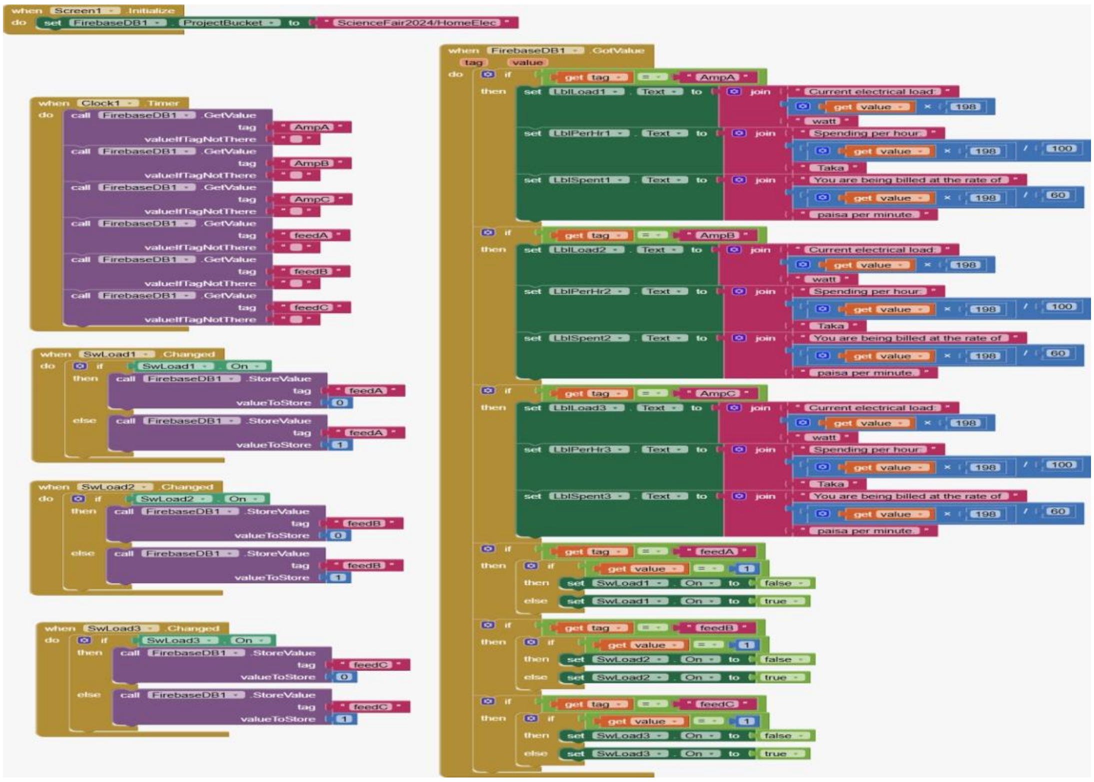


Figure 5.8: Drag and Drop code window

Before starting our major project, we created a few simple apps in App Inventor. The code and output part for the compass are seen above. The purpose of this block program is to inspect or create user-facing elevator buttons. This is linked by a microcontroller to the database.

5.4.3 Front Page Design

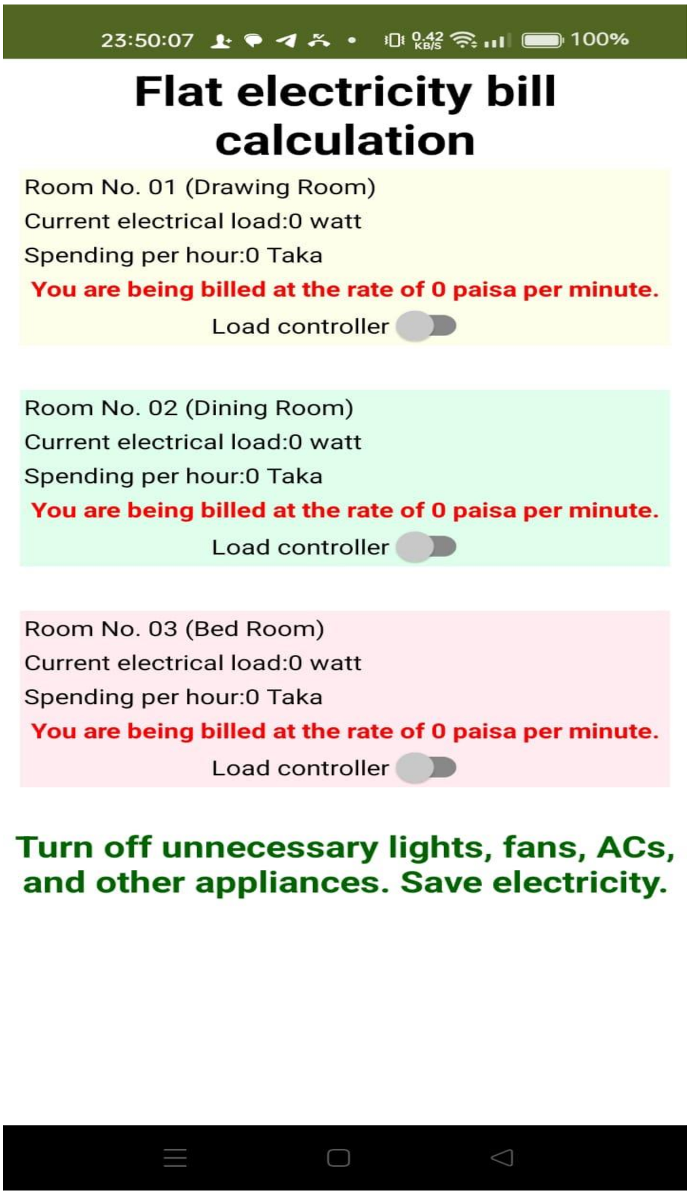


Figure 5.9: Screen View

All three loads are controlled from this page. We see all three loads are off conditions.

CHAPTER 6

RESULT AND DISCUSSION

6.1 Pictorial view of the final setup

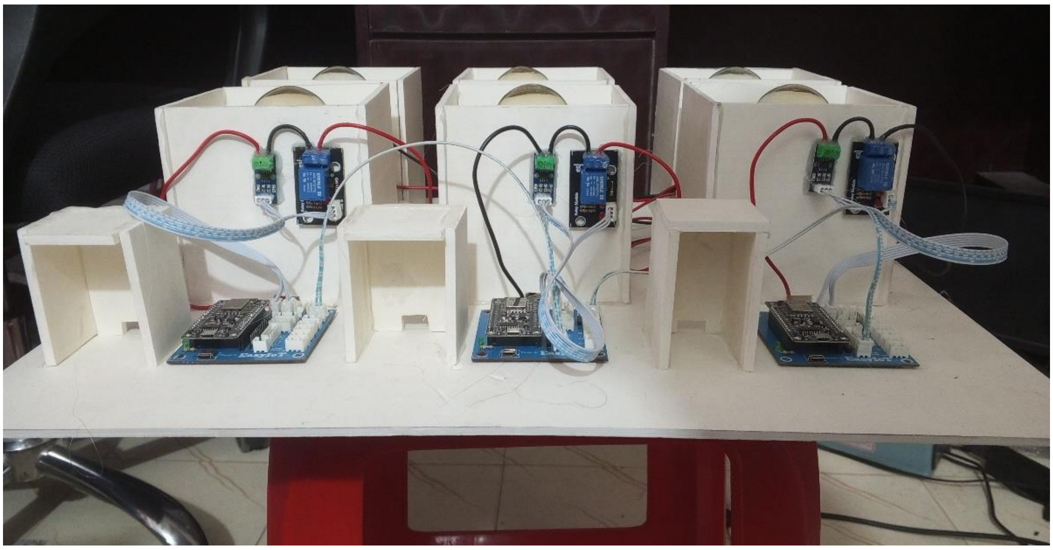


Figure 6.1: Pictorial View of the project

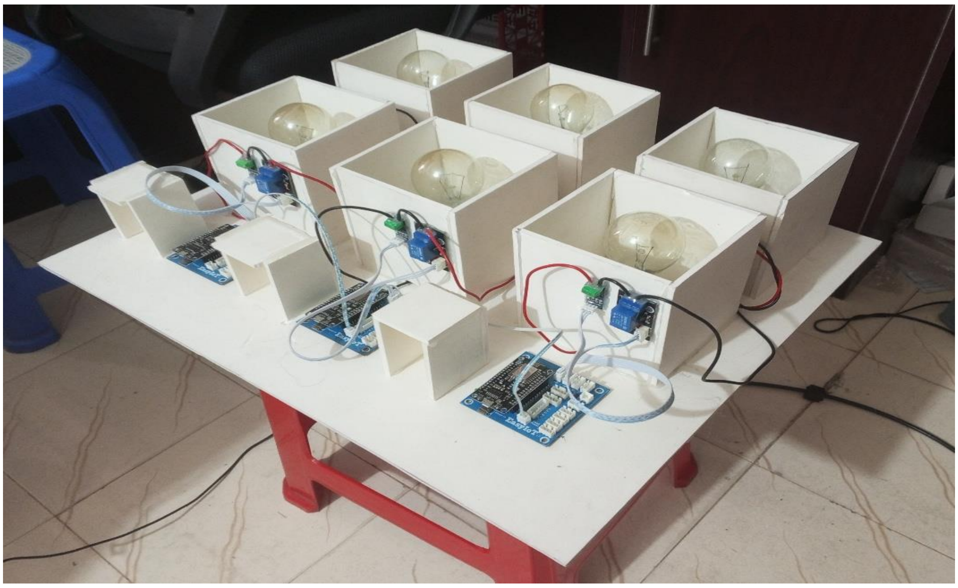


Figure 6.2: Isometric view of the project

The above Figure 6.2 is our final prototype project. Here overload or high current flow is created by switching off the extra load. When we switched it on we saw the specified load was turned on and a saw used to power on mobile phone via the internet. Here may be noted that the load was supplied 220v ac directly.

6.2 Data Calculation

Voltage, V = 220 V

Current, I = Current sensor measured Amp.

We know, 1kWh = 1Unit

Power, P = V*I=220 * .45455 = 100 Watt = .1 KW = .1 kWh = .1 / 60 unit

Here we calculate Per-minute Power Consumption

Electric bill per unit = 6.42 Taka = 642 coins

Electric bill per minute = P * 400 = (.1/60) * 642 = 1.07 coins per minute

6.3 Loads different running conditions

6.3.1 Drawing Room Working Conditions

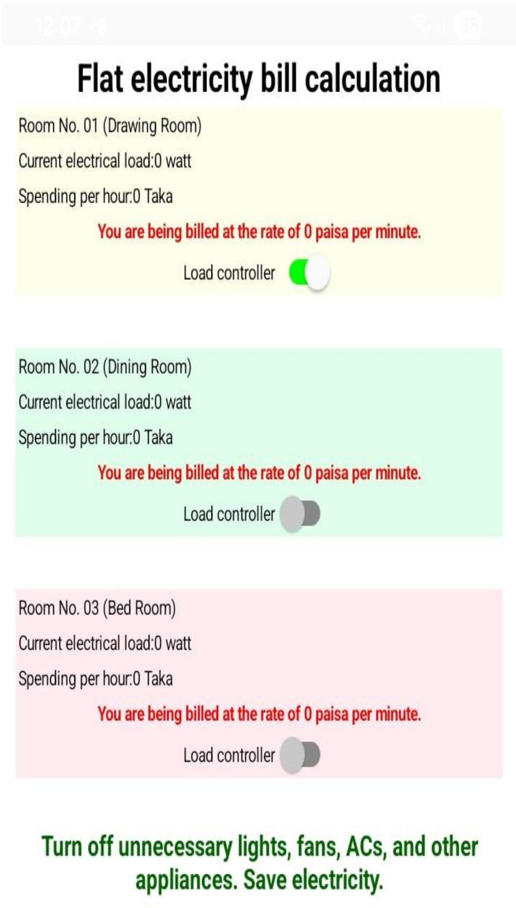


Figure 6.4: Drowing room load on

6.3.2 Dining Room Working Conditions

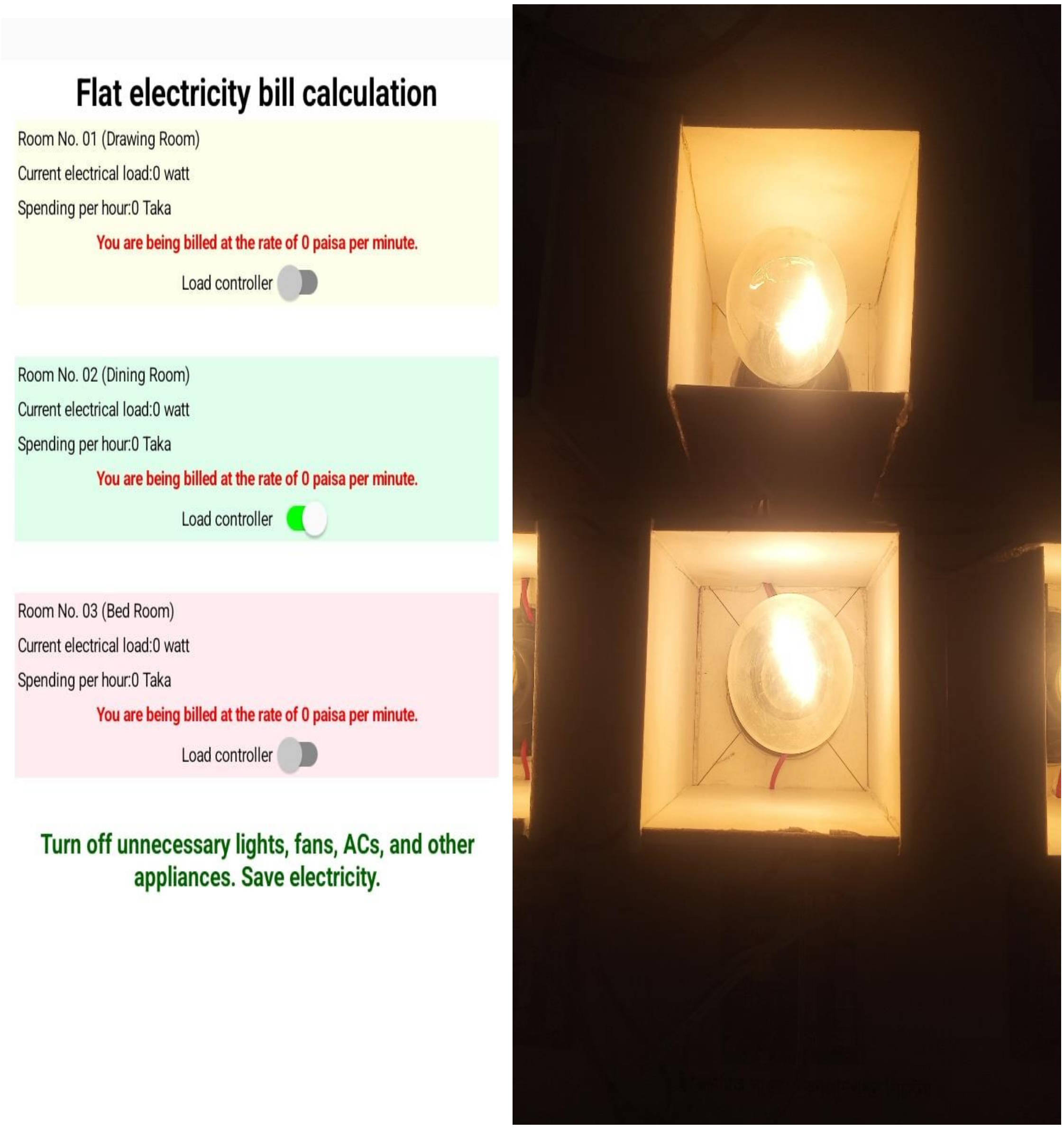


Figure 6.4: Dining room load on

6.3.3 Bedroom Working Conditions

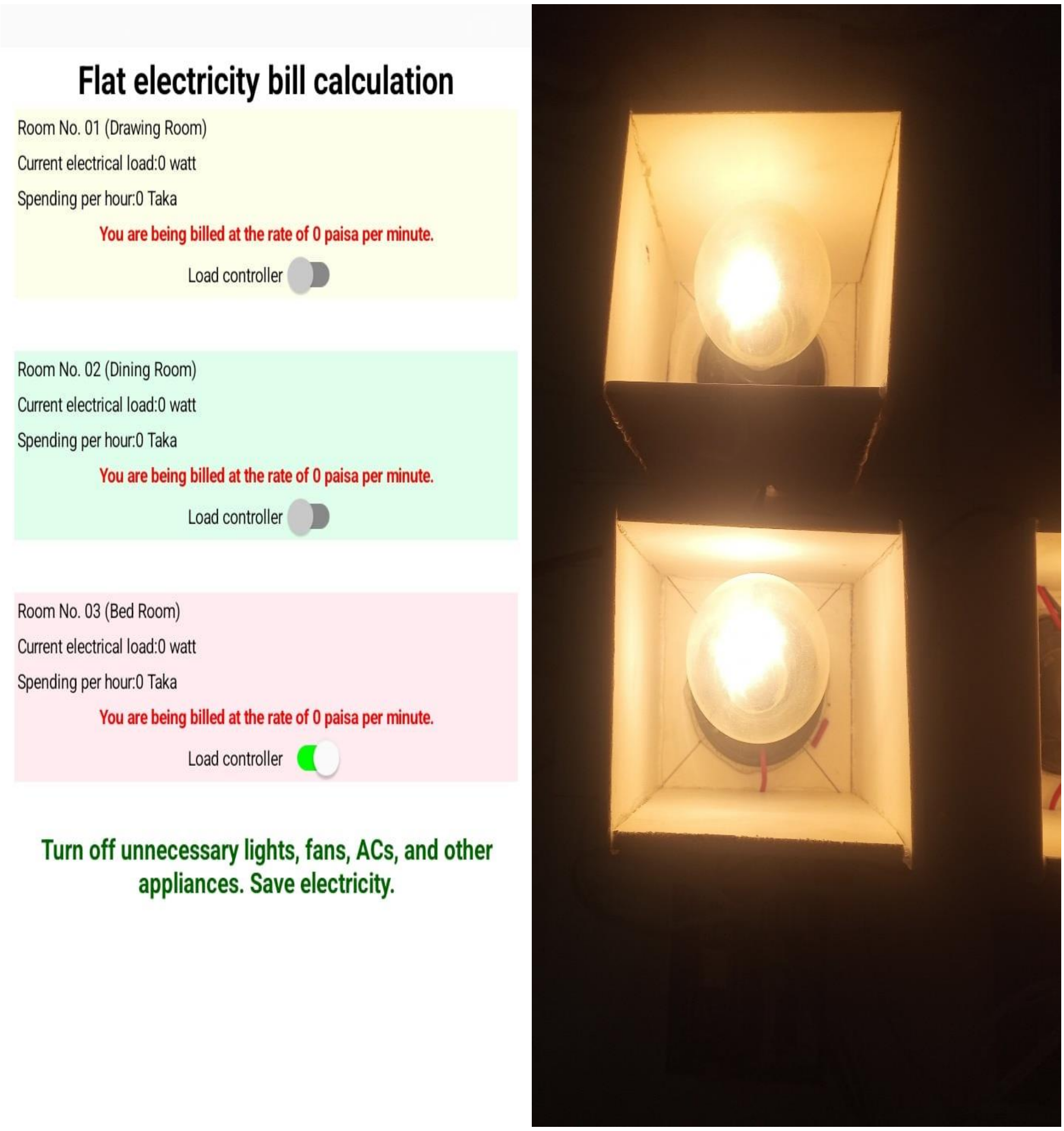
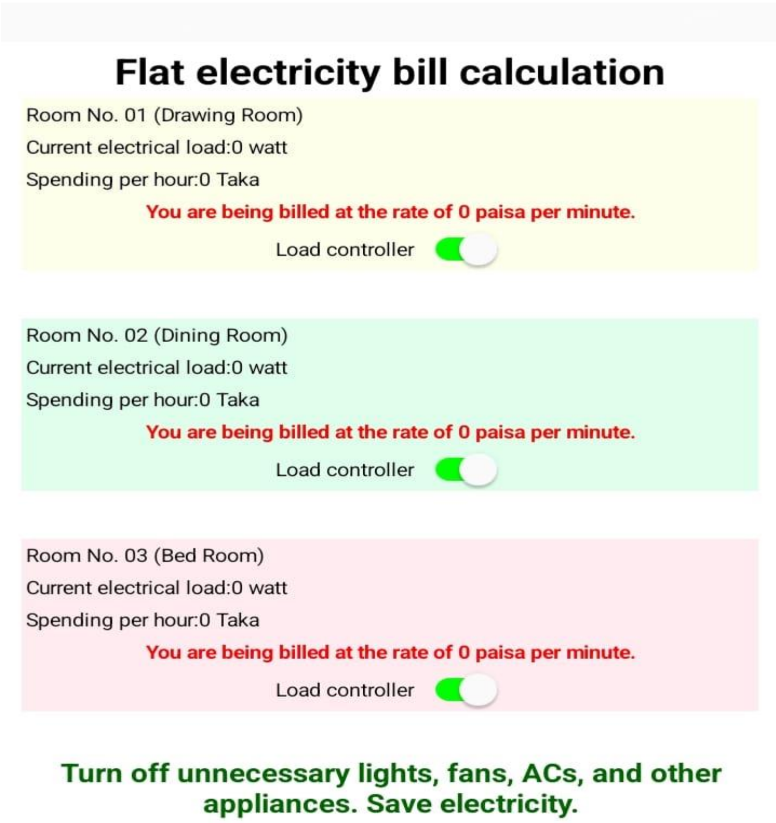


Figure 6.5: Bedroom load on

6.3.4 Dining, Drawing, and Bedroom Together Working Conditions

Figure 6.6: All three loads of the room load on



6.4 Discussion

We must learn how to automatically regulate the load and keep an eye on the various kinds of load for this project. We demonstrated a home management system for three loads in the dining area, bedroom, and drying room in this project. In the entire system, I have employed an ESP-8266 microcontroller, which primary purpose is to serve as both a control unit and a WiFi unit simultaneously. Here, a single-channel relay module is utilized for load switching, and a current sensor is used to detect current. Additionally, an Android app has been created to control all operations and display the unit's power use at all times. The electrical cost and power usage were low when the load was automatically managed.

CHAPTER 7

CONCLUSION AND FUTURE SCOPE

7.1 Conclusion

This prototype is designed to use a mobile device and the internet to control and monitor the room's locations. Relay switches, current sensors, and an ESP-8266 modem make up the system. There is a built-in checking mechanism that activates when a stack uses up current. To determine how much power is being consumed, the Arduino current sensor sends a signal to the database. The microcontroller is then connected to deliver a particular post application program that retrieves data from the database. The mobile device uses the microcontroller input from the app to regulate the signal company load. The ESP-8266 Wi-Fi modem will send a return feedback signal to the Firebase. An Android app has been designed so that the operator may quickly handle the loads from any location without the requirement for any applications. Skilled operator analysts and programmers are not required because the system is not as complicated as a PLC-based SCADA system.

7.2 Future Scope

Our project is not limited to load management and monitoring; it can also be used to monitor and regulate loads in any industry, including residential loads in homes. We will utilize this expansion in a few upcoming apps by including other components into this project. This reach might be expanded by the use of GPRS technology, which enhances the capacity to transmit controlled and validated information to any point on the planet. We just utilize the current sensor in this project to manage the load current; however, a voltage and frequency sensor would be added to control and monitor both voltage and frequency.

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APPENDIX

A. Programming Codes for Proposed Project

```
#include "FirebaseESP8266.h"
#include <ESP8266WiFi.h>


#define FIREBASE_HOST "iot-load.firebaseio.com"
#define FIREBASE_AUTH "Jnq5ikOjpEl0G2atw5Q6oI8wdLUi1UvtixTPQEGj"
#define WIFI_SSID "Elec"
#define WIFI_PASSWORD "12345678"

FirebaseData firebaseData,loadData;
FirebaseJson json;
int Connector=D4;
String Msg="";
int feedA=D0;

const int sensorIn = A0;
int mVperAmp = 100;

double Voltage = 0;
double VRMS = 0;
double AmpsRMS = 0;



float getVPP();

int loadR(String field)
  {
    if (Firebase.getString(loadData, "/ScienceFair2024/HomeElec/"+field))
    {
      return loadData.stringData().toInt();
    }
  }
void setup() {
  // put your setup code here, to run once:
  Serial.begin(9600);
  pinMode(feedA,OUTPUT);
  pinMode(Connector,OUTPUT);
  WiFi.begin(WIFI_SSID, WIFI_PASSWORD);
  Serial.print("Connecting to Wi-Fi");

  while (WiFi.status() != WL_CONNECTED)
  {
    digitalWrite(Connector,1);
```

```
    Serial.print(".");
    delay(200);
    digitalWrite(Connector,0);
    Serial.print(".");
    delay(200);

  }

  Serial.println();
  Serial.print("Connected with IP: ");
  Serial.println(WiFi.localIP());
  Serial.println();
  delay(3000);
  Firebase.begin(FIREBASE_HOST, FIREBASE_AUTH);
  Firebase.reconnectWiFi(true);
}

void loop() {
  // put your main code here, to run repeatedly:
  while (WiFi.status() != WL_CONNECTED)
  {
    digitalWrite(Connector,1);delay(200);
    digitalWrite(Connector,0);delay(200);

  }
digitalWrite(feedA,loadR("feedC"));
        Voltage = getVPP();
        VRMS = (Voltage/2.0) * 0.707; //root 2 is 0.707
        AmpsRMS = (VRMS * 1000)/mVperAmp-0.09;
        if(AmpsRMS>=0.20 && AmpsRMS<=1.50) Msg +=AmpsRMS;
        else Msg +=0.00;
        Serial.print(AmpsRMS);
        Serial.println("Amps RMS");
        delay(50);
Firebase.setString(firebaseData, "/ScienceFair2024/HomeElec/AmpC",Msg);
Msg="";
}




float getVPP()
{
float result;
int readValue;
int maxValue = 0;
int minValue = 1024;

uint32_t start_time = millis();
```

```
while((millis()- start_time) < 1000) //sample for 1 Sec
{
readValue = analogRead(sensorIn);
// see if you have a new maxValue
if (readValue > maxValue)
{
maxValue = readValue;
}

if (readValue < minValue)
{
/record the minimum sensor value/
minValue = readValue;
}
}
result = ((maxValue-minValue)* 5.0) / 550.0;
return result;
}
```