A PROJECT REPORT
ON

"DESIGN AND DEVELOPMENT OF ELECTRIC GRID CUT-OFF SYSTEM"

in partial fulfillment of the requirements for the award of the degree of Bachelor of Engineering in Electronics & Telecommunication Engineering

Submitted by

Mrunmay Chichkhede — **Nikhil Patil**

Nilay kanire — **Swaraj Deshmukh**

Rajat Thote — **Aditya Meshram**

Under the guidance of

Dr. AMOL PARDHI
Assistant Professor

Academic Year 2023 -2024

DEPARTMENT OF ELECTRONICS & TELECOMMUNICATION ENGINEERING
ST. VINCENT PALLOTTI
COLLEGE OF ENGINEERING AND TECHNOLOGY
Wardha Road, Gavsi Manapur, Nagpur-441108

CERTIFICATE

This is to certify that, this project report titled **"Design And Development Of Electric Grid Cut-Off System "** is the bonafide work of MRUMAY CHICHKHEDE , NIKHIL PATIL , NILAY KANIRE , SWARAJ DESHMUKH, RAJAT THOTE , ADITYA MESHRAM who carried out the project work under my supervision in partial fulfillment of the requirements for the award of the degree of Bachelor of Engineering in Electronics & Telecommunication of Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur.

Date: / /

Dr. AMOL PARDHI
Project Guide

Dr. HARISH RAJURKAR
Head, Dept of E&TC

Mr. SANDEEP SONASKAR
Director, VS Informatics

Mr. KUNAL KHAWASHI
Industry Guide

PRINCIPAL

Academic Year 2023 – 24

ARISE & SHINE

DEPARTMENT OF ELECTRONICS & TELECOMMUNICATION ENGINEERING

ST. VINCENT PALLOTTI
COLLEGE OF ENGINEERING AND TECHNOLOGY
Wardha Road, Gavsi Manapur, Nagpur-441108

CERTIFICATE

This is to certify that Mrunmay Chichkhede (Roll No. 49), Nikhil Patil (Roll No. 50), Nilay kanire (Roll No. 51), Aditya Meshram (Roll No. 34), Rajat Thote (Roll No. 57), Swaraj Deshmukh (Roll No. 65), students of Electronics and Telecommunication Engineering from St. Vincent Pallotti College of Engineering Nagpur completed successfully, the project "Design & Development of Electric Grid Disconnection System For Non-Paying Customers" as per the requirement, under the guidance of Dr.Amol Pardhi, Assistant professor Electronics and Telecommunication Department, St. Vincent Pallotti College of Engineering Nagpur and Mr. Sandeep Sonaskar, Director V S Informatics Pvt. Ltd.

During their 6 months (10 Oct 2023 to 15 April 2024) tenure of project, they were hard working and focused on this project assigned to them and completed on time.

Sandeep Sonaskar
Director
V S Informatics Pvt Ltd
27 April 2024

DESIGN AND DEVELOPMENT OF ELECTRIC GRID CUT-OFF SYSTEM

TABLE OF CONTENTS

I. LIST OF TABLES

II. LIST OF FIGURES

III. ACKNOWLEDGMENT

Our Mega project is titled **"Automated Electric Grid Cutoff System For Non-Paid Customer"**. Any project requires a lot of hard work, sincerity and systematic work methodologies. We express our deepest gratitude to our project guide, **Dr.Amol Pardhi,** for giving us an opportunity to be a part of this exciting project and guiding us in every step of the project.

We would also like to thank **Dr. HARISH RAJURKAR, Head of the department of Electronics and Telecommunication Engineering** and all our faculty members who regularly evaluated our project and pointed out the shortcomings in the project. They also gave us the important feedback for the further improvement of our project. We are highly indebted to them.

Mrunmay Chichkhede

Nilay Kanire

Nikhil Patil

Aditya Meshram

Rajat Thote

Swaraj Deshmukh

IV. ABSTRACT

In the present era, concurrent with the evolution of the Internet, the topic of automation has emerged as a captivating subject for discussion. This document explores the creation of an automated system designed for the disconnection of residential electricity, utilizing a network-based embedded controller. Currently, widespread discussions center around the challenges faced by governments in managing electricity-related issues. Given this context, there is a distinct incentive to develop an automated system for residential electricity management .The proposed system comprises an embedded device tasked with regulating the power supply main switch and updating pertinent data within a centralized data center. To alert users about impending electricity cutoff the system employs GSM and short message services for transmitting warning messages. This technological solution not only aids in curbing electricity consumption but also assists electricity providers in mitigating operational costs by automatically disconnecting electricity when usage exceeds predefined limits. In certain regions, there exists a subset of consumers identified as non-bill paying individuals who deliberately avoid settling their electricity bills. Faced with these challenges, some residents resort to illicit activities, such as tampering with meter connections or attempting to resolve issues through bribery when officials from the electricity board visit for disconnection. This misconduct contributes to instances of electricity power theft. Consequently, the proposed project aims to support governmental initiatives by ensuring timely bill payments, thereby enhancing revenue collection.

CHAPTER 1: INTRODUCTION

1. INTRODUCTION

In the current era, alongside the Internet's advancement, the subject of automation has become a compelling topic for discussion. This undertaking focuses on the creation of an automation system designed for residential electricity cutoffs, employing a network-based embedded controller. The prevailing discourse centers around the challenges faced by governments in managing electricity issues. Given this context, there is an external motivation to develop an automated system for residential electricity devices. The system comprises an embedded device responsible for managing the power supply main switch and updating relevant data in a centralized data center .Users receive cutoff warning messages through GSM and short message services. This system proves advantageous for electricity providers, aiding in the reduction of operational costs by automatically disconnecting electricity when usage limits are surpassed. In certain regions, there is a significant issue with consumers who intentionally neglect to pay their electricity bills. When officials from the electricity provider visit these sites for disconnection, some consumers attempt to tamper with meter connections, while others seek resolution through bribery.

This scenario contributes to instances of electricity power theft. Consequently, this project serves the government's interests by promoting timely bill payments, ensuring profitability, and addressing electricity power theft issues. Electricity utilities face considerable revenue loss each year due to energy power theft, leading to power supply shortages for residential and commercial premises. The project's objective is to design and implement a system that automatically disconnects electricity directly from the pole for consumers failing to pay bills on time. When officials arrive to disconnect the supply, some consumers engage in disputes and attempt to resolve the matter through bribes. Even after disconnection, certain consumers may attempt to bypass the system and connect home appliances directly to the service mains.

To address the aforementioned challenges, a prototype is suggested, incorporating NodeMCU ESP8266 and relays. This system is designed to automatically disconnect electric supply based on instructions from the microcontroller, directly from the pole, targeting consumers who fail to settle electricity bills within a specific timeframe. Additionally, the proposed Smart Energy Controlling System is positioned to combat power theft, which encompasses various methods such as direct line tapping, meter by passing, injection of foreign elements into the energy.

Furthermore, the cost-effectiveness of this system is highlighted, ensuring economic viability without compromising on functionality and accuracy. The paper introduces the concept of automated billing for energy meters, akin to a postpaid mobile connection. The user-friendly front end of the proposed system

allows individuals with minimal computer knowledge to operate the software and remotely access meter readings from an office setting. This feature proves valuable for billing purposes within electricity board authorities. To facilitate communication, a GSM modem is integrated with each energy meter, each equipped with its own SIM card, resembling a typical mobile phone SIM.

CHAPTER 2: LITERATURE SURVEY

2. LITERATURE SURVEY.

The Internet of Things (IoT) has dramatically transformed how we interact with and manage electrical devices in both domestic and industrial environments. This literature survey delves into some of the pivotal studies that have explored IoT-based solutions for automated control and monitoring of electrical devices, highlighting the significant advancements and contributions in this field.

One of the earliest and most influential works is the research paper on IoT-based automatic control of electrical devices using a smart switch, published in October 2017 in the International Journal for Research in Applied Science and Engineering Technology (IJRASET). This study proposed a sophisticated system that allowed users to remotely control and monitor electrical devices using IoT technology. The smart switch system was designed to enhance user convenience and promote energy efficiency by providing the ability to manage electrical devices from any location with internet access. This research underscored the potential of IoT to create smarter homes and industries, paving the way for more intuitive and automated control systems.

Another significant study is the research paper on a smart switch designed for connecting and disconnecting electrical devices at home via the internet, published in the International Research Journal of Engineering and Technology (IRJET). This paper introduced a novel smart switch system that not only improved user convenience by enabling remote control over the internet but also facilitated energy-saving practices. The system's ability to allow users to schedule operations and monitor energy usage in real-time made it a valuable tool for efficient energy management. The researchers demonstrated that such systems could significantly reduce energy wastage by ensuring that devices are only operational when needed.

In 2014, Siddarameswara et al. presented a GSM-based electricity identification system for houses and industries. This innovative system aimed to enhance energy management and monitoring by leveraging GSM technology for remote control and monitoring of electricity consumption. By providing real-time data and control capabilities, this system enabled users to better understand and manage their energy usage. The use of GSM technology allowed for widespread applicability, especially in areas where internet connectivity might be limited but GSM coverage is available. This research highlighted the versatility of combining GSM with IoT to create robust and accessible energy management solutions. The system's integration of GSM technology with IoT principles not only improved energy management but also paved the way for more efficient and sustainable practices in both residential and industrial settings.

Siddarameswara et al.'s work underscores the potential of innovative technologies to revolutionize traditional systems.The design and development of a GSM-based energy meter by Abhinandanain et al. in 2012 further advanced the field. Their work focused on creating a cost-effective solution for remote energy meter reading and monitoring. By using GSM technology for data transmission and communication, the researchers developed a system that allowed for accurate and timely tracking of energy consumption. This innovation provided a practical approach to managing energy use, especially in remote or rural areas where traditional meter reading methods are less feasible. The study demonstrated that GSM-based solutions could effectively bridge the gap between users and their energy consumption data, facilitating better energy management practices.

In 2007, Abdollahi et al. proposed an SMS-based reconfigurable automatic meter reading system for control applications. This system aimed to improve the efficiency and accuracy of meter reading by using SMS technology for data transmission and communication. The reconfigurable nature of the system made it adaptable to various application scenarios, enhancing its utility and effectiveness. By using SMS, the system could function in areas with limited internet access but where mobile network coverage was available. This research illustrated the potential of SMS technology to support IoT applications in diverse environments, making automated meter reading more accessible and reliable.

These studies collectively illustrate the profound impact of IoT and related technologies on the control and management of electrical devices. By enabling remote monitoring and control, these innovations have not only enhanced user convenience but also significantly contributed to energy savings and improved efficiency in both residential and industrial settings. The integration of IoT with technologies like GSM and SMS has expanded the reach and applicability of these solutions, demonstrating the potential for widespread adoption and implementation in various contexts.

CHAPTER 3: THEME OF PROJECT

3. THEME OF PROJECT

The theme of the project revolves around leveraging IoT technology to address challenges in residential electricity management, particularly concerning non-paying customers. By integrating smart grid solutions with automation and real-time monitoring, the project aims to modernize electricity distribution systems and promote responsible energy consumption practices.

3.1 PROJECT OBJECTIVES

1] Automated Grid Management: Develop an automated system capable of remotely managing the grid's power supply to disconnect electricity for non-paying customers efficiently.

2] Real-Time Monitoring: Implement real-time monitoring capabilities to track electricity consumption patterns and payment statuses, enabling timely interventions for non-payment issues.

3] Alert Mechanisms: Integrate alert mechanisms such as SMS notifications to inform customers about impending electricity cutoffs due to unpaid bills, fostering proactive action.

4] User-Friendly Interface: Create a user-friendly web interface accessible to both customers and administrators, facilitating easy navigation and interaction with the system.

5] Centralized Data Management: Establish a centralized data management system using MongoDB for secure storage and efficient retrieval of consumer information, enabling quick decision-making.

6] Cost-Effectiveness: Develop a cost-effective solution for electricity providers to streamline revenue collection processes and minimize operational costs associated with manual interventions.

7] Promotion of Responsible Energy Consumption: Raise awareness among consumers about the importance of timely bill payments and responsible energy usage through the implementation of the project's automated features.

3.2 BLOCK DIAGRAM

The Block Diagram of our project focuses on the development and implementation of a smart electrical grid system, specifically the interaction between our website and the microcontroller that controls electricity supply. The block diagram illustrates the process when our website sends information via the internet to the microcontroller .When the website sends a signal "0" to the microcontroller, it triggers a sequence of actions. First, the microcontroller cuts off the electricity supply to the consumer's house using the smart electric panel. This action is crucial for managing electricity consumption and ensuring timely payment from consumers. Additionally, the microcontroller sends a message through the GSM

interface to alert the consumer about the cutoff. This notification serves as a reminder for the consumer to pay their electricity bill and avoid further disruptions.

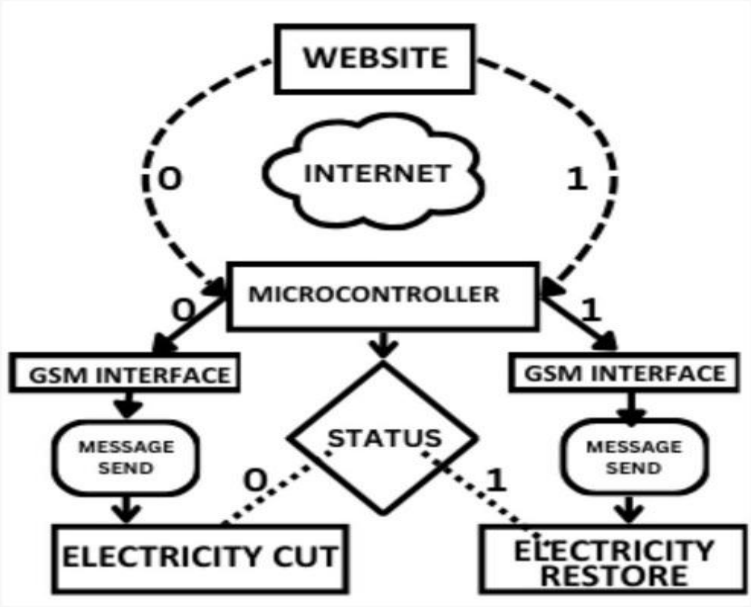


Fig 3.2 - Block Diagram

Conversely, when the website sends a signal "1" to the microcontroller, it initiates a different set of actions. The microcontroller receives the signal and restores the electricity supply to the consumer's house using the smart electric panel. This action is taken once the consumer has made the necessary payment, ensuring uninterrupted electricity supply. Similar to the previous scenario, the microcontroller also sends a message through the GSM interface to confirm the restoration of electricity and provide any additional information the consumer may need.

3.3 CIRCUIT DIAGRAM & EXPLANATION:

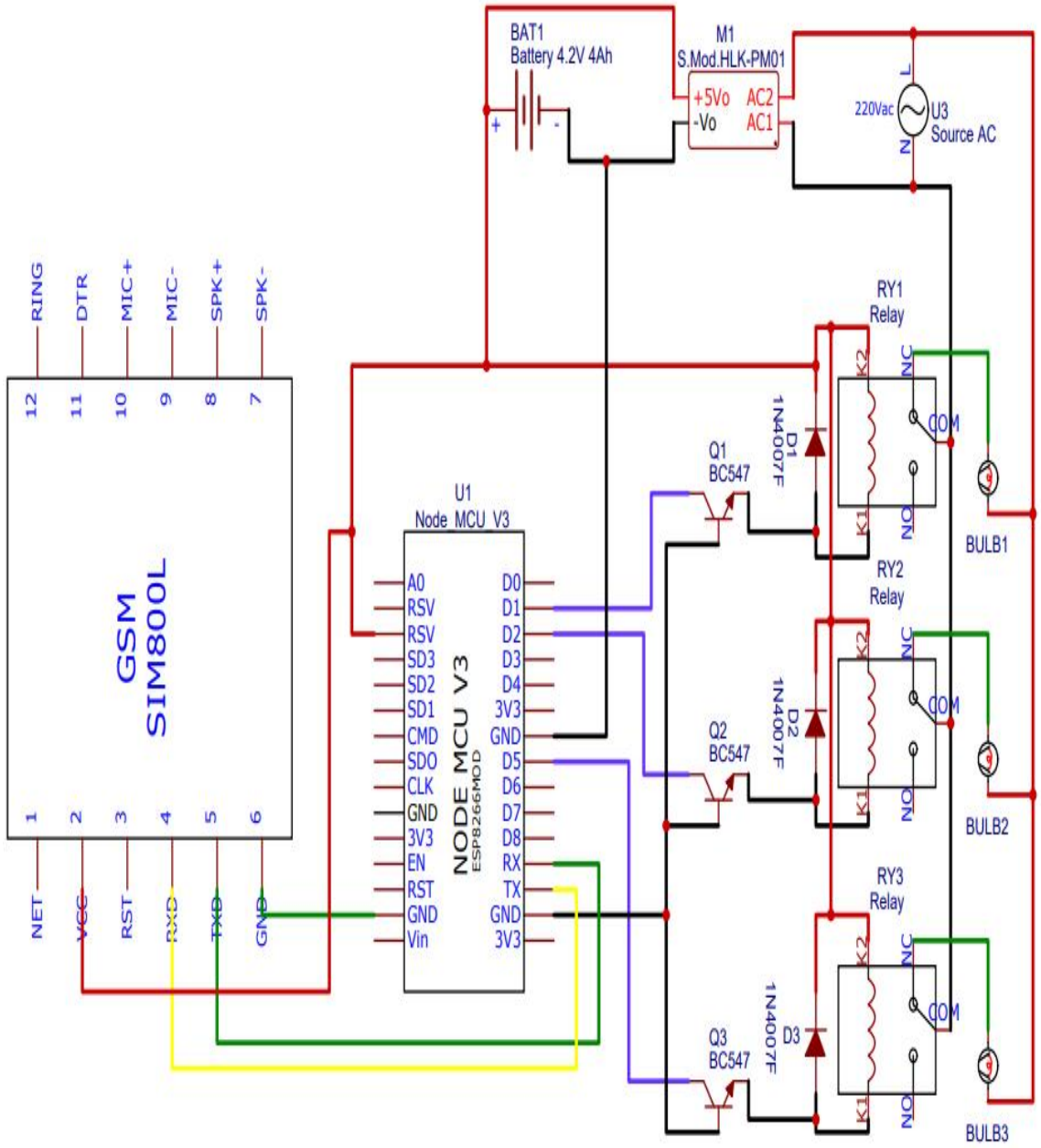


Fig 3.3 – Circuit Diagram

Conventional system includes the electricity meters which are installed at consumer's premises and the electricity consumption information is collected by meter-readers on their fortnightly or monthly visits to the premises. For an Electricity Power theft existing system had energy meters connect on each phase of line. By summation of the energy meter readings they calculate the Energy Power theft. In order to overcome all the drawbacks of conventional system we are designing "IoT Based Grid Cut-Off System for Non-Bill Paid Consumer". The system architecture of Smart energy controlling system consists of

NodeMCU ESP8266, SIM800l and Relays. The energy consumptions was calculated by MSEB person monthly. And if any consumer not pay the bill then the online system will turn OFF the grid and SMS will send to the consumer switching power is through the step down transformer. NodeMCU is wifi for continuous online monitoring. It online monitors the system and also trips the circuit via relay after getting signal command through NodeMCU. SPDT relay will disconnect and reconnect the supply as per the microcontroller's instruction .When the consumer fails to pay a electricity bill after a given period the NodeMCU will automatically disconnect the supply of that particular consumer through relays and when the consumer pays the electricity bill it will reconnect the supply of that particular consumer. Basically a circuit will be fitted i.e. System in consumers home so from that we will acquire data and after acquiring we will upload/update the data on cloud service so that owner of smart grid (MSEB) and customer can access that data. The system consist of Esp8266 module which is a microcontroller and it controls the whole system. The system is connected in between the Mains Line and the Home incoming supply to the energy meter. In the circuit, we give 230V supply as AC input to meter. Input part and Output part of meter each have one phase and one neutral port this output phase wire connected to load (bulb) through relay. Relay by default is in close condition. Circuit starts working when relay is in close condition.

Chapter 4: IMPLEMENTATION

4. IMPLEMENTATION

4.1 SOFTWARE ASPECTS

The software involves the integration of various technologies and frameworks to create a comprehensive platform for managing and controlling electricity supply. MongoDB is utilized for securely storing consumer and employee data, providing a reliable database management system. Express.js and Node.js power the backend of the platform, ensuring efficient performance and handling server-side operations. These technologies enable the creation of RESTful APIs and facilitate communication between different components of the system. Additionally, HTML, CSS, JavaScript, and EJS are employed for frontend development, ensuring a user-friendly interface for consumers and employees to interact with the system. Authentication and authorization mechanisms are implemented to ensure that only authorized users can access and manipulate data, enhancing security and preventing unauthorized access. Furthermore, integration with IoT devices via ThingSpeak allows for real-time data retrieval and monitoring of electricity usage. The platform also utilizes the Google Email API for communication, sending alert messages to consumers to remind them of pending electricity bills. Overall, the software methodology focuses on leveraging modern web development technologies and frameworks to build a robust, secure, and user-friendly platform for managing electricity supply effectively.

4.1.1 ARDUINO IDE:

The Arduino Integrated Development Environment (IDE) is a comprehensive programming environment that allows users to draft, compile, and upload programs to the ESP8266 microcontroller. It simplifies the development process for both beginners and experienced programmers by providing an easy-to-use interface and a straightforward programming language based on Processing, which itself is built on Java. This user-friendly language abstracts many of the complexities of traditional programming languages, making it accessible to a broader audience.When a user writes code in the Arduino IDE, the environment compiles and translates the code into assembler language, which the microcontroller can understand. The built-in code parser checks the code for errors, ensuring that any issues are identified and corrected before the code is uploaded to the microcontroller. This parser is an essential tool for catching syntax errors and other common programming mistakes, which helps prevent issues during the upload process.

The Arduino IDE also includes a variety of example programs, known as sketches, which are pre-written and ready to be tested on the device. These examples cover a wide range of applications and serve as a valuable

resource for learning and experimentation. Users can modify these examples to suit their needs or use them as a foundation for their projects.

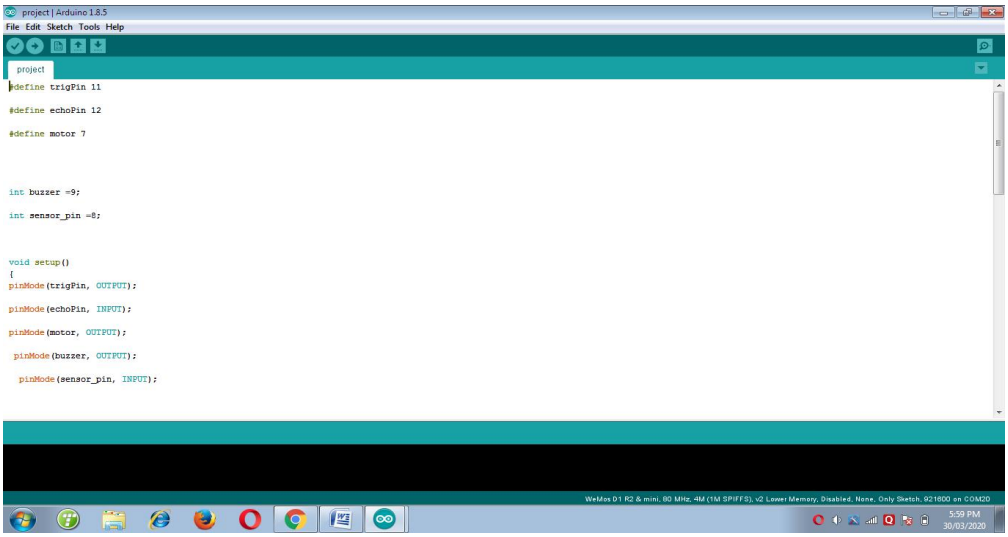


Fig 4.1. – Arduino IDE

Arduino IDE is programming environment that allows the user to draft different kind of programs and load them into the ESP8266 microcontroller. Arduino uses user-friendly programming language, which is based on programming language called Processing. After the user has written his code, IDE compiles and translates the code to the assembler language. After translating the code, the IDE uploads the program to the ESP8266 microcontroller. Arduino IDE has a built-in code parser that will check the user written code before sending it to the Arduino. IDE software includes the set of different kind of programs that are ready to be tested on the device. After testing the program, it can be uploaded to the ESP8266 by USB cable that varies in different models The Arduino Programming Language is basically a framework built on top of C++.The main difference from “normal” C or C++ is that you wrap all your code into 2 main functions. You can have more than 2, of course, but any Arduino program must provide at least those 2.One is called setup (), the other is called loop (). The first is called once, when the program starts, the second is repeatedly called while your program is running. We don’t have a main () function like you are used to in C/C++ as the entry point for a program. Once you compile your sketch, the IDE will make sure the end result is a correct C++ program and will basically add the missing glue by preprocessing it.Everything else is normal C++ code, and as C++ is a superset of C.

Installing the NodeMCU ESP8266 Board:

To install the board in your Arduino IDE, follow these next instructions:

1. Open the preferences window from the Arduino IDE. Go to File > Preferences.

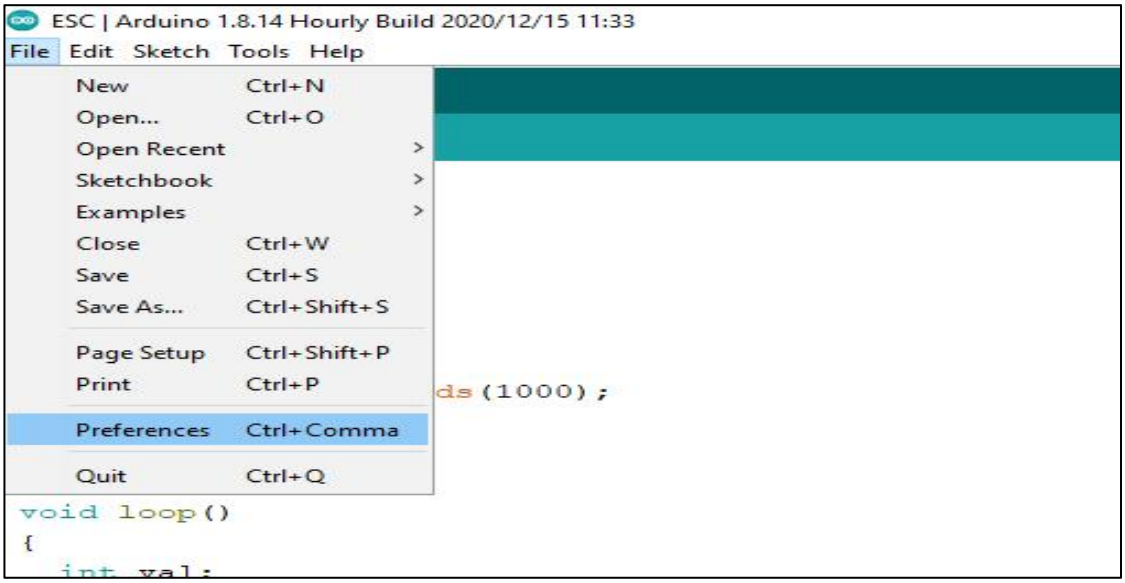


Fig 4.2 - Preferences Window

2. Enter http://arduino.esp8266.com/stable/package_esp8266com_index.json into the "Additional Board Manager URLs" field as shown in the figure below. Then, click the "OK" button.

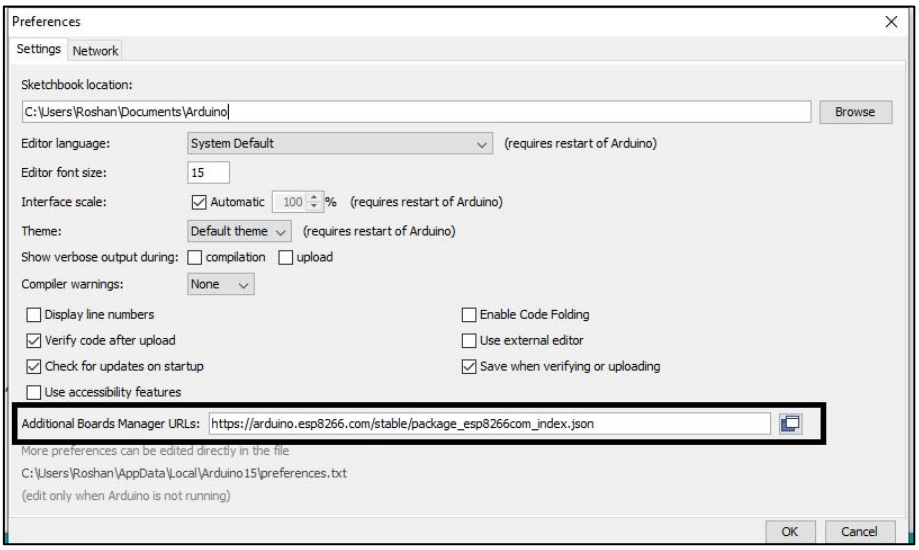


Fig 4.3 - Additional Board Manager URLs

3. Open board's manager. Go to Tools > Board > Boards Manager

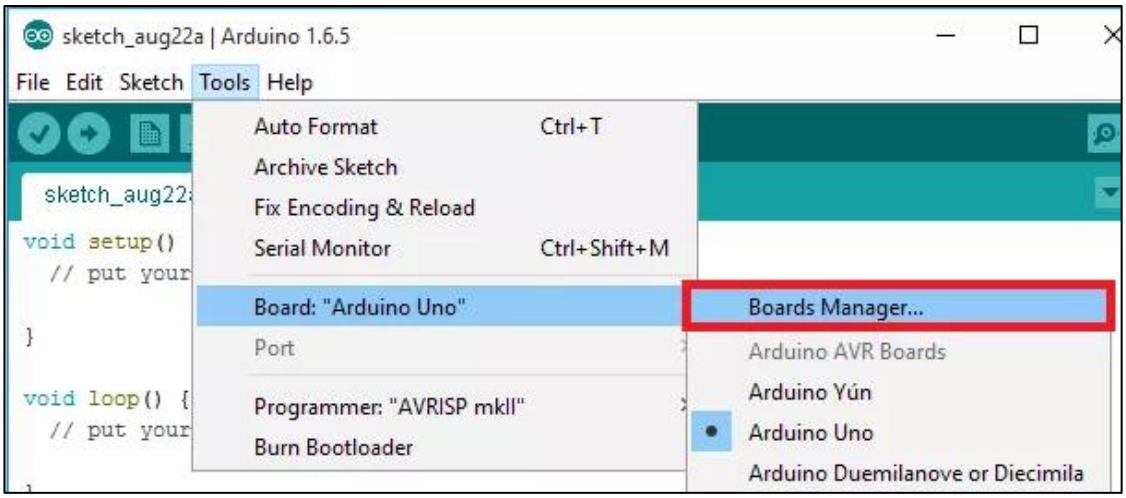


Fig 4.4 - Board Manager

4. Type Nodemcu in box and select it and Install

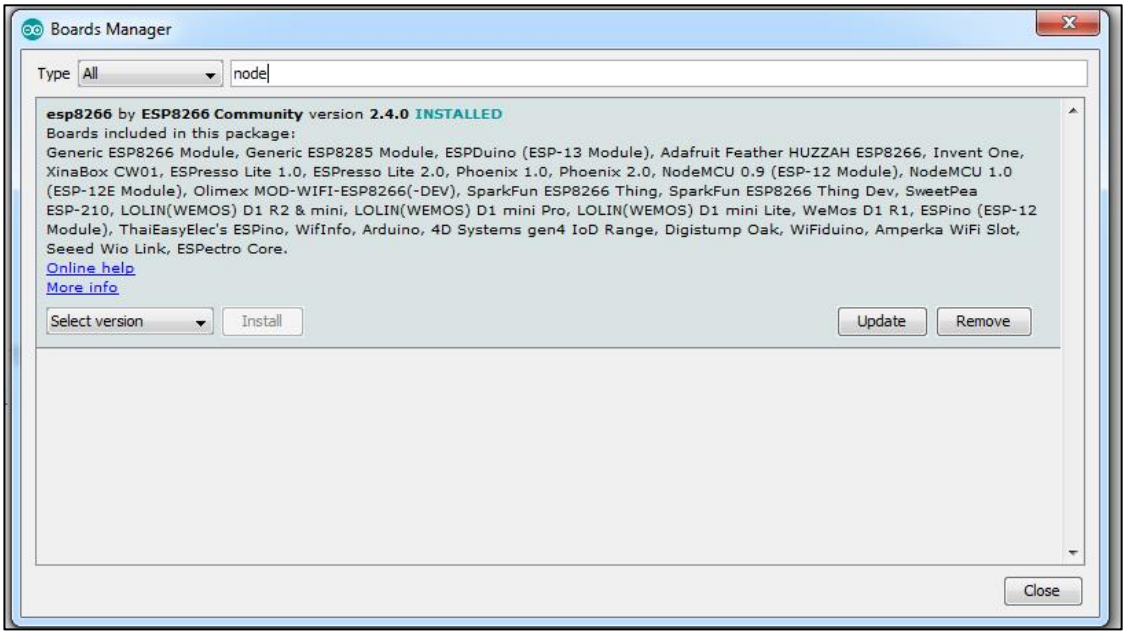


Fig 4.5 - NodeMCU Board Install

5. Wait till Finish the installation then close the IDE and restart PC

4.1.2 EASYEDA:

EasyEDA is a web-based EDA tool suite that enables hardware engineers to design simulate, share-publicly and privately and discuss schematics, simulations and printed circuit boards. Other features include the creation of a bill of materials, Gerber files and pick and place files and documentary outputs in PDF, PNG and SVG formats. EasyEDA allows the creation and editing of schematic diagrams, SPICE simulation of mixed analogue and digital circuits and the creation and editing of printed circuit board layouts and, optionally, the manufacture of printed circuit boards.

Fig 4.6 - EasyEDA Logo

EasyEDA is an integrated browser-based tool for schematic capture, SPICE circuit simulation, based on Ngspice, and PCB layout.

Import from AltiumDesigner, CircuitMaker, Eagle, Kicad and LTspice file formats as well as generic SPICE netlists is supported. SPICE netlists can be exported to third party simulation tools and export of PCB netlists in Altium, PADS and FreePCB formats is also supported. The ability to import LTspice schematics and symbols provides a useful way to port schematics to PCB layout without having to redraw them from scratch.

Once Gerber files of a completed PCB design have been downloaded and checked - using a third party Gerber viewer - the user is free to choose a PCB manufacturer or, for a fee, they can submit the Gerbers directly to EasyEDA for manufacture. Alternatively, printable PCB layer image output is also supported in PDF, PNG and SVG formats for home PCB etching.The tool also includes sharing and collaboration features and a comprehensive parts and an expanding SPICE model library.

4.1.3 VISUAL STUDIO -

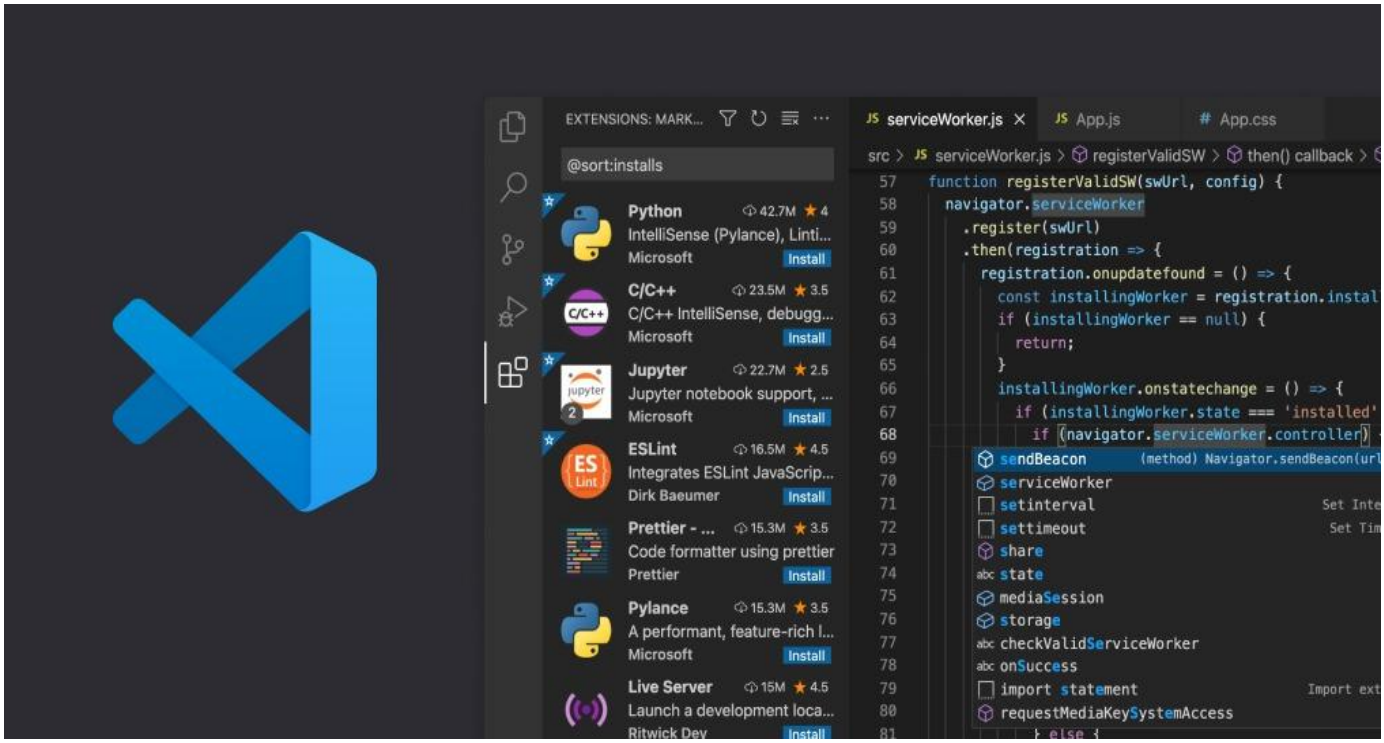


Fig 4.7 – Visual Studio IDE

Visual Studio Code (VS Code), developed by Microsoft, stands as a leading source-code editor revered by developers across diverse platforms. Its widespread adoption owes much to its versatility, performance, and expansive extension ecosystem. Catering to Windows, macOS, and Linux users, VS Code boasts a rich repository of extensions contributed by the community, augmenting its capabilities for various programming languages, frameworks, and development tools. With IntelliSense, developers benefit from intelligent code completion and syntax highlighting, enhancing productivity. Moreover, the built-in debugging support facilitates seamless troubleshooting directly within the editor environment. Integrating with Git, VS Code simplifies version control tasks, offering features like inline diff views and Git commands. Its flexibility extends to customization, allowing users to tailor settings, keybindings, and themes to their workflow preferences. The integrated terminal empowers developers to execute commands and scripts effortlessly, while task running and automation capabilities streamline workflow management. In essence, Visual Studio Code emerges as a preferred choice among developers for its simplicity, performance, and adaptability, serving as an indispensable tool in various development endeavors.

4.1.4 FRONTEND –

a) HTML –

HTML (HyperText Markup Language) is the standard markup language used for creating and structuring web pages and web applications. It provides a set of elements (tags) that define the structure of a webpage, such as headings, paragraphs, images, links, and more. HTML is essential for creating the basic structure and content of a webpage, forming the foundation for web development.

b) CSS –

CSS (Cascading Style Sheets) is used to style and design the appearance of a webpage created with HTML. It allows developers to control the layout, colors, fonts, and other visual aspects of a webpage. CSS works by targeting HTML elements and applying styles to them, either directly in the HTML file or through an external CSS file. This separation of content (HTML) and presentation (CSS) enhances the maintainability and scalability of web projects.

c) JavaScript –

JavaScript is a versatile programming language that is primarily used for adding interactivity and dynamic behavior to web pages. It can manipulate the HTML and CSS of a webpage, respond to user actions (such as clicks and input), and communicate with servers to fetch or send data asynchronously. JavaScript is essential for creating interactive features like form validation, animations, and AJAX requests.

d) Bootstrap –

Bootstrap is a popular front-end framework for building responsive and mobile-first websites and web applications. It provides a collection of CSS and JavaScript components, such as grids, forms, buttons, and navigation bars,that can be easily integrated into a project. Bootstrap helps developers create consistent and visually appealing designs that work well across different devices and screen sizes.

e) EJS –

EJS (Embedded JavaScript): EJS is a templating language that allows developers to generate HTML markup dynamically based on data from the server. It is often used with Node.js and Express.js to create dynamic web pages. EJS enables developers to embed JavaScript code directly into HTML templates, making it easier to generate dynamic content and maintain a clean separation between presentation and logic.

4.1.5 BACKEND –

a) Node.js –

Node.js is a runtime environment that allows developers to run JavaScript code outside the web browser. It is built on the V8 JavaScript engine from Google Chrome and provides a set of libraries for building scalable and high-performance web applications. Node.js uses an event-driven, non-blocking I/O model, making it lightweight and efficient for handling concurrent connections.

b) Express.js –

Express.js is a minimal and flexible Node.js web application framework that provides a robust set of features for building web and mobile applications. It simplifies the process of building server-side logic and handling HTTP requests by providing a simple and intuitive API. Express.js is widely used in conjunction with Node.js to create server-side applications and RESTful APIs.

c) MongoDB –

MongoDB is a NoSQL database that stores data in a flexible, JSON-like format called BSON (Binary JSON). It is known for its scalability, flexibility, and performance, making it suitable for handling large volumes of data and real-time applications. MongoDB is often used in Node.js applications due to its compatibility with JavaScript and its ability to store data in a format that is easy to work with in a Node.js environment.

d) REST API –

REST API (Representational State Transfer Application Programming Interface): A REST API is a set of rules and conventions for building and interacting with web services. It is based on the principles of REST, which emphasize a stateless client-server architecture, uniform interface, and resource-based interactions. REST APIs are designed to be simple, scalable, and easily accessible over the internet.

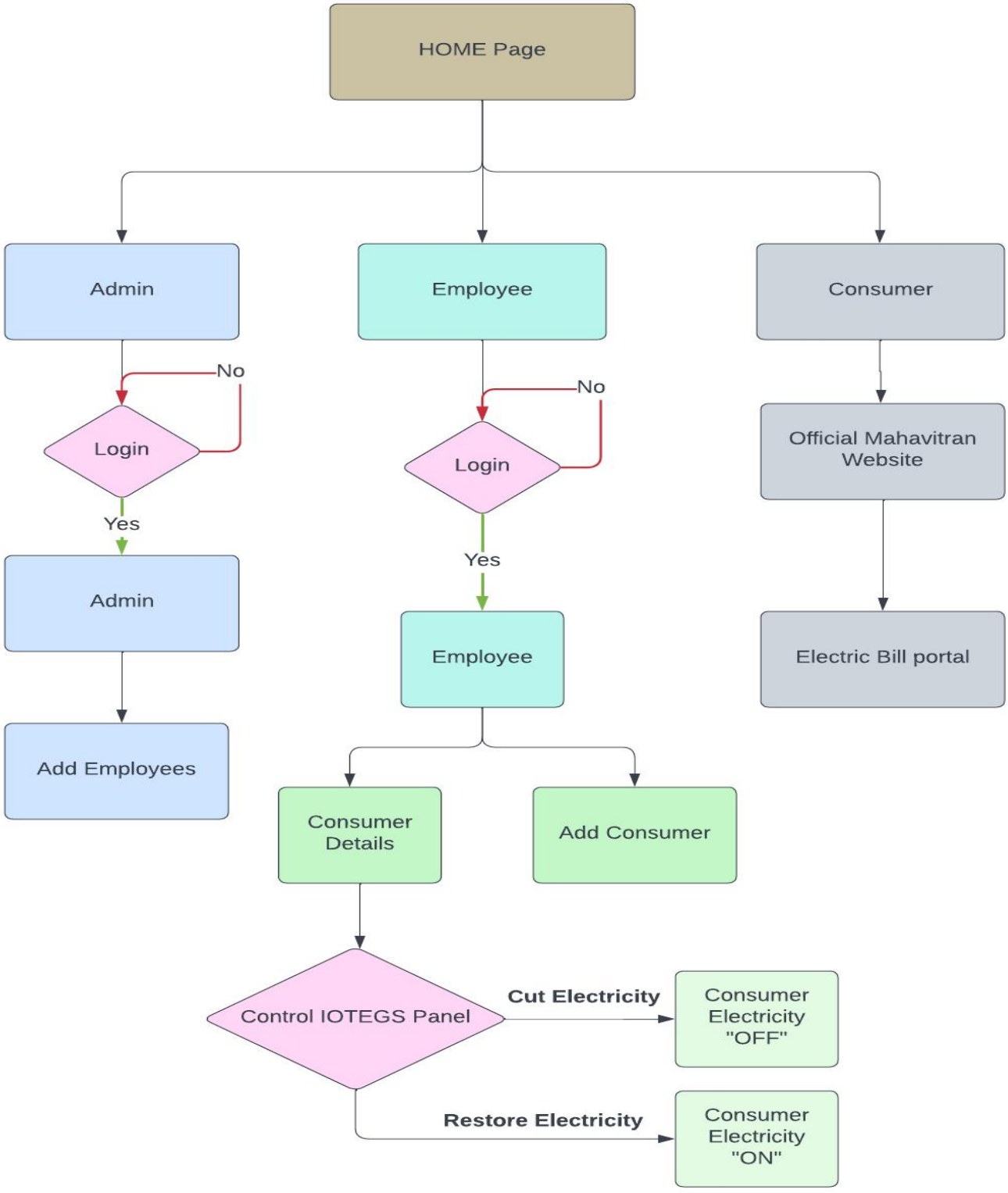


Fig 4.8. Flowchart of Website

Exploring Our Website: User Portals and Functionality :-

Fig 4.9. Website Home-Page

Our website's homepage has three options tailored for different user roles:

1] Admin/Developer Portal: This section is likely designed for administrators or developers who have special privileges or access rights. It's restricted to authorized members only, indicating that users need specific credentials or permissions to access this portal. This area include tools, resources, or functionalities for managing the website, its content, or its underlying infrastructure.

2] Consumer Portal: This option aimed at general consumers or users who want to interact with our website for specific purposes, such as making payments. The message "Pay Bill Here!" suggests that users can use this portal to complete billing transactions or manage their accounts.

3] Employee Portal: Similar to the Admin/Developer Portal, this section is restricted to authorized members, likely employees of our organization. It may provide access to internal resources, tools, or information relevant to employees' roles or responsibilities within the company.

Each of these options cater to different user groups with distinct needs or permissions levels.

Navigation and Functionality: A Guide to Our Website's Sidebar Options :-

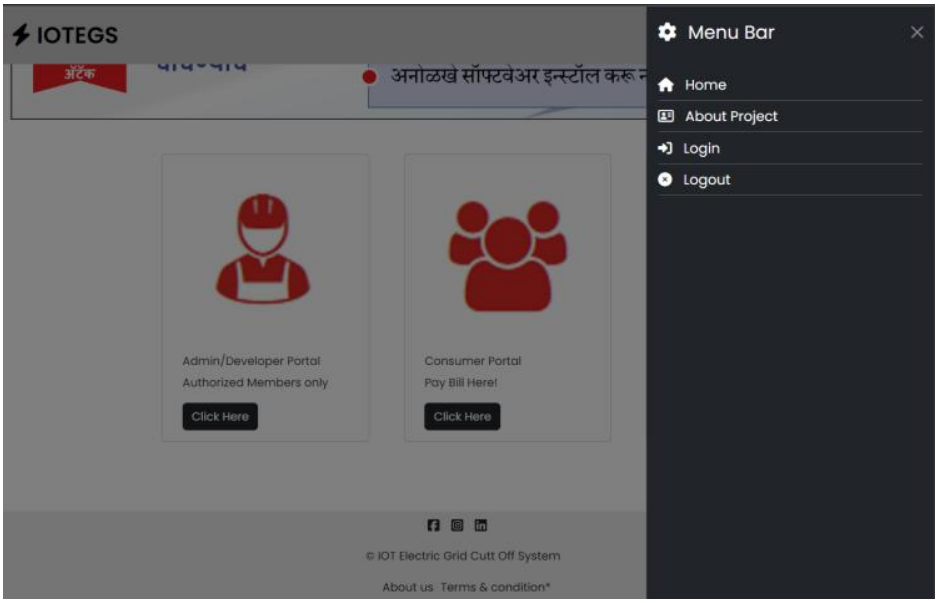


fig 4.10. Navigation Bar

1] Home: This option typically serves as a shortcut to the homepage of our website. Clicking on "Home" would take users back to the main landing page, providing easy access to the starting point of our website's content or functionality.

2] About Project: This option directs users to a page that provides information about the team members and mentor involved in our project.

3] Login: The "Login" option allows users to access their accounts or profiles on your website. By clicking on "Login," users can enter their credentials (such as username and password) to gain access to restricted content, personalized features, or account-specific functionalities. This is particularly important for portals that require user authentication, such as the Admin/Developer Portal and the Employee Portal mentioned earlier.

4] Log Out: This option is typically displayed when a user is already logged into their account. Clicking on "Log Out" terminates the current session, effectively logging the user out of their account. It's essential for ensuring user privacy and security by ending access to account-specific features and preventing unauthorized access to the user's account in case they're accessing the website from a shared or public device.

These sidebar options provide users with convenient navigation and access to essential functionalities, enhancing their overall experience and usability of your website.

I] <u>Steps to follow for "Admin/Developer" portal</u> :-

1. Go to the website Homepage through the given link :- https://mahavitran-pro.onrender.com/home

2. For the "Admin/Developer" role :

User click on the "Admin/Developer Portal Authorized Members only" option from the homepage.

Fig 4.11. Admin/Developer portal button

3. "Admin/Developer portal" login page :-

After clicking on the Admin/Developer Portal option, users are redirected to a login page.

Here, users must input their login credentials, including a username and password.

If the entered credentials are incorrect, access will be denied, and an appropriate error message may be displayed.

If the credentials are correct, the user proceeds to the next page.

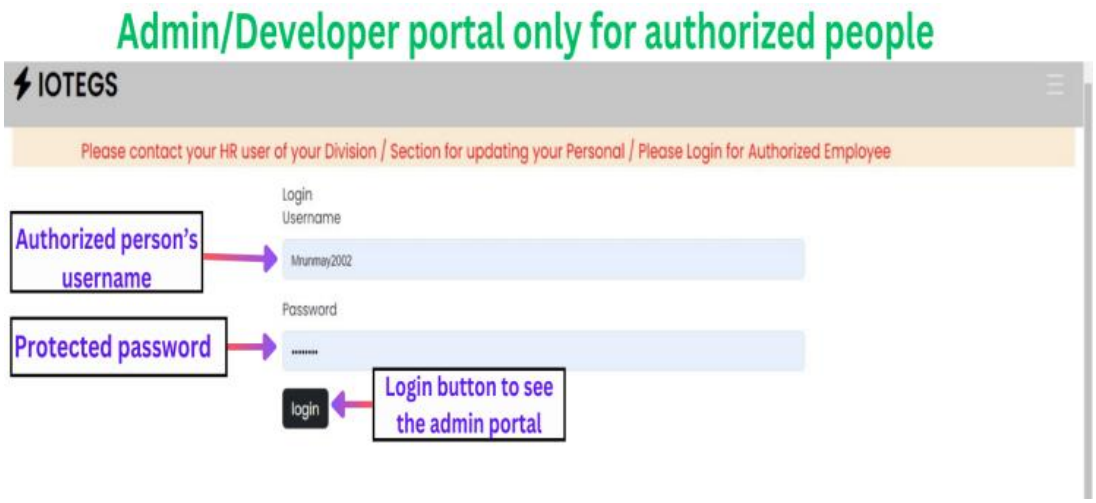


Fig 4.12. Admin/Developer portal login page

4. Upon successful login, users are directed to the admin dashboard :-

The admin dashboard provides various options and functionalities for managing administrative tasks.

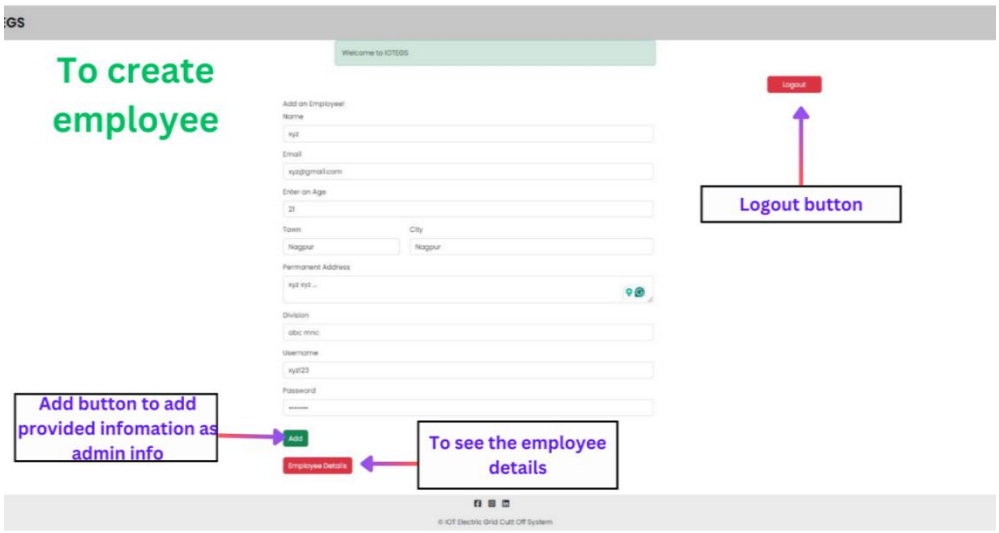


Fig 4.13. Admin portal -> Dashboard

5. The admin dashboard include options such as "Log Out", “Add Employee” and "Employee Details" :-

These options allow admin to perform specific actions or navigate to different sections of the admin portal.

i] Log Out Functionality :-

The "Log Out" button allows users to securely log out of their current session.

Clicking on this button terminates the user's session and revokes their access to the admin portal.

ii] Add Employee Form :-

The admin portal contain form for adding new employees to the system.

Admin can access this form by navigating to a page within the admin portal.

The form includes fields for entering details about the new employee, such as name, email, age, address, division, username, and password.

Once admin fill out the required fields in the add employee form, they can submit the form.

Upon submission, the system processes the information and adds the new employee to the database.

After successfully adding a new employee, users may be redirected to a confirmation page or shown a success message.

This confirms that the employee has been added to the system successfully.

iii] Employee Details Page:

Users can click on the "Employee Details" button to view information about existing employees.

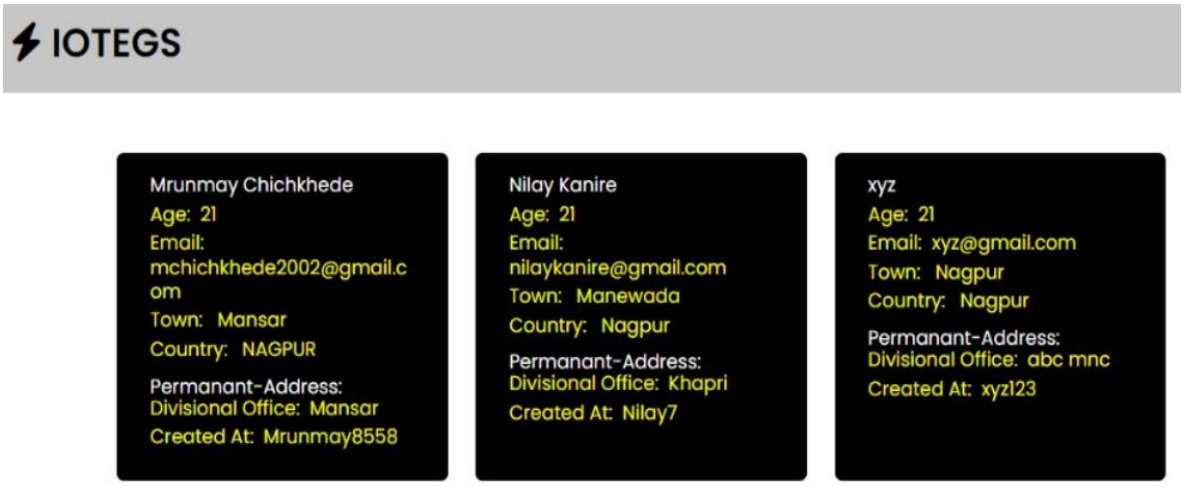


Fig 4.14. Admin portal -> Employee details

This page displays details such as employee names, emails, ages, addresses, divisions, etc.

Admin can use this information for various administrative purposes, such as managing employee records.

II] <u>Steps to follow for the "Consumer" portal</u> :-

1. Go to the website Homepage through the given link :- https://mahavitran-pro.onrender.com/home

2. For the "Consumer" role :-

Users click on the "Consumer Portal" option from the homepage.

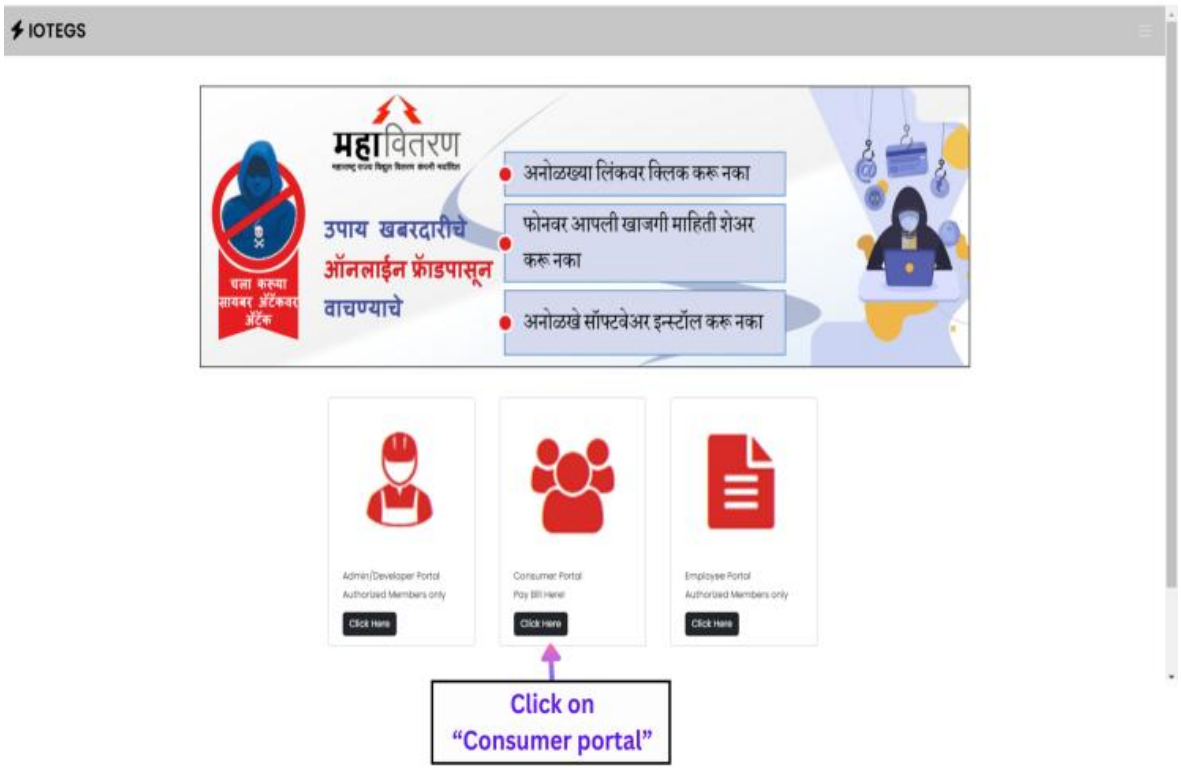


Fig 4.15. Consumer portal button

When consumers click on the consumer portal option, they are redirected to the official website of the government, specifically the Maharashtra State Electricity Distribution Company Limited (MSEDCL) website at https://www.mahadiscom.in/en/home/.

Our consumer portal serves as a gateway for consumers to access the official website of the Maharashtra State Electricity Distribution Company Limited. Consumers can use this website to access various services, information, and resources related to electricity distribution in Maharashtra.

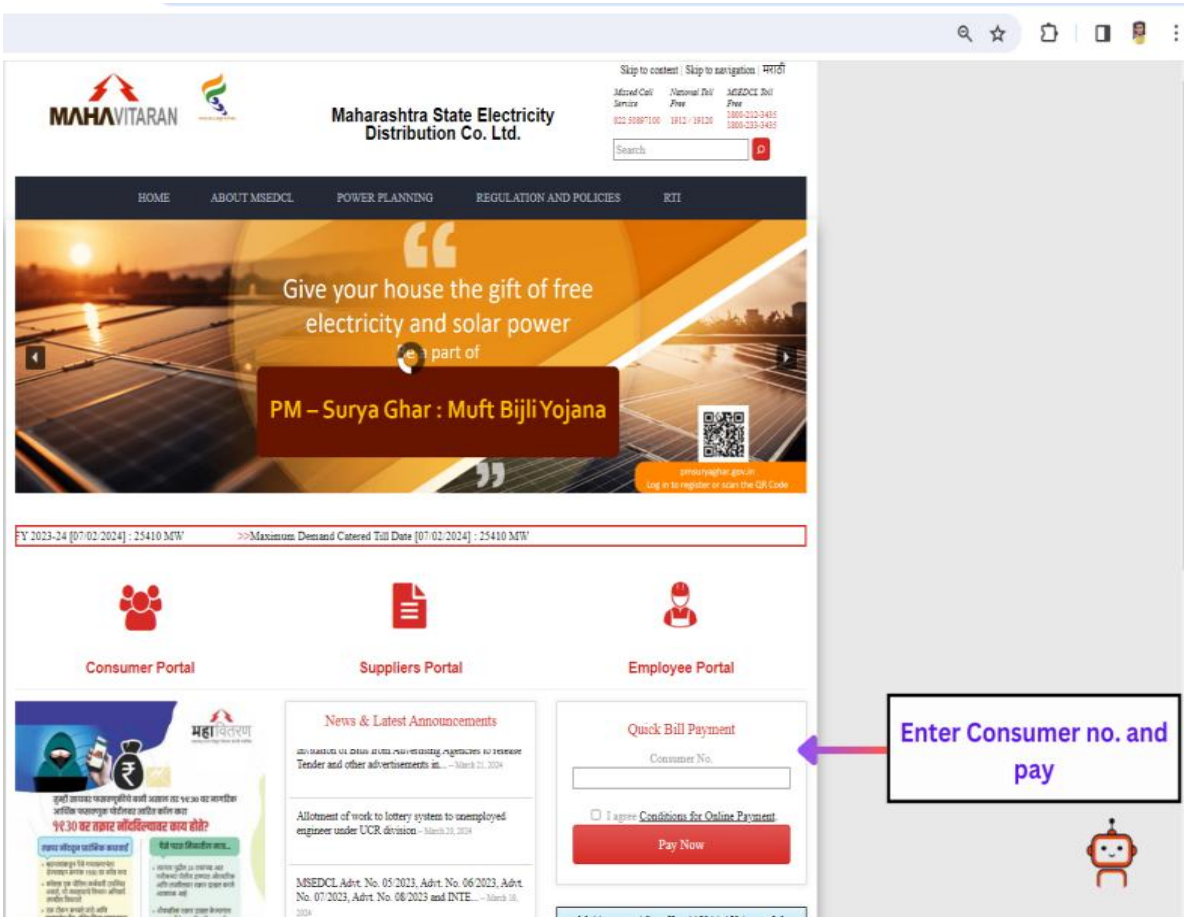


Fig 4.16. Official MSEDCL website

While our consumer portal may not have its own unique functionality beyond redirecting users to the MSEDCL website, it serves as a convenient entry point for consumers to access the relevant resources and services

provided by the government for managing their electricity accounts, paying bills, accessing information about power outages, and more.

III] Steps to follow for the "Employee " portal :-

1. Go to the website Homepage through the given link :- https://mahavitran-pro.onrender.com/home

2. For the "Employee" role :

Users click on the "Employee Portal" option from the homepage

Fig 4.17. Employee portal button

3. After clicking on the "Employee Portal" option, users are directed to a login page :-

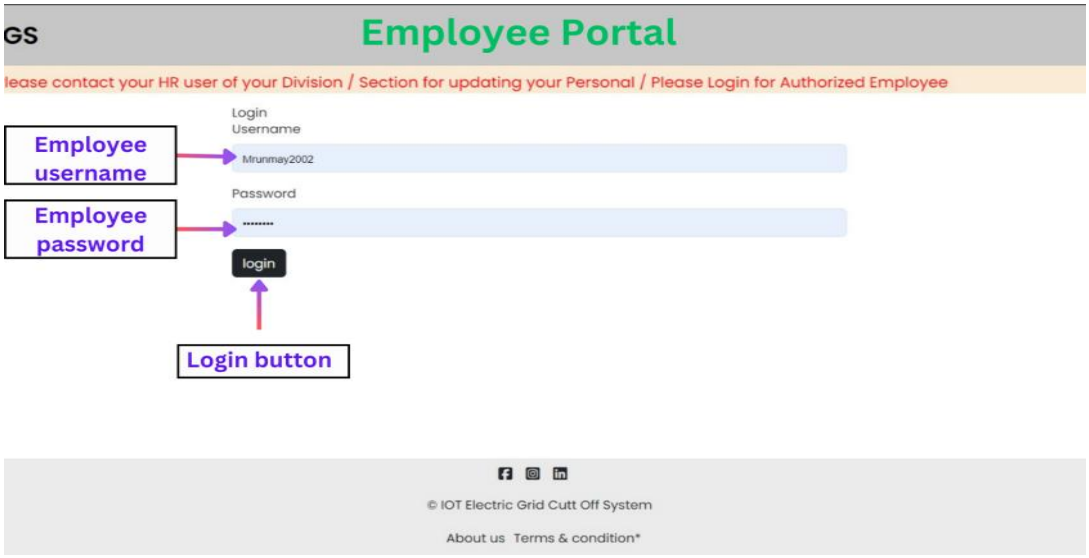


Fig 4.18. Employee portal login page

Here, users must input their login credentials, including a username and password.

If the entered credentials are incorrect, access will be denied, and an appropriate error message may be displayed.

If the credentials are correct, the user proceeds to the next page.

4. Add New Consumer Form :

The page after successful login consists of a form for adding new consumers to the system.

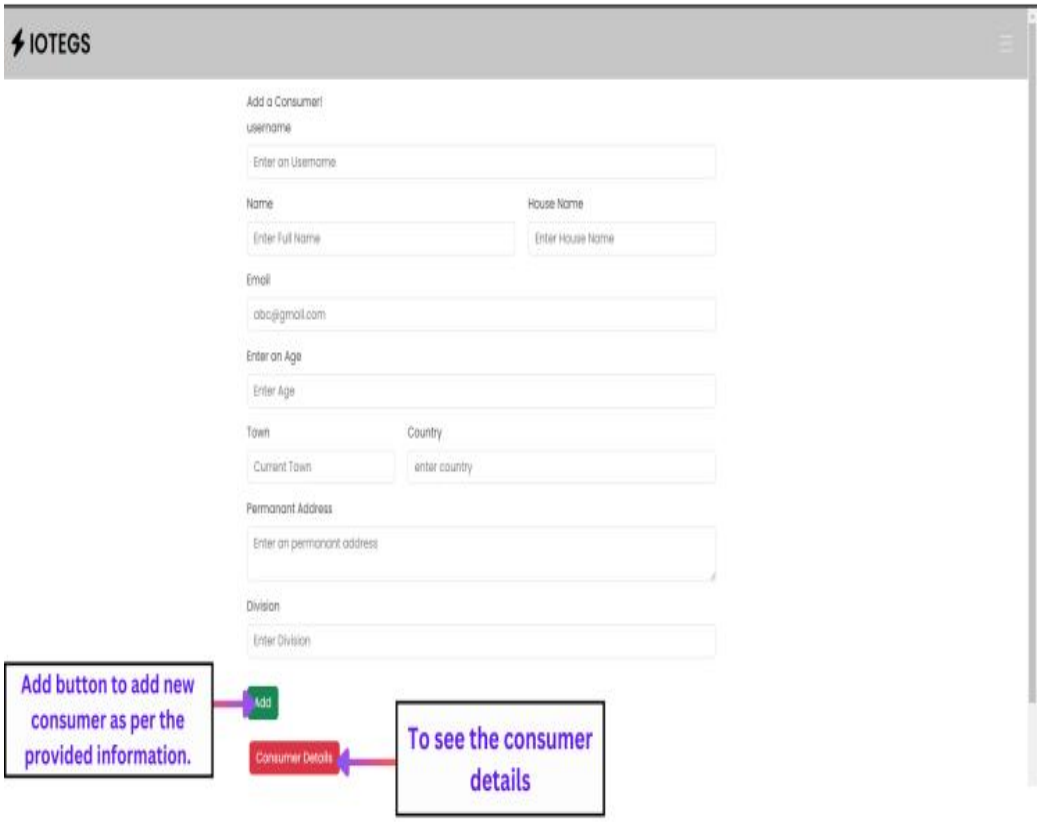


Fig 4.19. Employee portal -> New Consumer form

Users can access this form by navigating to a page within the employee portal.

The form includes fields for entering details about the new consumer, such as: Username, Full Name, House Name, Email, Age, Town, Country, Permanent Address, Division.

i] Submitting the Form :

Once employee fill out the required fields in the add consumer form, they can submit the form.

Upon submission, the system processes the information and adds the new consumer to the database.

ii] Add Consumer Button :

After filling out the form, employee's can click on the "Add Consumer" button to submit the details and add the new consumer to the system.

iii] Consumer Details Button:

There is a "Consumer Details" button available on the page.

After clicking on the “Consumer Details” button users are directed to the employee dashboard.Employee Dashboard :

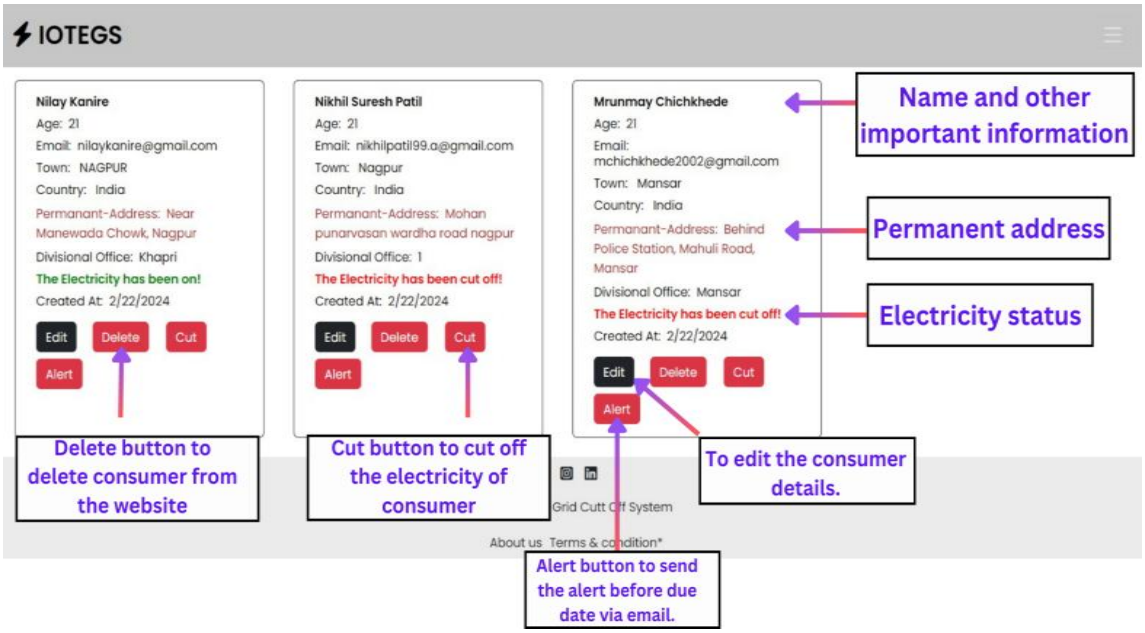


Fig 4.20. Employee portal -> Employee Dashboard

It allows employees to view details of existing consumers in the system.

The employee dashboard provides various options and functionalities for managing consumer-related tasks such as :

i] Edit Button :-

This button allows employees to edit the information of a specific consumer.

Clicking on the Edit button opens a form or modal where employees can update the consumer's details, such as name, email, address, etc.

After making the necessary changes, employees can save the updates, and the consumer's information will be updated in the database.

ii] Delete Button :-

The Delete button enables employees to remove a consumer from the database.

Clicking on the Delete button prompts a confirmation dialog to ensure the action is intentional.

If confirmed, the consumer's information is permanently deleted from the database.

iii] Cut Button :-

The Cut button is used to toggle the electricity status of a particular consumer. After Clicking on the Cut button, a new page is shown. This page indicates the current status of the consumer's house.

● Cut Electricity Button: Clicking on this button initiates the process to cut off the electricity supply to Nilay's house.

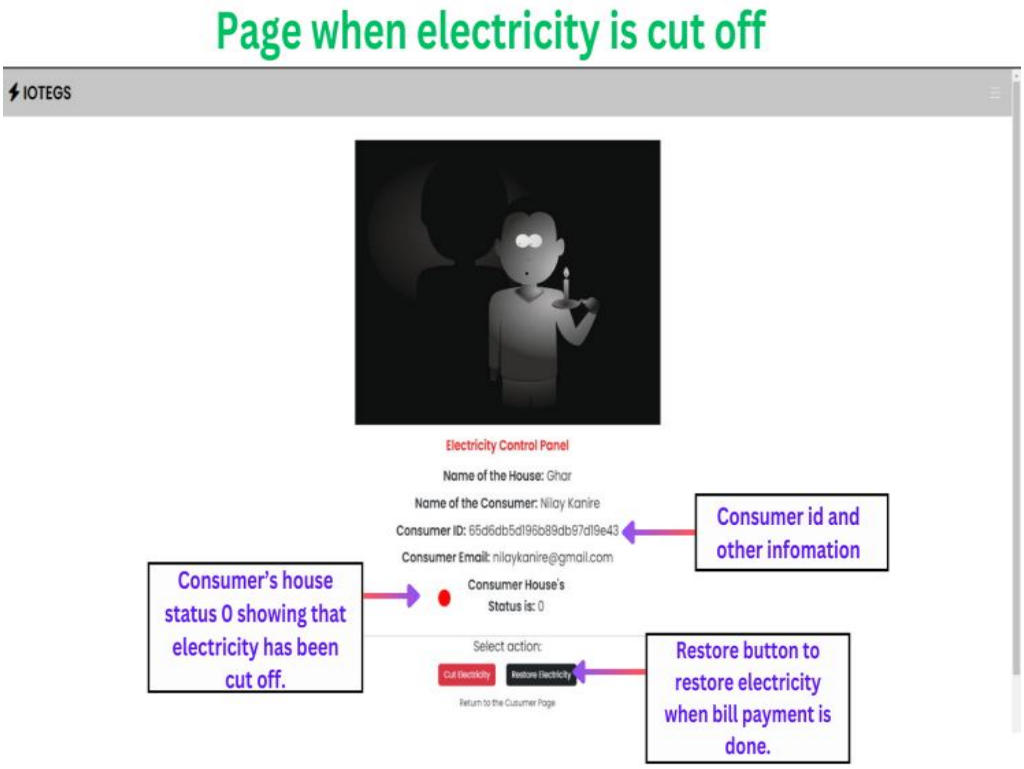


Fig 4.21. Employee portal -> Electricity Control Panel when electricity is cut off

The status is represented by a numerical value, where "0" likely signifies that the electricity is currently cut off.

● Restore Electricity Button: Clicking on this button initiates the process to restore the electricity supply to Nilay's house, assuming it's currently cut off.

These options provide employees with direct control over managing the electricity status of Nilay's house. Depending on the current status, employees can choose to cut off or restore the electricity supply as needed.

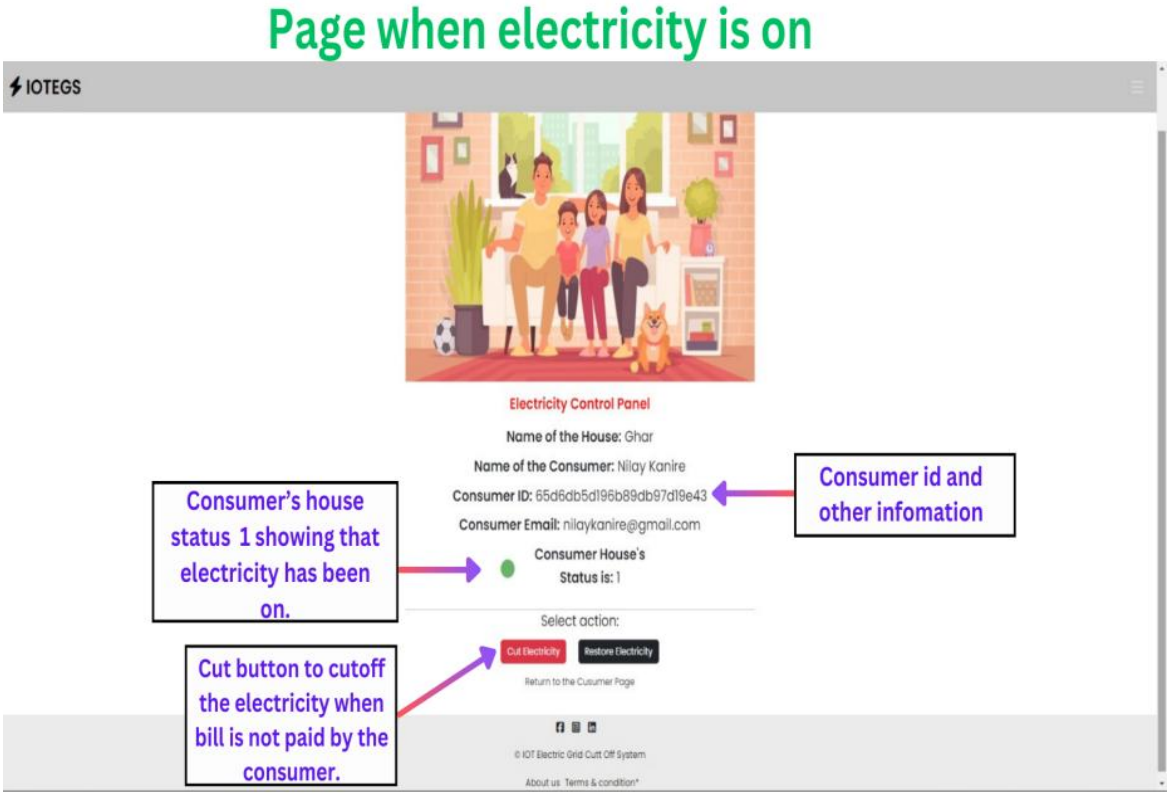


Fig 4.22 Employee portal -> Electricity Control Panel when electricity is restored

iv] Alert Button :-

The Alert button allows employees to send an alert message to a specific consumer when their electricity is cut off.

Clicking on the Alert button triggers the system to send a notification or message to the consumer, informing them of the power outage.

This alert helps consumers stay informed about disruptions in their electricity supply and can provide updates on the status of restoration efforts.

These buttons provide employees with comprehensive tools to manage consumer information and electricity statuses effectively. They streamline the process of updating consumer details, managing electricity supply, and communicating with consumers during power outages.

4.2 HARDWARE ASPECTS

4.2.1 NODEMCU ESP8266:

The board we are using is called “NodeMCU” and has an ESP8266 module on it, which we will be programming. It comes with the latest version of MicroPython already setup on it, together with all the drivers we are going to use.

The D0, D1, D2, numbers printed on the board are different from what Micro python uses – because originally those boards were made for a different software. Make sure to refer to the image below to determine which pins are which.

It has a micro-USB socket for connecting to the computer. On the side is a button for resetting the board. Along the sides of the board are two rows of pins, to which we will be connecting cables.

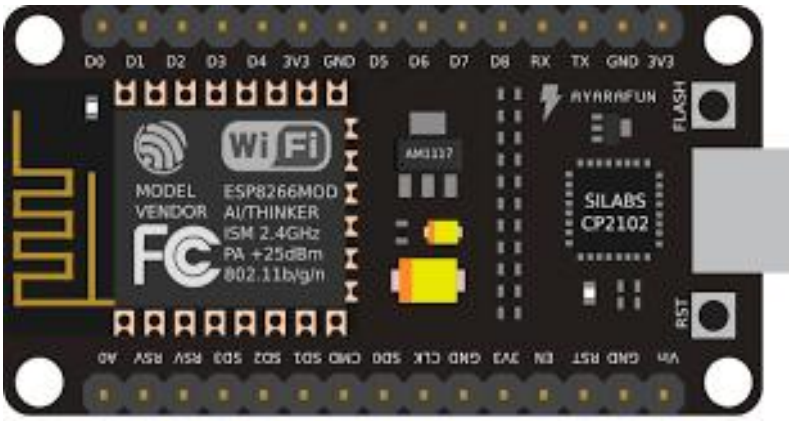


Fig 4.23 - Node Microcontroller ESP8266

1] The symbols meaning is as follows:

- **3v3** - this is a fancy way to write 3.3V, which is the voltage that the board runs on internally. You can think about this pin like the plus side of a battery.
- **gnd, G** - this is the ground. Think about it like the minus side of the battery.
- **gpioD0** - “gpio” stands for “general purpose input output”. Those are the pins we will be using for sending and receiving signals to and from various devices that we will connect to them. They can act as output – pretty much like a switch that you can connect to plus or to minus with your program. Or they can act as input, telling your program whether they are connected to plus or minus.

- **a0** - this is the analog pin. It can measure the voltage that is applied to it, but it can only handle up to 3.3V.
- **5V** - this pin is connected with the 5V from your computer. You can also use it to power your board with a battery when it's not connected to the computer. The voltage applied here will be internally converted to the 3.3V that the board needs.
- **rst** - this is a reset button (and a corresponding pin, to which you can connect external button).
- Many of the gpio pins have an additional function, we will cover them separately.

2] ESP8266:

Espressif's ESP8266EX delivers highly integrated Wi-Fi SoC solution to meet users' continuous demands for efficient power usage, compact design and reliable performance in the Internet of Things industry. With the complete and self-contained Wi-Fi networking capabilities, ESP8266EX can perform either as a standalone application or as the slave to a host MCU. When ESP8266EX hosts the application, it promptly boots up from the flash. The integrated highspeed cache helps to increase the system performance and optimize the system memory. Also, ESP8266EX can be applied to any microcontroller design as a Wi-Fi adaptor through SPI/SDIO or UART interfaces. ESP8266EX integrates antenna switches, RF balun, power amplifier, low noise receive amplifier, filters and power management modules. The compact design minimizes the PCB size and requires minimal external circuitries. Besides the Wi-Fi functionalities, ESP8266EX also integrates an enhanced version of Tensilica's L106 Diamond series 32-bit processor and on-chip SRAM. It can be interfaced with external sensors and other devices through the GPIOs. Software Development Kit (SDK) provides sample codes for various applications.

Espressif Systems' Smart Connectivity Platform (ESCP) enables sophisticated features including:

- Fast switch between sleep and wakeup mode for energy-efficient purpose.
- Adaptive radio biasing for low-power operation.
- Advance signal processing.
- Spur cancellation and RF co-existence mechanisms for common cellular, Bluetooth, DDR, LVDS, LCD interference mitigation.

3] Wi-Fi Key Features:

- 802.11 b/g/n support
- 802.11n support (2.4 GHz), up to 72.2 Mbps
- Defragmentation
- 2 x virtual Wi-Fi interface
- Automatic beacon monitoring (hardware TSF)
- Support Infrastructure BSS Station mode/SoftAP mode/Promiscuous mode
- Antenna diversity

4] CPU:

The ESP8266EX integrates a Tensilica L106 32-bit RISC processor, which achieves extralow power consumption and reaches a maximum clock speed of 160 MHz. The Real-Time Operating System (RTOS) and Wi-Fi stack allow 80% of the processing power to be available for user application programming and development. The CPU includes the interfaces as below:

- Programmable RAM/ROM interfaces (iBus), which can be connected with memory controller, and can also be used to visit flash.
- Data RAM interface (dBus), which can connected with memory controller.
- AHB interface which can be used to visit the register.

5] Memory:

ESP8266EX Wi-Fi SoC integrates memory controller and memory units including SRAM and ROM. MCU can access the memory units through iBus, dBus, and AHB interfaces. All memory units can be accessed upon request, while a memory arbiter will decide the running sequence according to the time when these requests are received by the processor. According to our current version of SDK, SRAM space available to users is assigned as below.

- RAM size < 50 kB, that is, when ESP8266EX is working under the Station mode and connects to the router, the maximum programmable space accessible in Heap + Data section is around 50 kB.
- There is no programmable ROM in the SoC. Therefore, user program must be stored in an external SPI flash.

- External Flash ESP8266EX uses external SPI flash to store user programs, and supports up to 16 MB memory capacity theoretically.
- The minimum flash memory of ESP8266EX is OTA disabled: 512 kB at least & OTA enabled: 1 MB at least.

6] High Frequency Clock:

The high frequency clock on ESP8266EX is used to drive both transmit and receive mixers. This clock is generated from internal crystal oscillator and external crystal. The crystal frequency ranges from 24 MHz to 52 MHz. The internal calibration inside the crystal oscillator ensures that a wide range of crystals can be used, nevertheless the quality of the crystal is still a factor to consider to have reasonable phase noise and good Wi-Fi sensitivity. Radio ESP8266EX radio consists of the following blocks:

i) 2.4 GHz Receiver:

The 2.4 GHz receiver down-converts the RF signals to quadrature baseband signals and converts them to the digital domain with 2 high resolution high speed ADCs. To adapt to varying signal channel conditions, RF filters, automatic gain control (AGC), DC offset cancelation circuits and baseband filters are integrated within ESP8266EX.

ii) 2.4 GHz Transmitter:

The 2.4 GHz transmitter up-converts the quadrature baseband signals to 2.4 GHz, and drives the antenna with a high-power CMOS power amplifier. The function of digital calibration further improves the linearity of the power amplifier, enabling a state of art performance of delivering +19.5 dBm average TX power for 802.11b transmission and +18 dBm for 802.11n (MSC0) transmission.

Additional calibrations are integrated to offset any imperfections of the radio, such as:

- Carrier leakage.
- I/Q phase matching.
- Baseband nonlinearities these built-in calibration functions reduce the product test time and make the test equipment unnecessary.

7] Clock Generator:

The clock generator generates quadrature 2.4 GHz clock signals for the receiver and transmitter. All

components of the clock generator are integrated on the chip, including all inductors, varactors, loop filters, linear voltage regulators and dividers. The clock generator has built-in calibration and self-test circuits. Quadrature clock phases and phase noise are optimized on-chip with patented calibration algorithms to ensure the best performance of the receiver and transmitter.

Wi-Fi ESP8266EX implements TCP/IP and full 802.11 b/g/n WLAN MAC protocol. It supports Basic Service Set (BSS) STA and SoftAP operations under the Distributed Control Function (DCF). Power management is handled with minimum host interaction to minimize active duty period.

8] Wi-Fi Radio and Baseband:

The ESP8266EX Wi-Fi Radio and Baseband support the following features:

- 802.11b and 802.11g
- 802.11n MCS0-7 in 20 MHz bandwidth
- 802.11n 0.4 μs guard-interval
- up to 72.2 Mbps of data rate

9] Wi-Fi MAC:

The ESP8266EX Wi-Fi MAC applies low-level protocol functions automatically, as follows:

- 2 × virtual Wi-Fi interfaces
- Infrastructure BSS Station mode/SoftAP mode/Promiscuous mode
- Request To Send (RTS), Clear To Send (CTS) and Immediate Block ACK
- Defragmentation
- CCMP (CBC-MAC, counter mode), TKIP (MIC, RC4), WEP (RC4) and CRC
- Automatic beacon monitoring (hardware TSF)

10] Power Management:

ESP8266EX is designed with advanced power management technologies and intended for mobile devices, wearable electronics and the Internet of Things applications. The low-power architecture operates in the following modes:

- Active mode: The chip radio is powered on. The chip can receive, transmit, or listen.
- Modem-sleep mode: The CPU is operational. The Wi-Fi and radio are disabled.
- Light-sleep mode: The CPU and all peripherals are paused. Any wake-up events (MAC, host, RTC timer, or external interrupts) will wake up the chip.

11] General Purpose Input/Output Interface (GPIO):

ESP8266EX has 17 GPIO pins which can be assigned to various functions by programming the appropriate registers. Each GPIO PAD can be configured with internal pull-up or pull-down (XPD_DCDC can only be configured with internal pull-down, other GPIO PAD can only be configured with internal pull-up), or set to high impedance. When configured as an input, the data are stored in software registers; the input can also be set to edge-trigger or level trigger CPU interrupts. In short, the IO pads are bi-directional, non-inverting and tristate, which includes input and output buffer with tristate control inputs. These pins, when working as GPIOs, can be multiplexed with other functions such as I2C, I2S, UART, PWM, and IR Remote Control, etc. For low power operations, the GPIOs can also be set to hold their state. For instance, when the IOs are not driven by internal and external circuits, all outputs will hold their states before the chip entered the low power modes. The required drive strength is small 5 μA or more is enough to pull apart the latch. Secure Digital Input/Output Interface (SDIO) ESP8266EX has one Slave SDIO, the definitions of which are described as Table 4-1, which supports 25 MHz SDIO v1.1 and 50 MHz SDIO v2.0, and 1 bit/4 bit SD mode and SPI mode.

4.2.2 SIM800L GSM MODULE:

SIM800L GSM/GPRS module is a miniature GSM modem, which can be integrated into a great number of IoT projects. You can use this module to accomplish almost anything a normal cell phone can; SMS text messages, Make or receive phone calls, connecting to internet through GPRS, TCP/IP, and more! To top it off, the module supports quad-band GSM/GPRS network, meaning it works pretty much anywhere in the world.

I] Hardware Overview of SIM800L GSM Module:

At the heart of the module is a SIM800L GSM cellular chip from SimCom. The operating voltage of the chip is from **3.4V to 4.4V**, which makes it an ideal candidate for direct LiPo battery supply. This makes it a good choice for embedding into projects without a lot of space.

Fig 4.24 - Overview of SIM800L Front View.

All the necessary data pins of SIM800L GSM chip are broken out to a 0.1″ pitch headers. This includes pins required for communication with a microcontroller over **UART**. The module supports baud rate from **1200bps** to **115200bps** with Auto-Baud detection.

The module needs an external antenna to connect to a network. The module usually comes with a **Helical Antenna** and solders directly to NET pin on PCB. The board also has a U.FL connector facility in case you want to keep the antenna away from the board.

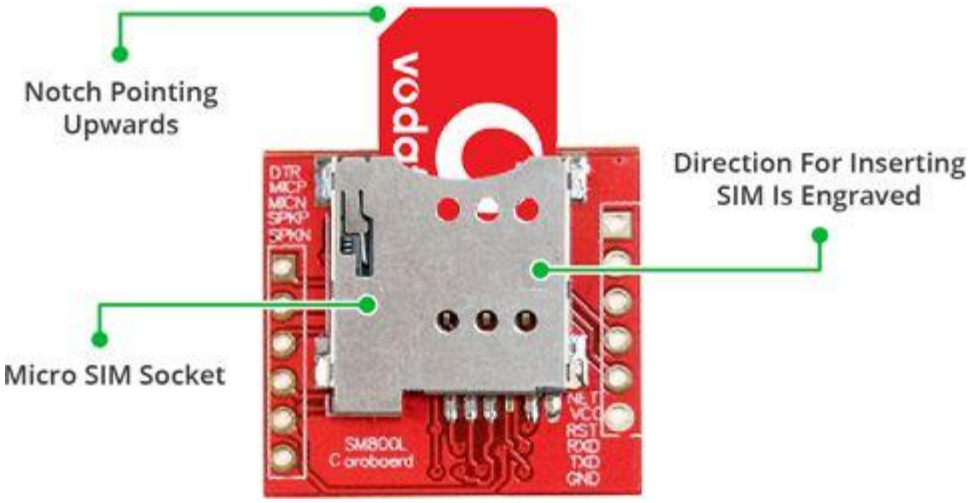


Fig 4.25 - Overview of SIM800L Back View

There's a SIM socket on the back! Any activated, **2G micro SIM card** would work perfectly. Correct direction for inserting SIM card is normally engraved on the surface of the SIM socket.

This module measures only 1 inch² but packs a surprising amount of features into its little frame. Some of them are listed below:

- Supports Quad-band: GSM850, EGSM900, DCS1800 and PCS1900
- Connect onto any global GSM network with any 2G SIM
- Make and receive voice calls using an external 8Ω speaker & electret microphone
- Send and receive SMS messages
- Send and receive GPRS data (TCP/IP, HTTP, etc.)
- Scan and receive FM radio broadcasts
- Transmit Power:
    - Class 4 (2W) for GSM850
    - Class 1 (1W) for DCS1800
- Serial-based AT Command Set
- FL connectors for cell antennae
- Accepts Micro SIM Card

II] LED Status Indicator:

There is an LED on the top right side of the SIM800L Cellular Module which indicates the status of your cellular network. It'll blink at various rates to show what state it's in:

- ***Blink every 1s***

The module is running but hasn't made connection to the cellular network yet.

- ***Blink every 2s***

The GPRS data connection you requested is active.

- ***Blink every 3s***

The module has made contact with the cellular network & can send/receive voice and SMS.

III] Selecting Antenna:

An antenna is required to use the module for any kind of voice or data communications as well as some SIM commands. So, selecting an antenna could be a crucial thing. There are two ways you can add an antenna to your SIM800L module.

The first one is a Helical GSM antenna which usually comes with the module and solders directly to NET pin on PCB. This antenna is very useful for projects that need to save space but struggles in getting connectivity especially if your project is indoors.

Fig 4.26 - Helical GSM antenna

The second one is any 3dBi GSM antenna along with a U.FL to SMA adapter which can be obtained online for less than $3. You can snap-fit this antenna to small u.fl connector located on the top-left corner of the

module. This type of antenna has a better performance and allows putting your module inside a metal case – as long the antenna is outside.

Fig 4.27 - 3dBi GSM antenna

IV] Supplying Power for SIM800L module:

One of the most important parts of getting the SIM800L module working is supplying it with enough power.Depending on which state it's in, the SIM800L can be a relatively power-hungry device. The maximum current draw of the module is around 2A during transmission burst. It usually won't pull that much, but may require around 216mA during phone calls or 80mA during network transmissions. This chart from the datasheet summarizes what you may expect:

Modes	Frequency	Current Consumption
Power down		60 uA
Sleep mode		1 mA
Stand by		18 mA
Call	GSM850	199 mA
	EGSM900	216 mA
	DCS1800	146 mA
	PCS1900	131 mA
GPRS		453 mA
Transmission burst		2 A

Fig 4.28 - Power Chart for SIM800L Module

Since SIM800L module doesn't come with onboard voltage regulator, an external power supply adjusted to voltage between 3.4V to 4.4V (Ideal 4.1V) is required. The power supply should also be able to source 2A of surge current, otherwise the module will keep shutting down. Here are some options you can consider to correctly power your GSM module.

V] SIM800L GSM Module Pinout:

The SIM800L module has total 12 pins that interface it to the outside world. The connections are as follows:

Fig 4.29 - GSM Module Pinout

NET is a pin where you can solder Helical Antenna provided along with the module.

VCC supplies power for the module. This can be anywhere from 3.4V to 4.4 volts. Remember connecting it to 5V pin will likely destroy your module! It doesn't even run on 3.3 V! An external power source like Li-Po battery or DC-DC buck converters rated 3.7V 2A would work.

RST(Reset) is a hard reset pin. If you absolutely got the module in a bad space, pull this pin low for 100ms to perform a hard reset.

RxD(Receiver) pin is used for serial communication.

TxD(Transmitter) pin is used for serial communication.

GND is the Ground Pin and needs to be connected to GND pin on the Arduino.

RING pin acts as a Ring Indicator. It is basically the 'interrupt' out pin from the module. It is by default high and will pulse low for 120ms when a call is received. It can also be configured to pulse when an SMS is received.

DTR pin activates/deactivates sleep mode. Pulling it HIGH will put module in sleep mode, disabling serial communication. Pulling it LOW will wake the module up.

MIC is a differential microphone input. The two microphone pins can be connected directly to these pins.

SPK is a differential speaker interface. The two pins of a speaker can be tied directly to these two pins.

V] Wiring – Connecting SIM800L GSM module to Arduino:

Start by soldering/connecting the antenna, insert fully activated Micro SIM card in the socket. Now, connect Tx pin on module to Rx pin on Arduino as we'll be using software serial to talk to the module.

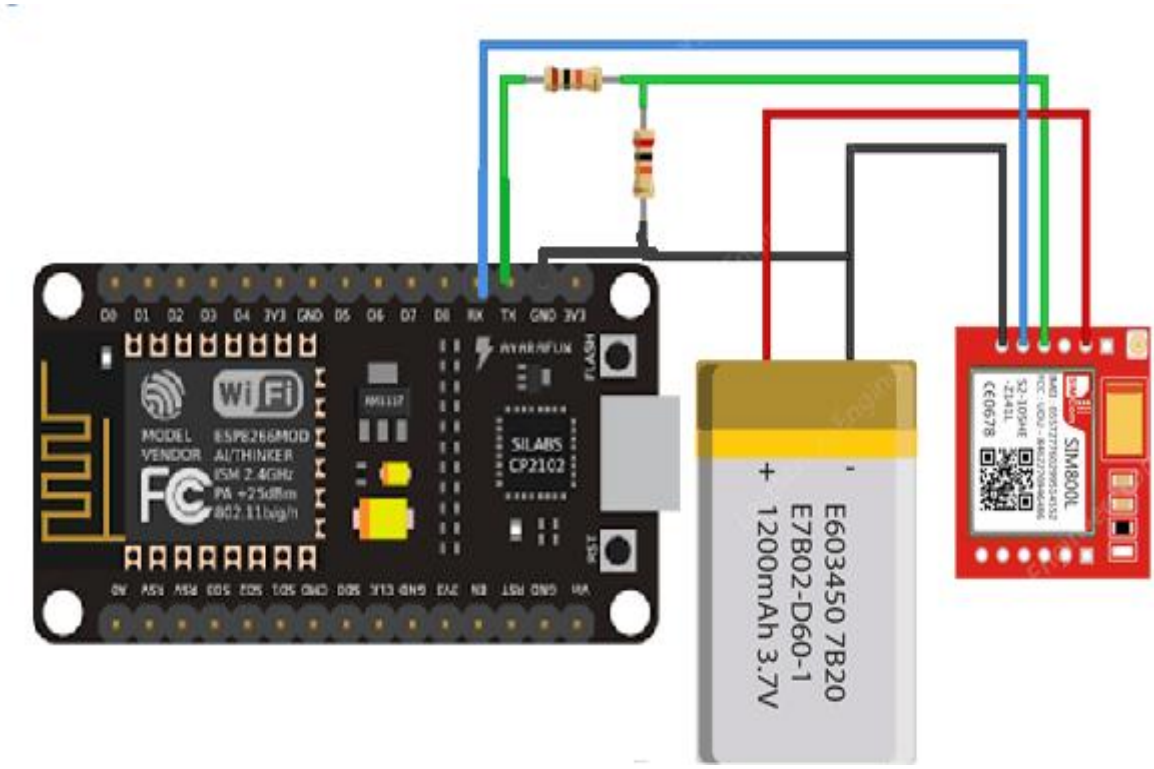


Fig 4.30 - Connecting SIM800L GSM module to NodeMCU

We cannot directly connect Rx pin on module to Arduino's Tx pin as Arduino uses 5V GPIO whereas the SIM800L module uses 3.3V level logic and **is NOT 5V tolerant**. This means the Tx signal coming from the Arduino must be stepped down to 3.3V so as not to damage the SIM800L module. There are several ways to do this but the easiest way is to use a simple resistor divider. A 10K resistor between SIM800L Rx and Arduino Tx, and 20K between SIM800L Rx and GND would work fine.

Now we are remaining with the pins that are used to supply power for the module. As you have multiple choices for powering up the module, we have provided two example schematics. The one uses 1200mAh Li-Po battery.

4.2.3 RELAY:

A relay is an electrically operated switch. Many relays use an electromagnet to mechanically operate a switch, but other operating principles are also used, such as solid-state relays. Relays are used where it is necessary to control a circuit by a separate low-power signal, or where several circuits must be controlled by one signal. The first relays were used in long distance telegraph circuits as amplifiers: they repeated the signal coming in from one circuit and re-transmitted it on another circuit. Relays were used extensively in telephone exchanges and early computers to perform logical operations.

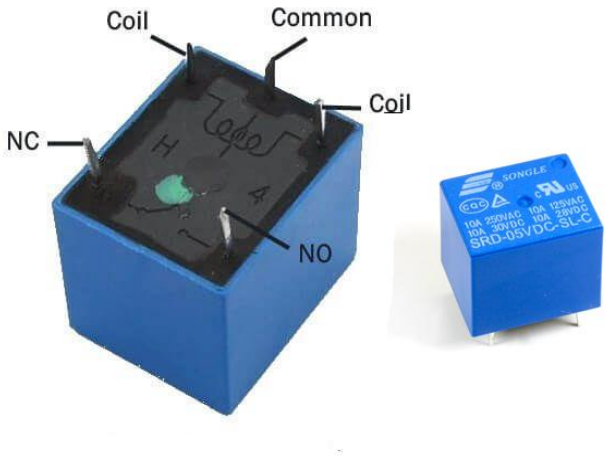


Fig 4.31 - Relay Pin Diagram

A type of relay that can handle the high power required to directly control an electric motor or other loads is called a contactor. Solid-state relays control power circuits with no moving parts, instead using a semiconductor device to perform switching. Relays with calibrated operating characteristics and sometimes multiple operating coils are used to protect electrical circuits from overload or faults; in modern electric power systems these functions are performed by digital instruments still called "protective relays".

4.2.4 BATTERY:

A battery is a device consisting of one or more electrochemical cells with external connections for powering electrical devices such as flashlights, mobile phones, and electric cars. When a battery is supplying electric power, its positive terminal is the cathode and its negative terminal is the anode.

Fig 4.32 - Battery

The terminal marked negative is the source of electrons that will flow through an external electric circuit to the positive terminal. When a battery is connected to an external electric load, a redox reaction converts high-energy reactants to lower- energy products, and the free-energy difference is delivered to the external circuit as electrical energy.

Historically the term "battery" specifically referred to a device composed of multiple cells; however the usage has evolved to include devices composed of a single cell.

4.2.5 DC-DC CONVERTER:

DC-DC converters are high-frequency power conversion circuits that use high-frequency switching and inductors, transformers, and capacitors to smooth out switching noise into regulated DC voltages. Closed feedback loops maintain constant voltage output even when changing input voltages and output currents. At 90% efficiency, they are generally much more efficient and smaller than linear regulators. Their disadvantages are noise and complexity.

DC-DC converters come in non-isolated and isolated varieties. Isolation is determined by whether or not the input ground is connected to the output ground. Four common topologies that makers might find useful are the buck, boost, buck-boost, and SEPIC converters.

A boost converter steps a voltage up, producing a voltage higher than the input voltage. A boost converter could be used to drive a string of LEDs from a lithium cell, or provide a 5 V USB output from a lithium cell.

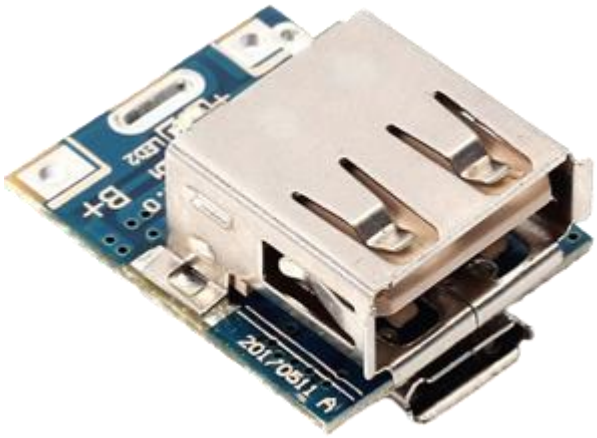


Fig 4.33 - Boost Converter

5V Step-Up Power Module Lithium Battery Charging Protection Board USB for DIY Charger.

4.2.6 PCB DESIGNING:

Following are the steps for PCB designing:

- Designing of actual material.
- Procurement of material.
- Layout of PCB.
- Preparation of PCB.
- Assembling of components.
- Testing.

i) PCB Fabrication Technique:

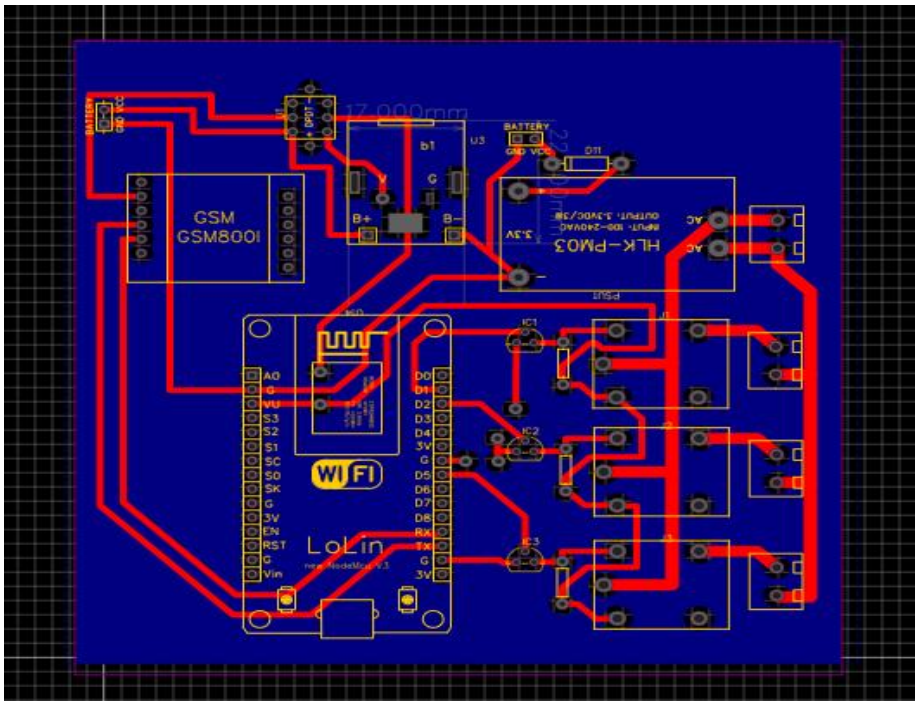


Fig 4.34 – Project PCB Layout Diagram

The first step of assembling is to produce a printed circuit board. The fabrication of the program counter plays a crucial role in the electronic field. The success of the circuit is also dependent on the PCB. As far as the cost is concerned, more than 25% of the total cost is for the PCB design and fabrication.

The board is designed using a personal computer. The layout is drawn using the software “EasyEDA”. The layout is printed in a “buffer sheet” using a laser procedure. First, a negative screen of the layout is prepared with the help of a professional screen printer. Then the copper clad sheet is kept under this screen.

The screen-printing ink is poured on the screen and brushed through the top of the screen. The printed board is kept under shade for few hours till the ink becomes dry.

The etching medium is prepared with the un-hydrous ferric chloride water. The printed board is kept in this solution till the exposed copper dissolves in the solution fully. After that the board is taken out and rinsed in flowing water under a tap. The ink is removed with solder in order to prevent oxidation.

Another screen, which contains component side layout, is prepared and the same is printed on the component side of the board. A paper epoxy laminate is used as the board. Both the component and the track layout of the peripheral PCB is given at the end of this report.

ii) Etching of PCB:

Etching is the process of chemically attacking and removing the unprotected copper from the copper plate to yield the desired conductor pattern. The most common enchant used in the industry is ferric chloride.

The erotically anyone of the following solution can be used to make PCB:

- Ammonium Per Sulphate
- Chromic Acid
- Cupric Acid
- Ferric Chloride

Method of etching includes tray rocking tank etching and spray etching. Out of there May rocking is the simplest one. This consist of the tray of Pyrex glass, attached to a powered rocking table is not available, rocking of the tray with etching solution and the plate can be done manually also.

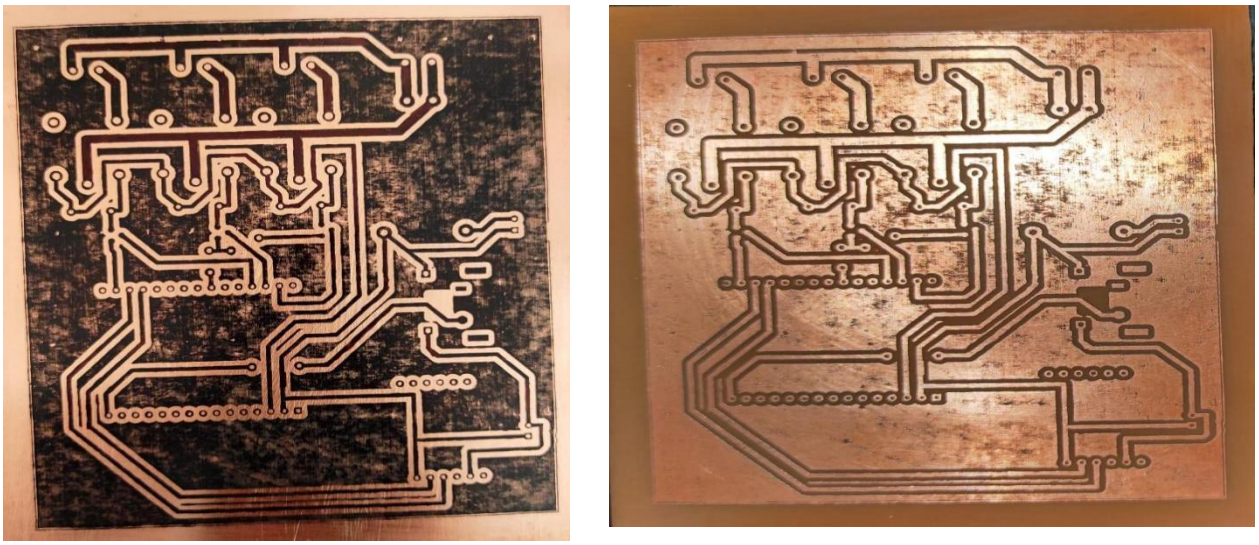


Fig 4.35 - Project PCB Etching Process

iii) Drilling:

Drilling is performed with the help of drilling machine. While doing drilling needles was change according to the required diameter of the hole is to be made.

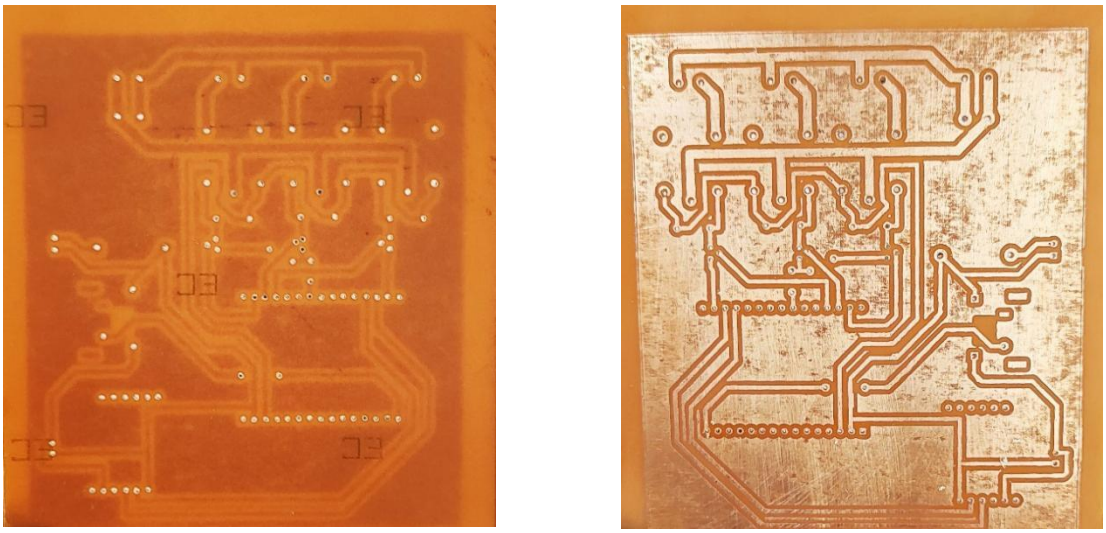


Fig 4.36 - Project PCB Drilling Process

iv) Mounting:

After drilling mounting, of the component is done. On PCB respective component was placed imperfective holes and finally soldered. After soldering the PCB was ready to be connected to the respective relays and supply. Before than wiring diagram areas draw which decide the external wire connection to the PCB.

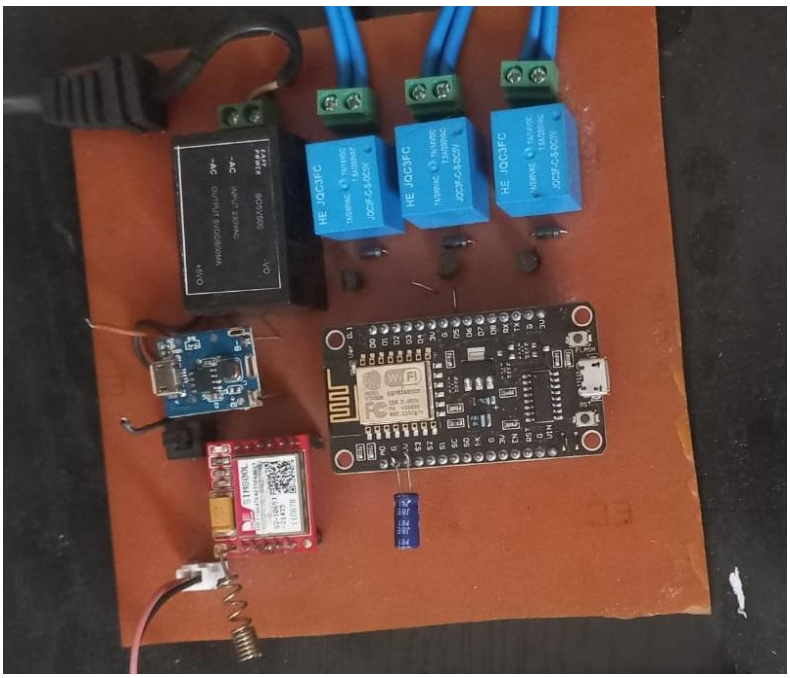


Fig 4.37 - Project PCB Component mounting Process

v) Testing:

Testing is the main event, which has its own importance in the electronics field. Testing is the process to find the output performance and fault of the circuit in the various forms. The main objective of the testing is to check the output performance as per our assumption.

The least carelessness may lead to the major fault in case of electronics circuit and it is depend upon the layout and design of the PCB. Printed circuit board are used to route electrical current and signal through the copper tracks which are primarily bounded to an insulating core. For the testing of any electronics circuit some common steps are performed.

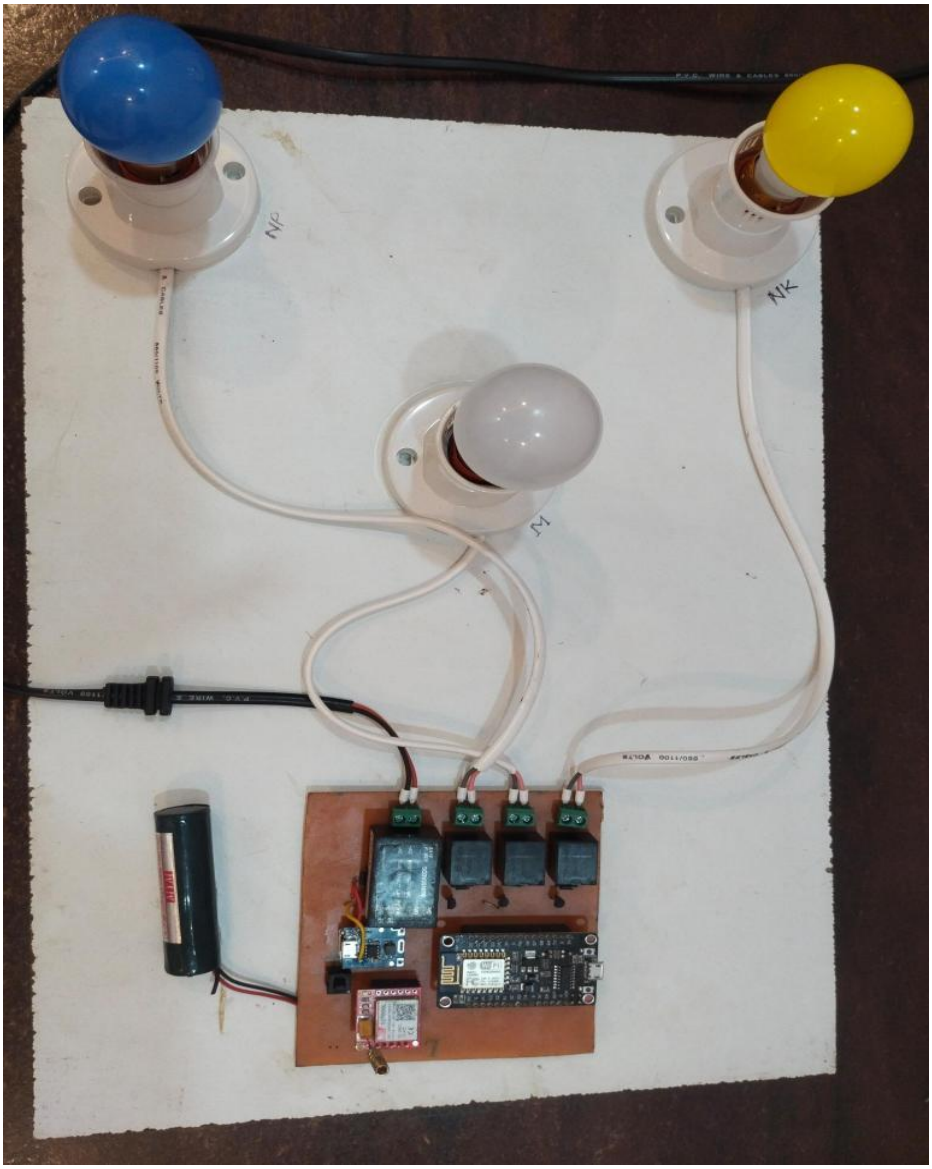


Fig4.38 -Final Project PCB

CHAPTER 5: RESULT

5. RESULT

The proposed project aims to develop an IoT-based Grid Cut-Off System for Non-Bill Paid Consumers, providing a solution to track energy consumption and control grid status remotely. This system is designed to operate without the need for human intervention, enhancing convenience and efficiency.

The system allows users to monitor their energy consumption through a web page, providing real-time data on usage patterns. Additionally, it enables the automatic cut-off of grid supply when a consumer fails to pay their electric bill, ensuring compliance with payment obligations. This feature not only helps in reducing energy wastage but also promotes awareness about responsible energy consumption practices.

One of the key features of the system is its ability to send SMS alerts to consumers when their grid supply is cut-off due to non-payment of bills. This notification serves as a reminder for consumers to settle their dues promptly, thereby avoiding further disruptions in their energy supply. By incorporating this feature, the system aims to improve payment compliance among consumers, leading to more efficient energy management.

Overall, the IoT-based Grid Cut-Off System offers a comprehensive solution for managing energy consumption and grid status, promoting responsible energy usage, and reducing wastage. Its remote monitoring and notification features make it a valuable tool for both consumers and energy providers in ensuring efficient and sustainable energy management practices.

1] Website with Consumer name “Nilay have electrical supply ON and remaining consumers connection are OFF”, As shown in the fig (5.1).

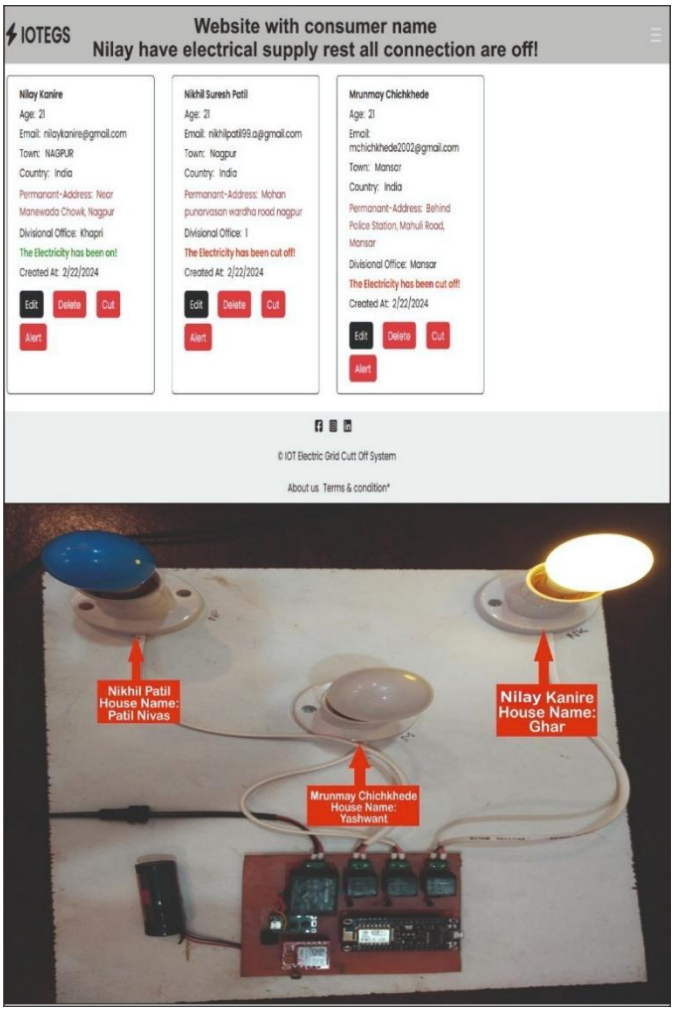
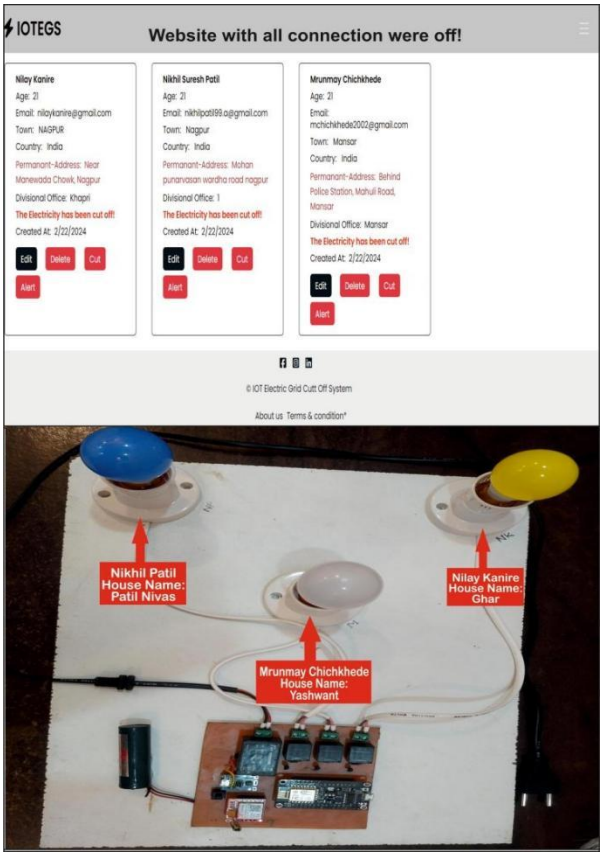


Fig 5.1. Hardware when only consumer Nilay connection is “ON

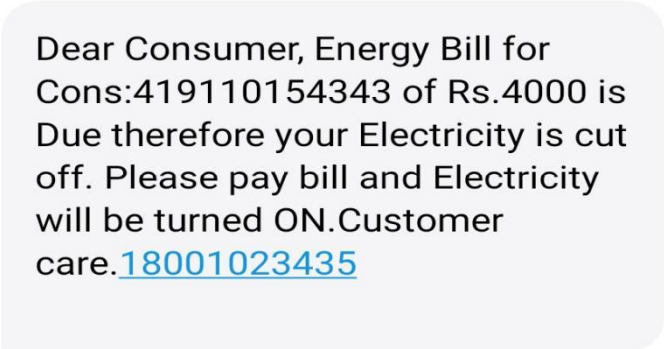
2] Website with all connection are off :

The Hardware is link with the website. All the connection of the consumer is currently off as shown in the fig (5.2).



Fig(5.2).Hardware when consumer Nilay connection is "CUT-OFF"

3] After disconnecting the electrical supply of the consumer named "Nilay Kanire", the gsm module will send the sms to the consumer's registered mobile number.



Fig(5.3) SMS via gsm module

CHAPTER 6: CONCLUSION

6. CONCLUSION

The project model aims to streamline labor-intensive tasks associated with monitoring and controlling the electric grid cut-off system. By utilizing the ESP8266 in our setup, we can leverage its capabilities to enhance wireless network systems, offering numerous benefits in terms of efficiency and effectiveness.

One of the primary focuses of this initiative is to monitor and control energy consumption on the consumer's end. By implementing an automated system, we aim to reduce the need for unnecessary human intervention, thereby improving overall efficiency and reducing costs.

In the current scenario, where energy management is becoming increasingly important, establishing an automated mechanism for monitoring and controlling the electric grid cut-off system is imperative. This approach not only ensures a more efficient and effective management of resources but also helps in reducing energy wastage and promoting responsible consumption practices.

By integrating the ESP8266 into our system, we can create a robust and reliable platform for managing energy consumption and grid status. This will not only benefit consumers by providing them with more control over their energy usage but also help in optimizing the overall energy distribution system.

CHAPTER 7: REFERENCES

7. REFERNCES

[1]. IOT Based Automatic Control of Electrical Devices Using Smart Switch, (IJRASET), and October 2017.

[2]. A smart switch to connect and disconnect electrical devices at home by using internet,International Research Journal of Engineering and technology(IRJET).

[3]. GSM Based Controlled Switching Circuit, IJCER, 2013.

[4]. Siddarameswara H.N."GSM based electricity the identification in houses and in industry sector", ICEE-21 june 2014, ISBN-978- 93-81693-6603-03.

[5]. Abhinandanjain,Dilip Kumar, jyotiKedia, "Design and Development of GSM based Energy Meter" , in IJERT , 2012.

[6]. Abdollahi, A. Dehghani, M. Zamanzadech, "SMS-based Reconfigurable automatic meter reading system" in control applications, 2007.

[7]. Barath, P.; Ananth, N.; Vijetha, S.; Prakash,K.V.J.; "Wireless automated digital energy control meter". In sustainable energy technologies, ICSET 2008.

[8]. S. Arun; Dr, Sidappa Naidu, "Design and Implemention of Automatic Meter Reading System Using GSM ZIGBEE through GPRS" in international journal of advance research in computer science engineering, 2012.

[9]. Primicanta, A.; Nayan, M. & Awan, M. Hybrid Automatic Meter Reading System Computer Technology and Development, 2009. ICCTD '09. International Conference on, 2009.

[10]. Norozina, A.; ICT in Service Delivery in TNB, Institute Tadbiran Awam Negara - Public Sector ICT Management Review: ICT in Service Delivery, 2008.

[11]. Tan, H., Lee, C. & Mok, V.; Automatic power meter reading system using GSM network Power Engineering Conference, 2007. IPEC 2007. International, 2007

[12].Ouchida, S., Nikpour, A., & Fairbrother, G. (2020). Reducing EEG (electroencephalogram) electrode-induced skin injury among ambulatory EEG monitored patients: a non-randomized interventional study of two commonly used cream-based products for electrode application. The Neurodiagnostic Journal

13].International reasearch journel of engineering and technology (IRJET). Internet of things based on smart grid, Shahid Yusuf wani, shaver Sharma.

14]. a review on iot based smart grid, maninder kaur and Dr. Sheetal Kalra.

15]. U. S. DOE, "Communications requirements of Smart Grid technologies," Tech. Rep., US Department of Energy, 2010, http://energy.gov/gc/downloads/communicationsrequirements-smart-grid-technologies

16]. Nodejs Official website :- https://nodejs.org/en

17]. EJS (Embedded Javascript tempalting) official website :- https://ejs.co/

ANNEXURE I

PLAGAIRISM REPORT

Mrunmay

by Dr. Vijay M Deshmukh

Submission date: 15-Apr-2024 04:17PM (UTC+0700)
Submission ID: 2273794790
File name: Thesis_95_PercentDone_.docx (4.44M)
Word count: 11671
Character count: 65930

Mrunmay

ORIGINALITY REPORT

6%	5%	3%	4%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

1	www.jetir.org Internet Source	1%
2	Submitted to Universitas Islam Lamongan Student Paper	1%
3	repo.darmajaya.ac.id Internet Source	1%
4	Pedro Ponce, Luis Ibarra, Omar Mata, Arturo Molina. "How to develop research skills among undergraduate engineering students to tackle current ongoing topics? A Smart-Grid case study", International Journal of Electrical Engineering Education, 2019 Publication	1%
5	www.coursehero.com Internet Source	<1%
6	www.studymode.com Internet Source	<1%
7	A. S. Werulkar, P. S. Kulkarni. "Design of a constant current solar charge controller with microcontroller based soft switching buck	<1%

converter for solar home lighting system", 2012 IEEE International Conference on Power Electronics, Drives and Energy Systems (PEDES), 2012
Publication

8	forum.arduino.cc Internet Source	<1%
9	www.theseus.fi Internet Source	<1%
10	Submitted to Universiti Tenaga Nasional Student Paper	<1%
11	mcehassan.ac.in Internet Source	<1%
12	ece.anits.edu.in Internet Source	<1%
13	forum.arduino.ru Internet Source	<1%
14	www.uok.ac.in Internet Source	<1%
15	tudr.thapar.edu:8080 Internet Source	<1%
16	Rishabh Jain. "Advanced Home Automation Using Raspberry Pi", Springer Science and Business Media LLC, 2021 Publication	<1%

ANNEXURE II: DATA SHEETS
Pin Configuration of ESP8266

Pin Category	Name	Description
Power	Micro-USB, 3.3V, GND, Vin	**Micro-USB:** NodeMCU can be powered through the USB port **3.3V:** Regulated 3.3V can be supplied to this pin to power the board **GND:** Ground pins **Vin:** External Power Supply
Control Pins	EN, RST	The pin and the button resets the microcontroller
Analog Pin	A0	Used to measure analog voltage in the range of 0-3.3V
GPIO Pins	GPIO1 to GPIO16	NodeMCU has 16 general purpose input-output pins on its board
SPI Pins	SD1, CMD, SD0, CLK	NodeMCU has four pins available for SPI communication.
UART Pins	TXD0, RXD0, TXD2, RXD2	NodeMCU has two UART interfaces, UART0 (RXD0 & TXD0) and UART1 (RXD1 & TXD1). UART1 is used to upload the firmware/program.
I2C Pins		NodeMCU has I2C functionality support but due to the internal functionality of these pins, you have to find which pin is I2C.

Table No. 1 : Data Sheet for ESP8266

ANNEXURE III

SOFTWARE PROGRAM DETAILS

```
#ifdef ESP32
#include <WiFi.h>
#include <HTTPClient.h>
#else
#include <ESP8266WiFi.h>
#include <ESP8266HTTPClient.h>
#include <WiFiClient.h>
#endif
#define relay1 D1
#define relay2 D2
#define relay3 D5
int u,c,d=0;
#include <Wire.h>

const char* ssid = "NIKHIL SIR";
const char* password = "123456789";
unsigned long lastTime = 0;
int b=1;
int box=1;
unsigned long timerDelay = 10000;
int device_status1;
int device_status2;
int device_status3;
void setup() {
Serial.begin(9600);
pinMode(relay1,OUTPUT);
digitalWrite(relay1,LOW);
pinMode(relay2,OUTPUT);
digitalWrite(relay2,LOW);
pinMode(relay3,OUTPUT);
digitalWrite(relay3,LOW);
WiFi.begin(ssid, password);
Serial.println("Connecting");
while(WiFi.status() != WL_CONNECTED) {
delay(500);
Serial.print(".");
}
Serial.println("");
Serial.print("Connected to WiFi network with IP Address: ");
Serial.println(WiFi.localIP());
pinMode(D7,INPUT);
}
String payload ;
String payload2 ;
String payload3 ;
```

```
void loop() {

WiFiClient client1;
WiFiClient client2;
WiFiClient client3;
HTTPClient http1;
HTTPClient http2;
HTTPClient http3;
//Nikhil
http1.begin(client1,"http://api.thingspeak.com/apps/thinghttp/send_request?api_key=DZUFRSBCTM2YV7AB")
;  //Specify request destination
int httpCode1 = http1.GET();
if (httpCode1 > 0) { //Check the returning code
payload = http1.getString();   //Get the request response payload
device_status1 = payload.toInt();
Serial.print("Device 1 Status=");
Serial.print(device_status1); //Print the response payload
Serial.println();
}
   if(device_status1 == 1){

digitalWrite(relay1,LOW);
Serial.println("Device 1 ON");
u=0;
}
else if(device_status1 == 0 && u==0){
digitalWrite(relay1,HIGH);
Serial.println("Device 1 OFF");
u=1;
sms1();
}
http1.end();
delay(2000); //Mrinmay
http2.begin(client2,"https://api.thingspeak.com/apps/thinghttp/send_request?api_key=2VB3I1AVCORBKV5P")
;  //Specify request destination
int httpCode2 = http2.GET();
if (httpCode2 > 0) { //Check the returning code
payload2 = http2.getString();   //Get the request response payload
device_status2 = payload2.toInt();
Serial.print("Device 2 Status=");
Serial.print(device_status2); //Print the response payload
Serial.println();
}
if(device_status2 == 1){
digitalWrite(relay2,LOW);
// Serial.println("Device 1 ON");
d=0;
}
else if(device_status2 == 0 && d==0){
digitalWrite(relay2,HIGH); d=1;
// Serial.println("Device 1 OFF");
```

```
sms2();
}
http2.end();
delay(2000);
//Nilay
http3.begin(client3,"http://api.thingspeak.com/apps/thinghttp/send_request?api_key=4DDRIZ7OJ1R0F50N");
//Specify request destination
int httpCode3 = http3.GET();
if (httpCode3 > 0) { //Check the returning code
payload3 = http3.getString();   //Get the request response payload
device_status3 = payload3.toInt();
Serial.print("Device 3 Status=");
Serial.print(device_status3); //Print the response payload
Serial.println();
}
if(device_status3 == 1){
digitalWrite(relay3,LOW);
// Serial.println("Device 1 ON");
c=0;
}
else if(device_status3 == 0 && c==0){
digitalWrite(relay3,HIGH); c=1;
// Serial.println("Device 1 OFF");
sms3();
}
http3.end();
delay(4000);
}
void sms3()
{
Serial.print("AT");  //Start Configuring GSM Module
delay(1000);         //One second delay
Serial.println();
Serial.println("AT+CMGF=1");  // Set GSM in text mode
delay(1000);                 // One second delay
Serial.println();
Serial.print("AT+CMGS=");     // Enter the receiver number
Serial.print((char)34);
Serial.print("+917249716907");

//Serial.print("+917249716907");
Serial.println((char)34);

delay(1000);
Serial.print("Dear Consumer, Energy Bill for Cons:419110151123 of Rs.6000 is Due therefore your Electricity
is cut off. Please pay bill and Electricity will be turned ON.Customer care.18001023435");
Serial.println();
delay(500);
Serial.write(26);
delay(1000);
Serial.println();
```

```
Serial.print(" ");

}
void sms1()
{
Serial.print("AT");  //Start Configuring GSM Module
delay(1000);        //One second delay
Serial.println();
Serial.println("AT+CMGF=1");  // Set GSM in text mode
delay(1000);                // One second delay
Serial.println();
Serial.print("AT+CMGS=");     // Enter the receiver number
Serial.print((char)34);
Serial.print("+917887748563");

Serial.println((char)34);

delay(1000);
Serial.print("Dear Consumer, Energy Bill for Cons:419110154343 of Rs.4000 is Due therefore your Electricity
is cut off. Please pay bill and Electricity will be turned ON.Customer care.18001023435");

Serial.println();
delay(500);
Serial.write(26);
delay(1000);
Serial.println();
Serial.print(" ");
}
void sms2()
{
Serial.print("AT");  //Start Configuring GSM Module
delay(1000);        //One second delay
Serial.println();
Serial.println("AT+CMGF=1");  // Set GSM in text mode
delay(1000);                // One second delay
Serial.println();
Serial.print("AT+CMGS=");     // Enter the receiver number
Serial.print((char)34);
Serial.print("+919156685436");
Serial.println((char)34);
delay(1000);
Serial.print("Dear Consumer, Energy Bill for Cons:419110154444 of Rs.5000 is Due therefore your Electricity
is cut off. Please pay bill and Electricity will be turned ON.Customer care.18001023435");

Serial.println();
delay(500);
Serial.write(26);
delay(1000);
Serial.println();
Serial.print(" ");
}
```

ANNEXURE IV

PAPER

PRESENTED

AUTOMATED ELECTRIC GRID CUTOFF SYSTEM FOR NON-PAID CUSTOMER

Guided by - Dr. Amol Pardhi[1]

Assistant Professor, Department of Electronics and Telecommunication Engineering,
St. Vincent Pallotti College of Engineering & Technology,
Nagpur, Maharashtra, India

Mrunmay Chichkhede[2]
Student of Electronics & Tele-communication Department
St.Vincent Pallotti College Of Engineering & Technology
Nagpur, India
mchichkhede2002@gmail.com

Nilay Kanire[3]
Student of Electronics & Tele-communication Department
St.Vincent Pallotti College Of Engineering & Technology
Nagpur, India
nilaykanire.fy20@stvincentngp.edu.in

Nikhil Patil[4]
Student of Electronics & Tele-communication Department
St.Vincent Pallotti College Of Engineering & Technology
Nagpur, India
nikhilpatil99.a@gmail.com

Rajat Thote[5]
Student of Electronics & Tele-communication Department
St.Vincent Pallotti College Of Engineering & Technology
Nagpur, India
rajatthote.fy20@stvincentngp.edu.in

Swaraj Deshmukh[6]
Student of Electronics & Tele-communication Department
St.Vincent Pallotti College Of Engineering & Technology
Nagpur, India
swarajd2204@gmail.com

Aditya Meshram[7]
Student of Electronics & Tele-communication Department
St.Vincent Pallotti College Of Engineering & Technology
Nagpur, India
adityameshram0899@gmail.com

Abstract - In today's age, automation has become a focal point of discussion alongside the Internet's evolution. This document delves into the creation of an automated system aimed at disconnecting residential electricity, employing a network-based embedded controller. With discussions revolving around the challenges governments face in managing electricity issues, there's a clear incentive to develop such a system. The suggested approach involves an microcontroller controlling the main electrical supply switch and updating pertinent information in a centralized data repository. To alert users about impending electricity cutoffs, the system utilizes GSM and short message services. This technological solution not only aids in curbing electricity consumption but also assists providers in mitigating operational costs by disconnecting electricity when usage exceeds predefined limits. Particularly, in regions with non-paying consumers resorting to illicit activities, such as tampering with meters or bribery, this project aims to support governmental initiatives by ensuring timely bill payments, thereby enhancing revenue collection.

Keywords - Automated Electric Grid, Grid Automation, Smart Grid Technology.

I - INTRODUCTION

In today's landscape, automation garners significant attention alongside the internet's advancement. This project focuses on an automation system designed for residential electricity cutoffs, employing a network-based embedded controller. Discussions often revolve around governmental challenges in managing electricity issues, driving the need for such automated systems. The proposed solution encompasses an embedded device managing the power supply main switch and updating relevant data centrally. Users receive cutoff warnings through Global System for Mobile Communications using SMS. This setup benefits electricity providers by reducing operational costs through automatic disconnection when usage limits are exceeded. Notably, in regions with non-paying consumers resorting to illicit activities, such as meter tampering or bribery, this project aims to support governmental initiatives by ensuring timely bill payments and addressing electricity theft issues.

II - LITERATURE SURVEY

In recent years, the Internet of Things (IoT) has revolutionized various aspects of our daily lives, including the way we control and manage electrical devices in our homes and industries. Several research studies have been conducted to explore the potential of IoT-based solutions for automated control and monitoring of electrical devices. This literature survey highlights some of the key findings and contributions from these studies.

One of the early works in this field is the research paper on IoT-based automatic control of electrical devices using a smart switch, published in October 2017 in the International Journal for Research in Applied Science and Engineering Technology (IJRASET). This paper proposed a system that enables users to remotely control and monitor electrical devices using IoT technology, providing convenience and energy efficiency benefits [1].Another significant contribution is the research paper on a smart switch to connect and disconnect electrical devices at home using the internet, published in the International Research Journal of Engineering and Technology (IRJET). This paper introduced a smart switch that allows users to control electrical devices remotely over the internet, enhancing convenience and enabling energy-saving practices [2].Siddarameswara et al. (2014) proposed a GSM-based electricity identification system for houses and industries. The system aimed to improve energy management and monitoring by using GSM technology for remote control and monitoring of electricity consumption [4].Abhinandanjain et al. (2012) presented a design and development of a GSM-based energy meter. Their work focused on developing a cost-effective solution for remote energy meter reading and monitoring, leveraging the capabilities of GSM technology for data transmission and communication [5].Another notable contribution is the research by Abdollahi et al. (2007), who proposed an SMS-based reconfigurable automatic meter reading system for control applications. Their system aimed to enhance the efficiency and accuracy of meter reading by using SMS technology for data transmission and communication [6]..

III - METHODOLGY

This research focuses on implementing an Automated Electric Grid Cut-Off System for Non-Paid Consumers using IoT technology. Key hardware components include microcontrollers (NodeMCU ESP8266), relays, GSM modules. The software integrates MongoDB for data storage, Express.js and Node.js for backend operations, HTML, CSS, JavaScript, and EJS for frontend development, and Google Email API for communication. The methodology emphasizes robust hardware infrastructure and modern web development technologies to effectively monitor and control electricity supply.

Steps to follow for the website :-

1. Go to the website through the link given to you https://mahavitran-pro.onrender.com/home

2. As per your role, click on the given option.

3. Enter your credentials in the login page.

4. As per your role and entered credentials, you will get forwarded to your assigned page and get access to the functionality specific to your role.

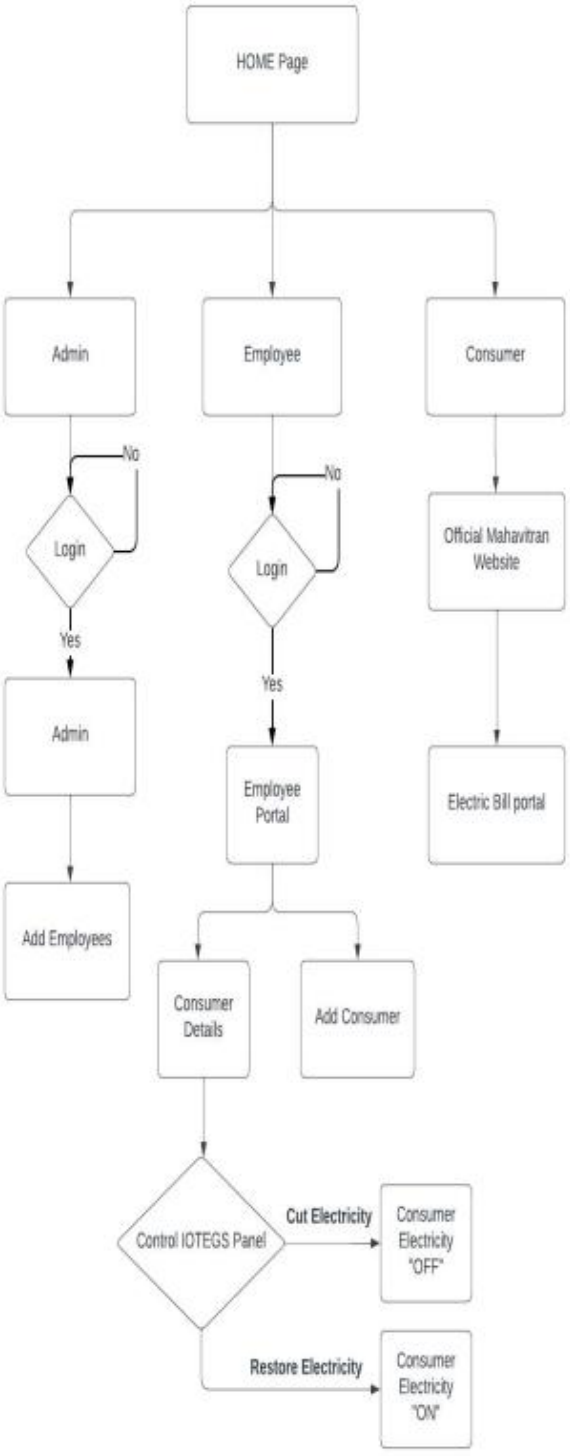


Fig (1). Flowchart of Website

IV - CIRCUIT DIAGRAM

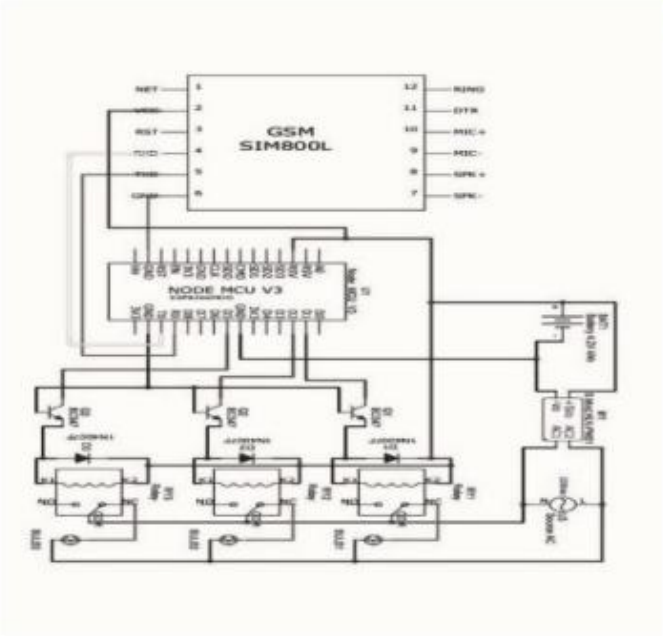


Fig (2). ciruit diagram of electric gird cut off system

Traditional systems involve electricity meters installed at consumers' premises, and meter-readers collect electricity consumption data during periodic visits. To address issues with this conventional setup, we are developing an "IoT-Based Grid Cut-Off System for Unpaid Consumers." The architecture includes NodeMCU ESP8266, SIM800l, and Relays. Energy consumption was previously calculated monthly by MSEB personnel. If a consumer fails to pay their bill, our online system will remotely disable the grid and send an SMS notification. The NodeMCU, equipped with Wi-Fi for continuous monitoring, plays a key role. It monitors the system online and triggers relay-based circuit disconnection upon receiving a command. The SPDT relay manages supply disconnection and reconnection based on microcontroller instructions. When a consumer neglects bill payment, NodeMCU automatically severs the supply via relays. Once the bill is settled, the system restores the connection. A dedicated circuit in the consumer's home acquires data, uploading it to a cloud service for MSEB and customer access.

The Esp8266 module, serving as a microcontroller, controls the entire system. Positioned between the mains line and the home's incoming supply to the energy meter, the circuit operates with a 230V AC input. Each meter phase has one input and output port, with the output phase wire connected to a load (e.g., a bulb) through a relay. The relay defaults to a closed position, and the circuit becomes active when the relay is closed.

V - BLOCK DIAGRAM

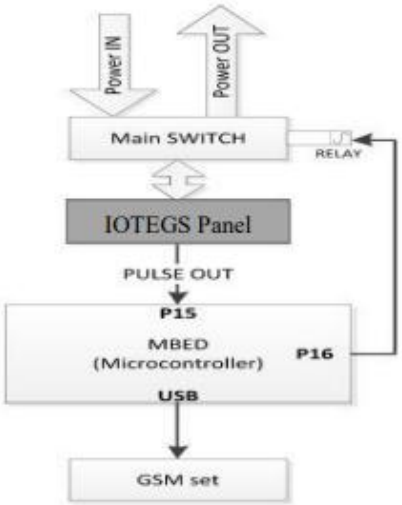


Fig (3). Automation of Residential Electricity Cut Off Using GSM Based Controller

The project model streamlines the labor-intensive tasks. The utilization of ESP8266 in our setup offers numerous benefits for wireless network systems. In this initiative, we are introducing a system designed to provide early alerts to users regarding the government-provided electric power. Currently, all clients rely on manual communication methods. To minimize manual efforts and mitigate human errors, the implementation of an automated system that monitors all parameters and the functionality of connections between consumers and the electricity board is crucial. Furthermore, deploying this system allows us to regulate electricity consumption on the consumer's end, preventing unnecessary power wastage.

Given the current scenario, it is imperative to establish an automated mechanism for monitoring and controlling energy usage, ensuring a more efficient and effective approach in the power sector.

VI - EXPERIMENTAL RESULT

In this phase of our research, the IoT-based grid cut-off system for non-paid consumers was thoroughly tested to evaluate its performance. The system underwent rigorous testing procedures to assess its effectiveness in monitoring energy consumption, enforcing timely payment of electricity bills, and automating the grid cut-off process. Data collected during the testing phase included electricity consumption patterns, payment statuses, grid cut-off events, and system

response times. Through extensive testing, it was observed that the system successfully achieved its objectives by promptly disconnecting electricity for non-paid consumers when necessary, thereby reducing energy wastage and promoting responsible energy consumption practices. The system's performance was evaluated based on predefined metrics such as accuracy, reliability, and efficiency, with results indicating high levels of effectiveness in meeting the specified requirements

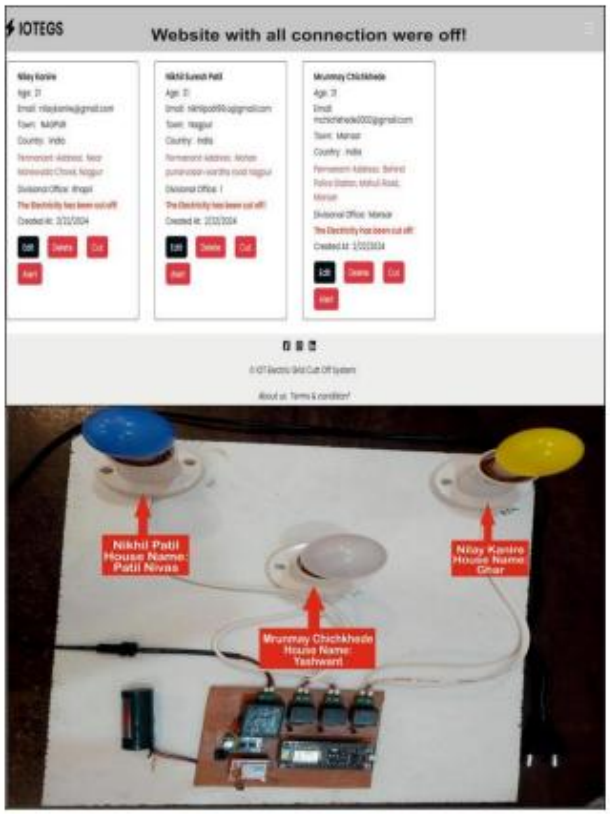
While certain challenges and limitations were encountered during the experimental phase, such as technical issues and operational constraints, overall, the experimental results demonstrated the feasibility and potential of the proposed system in addressing the identified research objectives and contributing to the efficient management of residential electricity supply.

1] Website with Consumer name "Nilay have electrical supply ON and remaining consumers connection are OFF", As shown in the fig (5).

Fig (4). Hardware when only consumer Nilay connection is "ON"

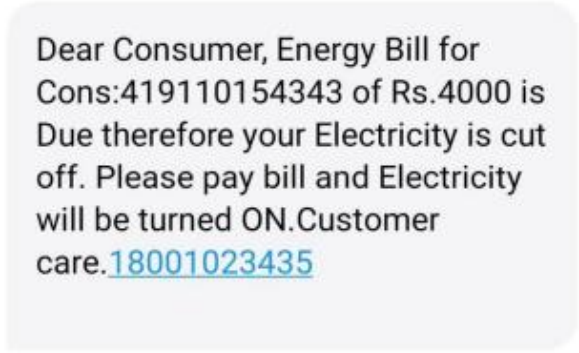
2] Website after disconnecting consumer nilay electrical supply :

The Hardware is link with the website.The connection of the consumer Nilay is currently disconnected as shown in the fig (4) due to the non-payment of electrical bill.



Fig(5).Hardware when consumer Nilay connection is cut-off

After disconnecting the electrical supply of the consumer named "Nilay Kanire", the gsm module will send the sms to the consumer's registered mobile number.



Fig(6). SMS via gsm module

VII - RESEARCH GAP

Based on the analysis of the other research papers several research gaps were identified and addressed in our work:
Integration of IoT Technology: While the others research discuss the use of IoT technology in managing electricity supply to some extent, our research specifically focuses on integrating IoT devices like NodeMCU ESP8266 and relays to automate the process of disconnecting electricity for non-paying consumers through our website. This emphasis on IoT integration for real-time monitoring and control of electricity supply through our website represents a significant research gap addressed in our paper.
Enhanced Security Measures: Our research places a strong emphasis on security measures, including authentication and authorization mechanisms, to protect consumer and employee data from unauthorized access. While some of the other research mention security concerns, our research provides a more detailed discussion on implementing robust security features, filling a research gap in ensuring data privacy and integrity in electricity management systems.
Cost-Effective Solution: Another research gap addressed in our research is the focus on cost-effectiveness without compromising functionality and accuracy. While some of the others research discuss the technical aspects of electricity management systems, our research highlights the importance of developing economically viable solutions, making it accessible to a broader range of users.
User-Friendly Interface: Our research emphasizes the development of a user-friendly interface using HTML, CSS, JavaScript, and EJS, allowing consumers and employees to interact with the system effortlessly. This focus on usability and accessibility fills a research gap in ensuring that technology solutions are intuitive and easy to use for various stakeholders involved in electricity management.
Overall, our research contributes to filling several research gaps identified in the existing literature by providing a comprehensive solution that integrates IoT technology, enhances security measures, ensures cost-effectiveness, offers a user-friendly interface for effective electricity management.

VIII - RESULT

The Automated Electric Grid Cut of System implementation successfully demonstrated a system capable of automatically disconnecting the electrical supply when a user has not paid their bill, thereby eliminating the need for manual intervention by employees. This system effectively restored electricity upon bill payment, relieving employees of the physical tasks associated with cutting and restoring electricity and reminding users to pay their bills. The automation provided by this system not only improves efficiency but also reduces operational costs and enhances customer satisfaction.

IX - CONCLUSION

The project introduces an IoT-based grid cut-off system for non-paid consumers, streamlining labor-intensive tasks and leveraging ESP8266 benefits for wireless network systems. Automation minimizes manual efforts, mitigates errors, and regulates electricity consumption, contributing to efficient power sector management. Establishing automated mechanisms for monitoring and controlling energy usage is imperative in the current scenario.To minimize manual efforts and mitigate human errors, the implementation of an automated system that monitors all parameters and the functionality of connections between consumers and the electricity board is crucial. Furthermore, deploying this system allows us to regulate electricity consumption on the consumer's end, preventing unnecessary power wastage.
Given the current scenario, it is imperative to establish an automated mechanism for monitoring and controlling energy usage, ensuring a more efficient and effective approach in the power sector.

ACKNOWLEDGMENT

The successful completion of this project would not have been possible without the support and guidance of many individuals. We would like to extend our deepest gratitude and appreciation to all who have contributed to this research.
First and foremost, we are profoundly grateful to our guide, Dr. Amol Pardhi, Assistant Professor, Department of Electronics and Telecommunication Engineering, St. Vincent Pallotti College of Engineering & Technology, Nagpur, Maharashtra, India. His invaluable guidance, insightful feedback, and constant encouragement have been instrumental in the completion of this project.We also wish to express our sincere thanks to the faculty and staff of the Department of Electronics and Telecommunication Engineering at St. Vincent Pallotti College of Engineering & Technology for providing us with the necessary resources and a conducive environment for our research.

REFERENCES

[1] IoT Based Automatic Control of Electrical Devices Using Smart Switch, (IJRASET), October 2017.
[2] A smart switch to connect and disconnect electrical devices at home by using internet, International Research Journal of Engineering and Technology (IRJET).
[3] Siddarameswara H.N., "GSM based electricity the identification in houses and in industry sector", ICEE-21 June 2014, ISBN-978-93-81693-6603-03.
[4] Abhinandanjain, Dilip Kumar, Jyoti Kedia, "Design and Development of GSM based Energy Meter", IJERT, 2012.
[5] Abdollahi, A. Dehghani, M. Zamanzadech, "SMS-based Reconfigurable automatic meter reading system" in control applications, 2007.

[6] Barath, P.; Ananth, N.; Vijetha, S.; Prakash, K.V.J.; "Wireless automated digital energy control meter". In sustainable energy technologies, ICSET 2008.
[7] GSM Based Controlled Switching Circuit, IJCER, 2013.
[8] S. Arun; Dr. Sidappa Naidu, "Design and Implementation of Automatic Meter Reading System Using GSM ZIGBEE through GPRS" in international journal of advance research in computer science engineering, 2012.
[9] Primicanta, A.; Nayan, M. & Awan, M. Hybrid Automatic Meter Reading System Computer Technology and Development, 2009. ICCTD '09. International Conference on, 2009.
[10] Norozina, A.; ICT in Service Delivery in TNB, Institute Tadbiran Awam Negara - Public Sector ICT Management Review: ICT in Service Delivery, 2008.
[11] Tan, H., Lee, C. & Mok, V.; Automatic power meter reading system using GSM network Power Engineering Conference, 2007. IPEC 2007. International, 2007
[12] Ouchida, S., Nikpour, A., & Fairbrother, G. (2020). Reducing EEG (electroencephalogram) electrode-induced skin injury among ambulatory EEG monitored patients: a non-randomized interventional study of two commonly used cream-based products for electrode application. The Neurodiagnostic Journal, 60(4), 300-316.
[13] International Research Journal of Engineering and Technology (IRJET). Internet of things based on smart grid, Shahid Yusuf wani, shaver Sharma.
[14] A review on iot based smart grid, Maninder Kaur and Dr. Sheetal Kalra.
[15] U. S. DOE, "Communications requirements of Smart Grid technologies," Tech. Rep., US Department of Energy, 2010,
http://energy.gov/gc/downloads/communicationsrequirements-smart-grid-technologies
[16] Nodejs Official website: https://nodejs.org/en
[17] EJS (Embedded Javascript tempalting) official website: https://ejs.co/
[18] Bootstrap official website: https://getbootstrap.com/
[19] MongoDB official website: https://www.mongodb.com/
[20] Expressjs official website: https://expressjs.com/
[21] W3Schools Online web tutorials: www.w3schools.com

CERTIFICATE


ST. VINCENT PALLOTTI
COLLEGE OF ENGINEERING & TECHNOLOGY, NAGPUR
(AN AUTONOMOUS INSTITUTION)
EUPHORIC 20 YEARS
International Conference on
Technological Innovations & Applications In Industry 4.0:
Challenges And Way Ahead (ICTIA-2024)
Organized by
Department of Mechanical Engineering
St. Vincent Pallotti College of Engineering & Technology, Nagpur
24TH - 25TH APRIL, 2024
CRC Press
Taylor & Francis Group
ISHRAE
Certificate Proudly Presented to
Nikhil Patil
For presenting the technical paper titled
Automated Electric Grid Cutoff System For Non-Paid Customer
Dr. Fr. Paul Chandrankunnel
Director
Dr. S. V. Gole
Principal
Dr. S. S. Satputaley
Convenor
Dr. M. A. Rehman
Convenor


ST. VINCENT PALLOTTI
COLLEGE OF ENGINEERING & TECHNOLOGY, NAGPUR
(AN AUTONOMOUS INSTITUTION)
EUPHORIC 20 YEARS
International Conference on
Technological Innovations & Applications In Industry 4.0:
Challenges And Way Ahead (ICTIA-2024)
Organized by
Department of Mechanical Engineering
St. Vincent Pallotti College of Engineering & Technology, Nagpur
24TH - 25TH APRIL, 2024
CRC Press
Taylor & Francis Group
ISHRAE
Certificate Proudly Presented to
Nilay Kanire
For presenting the technical paper titled
Automated Electric Grid Cutoff System For Non-Paid Customer
Dr. Fr. Paul Chandrankunnel
Director
Dr. S. V. Gole
Principal
Dr. S. S. Satputaley
Convenor
Dr. M. A. Rehman
Convenor


ST. VINCENT PALLOTTI
COLLEGE OF ENGINEERING & TECHNOLOGY, NAGPUR
(AN AUTONOMOUS INSTITUTION)
EUPHORIC 20 YEARS
International Conference on
Technological Innovations & Applications In Industry 4.0:
Challenges And Way Ahead (ICTIA-2024)
Organized by
Department of Mechanical Engineering
St. Vincent Pallotti College of Engineering & Technology, Nagpur
24TH - 25TH APRIL, 2024
CRC Press
Taylor & Francis Group
ISHRAE
Certificate Proudly Presented to
Aditya Meshram
For presenting the technical paper titled
Automated Electric Grid Cutoff System For Non-Paid Customer
Dr. Fr. Paul Chandrankunnel
Director
Dr. S. V. Gole
Principal
Dr. S. S. Satputaley
Convenor
Dr. M. A. Rehman
Convenor


ST. VINCENT PALLOTTI
COLLEGE OF ENGINEERING & TECHNOLOGY, NAGPUR
(AN AUTONOMOUS INSTITUTION)
EUPHORIC 20 YEARS
International Conference on
Technological Innovations & Applications In Industry 4.0:
Challenges And Way Ahead (ICTIA-2024)
Organized by
Department of Mechanical Engineering
St. Vincent Pallotti College of Engineering & Technology, Nagpur
24TH - 25TH APRIL, 2024
CRC Press
Taylor & Francis Group
ISHRAE
Certificate Proudly Presented to
Swaraj Deshmukh
For presenting the technical paper titled
Automated Electric Grid Cutoff System For Non-Paid Customer
Dr. Fr. Paul Chandrankunnel
Director
Dr. S. V. Gole
Principal
Dr. S. S. Satputaley
Convenor
Dr. M. A. Rehman
Convenor

ST. VINCENT PALLOTTI
COLLEGE OF ENGINEERING & TECHNOLOGY, NAGPUR
(AN AUTONOMOUS INSTITUTION)

EUPHORIC 20 YEARS

International Conference on
Technological Innovations & Applications In Industry 4.0:
Challenges And Way Ahead (ICTIA-2024)

Organized by
Department of Mechanical Engineering
St. Vincent Pallotti College of Engineering & Technology, Nagpur

24TH - 25TH APRIL, 2024

CRC Press
Taylor & Francis Group

ISHRAE

Certificate Proudly Presented to

Rajat Thote

For presenting the technical paper titled

Automated Electric Grid Cutoff System For Non-Paid Customer

Dr. Fr. Paul Chandrankunnel
Director

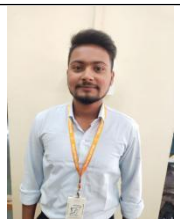
Dr. S. V. Gole
Principal

Dr. S. S. Satputaley
Convenor

Dr. M. A. Rehman
Convenor

ANNEXURE V

PROJECT MEMBER DETAILS

1	Name : Mrunmay Chichkhede Roll no. : 49 Sec : A Phone no : Email id : mrunmaychichkhede.fy20@stvincentngp.edu.in	
2	Name : Nikhil Patil Roll no. : 50 Sec : A Phone no : Email id : nikhilpatil.fy20@stvincentngp.edu.in	
3	Name : Nilay Kanire Roll no. : 51 Sec : A Phone no : Email id : nilaykanire.fy20@stvincentngp.edu.in	
4	Name : Swaraj Deshmukh Roll no. : 65 Sec : A Phone no : Email id : swarajdeshmukh.fy20@stvincentngp.edu.in	
5	Name : Rajat Thote Roll no. : 57 Sec : A Phone no : Email id : rajatthote.fy20@stvincentngp.edu.in	
6	Name : Aditya Meshram Roll no : 34 Sec : A Phone no : Email id : adityameshram.fy20@stvincentngp.edu.in	

ST. VINCENT PALLOTTI COLLEGE OF ENGINEERING AND TECHNOLOGY, NAGPUR
DEPARTMENT OF ELECTRONICS & TELECOMMUNICATION ENGINEERING

Course Name: Project **Course Code: BEETE806P**

Semester: VIII

Course (Project) Objectives

1. To design and develop an automated system capable of remotely managing the grid's power supply to disconnect electricity for non-paying customers efficiently.

2] To integrate alert mechanisms such as SMS notifications to inform customers about impending electricity cutoffs due to unpaid bills, fostering proactive action.

3] To create a user-friendly web interface accessible to both customers and administrators, facilitating easy navigation and interaction with the system.

4] To establish a centralized data management system using MongoDB for secure storage and efficient retrieval of consumer information, enabling quick decision-making.

5] To develop a cost-effective solution for electricity providers to streamline revenue collection processes and minimize operational costs associated with manual interventions.

6] To raise awareness among consumers about the importance of timely bill payments and responsible energy usage through the implementation of the project's automated features.

Course (Project) Outcomes (COs):

BEETE806P.1 [CO1]	To define problem statement for the project by carrying out suitable literature survey and keeping emphasis on industry based innovative application in Electronics and Telecommunication Engineering.
BEETE806P.2 [CO2]	To present work, ideas, and also interpret, analyze, test, integrate real life systems with good interpersonal relationship and leadership qualities.
BEETE806P.3 [CO3]	To develop a real life system using different modern computing tools and innovative ideas
BEETE806P.4 [CO4]	To understand importance of lifelong learning with an emphasis on social impact and concern to environmental issues.
BEETE806P.5 [CO5]	To enhance entrepreneurship skills

Mapping of COs &

POsAttainment Level:

1. Slight **2. Moderate** **3. Substantial**

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	3	2	1	2	3	2	2	3	3	2	3	2	2
CO2	3	2	2	1	2	3	2	2	2	2	2	3	2	2
CO3	3	2	2	3	3	2	2	2	2	2	2	3	2	3
CO4	3	2	2	2	2	3	2	2	2	2	2	3	2	2
CO5	2	2	2	2	2	3	2	2	2	2	2	2	2	2

Types and Relevance of the Project and their contribution towards attainments of Pos

Attainment Level:

1. Slight **2. Moderate** **3. Substantial**

Sr. no	Title of the Project	Relevance to Course/s	ICs used	S/W	Quality				Type			
					Environment	Safety	Ethics	Cost	Application	Product	Research	Review
1	"DESIGN AND DEVELOPMENT OF ELECTRIC GRID CUT-OFF SYSTEM"	IOT, EDC	ESP8266 L298N	Arduino IDE,	2	2	1	3	3	2	2	2