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Automated Electric Grid Cutoff System for Non-Paid Customer

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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

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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.

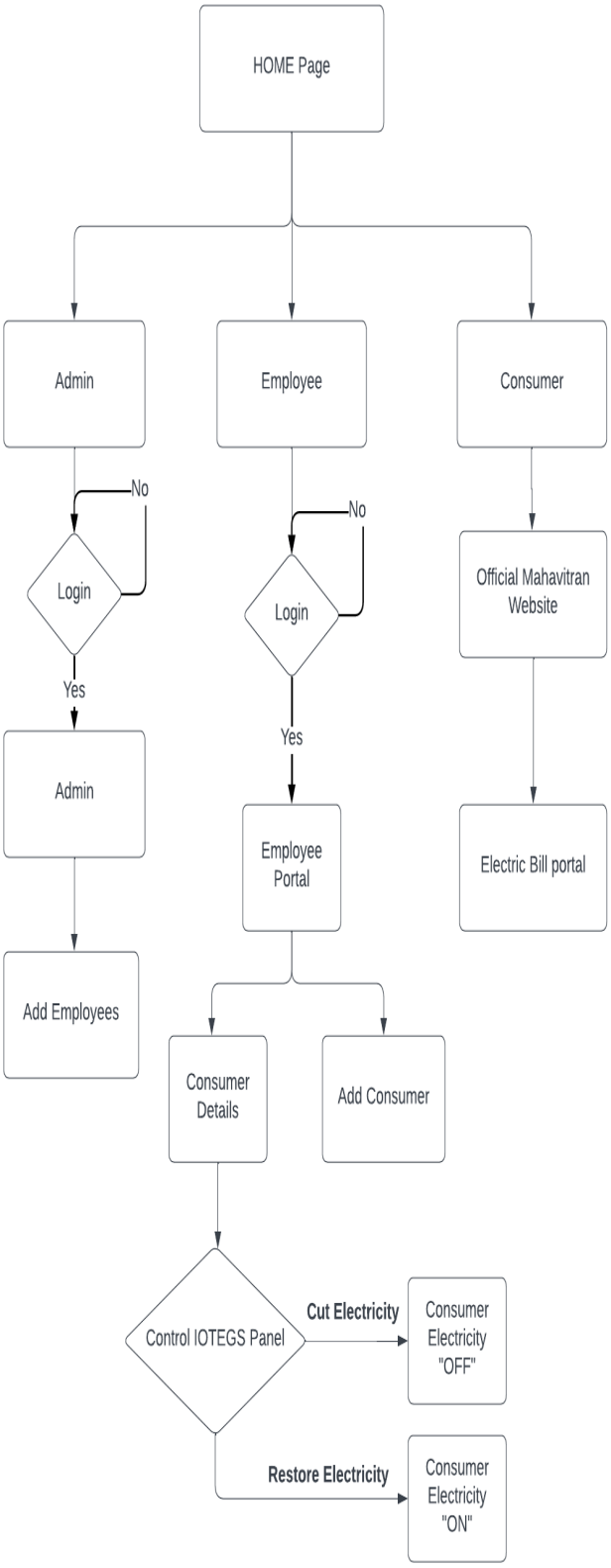

Fig (1). Flowchart of Website

IV - CIRCUIT DIAGRAM

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Vol. 9, No. 7, 2024, PP. 39-44

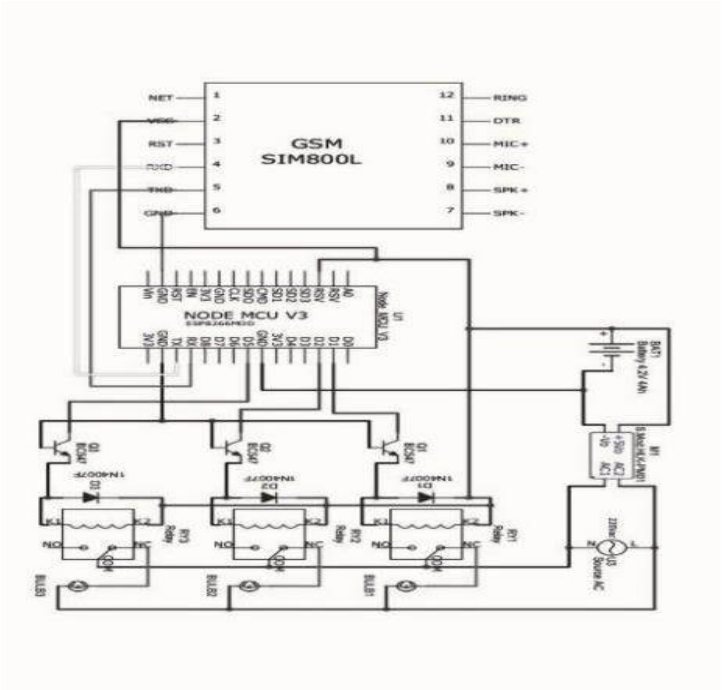

Fig (2). ciruit diagram of electric gird cut off system

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

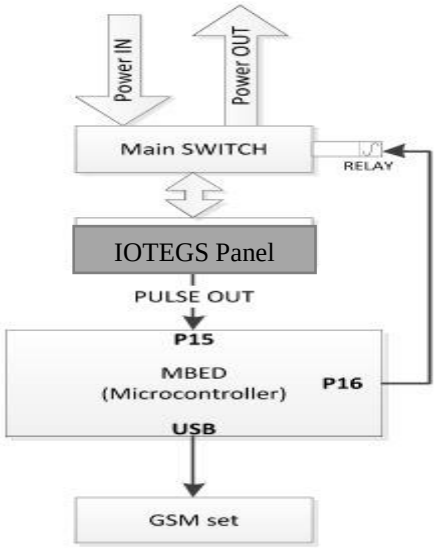

Fig (3). Automation of Residential Electricity Cut Off Using GSM Based Controller

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

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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).

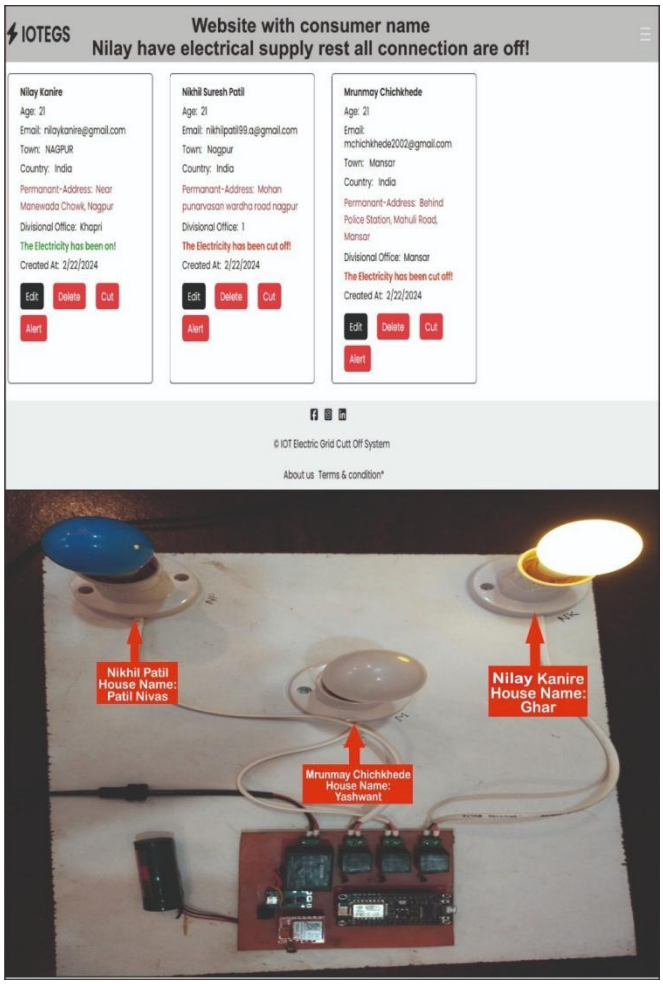
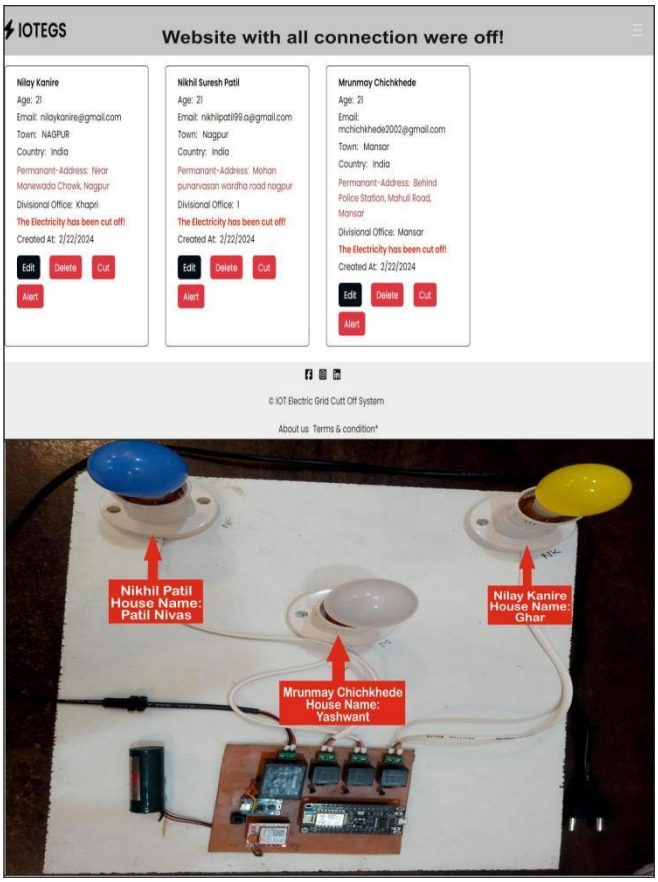


Fig (4). Hardware when only consumer Nilay connection is "ON"

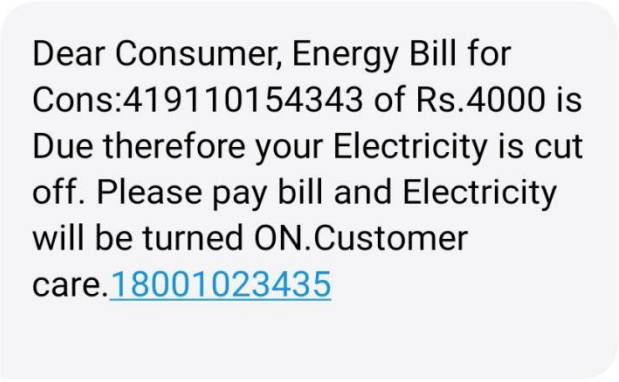
2] Website after disconnecting consumer nilay electrical supply :

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:

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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.

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