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IOT BASED ELECTRICITY THEFT DETECTION SYSTEM

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Abstract: Innovative solutions for various industries have been developed as a result of the proliferation of Internet of Things (IoT) devices. IoT has the potential to completely change how electricity is produced, transmitted, and used in the electricity sector. The use of IoT for detecting and preventing electricity theft is one such application. Meter tampering, also known as electricity theft, is a significant problem that affects the revenue and profitability of electricity boards. It entails circumventing meters in an unlawful manner in order to use electricity without paying for it. In this project, we propose creating an IoT-based system to track down and stop electricity theft. Smart meters with sensors and communication capabilities make up the system, along with a central server for data processing and analysis. Electricity consumption patterns are continuously monitored by smart meters, which also send data to a central cloud-based database. The database values are utilized by the authorities when it discovers anomalies or suspicious activity upon close monitoring of the data stored in real-time. The proposed system could significantly lower the number of instances of electricity theft, increasing revenue and profitability for the electricity providers while enhancing consumer safety. By offering real-time information on electricity consumption and billing, it can also assist utilities in streamlining their operations and enhancing customer service.

Keywords: **Database, Internet Of Things, Meter Tampering, Real Time Information, Smart Meters.**

I. INTRODUCTION

IOT has the propensity to alter people's lifestyles. People prefer to monitor things through automatic systems in today's world rather than through any manual system together with the circuitry driving the system, which are the main elements of the IOT-based electricity theft detection system introduced in this project. An economy's production and consumption of electricity are key determinants of its size and development, electricity theft slows economic growth. Even though exporting electric power is rarely profitable, most of it is produced for domestic use. Even though only a few nations profit from the export of electric power, the majority of it is used for domestic consumption in developing nations.

II. MOTIVATION

Electricity thefts are increasing every year across domestic as well as industrial domains which affect the economic status of the country. The project's aim is to design a system to monitor the power consumed by load and to detect and eliminate the power theft in transmission lines and energy meters. This work is also focused on communicating the theft information to Electricity Board through IoT. As a network of devices is connected like sensors it has the ability to exchange real time information through internet.

III. OBJECTIVES

As there is limited non-renewable resources are present in our daily life, Electricity is one of them which utilized in every country that results abundant losses due to electricity larceny. Power theft is going to be the key challenges. • A smart energy meter is used to minimize the electricity larceny. Basically, energy meter is

a device that calculates the cost of electricity consumed by homes, business, or an electrical device. It reduces the theft of electricity

IV. LITERATURE SURVEY

[1] "S. Brindha, Dev Anand R E, Dhanush Aravind K, "Smart Grid Integrity Monitoring System powered by Edge Computing", 2024 International Conference on Power, Energy, Control and Transmission Systems (ICPECTS), pp.1-4, 2024.

This paper proposes research aims to develop an architecture capable of detecting illegal activities between the utility server and customer energy meters. The system would allow real-time monitoring over the internet by utility providers.

[2] "Purva Mange, Rohini Savant, Kriti Singh, Aditi Lule, "Smart Grid Optimization Dimensioning Methods for Residential Solar Cell Dimensioning", 2024 2nd International Conference on Device Intelligence, Computing and Communication Technologies (DICCT), pp.387-391, 2024.

This study introduces the idea of client creation as a method of load management.

[3] "V.Manimegalai, V. Mohanapriya, P. Ravi Raaghav, D. Ranjan, S. Ranjan, S. Selvamurugan, "Leveraging Smart Meter Technology to Combat Energy Theft and Empower Consumption Monitoring", 2024 10th International Conference on Advanced Computing and Communication Systems (ICACCS), vol.1, pp.264- 269, 2024.

This paper proposes to monitor the energy thefts in the distribution network by means of developing a smart meter such as Tamper Detection, Data Collection, Unusual Pattern Identification.

[4] " Hemant Gupta, Resham Taluja, Sanchita Shaw, S. Lakshmana Chari, A. Deepak, Ajay Rana, "Internet of Things Based Reduction of Electricity Theft in Urban Areas", 2023 6th International Conference on Contemporary Computing and Informatics (IC3I), vol.6, pp.2642-2645, 2023.

This paper proposes the theft is been detected through iot using the smart meters that have been installed in all the units to control the power consumption.

[5] "Bobby Campos, Kimberly Canlas, John Dave Delos Reyes, Armie German, Kevin M. Suliva, "Electricity Pilferage Detection Using LoRA RF Module", 2023 4th International Conference on Power Engineering (ICPE), pp.265-270, 2023.

This paper proposes the system shows that the current sensors installed were reliable and efficient in terms of detecting abnormal currents, and LoRA was proven to be effective in terms of its data transmission.

[6] "Henry E. Amhenrior, I. Oloma, Braimoh A. Ikharo, "Design and Implementation of a GSM and Wi-Fi Based Low Cost Smart Prepaid Energy Meter", 2022 5th Information Technology for Education and Development (ITED), pp.1-8, 2022.

This paper proposes a GSM and Wi-Fi based Low Cost Single phase Smart Prepaid Energy Meter with some functionalities such as keypad and screen implemented in embedded software

[7] "Sumit Mohanty, M. Mohamed Iqbal, Parvathy Thampi M.S., "Controlling and Monitoring of Power Theft using Internet of Things", 2021 International Conference on Design Innovations for 3Cs Compute Communicate Control (ICDI3C), pp.111-115, 2021.

This paper proposes an Internet of Things based Power theft monitoring & control system which can monitor the real time current through all the constituent network as well as the source.

[8] "Sateesh Kumar kadala, Anil Kumar Rajagiri, A. Ajitha, Anil Kumar Thalluri, "Development of an IoT based solution for Smart Distribution Systems", 2021 International Conference on Sustainable Energy and Future Electric Transportation (SEFET), pp.1-6, 2021.

This paper proposes the developed system senses the power theft in a line by comparing current values at sending and receiving ends, if detected alerts the authorized personnel for necessary action.

V. METHODOLOGY

5.1The use of IoT technology for the reduction of electricity theft is a promising solution that involves the deployment of sensors and devices that monitor the flow of electricity in real-time.
5.2 Proposed a method to automate the better energy management and power theft on distribution lines.
5.3 When the energy consumption exceeds the threshold value the heavy loads will be automatically detected.
5.4 An LCD display is connected with microcontroller to show the consumed units and cost.
5.5 When the energy consumption is more than the threshold value the heavy loads in the home circuit will automatically tripped off using relays.
5.6 This method provides an indication system to aware the user about the over energy consumption(energy theft) than the threshold value and sends a SMS to consumers.

VI. BLOCK DIAGRAM

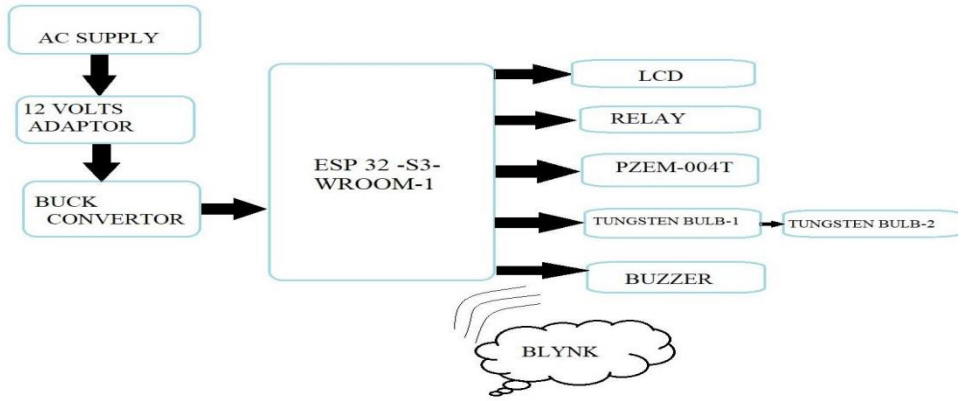


Figure 1: Block diagram of electricity theft detection system

The block diagram represents a system where various components work together to provide efficient control and monitoring of electrical parameters. The primary power supply is an AC source, which is first stepped down and rectified to provide DC voltage. This DC voltage is then regulated to a stable 12V output using a 12V adapter. The output from the adapter is further processed by a buck converter to ensure an optimal voltage for powering the ESP32-S3 WROOM 1, a microcontroller at the heart of the system. The ESP32-S3 communicates with other system components, including the PZEM-004T energy meter, which continuously monitors parameters such as voltage, current, power, and energy consumption. The data from the PZEM-004T is fed into the ESP32-S3 for real-time monitoring and control purposes. Additionally, the system includes an LCD for displaying real-time data, such as power usage or energy consumption, allowing for easy user interaction. The ESP32-S3 can be programmed to control a relay that acts as a switch for the tungsten bulb, allowing the system to automate or remotely control the lighting. When the ESP32-S3 processes certain conditions, such as an energy threshold or user input, the relay can turn the tungsten bulb on
or off. The integration of these components ensures that the system can monitor power usage and control electrical loads efficiently, while offering a user-friendly interface for operation and control.

VII. HARDWARE AND SOFTWARE COMPONENTS

7.1 **PEACEFAIR PZEM-004T:**This Peacefair PZEM-004T AC Multi-function Electric Energy Metering Power Monitor is very popular in electrical consumption measurement projects. It is capable of measuring four interrelated electrical variables as voltage, current, power, and energy.

Figure 2: PEACEFAIR PZEM-004T

7.2 **ESPRESSIF[ESP32-S3-WROOM-1]:** ESP32-S3-WROOM-1 is a powerful, generic Wi-Fi + Bluetooth LE MCU module that has a Dual core CPU. It is an ideal choice for a wide variety of application scenarios related to AI + Internet of Things (AIoT).

Figure 3: ESPRESSIF[ESP32-S3-WROOM-1]

7.3 **Relay Module:** A relay module is a versatile electronic component designed to enable low-voltage control over high-voltage systems, serving as a bridge between microcontrollers (such as Arduino, Raspberry Pi, or other embedded systems) and higher-power devices. It typically consists of a relay switch, which is an electromechanical device, and additional circuitry to provide proper control and protection.

Figure 4: Relay Module

7.4 **Buck Convertor**: It is a very simple type of DC-DC converter that produces an output voltage that is less than its input.The output voltage of an ideal buck converter is equal to the product of the switching duty cycle and the supply voltage.

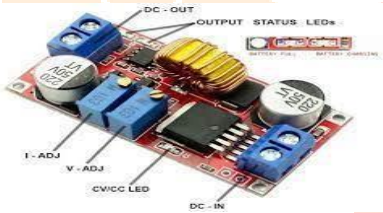


Figure 5: Buck Convertor

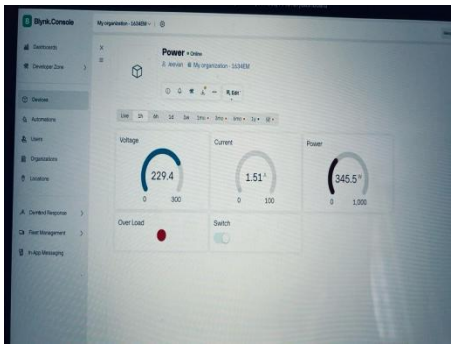
7.5 **Buzzer:** A buzzer is an electrical device used to produce a loud, attention-grabbing sound, often used as an alert or indicator in various systems and applications. It works by generating vibrations or oscillations within a resonating structure, typically driven by an electromagnet or a piezoelectric component.

Figure 6:Buzzer

VIII. APPLICATIONS

- Anomaly Detection.
- Early Warning.
- User Interface for Monitoring.
- Improved Security.
- Automatic Disconnection.

IX. RESULTS



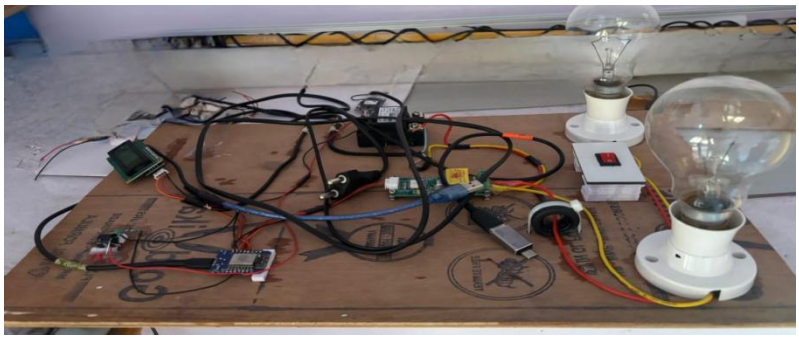


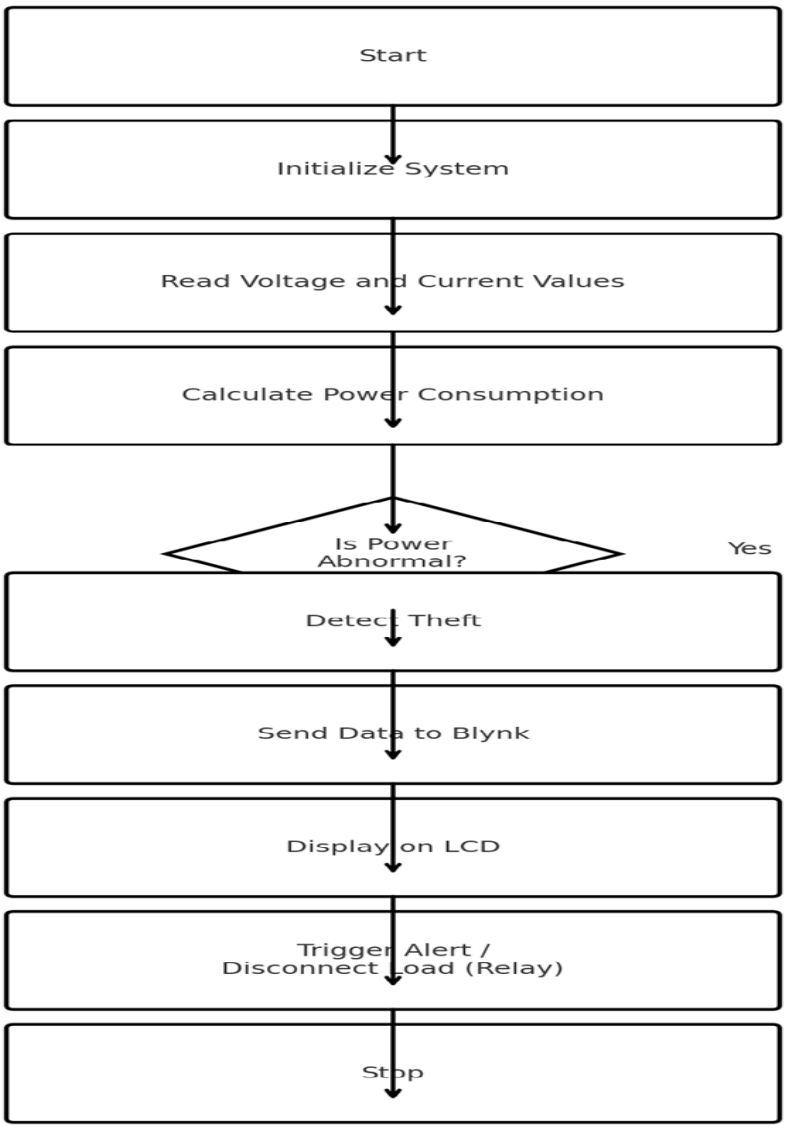
Figure 7: Output getting in web server

The project showcases a seamless integration of voice-controlled robotics with a billing interface, presenting innovative potential for applications in automation and retail. The robotic system operates based on voice commands, allowing hands-free movement and control to enhance operational efficiency. Additionally, a green LCD screen serves as an integral part of the billing process, displaying critical information such as whether the product is found or not.

The system also includes a web-based billing interface, featuring functionalities for managing items, viewing individual and total costs, and selecting payment methods. The "Item Management" interface allows users to add or remove items, review total costs, and proceed to payment options. However, as depicted in the current stage, troubleshooting card input validation may be required to address errors like "Payment Failed. Please check your card details and try again."

The physical setup of the prototype includes essential hardware components such as a breadboard, electronic circuitry, and the LCD screen, which collectively ensure smooth communication between the software and hardware systems. This combination of voice-controlled navigation, billing integration, and real-time display reflects an innovative approach to merging user interaction with automation, paving the way for practical and efficient real-world applications.

X. SYSTEM IMPLEMENTATION



Flow Chart for electricity theft detection system

XI. SYSTEM IMPLEMENTATION

The flowchart begins with initializing the system, which activates all components including the sensors and NodeMCU. It proceeds to continuously monitor voltage and current values from the connected power line. These readings are essential for calculating real-time power consumption. This step ensures a baseline is established for detecting any abnormal variations.

Once the power is calculated, the system compares it against predefined thresholds. If the consumption exceeds the normal range without a corresponding load, it indicates possible theft. In such a case, the system flags the incident and moves to initiate theft detection measures. This step is the core decision-making point within the logic.

After detecting theft, the NodeMCU sends the event data to the Blynk cloud for mobile notification. Simultaneously, it updates the LCD display with the real-time consumption status. A relay module is triggered to disconnect the power line to prevent further misuse. Finally, the process ends after securing the system and alerting the user.

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