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Power TheftDetection and Alert System

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Abstract: ***Electricity theft is a major challenge faced by power distribution companies, leading to significant revenue losses and reduced grid reliability. This paper presents the design and implementation of an intelligent power theft detection and alert system using smart metering and real-time monitoring techniques. The proposed system continuously measures energy consumption at both the distribution transformer and consumer levels to identify discrepancies that indicate unauthorized usage. An embedded microcontroller-based architecture is employed to collect data from current and voltage sensors, which is then transmitted to a central server using wireless communication technologies such as GSM or IoT-based protocols. Advanced algorithms are implemented to analyze consumption patterns and detect anomalies associated with power theft. Upon detection, the system generates instant alerts to utility authorities via SMS or cloud-based notifications, enabling prompt action.***
The system is cost-effective, scalable, and capable of minimizing human intervention while improving monitoring accuracy. Experimental results demonstrate the effectiveness of the proposed model in identifying irregular consumption and reducing energy losses. This solution contributes to the development of smart grid infrastructure and enhances transparency and efficiency in power distribution systems.
Index Terms: Power theft detection, smart meter, IoT, GSM, anomaly detection, energy monitoring, smart grid.

I. INTRODUCTION

The modern electrical system has been experiencing an exponential growth rate. A critical component of this system is the electrical power transmission line that links power generation plants with the end-users. However, due to the long length of the transmission line, faults may occur, which can disrupt the supply of power to consumers. Compared to other parts of the power system, transmission and distribution networks experience high losses. The vulnerability of the electric power infrastructure to various physical events, both natural and malicious, poses a significant threat to the stability and overall performance of the grid. If not detected and cleared quickly, faults in the transmission network can lead to transformer damage, destruction of human life, and even fire outbreaks. Unfortunately, in India, there is currently no-time system that notifies of faults as they occur on multiple parameters. This increases the risk of damage to connected devices and poses a threat to human life. To prevent such incidents, transmission lines require frequent maintenance, which demands increased manpower. However, frequent line checks may not prevent faults caused by unpredictable events such as tree topples and rainfall. Therefore, there is a need for a fast fault identification and clearance system. In response to the challenges described, the proposed solution is an Internet of Things (IoT) based transmission line with various fault detection and an indication system to notify the respective power stations of any detected faults. Here, the proposed system uses an Arduino nano, Various parameter sensors & Esp8266 sensor to detect the fault in the transmission line and then send the data accordingly to the power stations. The Smart Electric Bill is a complicated platform to the manner we acquire power nowadays. In earlier times the demand for electricity was substantial compared thereto presently. Since the demand for electricity has tremendously increased, a redesign of the present grid system is far needed. With the technology available in these times , the smart grid might be designed in such a fashion , that it uses digital technology to detect and react to local changes in usage. The system will feature a two-way dialog where electricity and knowledge are often exchanged between the buyer and utility. This can increase or decrease the quantity of energy a consumer needs by analyzing the feedback of the two-way dialog.

II. LITERATURE SURVEY

1) Akshit Sharma, Ankit Nirwan, Ajay Singh Shekhawat (2019)
Proposed *"Fault Analysis on Three Phase Transmission Lines and its Detection"*.
Focuses on analyzing faults in three-phase transmission lines to prevent instability and equipment damage, emphasizing system stability in power planning.
2) Sibisagar B., Surya V.R., Vignesh Vijayaraghavan, Dr. Suriya Krishnan (2020)
Proposed *"Self Regulating Line Fault Detection & Its Location In Transmission Lines"*.

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Uses Arduino UNO with voltage, current, and temperature sensors for continuous monitoring and automatic fault detection and location, reducing outage time

3) Prof. Vikramsingh R. Parihar, Shivani Jijankar, Anand Dhore, Arti Sanganwar, Kapil Chalkhure (2018)
Proposed *"Automatic Fault Detection in Transmission Lines using GSM Technology"*.
Introduces a GSM-based system for accurate fault detection and location, enabling quick communication to operators.

4) Sharmili W. Drugkar, Krishna R. Maske, Bhagyashree Gadekar (2017)
Proposed *"Transmission Line Fault Detection Using GSM Technology"*.
Detects various fault types (L-L, L-G, L-L-G, etc.) and sends real-time SMS alerts using GSM for faster maintenance response.

III. SYSTEM OVERVIEW

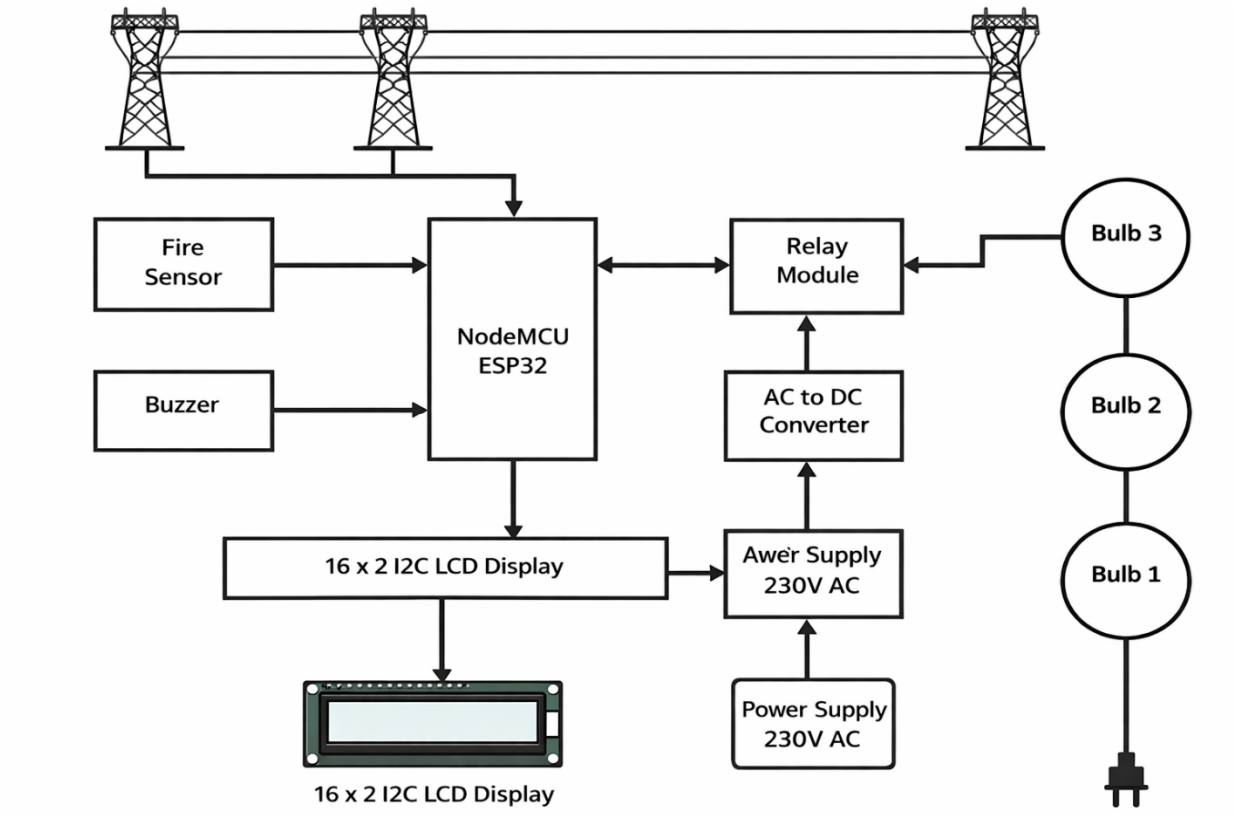


Fig1:Block diagram

The transmission line is connected between two transmission towers, and the system monitors the flow of electricity across this line. A fire sensor is used to detect abnormal conditions such as overheating or fire, which may occur due to illegal tapping or faults. The sensor sends signals to the ESP32, which continuously analyzes the input data.

A relay module is connected to the system to control the power supply to the load (represented by multiple bulbs). If any abnormal activity or power theft is detected, the ESP32 triggers the relay to disconnect the supply, thereby preventing further loss or damage. The relay is powered through an AC to DC converter, which converts the 230V AC supply into a suitable DC voltage for the system components.

For user interaction and monitoring, a 16×2 I2C LCD display is used to show system status, alerts, and fault conditions. Additionally, a buzzer is included to provide an audible alert whenever theft or fault is detected.

Overall, the system works by continuously monitoring electrical conditions, detecting anomalies, and taking immediate action through alerts and automatic disconnection, making it an efficient and reliable solution for power theft detection.

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IV. METHODOLOGY

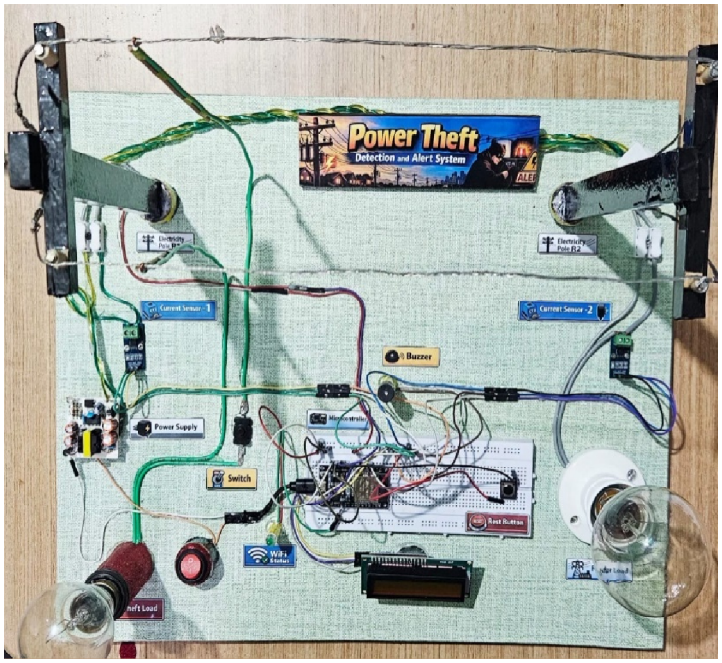


Fig.2.Systemphoto

1) Power Transmission Lines:
These are the main lines through which electricity flows. The system monitors these lines to detect any unauthorized tapping or faults.

2) Fault Detection:
It identifies abnormalities like voltage drops or illegal connections. This helps in detecting power theft and system failures quickly.

3) Arduino Uno:
It is the central controller of the system. It processes sensor data and controls all components like relay, GSM, and alerts.

4) GSM Module:
This module is used for communication. It sends SMS alerts to users or authorities when theft or faults are detected.

5) Access Control System:
It ensures that only authorized users can access electricity. It helps prevent illegal usage and improves security.

6) IR Sensors:
These sensors detect interruptions or unauthorized tapping in the line. They send signals to the Arduino for analysis.

7) LCD Display:
It shows real-time information such as system status and alert messages. This helps users easily monitor the system.

8) Buzzer:
The buzzer provides an audible alert during faults or theft detection. It ensures immediate attention to the issue.

9) Voltage Regulator:
It provides a stable voltage supply to all components. This protects the system from voltage fluctuations.

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10) Sensor:
Additional sensors (voltage/current) monitor electrical parameters. They help in accurate detection of abnormal conditions.

11) Relay:
The relay acts as a switch to control power supply. It disconnects the load when theft or fault is detected.

12) LED:
LEDs provide visual indication of system status. They glow during normal operation or alert conditions.

13) Arduino Compiler:
It is used to write and upload code to the Arduino. It converts the program into machine-readable format.

14) Arduino Code:
This code controls the entire system operation. It processes inputs, detects faults, and triggers alerts and relay actions.

V. Result

Thesystemsuccessfullydemonstrated:

- Accurate detection of power theft and line faults using sensors
- Continuous real-time monitoring of power transmission lines
- Immediate disconnection of power supply using relay during theft or fault conditions
- Instant alert generation through GSM (SMS), LCD display, buzzer, and LED

Testing results showed that the system operates reliably with fast response time, effectively reduces power loss, and provides a simple and user-friendly interface for monitoring and control.

VI. CONCLUSION

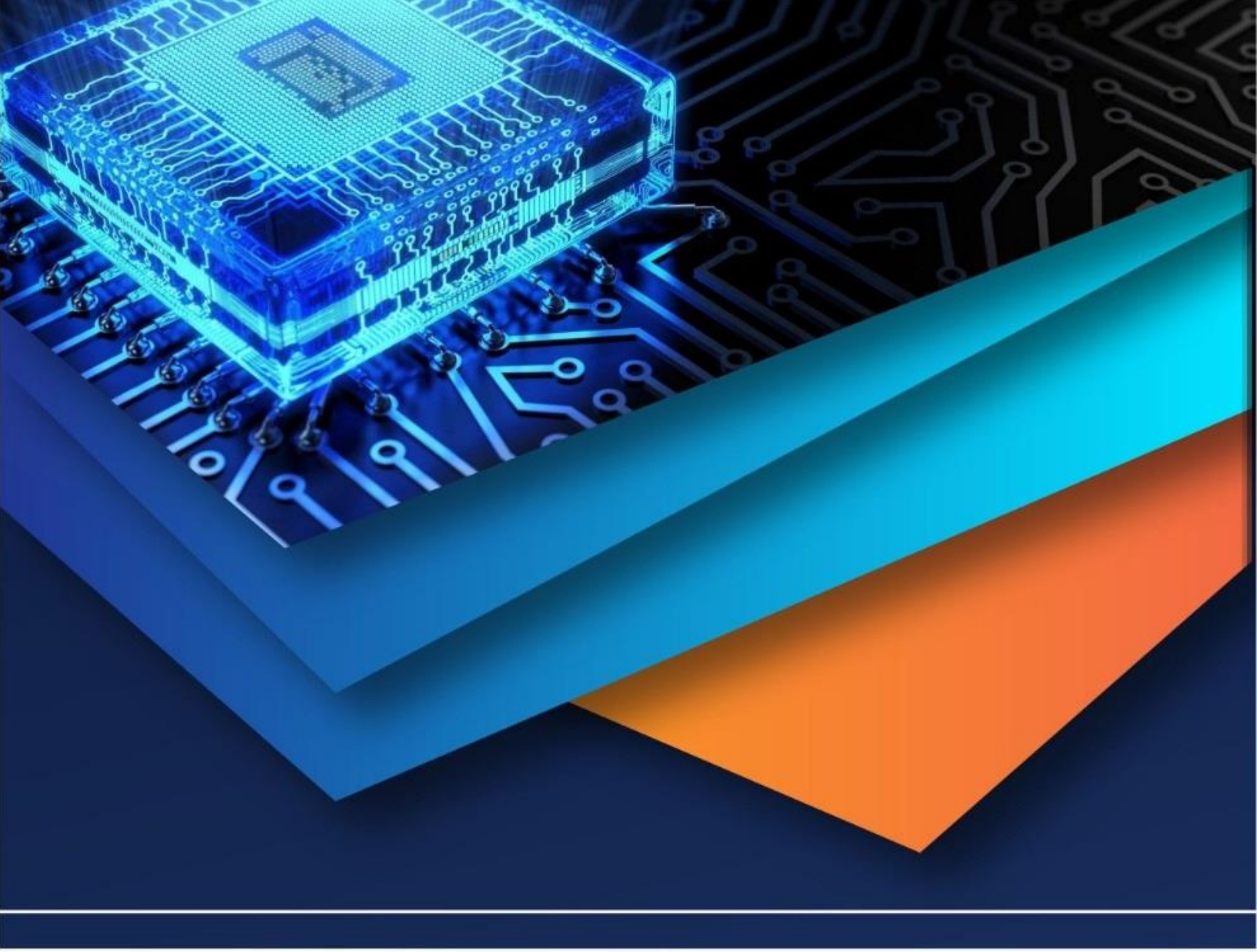
The power theft detection and alert system provides an efficient and reliable solution to reduce electricity losses caused by unauthorized usage. By using sensors, Arduino Uno, and communication modules like GSM, the system ensures real-time monitoring and quick detection of faults or theft conditions.
The integration of automatic relay control and alert mechanisms such as buzzer, LED, and LCD display enhances system responsiveness and user awareness. Overall, the system is cost-effective, easy to implement, and suitable for improving the security and efficiency of power distribution networks.

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