IOT based Smart Unlawful Electricity Usage Surveillance and Warning System

A. S. S. Murugan[1*], *Rajib Kumar Kar*[1], *M. Rajitha*[1] and *N. Karuppiah*[2]

[1]Department of EEE, CVR College of Engineering, Hyderabad, Telangana, India
[2]Department of EEE, Vardhaman College of Engineering, Kacharam, Hyderabad, Telangana, India

Abstract. The global issue of electricity theft has a negative impact on both the utilities and the people who use the energy. It impairs utility company economic growth, creates electrical risks, and has an effect on consumers' expenses for electricity. The emergence of smart grids is crucial for the detection of power theft as they provide vast amounts of data, including information on consumer consumption that can be used to identify theft using over voltage and over cur- rent detection methods. The solution presented in this article employs an Arduino uno micro controller board and IOT to monitor and maintain surveillance on power theft. An alarm with SMS notification will be sent to the officials and the power will be shut off whenever there is a power outage or tampering with an energy meter.

Keywords: Power Theft, Arduino, IOT, Sensor, Smart grid

1 Introduction

In our nation, electrical energy stealing constitutes the most prevalent issue. India has a large population, and electricity theft is also rising daily. Every year around the country, there are numerous thefts of electricity from commercial and residential customers, which makes it more expensive for the power supplier to distribute power. Many household electricity thefts and power supply thefts in the industrial sector occur annually in the nation, costing the supplier the ability to distribute power. The nation frequently has issues like power outages in both the urban and rural sectors as a result of power theft. India's Economy suffers significantly because of power theft. India loses more money than any other nation in the world to electricity theft. Up to INR 3000 crores in economic losses occur annually in India. There is a 1.5% decline in India's GDP due to electricity theft, according to estimates. Electricity theft is a persistent and widespread issue for Indian utilities. The primary root cause of the financial crisis that energy distribution companies are currently experiencing is power theft. This crisis has a domino effect on other issues such as overloaded lines, interruptions, reduced quality of service, and rising electricity prices. The challenges that the entire nation is currently experiencing are reduced and avoided due to this effort. Several academics are conducting investigations on power theft detection [1]. Researchers have

* Corresponding author: assm17174@gmail.com

suggested using prepaid electricity billing meters to maintain surveillance on home appliances [2-3].
This effort helps to reduce and steer clear of problems that the entire country is currently experiencing. The utility will provide uninterrupted, high-quality power to all the connected customers. The most typical method of stealing electricity is through direct taps into the power lines. The suggested strategy makes use of a variety of detection devices that are strategically placed in key locations to detect power theft and notify the necessary authorities through GSM.

2 Methodology and Proposed Technique

Electricity stealing is accomplished by drawing power directly from the wires. Power theft frequently takes place in this manner. It is possible to identify this type of theft using the assistance of multiple detectors in the lines. [4-5].
The second method is tampering with the energy meter. There are numerous ways to tamper with an energy meter. The spinning of the disc will slow down or even halt if a tiny magnet is positioned there; this prevents the measurement of power usage. This strategy was applied in the past. Nowadays, it is hard to tamper with power meters because they are all computerized [6-7].
The third way involves cutting the neutral wire and shorting the phase coils of the current transformer. The energy meter's phase and neutral wires are equipped with sensors that may detect this type of power theft [8].

2.1 Existing Techniques

The present wireless communication technology for the energy meter is implemented using GPRS and ZIGBEE. For serial information transfer using ZIGBEE, this method is typically employed to safeguard the signalling path. Real time load monitoring is not possible with this system; therefore, it is impossible to pinpoint where theft occurred.

2.2 Proposed Technique

The proposed solution employs IoT and GSM technology [9, 10] to correct the present scenario by alerting the supplier about illegal electrical activities. Through serial connections, an Arduino microcontroller is connected to the network, and monitoring equipment is also placed to gauge the current drawn by the appliance and the voltage across the electrical load. The theft of electricity will decrease as a result. The current strategy provides a resolution to issues that authorized electric organizations are now facing, including power theft, energy waste, and transmission line concerns.

3 Methodology

3.1 Sensor

The input current and voltage information are needed for power theft monitoring system. Hence current and voltage data is obtained using current and voltage sensors. To create net voltages and currents, the values of currents and voltages must first undergo some conditioning.

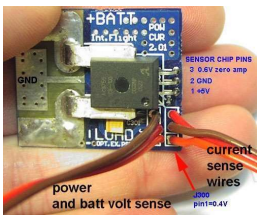

Fig. 1. (a) Current Sensor. (b) Voltage Sensor.

3.2 Arduino Controller

The enterprise, activity, and user group known as Arduino produces and markets microcontrollers with a single board and microcontroller sets for creating dynamic products that can recognize and work both manually and electronically. Since its products are offered with general license for Public, anyone is permitted to create Arduino boards and share software. Both pre-built and DIY kits of Arduino boards are available for purchase in the market.

Fig. 2. Arduino Controller.

3.3 LCD Monitor

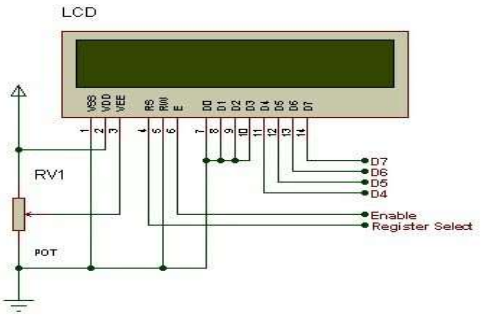

Fig. 3. LCD Display

The liquid crystal panel is one of the widely used peripherals for the Arduino micro-controller. The 16x2 and 20x2 screens with liquid crystal displays are most significantly apparent LCDs attached to the different processors. This is equivalent to sixteen alphabetical characters by 2 lines and twenty alphabetical characters by 2 lines, respectively. In addition to the three control lines, the LCD needs four to eight I/O lines as well as three I/O lines for the data bus. A total of seven lines are needed to transfer data for the LCD, which can be powered by either an eight-bit or a regular four-bit information bus, depending on the user's choice.

3.4 ESP 8266

The Chinese city of Shanghai China based Espressif Systems is a company that pro- duces the affordable Wi-Fi microprocessor known as the ESP8266 [11]. It can handle microcontrollers and contains a complete TCP/IP architecture. Western manufacturers were initially drawn to the ESP-01 package in August 2014 because of the chip, which was created by another company called Ai-Thinker. This little module enables microcontrollers to establish straightforward TCP/IP connections using Hayes style commands across a Wi-Fi network.

4 Results and Discussions

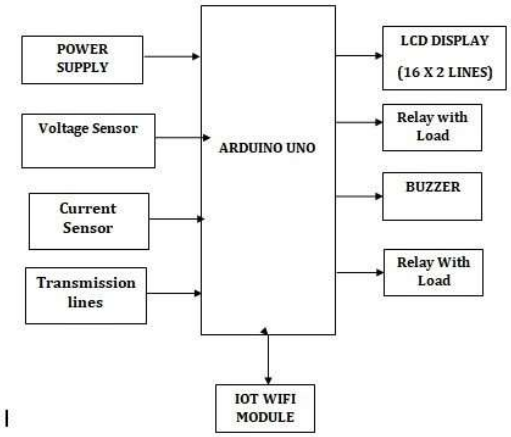

Fig. 4. Block Diagram

With the suggested system, information on theft detection is communicated to utility authorities via GSM and Internet of Things technology. To predict the current and voltage, this system communicates with the Arduino and the sensors that are connected to it. This will effectively prevent electrical theft. Therefore, the project's goal is to stop and eradicate thefts, preventing further energy waste in the nation. The parameters like power, current, and voltage are examined in this proposed system to calculate the energy and generate payments to the appropriate mail. If customer demand increases, the electricity provided to the load is cut off, and a notice about electrical consumption is communicated over Wi-Fi to both the owners of the property and the electricity distribution board.

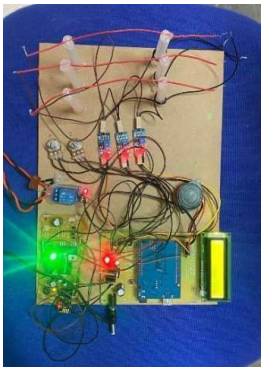

Fig. 5. Final Hardware Circuit.

A siren is also installed to warn the homeowner that a theft has occurred. An invoice depending on the quantity of electricity utilized by the consumer will subsequently be generated. To record the usual demand used, detect any rises in demand caused on the theft, and detect the crime itself, a TELNET application is utilized. The Uno chip used in the project at hand will constantly track the amount of load according to factors like energy, voltage, and current.

Fig. 6. LCD Output Display

Use an IOT (internet of things) technology as a Wi-Fi modem in this project. In this work, a voltage sensor is employed. It is situated close to the electricity measuring equipment and detects persons or any other object kept close to the electrical poles in order to prevent power theft. Since the current sensor produces pulses, the microcontroller reads those pulses, counts them, and then waits for a message from the Wi-Fi module.

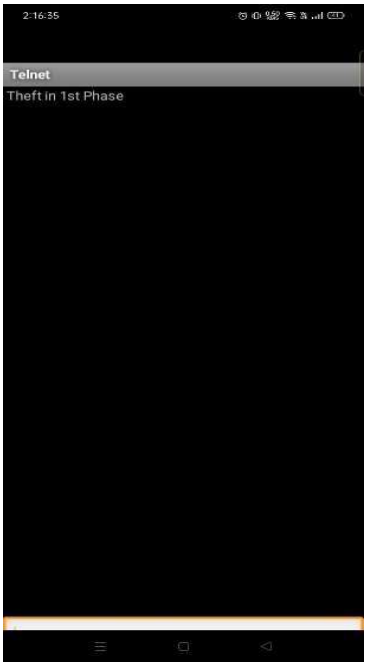

Fig. 7. Telnet Output

If there is no difference between the two current sensors' data, it is concluded that only normal load is active. The LCD panel indicates that there was no power theft and that the message "Not Found (NC)" has also been sent to the cloud via IOT. Line A has been tapped by an unauthorized person, according to data from two current sensors that differ. Then, the LCD display displays power theft in Phase A with the phrase "Found" and "Not Found" for the other two phases.

It should be noticed that an LCD display indicates that power theft happened in Line 1. Current monitoring devices may be mounted across the two ends for applications that operate in real time. The Arduino detects the difference and activates the relay, which subsequently disconnects the load from the power source and the GSM module notifies the consumer of the theft of electricity. If there was any electricity stealing across the power lines due to tapping, there will be an imbalance in the current sensors.

5 Conclusion

The development of a wireless system for electricity theft detection and monitoring involved careful hardware and software integration. This device offers a quick and simple method to identify electrical theft without the need for any human input. The multiple benefits of wireless network connections can be attained with the aid of IoT. The design of this technology can still be refined. The data from the sensors is analyzed using machine learning techniques. The idea of machine learning and deep

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