International Research Journal of Education and Technology
Peer Reviewed Journal
ISSN 2581-7795

Minimizing Electricity Theft Using IOT

Mownika SM,Shanmugapriya R,Ajay Karthik G
Department of Electrical & Electronics Engineering
Dr Mahalingam College of Engineering & Technology
Pollachi, Coimbatore, Tamilnadu 642003.

Arthur Vsanth J
Department of Electrical & Electronics Engineering
Dr Mahalingam College of Engineeering & Technology
Pollachi, Coimbatore, Tamilnadu 642003.

ABSTRACT

Electricity theft is a major issue for utility companies globally, resulting in revenue loss, higher operating expenses, and degraded system dependability. Traditional techniques of detecting and preventing theft frequently fail owing to their narrow scope and reactive nature. In recent years, the introduction of Internet of Things (IoT) technology has opened up new options for efficiently tackling this issue. This study provides a complete solution to reducing power theft by integrating IoT devices and sophisticated analytics. Utility companies may collect real-time data on energy usage trends and detect inconsistencies that indicate theft or manipulation by installing energy metres with sensors and communication capabilities. These energy metres continually monitor numerous characteristics like as voltage, current, and power factor, allowing for early detection of suspect activities. Furthermore, the use of IoT-enabled distribution transformers and power cables improves the identification and location of theft hot areas. By monitoring characteristics such as line losses, load imbalance, and unauthorised connections, utilities may identify high-risk regions for theft and prioritise enforcement operations appropriately.

In addition, deploying IoT-enabled distribution transformers and power cables improves the identification and location of theft hotspots. Monitoring characteristics such as line losses, load imbalance, and unauthorised connections allows utilities to identify high-risk regions and prioritise enforcement operations appropriately.

Additionally, adopting IoT for electrical theft reduction has benefits that go beyond loss prevention. Improved visibility into consumption patterns helps utilities to optimise resource allocation, improve load forecasting accuracy, and increase overall grid efficiency. IoT-based solutions enable utility providers and consumers to work together to ensure the integrity and sustainability of the energy infrastructure by promoting more openness and accountability.

I.INTRODUCTION

The first-of-its-kind Internet of Things-based energy theft detection technique detects both power theft and metre tampering. The system uses CT sensors to detect metre tampering or direct load connections before the metre in the supply. When a theft is detected, a microcontroller creates a log of the nature and timing of the theft, which is then saved on an IOT platform for backup posted concurrently on the internet page. When stealing attempts reach a certain threshold, the system sends a message to the phone. The installation expense is one-time and can be utilised for a lifetime. Eliminating power theft will raise revenue for the government while also saving electricity.

The process of producing, transmitting, and distributing electricity incurs significant operating losses. While generating ,losses may be identified, transmission and distribution losses are more difficult to quantify.This is the end of the information. This demonstrates the impact of non-technical parameters on transmission and distribution systems. Technical losses are created by power dissipation in transmission lines, transformers, and other power system components, as previously stated. Technical losses in transmission and distribution are calculated using total load and energy billing data. Nontechnical losses, however, are difficult to calculate accurately. The estimate is based on the differential between total energy delivered and invoiced to consumers. This type of loss might be a power theft in Metre manipulation, illicit connections, billing problems, and unpaid invoices are examples of violations. Power theft has become a major worry for utility companies and the government. It has numerous impacts, including financial and electricity quality.

Power theft has a financial impact in two ways: first, it results in lost money owing to uncollected services, and second, it leads to lower consumer charges. If there is electricity theft, it leads to inefficient use. Controlling the electrical system is crucial nowadays, as simply providing more electricity is no longer sufficient. This can significantly enhance power quality and prevent many types of power theft. Certain types of electricity might be challenging to monitor and regulate. It is difficult to quantify business loss caused by tampering with metres to misrepresent billing information or divert it to the power grid. Since there, Due to a lack of information on commercial and legitimate loads in the system, it is challenging to quantify commercial loss. Insufficient inputs prevent accurate loss calculations. Utility efforts are often insufficient to accurately estimate business losses due to reliance on outdated records.

identified instances as opposed to the electrical power system's real measurement. Utility companies are unable to completely control commercial losses, even if they do have some influence over their size. Electric utilities have lost a great deal as a result of this.

2. METHODOLOGY

The suggested system communicates theft detection information to costumer through the usage of the Internet of Things concept. In order to forecast the current and voltage, this system

interacts with the detectors that are attached to the micro-controller and the controller. Therefore, our approach aims to prevent and eradicate thefts, protecting the economy from more energy wastage. This present proposal checks all the parameters, including power, current, and voltage. Power is calculated and communicated to the user and

through IoT as an outcome.

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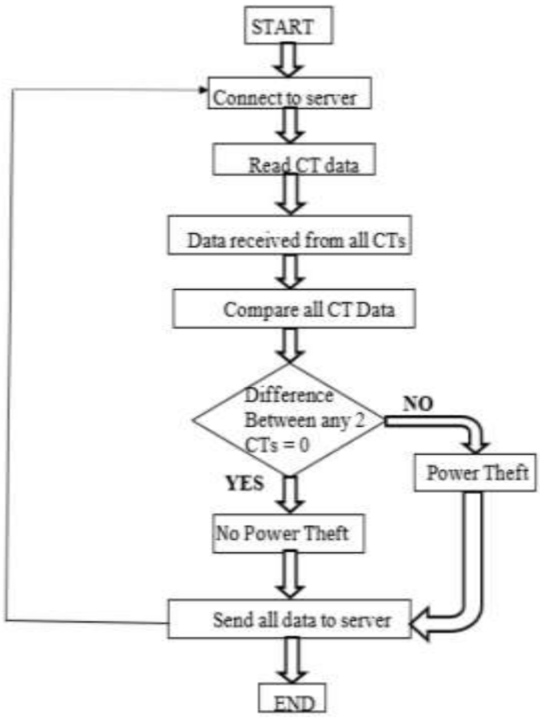
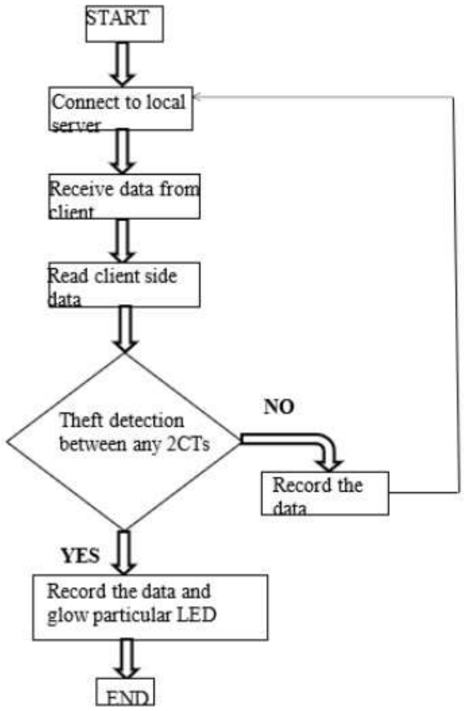
The costumer receives a message concerning power requirements, which is shown on the LCD, when the load grows and the power to the load is cut off. Additionally, IoT based GSM Module will be installed to alert the consumer and the individual homeowners through message, that there has been theft. Any additional load will also cause the power source to be cut off.





3.HARDWARE SETUP

3.1 Block diagram

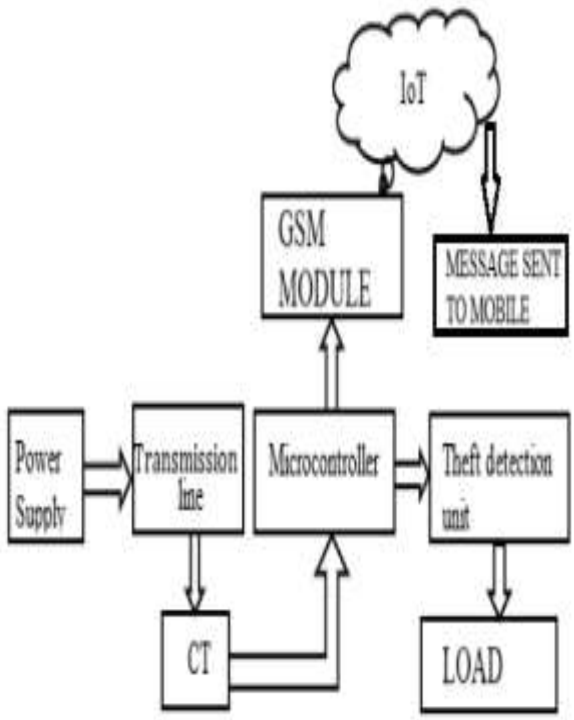


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FIGURE:3.1 BLOCK DIAGRAM

3.2 HARDWARE SPECIFICATION

3.2.1 ATmega-328 P

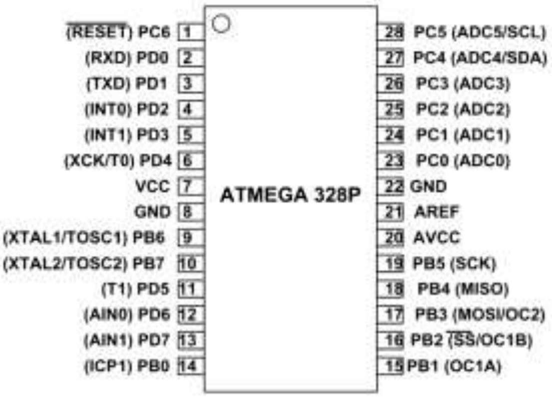

FIGURE:3.2 ATmega 328 P

ATmega328 is an Advanced Virtual RISC (AVR) microcontroller. It supports 8-bit data processing. ATmega-328 has 32KB internal flash memory.

ATmega328 has 1KB Electrically Erasable Programmable Read-Only Memory (EEPROM). This property shows if the electric supply supplied to the micro-controller is removed, even then it can store the data and can provide results after providing it with the electric supply. Moreover, ATmega-328 has 2KB Static Random Access Memory (SRAM). Other characteristics will be explained later. ATmega 328 has several different features which make it the most popular device in today's market. These features consist of advanced RISC architecture, good performance, low power consumption, real timer counter having separate oscillator, 6 PWM pins, programmable Serial USART, programming lock for software security, throughput up to 20 MIPS etc. Further details about ATmega 328 will be given later in this section. Atmega328 is the microcontroller, used in basic Arduino boards i.e Arduino UNO, Arduino Pro Mini and Arduino Nano.

- It has an **EEPROM** memory of 1KB and its **SRAM** memory is 2KB.
- It has 8 Pins for ADC operations, which all combine to form PortA(PA0 – PA7).
- It also has 3 built-in Timers, two of them are 8 Bit timers while the third one is 16-Bit Timer.
- You must have heard of Arduino UNO, UNO is based on atmega328Microcontroller. It's UNO's

  heart.
- It operates ranging from 3.3V to 5.5V but normally we use 5V as a standard.
- Its excellent features include cost-efficiency, low power dissipation, programming lock for security purposes, real timer counter with separate oscillator.
- It's normally used in Embedded Systems applications. You should have look at these Real Life Examples of

Embedded Systems, we can design all of them using this Microcontroller.

3.2.2 SIM 800 GSM MODULE

This is a plug and play GSM Modem with a simple to interface serial interface. Use it to send SMS, make and receive calls, and do other GSM operations by controlling it through simple AT commands from micro controllers and computers. It uses the highly popular SIM800 module for all its operations. It comes with a standard RS232 interface which can be used to easily interface the modem to micro controllers and computers.

The modem consists of all the required external circuitry required to start experimenting with the SIM800 module like the power regulation, external antenna, SIM Holder, etc.

FIGURE:3.3 SIM 800 GSM MODULE

Note: The modem consumes current of nearly 1A during transmission; please make sure that your power supply can handle such currents.

3.2.3 LCD DISPLAY

FIGURE:3.4 LCD DISPLAY

It is a flat-panel display or other electronic visual display that uses the light-modulating properties of liquid crystals. Liquid crystals do not emit light directly.

LCDs are available to display arbitrary images (as in a general-purpose computer display) or fixed images with low information content, which can be displayed or hidden, such as preset words, digits, and 7-segment displays as in a digital clock. They use the same basic technology, except that arbitrary images are made up of a large number of small pixels, while other displays have larger elements.

LCDs are used in a wide range of applications including computer monitors, televisions, instrument panels, aircraft cockpit displays, and signage. They are common in consumer devices such as DVD players, gaming devices, clocks,watches, calculators, and telephones, and have replaced cathode ray tube (CRT) displays in nearly all applications. They are available in a wider range of screen sizes than CRT and plasma displays, and since they do not use phosphors, they do not suffer image burn-in. LCDs are, however, susceptible to image persistence.

3.2.5 CT SENSORS

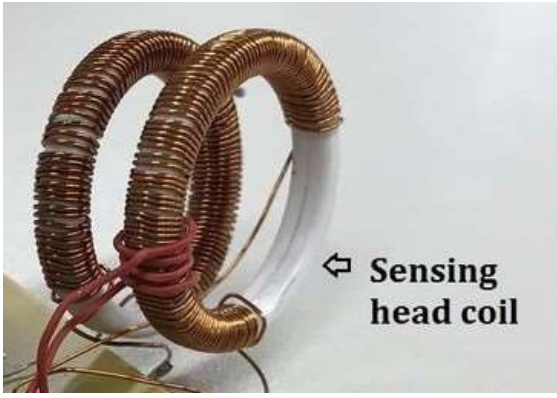

FIGURE:3.5 CT SENSORS

The Current Transformer (CT) is used to sense AC current in single-phase or three-phase mains circuits. The CT typically has a 1A or 5A AC secondary that connects to a current, power or energy meter. This allows the meter to be located away from the main wiring. CTs are available in various sizes and styles, with standard ratios of 50:5 to 4000:5. Split core models easily retrofit around existing wiring. Solid core models offer lower cost.

Some monitoring systems are supplied with current transformers that have a voltage output. The full scale on these devices is not standardized but usually is between 0.3-2V AC. Despite the lack of standardization, there are several advantages to using a CT with a voltage output. It eliminates the need for heavy leads or a high VA rating. The voltage output also allows a greater distance between the CT and the meter. Another consideration – an open secondary loop on a 1A or 5A CT can produce hazardous high voltage. Models with a voltage output are clamped to a safe level.

3.2.4 POWER SUPPLY

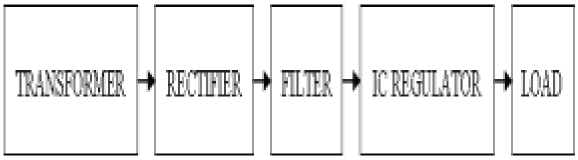

FIGURE:3.6BLOCK DIAGRAM(POWER SUPPLY)

The ac voltage, typically 220V rms, is connected to a transformer, which steps that ac voltage down to the level of the desired dc output. A diode rectifier then provides a full-wave rectified voltage that is initially filtered by a simple capacitor filter to produce a dc voltage. This resulting dc voltage usually has some ripple or ac voltage variation. A regulator circuit removes the ripples and also remains the same dc value even if the input dc voltage varies. This voltage regulation is usually obtained using one of the popular voltage regulator IC units.

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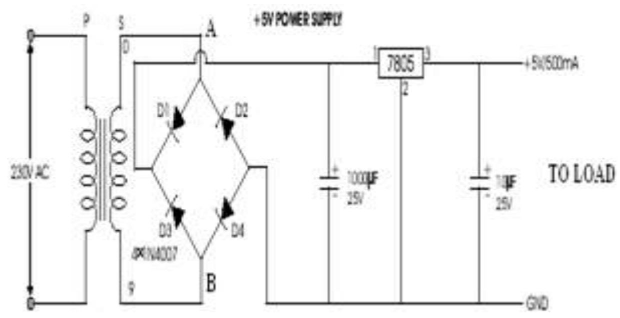


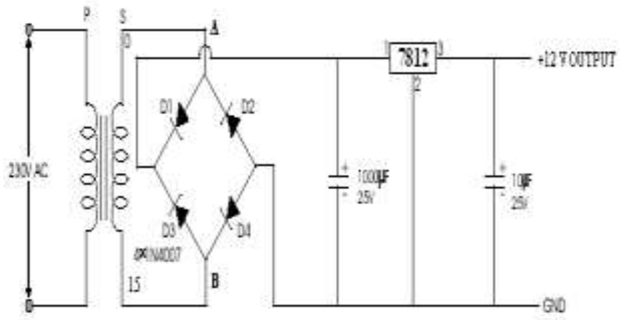


FIGURE:3.7 RECTIFIER AND TRANSFORMER

TRANSFORMER

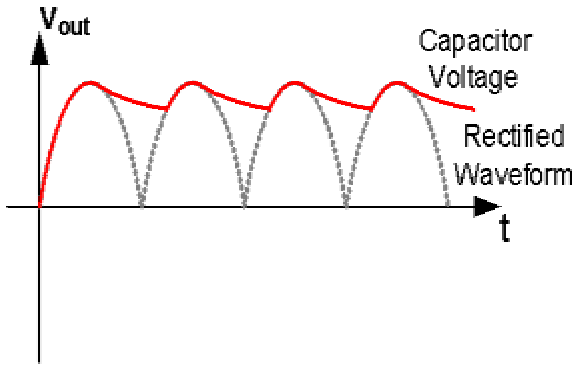
The potential transformer will step down the power supply voltage (0-230V) to (0-15V and 0-9V) a level. If the secondary has less turns in the coil then the primary, the secondary coil's voltage will decrease and the current or AMPS will increase or decreased depend upon the wire gauge. **This is called a STEP-DOWN transformer.** Then the secondary of the potential transformer will be connected to the rectifier.

BRIDGE RECTIFIER

When four diodes are connected as shown in figure, the circuit is called as bridge rectifier. The input to the circuit is applied to the diagonally opposite corners of the network, and the output is taken from the remaining two corners.

FILTER

If a Capacitor is added in parallel with the load resistor of a Rectifier to form a simple Filter Circuit, the output of the Rectifier will be transformed into a more stable DC Voltage. At first, the capacitor is charged



to the peak value of the rectified Waveform. Beyond the peak, the capacitor is discharged through the load until the time at which the rectified voltage exceeds the capacitor voltage. Then the capacitor is charged again and the process repeats itself.

IC VOLTAGE REGULATOR

Voltage regulators comprise a class of widely used ICs. Regulator IC units contain the circuitry for reference source, comparator amplifier, control device, and overload protection all in a single IC. IC units provide regulation of either a fixed positive voltage, a fixed negative voltage, or an adjustably set voltage.

A fixed three-terminal voltage regulator has an unregulated dc input voltage, it is applied to one input terminal, a regulated dc output voltage from a third terminal, with the second terminal connected to ground.

CONCLUSION

The right hardware and software integration has been used in the design and development of a electricity theft detection and monitoring system. This technology offers an efficient and simple method of detecting electrical theft. One way to take benefit from many benefits of wireless network connections is to use the Internet of Things. Power theft really involves evading the energy metre, but in our project, we've also indicated the theft by raising the load, and this is an economical way to do it. It is now possible to design, simulate, and build an IOT-based power theft system. It has addressed a variety of electricity theft scenarios, such as service personnel's lack of accountability and billing errors that result in a decrease in funds for the utility companies. The end user and the consumer cannot interact one-on-one because of this work. When the customer's metre readings are abnormal, an SMS is sent by remote monitoring of the metre. electricity metre, the solution that has been created could assist utilities in lowering the instances of theft of energy in homes. To remotely cut off the power supply to the home or any consumer attempting to commit power theft, the unit can be equipped with an automatic circuit breaker. The primary focus of this system design is single phase system for distributing electricity. The meter's timely tracking of the consumer's load has allowed for the automation of the customer billing system. Therefore, this design eliminates the need for human metre reading and the associated time-consuming system and bill manipulation that impact the business and result in higher costs for the customer.

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