International Scientific Journal of Engineering and Management ISSN: 2583-6129
Volume: 02 Issue: 04 | April – 2023 DOI: 10.55041/ISJEM00349 www.isjem.com
An International Scholarly || Multidisciplinary || Open Access || Indexing in all major Database & Metadata

IOT BASED REDUCTION OF ELECTRICITY THEFT

Dr.B.R.Tapas Bapu[1], Divyadharshini.J.A[2], Senthamil Selvi.D[3], Ulageswari.S[4]

Professor[1], UG Students[2,3,4]

Department of ECE, S.A. Engineering College, Thiruverkadu, Chennai, Tamil Nadu, India

***Abstract*: The Internet of Things (IoT) has emerged as a promising technology to address various challenges in different domains. One of the critical challenges in the power sector is the issue of electricity theft, which results in huge revenue losses for power utilities. To avoid such issues, the proposed system monitors the real-time electricity consumption of a household or commercial building using a current sensor and sends the data to a cloud-based IoT platform, ThingSpeak, using NodeMCU and WiFi. The platform analyzes the data and identifies any unusual electricity consumption patterns, which could be indicative of electricity theft.**

***Keywords*- IOT (Internet of Things), Electricity, Energy Meter Coil, ESP8266, ThingSpeak.**

I. INTRODUCTION

The power sector has been facing a significant challenge in recent years due to electricity theft. Electricity theft not only results in revenue losses for power utilities but also affects the overall efficiency and reliability of the power supply. Therefore, there is a need to develop a system that can monitor and identify any unusual electricity consumption patterns in real-time. The Internet of Things (IoT) has emerged as a promising technology to address such challenges in the power sector. IoT enables the integration of various devices and sensors to collect and analyze data in real-time, which can be used to improve the efficiency and reliability of power supply systems. As the world becomes increasingly connected, the IoT has emerged as a powerful tool for monitoring and controlling various aspects of our daily lives. One area where IoT can be particularly effective is in the reduction of electricity theft. It is a significant problem in many parts of the world, causing financial losses for power companies and leading to higher energy costs for consumers. Traditional methods of detecting and preventing electricity theft can be time-consuming and expensive, and may not always be effective. It is a serious issue that affects not only the utility companies but also the society as a whole. It results in the loss of revenue for the utility companies, which in turn affects their ability to invest in infrastructure and provide better services to their customers. Moreover, electricity theft can also lead to electrical accidents and fires, endangering the lives of people and damaging property. By leveraging IoT technologies, however, it is possible to detect electricity theft in real-time and take action to prevent it. Through the use of smart meters, sensors, and other IoT devices, energy providers can monitor energy usage patterns, identify anomalies, and take immediate action to stop theft.

In this context, we propose a system that uses IoT to monitor the real-time electricity consumption of a household or commercial building. The system consists of a current sensor that measures the electricity consumption of the building and sends the data to a cloud-based IoT platform, ThingSpeak, using NodeMCU and WiFi. The platform analyzes the data and identifies any unusual electricity consumption patterns, which could be indicative of electricity theft. The proposed system has the potential to address the issue of electricity theft in a cost-effective and efficient manner, thereby improving the overall efficiency and reliability of the power supply. Moreover, the system can also be extended to monitor the electricity consumption of a larger area, such as a neighborhood or a city, to identify any trends or patterns that may indicate electricity theft.

II. LITERATURE SURVEY

Electricity is a crucial resource for economic growth and development in most countries. It is used to power industries, businesses, and homes, making it a vital component of modern life. However, the utility sector has been facing significant losses due to electricity theft. These losses not only affect the revenue of utility companies but also slow down the overall economic growth of a country. Electricity theft can occur in various forms, including meter tampering, unauthorized connections, and bypassing. These activities are difficult to detect and prevent, leading to a significant impact on the utility sector. Therefore, there is a need to develop effective methods for detecting and preventing electricity theft. The emergence of the IoT presents an opportunity for the utility sector to address the issue of electricity theft. IoT devices can be used to monitor energy consumption and detect any anomalies that may indicate theft. This technology can provide real-time data to utility authorities, enabling them to take immediate action.

In [1], the production and consumption of electricity are indicators of economic growth, but electricity theft leads to losses for utility authorities. These losses are divided into technical and non-technical losses, with non-technical losses occurring due to inaccurate metering and electricity stealing. This paper proposes using the Internet of Things and Raspberry Pi to detect electricity theft in real-time, allowing utility authorities to monitor and prevent illegality between the utility server and customer's energy meters. In [2] The Internet of Things (IoT) connects objects to the internet, allowing for data

© 2023, ISJEM (All Rights Reserved)

and services to be stored and retrieved. One application of IoT is in reducing electricity theft, which is a significant concern in many countries. A smart energy meter can be used to detect electricity theft, and in this paper, a Raspberry Pi is used to communicate with the energy meter via GPIO pins. The data is then transferred to the government officials, who can monitor the status of the energy meter in real-time and identify any dishonest users. The system is connected to the network, enabling remote monitoring.

In [3], discusses the issue of power theft and its impact on the power sector in different settings, including homes and industries. The project aims to reduce illegal electricity use and theft by designing a system that automatically collects energy readings and detects theft. This system reduces manual manipulation work and aims to achieve theft control. The project is based on a GSM module, allowing for real-time monitoring and control of electricity theft. [4] The paper discusses the issue of increasing electricity thefts across homes and industries and the economic impact it has on the country. The project aims to design a system that monitors power consumption and detects and eliminates power theft in transmission lines and energy meters. The system utilizes IoT technology to communicate theft information to the electricity board via a network of connected devices. Raspberry Pi is used to detect power theft and send commands to the GSM module, which sends theft information messages to the electricity board.

In [5], proposes a smart energy meter with overload detection, automatic billing, and theft detection using a microcontroller and GSM integration. The system sends information about consumed energy, produced charge, and security services through the GSM module, which can be incorporated into existing energy management systems at power organizations. The system also detects power theft using a vibration sensor. The paper aims to reduce the unlawful utilization of power and decrease the chances of theft, which continues to be a problem in power usage across the country. [6] The paper discusses the increasing prevalence of power theft and the need to detect and eradicate this crime. It proposes an IoT-based system that is simple to understand and easy to implement, with transmitting, receiving, and processing sections. The main objective of the project is to detect power theft and transmit this information to the electricity board using embedded technology and a wireless method.

In [7], presents an IoT-based framework for detecting electricity theft by analyzing past consumption data and adding IoT devices to metering units and electricity supply lines. Real-time data is accumulated through these devices via GSM technology and analyzed to pinpoint the specific area of theft. A vigilance IoT device captures images to monitor naked wires for prevention. The framework generates alerts for power distribution company representatives to take necessary steps to reduce energy theft. [8] proposes the use of IoT to minimize electricity theft, which is a major challenge for power companies. A smart energy meter is used to calculate the cost of electricity consumed, and this data is communicated to a Raspberry Pi device, which is connected to the internet. Government officials can then monitor the status of the energy meter at the back end of the electricity office through graphs and identify dishonest users.

In [9], discusses the problem of electricity theft, which costs distribution companies millions annually, and presents a solution in the form of an electricity theft detector with a GSM module and alarm system. The system is composed of an Arduino Uno module, GSM module, LCD, and current sensors. It detects electrical pilferage by monitoring the current difference between the two sensors, and whenever there is theft, it triggers an alarm and sends an SMS prompt to the electric utility company. [10] proposes an IoT-based smart energy meter for monitoring and identifying electricity theft. The system consists of an Atmega 328 microcontroller with WiFi and GSM modules, a current detector, and a screen. Users can set costs for the unit and configure the system via SMS.

III. COMPONENTS USED

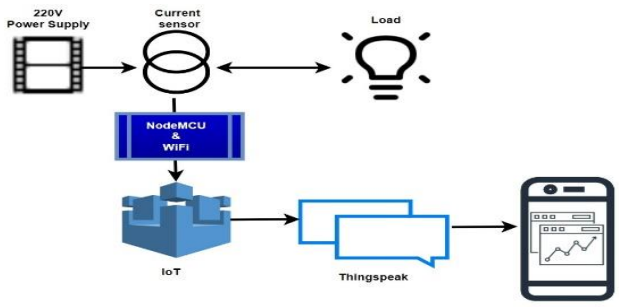

Figure 1: Block Diagram

A. *ESP8266:* The NodeMCU ESP8266 is an open-source development board that is designed for IoT projects. It is based on the ESP8266 WiFi module, which has an embedded 32-bit MCU and Wi-Fi capabilities, making it a popular choice for IoT applications. The NodeMCU ESP8266 also includes a USB-to-serial converter for easy programming and debugging, as well as GPIO pins for connecting sensors and other devices. It can be programmed using the Arduino IDE or with Lua scripting language. Overall, the NodeMCU ESP8266 is a cost-effective and versatile option for building IoT projects.

B. *Load:* The amount of power that is drawn from an electrical system by devices or appliances that are connected to it. The load can be either resistive or reactive, depending on the type of devices or appliances that are connected.

C. *Energy Meter coil (Current sensor):* An energy meter coil is an essential component of an energy meter, which is a device used to measure the amount of electrical energy consumed by a residential or commercial building. The coil is responsible for detecting the current flowing through the electrical circuit and producing a proportional magnetic field. The energy meter coil is typically made of a thin wire wound around a magnetic core. When an electrical current flows through the wire, it generates

magnetic field that interacts with the magnetic core, causing it to vibrate or rotate. This movement is then detected by a sensor and converted into an electrical signal that can be processed by the meter to determine the amount of energy consumed.

D. *Power Supply:* A power supply is a device that converts electrical power from one form to another in order to supply electrical energy to an electronic device. In general, power supplies can be classified into two categories: AC (alternating current) and DC (direct current) power supplies.

E. *Transformer:* A transformer is a device that is used to transfer electrical energy from one circuit to another through electromagnetic induction. It works on the principle of Faraday's law of electromagnetic induction, which states that a changing magnetic field induces an electromotive force (EMF) in a conductor. When an alternating current (AC) is passed through the primary winding of a transformer, it creates a magnetic field that is transferred to the secondary winding through the core of the transformer. The magnetic field induces an EMF in the secondary winding, which produces a current in the secondary circuit. The rating of a transformer is specified in terms of its voltage and current capacity. In the case of a 0.5 amps transformer, it means that the maximum current that can be passed through the transformer is 0.5 amps. Transformers are commonly used in power supplies, audio equipment, and electronic devices to step up or step down the voltage levels. They are also used in the transmission and distribution of electrical power to reduce losses due to resistance.

F. *ThingSpeak:* ThingSpeak is an IoT platform that allows users to collect, store, and analyze sensor data in the cloud. It provides an open-source API that enables IoT devices to send data to ThingSpeak, which can then be displayed on customizable charts, graphs, and maps. ThingSpeak also supports third-party integrations with services such as Twitter, MATLAB, and IFTTT. It is free to use for small-scale projects and offers paid plans for larger-scale or commercial use.

G. *ThingShow:* ThingShow is a feature within the ThingSpeak IoT platform that allows users to create custom dashboards for data visualization and analysis. It allows users to choose different types of visualizations such as charts, gauges, and maps, and customize them according to their needs. With ThingShow, users can easily monitor and analyze data from their IoT devices and sensors in real-time. Additionally, ThingShow provides easy sharing options, allowing users to share their dashboards with others for collaboration or data sharing purposes.

H. *C++ (Programming Language):* C++ is a high-level programming language that was developed as an extension of the C programming language. It is an object-oriented language that supports features such as classes, objects, inheritance, and polymorphism. C++ is a compiled language and allows for low-level memory manipulation, making it suitable for developing system software and applications that require high performance. It is used in a wide range of applications including operating systems, embedded systems, game development, and scientific computing. C++ is known for its efficiency, performance, and versatility, and is considered a popular choice for programming complex systems and applications.

IV. IMPLEMENTATION

The first component in this system is the power supply, which is responsible for providing the electrical energy needed to power the other components.The 0.5amps transformer is then used to step down the voltage from the power supply to a suitable level for the energy meter coil, which is used to measure the amount of electricity being consumed by the load.

The load is the electrical device or appliances that consume the electricity, such as a light bulb or a refrigerator. By measuring the amount of electricity being consumed by the load using the energy meter coil, it is possible to detect any discrepancies between the amount of electricity being consumed and the amount being recorded by the utility company.

To monitor the electricity consumption data, an ESP32 microcontroller can be used. This microcontroller is responsible for collecting the data from the energy meter coil and transmitting it to a cloud-based platform such as ThingSpeak, which is used to store and analyze the data.

ThingSpeak is an open-source IoT platform that allows for the collection, analysis, and visualization of data from a variety of sources. In this case, ThingSpeak is used to collect and store the electricity consumption data from the ESP32 microcontroller.

The ThingShow is a web-based application that allows users to view the data collected by ThingSpeak in real-time. This viewer can be accessed from any device with an internet connection, allowing for easy monitoring of electricity consumption data from anywhere in the world.

V. WORKING

The energy meter coil is connected to the load and measures the amount of electricity flowing through it. The voltage generated by the energy meter coil is proportional to the current flowing through it. The ESP8266 microcontroller reads the voltage generated by the energy meter coil and calculates the amount of electricity consumed by the load. The microcontroller then sends this data to the Thingspeak platform using Wi-Fi connectivity. The data is sent in real-time, allowing the user to monitor the electricity consumption of the load remotely. The Thingspeak platform collects this data and provides a graphical representation of the electricity consumption of the load. The user can access this data from anywhere in the world using a web browser.If the electricity consumption of the load is significantly lower than what is expected, it could be an indication of electricity theft. The ESP8266 microcontroller can detect this and send an alert to the user via email or SMS.

International Scientific Journal of Engineering and Management ISSN: 2583-6129
Volume: 02 Issue: 04 | April – 2023 DOI: 10.55041/ISJEM00349 www.isjem.com
An International Scholarly || Multidisciplinary || Open Access || Indexing in all major Database & Metadata

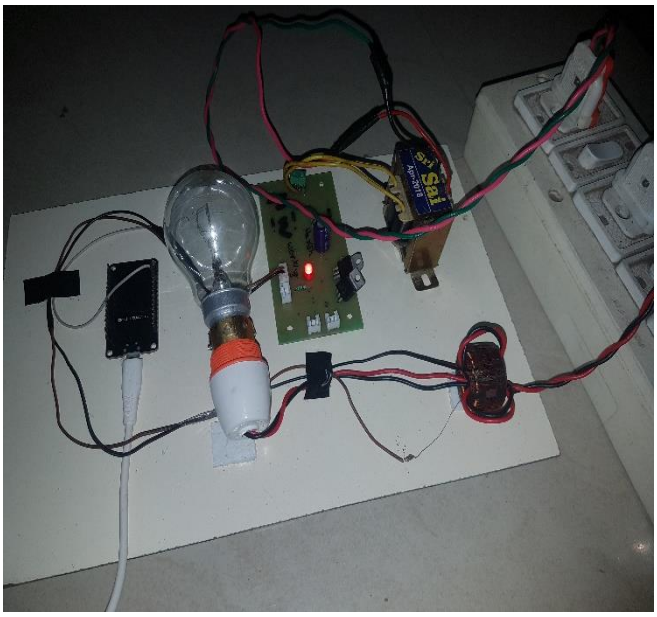

Figure 2: Working Model

VI. RESULT AND DISCUSSION

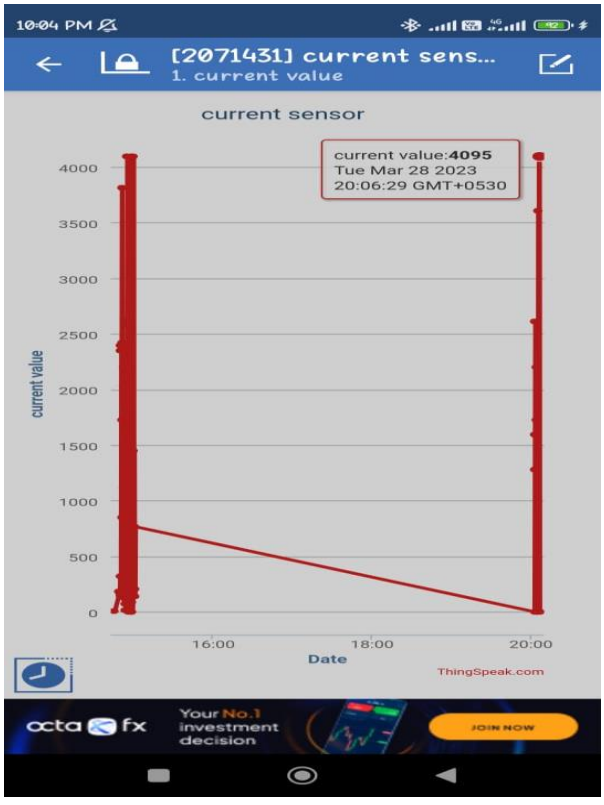

Figure 3: Graphical Output

The graph monitors the real-time electricity consumption of a household or commercial building using a current sensor and sends the data to a cloud-based IoT platform, ThingSpeak, using ESP8266. The x-axis of the graph represents time in hours, with each centimeter representing an hour. The y-axis represents the current value, with each centimeter representing 500A. The current value is 4095A, which means that at the time of Tue Mar 28 2023, 20:06:29 GMT+0530, the current was measured at 4095 units. The graph can help identify unusual electricity consumption patterns, which could be indicative of electricity theft. By analyzing the data collected by the sensor and comparing it to expected patterns, the platform can flag any anomalies and alert the building owner or manager to investigate further.Overall, the graph provides a useful tool for monitoring and managing electricity consumption in buildings, helping to reduce waste and potentially prevent theft.

VII. CONCLUSION AND FUTURE SCOPE

The implementation of an IoT-based system for reducing electricity theft can be an effective solution for preventing electricity theft and improving energy efficiency. By using an ESP32 microcontroller, the system can collect real-time data on energy usage and detect any abnormal patterns that may indicate theft. The energy meter can accurately measure the amount of electricity consumed, while the load and transformer help simulate real-world conditions. With the help of ThingSpeak, the collected data can be easily monitored and analyzed from anywhere with an internet connection, allowing for quick identification and response to any suspicious activity. Overall, an IoT-based system for reducing electricity theft can help to promote sustainable energy use and reduce costs for both consumers and utility companies. Future scopes for this system are Enhanced security features, Integration with smart home automation, Integration with renewable energy sources, Predictive maintenance.

REFERENCES

[1] Oscar FAMOUS Darteh, Xiaodong Liu, Qi Liu, Raphael Anaadumba, “Internet of Things Based Electricity Theft Detection Using Raspberry PI”, IEEE, 2020.

[2] Hariharan R, Gunapriya D, Jayaram K.T. K, Naveenkumar N, Sundar.P. P, Sri Madhavan C, “Reducing Theft of Electricity by Using IOT”, IEEE, 2022.

[3] Nilesh Mohite , Rinkuraj Ranaware, Prakash Kakade, "GSM Based Electricity Theft Detection”, International Journal of Scientific Engineering and Applied Science (IJSEAS), 2016.

[4] R Meenal, Kevin M Kuruvilla, Adrin Denny, Rejin V Jose, “Power Monitoring and Theft Detection System using IoT”, Journal of Physics Conference, 2019.

[5] Anubhuti Anand, Yashee Chaudhary, Ajay Yadav, Rahul Mukherjee, “GSM Based Smart Energy Meter with Theft Detection and Load Control”, 7TH International Conference

On Signal Processing And Communication, 2021.

[6] Dr. A. Rajasekaran, P. Ajay Sai, P. Bhanu Teja, P.G.S. Swetha Priya, "Iot Based Power Theft Detection", IJSDR, 2020.

[7] Kuldeep Sharma, Arun Malik, Isha Isha, "An Efficient IoT Based Electricity Theft Detecting Framework For Electricity Consumption", IEEE, 2021.

[8] Maninderpal Singh, Er.Varun Sanduja, "Minimizing Electricity Theft by Internet of Things", International Journal of Advanced Research in Computer and Communication Engineering, 2015.

[9] Jennica Astronomo, Mariel Dane Dayrit, Christopher Edjic, Engr. Richard T. Regidor, "Development of Electricity Theft Detector with GSM Module and Alarm System", IEEE, 2020.

[10] Suraj Rajendra Bhole , Vishvajeet Tukaram Dabhole , Rihan Kashim Mulani , Kuldeep Sanjay Salunke, "Iot Based Smart Energy Meter Monitoring With Identification Of Electricity Theft", IJCRT, 2022.

[11] P V Ashwathy Devraj, A Mohanraj, Dipesh Uike, S. Sasireka; S. Subha, Amara S A L G Gopala Gupta, "IoT-based Mobile Application for Power Theft Detection", IEEE, 2022.

[12] Y. Yao, H. Hui, Z. Liang, X. Feng and W. Guo, "AdaBoost-CNN: A Hybrid Method for Electricity Theft Detection", 6th Asia Conference on Power and Electrical Engineering (ACPEE), 2021.