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Smart Energy Meter with Advanced Billing and Power Theft

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Abstract: *The remote energy monitoring system is a meter and IOT software combo that provides amenities for the consumer. Indonesia swiftly embraced smart metering over traditional metering. India still uses the conventional type, which has issues such as electromechanical meter errors, human errors, and processing flaws. Using an ATMEGA 328p and a node MCU Micro Controller, we constructed a power theft detection and invoicing system for this project. It contains tools to monitor power in real-time using Internet of Things technology and is capable of automatically generating power bills. Additionally, in addition to alerting the user when power changes such as undervoltage, overvoltage, or overload occur, our system also looks for instances of power theft. The Power Theft Detection and Power Billing System is a ground-breaking initiative that was created as a result of the energy management industry's unwavering quest of innovation. This project represents the future of intelligent energy management since it is based on the confluence of technology and pragmatism*

Keywords: Remote Energy Monitoring system, IOT software, ATMEGA 328p, Node MCU Micro Controller, Theft Defection, Power Billing System

I. INTRODUCTION

As the population grows, so does the demand for energy. It is getting increasingly difficult to sustain and control electricity due to rising population and demand. An energy meter referred to as a tool is used to calculate the electric energy utilized by the control devices. After the 1980s, the adventure of the energy meter began. Then there were large energy meters that were designed with numerous technologies to reduce their weight and size. Most countries are transitioning from traditional energy management activities to advanced ones by replacing traditional energy meters with smart meters installed with a prepaid system to measure electricity usage and minimize billing losses for utilities owing and consumers' inability to pay for used resources on time.

According to a recent survey for an energy efficiency by American Council, “Germany was the best country overall for energy efficiency, scoring high in multiple categories for a total score of 65 points out of 100. Next comes Ireland, Denmark, UK, Norway, France, Austria, Italy, Mexico, Australia [1].

In India, nearly 200 million people lack access to electricity. Both the supplier and the consumer suffer losses as a result of a lack of power distribution and electricity use preparedness. The increase in customer bills is due to the absence of preparedness and awareness of electricity usage. The disadvantage of the traditional method is that it involves more work and time to do invoicing and data studying, and even if the data obtained here is valid, human errors may occur in some scenarios, resulting in the breakdown of the power unit. One of the major causes of electrical board failure is deceitful servicemen [2]. Manual operators would be unable to detect inappropriate linkages and malpractices [3]. These concerns can be discovered in Postpaid schemes; however, the adaptation of the remote approach can provide us with a complete understanding and appreciation of the importance of saving electrical energy. There are currently a few smart meters in use, such as smart energy meters that use GSM, IOT, and machine learning.

In this project, we used an ATMEGA 328p and a node MCU microcontroller to construct a power theft identification and invoicing system. This will include tools to track power in actual time utilizing Internet of Things technology and be able to create power bills automatically. In addition to detecting power changes like undervoltage, overvoltage, and overload and alerting the user, our system also looks for power theft.

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A novel project, a Power Theft Detection and Power Billing System, has been conceived and realized as a result of the energy management industry's unwavering quest of innovation. This proposal, which is based on the combination of technology and pragmatism, represents intelligent energy management in the future.

II. LITERATURE REVIEW

A review of the literature that includes works that have been published. The IEEE Explorer, journals, and works cited in the listed papers were all used in the search.

The following section contains critical analyses of current publications on chatbot creation.

The substantial rise in energy consumption, as well as the rapid growth of renewable energy sources such as solar and wind power, have posed major obstacles to energy security and sustainability, while also stimulating the development of energy networks in a more intelligent direction. The most fundamental components of intelligent energy networks (IENs) are smart meters. Smart energy meters can share information on energy use and the condition of energy connections across utility companies and consumers in addition to monitoring energy flows. In addition, smart energy metering can be used to track and control household appliances and other equipment based on the instructions of the customer. This study examines the creation and implementation of smart energy meters, such as smart electricity meters, smart heating meters, and smart gas meters, in detail. This article gives insights and directions for the future development of smart meters by exploring various functions and uses of smart energy meters, as well as related advantages and costs. [4]

Increased energy demand, combined with advancements in renewable energy generation, has posed a significant challenge to the energy business. To meet the demand for higher energy efficiency, researchers and developers have been working on intelligent power systems as a potential energy network. Smart Electricity Energy Meters are a fundamental component of the coming intelligent network or smart grid, gauging energy flow and transferring details about consumption of energy between utilities and consumers, as well as tracking and managing home appliances and devices using consumer data. The authors suggest an IoT-based Smart Energy Meter with Arduino and ESP8266 Wi-Fi unit that can deliver electricity bill information by SMS or E-mail and provide energy monitoring usage anytime and anyplace on Earth. [5]

Efficient energy usage is critical for the establishment of a smart grid in the power system. As a result, accurate monitoring and regulation of energy use is a top concern for the smart grid. There are several issues with the current energy meter system, one of which is the lack of full duplex transmission. To address this issue, a smart energy meter based on the Internet of Things (loT) is proposed. The suggested smart energy meter manages and calculates energy use with an ESP 8266 12E and a Wi-Fi module before uploading it to the cloud, where the customer or producer may examine the information. As a result, energy analysis by the customer becomes considerably easier and more manageable. This technology also aids in the detection of electricity theft. [6]

Single phase energy meters with 1.0 precision grade as per IS 13779 for railway traction are available for measuring electricity energy. All EHV (Extra High Voltage) users in India must be provided with 0.2S accuracy class metering systems, according to Central Electricity Regulatory Commission (CERC) and Central Electricity Authority (CEA) rules. Summation meters are used to measure energy in multi-feeder circuits. Due to summation CT, there are several limits for energy measurement in summation meters. This work describes the planning and fabrication of a dual phase four wire energy measurement system for an electrical locomotive, i.e., railway traction. The 0.2S precision grade traction meter is built using a standard 3-phase four wire meter. [7]

Nowadays, the globe cannot imagine living without electricity; nearly all of the products, equipment, and machinery used in daily life rely on electricity to function properly. It has been a fundamental component of our lives since the advent of power. The second alternative is solar energy, which has a few drawbacks such as environmental issues, expensive capital costs, and so on. In today's world, every device deals with power, from the revolving brush to massive motors. As a result, power usage expands from regional to metropolis and from locally produced to mechanical zones, but with electricity theft at hand. By sensing the situation using an energy meter at the rear end of the power board and combining gravitational pursuit computation with IOT-based power robbery ID, a system may discover the dishonest client. [8]

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III. BLOCK DIAGRAM

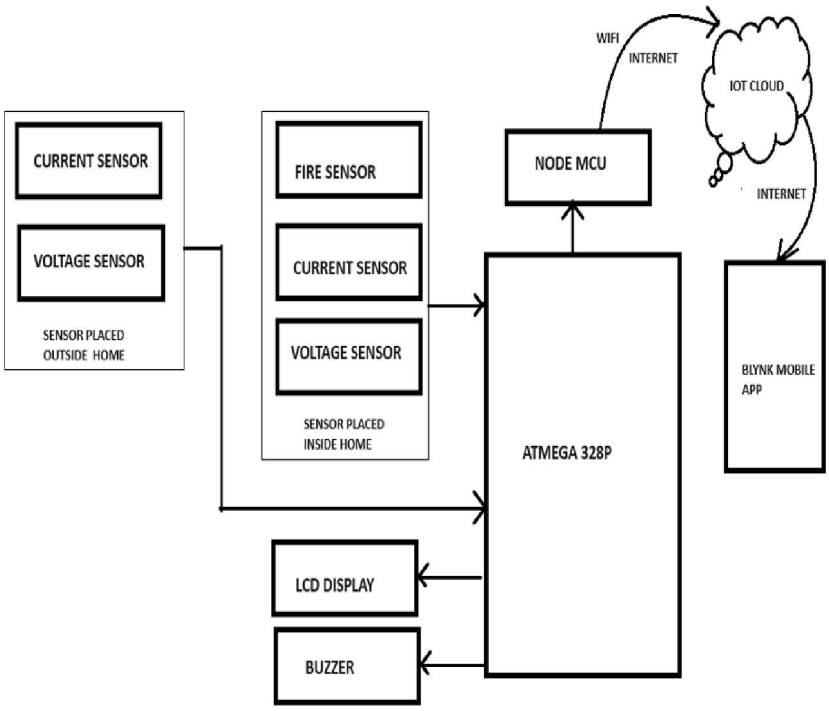

Figure. 1. Block Diagram of the Framework

IV. WORKING

Our solution uses an ATMEGA 328p microprocessor and a node MCU microcontroller for automated power billing and monitoring. Using the Blynk mobile app, owners and authorities may keep an eye on power consumption and associated bills without the need for a manual human operator to read each home's usage and create a bill accordingly, saving money and time on labor. Additionally, our system sounds a buzzer to notify the user in the event of a power outage caused by an electrical fire, undervoltage, overvoltage, or overload.

An ATMEGA microcontroller with a current and voltage sensor linked allows for the real-time measurement of current and voltage as well as the execution of several tests, including real-time undervoltage, overvoltage, and overload calculations. The microcontroller also computes real-time power usage and creates bills.

An ATMEGA microcontroller is coupled to a fire sensor to detect fire. The ATMEGA microcontroller will be linked to the node MCU, and node MCU will receive serial communication from the ATMEGA microcontroller measuring voltage, current, and warnings. Node MCU will also use a wi-fi connection to relay data to the Blynk server. Additionally, there is a 16x2 LCD attached to the system that shows data locally. A combination of current and voltage sensors is employed at the home's exit node to identify power theft.

Ultimately, the total electrical power consumed at that line will be compared to all the power drawn at the exit nodes to residences. We'll take the losses into account, but when there's a significant difference shown then this power theft will be displayed via Mobile App and Alerted through Buzzer.

V. RESULT

Using a resistive load, the power meter was tested. The remote energy monitoring meter is used to measure the power consumed by the load.

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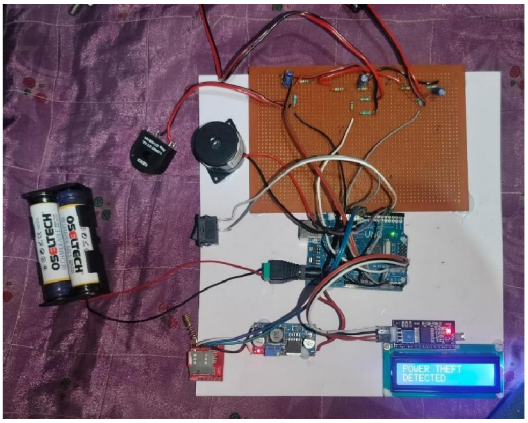

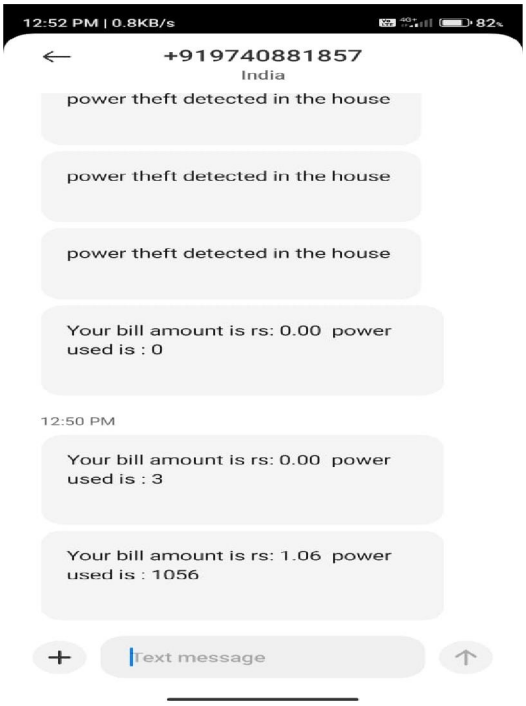

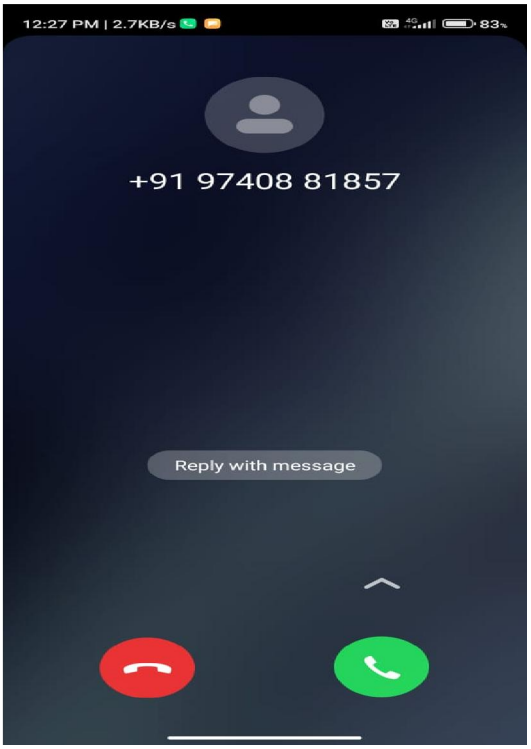

VI. CONCLUSION

As a result of employing our technology, there will be no need for manual labour to bill the house power usage, which consumes a significant amount of human resources and time since they must visit each home to check the meter and create a bill. The energy board can automatically switch off the power if the client fails to pay the bill. By doing so, we can reduce labour costs for billing as well as the paper needed for billing. By contributing to an eco-friendly billing system, we can also identify power theft. This effort would enable consumers to improve their management of power by employing peak hour and load warnings, as well as its utility in the Electrical Board's delivery system for commercial liabilities.

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