

Smart Energy Meter Using IOT

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Abstract

Due to the increasing development of the human population and their reliance on electricity, the demand for power has increased, leading to a shortage of electricity at peak hours. Resolving the energy issues requires updating the electrical infrastructure. Energy distribution and consumption scenarios can be addressed by the application of Internet of Things (IoT) technologies. Power optimization, power card facilities, automatic billing, and providing users with relevant energy consumption data are the main topics of this article. The controller, the Wi-Fi detection device, and the smart energy meter itself are the three essential components of an Internet of Things (IoT) smart energy meter system. The controller plays a major role in keeping all the components operating as intended. This system has internet-connected energy meters. That is to say, the idea of the Internet of Things eliminates the necessity for human involvement in the upkeep of electricity. When a customer doesn't pay their monthly bill, the service provider can shut off the electricity thanks to the IoT-based meter reading system in the proposed work, which is designed to continuously check the meter reading. Additionally, it eliminates the need for human intervention, yields precise meter readings, and prevents billing errors.

Keywords: Internet of things (IoT), smart energy meter, automatic billing, power optimization, Wi-Fi.

INTRODUCTION

The distribution businesses are unable to monitor the fluctuating maximum demand of customers under the current invoicing method. The customer is having issues with things like receiving past-due bills for amounts that have already been paid, as well as inconsistent electricity supply and quality even in cases where payments are made on a regular basis. Monitoring customer load promptly is the solution to all of these issues. This will ensure correct billing, allow for the tracking of maximum demand, and enable the detection of threshold values. All of these elements need to be considered when creating an effective energy billing system [2]. Right now, the most important resource for human survival on Earth is electricity. Every home, company, and industry requires an electricity connection to function properly. Due to the increasing development of the human population and their reliance on electricity, the demand for power has increased, leading to a shortage of electricity at peak hours. Resolving the

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energy issues requires updating the electrical infrastructure. Energy distribution and consumption scenarios can be addressed by the application of Internet of Things (IoT) technologies [1]. The concept of a "smart city" is evolving into something more sophisticated than it once was thanks to the most current developments in IoT and digital technology. In order to lessen reliance on these resources, it is imperative to switch to more advanced and superior alternatives like smart metering, smart grid, and zero energy buildings. These will do this by increasing the usage of renewable energy sources and consuming less energy. This will increase the power and energy management system's efficiency. The

implementation of a suitable tariff and billing system, precise metering, and theft detection are all necessary for the management of electrical energy use. Getting readings from meters is one of the most challenging billing procedures. The traditional approach to collecting data from electrical energy meters is for a utility provider person to regularly visit the customer's location and take the meter's reading. This method has many drawbacks, such as its length, labor intensity, need for additional staff, susceptibility to human mistake, and potential for corruption. The procedure may be stopped by inclement weather, and billing may be delayed and a human operator may be required to check in if the customer is not present. During peak hours, India has an energy deficit. Low voltage has been found to be a major issue with power quality during peak hours. Utility companies often employ load shedding as a power management strategy. Energy conservation is essential given the current escalating demand for electrical energy. The way energy bills are now calculated is tedious, error-prone, and takes a long time. Every step of the energy billing process is susceptible to error, such as mistakes made by humans when recording the meter reading or with electro-mechanical meters. The smart energy meter can be used to fix these mistakes. The development of a smart energy meter is the primary goal of the proposed study [1–8].

LITERATURE SURVEY

1. Prathik et al. [10] proposed an electronic device called an SSEM (Smart Sensory Energy Metering) keeps track of electric energy consumption and lets users schedule how and when their homes utilize energy.
2. 2: Sahani et al. [9] proposed their study in this form that the smart grid is a significant component of our modern networks and society. Smart meters are essential. A smart meter offers user engagement, energy control, automated information collecting, and instantaneous monitoring of dependable status. Additionally, it offers two ways for information to move between suppliers and customers, improving efficiency and control. In addition, it offers power control and real-time usage information. An intelligent power meter will assist in separating the electricity supply to consumers if their maximum load consumption exceeds the maximum value. A smart meter should last five to six years under regular workload conditions and excellent environmental conditions. The initiative introduces the Internet of Things (IoT) smart meter era. The three primary components of the Internet of Things (IoT) power meter system are the Wi-Fi, the remote control, and the theft detection component. Based on the information it receives, the theft detection sensor determines the error response and the circuit in the event of a theft or error. In order for the system to function properly, the console is essential. Consequently, the three phases of the smart grid are where the Internet may most effectively enhance its performance and efficiency.
3. Smart Meter Implementation serving as the Building Energy Management Systems' IEEE1888-6LoWPAN Gateway. First of all, The Smart Meter (SM) is a crucial component of the power management system since it helps users track their energy consumption and feel more engaged. Consequently, numerous attempts have been undertaken to enhance the functionality of this apparatus with the aim of aiding in the decrease of energy usage in the direction of a sustainable development and green economy. Different protocols have been created in addition to SM to offer safe, easy, and intelligent control and management between building blocks or buildings. IPv4 integration of millions of devices is not the ideal solution given the exponential increase in Internet-connected devices, or the Internet of things. IPv6 is therefore intended to address this issue. More Internet-based gadgets are possible using IPv6. Device energy consumption is typically higher with IPv6 due to its complexity compared to IPv4. The low power IPv6 protocol was created for the wireless personal area network in response to earlier worries about consumption.
4. Prathik et al. [10] extended on the design and execution of an energy monitoring system that shows power wasting by utilizing an Arduino microcontroller and a GSM (Global System for Mobile communication) module. This method has the benefit of helping the user control electrical appliances more effectively and comprehend how much energy they waste on a regular

basis, which promotes energy conservation. The consumer can find information about the total cost, payment options, and the date of the power outage in the electrical board area. If the customer fails to pay the bill on schedule, the user gets notified.

5. Suciu et al. [11] outlined the security measures for smart grid systems, including how deploying blockchain technology safeguards the confidentiality and integrity of the system. It was demonstrated that blockchain is a secure alternative to mining systems since it allows for secure database applications. The use of blockchain technology and its possible effects on a smart power management system based on Sealed GRID are demonstrated in this article. Since it allows users to observe real-time power usage in a smart grid system, this platform was designed with security and attack resistance in mind.

Idea about Internet-of-Things

The Internet of Things (IoT) makes it possible for objects to be sensed or controlled remotely over already-existing network infrastructure. This opens possibilities for a more direct integration of the physical world into computer-based systems, which can lead to reduced human intervention and improvements in efficiency, accuracy, and economic benefit. The Internet of Things (IoT) can be enhanced with sensors and actuators to form part of a broader class of cyber physical systems, which includes virtual power plants, smart homes, smart cities, and smart grids. Using its embedded computer system, each object has a unique identity, but it can still communicate with the current internet infrastructure [10]. Representation of IoT system is shown in Figure 1.



Figure 1. IoT Representation.

Individuals also wish to use the internet to communicate with any non-living object, including clothes, furniture, appliances, and stationery. Although individuals currently have many tools at their disposal to interact with living things, the Internet of Things makes it possible to comfortably converse with inanimate objects.

The Internet of Things (IoT) is the result of the confluence of many different technologies, including embedded systems, ambient intelligence, ubiquitous and pervasive computers, sensors, actuators, and communications technologies [10]. The Whole Working of Internet of Things (IoT) is shown in Figure 2.

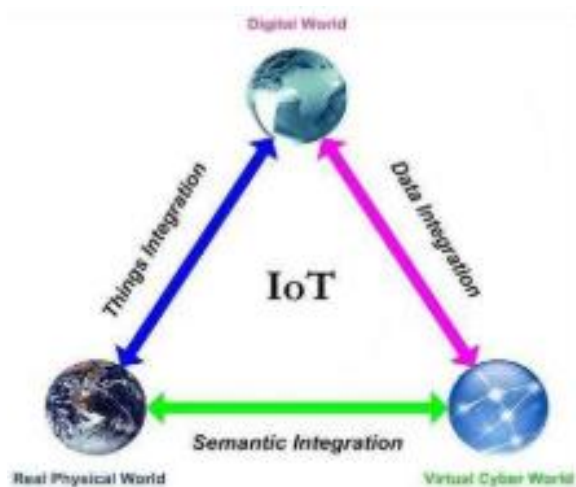


Figure 2. IoT Working.

METHODOLOGY

Below is a quick discussion of the project's methodology. The project was completed in the order listed below, and it was then put together to create a functional system.

Material Survey and Selection

This was the project's first and most crucial stage. The goal of the market survey was to determine which hardware would be best for the project, and the best option was selected. Selecting the appropriate microcontroller, sensors, and WiFi module was necessary for this.

Interfacing current sensor to the Nodemcu

During this stage, the controller and the current sensor board were interfaced so that the load could be controlled by the web browser's commands. In this project, a 4-channel relay was interfaced.

Programming and android application development: During this stage, a web page is created to control the appliances via the internet, and the established system is coded using Arduino and logic. Additional Android applications are being created to evaluate the project's outcomes.

In our recommended setup, Nodemcu, CT, and PZEM-004T modules are utilized. The Wi-Fi module is the key component of the Internet of Things. The readings are processed by the Wi-Fi module, which then updates them over the network. The webpage with the latest readings is easily accessible to users. This allows the user to check the energy usage with ease using a simple online application. Consequently, this method makes it easy for consumers to monitor their electric meter readings and check their online bills.

RESULTS

Increase in the efficiency in Smart Energy Metering has been observed after aiding with node MCU and Internet of Things (IoT), making it simple for consumers to obtain information from energy meters via IoT and the remote server's service has also been disconnected. Display of efficient smart energy meter with aid of Internet of Things (IoT) is shown in Figure 3.

ADVANTAGES

1. The consumer can adjust the monthly budget for electricity billing from this system. Thus, there is minimal energy waste.
2. Because the person from the electricity department does not need to visit the customer's home each month to record the amount of energy used, labor work is decreased.

3. The system uses inexpensive hardware, and the installed energy meter won't be changed or tampered with, so the cost of this gadget isn't higher. This system receives input from the authorized energy meter that has been placed.

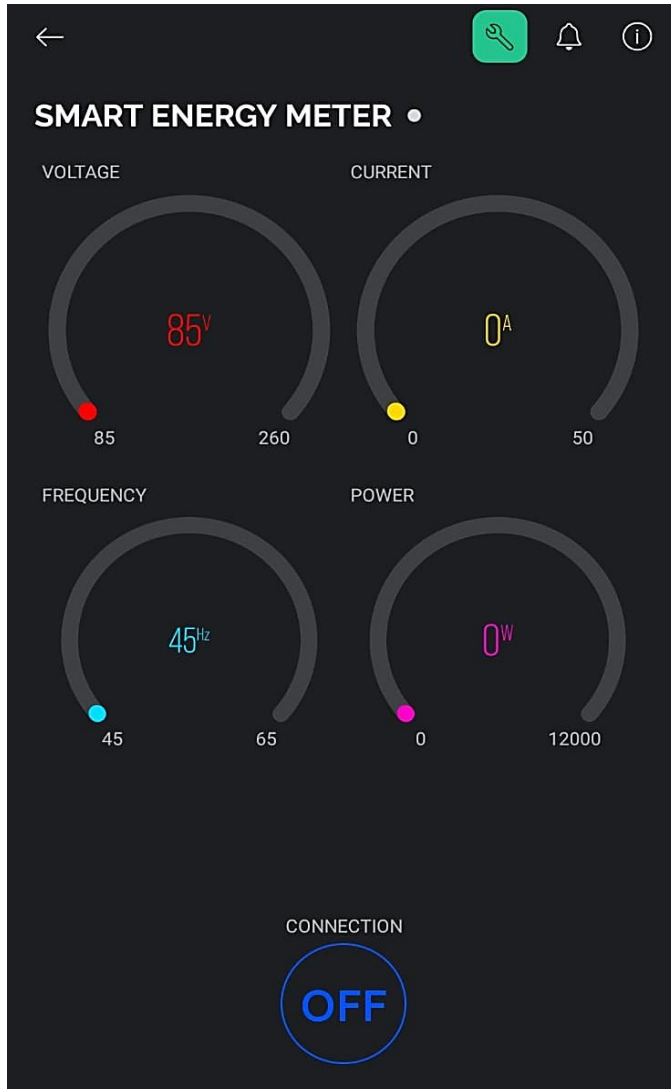


Figure 3. Display of efficient smart energy meter with aid of Internet of Things (IoT).

CONCLUSION

Prototype smart energy meters are a step ahead in the era of smart cities and smart grid advancement, primarily focusing on the connectivity and networking aspect of the Internet of Things. In this system, Nodemcu is used in the embedded system domain to design and perform an energy consumption calculation based on the counting of calibration pulses. The IoT-based meter reading system in the proposed work is used to continually monitor the energy usage and meter reading, and the service provider has the ability to cut off the power source if the customer fails to pay the monthly payment. Additionally, it prevents billing errors, provides accurate meter readings, and does away with human interference.

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