Design of IoT Based Smart Energy Meter for Home Appliances

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Abstract: Communication technology development is increased day by day. Due to the development of communication technology, every product is manufactured with smart activities. From the past decade, most electric devices are executed automatically using the remote control. Internet of Things (IoT) is used to connect various devices easily with the help of sensors. All the connected devices are working automatically without any human interventions. The roles of human beings are only to manage and control the connected devices from a remote location. Electric meters also using the concept of IoT. This paper describes smart meter devices. This system's main purpose is to automatically read the number of current consumption units with LED light, calculate the amount, and display the messages to the user's website and user's smartphone. This system also issues the user's alert message when the current consumption unit crosses the limited level.

Key Words: Smart Energy Meter, Electric board, LED, IoT, GSM, Wi-Fi, webpage.

1. Introduction

Now the growth of population is increased day by day. Due to this reason, the residential places and industries need a large amount of current. Various systems are already introduced to save energy from residential electric meter devices. In traditional days, the energy meter device fits inside the users' premises. The consumption rate was taken by human beings and updated into the system. This system was extremely dependent on operator. The operator wet it to the users’ locations for collecting the information. It is a very difficult process. To avoid this condition, the proposed system is used to measure the current consumption rate automatically. This system is used to collect the current consumption value and provide the alert message to the user with IoT. The IoT concept permits physical devices to be measured and managed vaguely across an already available network connection, creating direct communication between the real world and computer systems. The result of the IoT technique is getting an accurate result and avail financial benefit. This technology has developed from its starting stage and currently using this concept. Electricity is important in everyone’s life. Without electricity, people cannot able live in this current world.

This proposed system is used to collect the data from the user's location and use it for the bill calculating process. The measured value will be stored on the server, and it is used for amount calculation also. This system measures the current consumption units accurately. This system removes human
intervention. This proposed system displays the real-time current consumption data on the LCD screen. Wi-Fi modem can be used to check the consumed units and give threshold unit level via a webpage.

The paper is divided into various parts. Section II describes the same work available in the existing study. Section III presented the current system architecture. The new proposed system was practically implemented and tested, and the offered results are shown in section IV; at last, the section discussed the conclusion of the proposed system.

2. Literature Survey

This work explained the traditional meter reading system. In the existing meter reading system, a human can come from the electricity board and stand in front of the electric meter to measure the current consumption units. This is used for calculating electricity bills. The main disadvantage of this traditional system was that the human went to the users' location, measured the units consumed, and handed the bill to the consumers. Based upon their calculation, the users pay the amount. Sometimes an extra amount will be added to the electricity bill by human's mistake. To avoid this problem, the authors constructed a new system using IoT and Arduino concept. In this proposed work Arduino controller was used. Because it uses less power and fast processing capability than other controllers, this proposed system was embedded with the existing system. GSM concept was used to send the messages to the user [1].

This paper presents that the electricity people directly went to the users' location and note the meter readings in the existing system. Based on the unit's value, the electricity bill was created and given to the user. Here the authors proposed a new system to read the meter reading automatically by using an Arduino controller. This system was providing the privilege to check the energy consumption and the bill amount using Wi-Fi module. This system will reduce human energy and prevent the machines from repair [2].

Moreover, provide a new architecture to measure and control the electric meters in residential places continuously. Finally, they constructed a new system controlled from a remote location. This proposed architecture can transfer the information to the server and send the SMS using the GSM concept. This framework has been implemented using an ARM processor controller with some sensor sets [3].

Additionally, it is constructed a new system for measure power usages. This system entirely avoids person interruption during the power measurement stage. It was constructed by using the new concept IoT. This technology is used to create the connection in physical objects with various software and sensor devices. Using this IoT concept, every device can transfer the data between them. This smart meter automatically reads the electrical consumption from the user's meter device and transfers the data to the server. Using this data, the bill will be calculated and send to the user, and the current readings will be displayed on the screen. This proposed system will be used to produce accurate results and proper amounts [4].

Although, explained the various disadvantages of the existing meter reading system. This proposed system measures the current consumption rate automatically at a small level. The main objective of this proposed system was to reduce the power usages in various appliances. This project was implemented by using Arduino UNO microcontroller and IoT techniques. If any critical conditions are measured, this system automatically cuts the power supply [5].

Furthermore, it described the monitoring of power consumption in domestic places and calculating electricity bills with the help of current telecommunication technologies. The main aim of this system was to decrease the human resource in the electrical department. The electricity bill was calculated automatically and sent directly to the consumers with IoT. The electricity bill has seen anywhere from the world. All information is sent by using IoT and stored in a web server [6].

The proposed system explained grid techniques used in electric products. The smart electric meter is constructed by using advanced metering infrastructures. This new system is extensively spread and
organized to the newly connected network. Now power-producing systems are also affected by various attacks. The presented system was operated based on IoT using an Arduino controller [7].

However, constructs and implements a new system used to avoid personal intervention in electric meter reading and generating an electric bill. This proposed system's major benefit was avoided corruption in electric power usages and generating an electric bill. This system is constructed using the GSM approach, Arduino controller combined with the LDR sensor module and relay capability. Here the LDR sensor integrated with the LED light on the meter box tool and transfer the data to the microcontroller using the GSM module. This system is also used to send SMS to the concerned users [8].

This work says that smart electric meters are talented in the direction of a boost in energy competence. But the installation of this proposed system was very difficult to compare with an existing traditional system [10]. In this smart meter, the LDR sensor was used to measure the LED blinking frequencies. Normally the number of LED blinks directly proportional to the normal power stored in the traditional meter device. The sensed data from the LED blinker will be stored on the webserver for the future purpose [9].

This Author developed a new electric meter using the concept of IoT. In this system LDR sensor is used to calculate the frequency of the LED blinks. According to the number of blinks, the electric bill will be calculated. The microcontroller collects the data from the LDR sensor and displays the LCD screen's result connected with the controller [11].

Even though, it designed an advanced electric meter using Arduino microcontroller and GSM technology. This smart meter automatically generates the electric bill and automatically sends the bill to the user via the GSM modem [12].

Finally, the number of smart devices increases day by day. These smart devices are used to making everything smart work. It allows making the city as a smart city, home as the smart home, etc. The smart meter consists of various hardware parts and software. Most of the smart meter parts are constructed by using chips that compute the attributes used to evaluate energy usage. The smart meters mostly calculate the energy usage, which is based on a chip that calculates the parameters needed to [13].

3. Proposed Method
This proposed smart meter is used to automatically measure energy consumption and automatically calculate the bill with the help of IoT and GSM techniques [15]. This system is developed by using an Arduino microcontroller. All the devices are integrated with the microcontroller. The Figure 1 represents the actual architecture diagram of the proposed system. Here the energy consumption units are measured from the user's location and calculate the bill [14]. The generated bill sends to the user smartphone through SMS service.

![Figure 1: Architecture diagram of Proposed System](image-url)
4. Results and Discussions
This proposed system is used to measure the electric current consumption automatically. The unit count will be based on the number of blinks of the LED light. The LED light is already available in the smart meter. The LDR sensor is connected with the LED light. Based upon the LED blinks' frequency, the unit of electric current will be calculated by the controller. After the calculation process, the controller sends the bill to the concerned user. Simultaneously, the bill will be updated on the user's website using the Wi-Fi module also [15]. If the user crosses the limited range, the system will automatically produce the alert SMS message to the user's smartphone. An Arduino microcontroller develops this system.

![Flow Diagram of Proposed System](image)

**Figure 2:** Flow Diagram of Proposed System

![Output Screens 1](image)

**Figure 3:** Output Screens 1
The following Figure 2 shows the flow diagram of the proposed smart meter system. The following screenshot shows the sample output of the proposed system. Based upon units consumed, the amount will be calculated. This proposed system also provides the alert message to the user if the consumed electric power cross the limit. The following Figure 4 shows the alert and awareness message displayed to the user. The sample output Screens are shown in Figure 3.

5. Conclusion
This proposed smart meter is used to automatically measure energy consumption and automatically calculate the bill with the help of IoT and GSM techniques. This work deals with the energy consumption units measured from the user's location and calculates the bill consisting of hardware and software parts. After the calculation process, the controller sends the bill to the concerned user. Simultaneously, the bill will be updated on the user's website using the Wi-Fi module. An advanced energy meter accurately measures electrical energy consumption and provides extra information because compared to a conventional energy meter; the system is developed by the Aurdino microcontroller. The smart meter's main advantage is it alerts us when our energy consumption crosses the actual limit by sending a message. These smart meters can measure the reading and send the information to the customers within a small-time interval.

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