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IoT-Based Smart Energy Metre And Monitoring System

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ABSTRACT

The work involved in gathering readings from utility metres for electrical use. In this project, we will use the Internet of Things (IoT) to automatically generate electricity bills for household appliances by measuring their power consumption and transmitting that data wirelessly. The IoT also allows us to detect when power is being used. Distributed topologies that can dynamically absorb multiple energy sources are necessary for the implementation of the energy grid. The Internet of Things (IoT) has several potential uses in smart grid applications, including smart metres for distributed energy plants, smart metres for both generation and consumption, demand side management, and other areas of energy production.

Keywords—Energy Meter, IoT, Monitoring System.

I.INTRODUCTION

An electric instrument known as an energy metre may be used to track the usage of energy. The consumer is kept informed about the cost and regular use of power consumption in order to combat excessive bill utilisation. By displaying the number of units spent and transmitting this information to the electrical board and the client, the energy metre helps to decrease the need for human labour. The user has complete control over when and where they may monitor their Power use. Using the Internet of Things (IoT), we can control our home appliances' on/off states using relay and Arduino interfaces. The power consumption is the target of this system's monitoring capabilities. In the long run, lowering overall power usage is good for both the distributor and the customer.

II.LITERATURE SURVEY

The internet of things (IoT), an emerging topic, and gadgets based on it have revolutionised electronics and information technology (IT), according to "Smart energy metre surveillance using IoT" offered by Anitha et al., [1]. Primarily, this initiative aims to raise awareness about energy usage and the need of using household appliances efficiently in order to save energy. There are a lot of problems with the current power billing system since it relies on human labour. When power usage goes beyond the set limit, this system will notify the user via IoT and provide information about the metre reading. The goals are achieved by programming the Arduino esp8266 micro controller with the aid of the GSM module. The current energy metre has several drawbacks, but this one is supposed to fix them all. The information is sent to the customer's mobile device via the Internet of Things and the GSM module, and it is also shown on the LCD. Saving time and reducing or eliminating human error are two benefits of the Internet of Things.

According to Devadhanishini et al., [2] "Smart Power Monitoring Using IoT," energy consumption is a major and difficult problem. Large electric energy distribution systems employ automatic electrical energy metres. This system becomes a Smart Power Monitoring system when Arduino WIFI and SMS are included. The data provided by a smart energy metre may help optimise processes and reduce power use. present is a motion detector built into this system that will cut electricity to the home or building if it detects that no one is present.

In their article "Design and implementation of smart metre using IoT," Mohammed Hosseiu et al. [3] detailed the expansion of digital technology and the Internet of Things. Distributed topologies that can adapt to fluctuating energy demands are essential for the future of the power grid. A number of smart grid applications, including electric power demand side management, smart metres, smart consumption, and energy generation, may make use of the Internet of Things. In this article, we will go over what Smart Energy Metering (SEM) is and why it's important. SEMs gather data on how much energy different appliances consume, keep an eye on environmental factors, and offer the services that homeowners need.

The "Arduino based smart energy metre" developed by Himanshu K. Patel et al., [4] eliminates the need for human interaction during metre readings and bill creation, eliminating a common source of human error in India. The solution allows users to get energy usage updates, generate final bills, and replenish their accounts using SMS. The use of a relay allowed for the automatic cutting off of electricity in response to user input or past-due payments. In order to provide two-way communication, the system makes use of GSM.

When it comes to developing smart grids in power systems, the "smart metre using IoT" that Bibek Kanti Barman et al. [5] suggested is crucial for effective energy use. So, the smart grid primarily aims at managing and monitoring electricity use. One of the major issues with energy metres is that they do not have full duplex communication. To address this, an Internet of Things (IoT) smart energy metre has been developed. The ESP 8266 12E, a Wi-Fi module, is used by the smart energy metre to manage and compute the use of energy. The readings are then sent to the cloud, where the customer or consumer may see them.

In response to the growing demand for energy, Garrab et al. [6] suggested an AMR strategy for smart grid energy savings via the use of smart metres and partial power line communication. One of the suggested solutions for the Smart Grid is smart metres. An AMR system that provides comprehensive end-to-end implementation is discussed in this article. It uses the Power Line Communication standards and an energy metre with a low-power microprocessor (MSP430FE423A). The ESP430CEl energy metering module is a part of the microcontroller.

In their presentation on a cost-effective, real-time ARM-based energy management system, Landi et al. [7] discussed the use of smart metres and web servers. An integrated web server is useful for collecting data on power quality, energy usage, and devices that may shift loads. Accessing the information is done via the device. As a result, the power system's power usage may be carefully controlled.

In 2004, digital metres began to replace electromechanical ones in Singapore, as reported in "Design and implementation of Bluetooth energy metre" (Koay et al., [8]). It would be much easier to read the metre with a wireless digital power metre. A wireless approach that may work here is Bluetooth technology. By using Bluetooth technology, the power reader is able to wirelessly gather readings of the energy metre about power usage. The intended applications include two methods—Automatic metre reading (AMR) and the Automatic polling mechanism (APM)—that can get the metre reading with little human participation. The Bluetooth-enabled energy metre has a few practical business uses.

III.PROPOSED METHODOLOGY

The smart energy meter monitoring system is shown in figure 1. The block diagram consists of Arduino, energy meter,WIFI module and IoT, Relay and transformer.

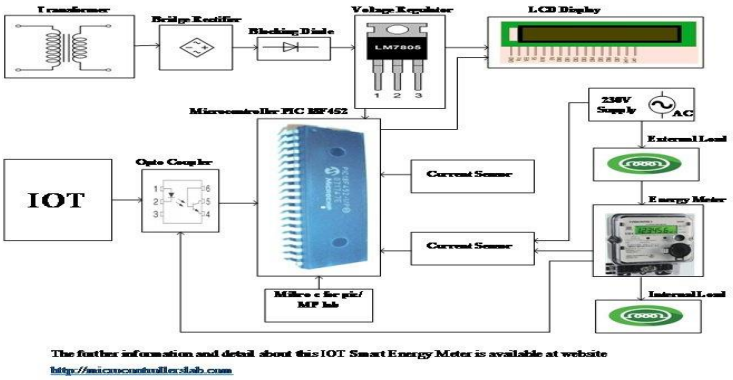

Fig.1 Smart energy meter

Here, a clamp energy metre is used.Inputted to the transformer is 230V AC mains, which is then transformed into low voltage.

The live current, voltage, and power are measured in KW-h using an energy metre. These parameters are read by the microcontroller, which then sends the data to the cloud. A Wi-Fi device with an embedded microcontroller is called a NodeMCU. All it does is link the local router to the Internet of Things. You may check the status of these parameters using your mobile device or desktop.

Data communication is facilitated via WIFI. Arduino is used to setup WIFI.

The user's mobile phone receives data sent from the energy metre using the WIFI module and Arduino. The user may control the system's mains power and other household appliances via an app on their Android smartphone. The WIFI module communicates with the cloud, gets data, and then transmits it to the Arduino, which in turn controls the relay to turn the house's power on and off. [8-9].

A. Transformer

Choosing the right transformer is crucial. An important consideration is the transformer's current rating and secondary voltage. The amount of current required to drive the load determines the current rating of the Transformer. It is recommended to use an input voltage of at least 7V for the 7805 IC, as its output voltage should be 2 volts higher than the input voltage. Consequently, a 6-0-6V transformer rated at 500mA is used.

Fig.2 Transformers

B. Relay

A relay is a control device with three high-voltage terminals (NC, C, and NO). The ground, Vcc, and signal pins on the relay are low-voltage connections to the Arduino. An electromagnet is attached to a set of 120–240 switches within a relay.

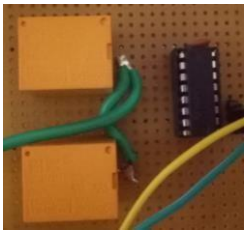

Fig.3 Relay Modules

C. Energy Meter

Energy metre is a device that measures the amount of energy that an electric load consumes. The energy is the sum of all the power that the load uses and consumes during a certain time span.

Fig.4 Energy Meter Module

D. Wi-Fi Module

Users' ongoing desire for optimal power utilisation is met by the Wi-Fi module, which gives a highly integrated WI-FI solution.

Fig.5 Wi-Fi Module

E. Internet of Things

Any object, no matter how far away, may be connected via the Internet of Things (IoT). It is able to communicate with almost any device on the planet. This data or a control signal from this realm might be the medium of communication. Many methods exist for transmitting this kind of data via the internet. The data collected by automated items is sent into the machine learning system by means of the Internet of Things (IoT). In order to turn things on and off, the data is saved in the cloud and sent to the energy metre.

F. Final Hardware

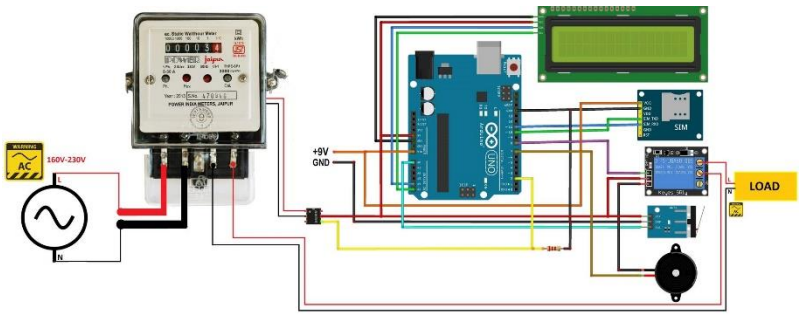

Fig.6. Project Module

Source: https://how2electronics.com/gsm-based-prepaid-electricity-energy-meter-using-arduino/

Here, the PIR sensor picks up on both human movement and data sent by the Arduino. It triggers the power-off relay by sending a signal to it. Software applications that have API read, read will communicate with the user and run the system. To store and retrieve the data, Thing Speak is an open-source application and API.

IV.RESULTS AND DISCUSSIONS

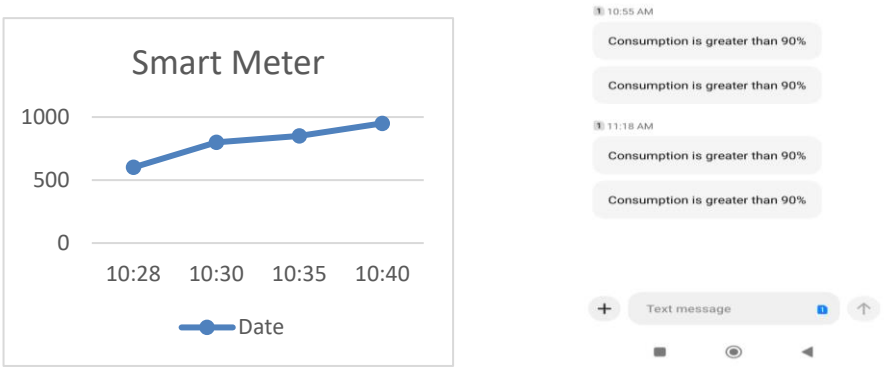

Fig.7 Expected Results

In this case, the graph is shown using power units instead of time. One user's energy use at a time is shown. When the user's power consumption hits 90%, they will get an alarm message.

V. CONCLUSIONS

The components of a smart energy monitoring system are an energy metre, WI-FI, and an Arduino. With the use of an app, the system can read the energy metre automatically and automate your home's power management. Less energy is used by the suggested method, and physical labour is reduced as a result.
The centralised office may get monthly energy usage data from a distant site. We can save time and effort by not having to physically visit each residence to record the metre readings, which is the current method.

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