IoT Based Energy Monitoring and Controlling System with Electric Billing Using LabVIEW

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Abstract. Rapid technical developments have occurred in the field of E-Metering (Electronic Metering), and there is a rise in the need for an Automatic Meter Reading (AMR) system that is dependable and effective. In order to automate invoicing and manage the obtained data internationally, this article outlines the design of a straightforward Internet of Things energy metre and its related user interface. The proposed technology replaces conventional metre reading techniques and allows the energy supplier to remotely access an existing energy metre. Additionally, they are able to periodically check the metre readings without having to visit every home. Each entity's electronic energy metre has a wireless connection module incorporated into it so that remote access may be made to the electricity use. The billing point is a personal computer that has a receiver and a database on the other end. The energy metre sends back a live reading to this billing point. Regularly, and a central database is updated with these facts. After analysing this data, the customer receives a message including the whole monthly consumption and owing charge.

Keywords: ESP8266 · GSM · 555 Timer · Electric Meter · Voltage Regulator

1 Introduction

Electricity is now essential to human growth and existence. Automation in energy distribution is also required to raise people's quality of life, in addition to attempts to fulfil expanding demand. To satisfy the demands of future residential growth, manual metre reading is an inefficient method. Automatic Meter Reading (AMR) systems, which electronically gather metre readings, are therefore in greater demand, and their use is growing. The automation of utility metering is made possible by the use of electronic metres. Numerous new features on automated utility metres serve to lower the cost of providing utilities to customers and the cost of supplying utilities to the utility provider. Therefore, given the present environment, a system that delivers the bill to consumers' mobile devices will be more appropriate. In this study, a brand-new post-paid electronic energy metering technique is presented. It automatically senses the energy consumed, continually logs these readings, and then communicates the information to the billing

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point through the already-existing GSM network. In the end, a built system software generates a bill after processing the obtained data, and the consumer is notified by SMS (Short Messaging System).

Due to the analogue and mechanical character of the parts in these metres, the conventional electro-mechanical metres, which are still commonly used today, are prone to drift over temperature and time. Because a metre reader must physically be there to take the readings, collecting metre data is also inefficient and challenging as the reading must be obtained from rural areas. Due to reluctance to visit to these locations, metre readers frequently report erroneous estimates of the quantity of power used. Moreover, after processing the data acquired, our system creates invoices, and the customer is alerted by SMS, guaranteeing that the bills are correct and sent on time. This strategy makes sure that customers have a more practical and dependable means to pay their bills, which is crucial in rural regions where conventional ways could be less dependable.

Bernd Skiera, "Tarrif-Specific Preferences and Their Influence on Price Sensitivity", Customers have a variety of extra tariff options to select from numerous services, each with a different access and usage charge. According to recent studies, preferences for particular tariffs may influence how customers pick a tariff. Those facts do not lower their anticipated billing rate. This study examines the relationship between tariff-specific preferences and how responsively people use and select tariffs to changes in price [9].

Vu Le, "Integration of resident's energy costs in short stay accommodation billing system", The short-term lodging business can now calculate the real energy usage of occupants thanks to the software package presented in this article and its associated energy information automation system. The suggested energy management system is utilised to create a "unique deal" strategy for short-term lodging based on the incorporation of the energy expenses at the room level into the billing system [10].

Rana Asad Ali, "Low-Cost GSM based Smart Energy Meter Design: Capable of Demand Side Management and Data Logging". The goal of the study on the SMS-based Automatic Billing System of Power Consumption was to alter how the power utility supplier currently collects and manages billing data. The remote site and the base station are the two fundamental components of the system. While the latter gets metre readings, computes billing costs, and processes client payments, the former computes and delivers power consumption [11].

2 Existing Model

- Rise energy monitoring system

  Rise created and built this method to keep track of the energy usage in the house. Customers that use this technology can reduce their energy costs. This gadget has energy monitors that actively track how much energy is consumed in the house by connecting to the electrical panel (Fig. 1).
- Digital energy monitoring system

  It is a computerised control system made to control the operation of energy-consuming systems, such as the lighting, heating, ventilation, and air conditioning (HVAC), and water heating systems, in order to control the energy consumption of a building (Fig. 2).

Fig. 1. Energy monitoring system by Rise

Fig. 2. Digital energy monitoring system

3 Proposed Model

In the system firstly we are going to take the meter reading from the [3] CT sensor which is available in the energy meter the output of the energy meter is given to the [4] step down transformer which is used to down the 230v power supply then this AC current Is converted to DC with the help of rectifier and filter and this is given to the voltage regulators which will regulate the output voltage. The components now connected to the [1] ESP8266 micro controller to do the specific task and to decide based on given program the program is to reflect the amount. On the [2] blynk application along with units consumed. A buzzer is used to find out the limit exceeded.

After that there is button or switch which will send the amount and the [5] units consumed to the Electricity department with the help of GSM. The user will receive the consumption in the form SMS to their mobile. The billing system then calculates the customer's electricity usage and generates a bill, which can be automatically sent to the customer through email or other electronic means. This system can help reduce errors and inaccuracies in billing, and can also provide customers with more detailed information about their energy usage patterns.

4 Methodology

This project's main goal is to support middle-class families. to limit how much power is consumed via daily or hourly monitoring of current usage. The user may control how much electricity is used by keeping an eye on it. This may make it easier for them to control their electricity costs and conserve power.

1. **Node MCU ESP8266**

[1] A cheap, low-power, Wi-Fi-capable microcontroller chip is the ESP8266. It is made by Espressif Systems, and because of its compact size, inexpensive price, and integrated Wi-Fi functionality, it has grown to be a popular option for Internet of Things (IoT) applications.

2. **Energy Meter**

An [6] energy metre is a tool used to gauge how much electricity is utilised in a building, be it residential or commercial. Utility providers often install energy metres to track electricity use and produce invoices.

3. **555 Timer**

[7] An integrated circuit (IC) called the 555 timer can be used as a flip-flop, oscillator, or timer. Signetics first presented it. Two comparators, a flip-flop, a discharge transistor, a voltage divider, and a voltage divider make up the 555 timer. The three modes that it can function in are monostable, astable, and bistable.

4. **Blynk Application.**

A mobile app development platform called Blynk enables programmers to create iOS and Android apps for managing and controlling internet of things (IoT) gadgets. Users of these IoT devices may monitor and adjust a variety of metrics in real time, including temperature, humidity, and other environmental variables, using the Blynk app, which offers a user-friendly interface.

5 Implementation

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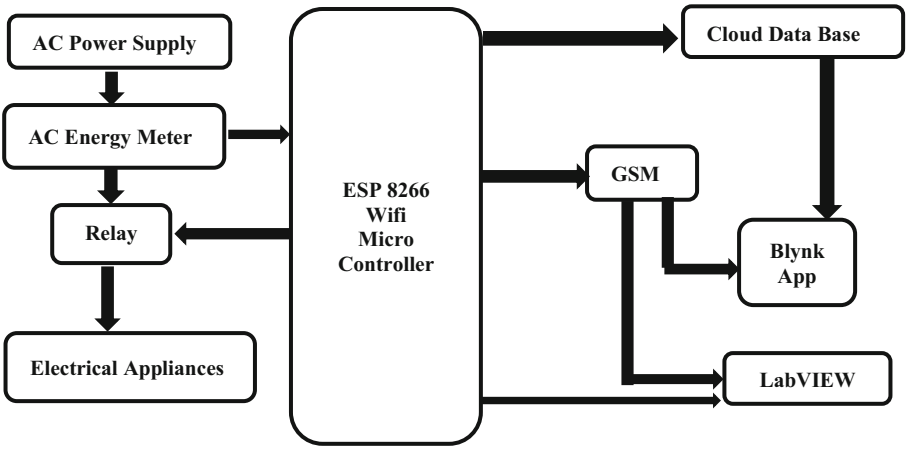


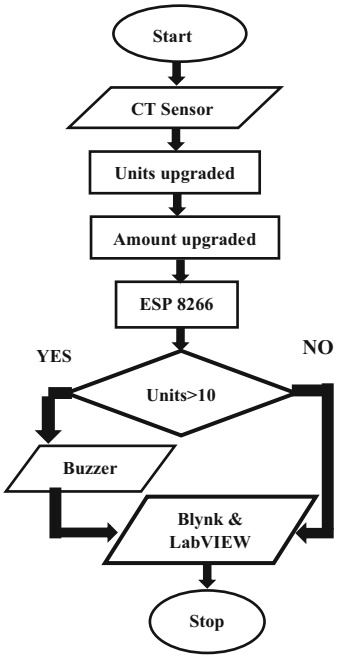
Here, the energy meter is provided with an ac power supply. The energy meter is linked to the ESP 8266 with the aid of a step-down transformer and voltage regulators, and

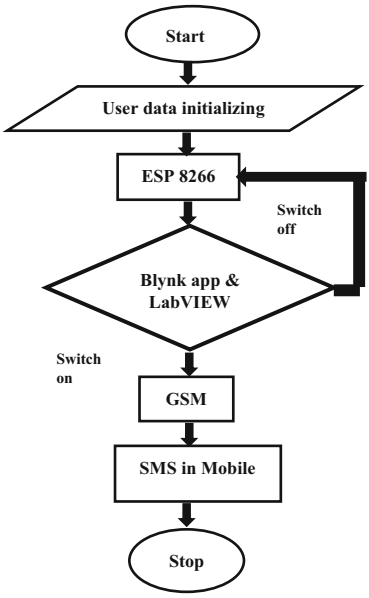
it operates in accordance with the directions provided. The four digital pins here are reserved for the energy meter, light holder, buzzer, and LDR. a CT sensor is used to extract the output from an energy meter. The ESP 8266 microcontroller receives the measured output of the CT sensor and uses it to calculate the amount and give the appropriate amount value and the units value to the blynk application, an Internet of Things-based program used to wirelessly display the output. This buzzer will be attached to one of the GPIOs of the esp8266 microcontroller. Its function is normally to emit a sound Also, we picked LabVIEW because of its graphical user interface, which makes it simple for the user to grasp the measurements and determine how much power is being consumed, as well as its ability to communicate data through GSM. LabVIEW serves as a supervisory control and data acquisition (SCADA) system in the proposed system, which is in charge of real-time monitoring and energy consumption control. The ESP8266 microcontroller collects data from the energy metre and sends it to LabVIEW using the VISA palette. The user may view the energy use over time using LabVIEW's graphical user interface (GUI), which processes the data and displays it. The GUI may show a variety of metrics, including voltage, current, and energy usage as well as real-time power consumption. When particular criteria are satisfied, such as when the energy usage surpasses a given threshold, LabVIEW may also produce warnings. Users may control their energy use and cut their electricity costs thanks to this.

FLOW CHART

The model is divided into two major modules

Admin Module…. The admin module describes the data that is actually happening in the software code which clearly explains the interior flow of the model. The flowchart shows a common method for reading data from an energy meter and automatically reading metre using the Blynk IoT platform. The Flowchart starts off by specifying the appropriate pin connections and adding the relevant libraries. The Wi-Fi connection is subsequently established, and a Blynk session utilizing the network information and given authentication token is started. When a pulse is detected, the main loop increments a counter and reads the energy metre through the pin linked to it. The counter value is used by the application to determine consumption and billing amounts. By executing the virtual Write () method with the appropriate pin numbers, it utilises the Blynk library to communicate the count and the billing amount to the Blynk app. When the light level is low, the flow additionally checks the condition of an LDR and turns on a light. The alarm buzzer activates if the counter value goes beyond a threshold. Finally, the Flow watches for a message trigger from the Blynk app and, if one is received, sends an SMS message with the billing amount to the designated phone number. Transmit the SMS message you need a SIM900A module or something similar. The phone number in the needs to be updated.





User Module… The user module typically specifies the data flow and how the user will get it. At the beginning, we will provide the user's data to the ESP module so it can determine the user's wi-fi data and cell number so we can send the user an SMS. Following data transmission to the ESP controller, a key component that governs the whole model based on the data, additional actions will be taken based on admin module data that will be sent to the user database depending on the supplied user data. The admin data, such as the number of units eaten and quantity consumed, are presented in both the LabVIEW tool and the blynk application once data has been successfully delivered to the latter. With the forementioned tools, there is a switch that allows the user assistance to send an SMS. With both LabVIEW and the Blynk app, the user was given a switch to activate if he wanted to submit data to the electrical department. By pushing the switch, the data was transferred to the department through GSM. The department will send an SMS about the bill that the user has to pay after perfectly validating the data from the transmitter in the ESP controller. If the user doesn't want to send the data to the department there is no need to turn on switch.

6 Results

A prototype is an early version of a product that has been produced to test a theory or procedure. The prototype shown in the above image has all necessary parts and is interfaced to the esp8266 microcontroller (Fig. 3).

The Image illustration demonstrates how our project works. When the room is dark, the light turns on automatically. When the room is not dark, the LDR is exposed to light;

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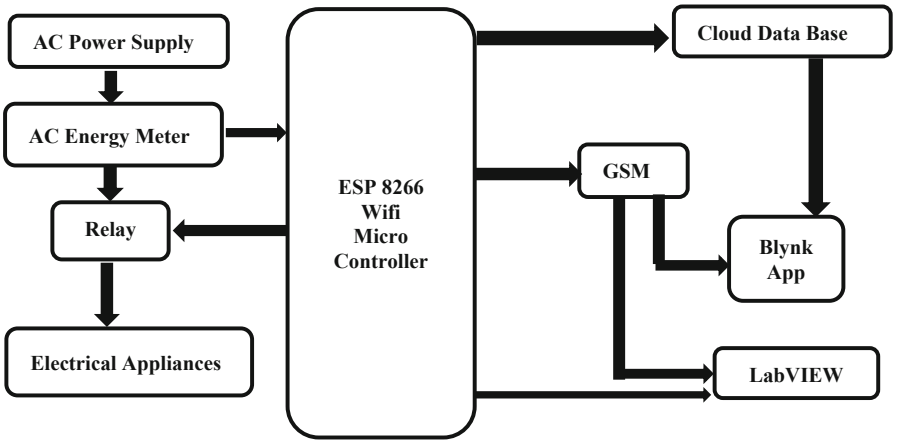

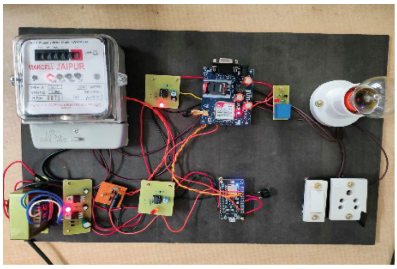

Fig. 3. Prototype.

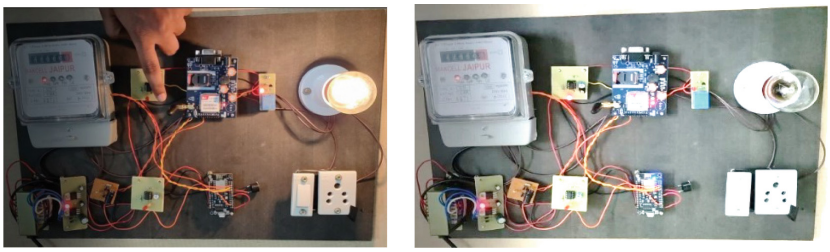

Fig. 4. Whether the room is dark or not.

in this situation, the bulb that was interfaced with the LDR will not shine since there is a light around it; in order to save energy, it will not glow at that time (Fig. 4).

Since the user exceeded his threshold limit in the aforementioned image, the buzzer is blown. As a result, the buzzer blows, alerting the user to the need to reduce their power usage (Fig. 5).

In the screenshot above, the buzzer is not blown while the user's power consumption is within the limit since the buzzer only sounds when the user's consumption exceeds the limit.

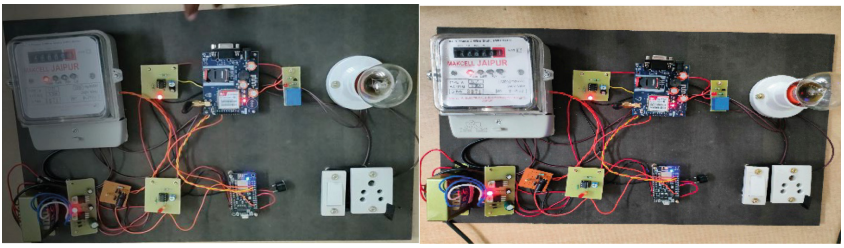

Fig. 5. Buzzer case.

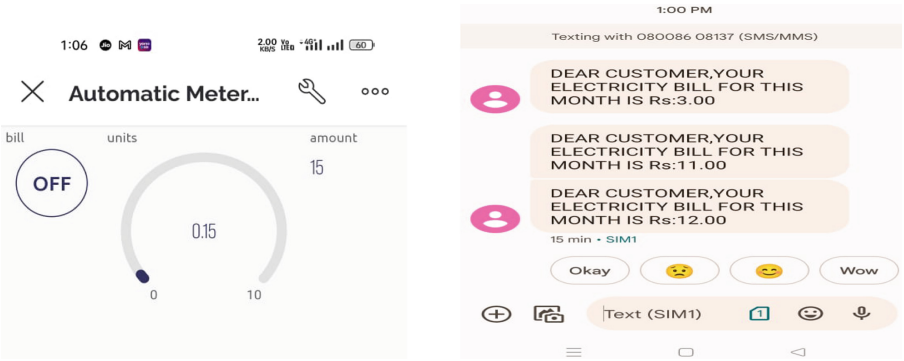

Fig. 6. Consumption of power displayed in Blynk & SMS sent through GSM.

The following graphic shows the user's bill depending on how many units he used, as estimated by the power department and sent to him through SMS. And the output got displayed on the blynk app (Fig. 6).

The front panel display of LabVIEW, which is seen in the above image and features an option to send the department an electricity bill and the amount utilised, shows the user's electricity usage. As we have displayed in the Blynk app (Fig. 7).

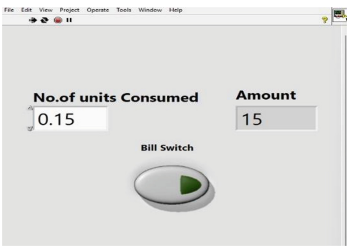

Fig. 7. Output displayed on LabVIEW.

7 Conclusion

To solve the problems with standalone meter readings, which are highly individualized and impossible to prevent. Reading an electromechanical meter by hand A number of managerial and societal problems afflict the billing industry. Possible meter lock-out due to easy access, human reading error, wildly inaccurate estimated readings, contentious billing, a lack of information on a detailed breakdown of energy consumption over time, irregularities in billing time, the possibility of a misplaced paper bill, and tampering are a few of these problems. We introduced an IoT-based energy monitoring system that offers solutions to these problems. Automatically gathering use, diagnostic, and status information from energy metering equipment, especially electricity, and transferring that information to a central database for billing and troubleshooting.

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