Prepaid Electricity Monitoring System

Abstract

This paper is about a prepaid electricity monitoring system using the internet of things, which monitors electricity consumption and provides feedback on power usage. The conventional electricity meters are not easily accessible and lack in keeping a record of electricity consumption daily. This paper represents a system that tracks electricity usage and stores the data on a cloud server and thus can be accessed from anywhere in the world. The system will give notification on reaching a predefined limit and will also generate the bill of total electricity being used. As this is a prepaid electricity monitoring system the user has to feed a particular amount as per the requirement and that amount gets deducted as per the electricity consumption of the household.

Keywords— electricity monitoring, notification, generate the bill, prepaid system.

I. Introduction

Most of the conventional power meters currently installed in households only display the real-time usage of its power and the amount of electricity consumed. There is no other way to see what the day's, week's or month's consumption was on these meters and also sometimes these power meters are placed in an inappropriate location which makes regular monitoring somewhat difficult. These power meters are also not capable of monitoring appliances individually; thus hiding vital information.

In this paper, we present a prepaid electricity monitoring system based on the internet of things. According to researchers, "The Internet of Things is a system of interrelated computing devices, mechanical and digital machines, objects, animals, or people that are provided with unique identifiers and the ability to transfer data over a network without requiring human-to-human or human-to-computer interaction" [5]. This paper aims to implement a system that can monitor the consumption of electricity using IoT technology. It can also notify about the consumed power units via email/SMS and store the data on a cloud server database which can be accessed anytime from anywhere. The system comprises a dashboard android application for electricity bill and power unit monitoring, a cloud server database, an automatic email/SMS trigger along with other hardware components.

II. Literature Survey

In recent years, research into saving energy has been increasing in view of dealing with environmental problems and using energy resources to its fullest. Research about electric meter design has been done by [1] and [2-4]. The three-phase electric power meter is a meter that measures power on a three-phase power system. Research done by [1] implements the single-chip application with a digital optocoupler as the isolation between the microcontroller circuit and the measurement unit. The method proposed by [2] depends on the AT89S52 chip to calculate power. However, it has no data logging feature. Approach taken by [4] is more on data logging

which uses the GSM network to log the power measurement data. However, it is limited to a single-phase application. This paper proposes the design of an Electricity monitoring and controlling system using IOT which is different from the conventional power meters.

III. Proposed Solution

In this paper, we made a Prepaid Electricity Monitoring System using the ESP8266 Wi-Fi module which can not only send you an SMS/Email of your electricity Bill but also you can monitor the energy uses anytime and from anywhere within the world. Here we have used a Current Sensor ACS712(clamp sensor) to measure the energy consumption. We took the help of the Zapier platform to link our Wi-Fi to SMS/E-mail notifications. We also used the concept of a website that helps us to make the online payment/recharge. It contains a registration page, login page, dashboard, and recharge page. This will help the user to do all the things at a single destination. This paper also keeps a regular check on the energy usage and warns about the peak hours where maximum energy is being used.

IV. Methodology

In this paper, the prepaid electricity monitoring system is proposed, based on IoT, which is linked to home automation systems and hence a smart system is obtained. This system without challenging the comfort level of the customer takes precise decisions of its own. Various features like recharging and emergency demand in need are made available to customers by logging into a web portal. Also it cut off the power if either the balance gets out of order or expires or if your energy unit bucket gets empty.

A. Hardware

The hardware aspect of this project needs a variety of components that had to be tested before ordering and implementing them into the system. A small programmable microcontroller (ESP8266), was used because of familiarity, cost-effectiveness and its capabilities for all aspects of this project. We also attached different external components for current sensing (ACS712 30A Hall Current Sensor) and 220V AC – 5V DC Power supply.

ACS712 Current Sensor:

This module works on the principle of Hall-effect. This principle is named for physicist Edwin Hall. In 1879 Edwin Hall discovered that when a semiconductor or conductor with current flowing in one direction was introduced perpendicular to a magnetic field a voltage could be measured at right angles to the current path. The measurements will be in millivolts which is called the hall-voltage. This measured hall voltage is proportional to the current that is flowing through the conductor.

The primary benefit of using ACS712 Current Sensor is that it can measure both AC and DC current and it also isolates the load (AC/DC load) and measuring unit (microcontroller portion). As depicted in the picture there are three pins on the module which are ground, Vout and Vcc respectively.

ESP 8266 Wifi-Module:

NodeMCU is an open-source IoT platform. It is interactive, simple & smart, programmable & Wi-Fi enabled. It includes firmware that runs on the ESP8266 WiFi SoC from Espressif Systems, and hardware that is predicted on the ESP-12 module. The ESP 8266 Wi-Fi module is a low-cost component with which manufacturers are making wirelessly networkable microcontroller modules. ESP 8266 WiFi module is a system-on-a-chip with capabilities for 2.4 GHz. It provides a 32 bit RISC CPU running at 80 MHz. NodeMCU is based on the TCP/IP (Transfer control protocol). It is the most important component in the system as it performs the IoT operation. It has 96 kb data RAM, 64 kb instruction RAM, 64 kb boot ROM.

ESP8266 has an operating voltage range of 3V to 3.6V and it comes with an LDO voltage regulator to keep the voltage steady at 3.3V.

B. Software

The system is controlled using a Website that is based on the IoT platform. The Graphical User Interface of the Web Page is shown in Fig -4.

Firstly, users have to sign up themselves to the online portal of the prepaid electricity monitoring system for their online registration. while registering users have to enter the electricity meter number which is unique for all.

After registering each user gets a unique ID and then they are directed to a login portal, where the user has to enter the Name and Password for login.

In the Dashboard, we are displaying Power Units Remaining, Peak Hours(Max. power used during that period), Balance Remaining, Expected date of expiry of power units. There is a recharge form present on the dashboard, where each user has to add some amount according to the tariff plans and then power units can be credited to individual users. Each user can have different power unit credits. Once the credit is finished it auto cuts the supply to that house.

VI. Conclusion

The design of the prepaid Energy Monitoring System using can make the users pay for the electricity before its consumption. In this way, consumers hold a number of units and then use the electricity until the unit is exhausted. If the available units are exhausted then the notification message sent to the consumer’s registered number and electricity supply is cut-off by a relay. This increases the efficiency in the calculation of bills for used electricity and at the same time reduces human efforts. Prepaid electricity meters will bring a solution of creating awareness on unnecessary wastage of power and will tend to reduce wastage of power. This system will reduce the burden of energy provided by establishing the connection easily and power theft will be nullified.

VIII. Future Scope

This paper is focused on the government’s plan to turn the major cities (including Indore) of the country into smart cities. It provides the entire energy readings at one’s fingertips. The project can be further extended to detect energy meter tampering i.e. energy theft. A smart application

can be created to provide various alerts based on the readings from the device. A unified platform can be provided to the customers for viewing the energy usage as well as to pay the bill online following the digital India initiative. The service provider can also evaluate the bills which are not paid and can disconnect the energy connection remotely. A GPS location can be sent to the electricity board where the energy meter tapering can be detected. An alarm can also be installed when the energy unit bucket is about to get emptied.

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