Energy Meter Reading over Internet

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Abstract - All human beings use different types of technologies in many fields. Nowadays, the electricity energy *provider company's em*ploys visit each house and record the meter reading manually. This produces errors due to human intervention; hence proposed system reduces manual work, time and makes this system accurate and user friendly. The IoT based energy meter is based on Arduino. In this system, the live meter reading can be displayed on the android app through which bill is calculated. Using Wi-Fi module meters reading will transmitted to the centralized server along with their unique meter number. This data will be processed by the server and automatically generates the bill. After generation of bill it will send to every customer via SMS facility. Any customer can pay their bills through the android app of specific amount. A specific amount equal to the bill is deducted from users account. This system is also designed to register complaints from users whenever needed and users also can give their feedback about system.

Key Words: Internet of Things (IOT), Wi-Fi module, Android application, Energy meter, Arduino.

1. INTRODUCTION

The proposed system uses energy meter with microcontroller system to monitor energy usage using a meter. The meter is used to monitor units consumed and transmit the units as well as cost charged over the internet using Net connection. This allows user to easily check the energy usage along with the cost charged online using a simple application. Thus the energy meter monitoring system allows user to effectively monitor electricity meter readings and check the billing online with ease [4]. The main component for this proposed system is Arduino UNO board along with Arduino Ethernet Shield to give it a wireless connectivity. Arduino runs a code to control a relay board according to the input and also serves a web page through which respective output to the relay board can be controlled [4].

2. EXISTING SYSTEM

A new concept of energy meter will be discussed, where maximum demand of energy of a consumer will be indicated in the meter used by the consumer. After exceeding the maximum demand, the meter and hence the connection will automatically be disconnected by an embedded system inserted in the meter itself [1]. GSM MODULE SIM 300 is used to produce communication between load circuit and utility side. We actually have used max232 along with DB9 connector to interface it [2]. The system consists of the electricity meter which measures the electricity bill and informs the consumer about the number of units consumed and associated costs with it.

1. R. Ahin Shapiro et al.; International Journal of Advance Research, Ideas and Innovations in Technology, 2019

The proposed system collects the energy consumption from residential as well as corporate zones and sends it directly to the central server maintained by the administrator where processing is done on that data for preparation of bills as well as monitoring the power consumption.[1]

2. Development of a Smart, Low-cost and IoT-enabled System for Energy Management Olayinka S. Omole, David Akpobasah and Aderemi A.Atayero, 2016

Using Wi-Fi Technology application is developed for Apple and BlackBerry 10 OS, thus providing multiple platform users support [5]. In this paper, measurement equipment for the calibration of energy meters is presented [5]. Its structure and metrological characterization are discussed [5]. To improve its performances without increasing its costs, two online digital compensation procedures have been realized and are shown: one increases the spectral purity of test signals and one corrects the transducer frequency response [5].

3. IoT Based Smart Energy Meter, Mrs Sandhya Shinde, 2017

Using IoT technology An IoT device was created for measuring the voltage, current, power and energy of a three phase four line power line in a laboratory building. The authors propose, design, and implement a low-cost universal smart energy meter (USEM) with demand-side load management [4]. The meter can be used in the postpaid and prepaid modes with flexible tariff plans such as time of use, block rate tariff, and their combination [4]. The smart meter comprises of a potential transformer, current transformer, and microcontroller unit with an embedded communication module [4].

4. Smart Energy Meter for Advanced Metering and Billing Alert Framework R.Asha, R.Aruna, 2018

GSM technology implemented automatic power will be reading [2]. In this paper, a prototype of an energy monitoring device based on an open source concept is presented [2]. This architecture assures several advantages with respect to traditional energy meters, such as easy

development of new applications making cost- and time effective the migration to future smart grid infrastructures and simple adjustments to change in the relevant standards [2].

5. Pujari Lilavati; International Journal of Advance Research, Ideas and Innovations in Technology, 2018

Using IoT device was created for getting the electricity bill, electricity providing days, and the previous bill also, and even easy to make payment of electricity bill[3].

3. Objectives

- To design and develop less expensive and functional alternative to existing expensive smart meters.
- The developed metering device will have a simple connection, which can be used to measure total energy use at connection points.
- The device will store energy consumption data to a database to be used by individuals or organizations.
- A Simple Graphical User Interface (GUI) will be developed by which data from the Meter can be accessed by smartphones over an Internet connection.
- Ease of accessing information for consumer from energy meter through IoT.
- We can make an IoT system where a user can monitor energy consumption and pay the bill Online.
- Reduce the power wastage.

4. Scopes

Energy monitoring through the internet is easy. It gives the real power consumption as well as accurate reading. Also, it requires fewer labors and less time to monitor the energy. It can transmit the data to the utilities and also can receive information from utilities [4]. The tedious task of appointing members to calculate the distribution and consumption of electricity meters in every region can be eliminated as the bills are generated automatically. No callous amounts of electricity would be lost thereby saving energy for interior rural networks which face a lack of electricity.

5. Methodology

5.1 System Architecture

This system uses the current sensor to detect the flow of electricity through the lines as well current sensor also detects the no. of units of current transferred through the lines. Later the electricity vendor specifies the cost per unit of current. No. of units consumed is multiplied with the cost per unit, which gives the total cost per consumed energy [1].

Total Cost = Consumed energy * Cost per unit.

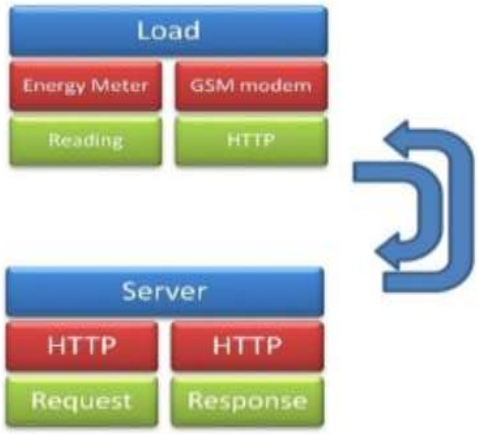

Fig 2.1: System Architecture

5.2 Energy Reading Module

Sensors detect the supply voltage from the electrical or electronic appliances. The minimum Operating voltage is 3.3v and maximum is 5v. The voltage sensor will detect the voltage automatically without any human influence. Whenever the voltage goes up or down it will read the voltage dynamically.

Current measurement is of vital importance in many power and instrumentation systems. Traditionally, current sensing was primarily for circuit protection and control. However, with the advancement in technology, current sensing has emerged as a method to monitor and enhance performance. The current sensor will measure the current range from -5A 5A. The supply voltage is 4.5v 5.5v DC. The Current sensor

has sensitivity from 180mV/A to 190mV/A [1].

Fig 5.2: Energy reading module

Special features: These are special types of transformers used for the measurement of currents. As the name suggests, these transformers are used in conjunction with some relevant instruments such as ammeters and control relays. Current transformers are usually used when the AC currents exceed the safe worth for the activity instruments. The power loss in Current Transformer instrument transformers is incredibly little as compared to power loss thanks to the resistance of aiding devices like shunts or multipliers. By using current transformers with tong testers, the currents in the heavy current circuits can easily be measured.

5.3 Meter Controller Module

It is an ARM (Advanced RISC (reduced instruction set computer) Machines) Cortex M3 microcontroller it is based on the ARM architecture.it is a 32-bit core microcontroller. Its CPU clock at 84Mhz. Operating voltage is 3.3v. The recommended input voltage in 7-12v.It contains 54 Digital I/O pins and 12 Analog pins.

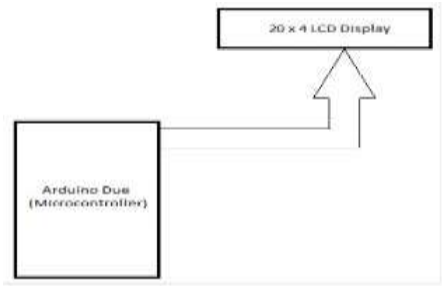

Fig 5.3: Meter Controller Module

It has a DMA (Direct memory access) controller that can relieve the CPU from doing memory intensive tasks. The Due is additionally the primary Arduino to feature a built-in digital to analog converter, in fact, two of them. It is also to have an audio library to take advantages of its ability to playback wav files. The Arduino capability has perpetually been extended by shields, add-on boards and circuitry such as motion sensors and LED light arrays, many of them for third-party manufacturers. The Due will work with all Arduino shields that adapt to the official Arduino Revision three layouts. However, the Due operates at 3.3V whereas earlier Arduino operates at 5V, so some third-party shields that don't follow the R3 (Rescue, Recovery and Renewal) specs to the letter may not be compatible, depending on their voltages. This additionally suggests that anyone victimization the Due in existing applications ought to pay specific attention to voltage [2].

The Smart meter is made as follows, the voltage sensor is connected with the wire from the meter to the household appliances, and the current sensor is also connected with the wire from the meter to the household appliances. These sensors read data consecutively and find the number of units used per day and send it to a service running in the cloud [1]. The Arduino board is connected to a power supply, then the voltage sensor the current sensor which is attached with the Mainline of the house is connected to the input pins of the Arduino board. The Arduino board is also connected with a GSM (Global System for Mobile) module which helps in providing the board with Internet Availability so that the data collected could be sent to the cloud.

5.4 Data Storage Module

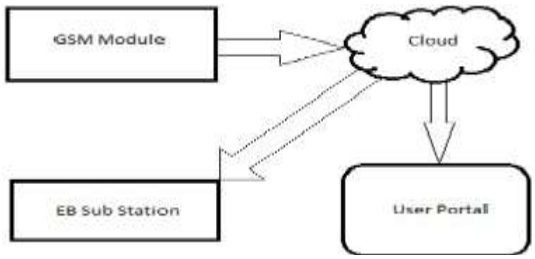

Fig 5.4: Data storage module

GSM (Global System for Mobile) module will enable the access through the internet, SMS and call facility. It will provide the GPRS (General Packet Radio Service) facility for internet access. It supports communication through RS232 (Recommend Standard number 232) with DB9 connector, Time-to-live (TTL) pins and I2C pins. Mic input, LINE input and Speaker output are also available [4].

- Quad-Band 850/ 900/ 1800/ 1900 MHz
- Dual-Band 900/ 1900 MHz
- Low power consumption: 1.5mA (sleep mode)

GSM technology has been matured since long and hence GSM mobile phones and modems are widely available across the world. It provides very cost effective products and solutions.

The GSM-based networks (i.e. base stations) square measure deployed across the planet and thus same mobile works across the world. Advanced versions of GSM with a higher range of antennas can offer high-speed transfer and transfer of information. SAIC and DAIC techniques offer a terribly high transmission quality [5]. SAIC stands for Single Antenna Interference Cancellation technique whereas DAIC stands for twin antenna interference cancellation. It is straightforward to take care of GSM networks thanks to the convenience of a huge range of network engineers at a reasonable value. This will facilitate in revenue increase by the telecommunication operators. The phone works supported SIM card and thus it's straightforward to alter the various forms of phones by users. Through this GSM module, the data is sent to the Service running in a server which would store the data in the database for further use.

5.5 User Access Module

The user portal is a Progressive Web Application (PWA) which is in recent trends hitting in the IT industry. The Users portal initially has the Sign-Up page where the new user gets his account registered with the portal using his/her meter Consumer Number.

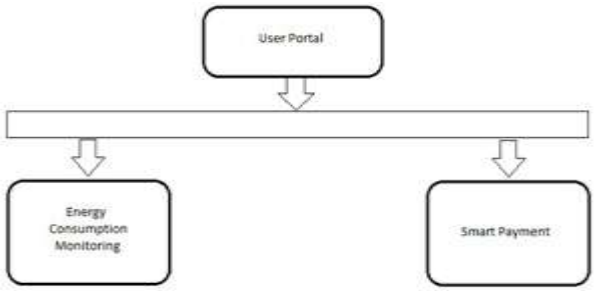

Fig 5.5: User Access Module

There would be verification of the account by sending the verification link to the users email ID. If the account is verified the user will be allowed to log in. If he tries to verify with a false code the account will be deactivated and the registration will be deleted.

Once the user logs in to the portal using his Consumer Number and Password, he has a graphical view of the Power consumption over the past two weeks, the highest consumption, Lowest consumption with value and date, the bill to be paid and much more. He/She has the feature to change the password of their account or even change the data from their personal information [1]. This also has a smart way to pay the bills. The user could also recharge his/her wallet in the portal and could check the auto pay feature wherein once the bill is generated for the user the portal itself pays the bill instead of the user having to remember about the bills and stuff. There will also be an Online payment Integration with the portal along with the third party gateways like Paytm, Phone pay, etc.

6. Hardware & Software Specifications

6.1 Hardware Specifications

RAM : 512MB MINIMUM

HARD-DISK : 2GB MINIMUM

Hardware specifications are Arduino Uno, Energy meter, power supply, transformer, bridge - rectifier, voltage regulator, LCD, diodes, resistors, capacitors, transistors LEDs, current sensor, Wi-Fi module.

6.2 Software Specifications

Software specifications are php, Arduino, C++, Eagle (PCB), MySQL.

7. Advantages of proposed system

1. It provides accuracy in meter reading and checks theft status hence improves security.
2. This proposed system helps in effectively controlling energy consumption and also avoids Energy wastage.
3. Meter reading can be accessed from anywhere on the globe at any time.
4. This system eliminates the human involvement in energy management.

8. Snapshots of Energy Meter Reading over Internet

Fig 8.1: Login page

Fig 8.2: Admin Login page

Fig 8.3: Admin homepage

Fig 8.4 User login page

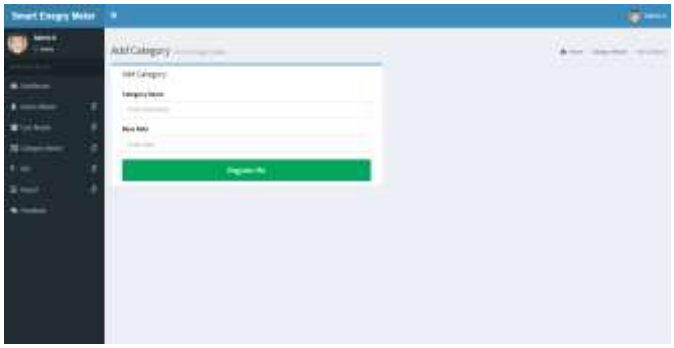

Fig 8.8 Add category

Fig 8.5 User Home page

Fig 8.9 Device Registration

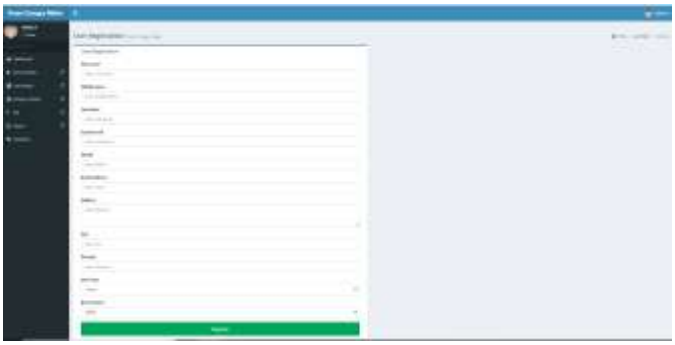

Fig 8.6 User Registration page

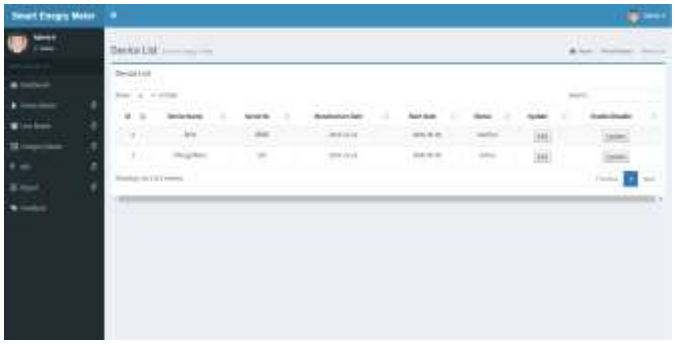

Fig 8.10 Device list

Fig 8.7 User list

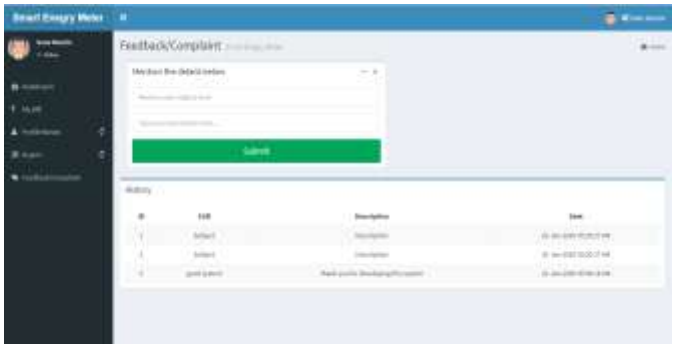

Fig 8.11 Customer feedback

9. CONCLUSIONS

Keeping the 21st century's technology in view, this system is developed to reduce human efforts. This system is based on a Arduino and implementation of energy meter using IoT concept. Energy monitoring through the internet is easy. It gives the real power consumption as well as accurate reading. Also, it requires labors and less time to monitor the energy.

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