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Power Monitoring and Billing System using IoT

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Abstract: The Existing domestic Energy meter reading systems universally exist many problems, such as difficulty in construction, too narrow bandwidth, too low rate, poor real time, not two way communication quickly etc. To solve above problems, this paper uses the wireless technology for Automatic Meter Reading and billing System. This proposed method provides the communication between the Electricity Board section and the consumer section using Internet of Things (IOT) for transmitting the customer's electricity consumption and bill information that is calculated using Arduino. The information regarding the bill and payment details are communicated to the consumer via GSM (Global System for Mobile communication). The electricity consumption details and billing information is continuously transmitted and monitored by the Electricity Board section.

Keywords: Arduino Mega (microcontroller), IOT, GSM900, Wi-Fi module, Web server

I. INTRODUCTION

Embedded systems and Real Time Operating systems are two among the several technologies that will play a major role in making these concepts possible. The present Scenario we are facing is a person from the electricity authority and visit each home and read the meter and generate the bill but this needs human work. This process may include human error while bill generation and it consumes more time. We are trying to prevent human intervention in this project. IoT (Internet of Things) is a concept that connects all the devices to the internet and let them communicate with each other over the internet. IoT is a network of connected devices – all of which gather and share data about how they are used and the environments in which they are operated. Major Keys to the Internet of Things is Safety and Security. Since IoT allows devices to be controlled remotely across the internet, thus it created opportunities to directly connect & integrate the physical world to the computer-based systems using sensors and internet. Multiple embedded devices are interconnected and these interconnections will be resulting in automation in nearly all fields and also enabling advanced applications. This results in the improved accuracy, efficiency and it also provides economic benefit with reduced human intervention. Since IOT is cost effective, monitoring of energy meters at lower cost is made possible. Daily electricity consumption details are generated which can be monitored through web portal. Also, Non-android users can also see the SMS and pay their bills online. The system is more reliable and accurate reading values are collected from energy meters.

II. RELATED SURVEY

YujunBao and Xiaoyan Jiang, "Design of electric Energy Meter for long-distance data information transfers which based upon GPRS", 2009,With the popularization of Internet in China, as GPRS service improved increasingly, electric energy meter transmits the data information and controlling command remotely and wirelessly. Based on the current electric energy meter, with the well-functioned ARM kernel microprocessor, it not only finishes the power data's measuring and processing, but also realizes the TCP/IP by cutting. The ARM kernel microprocessor will control the GPRS module, that enables the electric energy meter could be linked to the Internet by use of GPRS service. This system is managed by mu C/OS-II operating system soothe overall system is stable and reliable. It not only raises the efficiency of electric energy meter data information's acquisition and transition, but also the national measure management of electric energy improved greatly. Disadvantage is that This is especially for some outlying areas where the Cable Network hasn't been popularized. Ashna.K and Sudhish N George, "GSM based automatic energy meter reading system" IEEE Wireless communications,paper was presented in 2013.The technology of e-metering (Electronic Metering) has gone through rapid technological advancements and there is increased demand for a reliable and efficient Automatic Meter Reading (AMR) system. This paper presents the design of a simple low cost wireless GSM energy meter and its associated web interface, for automating billing and managing the collected data globally. This paper proposed system replaces traditional meter reading methods and enables remote access of existing energy meter by the energy provider. Also they can monitor the meter readings regularly without the person visiting each house. A GSM based wireless communication module is integrated with electronic energy meter of each entity to have remote access over the usage of electricity. A PC with a GSM receiver at the other end, which contains the database acts as the

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billing point. Live meter reading from the GSM enabled energy meter is sent back to this billing point periodically and these details are updated in a central database. A new interactive, user friendly graphical user interface is developed using Microsoft visual studio .NET framework and C#. With proper authentication, users can access the developed web page details from anywhere in the world. The complete monthly usage and due bill is messaged back to the customer after processing these data.But disadvantage of this paper was it was very complicated and costly to build and it used .Net framework and C#.

Philip Garner, Ian Mullins, Reuben Edwards and Paul Coulton, presented the paper in 2006 ,This paper manages the execution of power line system in the field of power billing. In the present situation Power Line Communication (PLC) is one of the temperate methods for correspondence of information. Despite the fact that there are new strategies for remote communication Design of Narrowband PLC for Power Distribution System with Automated Billing Generation through GSM Network techniques, basically it is especially tedious to introduce such a system, and furthermore it is exceptionally taken a toll devouring strategy .But the electrical lines which as of now exist and interface each household device in a specific territory is more invaluable as it doesn't require any new establishment or erection for communication channels, and thus is not a time consuming one. In PLC power line communication it requires high carrier frequency for data transmission, older wires can affect the performance and connection is complicated there are some disadvantages of this system.

Vivek Kumar Sehgal,Nitesh Panda, NipunRaiHanda, presented the paper on automated billing of energy meter. It is just like postpaid mobile connection. In the proposed work, the front end is user friendly and one can work on this software with minimum knowledge of computers and can read the meter by sitting in the office. This is useful for billing purpose in electricity board authority.

Manisha shinde, Pradip kulkarni "Camera click energy meter reading system",this paper was presented in 2015 Now a days, electricity power consumers have increased in every sectors like rural, urban, residential, commercial and in industrial area. Hence it is very important to ensure proper use of energy to generate accurate bills, invoices and try to reduce the frauds. It is hard to access the meters at rural accounts, indoor meters and meters with obstacles. To avoid this here we are going to introduce automatic meter reading concepts (AMR) which automatically collect the consumption of energy and then the system transfer that collected data to a central database for billing. Because of this expenses are reduced on meter reader, his periodic trips to each house to read a meter in case when in the first trip reading is not available. With this automation speed, accurateness and effectiveness has increased. Here transistor transistor logic (TTL) serial camera is used to capture the image and wirelessly transfer this to server Personal Computer (PC) where it undergoes processing to extract digits and with reference to previous month data base new bill is generated with tariff consideration. This system used camera which is costly to install in every house and it is expensive process and camera also should have high pixels to capture the details and this is the disadvantage of this sytem.

In 2016 V.Preeti, G.harish, "Design and implementation of smart energy meter" was presented.This paper presents a smart energy meter for an automatic metering and billing system. In this meter energy utilized and the corresponding amount will be displayed on the LCD continuously and communicated to the controlling base station. The feedback from the user helps in identifying the usages between authorized and unauthorized users which helps in controlling the power theft. Communication between user/household and substation is done using Zigbee. GSM network is used for sending SMS to the local authorities regarding the theft cases. This meter can work as either prepaid or post-paid meter. The proposed system replaces traditional meter reading methods and enables remote access of existing energy meter by the energy provider. Also they can monitor the meter readings regularly without the person visiting each house.But Zigbee has limited distance as its limitation.

III. ARCHITECTURE DIAGRAM

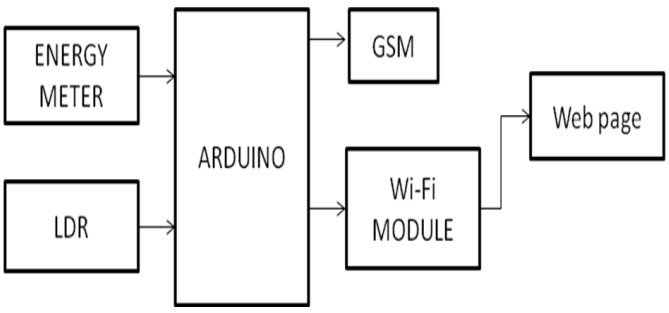

Fig 1:Architecture Diagram

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The users can be aware of their electricity consumption. The human work of collecting readings by visiting every home at the end of every month can be avoided by generating electricity bills automatically. Theft of electricity can be avoided by tamper proof energy meters. The errors in the system can be identified quickly. In the above figure (Fig 1),it consist of a simple energy meter, a GSM modem, a LDR,LED lght,an Arduino, Wi Fi module,web portal. Electricity supply is provided to the meter ,the LED which is attached to the meter will blink once for each rotation of the wheel in the meter. Number of the times it blinks will be the value counted by LDR and passes to the Arduino as number of units consumed.That data will be sent to the website through GSM. Bill and the units consumed will be displayed on the web site which will in turn be sent to the user for bill payment.

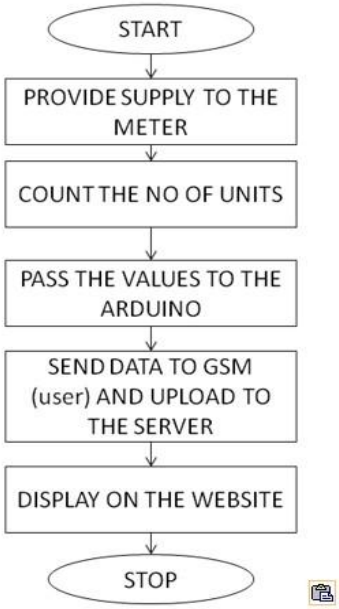

Fig 2:Flow chart

The above figure (Fig 2), shows the flow chart our developing system. Electricity supply is provided to the meter ,the LDR which is connected to the meter will counts the number of units consumed based on LED blinks. Units consumed is passed to the Arduino, number of units consumed will be The users can be aware of their electricity consumption. The human work of collecting readings by visiting every home at the end of every month can be avoided by generating electricity bills automatically. Theft of electricity can be avoided by tamper proof energy meters. The errors in the system can be identified quickly. In the above figure (Fig 1),it consist of a simple energy meter, a GSM modem, a LDR,LED lght,an Arduino, Wi Fi module,web portal. Electricity supply is provided to the meter ,the LED which is attached to the meter will blink once for each rotation of the wheel in the meter. Number of the times it blinks will be the value counted by LDR and passes to the Arduino as number of units consumed.That data will be sent to the website through GSM. Bill and the units consumed will be displayed on the web site which will in turn be sent to the user for bill payment. based on the LDR counts. The passed Data will be sent to the website through GSM and displayed on the web site which will in turn be sent to the user for bill payment.

Methodology:

The designed energy meter includes a simple energy meter, a GSM modem (SIM-900), An Arduino (master controller), (measure electric pulse).The pulse count value will be sent to particular person through GSM.

Energy meter: it is used for measuring the energy utilizes by the electric load. Energy Meter is also called as Watt-Hour Meter, it is an electrical device that measures the amount of electrical energy used by the consumers. Utilities are one of the electrical departments, which install these devices at every place like homes, industries, organizations, commercial buildings to charge for the electricity consumption by loads such as lights, fans, refrigerator, and some home appliances. Energy meter measures rapid currents and voltages.

LDR: Light dependent resistor is also called as photoconductor or photo resistor**.** It is a Digital Sensor which works on the availability of light. Basically it is a semiconductor which will act as a conductor once the light falls on it.LDR is used in Automatic Street Light Circuit, Simple Fire Alarm Circuit **,**Light Activated Switch Circuit**,** Automatic LED Emergency Light, Night Security Light**.**

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Arduino UNO: Voltage= 5v**,**it is a microcontroller which has digital pins and 14 analog pins. It consists of ATMEGA328 microcontroller IC. 16MHz crystal oscillator. Arduino is an open-source electronics platform based on easy-to-use hardware and software. Arduino boards are able to read inputs - light on a sensor, a finger on a button, or a Twitter message - and turn it into an output - activating a motor, turning on an LED, publishing something online. You can tell your board what to do by sending a set of instructions to the microcontroller on the board. To do so you use the Arduino programming language (based on Wiring), and the Arduino Software (IDE), based on Processing.

GSM Model: 900A: This sim chip Works on 12V AC/DC. It is basically working on AT commands. Can perform both calls and SMS. Customers will have this sim, in order to get the details about consumption of electricity and bill.

WIFI module: we are using **Model: ESP12** as Wi-Fi module in our project**.** It is a microchip which is safe and easier to use. It works on the AT commands. It can acts as both access point and standalone. Its operating voltage is 3.3v and can work at maximum of 5v as input. It works on UART protocol.
It can give access to our WiFi connection.

Arduino IDE: It is the kind of text editor where we will write program code for microcontroller Arduino. Thus this software used to program an Arduino. It is a freeware, cross platform and easy to use software. It consists of build in keywords which are used for programming.

Embedded C: Embedded C Programming is the soul of the processor functioning inside each and every embedded system we come across in our daily life, such as mobile phone, washing machine, and digital camera. Each processor is always associated with an embedded software. The embedded software decides the functioning of the embedded system. Basically nowadays all the microcontrollers are programmed using embedded C only. It is typically similar to C language. Usually hardware programming is done using embedded C. Embedded C language is most frequently used to language to program the microcontroller. The C code written is more reliable, scalable, and portable; and in fact, much easier to understand. Embedded C is a generic term given to a programming language written in C, and it is associated with a particular hardware architecture. Embedded C is an extension to the C language. It has some additional header files.These header files. The microcontroller 8051 #include<reg51.h> is used.

Thingspeak: It is a website designed and handled by mathworks. It is used to save data coming from the hardware.And displays the details about electricity consumption and bill.

IV. CONCLUSION AND FUTURE ENHANCEMENT

The IOT based energy meter saves the customer's time by making them work. "leaner". The operation of the calculating the power cost is simple and doesn't involve delays. The power cost is send through serial communication to the User through GSM. The users can be aware of their electricity consumption. The human work of collecting readings by visiting every home at the end of every month can be avoided by generating electricity bills automatically. Theft of electricity can be avoided by tamper proof energy meters. The errors in the system can be identified quickly.

In future we can implement our project by creating mobile application or web application so that the customer can get the power consumption details and bill of the electricity used from anywhwere in the world and they can get it in der hands just with a click using mobile app.

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