International Conference on Innovative Research in Engineering, Management and Sciences
International Journal of Scientific Research in Computer Science, Engineering and Information Technology
© 2019 IJSRCSEIT | Volume 4 | Issue 9 | ISSN : 2456-3307

Microcontroller Based Talking Energy Meter

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ABSTRACT

In current years, the electricity demand has augmented in households with the usage of different appliances. This increases a worry to many developed and developing nations with the demand in instant rise of electricity. Consumers are unconscious of energy used up by various appliances. The total amount of energy used up by various appliances is calculated by an electricity meter device. The major disadvantage of earlier old-style electricity meters are they do not give information to the consumers about how much energy is consumed. To overcome this a novel electricity meter called talking energy meter is accomplished. As consumption of the power is raising day by day there should be more attention on understanding consumption patterns. Outmoded electromechanical energy meters are now substituted by electronic meters in all types of applications such as domestic and commercial applications. In this paper, aims to design a circuit which helps the consumer in taking care of the electrical energy consumption. This system helps the users by notifying them about the billing status and unit consumption.

Keywords : Energy Meter, Microcontroller, Electricity, Arduino, Embedded C, GSM.

I. INTRODUCTION

The traditional energy meters are used in household technology in olden days to measure the amount of power consumed. These energy meters play a important role in measuring the power consumption of electrical energy in distinct households. With the advancement in technology, the usage of these energy meters has been decreased slowly. The major disadvantage of these meters are people are not aware how much energy is consumed on daily basis. The energy consumed will be generated on monthly basis which is not sufficient as the consumer will not have any knowledge on how much energy does the individual appliances consume. To overcome the problems of traditional electricity meters, electronic meter or static energy meter comes in picture. Technology is increasing very exponentially in these days. Together with electricity distribution, in all other fields also highly automatic and secured systems are preferably chosen. Electrical energy is commonly considered as an most important commodity for all living beings. Energy is the major agent of economic growth and is important to the wherewithal of modern economy. The economic growth of the future is mostly depends upon the availability of energy from its sources for long term.

Micro-controller based "Talking Energy Meter" mainly objects at the two classes (middle and lower) family to bring down the electricity bill with the help of the power consumption alert system. It benefits the government as it is helps in reducing the power consumption and thereby can reduce the unusual power usage. Energy meters being deployed at homes are used for reading the power that is being consumed. Each consumer may fix a customized threshold value (unit). If the value reaches above the threshold, it will alert to the consumer by voice module. This system may install at any place where the energy consumption should be regularly monitored and controlled. The consumers can fix their own threshold budget values and can be easily customized based on their requirements. The main use of this is to continuously check the reading of the energy meter and give the information of number of units spent along with the cost to the consumer. It also alerts the user if someone tries to steal the electricity from meter by using IR sensor and cut the line and inform the Electricity Board by mobile application.

The most important components used in this system are Micro-controller ATMEGA 328, Energy Meter, GSM module, Voice Module aPR33A3, IR Sensor. Micro-controller is the central unit of this system and is connected to GSM module, Voice Module aPR33A3 and energy meter is connected through various ports.

Micro-controller drives the voice module to play the voice messages based on the energy meter readings. The typical voice alerts are like "threshold limit is reached", "pay electricity bill" etc. The LCD display in this system displays continuously the real time energy meter readings. This can be done by the use of micro-controller ATMEGA 328 unit that is used to record and monitor the readings of energy usage in its memory. The micro-controller that we use in our project is ATMEGA 328.

II. TALKING ENERGY METER

The main purpose is to design a talking energy meter circuit which will provide information to the consumer about their usage of energy by giving the voice alert when consumed energy set by the user exceeds the threshold limit which is set according to their requirement. It also has many advantages such as helps to monitor the electrical energy usage and protect the meter if someone tries to theft the electricity by cutting the line of meter with prior SMS to the electricity board.

An AC source is given to the electric energy meter and from this; the load is connected to the meter via a relay switch. The fourth LED of the energy meter is given to one of the digital pins of microcontroller ATMEGA 328 at port C. The microcontroller is connected to the voice module and the GSM module. The main function of the GSM unit is to send and receive messages through a mobile network to give daily alerts.

The energy values once taken from the energy meter are digitized and processed with the help of a microcontroller ATMEGA 328. The billing of the corresponding energy usage is determined and per unit rate of consumption is set at the time of programming. The threshold unit value is set for which the consumption level increase is notified to the user. And the user can change that threshold limit according to the requirement by using dome switch.

A relay switch is connected with the microcontroller and the load which is used to cut the supply if someone tries to steal the electricity. It is used as protection purpose. Voice Module is used to give the alert when consumption of units exceeds the set limit by user. As soon as the limit exceeds, the voice alert occur and SMS get send on registered mobile number.

The drawbacks of Existing System are 1) The electricity consumption is calculated or done on every month basis by the human operator by going from one place to another where human errors will occur and cause wrong readings and wrong billings too. It also takes more time in collecting the data and requires more man power. 2) One more disadvantage is no monitoring of usage of Electricity, because of this consumers are not aware of how much usage of electricity is done and not aware of daily usage as well.3) No Provision for energy stealing in previous meter, if energy gets theft by the other people, owner not gets information about the stealing of their energy meter. And owner get suffer from this.

In this proposed system, all the disadvantages of existing system are overcome. Talking Energy Meter based on microcontroller is design to give voice alert and monitor the energy usage. Voice can be in any language so that it easy to understand for common people. It is more convenient to physically disabled people.

III. BLOCK DIAGRAM AND FLOW CHART

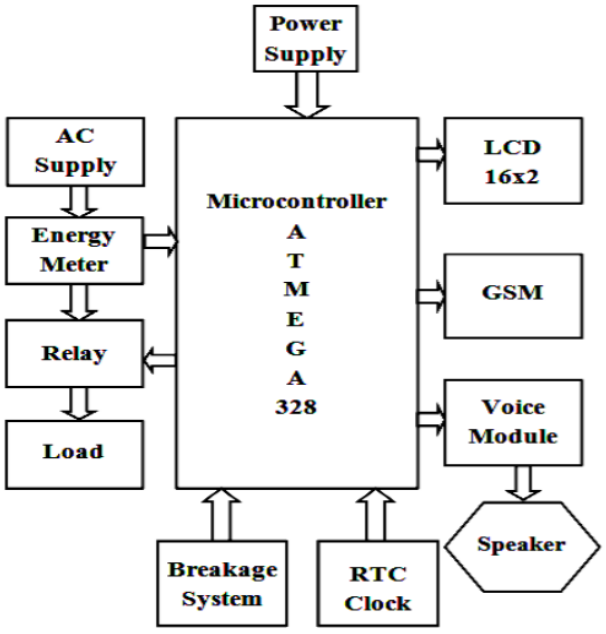

Figure 1: Block diagram of Talking Energy Meter

The hardware requirements are Arduino, Energy meter, LDR, GSM, LED, current sensor. The software are Arduino IDE and Embedded C programming.

Arduino is an open-source electronics platform based on easy-to-use hardware and software. Arduino is open-source hardware. An early Arduino board has a serial interface of RS-232 and a microcontroller chip of ATmega8 by Atmel. The board also contains 14 digital Input /Output pins are at the top, the 6 analog input pins at the lower right, and the power connector at the lower left.

An Arduino board consists of different bit Atmel AVR microcontroller such 8-bit, 16-bit or 32-bit (although since 2015 other makers' microcontrollers have been used) with other supporting components that enable programming and integration into other different circuits. One of the important feature of Arduino is, it has typical connectors which allows the user to connect the CPU board to a diversity of substitutable add-on modules known as shields. Some of these shields directly make a connection with the Arduino board through various pins. But many shields are addressed individually using a I²C serial bus, because of this shields can be stacked and can be used in parallel. Previously, Arduino boards had used the series of Atmel Mega AVR chips. Mostly used chip series are ATmega8, ATmega168, ATmega328, ATmega1280, and ATmega2560.In the year 2015, different units are added by other producers. We can make use of the board to perform different functions such as reading inputs, glowing of LEDs, rotating the motor etc by sending a set of instructions(program) to the microcontroller on the board. Depending upon the processing, we use the programming language of Arduino which is based on wiring and Software IDE.

The Atmel ATmega328/P is a CMOS 8-bit microcontroller which consumes less power. The architecture is enhanced Reduced Instruction set Computing (RISC). The ATmega328/P attains throughputs near to 1 MIPS per MHz by executing powerful instructions in only one clock cycle. This authorizes the designer to have a trade-off between processing speed and amount of power consumed.

The European Telecommunications Standards Institute (ETSI) has developed a typical set called GSM (Global System for Mobile Communications), to define protocols for second generation digital cellular networks used by mobile phones. It is an advanced one which replaces first generation (1G) analog cellular networks. It is described as digital, circuit switched network optimized for full duplex voice telephony. This was extended from time to time, and includes many things such as data communications, then by circuit switched transport via GPRS (General Packet Radio Services), EDGE (Enhanced Data rates for GSM Evolution or EGPRS).

In a cellular system, the operator covering area is divided into cells. A cell consists of one transmitter or less number of transmitters. The amount of power gives the information about the size of a cell.

The main idea of cellular system is to use low power transmitters such that the frequencies have an effective reuse. In fact, if the transmitters used are very powerful, the frequencies cannot be reused for hundreds of kilometers as they are limited to the covering area of the transmitter. The frequency band allocated to a cellular mobile radio system is distributed over a group of cells and this distribution is repeated in all the covering area of an operator. The whole number of radio channels available can then be used in each group of cells that form the covering area of an operator. Frequencies used in a cell will be reused several cells away. The distance between the cells using the same frequency must be sufficient to avoid interference. The frequency reuse will increase considerably the capacity in number of users.

In order to work properly, a cellular system must verify the following two main conditions: 1) The power level of a transmitter within a single cell must be limited in order to reduce the interference with the transmitters of neighboring cells. The interference will not produce any damage to the system if a distance of about 2.5 to 3 times the diameter of a cell is reserved between transmitters. The receiver filters must also be very performant. 2) Neighboring cells can not share the same channels. In order to reduce the interference, the frequencies must be reused only within a certain pattern

The general purpose photoconductive cell is also known as LDR – light dependent resistor. It is a type of semiconductor and its conductivity changes with proportional change in the intensity of light. The complete principle of an LDR is as follows. In a semiconductor an energy gap exists between conduction electrons and valence electrons. As an LDR is also known as semiconductor photoconductive transducer, when light is incident on it, a photon is absorbed and thereby it excites an electron from valence band into conduction band. Due to such new electrons coming up in conduction band area, the electrical resistance of the device decreases. Thus the LDR or photoconductive transducer has the resistance which is the inverse function of radiation intensity.

ESP8266 gives a full and self-sufficient Wi-fi networking solution, permitting it to host the application or to offload all Wi-Fi networking functions from another application processor. When ESP8266 hosts the application, and when it is the only application processor in the device, it is able to boot up directly from an external flash. It has integrated cache to improve the performance of the system in such applications, and to minimize the memory requirements.

The designed energy meter includes a simple energy meter, a GSM modem, an Arduino, web portal. The energy meter blinks the LED light and the LDR connected to the Arduino counts the number of times the LED blinks and this count is send to user by SMS and also displayed on the web page.

The users can be aware of their electricity consumption. The human work of collecting

readings by going to 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 recognized quickly.

The advantages of the proposed system are Voice based alerts, Efficient and low cost design, User friendly, Low power consumption, Energy readings are stored in non-volatile memory. The disadvantages is that it is delicate to interface microcontroller with energy meter. The important applications of this system is that it can be practically implemented in real time where there is a limitation on energy utilization.

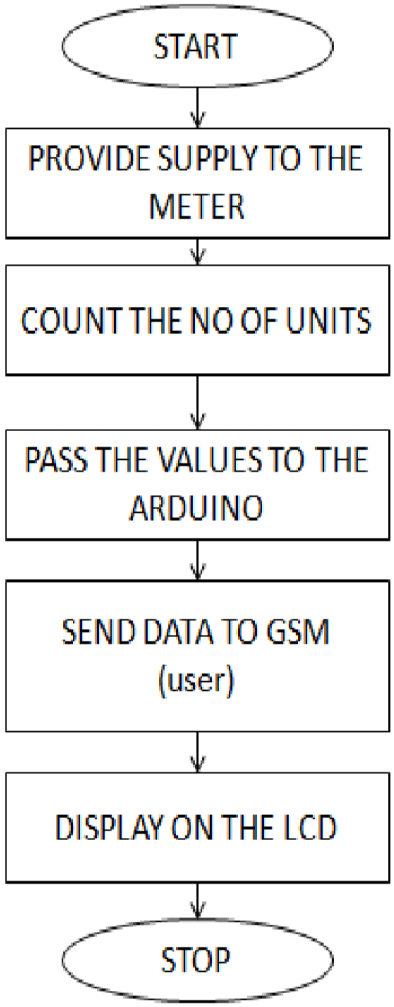

Figure 2: Flow chart of Talking Energy Meter

IV. RESULTS AND DISCUSSION

The Microcontroller based Talking Energy Meter mainly aims at the middle class and the lower class family to bring their electricity bill down with the help of the power consumption alert system. It benefits the government as it helps in reducing the power consumption and can reduce the unusual power usage. The snapshot of LCD display is shown below.

The GSM output format has been analyzed. The Arduino operations were studied and it is programmed and the system working model was developed in order to accomplish the objective. 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 sent through serial communication to the user through GSM.

V. CONCLUSION

The project is mainly intended to get a voice alert if usage goes beyond a set value. This system used a voice module into which a predefined alert voice messages are stored. It sends the SMS to user of billing status and when preset limit is exceeded.

FUTURE SCOPE

The size of this project can be reduced by use of advanced processor. The extra features to detect the faulty condition like over voltage, over current, earthing fault, etc. can be included in the design of talking energy meter to improvise.

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