Prepaid Energy Meter Using GSM Module

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Abstract:

Electric energy is the most important concern in any country, which should be used efficiently, to improve the efficiency, advanced technologies must be penetrated in the electric energy systems. Due to defective subsystems, there may be a losses in utilities due to illegal access to power. As power theft also in adequate usage of energy, non-payment of bills, and distortions occurring in power quality. Due to advancement in technology many solutions are proposed to overcome losses and improve efficiency. One of the solutions is to make use of smart energy meter and management system. The aim of this project is to reduce the waiting time at billing counters and also restricting the energy meter usage if the bills are not paid. This project is designed using ARDUINO UNO and GSM technology. This GSM technology facilitates the consumer with receiving messages about power consumption and also reminds about payment of dues.

Keywords

GSM Module, ARDUINO UNO, Prepaid Energy Meter.

1. Introduction

Since 100 years ago the electrical metering instrument technology came into existence. Few years ago the energy meter is bind with huge number of coils and magnets, there are also many improvements like reduction of in size and weight and also increases the specifications and features. Day by day the accuracy is also increases simultaneously. In olden days the measuring of digital meters (electrical parameters) are differently calculated. The digital meters started with measuring of ammeters and voltmeters. Now a days the energy distribution and consumption has become a discussion due to huge difference in energy consumption as well as production. As it is necessary to reduce the power thefts and power cuts, distribution of electricity should have opportunities to all urban and as well as rural areas. So, the government should have accurate to

policy for energy conservation and energy consumers. Hence, it has to introduce by implementing the automatic energy meter for all energy consumers. At present the energy meter playing a vital role for the energy conversation and energy consumed by the consumers can be easily displayed (by calculating mathematically) and the data also stored in the meter. And the same data can be transmitted to the concerned authority. The energy meter is developed by microcontrollers. But now the consumed energy data of particular customer is became wireless communication system designed. This system is also known as automatic energy meter reading system. In this system is used for automatically can take the readings without going to the consumer house and take the electricity bill. Advantages of energy meter are Accuracy, Low current performance, Low voltage performance, Installation. The efficiency of utility can be improved through prepaid meter and remote meter which are the new features of energy meter. To eradicate the loop holes and efficiency in present electromechanical meters now there are replaced with electronic meters

2. Problem Statement

As we said that several profits of smart energy meters, there will be always changes in the responding and rectifying the different materials as per public response. Problems which are stated should be rectified. Major problem is more number of workers are needed for billing purposes and for payment of the generated bill. Some consumers will pay on time and some consumer will neglect to pay on time as they should wait in line for a long period to pay the bill. Wastage of electricity by consumers as they are careless of its cost. And because of these power thefts issues will be raised in measuring and counting of pulses.

3. Existing Prepaid System

At present smart energy meter has two main components; smart card and smart reader. Smart card is made up of plastic card which has various components such as CPU, ROM, EEPROM, etc.

In smart card there is an integrated circuit which is developed by embedded system. The whole data of the energy consumer can be controlled by smart card. Firstly customer inserted the card, recharges the amount as much he wants and stores in the smart card. By recharging the amount the energy meter generates the units and pulses for certain time period. When the balance is low, then customer need to recharge the amount if not the power gets disconnected. In other words, a message sent by the customer with the help of GSM module and received to smart meter after the recharging amount through mobile. Then it generates the units and pulses by smart energy meter. By consumer usage of electricity slowing pulses and units gets reduced. If balance became low customer need to recharge if not supply will get disconnected. When next recharge is done by customer and sent to smart meter, it deducts the registered user number and units gets added so, power gets restored.

RFID is also one example for existing prepaid system. RFID stands for radio-frequency identification detection. It has main two components; RFID card and RFID tag. RFID is a programmed automatic identification method, by utilizing devices like RFID and transponder where the data can be stored and can be retrieved. This tag can be for all living organisms. RFID cards can be issued by electricity appliances and it will have an unique code in it and consumers are ready free make flexible charges such as prepaid cards for mobiles.
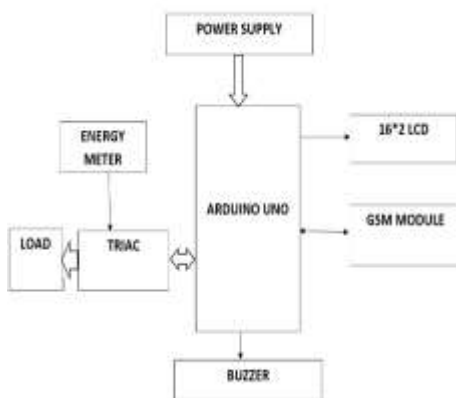
4. Designed System

Fig.1: Block Diagram

4.1. Description
The above block diagram is designed system scale. It various components such as

ARDUINO UNO, energy meter, LCD, GSM module, TRIAC and load. Energy meter is connected to TRIAC (which is three terminal device) one terminal is connected to load and another terminal is connected to controller which is bidirectional. The consumed power is calculated and displays on LCD screen. Whereas GSM module is used for sending and receiving messages from the customer. Simultaneously buzzer gets beep sound which is used for indicator.

4.2. Components Explanation
4.2.1. ARDUINO UNO

Fig.2: ARDUINO UNO

In ARDUINO UNO where UNO means "one" so, it has one microcontroller board that is the Atmel microcontroller chip it is the largest chip on the board and for the ARDUINO UNO board it is the Atmega 328P chip. It has 32 kilobytes of memory. The crystal oscillator has 16 MHz frequency. The software which is used in the board is ARDUINO IDE (integrated development environment) which is used to write the code of project. In ARDUINO it has fourteen digital I/O pins, six analog pins, seven power pins, a USB cable connection, one reset button, etc. In power it has 3.3v and 5v regulator and reset switch which is used to restart the process of the project.

4.2.2. Energy Meter

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Fig.3: Energy Meter

It is a device which measures the power utilizes by the electric load is known as the energy meter. The total power consumed by the load at a particular interval of time is its energy and **i**s measured by the energy meter. The meter is less expensive and accurate. The recharge amount done by the consumer and sent to the energy meter and it generates the units. These units can be calculated in form of kilowatts per hour (KWh). Energy meter is require for everyone. Energy meter is used in houses, industries, organizations etc. to energy consumption by loads like home appliances, bulb, fan etc. it has different meter such as single phase, three-phase meter.
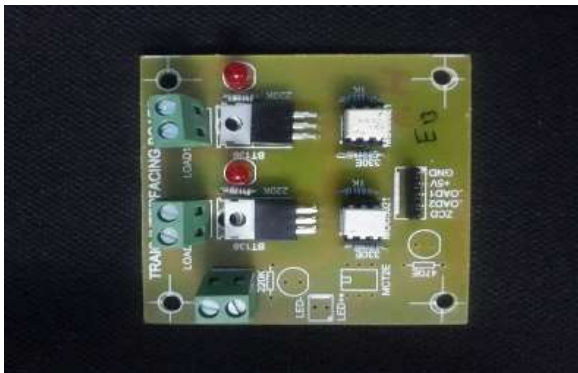
4.2.3. TRIAC

Fig.4: TRIAC

TRIAC means triode alternating current. It is advanced diode. The diode once it is in forward bias state it will get conducted with no controlling switch where as in triode has control signal which present in third terminal which control signal of forward bias. TRIAC can triggered in both direction.
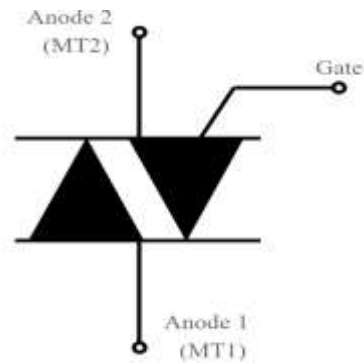

Fig.5: symbol of TRIAC

It consists of three terminals and works one complete cycle of applied AC input voltage i.e. small voltage and current can controlled large voltage and current.

4.2.4. Load

Fig.6: Bulb

A load is an electrical device which consumes the electric power source and generates the pulses. The count of pulses is calculated by the energy meter and generates in form of units. The electrical loads such as fan, bulb, tube light or any other home appliances. In other words, energy consumption is consumed by the circuits.

4.2.5. LCD

Fig.7: LCD

A LCD stands for Liquid Crystal Display. This LCD looks like flat plane screen. The LCD has 16*2 display so, it displays 32 characteristics. It has total 16 pins where three of them are controls pins and eight data pins. There is another pin i.e. VEE pin which adjust the brightness of LCD. There are also some commands which are allotted to control pins. LCDs are uses in T.V., monitors, laptops, etc. Some portable devices which has small LCD screen which are used in cameras, watches, smart phone, telephones, etc.

4.2.6. GSM

Fig.8: GSM Module

At present the GSM module playing a major role and used for wireless communication system. GSM stands for Global System Mobile Communication. It is mainly used for transmitting and receiving data. GSM has four pins there are; VCC, Ground, TX and RX. From GSM module TX is connected to RX pin of ARDUINO UNO similarly the RX pin of GSM module is connected to TX pin of ARDUINO UNO. In this system it has different cells there are macro, micro, pico, etc. Each cells varies the coverage area accordingly to the environment. It reduces the data, passes through different lines of client data, in correct time. The data rates carries from 64kps to128kps.
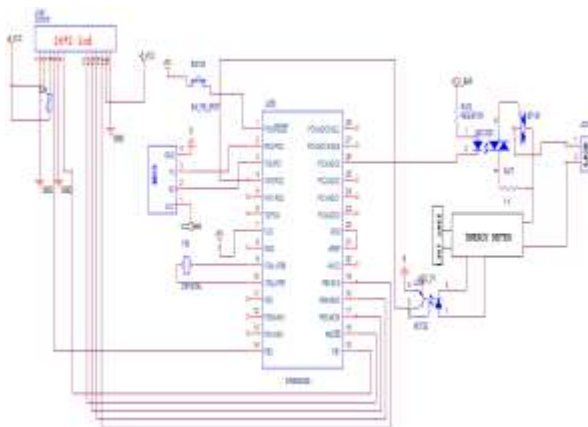
4.2.7. Methodology

Fig.9: Circuit Diagram

When the power supply is switched on power is consumed and passed through ARDUINO Uno controller which performs single task at a time. If it has sufficient number of units then it supplies power to the load through TRIAC. Certain load is consumed and passes to the smart energy meter the power is consumed and generates in the form of units. If there are less number of units, the GSM module gives notification to the respective phone number to recharge. If the units is recharged with in the time then the power supply will be continued. If it is not recharged power supply will be disconnected.
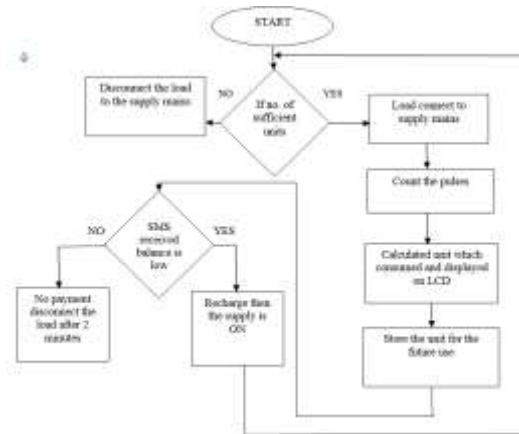
4.2.7. Flow Chart

Fig.10: Flow Chart

When power is switched on power is consumed and passed through all the components. If there are number of sufficient units then the load connect to supply mains counts the pulses and calculates the units consumed and displays on LCD and if there are less number of units gives notification to the registered number to recharge and also stores the total number of units consumed by every month. If the units is recharged in time then supply will be continued or else supply will be disconnected.

5. Results

Firstly, the power supply is ON it consumes the power and passes to all components and displays "welcome" on LCD screen as shown in fig.11.

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Fig.11

When we send data then mobile number registered. Initially pulses(P)=0,units(U)=0,balance(BL)=0 as shown in fig.12.

Fig.12

Customer recharges the bill with command (RCamount) generates the units and pulses as shown in fig.13.

Fig.13

By receiving message to the customer recharge bill then load gets ON as shown in fig.14.

Fig.14

When the balance is low the it sends pre alert message to the customer as shown in fi.15.

Fig.15

If customer does not recharge the bill but load continues for 2 minutes as shown in fig.16.

Fig.16

Recharge amount should be done more than the consumption of extra units. So, that the extra amount will be subtracted from the recharged amount as shown in fig.17.

Fig.17

Now the remaining balance will be shown after comparison as shown in fig.18.

Fig.18

If the recharge is not done in time load gets disconnected as shown in fig.19.

Fig.19

Prepaid energy meter is a project which was earlier developed by using 8051 micro controller. At present we are transforming with into automated system by using ARDIUNO and GSM Module, which also disconnect the home power supply connection either the balance is zero or low in the account. It is also good concept where we can recharge its balance as we do in our prepaid mobile phones.

6. Conclusion

By implementing of advancing energy distribution system and latest technology are always in the improvement load which is reduce the problems in electricity and load shedding process. So, we have given proposal this paper by using ARDUINO Uno and GSM technology. The units are purchased by GSM and also improve energy conservation. At present in power sector companies engaging for personnel for meter reading will not be required for future, they can the cost effective and saves lots of money.

7. Acknowledgment

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