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Wireless Energy Meter Monitoring System with Automatic Tariff Calculation Using Zigbee and GSM Module

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ABSTRACT

The purpose of this project is to remote monitoring and control of the digital energy meter. This system enables the electricity department to read the meter readings regularly without the person visiting each house. In this, aurdino UNO is used for manage energy data and Zigbee module is a wireless protocol which is used to enable communication between the energy meter and electricity board. Real time data will show on LCD which is connected near to energy meter. GSM (Global System Mobile) is also use for sending the billing information on consumer's mobile.

keywords: Energy meter, Aurdino UNO, Zigbee, GSM.

I. INTRODUCTION

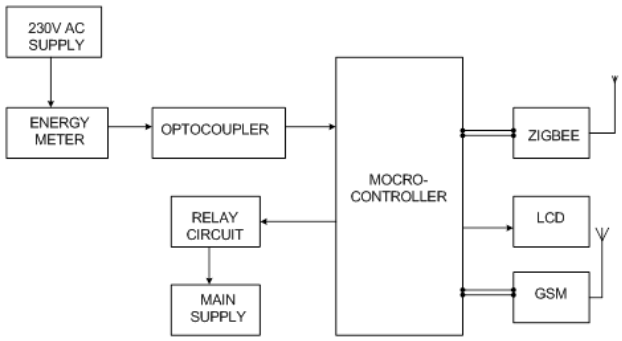
With the passage of time, technology has merged itself with the daily life of humans. We have seen so much progress in the field of science and technology but we are not able to make full use of it. One such area for improvement is the electricity board billing system. Our existing electricity board billing system in India is absolute and time consuming. We are proposing a system through which electricity billing becomes fully automated and communication is made possible via. GSM networks. In EB meters there are two types, Analog meters and digital meters. The analog meters were mostly used in olden days. These meter readings are calculated under the basis of the number of rotation made by the rotating disc. The digitl meter is the mostly used EB meters now a day. This meter works on the basis of the flash made by the LED and according to that the reading are calculated.

The EB meter present in each house is connected by wireless network through a GSM modem with the EB office and also the home user is provided with a Zigbee network in which one Zigbee is connected to the home user personal computer for timely viewing of the reading consumed by his household and also provides a provision of knowing the individual energy consumption by each device used in our homes. The design of a simple low cost wireless GSM and Zigbee based energy meter and its associated interface, for automating billing and managing the collected data globally. The block diagram of consumer side is shown in Figure 1.

This 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 and Zigbee based wireless communication modules are integrated with electronic energy meter of each entity to have remote access over the usage of electricity. A PC with a Zigbee receiver at the other end, which contains the database acts as the home section point where the domestic user can have a track of how much amount of energy is consumed. This consumed units are transfer to the EB (Electricity Board side fig.2) side with the help of Zigbee transmitter and EB side Zigbee receiver receive the consume units. Then with the help of GSM technology we able to send SMS to consumer. In SMS thier is information regarding billing of number of units consumed by the consumer.

BLOCK DIAGRAM:



Figuer 1. Block Diagram Consumer side

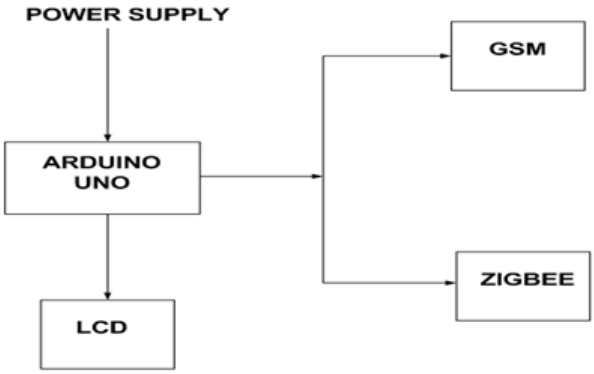


Figure 2. Block Diagram Consumer Side

Energy Meter: An electricity meter is a device which measures the total electrical energy (or electricity) consumed by the appliances which draw electrical energy from the main power supply at a house or an official space and so on. Electricity meters are a common sight in the households today. When we look at meter, we see a few digits on it. These digits (reading on the meter) tell us how many units of electricity (mentioned as kWh in the meter) have you consumed so far. And electricity bill is entirely dependent on this meter. The reading of the meter is cumulative. So to determine consumption reading of a particular month, the difference between the readings of that month and the previous month is calculated.

Types of electricity meter:

1. Electromechanical meter
2. Electrostatic meter

1.Electromechanical meter: Electromechanical meter were very common in India few years ago. They still are very popular in the rural areas where the penetration of the

Figure 3. Electromechanical Meter

modern technology is not as high as it is in the urban areas. The working of electromechanical meters is fairly simple and it is shown in Fig.3. There is a non-magnetic metallic disc attached to it internally which rotates depending upon the power passing through it. So if the power passing through is high, then the disc is rotates faster and when the

passage of the power is low, the disc rotates slower. The rate of the rotation in turn decides the reading on the electricity meter. Higher the number of rotation, higher is the reading and vice-versa. Since there is rotation of a disc involved, it is bounded to consume some electrical energy itself to facilitate the rotations. The power of around 2watts is consumed to make it rotate and this power consumption is not registered on the meter.

2. Electronic meter: Electronic meter are becoming increasingly popular now-a-days in urban areas. An electronic meter has a LED/LCD display on which the readings of the connected appliances. The readings are digital in the electronic meters in contrast to the electromechanical meters. This meter shown in Fig.4 These are much more efficient than the electromechanical meters in the sense that they do register every small unit of electricity consumed.

Figure 4. Electrostatic Meter

RELAY:

Relay is an electromagnetic device which is used to isolate circuit electrically and connect them magnetically. Relay shown in Fig.5. They are very useful device and allow one circuit to switch another one while they are completely separate. They are often used to interface and electronic circuit (working at low voltage) to an electrical circuit which works at very high voltage.

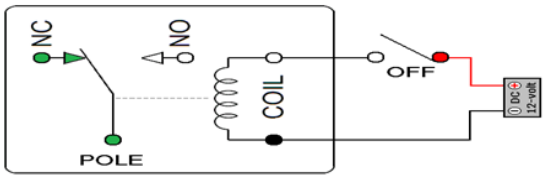


Figure 5. Relay

A relay switch can be divided into to parts: input and output. The input section has a coil which generates magnetic field when a small voltage from an electronic circuit is applied to it. This voltage is called the operating voltage. Commonly used relays are available in different configuration of operating voltages like 6V, 9V, 12V, 24V, etc.

The output section consist of contactors which connect or disconnect mechanically in a basic relay there are three contactors: Normally open(NO), Normally closed(NC) and Common(COM). At a NO input state the COM is connected to NC. When the operating voltage is applied the relay the relay coil is energized and the COM changes contact to NO.

OPTOCOUPLER:

"In electronics, an opto-isolator, also called an optocoupler, Photocoulper or optical isolator, is a component that transfers electrical signals between two isolated circuits by using lights. Opto-isolators prevent high voltages from affecting the system receiving the signal."

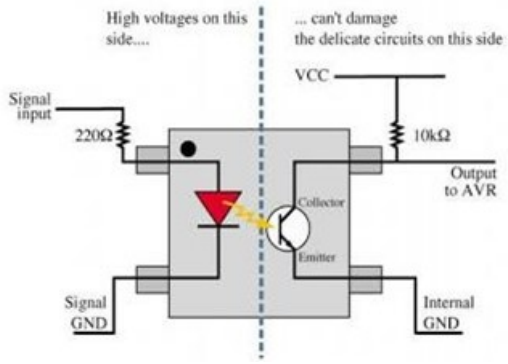


Figure 6. Optocoupler

A common type of opto-isolator consists of an LED and phototransistor in the same opaque package as shown in Fig.6. Other type of source –sensor combinations include LED-photodiode, LED-LASER and lamp-photo resister pairs. Usually photo-isolators transfer digital(on-off) signals, but some techniques allow them to be used with analog signals.

AURDINO UNO:

Arduino is an open source software and hardware company, project and user community that designs and manufactures single-board microcontrollers and microcontroller kits for building digital devices and interactive objects that can sense and control objects in the physical world. The microcontrollers are typically program using a dialect of features from the programming languages C and C++.

Figure 7. Aurdino UNO

The name arduino comes from a bar in Ivrea, Italy. Arduino is an open source hardware. Arduino microcontrollers are pre-programmed with a bootloader that simplifies uploading of programs to the on-chip flash memory. Fig.7 shows the Aurdino UNO.

This Arduino used in DC motor control using arduino and H-Bridge and impedance sensor system.

ZIGBEE:

Zigbee is a wireless technology developed as an open global standard to addressed the unique needs of low-cost, Low-power, Wireless sensor network. Zigbee is set of specs build around the IEEE 802.15.4 wireless protocol. The Zigbee technology is broadly adopted for bulk and fast data transmission over a dedicated channel. Zigbee module is shown in Figure 8.

The major advantage of this system is making use of zigbee module which helps for an wireless transmission. We can also enjoy the freedom of sharing same reading with a multiple Zigbee ports where we need not required the multiple transmitter. The distances that can be achieved transmitting from one station to next extend upto about 70meter, Although very much greater distances may be reached by relaying data from one node to next in the network.

Figure 8. ZigBee Module

GSM:

GSM (Global System For Mobile Communication, originally groups special mobile) is a standard developed by the Europe Telecommunication standards institute(ETSI) to describe the protocols for second-generation digital cellular networks used by mobile devices such as tablets, first deployed in Finland in December 1991. GSM operates in 900MHz band (890Mhz-960MHz) in Europe and Asia and in the 1900MHz (sometimes referred to as 1.9GHz) band in the United state. GSM is also the basis for Integrated Digital Enhanced

Network(iDEN). GSM network is used to sending SMS to the local authorities regarding the theft cases. GSM module is shown in Fig.9. A GSM based wireless communication module is integrated with the electronic energy meter of each entity to have remote access over the usage of electricity.

Figure 9. GSM(Global System For Mobile

LCD:

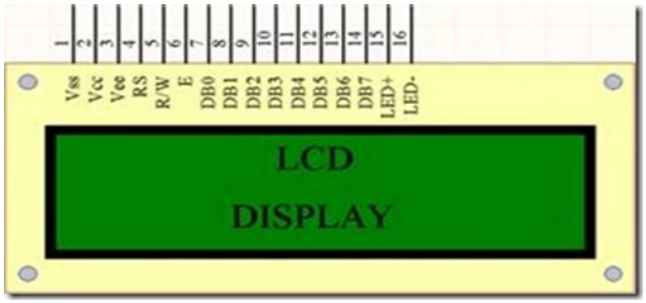


Figure 10. LCD Display

"A light-emitting diode (LED) is a two lead semiconductor light source. It is a p-n junction diode that emits light when activated. When a suitable voltage is applied to the leads, electrons are able to recombine with electron holes within the device, releasing energy in the form of photons." LED have many advantages over incandescent light sources, including lower energy consumption, longer lifetime, improved physical robustness, smaller size and faster switching. Light-emitting diodes are used in application as diverse as aviation lightning, traffic signals. They are also significantly more energy efficient and arguably, have fewer environmental concerns linked to their disposal. LEDs have led to new display and sensors, while their high switching rates are useful in advanced communications technology.

Conclusion and Future Scope: We believe that there is definitely a place in the market for ZIGBEE & wireless HART (Highway Addresable Remote Transducer Protocol) Industry can further extended use of ZIGBEE in remote controlled application. It can be used for providing control through mobile phones. The data like reactive power, apparent power & power factor with a sign also can be sensed through this network by simply tracking the internal register of the chip. Basing on the address application, we present an improved routine protocol according to different packed types in AMR system to realize less data latency and better transmission reliability in local terminal. In future work, we plan to research and construct more complex ZIGBEE wireless network for industry monitoring system. This working prototype of ZIGBEE based AMR system is to demonstrate the upgrading made to traditional meter is very effective. It has low infrastructure cost simple and easy installation that resolves the reading problem of manual meters.

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