Hi-Tech Energy Meter with Automatic Load Control

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***Abstract*- Nowadays automation is being implemented in all the fields. However it is seen that electricity service providers still use the same old method of reading meters manually from house to house. Our proposed project will send all the details of the meter to the service provider as well as the consumer through a SMS by using GSM module. The use of ZigBee will help in quick data transfer wirelessly. The use of LCD display will help in notifying the consumers about any changes in the power supply by the service provider. The load can be controlled from both the ends by consumer and service provider with the help of relay circuit. Thus this project will be both service provider and consumer friendly. The detection of electricity theft can also be done through the use of this system.**

Keywords- Automatic meter Reading (ARM), Microcontroller, GSM, ZigBee

I. INTRODUCTION

We all know that electricity is the base for development of any sector and is required at levels be it residential, commercial or industrial areas. However this electricity cannot be made available free of cost and for this reason meters are installed inside or outside the consumer's premises to keep a track on electricity consumption and based on this the bill is generated. The reading is generally noted down by the meter readers manually mostly on monthly basis. The energy meter installed will be such that any tampering to the meter can be detected quickly.

This method is however tedious and time consuming and thus not prove sufficient in most of the situations. There may be a situation such that meter is installed inside the consumer's house and if he is out of town then the average of previous bills is taken to generate the new bill even if consumption might be low. This situation if faced in many cases may prove a burden for the service provider as well as consumer. Many consumers may not cooperate with meter readers for any reason such as they might consider it as an invasion of their privacy. Also there might arise a condition where the reading is noted wrongly by the reader. To overcome this and many other such unwanted situations the use of energy meter with automatic load control using GSM technology along with ZigBee can be implemented in this sector.

This method brings in automation, the need for manual meter readings is not required. This method is both service provider and consumer friendly. The meter readings are accessible to both the sides anytime and anywhere. Various notifications such changes in rates, power cutoffs etc can reach the consumer quickly which will help the consumer stay prepared for any such situations. The LCD display will help in these notifications. The bill will be sent to the consumer via SMS also a hardcopy will be provided. This will also help in keeping a track on the consumer's consumption without inconvenience. The relay circuit will help in controlling load from either side. A track of more power consuming appliances can also be kept by the consumers reduced as per convenience. Thus using GSM technology will quicken the process of billing and reduce manual work.

The use of ZigBee will bring in wireless data transfer thus the process of meter reading or any service related to the meter connection is fastened. ZigBee can cover a range upto considerable distance in meters. Nowadays the procedure to incorporate ZigBee in various areas for automation is being considered. ZigBee in automation of meters is thus a safe and fast method.

II. PROBLEM STATEMENT

Earlier the meters were installed inside one's house or yard and it thus began to be inconvenient for company to record data monthly or fortnightly due to this many problems existed. This resulted in burden on electricity supply company. Also some of the meter holders do not pay their bills during the scheduled period and keep it pending for a long time. This leads to an economic burden on the service providers. It is also seen that theft of electricity has increased largely at various places leading to losses for consumers as well as the service provider. The meter readers may make some error in reading which result in false billing. Due to such shortcomings, the Short Messaging Service has extended their service which led content provider to deliver messages through mobile telephony system. We can easily send and receive messages from messenger app. The best advantage is global module broadcasting feature easily access data from service provider wirelessly and monitor the power consumption of the appliances.

III. PROPOSED SYSTEM

Basically, digital energy meter generates pulses as well as count the power consumed. It also has LED which blinks and notifies the consumer for specific number of times changes occur. The microcontroller used is 8951

rather than 8051 as it has 4KB Flash memory. It is provided with 5V supply for internal storage systems. The microcontroller is connected to a 8 way DIP switch. A ZigBee module is connected to the microcontroller at receiver and transmitter which transfers data wirelessly to the service provider.

At the service provider side the ZigBee obtains data from meter side. This in turn is connected to serial port. Through the USB pin the port is connected to the PC or laptop. The operator can read the meter readings from the screen. Another serial port is connected to the PC which links the GSM module.

The relay logic is used for switching purpose. When an ON command is given to the circuit connection the relay operates and current flows. The outputs displayed on LCD display. The readings are noted and an SMS will be sent to the consumer.

If the service provider detects that the previous bills are not paid, then a message will be sent to the user. If the consumer keeps the bill pending then the meter connection is deactivated by the operator through meter OFF icon provided. When the OFF command is given the relay stops operating and no cuurent will flow. Thus the supply is disconnected.

Once the bill payment is done the electricity supply can be restored immediately. This leads to automatic meter control.

The meter connection will be disrupted in case of any tampering done to the meter with any intention mainly theft of electricity the contact between meter cover and board shall break. Hence this system will also help in a clean supply of electricity without any improper activities.

The proposed system is as shown in the following diagram and connections are done accordingly.

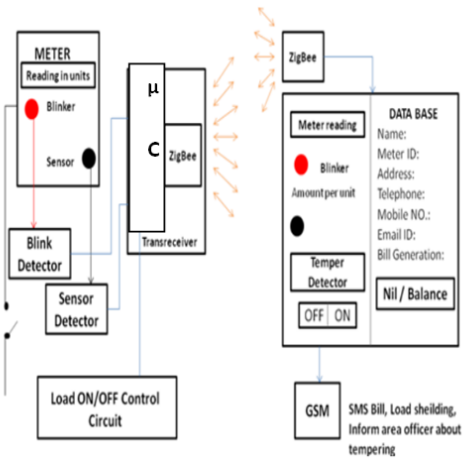


Fig 1. Block Diagram of Proposed System

IV. HARDWARE IMPLEMENTATION

The larger part of this project is based on hardware components to accept the meter reading and send it to consumers. The major part of the implementation is of microcontroller, energy meter, relay circuit and GSM module, a wireless link, ZigBee, Serial to USB.

A. Microcontroller:

The microcontroller used is 8951.It has 4KB flash memory with erasable read only memory (ROM) and 128 bytes of random access memory (RAM).It can be erased and programmed to a maximum 1000 times. It is a 40 pin microcontroller having 4 ports namely P0, P1, P2 and P3. These ports are bidirectional i.e can be used as input and output.

B. Energy meter:

The energy meter used will be a digital energy meter. It is used for measuring the amount of consumption of electricity by the residence or commercial sectors. They measure in Kilowatt/hour (KWh). This helps in noting the values easily and directly. A switch is provided on the energy meter which is initially intact.
If any tampering is done to the meter the contact between the meter and the cover is loosened and supply is disrupted. This will in turn lead to prevention of power theft. The energy meter readings obtained shall be different for every manufacturer based on the pre decided value of pulse rate i.e the blinking of LED light.

C. ZigBee:

The ZigBee used is XB-24-B. It can cover a range upto 30 metres. Baud rate is 9600 and frequency 2.4 GHz. It has 20 pins of which pin 2 and pin 3 act as receiver and transmitter respectively. A supply of 3.3V is provided at pin 1. The key features of ZigBee are that they are self-routing, self-healing mesh networking and fault tolerant.

D. GSM module:

A GSM module assembles a GSM modem with standard communication interfaces like RS232 (SERIAL PORT), USB etc so that it can be easily interfaced with a computer or a microcontroller based system. The power supply circuit is built in the module that can be activated by using a suitable adaptor.

A GSM modem can accept any kind of GSM network and act as a mobile phone with its own unique phone number. The applications of this modem are SMS control, data transfer.

E. Serial to USB port:

The serial to USB port is a RS232 port. It is used for supporting various serial devices like modem, phones, cameras. It has easy plug and play installation. The rate of data transfer is over 1 mbps. It supports power management and no IRQ resource is required.

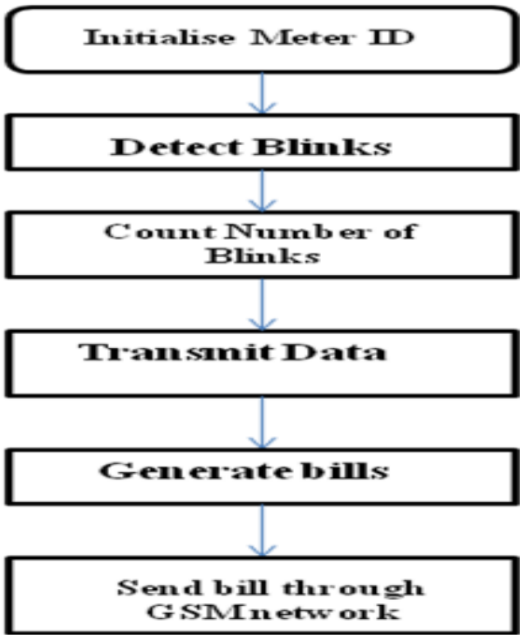
V. SOFTWARE IMPLEMENTATION

The operating system used is Embedded C and software is BASCOM8051.It runs on all versions of Microsoft Windows. The variables and labels can have a length of 32 characters.

It has a fast machine code rather than interpreted code. Special commands can be used LCD displays.

An integrated simulator is used for testing and can be efficiently used along with 8951 microcontroller.

The working of the system through the use of software can be seen from the following flowchart.



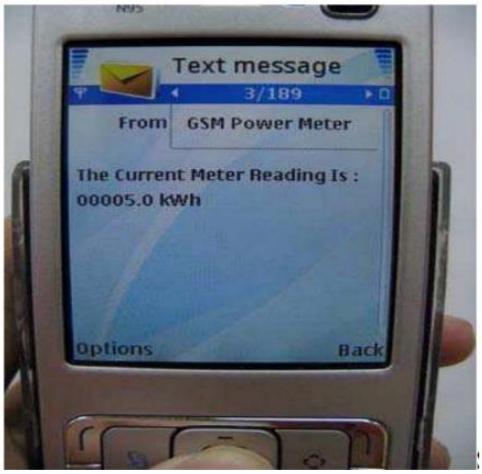
The use of this software provides ease of operation and programming is easy. The programming can be done using if-else loop which is easy and errors within it can be easily detected and compilation is faster.

VI. RESULT

The facility to get meter reading at any time is provided for the consumer. The consumer will have to send a SMS to the service provider asking for the meter reading. Based on the message a reply shall be obtained from the service provider side.

The message to be sent to the service provider shall be as follows.

The reply from the service provider shall be as follows.



At the end of the month the consumer will receive an email, hard copy at the given postal address along with a SMS on the given mobile number. Thus the system is user friendly. The provision of SMS makes it easier to get any meter related information for the consumer. The consumer can make bill payments quickly as he will be notified beforehand.

VII. ADVANTAGES OF SYSTEM

The system reduces the efforts of manual data collection of energy meter. Data which will be received at service provider side is easy to manipulate for bill generation and other meter related tasks. With this system we can collect the reading as well as control the supply to the user and manipulate the required usage as per the customers demand quite efficiently. The use of software at service provider side will help to inform the customer about the status of current meter reading, bill for the current cycle, status of the line and other parameters to the customer with a message. Electricity can reach even to the remote areas. The use of this system prevents theft of electricity also. Thus the application of this system can be seen in various areas such as commercial and residential meter holders, railways etc.

VIII. CONCLUSION

A complete proposed system is done to demonstrate meter reading using GSM module. The hi-tech energy meter has eradicated many problems through e-billing system in the form of SMS. This system saves time as well as cost. It is much reliable for human operator to handle. The consumers will get appropriate details about consumption of energy. By making use of this technology the tedious and tiring process of meter reading can be replaced easily by a better and more feasible method reducing the excess burden related to meter works. This system can be used in remote places and thus electricity supply can be provided to every area. The use of this system helps in wireless transmission and hence overhead wires are eliminated. The modifications can be done in the

existing meters at the consumers end and hence there is need to completely replace the current meter. The value of unit usage can be easily varied through controls provided. Economically it is beneficial for the service provider as the bills will be paid on time.

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REFERENCES

[1] S.Arun, Dr.Sidappa "Design and Implementation of Automatic Meter Reading System Using GSM, ZIGBEE through GPRS." International Journal of Advanced Research in Computer Science and Software Engineering Research Paper. Volume 2, Issue 5, May

[2] Liting Cao , Jingwen Tian and Dahang Zhang ,"Networked Remote Meter Reading System Based on Wireless Communication Technology" in international Conference in information Acquistion , 2006 IEEE

[3] Bharat Kulkarni "GSM Based Automatic Meter Reading System Using ARM Controller" International Journal of Emerging Technology and Advanced Engineering Website:, Volume 2, Issue 5, May 2012)

[4] Mr. Rahul Ganesh Sarangle, Prof. Dr. Udaypandit Khot, Prof. Jayan Modi" Gsm Based Power Meter Reading And Control System "Mr. Rahul Ganesh Sarangle, Prof. Dr. UdayPaniKhot, Prof JayenModi International Journal of Engineering Research and Applications (IJERA)4, June – July 2012.

[5] Tariq Jamil, , "Design and Implementation of a Wireless Automatic Meter Reading System" WCE 2008, July 2 - 4, 2008, London, U.K IAENG Proceedings of the World Congress on Engineering 2008 Vol I. , July 2 - 4, 2008, London

[6] Yu Qin, "The Research and Application of ARM and GPRS Technology in Remote Meter Reading Terminal Equipment", A Thesis Submitted in Partial Fulfilment of the Requirements for the Degree of Master of Engineering, 2007

[7] O.HomaKesav, B.Abdul Rahim "Automated wireless meter reading system for monitoring and controlling power consumption " IJRTE Volume-1, Issue-2, June 2012.

[8] Arnab Ganguly and Dr. K.P.Satheyamurthy " Hitech Energy Meter With Automatic Load Control" IJICA Vol 2 issue 1

[9] Dr. G Sridhar,Harikrishnan,Renjith,Vinu "Hitech Energy Meter With Automatic Load Control" IJDCN,Volume 3,Issue1,January 2016

[10] VedantParmar,Ishan Mistry,Nimish Vaghela,Prof.Ajaykumar Daiya,Mrs.Leena Govekar,Birla Vishwakarma Mahavidyalaya "Hi-Tech Energy Meter With Automatic Load Control" IJSTE Volume 1,Issue 11,May 2015

[11] Prof.S.R.Kurkute,Gopal Girase,Prashant Patil "Automatic Energy Meter Reading System Using GSM Technology" IJIREEICE,Vol 4,Issue 3,March 2016

[12] E. Moni Silviya, K.MeenaVinodhini, Salai Thillai Thilagam.J. "GSM Based Automatic Energy Meter System with Instant Billing" IJAREEIE,Vol3,SpecialIssue3,April2014

[13] Sudhish N George and Ashna K (2013), "GSM Based Automatic Energy Meter Reading System with Instant Billing", International MultiConference on Automation, Computing, Communication, Control and Compressed Sensing, pp. 65–72.