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NEW AGE ENERGY METER READING SYSTEM

Nikit Khandagale[1], Nikita Bhatia[2] , Richa Srivastava[3] and Somyata Rastogi[4]

[1,2,3&4]Dept of Electronics and telecommunication,
VESIT Mumbai-74

Abstract

The purpose of this project is the remote monitoring and control of the Domestic Energy meter. This system enables the Electricity Department to read the meter readings regularly without the person visiting each house.
This can be achieved by the use of microcontroller unit that continuously monitors and records the Energy Meter readings in its permanent (non-volatile) memory location and the live meter reading can be sent to the Electricity department on request. This system also can be used to disconnect the power supply to the house in case of non-payment of electricity bills. A dedicated GSM modem with SIM card is required for each energy meter.
The implementation is done in such a way that a SMS is delivered to the Modem whose reading is to be noted and then that meter replies to the server in the SMS format. The purpose of this project is to remote monitoring and control of the Domestic Energy meter. This system enables the Electricity Department to read the meter readings regularly without the person visiting each house. The GSM AMR takes the advantage of available GSM infrastructure nationwide coverage and the Short Messaging System (SMS) cell broadcasting feature to request and retrieve individual houses and building power consumption reading back to the energy provider wirelessly. A server and database handles all the records at electricity board end. An android application has been designed for user end which enables not only e-billing but access to live meter reading and plethora of other options like switching off an electric appliance if it exceeds usage limit.

Keywords: ATmega32, SIM300, Android app, database.

1. Introduction

Current system of electric metering has a myriad no. of shortcomings that can be very well mitigated or alleviated after employing our project. The problems can be accounted as follows:

1) Use of excessive man power and other resources that increase the overall cost of billing procedure
2) Consumer can't keep the track of his consumed units until the end of the month.
3) Discrepancy may creep into system because of human errors and limitations.

Billing is a critical function of Electricity board to get a meter read. Meter reading, even though it looks simple, is far from simplicity and involves processes that can give various problems. Most problems, currently seen, result from the manual processes followed. Calculation errors, delays in system updating and fault tracking issues are the major problems that companies find difficult to find answers for. This paper suggests a GSM based system to collect, process and notify consumers about consumption. This system will be reliable, efficient and accurate to suit the requirements of these companies. The proposed solution uses evolving web technologies, over a solution which can handle a company's day today work. The burden on the Meter Reader is lessened and other new features have also been introduced. Customer interaction with the company is improved and customers can easily view their current electricity usage and can also carry out bill payment sitting online from their homes.

2. METHODOLOGY

The actual implementation takes place in the following manner. The consumer requests Electricity Board for meter readings. The consumer makes the request either using SMS or through his profile on Board's website.
Client sends message to number which is SIM number of SIM card used in GSM module. Once a request is made, the GSM module is triggered and simultaneously the microcontroller understands that a request has been made. It then refers to its memory for the current value of counter. A counter is employed which counts the number of pulses given by energy meter's microcontroller. The two microcontrollers (internal microcontroller of energy meter and ATmega32) are interfaced and pulse information is shared. The external microcontroller that is ATmega32 keeps on counting the incoming pulses and maintains the count in its memory. Now whenever GSM triggers microcontroller it refers to its memory to get this pulse count. This pulse count is then transmitted to the GSM module using serial communication. The server contact details are already fed in SIM's memory and thus the count is obtained at server end. At server end, the incoming information includes SIM number and the pulse count. This pulse count is then compared with the previously saved latest pulse count. The difference of these two values is the number of units consumed. From the number of units the bill is calculated and accordingly updated on user's profile which is accessible through android application. The user

has an option of making online payment. If the user wishes to make payment then the person has the freedom to do so. Along with these details, projected numbers of units are also displayed. Also the option of switching off any electrical appliance if it exceeds particular energy consumption level is possible through this application.[1]

Functional block diagram:

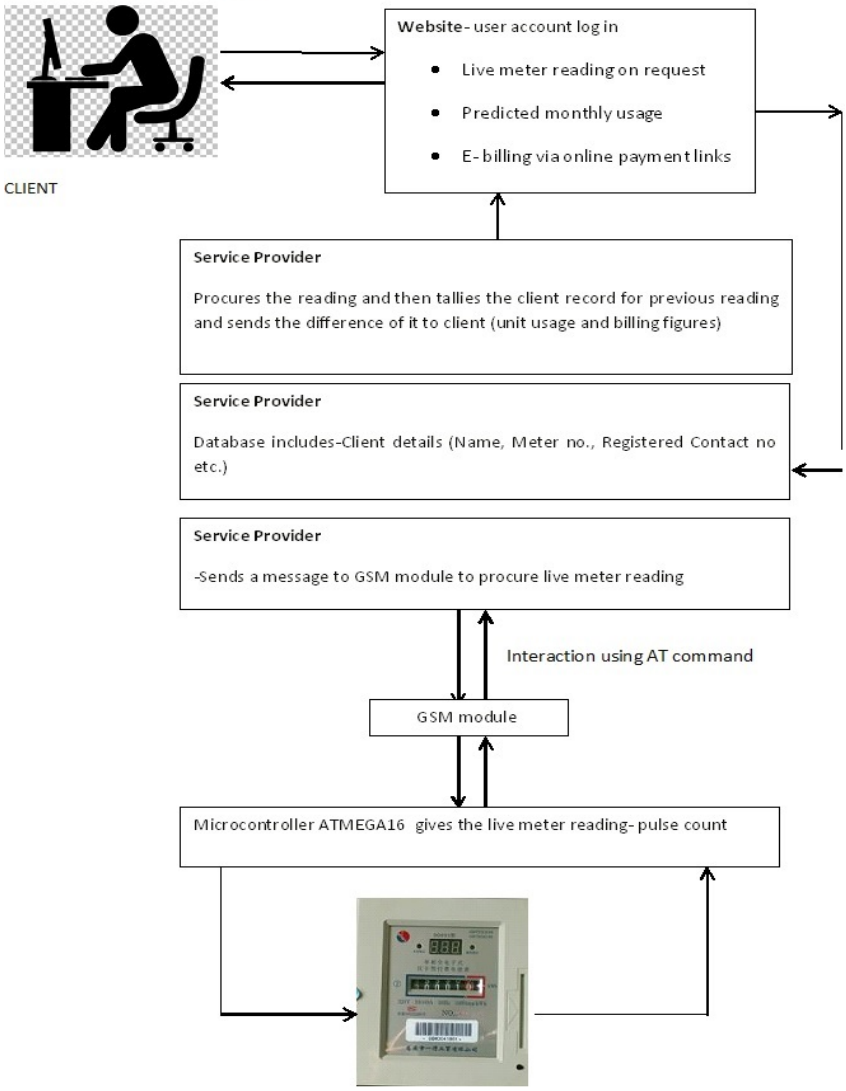


Fig 1. Block diagram for project

The project mainly uses the following resources:
1. Digital Energy Meter
2. Microcontroller- Atmega32
3. LCD Display
4. GSM Module- SIM300
5. A computer- Server end
6. An android application

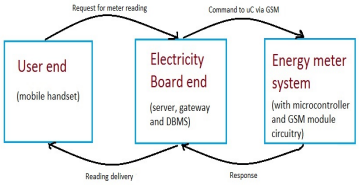


Fig. 2. Project overview diagram

Single phase digital energy meter has been used in the project. The reason behind using a digital energy meter or the electronic energy meter (EEM) is that it functionally outperforms the traditional Ferrari's wheel meter. One important advantage of EEM is that in non-linear loads, its metering is highly accurate and electronic measurement is more robust than that of the conventional mechanical meters. The output pulse of energy meter is detected using a photodiode. The photodiode detects the pulse from the blinking LED on the energy meter and the detected pulse is sent to the microcontroller.
For the programming and development of the controller part of the project at the energy meter end, we use an Arduino board with ATMega32 microcontroller. Arduino is an open source electronics prototyping platform. It is inexpensive, simple, cross platform and has other extensible properties. The microcontroller has a flash memory of 32kB, making the processing speed fast enough for the single IC to cater to not just one but multiple microcontrollers in a residential building.[2]

1. Interfacing SIM300 with ATmega32:
The GSM module SIM300 is interfaced with ATmega32 through UART port. Serial communication takes place between these two components. ATmega32 can be programmed either by using Assembly language or using C programming. SIM300 is accessed using AT commands. So to implement these two programming tasks simultaneously we use AT commands within the C program.[3]
The AT commands can be implemented using applications like Turbo C/C++, Microsoft Visual Studio, Command prompt etc. Such methods will employ AT commands in the syntax of standard computer languages like C, C++, Java, C# etc. Let us see implementation of an AT command for example of write function that is AT <x><"...">. We now use C syntax to implement it. The syntax will be such that the serial port will be activated first through C program; then the actual commands can be used while programming the port. [4]

Code Snippet:

SET 1)
Void setup()
{
Code that will execute once :
Functions
• 1. Setting baud rate for UART 1 to connect with SIM300 module
• 2. Setting baud rate for UART2 to connect with Serial Monitor
• 3. Setting SMS format to text mode (AT+CMGF=1)
• 4. Setting calling line identification presentation ON (AT+CLIP=1)
• 5. Configuring normal I/O pins
}
SET 2)
Void loop()
{
Code that will execute again and again :
Functions:

• 1. Pulse Measurement of all the meters
• 2. Entering AT commands using serial monitor
• 3. Displaying communication between Arduino and SIM300
• 4. Identifying sender And replying accordingly
}

2. Electricity Board end:
The changes that the electricity board needs to incorporate so as to use the proposed metering technology are described further. Firstly, the board needs to maintain a complete database of all its consumers. The entries may include ID, name, meter_ID, address, contact number, payment status, log of requested readings etc. The server needs to be developed so that the system is automatic. The database and server can be developed using either Microsoft SQL server, mySQL. To enable the server for SMS communication, we need to use a gateway. The gateway can be software which will allow computers to send/receive messages either using another GSM module or using IP based SMS. The examples of such gateway softwares are: Ozeki NG SMS server, diafaan etc. Diafaan is one such system which is easily compatible with various servers. The connectivity between server and gateway can be established using ODBC connectivity. The proceedings at electricity boards' end are described: Whenever a user requests reading, the request is received at server end. This request is then routed to the corresponding meter and controller system. The response received by meter is first

received at server end.

The database tables are updated with latest values of reading and billing amount. The updated data is then received back by the user.

3. User-end: Android application

An android application has been developed using Eclipse software that allows user to make registration (for the first time only) and then allows him to procure his live meter reading at any point of time. It also provides options like e-billing via online payment and also it can project meter billing on the basis of trend in usage of the customer.

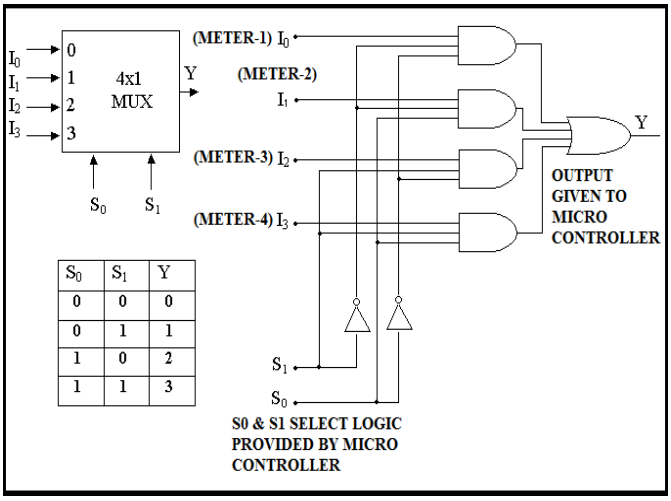
3. Result

A fully automated energy meter reading system was developed to collect, process and notify the consumption. The project takes care of the convenience of all sets and sections of consumers and at the same time presents an efficient management system to the electricity board. Features like electricity bill prediction, DBMS end operation, extension for multiple meter configurations, operation on various platforms like SMS, Android application and website and many other potential extension properties like integration with home automation system make this project unique.

4. Analysis

Project compatibility with existing systems is fine. The existing system doesn't need to change; it only has to be augmented with the project. This process will be both easy and economical. Moreover the project can also be extended to serve with any home automation system that will allow keeping a check on utilities that consume more power.

The same project can be extended to multiple meter configuration for residential buildings and complexes where there are multiple meters installed at one place. All that is required is a small change in the logic of the project and a few additional circuitries. We use a counter IC 4026 together with a multiplexer to count the pulses from the microcontroller. So without much additional cost our project will cater to extended application.



S_0	S_1	Y
0	0	0
0	1	1
1	0	2
1	1	3

FIG 3. Scheme of logic applied

5. Conclusion

Electricity bill prediction in between the month is now possible by taking into account on the current consumption rate of the user and the seasonal trends in consumption. This can help the customer keep a check on his consumption levels. hus the project also promises an indirect control on electricity usage, leading to conservation of the precious energy resources.

The features of the proposed system can be summarized as follows:

1. Provides user friendly remote energy meter monitoring.
2. Supports controlling of meter.
3. Can be controlled anywhere in the world.
4. Non-volatile memory based energy-reading storing.
5. Auto disconnect feature.

The system can be used for automated metering in the Electricity departments, Household Energy meter monitoring, Railway electrical systems, Industrial Energy remote monitoring, Remote controlling systems.

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AUTHORS

Nikit Khandagale is currently pursuing B.E. degree in Electronics & Telecommunication Engineering. He is a student of V.E.S. Institute of Technology,Mumbai. He has been the member of IEEE, CSI and ISTE VESIT chapter for years 2012 to 2014. Embedded Systems and Wireless Technology are his areas of interest. He has successfully completed the Robotics with ROBOT C International Internship conducted by Technophilia Systems Pvt Limited in year 2013 which is accredited by Carnegie Mellon University. Also he has hands on experience working with ARM Cortex M3 Microcontroller embedded systems during Internship on embedded systems at Technophilia in year 2013. He is currently developing real time embedded modules suitable for easy and small domestic applications.

Nikita Bhatia is a student of final year of Electronics and Telecommunication. She studies at VES Institute of Technology. She has participated in various inter-collegiate and intra-collegiate technical events and presentation presentation competitions and has won some of them. She had published her survey over compression techniques techniques of realtime databases. She has always been an active member of IEEE(Institute of Electrical and Electronics Engineeers), CSI(Computer Society of India), ISTE(Indian Society of Technical Education).

Richa Srivastava is a final year student of Electronics and Telecommunication Engineering at V. E. S. Institute Institute of Technology, Mumbai. She is an active member of two student chapters- ISTE-VESIT and IEEE-VESIT. She participated in a national level paper presentation on 'Biologically Inspired Intelligent Robots' conducted by IETE Students Forum at SIES Graduate School of Technology, Navi Mumbai (India) in February 2012. She was a finalist of Intra-collegiate technical paper presentation completion on 'Application of Machine Learning in in Industrial Applications' in V. E.S. Institute of Technology, Mumbai (India) in September 2012. She also participated in in an Intra-collegiate technical paper presentation on 'Intelligent Transport System' conducted by Fr. C. Rodrigues Institute Institute of Technology, Vashi, Mumbai (India) in March 2013. She had published her survey over compression techniques techniques of realtime databases.

Somyata Rastogi is a final year student of Electronics and telecommunication Engineering at V.E.S. Institute of Technology, Mumbai. She is an active member of ISTE(Indian society of technical education) and has won several intra-collegiate technical and non-technical competitions. Her area of interests is wireless networks and electrical networks. She has participated in various national level paper presentation competitions. She has also won 1st prize for her final year project in an intra college project competition. She has also published her work for silent sound technology.