Design of GSM based Talking Energy Meter

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Abstract- GSM based Talking Energy meter is a new concept in the measurement of electricity consumption remotely on periodic basis and alerting user regarding power consumption, overloading & tempering through Audio Signal. This method of measurement and data collection discards the conventional method of taking the meter reading manually. Though the Talking Energy Meter display and sounds the number of electrical units consumed by the user as well as warning signal at the load centre but on the other side, there is urgent need to develop a system which will transmit the units consumed by the individual user to the Power Utility Company(PUC). In this paper design of GSM based Talking Energy Meter is presented which will be able to communicate based on GSM network; for the transparency between the user and the PUC. The GSM based Talking Energy Meter(GTEM) consist of a energy meter connected with the compatible microcontroller, a display device, an audio module, GSM modem and a compatible software to capture, transmit and maintain the record of the electricity consumption data of a particular user.

Index Terms— Automatic Meter Reading, Power Utility Company, Global System Mobile, Short Messaging Service

I. INTRODUCTION

Traditional meter reading for electricity consumption and billing is done by human operator by visiting one place to another. This requires more time to collect data regarding energy consumption by user and also requires more labour operator. Moreover, human operator billing are prone to error as sometime some locations are not easily accessible for reading energy consumption. Sometimes bad weather conditions also restrict labour billing job. Printed billing has tendency of losing in the mail box. Also the user with busy work schedule does not constraint on energy meter for reading power consumption. Physically disable person are also unable to get information & alert signal regarding power consumption. In order to achieve efficient meter reading , reduce billing error and operation cost, facilitate handicapped user, GSM based Talking Energy Meter (GTEM) plays a vital role to address the above mentioned problems. GTEM is an effective means of data collection that allow substantial saving through reduction of meter re-read, greater data accuracy, allow frequent reading, improved billing and customer services, more timely energy profiles and consumption trends updates, more convenient for user with busy lifestyle, highly facilitation to physically disable persons and better deployment of human resource. With advancement in digital technology, analogue electro-mechanical meter is continuously replaced by digital electronic meter. Digital energy meter offer greater convenience to implement and establish automatic meter reading system electronically. Efficiency and reliability of retrieving meter reading in the GTEM was a major challenge. Various Automatic Meter Reading (AMR) methods & technologies using Power Line Carrier (PLC) Communications, Supervisory Control & Data Acquisition (SCADA), telephone modem, internet, Ethernet, Embedded RF Module, Wi-Fi, Bluetooth & Zigbee were established and developed to provide & demonstrate the solutions of efficiency , reliability and effectiveness of AMR. The above mentioned method have a number of drawbacks like higher cost, short distance, interference effect in communication channel, system complexity, error prone etc. With rapid development of Global System Mobile (GSM) infrastructure, in past decade has made wireless automatic meter reading system more reliable and possible.

GSM based Talking Energy Meter (GTEM) based on GSM network is presented in this paper takes advantages of available GSM infrastructure nationwide coverage in the country and the SMS cell broadcasting feature to request and retrieve individual houses and building power consumption meter reading back to the Power Utility Company(PUC) wirelessly. The Audio Module of this Automatic Meter Reading (AMR) syetm alerts the user through audio signal about power consumption, bill due dates, meter overloading and/or meter tempering. This feature facilitate in alerting the customer having busy schedule and also to physically handicapped persons.
II. SYSTEM OVERVIEW

The complete system overview for Talking Energy Meter is given in Fig. 1. The complete system is made up from Single Phase Energy Meter, 8-Bit Microcontroller, GSM Modem with RS-232 communication Interface, Audio Module APR9600. Energy Meter is basically digital KWh power meter which utilizes the GSM network to send the power usage reading back to the energy provider wirelessly upon the request from the PUC. This AMR is basically integration of single phase class 1, IEC 61036 standard compliance digital KWh power meter and a GSM modem. A SIM card with a unique special service number is requires for the operation of GSM modem to receive and reply its meter reading to PUC using SMS. The special service number SIM card works with similar mobile phone number except it is not mean for voice service. The SIM card service number is also used to identify and retrieve the owner or customer detail from the data base for billing purposes.

Fig. 1 Overview of GSM based Talking Energy Meter

An AMR reading took place upon request by the PUC using SMS at monthly interval. This system can also be modified for prepaid mode of billing. Upon meter reading execution the SMS gateway performs cell
broadcasting of request through SMS to all AMR systems to request for meter reading. Once each individual
GSM power meter received the requesting SMS, it will immediately response by composing its consumption
reading in six digits kWh with one decimal point unit in SMS format and revert it to the PUC SMS gateway.
The SMS gateway starts to receive the reply meter readings from all the individual GTEMs and will store the
meters reading information accordingly. The retrieval of all individual meter through SMS for through whole
country may take some time depends on the GSM cell area. After completion of the meter reading request, the
application terminal will starts to retrieve the meter reading from the SMS gateway to store and update to the
database server. So after that the application terminal eBilling system will starts to calculate the billing amount
for an individual meter based on the tariff rate from the PUC. The billing notification are later sent to all the
owners through email by the Email Server, SMS to the owner through SMS Gateway and hardcopy printing
through the Print Server for postal mail for owner who prefer hard copy printing. A Web portal has also been
setup at the Web server to provide easy check and payment service. Once the owner received the billing
notification from SMS, email or hard copy printing bill, then the owner can access the web portal and able to
logon to check their billing detail since the web server is linked to the data base server. The owner can choose to
pay their bill online using credit as the web server is connected to the e-commerce server that is handling online
banking transaction. The owner can also choose to pay their bill by cash at any of the PUC outlet that have
access to the application terminal. The owner can also use their mobile phone to retrieve their power meter
reading to verify the billing reading. This can be achieved by just sending a SMS to the owner AMR service
number. Once the AMR receive the SMS it will compose the current meter reading and reply to the owner
mobile phone through SMS. With this feature the consumer can monitor their power usage anytime and
anywhere. On user side, the audio module provides the alert signal and warning signal in audio form.

III. TALKING ENERGY METER DESIGN

The design of the GSM based Talking Energy Meter is an integration of a single phase class1, IEC61036
standard compliance digital kWh power meter, 8-bit Microcontroller, GSM Modern with RS-232
communication interface, Audio Module APR-9600, EEPROM, Current, Pulse & Temper sensors and Relay
module as shown in Fig. 2.
The GSM based Talking Energy Meter (GTEM) is used to measure the power consumption drawn from the PUC sub station to the consumer unit in kWh unit. A Static Single Phase Watt Hour Meter from Jaipur Electronics Co. is chosen for Talking Energy Meter implementation. The digital power meter was set to display six digits with one decimal point reading in kWh unit and a meter constant of 800 impulse per KWh. The digital power meter has as optocouple meant to couple the impulse count to any external electronics circuitry without direct contact to the digital power meter circuitry. 8-bit Microcontroller from ATMEL corporation - AT89S52 is used to control and process all basic blocks of this system. 16*2 LCD is used to display the information form microcontroller. GSM modem is interfaced to microcontroller through RS-232 standard using MAX-232 IC. Predefined Audio Warning & Alert signals are stored in memory of audio module APR9600. The PUC can disconnect any user remotely and instantly with help of relay module. Current & Pulse sensors of energy meter are interfaced with microcontroller via opto coupler. This collected reading is stored in EEPROM of system before displaying on LCD. The EEPROM used here is a 24CXX series from ATMEL and is a serial EEPROM. This memory plays a vital role for power consumption reading backup in case of power failure. Whenever the current sensor shows meter overloaded or temper sensor shows meter tempering, corresponding message is shown on LCD as well as sent to PUC via GSM network. The reading information of user’s power consumption is also sent periodically, simultaneously or on demand to PUC through GSM modem in SMS form periodically. The text message is decoded by PUC server for official records and documentations. A text message also sent to user for displaying information about power consumption in KWh form as shown in Fig. 3.
This reading can also be collected by PUC as per predefined schedule and according to their rule & regulations. GSM modem is interfaced serially to microcontroller through RS-232 communication. The Talking Energy Meter Prototype is shown in Fig. 4. The various units of this AMR are embedded into single module. Audio Module APR9600 consists of inbuilt memory for predefined storage of voice messages.
IV. SYSTEM TEST APPROACH

For demonstration purpose the GTEM and SMS gateway GSM modem uses an ordinary SIM card phone number. The GTEM is power up from a socket outlet and load is connected to main supply through relay module of GTEM. The consumed power is displayed on LCD as well as in SMS text form to user’s predefined mobile number. The audio module also provides corresponding audio signal on meter overloading, meter tempering and bill due dates (in prepaid mode) successfully to user.

V. CONCLUSION

A complete working prototype of the GSM based Talking Energy Meter (GTEM) was built to demonstrate an automatic meter reading using GSM network. This system takes advantages of existing GSM infrastructure that have virtually full coverage of all housing and building area across the country which lead to low infrastructure implementation cost, simple and easy installation of GSM based Talking Energy Meter at consumer side as GTEM has no difference from existing ordinary analogue or digital meter installation. The complete eBilling System required ICT expertise personnel to setup, run and maintain all the servers. The GSM Talking Energy Meter proven to provides effective, reliable and efficient wireless automatic power meter reading, billing and notification through the use of GSM networks, thus reduce human Operator meter reading operation cost.

REFERENCES