Secure Cloud Based Smart Grid Application

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ABSTRACT

The present system of energy billing is error prone and also time and labor consuming. Errors get introduced at every stage of energy billing like errors with electro-mechanical meters. In the Modern world intelligent control is adopted in every field, although the service provider for energy are still uses the conventional methods for getting the energy consumed by the customer. The conventional method is very time consuming and expensive which may also lead to human error. And it will take huge memory to store all consumers' billing information. Our proposed method will automatically send the data of the energy meter to the service provider, consumer and cloud with the help of the GSM modem, once in a day and hence the system will generate a report and send to the service provider once in a day through SMS. The same system can be used to check the last reading consumed by the consumer via cloud, when the demand request sent by the user through the same methodology. It can also be used to control the load from both the ends with the help of relay circuit. An LCD display is provided to display the readings and to update the consumer's information such as tariff change or sudden power cut. And it is very secured system; it will also help for present irrigation system to turn ON/OFF the motor.

Keywords: *Smart grid application, Cloud based smart grid application, GSM and Text-Web based Electric meter reading system.*

1. INTRODUCTION

Smart distribution automation not only reacts to maintain or restore stability but also evaluates all available mitigations to use "best choice automation." A simple example includes evaluating pre-event demand and supply at all points on the system. Using this information and knowledge to predict near-term demand profile changes leads to a best choice reconfiguration strategy. This creates a solution that mitigates the fault or event and provides electricity free of sags, spikes, disturbances, and interruptions. Since the first Global System for Mobile communications [6](GSM) network started to commission and operation in 1991. The SMS was developed as part of the Global System for Mobile

Communication (GSM) phase2 specification in 1992 as a text paging mechanism in addition to the original GSM voice service. The SMS has extended their service to content providers to deliver a wide variety of services to mobile phone users. SMS is one of the convenient mean of communication especially for reminder, notification, and a short note when the mobile phone user is not expect to answer or respond immediately. With the advancement and booming of IOT (internet of things) and ICT (internet communication technology) makes online information system applications such as e-commerce are gaining more acceptances by the public. The convergence of GSM and IOT network allow more mobile and wireless applications to be implemented such as electricity

meter reading, billing, payment and distribution control.

Now a day's Current electricity billing is done by labor and manual reading from houses to houses shown on Table 1.1. This requires huge number of labor operators and long working hour to achieve complete area billing.

Operator billing are prone to reading error as sometime the houses power meter is place in a location which is hard to read with naked eyes. Labor billing job is sometime restricted and slow down by bad weather condition. The printed billing has the tendency of missing in the mail box. We have very good technology called GSM which can communicates to consumer and provider, and all are aware of GSM mobiles and everyone is adopted to this technology, still require some intervention of human operators to control electric meter reading system, and there is no control on meter.

Table 1.1: Different analysis of cost

Meter reading: Cost drivers	
Cost heading	**Sub cost headings**
Manpower cost	1.Salaries
	2. Risk and insurances
Transportation cost	1. Cost of ownership (Vehicle)
	2. variable cost (Fuel)

With the rapid development of Global System Mobile (GSM) infrastructure and Internet of things (IOT) in the past two decades has made wireless automatic meter reading system more reliable and possible. The GSM Power Meter Reading and Control (GPMC) System takes advantage of the available GSM infrastructure nationwide coverage in the country and the Short Messaging System (SMS) cell broadcasting feature to request and retrieve individual houses

and building power consumption meter reading back to the energy provider wirelessly and the control system will monitor the power of the appliances which consumes more power than its predefined limit. The followings are the objectives of the research project to ensure it meets the aim.

- To design a circuit which continuously monitors the meter reading and sends the message to user and electricity department.

- To design a mechanism that monitors and controls the power of appliances.

2. LITERATURE REVIEW

Problem addressed in [1] Human resource is required to distribute the bill and No guarantee that meter information is sent successfully. Automatic electrical meter reading system contain a small hand held device standalone, which will take reading from analog meter and convert this data into digital data and transmit to the provider. In the data receiving and processing unit meter reading will be collected from the transceiver which is controlled by another microcontroller. There will be a computer application that will take the data from the microcontroller. Problem addressed in [2] Zigbee protocol is chosen as Lower Layer Communication Protocol with these application the standard is optimized for low data rate low power consumption Security and Reliability. At the provider side an e-billing system is used to manage all received SMS meter reading, compute notification to the respective consumer through the SMS, email, web portal and printed postage mailings.. In [3] Author proposed Displacing SIM card from GSM modem to their own GSM mobile.

The emerging applications of the GSM technology is to send power usage reading data, using Short Messaging Service (SMS) to the energy provider as well as service consumers. It is a simple system which is used for measuring electrical bills through wireless communication and sends the information regarding consumed power & also send the dead line for paying of

electrical bill and the system also having the power on/off circuit used to disconnect the power supply to energy meter by using wireless technology when the consumer fail to pay the electrical bill. Problem addressed in [4]. About wireless energy meter reading system along with power on/off circuit. It is a simple system which is used for measuring electrical bills through wireless communication. Again there is a little work to service provider to turn off the services to consumers who did not pay the bill. Presently maintenance of the power is also an important task as the human operator goes to the consumer's house and produces the bill as per the meter reading. If the consumer is not available, the billing process will be pending and human operator again needs to revisit. Going to each and every consumer's house and generating the bill is a laborious task and requires lot of time. It becomes very difficult especially in rainy season. If any consumer did not pay the bill, the operator needs to go to their houses to disconnect the power supply In [5] Author proposed. Hybrid Automatic Meter Reading System, There are three key elements in an automatic meter reading (AMR) system: consumption measurement, meter reading and data transmission, and data processing and billing. An AMR system has to be cost-effective. That means reducing the costs of implementation, maintenance, while providing robust and reliable performance. On top of that, the relationship between the customer and the supplier must be considered. Wireless sensor networks bring advantages in the form of lowering the cost of sensor installation. Lowering the cost is achieved by avoiding the need for cabling, materials and testing which all raise the costs of labor. Secondly, 'the last meter connectivity problem' – cable connectors getting loose, lost misconnected or broken - is no longer an issue . Problem addressed in [6]. ZigBee based electric meter reading system, the system will use ZigBee and GSM system for communication protocol. The ZigBee is used since the application don't need high speed data rate, need to be low powered and low cost. Presenting the remote wireless

Electric Meter Reading System, this aims at resolving the shortcomings of the technology of the traditional Electric Meter Reading, combining the characteristics of the ZigBee technology and IEEE802.15.4 standard. The hardware implementation was designed, and then analyzed the use cases for Electric Meter.

3. PROPOSED SYSTEM

In this section, demonstrated the implementation of proposed system, in this system GSM and Microcontroller will play major roll. Microcontroller will continuously keep track of meter reading information via serial communication interface and compute the billing information and sends to the consumer, or provider (on user demand bases via GSM) or Cloud (without any demand, Hence consumer and provider may access the billing information at any time via TextWeb). GSM will receive the message from the user and sends to the microcontroller to process further, Microcontroller will receive the same message and will convert the message into command and sends to relay controller, on receiving command from the microcontroller the relay will turn on / turn off the home appliances. And also the user can check the status of the home appliances by sending "S" command to the GSM.

3.1 Block schematics:

The figure 3.1 shows the block schematic for the meter side for the measurement of meter reading from the remote location. Microcontroller which is continuously taking the reading from the meter via serial peripheral interface, and calculate the billing information, calculated billing information will have been send to the user (consumer, Provider and Cloud (TextWeb)), and also it will receive the message which is sent by the user side for the request of the controlling the load which is firstly received by the GSM modem, then microcontroller will read the message from the sim card, and will give response as per the request. Request may be, turn on the electric appliance, or turn off the electric appliance or t view status of the electric appliances.
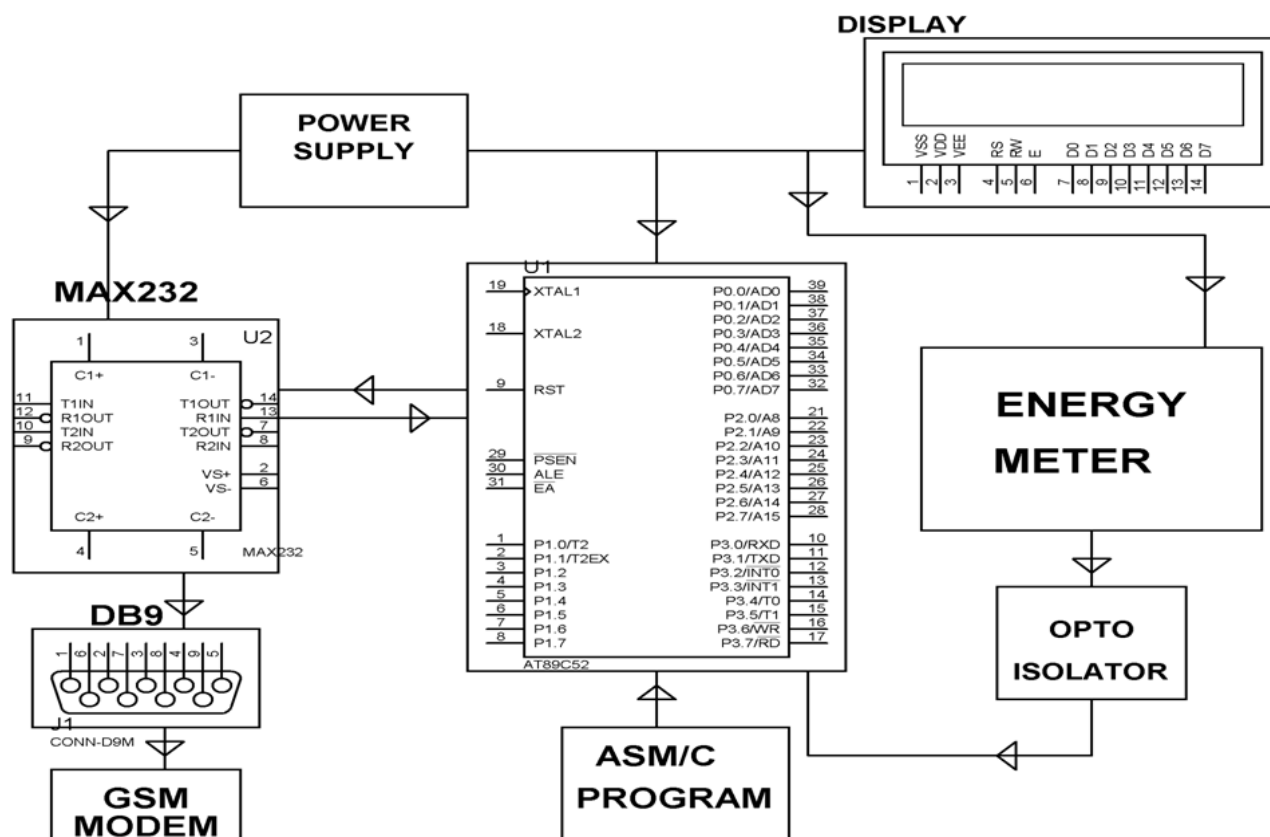
Fig 3.1: Block diagram of Smart meter reading system

3.2 Hardware implementation

A large part of the project involved choosing the appropriate hardware components to take the meter reading from the meter and send it to user and to cloud remotely and to control the power consumption and provide a wireless link. The initial idea was to search for an all-in-one solution that would have all the components integrated, allowing or the smallest size possible. Initially it was thought that a simple circuit could be built and attached to a microprocessor to control the power. But the cost of the circuit with microprocessor is very high. It was decided that designing a simple circuit, with the help of the microcontroller and would provide accurate power controlling and the measurement of meter reading.

3.3 Software implementation

According to the hardware circuit design features, meter reading terminal program flowchart was introduced as shown in figure 5.1. First the system initializes each module, and then reads the meter reading regularly and stores them. After pulse count reaches multiples of 10, system sends the consumed units and cost of consumed unit's information. And if GSM receives any message from user, the microcontroller will read the message and convert it into command and react as per the command. Table 3.1 gives the commands and corresponding reactions. When the Command is even number i.e. mod 2 is equal to zero the microcontroller will send signal to relay controller to turn OFF the reminder of command / 2 load in home appliances. When the Command is odd number i.e. mod 2 is not equal to zero the microcontroller will send signal to relay controller to turn ON the quotient of command 2 load in home appliances.

Table 3.1: commands and reactions

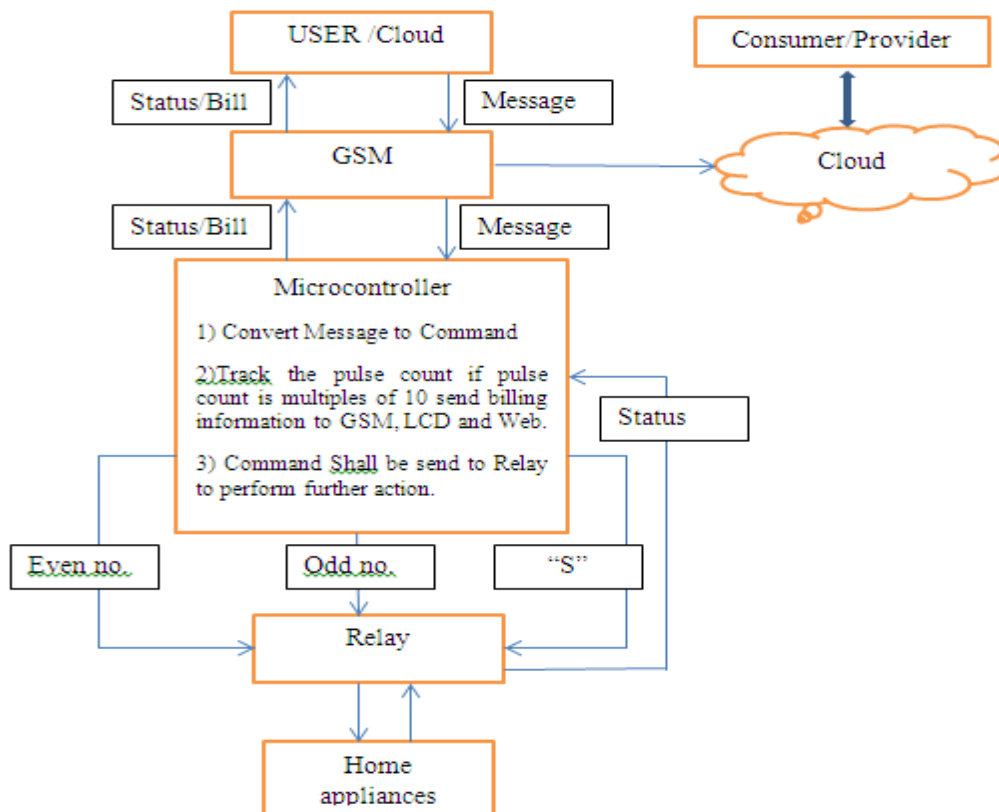| Message	Command	Reaction
"1"	Load1 ON	Send signal ON to relay1
"2"	Load1 OFF	Send signal OFF to relay1
"3"	Load2 ON	Send signal ON to relay2
"4"	Load2 OFF	Send signal OFF to relay2
"S"	Status	Collect the status of home appliance from the relay circuit and send to GSM

4. DATA FLOW DIAGRAM

Fig 4.1: Dataflow diagram of system

5. RESULTS

Fig 5.1 Shows Microcontroller will send billing information to consumer, provider and cloud.

Fig 5.1: Sending Bill info.

Fig 5.2: Shows, Bill information from cloud (TxtWeb)

Fig 5.2: Bill information from cloud

Fig 5.3 Shows controlling home appliances remotely.

Fig 5.3: Controlling Home appliances

6. CONCLUSION

As we have witnessed in the past, the problem of meter reading system is taken care with high security, the presented solution is very helpful in next generation, since here there is no manual work required, and in early system there may be chance of making error while generating bill since probability of manual work is always high, but in proposed we can say it is 100% error free system.

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