NEW DEVELOPMENT IN ENERGY METER READING SYSTEM

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ABSTRACT

Traditional meter reading for any utility consumption and billing is done by human operator from houses to houses and building to building. This requires huge number of labor operators and long working hour to achieve complete area data reading and billing. Human operator billing are prone to reading error, also has errors while recording what was read and during data entry. Hard to access meters at rural accounts, indoor meters, obstacles. Conveying tamper recording remains on the meter reader's loyalty. Also no clue on demand/over drawls by the consumer. If there is delay in meter readings, delay in bills delayed revenue, delay in cash-flow. Hence Automatic meter reading system is used to telemeter the consumption of electricity, gas, water, heat, liquid, oil and steam, since the direct physical access or visual reading of meters are very inconvenient. Automatic meter reading, or AMR, is the technology of automatically collecting consumption, diagnostic, and status data from water meter or energy meter devices (gas, electric) and transferring that data to a central database for billing, troubleshooting, and analyzing. This technology mainly saves utility providers the expense of periodic trips to each physical location to read a meter. Another advantage is that billing can be based on near real-time consumption rather than on estimates based on past or predicted consumption. This timely information coupled with analysis can help both utility providers and customer's better control the use and production of electric energy, gas usage, or water consumption.

KEYWORDS— AMR, Zig-Bee, PLC, GSM

I.   INTRODUCTION

Metering is essential for our modern life. The metering system includes water supply, electricity and domestic fuel etc. The charges incurred by a user can be calculated by using a metering system. For current typical metering system, four steps are usually involved. In the first step, a meter records the amount of water, power and fuel is consumed by the customer. Then, a worker records the reading of meter for each user. After that, the recorded readings input to a computer system to calculate the charge for each customer. Finally, a bill is generated and mailed to each customer. Collecting the meter reading is the most difficult task. A worker from each supplier visits every house regularly to record the reading of meter. The classical approach is simply writing down the reading in a hardcopy and data entries are done manually to the computer system in step 3. Another generic approach is inputting the reading directly to a PDA in a soft copy and later the data entries are done automatically using a program. Some of the meters are installed inside the houses; the worker would encounter more difficulties for recording the reading due to nobody there. As a result, the worker needs to revisit the house. To collect the reading of every customer, the worker also visits house by house. Visiting every customer to collect the reading of meter is the current majority approach for metering. Although the current approach has been used for very long time, it obtains room to improve. First, more manpower is required for current systems because all customers are visited regularly to collect the readings. Secondly, the process is time consuming because the data collection may not be completed in first visit. Finally, accuracy cannot be assured due to human error of incorrect readings.

To improve the efficiency and accuracy of metering, Automatic Meter Reading (AMR) system has been discussed and used for a long time. AMR is the technology of automatically collecting data from water meter or energy metering devices (water, gas, electricity) and transferring the data to a central database for billing and/or analyzing. This means that billing can be based on actual consumption rather than an estimate based on previous consumption, giving customers a better control of their use of electric energy, gas usage, or water consumption[12].

The Automated Meter Reading (AMR) was first design in 1962 by AT&T, which was not successful. After successful experiments, AT&T presented to provide phone system-based AMR services at $2 per meter. The price was four times more as compare to the monthly cost of a person to read the meter-50 cents. Hence the program was considered inexpensively unfeasible. In 1972, Theodore George "Ted" Paraskevakos, developed a sensor monitoring system which used for meter reading capabilities for all utilities.

In 1974, Mr. Paraskevakos was awarded a U.S patent for this technology. In 1977, He launched Metretek Inc., which developed and produced the first fully automated, load management system and commercially available remote meter reading. Since this system was developed pre-internet, Metretek utilized the IBM series one mini-computer. The modern era of AMR began in 1985, when some major full-scale projects were implemented. Hackensack Water Co. and Equitable Gas Go. Were the first to commit to full-scale implementation of AMR on water and gas meters. In 1986, Minnegasco initiated a 450,000-point radio-based AMR system. In 1987, Philadelphia Electric Co. faced with a large number of inaccessible meters, installed thousands of distribution line carrier AMR units to solve this problem[13]. Thus, AMR is becoming more viable each day. Advances in solid-state electronics, microprocessor components and much low cost surface-mount technology assembly mechanisms have been the categories to produce reliable cost-effective products capable of providing the economic and human advantages which justify use of AMR systems on a large, if not full-scale, basis.

In next section II we are presenting the literature survey over the previous techniques based on meter reading. In section III, the proposed system block diagram is depicted. In section IV we are presenting the current state of implementation and results achieved. Finally conclusion and future work is predicted in section V.

II.   LITERATURE SURVEY

Automatic Meter Reading system (AMR) continuously monitors the energy meter and sends data on request of service provider through SMS. That system was allowed to the customers to pay online bill either by credit card, debit card or by net banking is explained by Abhinandan jain et al.[1]. Who has developed fully automatic energy meter having the capabilities   of remote monitoring and energy meter controlling.

In paper [2] (2007) H. G. Rodney Tan et al. introduced working prototype of GAPMR system which is built to demonstrate the effectiveness and efficiency of automatic meter reading, billing and notification through GSM network.

Ashna K, Sudhish N Gorgre proposed system [3] which automatically reads the energy utilized and sends it to the service provider with the use of the existing short messaging services (SMS).

Tian yew lim and tat Wai chan [4] described a prototype automated meter reading system with use of the power lines and frequency shift keying modulation operated in the EN 50065-1 A Band. The system's performance and reliability aspects are presented by them.

M Popa describes an AMR system based on Power Line Communications [5]. Smart meters were connected through a Lon Work type industrial bus to the Gateway. In this The Gateway sends messages to meters and reads the collected information. The communication was, through GSM, with a Data Acquisition Center (DAC) where data is processed.

The data received from an energy meter has been stored in database server which located at electricity board station through SMS gate way for further processing by energy provider, provider further sends electricity bills either by email, SMS or by post. Power lines [6] are readily available and making the full use of them is most desirable for the energy suppliers. These papers presented an investigation of the LV power line characteristics in the A Band of European Committee for

Electromechanical Standardization European Norm (EN) 50065-1 standard for implementation of automated meter reading in dense residential areas.

A. Ali et al. presented AMR using radio frequency technologies [7] provides electric utility service company the opportunity to increase operational efficiency, improve customer services, reduce data collection costs and quickly gather critical data that provide insight to the company decision makers. The existing digital electric meter in the marketing is upgraded by adding RF module to provide remote communication capabilities. Development of an automatic meter reading system based on ZigBee [8], [9] is wireless electric power management and control system. An automatic meter reading system focusing on the design for an energy meter implemented with ZigBee wireless communication protocol conforming to IEEE 802.15.4 standard [9]. Where microcontroller is used to manage energy data and ZigBee to enable communication between the energy meter and data centers. The secure mobile agent concept was presented in [10] which tell that energy meters can be organized in a group based upon the geographical location. In one location energy meters perform their jobs under a security manager. The concept of local mobile agent is proposed to avoid the visit of external mobile agent to energy meters directly. Local mobile agent carries the acceptable queries from security manager and visits energy meters. Embedded energy meter is developed in which [11] maximum demand of energy of a consumer will be indicated in the meter used by the consumer. After exceeding the maximum demand, hence the connection will automatically be disconnected by an embedded system inserted in the meter itself.

III. PROPOSED SYSTEM AND DESIGN

A. Problem Definition

Today's method of meter reading has very much errors, as there is a human intervention. Person from the EB visit each house & take the photograph of meter thus he can take approximately 100 meters photo each day. Next these photos are read to get data from them. If the house is closed person has to revisit that place, some meters are also not accessible. If door is closed for more than 2 months to other way to take reading instead of taking average of previous bills, which is not correct. Again if customer gets faulty bill he has to visit the office, stand in a queue and get it corrected. These problems are just because of human intervention. To avoid human intervention in the billing process, in this new generation, Automatic reading meter system is considered.

B. Proposed Architecture

In this paper, proposed system is discussed as automate the energy meter reading system with the use of camera. This camera is place in front of energy meter of each house to capture image. This image is transferred to server wirelessly. Where it is processed to get digits separate out & to calculate the bill for the month.
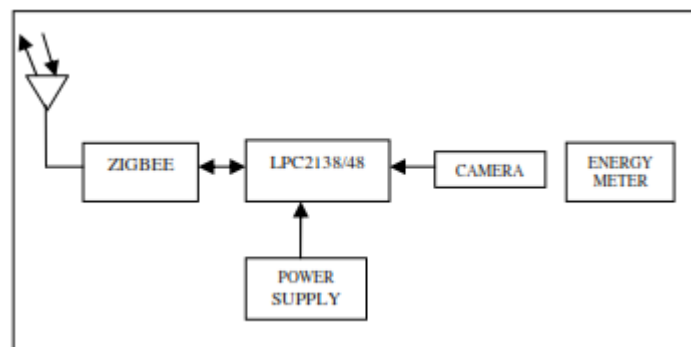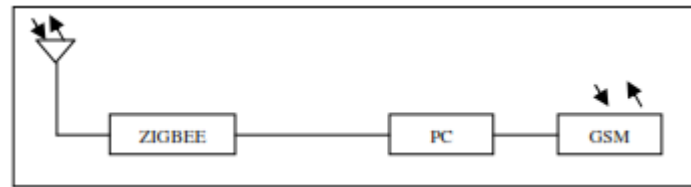

Fig. 1. At user side

Fig. 2. At server side

As a definition automatic meter reading system is a technology which is used to gather data from energy, water and gas metering devices and transfer it to central station in order to analyze it for billing purposes. AMR allow substantial saving through meter re-read, greater data accuracy, allow frequent meter reading, improved billing and consumer service, and consumption update and better deployment of human resource. As a new concept to automate meter reading, here one serial camera C328R is attached in front of energy meter, when command is send from the server PC to capture the image this camera will take the photograph. To transfer this photo data from consumer's meter to the central station, various communication technologies wired or wireless have been proposed, but wired communication has much many problems of noise interference, attenuation & cost of implementation is also high, hence go for wireless including mobile technologies, based on radio frequency, transmission over the power line, or telephonic platforms etc, here ZigBee is used as a communication media. Now this captured image undergoes preprocessing in MatLab at the server side to get digits separate out & used for billing process.

C. Algorithm

1. Start
2. Initialize camera and start communication
3. Capture image with camera
4. Send image to PC
5. Recognize characters/numbers from image
6. Calculate Bill taking some tariff amount.
7. Display GUI with image, Units consumed & Bill amount.
8. Now with respect to previous reading GUI will show the bill.
9. Same reading of bill, previous meter reading & current reading are send as a SMS to customer.
10. Stop

IV.   WORK DONE

For developing the proposed system following things are undertaken.

a)   *Input:*

Input for experimental practice is Image capture from serial VGA camera placed in front of meter.

b)   *Hardware and Software Configuration*

Hardware Requirements:

Processor: Pentium IV 2.6 GHz
Ram: 512 MB DD RAM
Monitor: 15" COLOR

Hard Disk: 20 GB
Software Requirements
Front End: Matlab
Tools Used: Keil µVision4, flash Magic
Operating System: Windows 7/8

c)   Devices: Energy meter, Camera
Microcontroller: ARM LPC 2138/2148
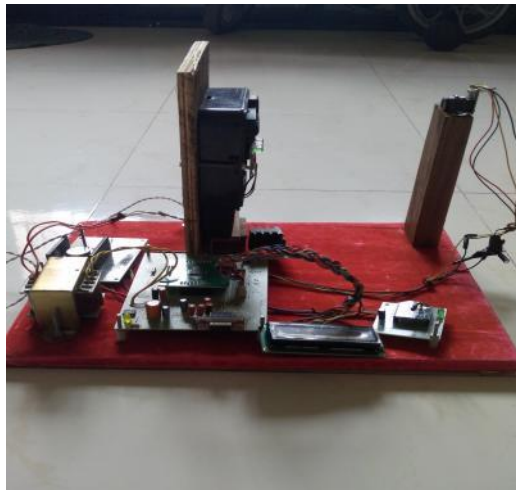Zigbee module, LCD

d) Actual Implementation

Fig. 3. Actual setup of system

Above Fig.3 shows the actual setup of system where serial camera C238R is attached in front of energy meter, which will take the photo of meter when 'capture image' command is given from MATLAB software. This image is transferred to PC through ZigBee using ARM LPC2138 as interfacing device. Now this meter image undergoes preprocessing in MATLAB, to extract separate digits of the meter reading. These digits are correlated with real numbers and meter reading is displayed at the GUI. For extraction of digits from the whole image only the digits plate is cropped it undergoes preprocessing such as rgb to grey, B/W image & then each digits are segmented. After that this each digit is undergoes the process of grid technique to find the value of this digit with previously stored digits database & numbers are recognized easily. This reading is the current meter reading. Now to calculate bill previous reading is subtracted from this reading and multiplied with tariff here it is taken as 4 Rs per Unit, to get actual bill amount which is also displayed on the GUI. This bill is transferred to customer as a SMS along with previous reading & current reading.

e) Results of work done

The final project GUI is as in below Fig. 4 which indicates the meter reading character recognition, will extract the digits and finally meter reading is shown as units. After calculation of previous meter reading with actual meter reading along with tariff will show the result as a bill amount.

For taking different readings rotate the disc of the meter placed at the end of the digits which will change the reading display on the meter which will be the second month meter reading photo or second customer energy meter photo.

Fig. 4. Result GUI

V. CONCLUSION AND FUTURE WORK

In this paper with the help of presented proposed system it is possible to avoid meter reader visit and revisit (if there are any problems in billing) to each house to take reading. Also if consumer gets

faulty bill he has to go to MSEB office to correct it and be in long queue. This is avoided here by taking photo of meter reading with camera located in front of meter and sending these readings to server wirelessly, keeping the database updated which is hard to maintain now a day's manually.

In future to reduce cost it may be possible to use single camera for each society or whole apartment energy meter room.

REFERENCES

[1]. Abhinandan Jain, Dilip Kumar, Jyoti Kedia, "Smart and intelligent GSM based automatic meter reading system", International Journal of Engineering Research & Technology (IJERT), ISSN: 2278-0181, Vol 2, Issue 3, pp. 1-6, May 2012.

[2]. H. G. Rodney Tan, C. H. Lee and V. H. Mork, "Automatic power meter reading systems using GSM network", IEEE, 8th International Power Engineering Conference, pp. 465-469, 2007.

[3]. Ashna K, Sudhish N Gorgre, "GSM based automatic energy meter reading system with instant billing", IEEE International conference held at Kottayam, pp. 65-72, 2013.

[4]. Tian yew lim and tat Wai chan, "Experimenting remote kilowatthour meter reading through low voltage power lines at dense housing estates", IEEE Transactions on Power Delivery vol. 17, Issue 3, pp. 708-711, Jul 2002.

[5]. M.Popa, "Gateway design and implementation in an automatic meter reading system based on power line communication", 7th International Conference on Networked Computing and Advanced Information Management (NCM), pp. 295-298, 2011.

[6]. G Thavasi Raja and T.D. Sudhakar, "Electricity consumption and automatic billing through power line", International Power Engineering Conference (IPEC), pp. 1411-1415, 2007.

[7]. A.Ali, N.A. Razali, N.H.Saad, N.Vitee, "Implementation of Automatic meter reading using radio frequency module", IEEE International Conference on Power and Energy (PEcon), pp. 876-879, Dec 2012.

[8]. Guilin Zheng, Zhifu Zhang, "Intelligent wireless electric power management and control system based on ZigBee technology", International Conference on Transportation, Mechanical, and Electrical Engineering (TMEE) Changchun, China, pp.1120-1124, December 16-18, 2011.

[9]. Champ Prapasawad, Kittitach pornprasitpol, Wanchalerm pora, "Development of an automatic meter reading system based on ZigBee pro smart energy profile IEEE 802.15.4 standard", International Conference on Electronic Devices and Solid State Circuit (EDSSC), pp.1-3, Dec2012.

[10]. Najmus Saqib malik, Friedrich kupzog, Michael Sonntag, "An approach to secure mobile agents in automatic meter reading", IEEE, International Conference on Cyberworlds, computer society, pp. 187-193, 2010.

[11]. Subhashis Maitra, "Embedded Energy Meter- A new concept to measure the energy consumed by a consumer and to pay the bill", Power System Technology and IEEE Power India Conference, 2008.

[12]. Priya Kamble, Sonali Bodkhe, "A new approach for design and implementation of AMR in Smart Meter", International Journal of Advanced Engineering Sciences and Technology, Vol. 2, PP. 57-61, 25April 2011.

BIOGRAPHIES

Manisha V Shinde born in India on 9th Feb 1984. She received BE (Electronics) degree from Shivaji University in 2006. She is doing her ME(E&TC) VLSI & Embedded Systems from Pune university. Her research interest includes automatic & wireless billing system for energy meter.

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