

## Automated wireless meter reading system for controlling power consumption

Myilsamy K.

Kongu engineering college, Erode.

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### ABSTRACT

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*This paper describes about the implementation of wireless automatic electric meter (AMR) network, implementing based on Zigbee technology for reduced power consumption. Wireless Electric meter is used for the collection of unit count and it is evolved from traditional meter reading scheme and power theft from the transmission line. This wireless automatic reading technology saves human resources and improves the accuracy. Zigbee is used as communication protocol since the application don't need high speed data rate, need to be low powered and low cost. Reduced power consumption can be effectively achieved and this system focussed to implement in a building or in an office.*

**KEYWORDS-** zigbee technology

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### I. INTRODUCTION

With the development of country's economy and the improvement of national power, the power requirement is still ever increasing due to use of improper power management systems and the conventional energy metering systems. Over the past years, metering devices have gone through much improvement, and are expected to become even more sophisticated, offering more and more devices. Meters in the past, and today in a few countries, were electromechanical devices with poor accuracy and lack of configurability. Theft detection was also a challenge. Such meters are limited to providing the amount of energy consumption on site.

Recent developments in this direction seem to provide opportunities in implementing energy efficient metering technologies that are more precise and accurate, error free, etc. The implementation of Wireless Automatic Meter Reading System (WAMRS) provides with many features as compared with the analog utility meter reading with man power.

Automatic electric meter reading system is one method reading and processing data automatically with computer and communication. It is the need of improving the automatic level of energy consumption and the necessity of rapid development of computer and communication technology too. It can relieve reading person's labour intensity, reduce the reading mistake, but also has the advantage of high speed and good real-time. AMR requires smart meters. AMR requires specific infrastructures. It is convenient to implement wireless electric meter by interfacing Zigbee module with the digital electronic meter. All digital electronic meter along with Zigbee module can form a network.

Zigbee technology is emerging following the Bluetooth. It is a short-range, low power, low cost and low complexity of wireless communication technology. The technology is applies value in the home automation, building automation, industrial control and industrial areas of logistics. Zigbee uses a FM technology and spread spectrum technology to work in the 2.4GHz ,Zigbee technology can transmit 10 meters in the outdoor, while in the outdoor transmission can reach 200 meters; The actual distance will be based on the size of transmission power. Here Zigbee is chosen as lower layer communication protocol. With these applications, the standards optimised for low data rate, low power consumption, security and reliability.

### II. RELATED WORKS

The involvement of smart meters in measuring and managing utilities has been described in other scientific papers too.

Reference [1] presents the data collecting in an advanced metering infrastructure system. The meters are connected to power lines through meter interfaces and send data to the gateway which is built around the Echelon PL3150 microcontroller. And it is specialised in communicating on low voltage lines. Gateway sends wirelessly the collected data to a central computer. It offers the advantage of IT infrastructures to monitoring energy consumption.

Reference [2] presents a wireless remote meter reading system is designed through analysis and experiments. The system combines the zigbee technology with the GPRS network. It is using an important PIC microcontroller by CC2430 to do communication in short distance and SIM300 to achieve communication function in long distance, using RS-232 communication link. This system has low cost and a little power consumption.

Reference [3] presents an electric meter with base station and will send utility data such as unit count and receive bill for that unit count. This system consumes less power to set the network by designing like this.

Reference [4] presents a novel AMR system based on IEEE 802.15.4 compliant wireless networks is proposed. Data collection can be done in a star topology or peer to peer topology. The peer to peer solution was chosen due to its increased flexibility and robustness.

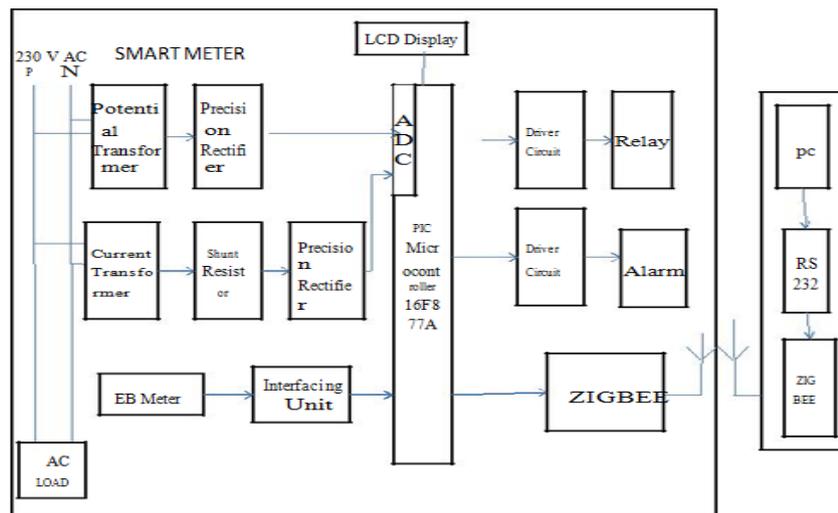
Reference [5] presents the design and implementation of a smart power meter. It is based on a microchip dsPIC30F microcontroller and on the zigbee interface for sending the data.

The system described in this paper uses zigbee for connecting smart meters to the server unit and zigbee technology enables to make a communication between the server and remote unit. PIC Microcontroller 16F877A is used as the system needs ADC for converting the analog signals to the digital signals.

### III. PROPOSED SYSTEM

The proposed system deals with a wireless energy transmitter with tariff system through microcontroller. It can explore new possibilities for the next generation Automatic Meter Reading whose goal is to help collect the meter measurement automatically and possibly send commands to the meters. Wireless Smart Meter which is fixed on the remote unit will send the power units which are consumed to the server unit whenever a query commands sends. The main aim of this system is to reduce the power consumption by collecting datas from the smart meter through zigbee technology and controlling over the each smart meter in the remote unit. And theft detection was also a challenge. In the server unit Personal computer is connected to the zigbee through RS 232 serial communication cable.

(a) Block Diagram



The system is designed by following blocks

- Digital EB meter
- Potential Transformer
- Current Transformer
- Microcontroller
- LCD display
- Zigbee

There are three input parameter in the system. They are voltage sensing potential transformer, current transformer and the digital energy meter. The potential transformer is used to step down the voltage and it is given to the precision rectifier which converts AC to DC without loss. Then the digital voltage signal is fed to the ADC of the microcontroller, the ADC converts analog to digital signals, then the microcontroller processes the digital values. The current transformer senses the current and gives the appropriate current to the precision rectifier. A shunt rectifier is connected between current transformer and precision rectifier to convert the current to the voltage signal. Then signal from the precision rectifier is given to the ADC. The digital meter is interfaced with the controller through an interfacing unit. The microcontroller calculates the units of energy consumed and transmits the messages through the zigbee interface. The PC receives the value from the zigbee through RS 232 interface and It calculates the amount of unit consumed by each customer and the database stores the appropriate information. The LCD display in the controller displays the information and the unit consumed. The relay is used to shutdown the supply when the consumer is left unpaid.

#### **A. Zigbee Technology:**

It is short-range, low power, low cost and low complexity of wireless communications technology. When using the 2.4GHz band, ZigBee technology can transmit 10 meters in the indoor, while in the outdoor transmission distance can reach 200 meters.

The XBee and XBee-PRO OEM RF Modules were engineered to meet IEEE 802.15.4 standards and support the unique needs of low-cost, low-power wireless sensor networks. The modules require minimal power and provide reliable delivery of data between devices. The modules operate within the ISM 2.4 GHz frequency band and are pin-for-pin compatible with each other.

#### **B. PIC Microcontroller:**

A microcontroller is a kind of miniature computer that you can find in all kinds of Gizmos. The microcontroller that has been used for this project is from PIC series. PIC microcontroller is the first RISC based microcontroller fabricated in CMO that uses separate bus for instruction and data allowing simultaneous access of program and data memory. . Easy Programming and Erasing are other features of PIC 16F877.

DEVICE	PROGRAM	DATA	DATA
	FLASH	MEMORY	EEPROM
PIC 16F877	8K	368 Bytes	256 Bytes

### **IV. RESULT ANAYSIS**

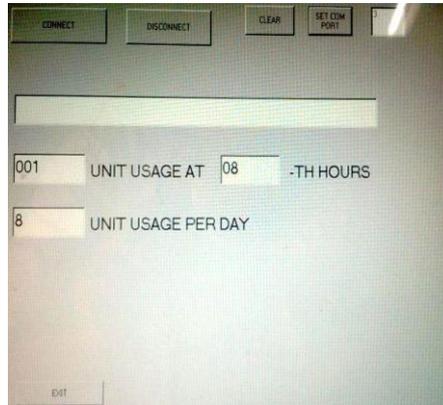
In this section, we demonstrated the experimental results of the proposed system. The monitoring and management interface of the wireless automatic meter reading system in this research is coded with the Visual Basic Program language developed by Microsoft

It consist of different blocks like microcontroller block, zigbee, precision rectifier, EB meter to calculate power consumed, current and voltage transformer for calculating voltage and current in use. At the server end, it receives electric meter data and the load was connected. It transfers measured data by Zigbee module in RS-232 communication format to complete the automatic wireless meter system. The user can monitor the power consumption details on the LCD. The system communicates with the remote station through communication module. Depending on the information received from the remote station, the 16LF8A can control the Relay module to shut off or resume the electric power supply. Outputs of average real power information based on the load are displayed on the LCD. Depending on the data received from the energy meter module, it sends information of the user meter to remote place through wireless communication module. In addition to that, the same information is sent to the user through LCD. In the Load bank section, a 60W incandescent bulb is used as a load for the purpose of energy consumption of the user.

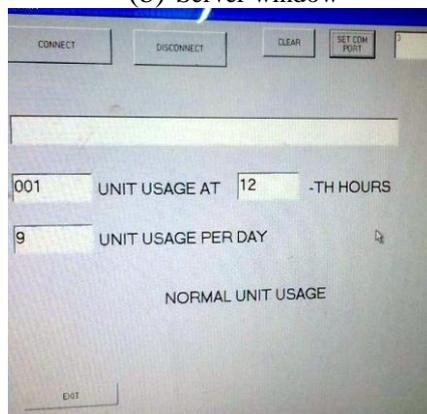


(a) Hardware architecture

The electric meter, measures amount of power and this data is then send to PC via RS 232 communication format. For demonstration purpose, 60Watt bulb is used as load to examine our system. The bulb is connected to load and the Energy meter which is used to measure the average real power information. The test is performed and power consumption is observed. For demonstration 10 seconds is considered as one hour. During this period the bulb glows continuously. After every hour, the power consumed by the remote unit is recorded at the server. Initially, the value displayed will be zero and it exceeds according to the power consumption.



(b) Server window



(c) server window

When the power exceeds the reference value, a warning is sent to remote unit and the warning is also displayed on the LCD. For this experiment, reference value is considered as 30 units. When the warning is generated the user can click on the disconnect option for disconnecting the system or can click on the connect option for enabling the power consumption by the remote unit. The reference value can be changed to 40 units by using another microcontroller, programmed to a reference value of 40 units. The warning generation can be shown by using a 600 watt bulb instead of 60 watt bulb. After the generation of warning controller can turned off

the bulb through the relay.

## **V. CONCLUSION**

An economical prototype of Wireless automatic reading system has been developed to continuously monitor the meter and to shut down the power supply remotely whenever the consumption exceeds than the reference value. The technology has strong market competitiveness. Moreover, no cabling is required with relatively economically investment. Xbee makes this system low costless power consumption, secure and reliable. ZigBee wireless meter reading system uses short-range wireless communication and computer network technologies to read and process metering data automatically. This system can not only reduce the shortcomings of traditional metering system but will reduce manpower requirements. It avoids the human intervention, provides efficient meter reading and reduce the maintenance cost The proposed system hasan advantage that the embedded system is not dependent on the GSM module.

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