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Automated Utility Meter Reading Using Wireless System Bluetooth with MSP430 Microcontroller

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ABSTRACT

This paper is focused on the description of the possible benefits for the electric utilities and residential customers from the automatic meter reading system usage. AMR is always seen as away to read consumption without visiting every meter. Major benefits of the AMR, mentioned in this paper are power quality monitoring, distribution network management, theft detection and so on. The present system in India is obsolete and time consuming and it has major drawbacks. So we are proposing a system is that Automatic Meter Reading System using MSP430 Microcontroller which becomes fully automated and communication is made possible via Bluetooth network.

The electricity meter present in each house is connected by wireless network Bluetooth with the Electricity Billing Office which periodically gets updates from the meter. The Electricity Billing Office using a backend database calculates the amount to be paid according to the number of units consumed and sends it back to the meter for display and also we can see the bill detais in the mobile Bluetooth terminal. The advantages of the proposed system make the existing system incompetent. The new system is user friendly, easy to access and far more efficient than the existing system.

Keywords: MSP430F5529 Board, Bluetooth Module, Mobile Phone, LCD Display.

INTRODUCTION

This paper is to make use of new modern technologies and implement them into more practical fields. Our paper deals with the implementation of wireless networks in the field of electricity billing. We can make use of this technology to such an extent such that even complex problems can be handled in a easier way. Wireless networks are the eminent futuristic replacement of cables and power lines that connect every household in a particular area. This type of networks can also be used for creating emergency response networks. Our paper eliminates the need for employing electricity billing meter readers and this set of employers can be used elsewhere.

AMR is the technology of automatically collecting consumption, diagnostic, and status data from energy metering devices and transferring that data to a central database for billing, troubleshooting, and analysing. 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 consumption.

The AMR system is also able to provide a set of different services, which are useful for the utility companies in their operation and planning and maintenance, they are load management, outage and fault reporting, customer services, power quality monitoring, network management , theft detection , billing, balance settling, energy settling, assest management, energy usage information, interruption reporting etc.

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LITERATURE REVIEW

This method can eliminate the problems such as manpower requirement for billing and errors during calculation etc., and can provide necessary information such as tariff variation and due date for payment etc. to the consumer through the wireless medium. The wireless technology can be implemented by having a Bluetooth enabled transceiver interfaced with the electricity billing section server as well as in the consumer side.

Existing System

A Bluetooth Advanced Metering infrastructure is a existing one for automatic meter data collection and energy auditing and management. In this the system operates with multiple channels and frequency hopping and coexists with potential interferers. In this method if any tariff variation occurs, the new tariff rate will be changed only through reprogramming the controller otherwise the previous tariff rate will be displayed on the LCD display. This may cause major problems in billing. Here, there are no intimations given by the electricity board to the consumers about the status of energy consumption. There are no details about the previous month's consumption and the amount of bill paid. We are focusing about these draw backs and overcome in our project Automatic Energy Meter through wireless smart meter using Bluetooth.

Proposed System

In order to overcome the above mentioned drawbacks, we are proposing a new method automatic energy meter through wireless system Bluetooth with MSP430 Microcontroller which is having the advantages such as no need of manpower, errorless tariff calculation, tripping can be done from the electricity billing side in case of not paying the bill and intimation about tariff variation, amount to be paid and due date for payment.

This system is designed with two modules which are as follows:

- Consumer module in the system
- Electricity Billing Office module in the system

Consumer Module

The consumer side is equipped with energy meter, MSP430 controller, LCD display, indication unit (can be an indication lamp). The controller continuously monitors the energy meter reading and calculates the amount till last usage. These details can be viewed in the LCD display and also it will be sent to the Electricity Billing Office server during each month through the Bluetooth transmitter. The indication unit is provided for the attention of the consumer in case of exceeding normal usage, delaying the payment and in case of any tariff variation by the Electricity Billing Office.

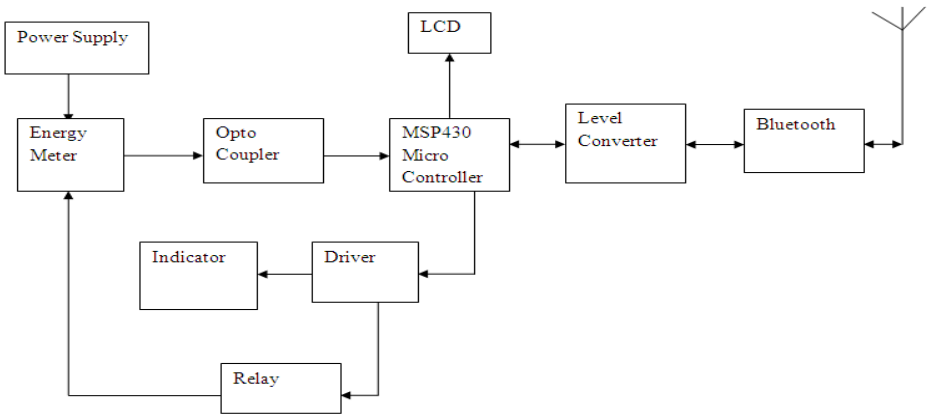

Figure1. *Consumer Module*

Working of Consumer Module

The home module is designed to work as follows. The LED, which indicates the consumption of energy, is replaced by an opto coupler which produces pulses as energy is being used and transfers to the MSP430 microcontroller. The counter which counts the number of times the LED blinks and sends the data to the MSP430 microcontroller. This is received by the controller as an external interrupt. The controller is so programmed that it calculates the amount based on the number of units consumed. These details will be displayed on the LCD panel attached to the home module too. A key button is provided in the LCD display with EEPROM memory which can provide the details of previous month's payment and energy consumption to the consumer. The indicator lamp attached nearer to the LCD display will indicate the overset limit range. A relay is attached to each and every home module which plays the major role of tripping the connection, if the bill is not paid in time. Thus the relay acts as a switching device. The Bluetooth transceiver, which is a wireless communication module, transmits the details calculated by the microcontroller regarding the usage of energy to the electricity board office once in a month. Thus this methodology reduces the manual effort to a great extend. Electricity Billing Office can give information about the tariff variation to the consumer, as notification on LCD display with lamp indication.

Electricity Billing Office Side Module

The Electricity Billing Office module consists of a database at the back end for storing values which are got from the home module via Bluetooth. After the values are got from the home units the cost is calculated and the values are sent back to the home unit and they are displayed in the LCD display for the user to make to make note of it. Also the cost and amount of units are sent as a SMS to the customer's mobile phone. The data's are transmitted and received using Bluetooth. There is an encoder and decoder both at the central office and also at the individual home units. This facilitates secure transmission and reception in the system.

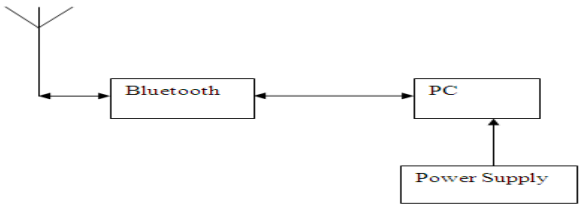

Figure2. *Electricity Billing Office side Module*

Working of Electricity Billing Office Side Module

The Electricity Billing Office side module is designed to work as follows. The receiver module is interfaced with a system which is monitored by the officials in the electricity board. The Bluetooth transceiver on the Electricity Billing Office module receives the data and displays it in the terminal C window of the system interfaced with it. The home module will be reset by the Electricity Billing Office officials as the bill is paid. The thing to be noted here is that only when the command is given, board will supply power to the particular customer. Else the supply will be disconnected until the payment of the bill. There by we contribute a small part to prevent the power crises as well.

HARDWARE IMPLEMENTATION

Wireless Smart Metering Module

Two parts of the wireless smart metering system are the smart metering module and the Monitoring module. The smart metering module consists of a MSP430 core and a Bluetooth module. The

MSP430 core collects data from the electrical appliance with the help of suitable integrated sensors. Then it uses the Bluetooth module to send the collected data to the monitoring module. There is a Bluetooth module connected to the computer via a serial communication port in the monitoring module. Bluetooth module uses chip antenna to send and/or receive data. On the other hand, RS-232 serial communication interface is established between the Bluetooth module and the computer. It is also possible to use the USB port with the help of a serial port to USB converter.

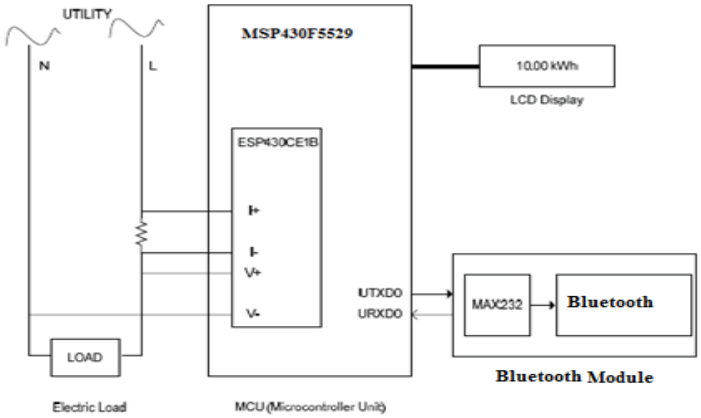

Figure3. *The hardware diagram of wireless smart meter*

Monitoring Module

The Bluetooth device in monitoring module is responsible for receiving the energy data from wireless smart meters and transmitting the request command from control centre to wireless smart meter. Communication is performed between Bluetooth module and control centre by RS232 serial communication. Also the collected energy data can be sent to the utility companies via internet by a network gateway in monitoring module.

MSP430F5529

The microcontroller MSP430F5529 series is an ultra-low-power mixed signal microcontrollers with built-in 4x16-bit timers with PWM capability, up to 40 I/O pins, a 12 channel comparator, and built-in communication capability using the universal serial communication interface. In addition, it also has a 12-bit analog-to-digital (A/D) converter. It is the heart of the circuit, holds the logic to run each of the peripherals.

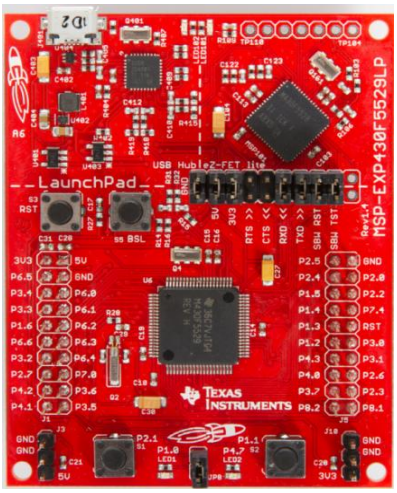

Figure4. *MSP430F5529 launch pad*

SOFTWARE IMPLEMENTATION

Code Composer Studio

CCS is the integrated development environment for TI's DSP, microcontroller and application processors. It includes compilers for each of TI's device families, source code editor, project build environment, debugger, profiler, simulators and many other features. Following are the steps for implementing application.

- Open CCS and select a workspace directory.
- Select project > import existing CCS/CCE eclipse project.
- Make sure the project is selected and click finish.
- Build and Deugg the code on MSP430F5529.
- Connect "eZ-FET" USB to the PC.

PROCEDURE AND RESULTS

Procedure

MSP430 collects the data from electrical appliances with the help of particular sensors. Bluetooth network will send all this data to the central office with the help of antenna chip. At the central office there is one more Bluetooth network to receive the collected data after receiving the data will be modified and the modified data will be sent back to the customers house which will be displayed on the LCD and customers mobiles.

Results

Figure5. *Wireless Metering System When Power is Off*

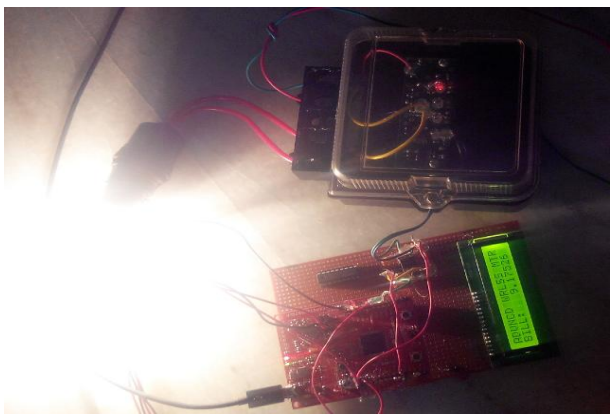

Figure6. *Wireless Metering System when Power is ON*

ADVANTAGES

- Accurate meter reading, no more estimates.
- Improved billing.
- Accurate profile classes and measurement classes, true costs applied.
- Improved security and tamper detection for equipment.
- Less financial burden correcting mistakes.
- Less accrued expenditure.
- Improved procurement power though more accurate data-"de-risking" price.
- In case of shortages, utility will be able to manage/allocate supply.

CONCLUSION AND FUTURE SCOPE

Conclusion

This proposed automated metering system includes an office module which has a PC with its back end connected to a database. The other module is the customer home module which is present at the home this module is used to make note of the amount of power consumed by the customer and it sends the PC which is present in the billing office. This Electricity Billing Office module calculates the data and sends it to the customer along with the due date. The customer also gets details of the bill on his mobile phone through which he can pay the bill.

Future Scope

In future phase of this project, you will be able to view your daily energy usage, at your convenience, by logging in to your account on website. Knowing both how you use energy, and when, will allow you to decide what energy-saving changes you would like to make. You can always check our website for current information, and the Texas power magazine will continue to provide information on when new options are available.

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