Abstract

Presently electronics energy measurement is continuously replacing existing technology of electro-mechanical meters especially in China and India. By the year 2004, digital meter will start replacing electromechanical meters in Singapore. A wireless digital energy meter will definitely offer greater convenience to the meter reading task. Bluetooth technology is chosen as a possible wireless solution to this issue. In this paper, we present the design and implementation issues of a Bluetooth-Enabled Energy Meter. The Energy Reader can collect the energy consumption reading from the Energy Meter wirelessly based on Bluetooth. Two methods, which can retrieve the meter reading with little human intervention, are proposed and implemented in the targeted applications. They are AMR (Automatic Meter Reading) and the APM (Automatic Polling Mechanism). Few commercial applications are suggested to apply for the Bluetooth-Enabled Energy Meter.

We have successfully implemented the Bluetooth-Enabled Energy Meter for these suggested commercial applications to demonstrate the advantage of reading the electricity consumption wirelessly via Bluetooth technology.

Key words: Bluetooth, wireless data, and energy meter.

1. Introduction

Presently electronics energy measurement is continuously replacing existing technology of electro-mechanical meters worldwide. A wireless digital energy meter will definitely offer greater convenience to the meter reading task. By the year 2004, digital meter will start replacing electromechanical meters in Singapore. A wireless digital energy meter will definitely offer greater convenience to the meter reading task. Bluetooth technology [1] is chosen as one of the possible wireless solutions to this task at hand.

2. Design of Wireless Electricity Meter

In the beginning of the development stage, PC is used as a Meter Reader. We later implement the Meter Reader into some commercial application, e.g., .... The interface between a Meter Reader, PC, and the Energy Meter, via a Bluetooth link, can be categorized into three main distinctive portions as shown in Fig. 1. The first portion consists of the interface between a PC and the Bluetooth radio module. The second portion comprises the interface between the Bluetooth radio module and the micro-controller. The interfaces in the first portion and second portion are both using the standard RS232 protocol. And finally, the last portion would be the interface between the micro-controller and the Energy Meter, whereby the communication link is conforming to the Serial Peripheral Interface (SPI) standard. The digital photo of the developed Bluetooth-Enabled Digital Energy Meter is shown in Fig. 2.

In order to facilitate the work of retrieving the meter reading with little human intervention, two useful techniques are developed. They are:

1. AMR (Automatic Meter Reading) - AMR is a feature whereby the Bluetooth Energy Meter sends the recorded power consumption of a household in
the certain interval of time to a ‘wirelessly’ connected Energy Reader. When the wireless link between the Energy Reader, e.g., PC, and a Bluetooth energy Meter is set up, the PC will send a “start” command to the Energy Meter. Upon receiving this command, the Energy Meter will start sending the energy consumption value of the particular household periodically. The transfer will stop when the PC send a “stop” command to it.

2. APM (Automatic Polling Mechanism) - APM is a feature whereby a Master (PC) will poll each and every individual Bluetooth Energy Meter automatically (in the certain interval of time) in order to get the meter reading of the corresponding household. The Master will then have a record of all the energy consumptions for all the households.

As these two features facilitate the work of retrieving the meter reading with little human intervention, it helps to save the cost and time as compared to the conventional method of getting the meter reading by people. We believe these two features will greatly enhance the commercial value of a Bluetooth Energy Meter.

The Microchip micro-controller is being chosen as solution to integrate between the BlueEZ and the Energy Meter. The Microchip micro-controller, which supports both the UART and SPI, has become a middleman between the BlueEZ module from CSR and the Analog Devices ADE7756 Energy Meter. The BlueEZ platform is shown in Fig. 3. CSR is the Bluetooth world leader, who has 60% of market share of all qualified Bluetooth design. And, the Analog Devices is the long-standing market share leader in high-performance analog technology. With the integration of both CSR Bluetooth BlueEZ module and Analog Devices ADE7756 energy meter, an inexpensive and reliable solution is provided. Besides, a simple but yet attractive reader GUI is designed as depicted in Fig. 4.

Targeted applications were written in order to demonstrate the advantage of a Bluetooth-Enabled Energy Meter. Applications written include the two main mechanisms, the AMR (Automatic Meter Reading) and the APM (Automatic Polling Mechanism).

3. Possible Commercial Applications

In previous section, the set up is based on a PC and the wireless Energy Meter. In this section, we suggest three ways to set up a complete Bluetooth-Enabled Energy Meter System for commercial applications. (Are these commercial have been implemented and demonstrated in the project, if so, please mention). They are presented as such: -

- PDA as a Reader
  Instead of using PC as an Energy Reader, PDA can be used. Fig. 5 demonstrates the idea of using a PDA to read the energy consumption of each household by a metering man. All this man has to do is to walk along a residential area and use the PDA to retrieve the energy consumption of each household automatically.

- Data Collection via Fixed-line Telephone Network
  By proper configuration to the Bluetooth-Enabled Energy Meter, it is possible to send the energy consumption data to the energy service provider via the existing fixed-line telephone network. The Energy Meter will have to utilize the dial-up service of a Modem in order to connect to the telephone network as illustrated in Fig. 6. In this case, the Modem can be used as an Energy Reader and be equipped with the Bluetooth technology.

- GSM Modem as a Gateway
  By using this method, each residential flat unit in a high-rise building needs one Bluetooth-Enabled GSM Modem as shown in Fig. 7. The GSM modem will serve as a gateway for all the Energy Meters in that high-rise building. At a specific time, each Energy Meter in each residential flat unit will try to contact with the GSM modem and then send its meter reading to the service provider.

4. Conclusions

In this paper, we present a design of a Bluetooth-Enabled Energy Meter to read the energy meter wirelessly. Two features, which can retrieve the meter reading with little human intervention, are proposed and implemented in the targeted applications. They are AMR (Automatic Meter Reading) and the APM (Automatic Polling Mechanism). The design is based on CSR Bluetooth BlueEZ module and Analog Devices ADE7756 energy meter to build an inexpensive and reliable Bluetooth-Enabled Energy Meter system.

We have successfully implemented the Bluetooth-Enabled Energy Meter for several suggested commercial applications to demonstrate the advantage of reading the electricity consumption wirelessly via Bluetooth technology. It definitely helps to save cost and time as compared to the conventional method of getting the meter read
References

**Fig. 5:** PDA as an Energy Reader

**Fig. 6:** Data collection via fixed-line telephone network.

**Fig. 7:** GSM modem as a gateway.