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Energy Meter Reading Load Balancing Using LoWPAN Node

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Abstract: The constant advancement in the world of wireless communication has led to the advent of low power wireless networks that have been deployed successfully to meet their purpose. The standard for these Low Power Wireless Personal Area Networks (LoWPANs) is the IEEE 802.15.4. This standard has been instrumental in bringing in a sense of realization to the information that was at once only possible to envision. The objective of this study is to give an insight on a possible design for the energy meter information of a device that can be visible and recorded in to the realization. The design implements the usage of two LoWPAN energy devices. LoWPAN node1 is intended to be used with the microcontroller. Once the analog data from the energy meter is received by the microcontroller, data will be transferred to the LoWPAN node1 serially. The two pan nodes are interfaced wirelessly as a full duplex communication. The LoWPAN node2 is interfaced with the personal computer through Ethernet followed by embedding it through the IP address assigned to it.

Key words: LoWPANs, energy meter, PIC microcontroller, IP address, Ethernet

INTRODUCTION

In the recent years the demand increases, flexibility, mobility, reduce cost, etc. has resulted in increased demand for wireless communication and it spreads in the environments like office, homes, factories, agricultural, educational, almost in all the places LoWPAN wireless personal area networks are deployed. The aim of this study is to enhance the wireless transmission through the low consumption of energy in the wireless transmission and connected to the internet.

Today in the development of modern economic and the intelligent improvements the demand increases among the people and the trend becomes inexorable which paves the way to the automatic meter reading (Hao and Song, 2005). The study discuss about the visions of energy meter which concerns about how the meters and metering systems is presently working and how can it be improved. Experiencing the remote reading meters and their values makes the system more easy and clear visibility. The data base updating system is maintained in the wireless communication and it can be connected to the internet while connecting to the LoWPAN. A networked remote meter reading system based on the LoWPAN wireless communication technology is deployed.

The remote meter reading system mainly focuses in the design of the intelligent system which is used to acquire the information and can control the energy consuming and can be controlled in the network all around.

The design system has two LoWPAN nodes like LoWPAN node1 and LoWPAN node2. The device1 gets the information from the energy meter through a microcontroller and then the data is transferred to device2 through wireless communication indeed it is connected to the internet through the IP address assigned for that particular lowpan node and where the energy meter reading can be accessed by the user remotely from anywhere.

The ON/OFF condition of the energy meter can be controlled remotely by accessing the IP address through internet. The IEEE 802.15.4 is designed to work in the short distance networking (Gutierrez *et al*., 2004) with the low consumption of power and in the required data rate form and also the low band width and low transmit power. Researchers are going on in the process of integrating the LoWPAN with wired and wireless IP communication.

IEEE 802.15.4 works in the operating range of approximately up to 20 m, the bit rate is up to 250 kb sec^{-1}. It is mainly designed for the low-power access specification. The above mentioned IEEE standard generally communicates in the low cost node in the large geographical area which is widely used in the embedded applications.

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Literature review: IEEE 802.15.1 (Bluetooth) wireless link technology falls under the WPAN. Within the limited number of nodes and the small range, the blue tooth technology results a high throughput technology. IEEE 802.15.3 overcomes WPAN, results in more outputs and more nodes with the extended throughput. IEEE 802.15.4 supports low data-rate low cost and 65000 nodes. It also reduced complexity with eight-bit microcontrollers having 8 kbytes of RAM. The point to point communication in a single hop has been done by Bluetooth over Bluetooth Network Encapsulation.

It explains about the remote meter reading system of the power companies which introduces GPRS Remote Meter Reading Model with Web Services technology. The efficient integration and cross-system co-operation among the heterogeneous information systems is realized on this basis. Using the java networking language protocol the researchers, deployed and maintained the entire system using the wireless technology like GSM/GPRS, the real time front end based on the java multithreading technology (Wei *et al*., 2009). This study explains about the low power wireless networks differs from the different environments like home automation system, wireless sensors network like health monitoring like hospitals (Delaney *et al*., 2009; Pottie and Kaiser, 2000).

This study explains the GSM automatic power meter reading which is installed in each consumer unit. Each meter reading is sent wirelessly to the energy provider through the mobile service in the form of SMS service. At the server side the e-Billing System is used to manage the SMS meter reading, billing cost and the corresponding notification is sent to the corresponding consumer through the GSM (Tan *et al*., 2007).

The study explains how the remote meter reading are structured across the network using the Bluetooth technology and GSM technique. Using the intelligent terminal the information from the device will be sent through GSM to the management centre. From the management center the data transmission, the quantity of energy consumed and the data will be transmitted to the particular user. The energy consuming devices will be monitored by the management department (Cao *et al*., 2006).

In this literature survey an extend research experimented in the performance analysis and the evaluation technique which are experienced through the energy consumption, packet delivery status through the reasonable experiments (Zheng and Lee, 2004; Lu *et al*., 2004). The energy efficiency analysis is done on 802.15.4 and the slotted CSMA is analyzed by Lee (2005) and Golmie *et al*. (2005). When the energy break down happens several ways are explained by the researcher like reducing the state transition time and the transmitting the data packets in the large quantity in the wireless sensor networks. The efficiency of the energy depends on the RF transceivers in some scenarios.

MATERIALS AND METHODS

System description: The block diagram given in Fig. 1 depicts the transfer of data to the corresponding user using the internet. The system explains with the PIC microcontroller PIC16F877A. The LoWPAN node is used for the transmission and the reception of the data in the communication through internet. Once the data is communicated to the user through device2, the corresponding value of the energy meter is transmitted to the user. The user can get the information through the web communication. The analog value from the energy meter is transmitted to the device1. From the device1, the data is transmitted wirelessly through device2. Both the devices are connected to the full duplex fashion. With the help of the IP address assigned to the device2 meter reading provided through the internet to the requested commands. The corresponding user can get the meter id information through internet. Since, the information is transmitted through the internet, the security issues should be taken and the password should be provided to the particular user to encrypt and to make the data more confidential. The remote user can off the power if any different or abnormal value detected. The flow dig given in Fig. 2 explains the flow of the system.

Design process: The system uses an 8 bit microcontroller of PIC (Peripheral Interface Controller). PIC16F877A is the microcontroller been used here. PIC16F877A microcontroller has internal 8 channels ADC on chip. Energy meter is interfaced with PIC controller. The energy meter is an analog device which provides the analog value to the ADC pin of PIC microcontroller. Port A is a multi functionality port which is configured as ADC port by

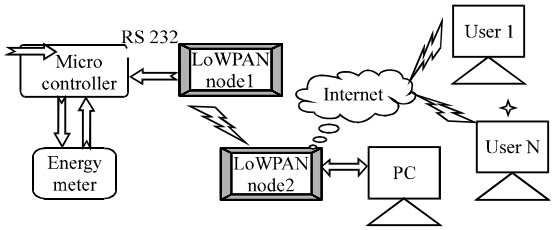

Fig. 1: Block diagram

setting the ADCON register. After configuring the port as ADC the analog values from the energy meter is gathered and is converted to digital value by the controller.

The microcontroller is interfaced with LoWPAN node1. After validating the input values from the energy meter the controller will transfer the data to the LoWPAN node1 serially through RS232 standard. LoWPAN node1 in turn wirelessly sends the data to LoWPAN node2.

Node1 and node2 are connected in a full duplex fashion Node2 is configured as a network node by fixing up an IP address to it so that the node2 can be accessed through internet. LoWPAN node2 is interfaced to PC through RJ45 standard so that TCP packets can be captured.

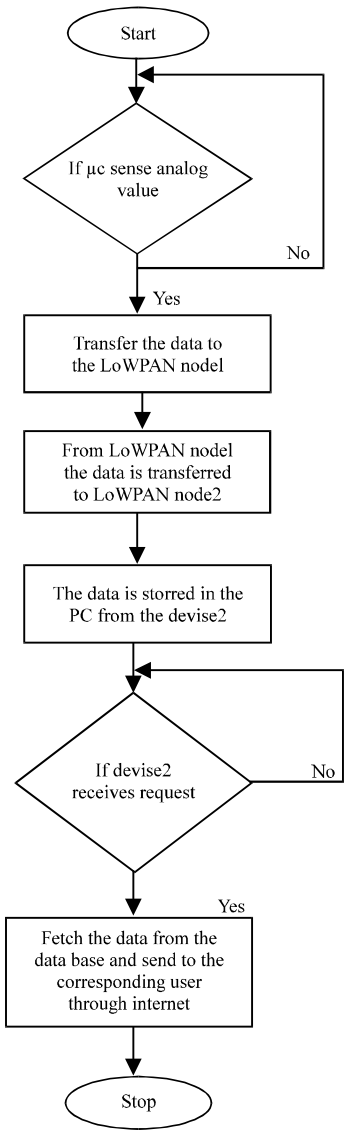

Fig. 2: Flow diagram

A database is maintained in the system. So that, the data can be gathered by requesting the node2. With the help of IP address assigned to the LoWPAN node2 user can get the meter reading value by providing a necessary command. Once the node2 receives the command it will automatically validate the command and fetches the data stored in the system database and send to the requested user through internet. Also, the remote user can shut down the power in case of any abnormal value is detected. A password based protection is provided to the system which ensures the security of the system.

Work flow of architecture:

Step 1: Microcontroller sense the analog value.

Step 2: If the value is sensed the data will be transferred to the LoWPAN node else the loop will be transferred to the step 1.

Step 3: From the LoWPAN node1 the data is transferred to the LoWPAN node2 in the wirelessly fashion.

Step 4: From the node2 the data is transferred to the pc.

Step 5: If the device2 receives the request, the data will be fetched form the data base. Else the loop will be transferred to the step 4.

RESULTS AND DISCUSSION

Remote energy meter reading using LoWPAN nodes and pic microcontroller is established as shown. This research clearly explains the hardware arrangement of the system and data packet transmission in network layer. Energy meter which gives the reading of energy bieng utilized by home is connected to LoWPAN node as shown in Fig. 3 using microcontroller.

Fig. 3: Connecting between the LoWPAN nodes and the devices

The microcontroller conveys the digital information obtained from the processed analog values of energy meter to LoWPAN node1 as shown in Fig. 4.

The low wireless communication efficiently transmit the information to node2 which in turn stores the received information in database as shown in Fig. 5 for later intake by querying through internet. After user's request the corresponding TCS data is securely transmitted to end devise which reflect the status as shown in Fig. 6.

Then, coming to data transmission Fig. 7 shown the packets bieng transmitted in the network and isolated TCS packets from other as shown in Fig. 8. The system as shown in Fig. 9 yields count on captured packet during

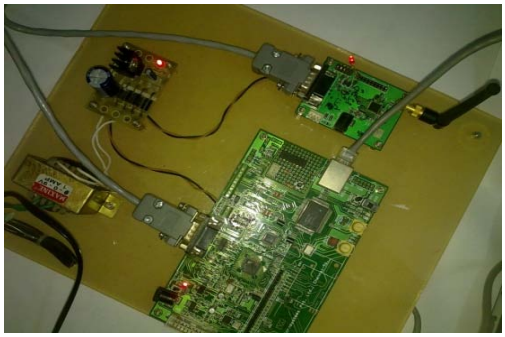

Fig. 4: LoWPAN node transmitting the parameter

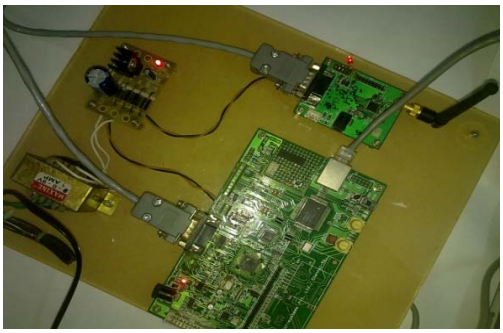

Fig. 5: LoWPAN node transmitting

Fig. 6: LoWPAN node in source station sending TCS data to server

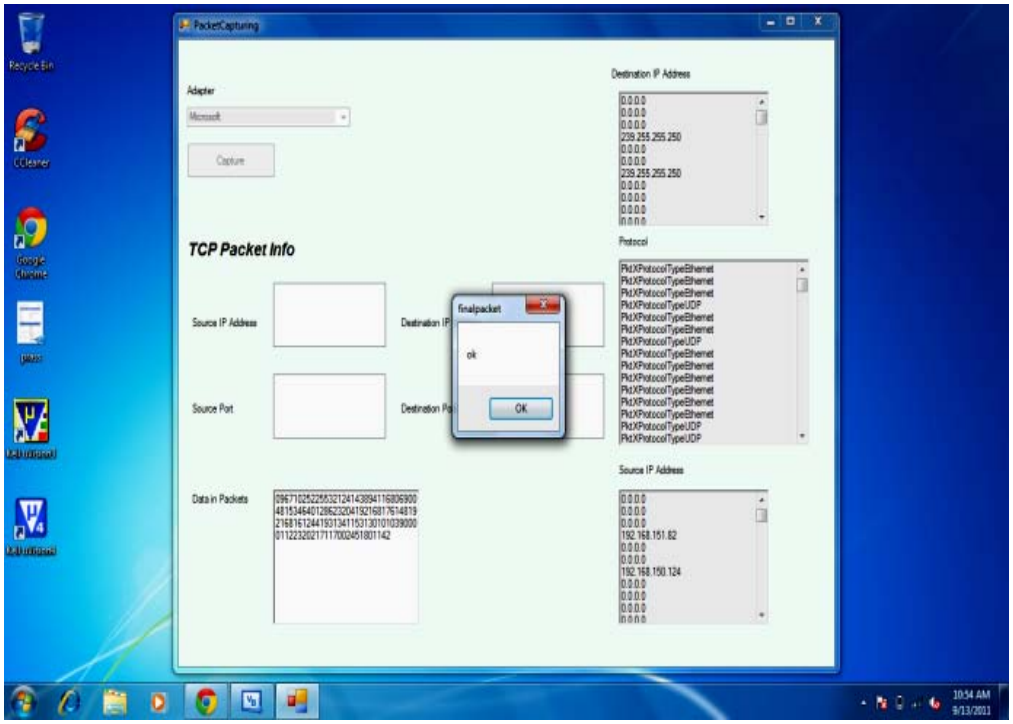

Fig. 7: Capturing the network packets

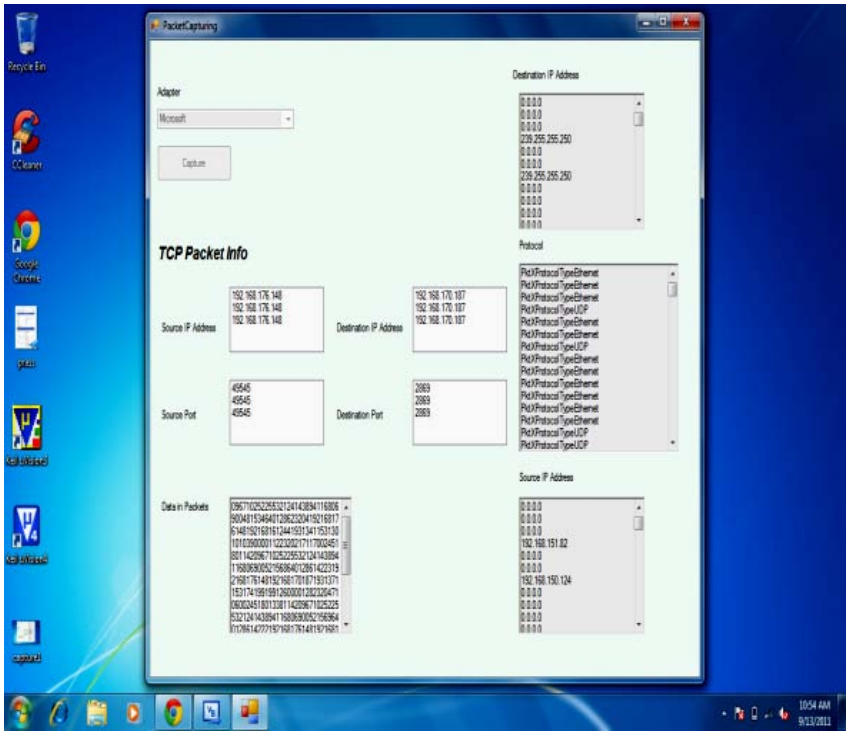

Fig. 8: Separating TCS packets

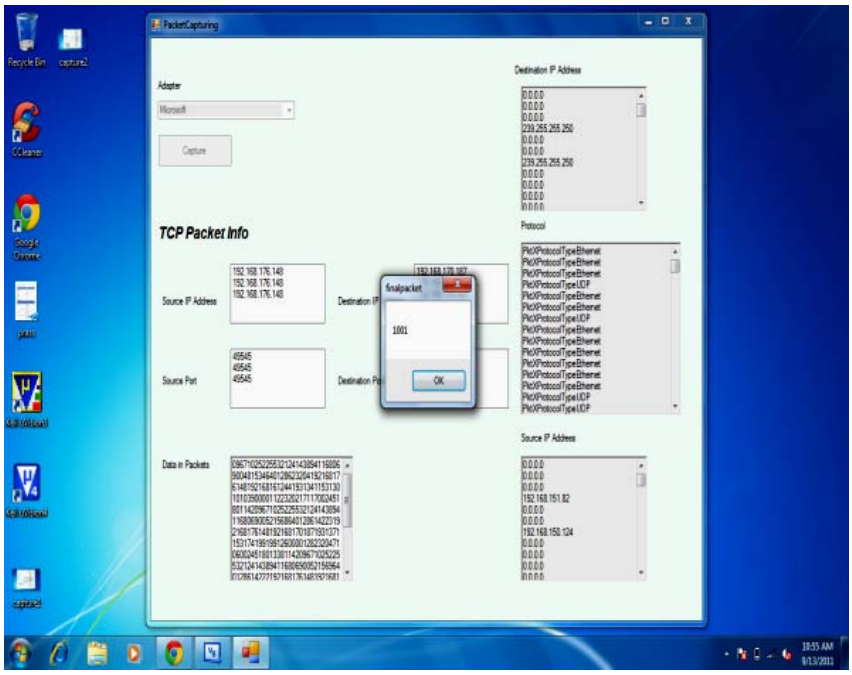

Fig. 9: Number of packets capture

data transmission. Thus, the system securely establishes energy meter reading with help of PIC and LoWPAN nodes. Figure 8 explains the sepration of the TCP packets out all the packets which are transmission through the connection. Figure 9 explain about how many packets has been captured during the data transmission.

CONCLUSION

This study has met its objectives by providing an order to obtain low data rate for the implementation of cheap devices thereby making it viable to implement them in today's world. As shown above the IEEE 802.15.4 proves to be an efficient standard which defines the communication from the networking aspect to the connectivity in a metaphorical form. This standard qualifies as an ideal standard for usage in various applications where the broad range of applications is implied. It provides an inter-operability scope for even other modes of networks within the IP networks such as WIFI, Ethernet and GPRS, etc. IP based connection is known for its industrial standard support for end to end connection for the reliability link

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