Power Monitoring and Controlling using Zigbee

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Abstract: Now-a-days the world faces the biggest problem of power. As we all know that production of power is less than the demand. In many countries the increase in demand of power is growing at faster rate than transmission capacity, and also the cost of power increasing because of higher coal prices and deficiency of fuel. Today, the growing population of countries is also one of the reasons of not getting full power. So, here we are designing such system which can efficient to both automatically monitoring and controlling of power. We can design this system using Zigbee network. Here, Zigbee plays important role in monitoring and load controlling for efficient power utilization. We discuss different hardware techniques for power monitoring, management and power controlling. Due to global warming, percentage of water on earth decreases gradually which is useful for generation of electricity. To overcome the problem of power distribution this paper will gives the solution for equal power distribution by using Zigbee network.

Keywords: Zigbee, PIC microcontroller, Current sensor, monitoring and controlling.

I. INTRODUCTION

Today's world is a smart world. In this smart world all work is based on an embedded system. This makes human life very smarter and to feel comfortable.

Growing population of world, becomes reason of not getting full power at consumer set wired interface becomes hard to implementation or installation. Apart from that wireless interfaces are easy to organize and install. And also Zigbee has many technical advantages or convenient features over Bluetooth, Wi-Fi, infrared rays etc. Zigbee is one type of communication technology which is low power consuming and having coverage area surrounded by 200 m. Zigbee has data rate running from 20 kbps to 250 kbps [2]. Table I show the comparisons of Bluetooth, Wi-Fi, Zigbee.

In this paper, we discuss different options of hardware technique for power controlling and monitoring architecture. We using PIC microcontroller as a controlling device and Zigbee wireless network also plays most important role for communication. Microcontroller alerts the system about excessive use of power. Then after alerting Zigbee passes this information to receiver side where controlling system is implemented, which also based on PIC microcontroller.

Table I Comparisons of various technologies

Stand-ard	Range (m)	No. of Nodes	Freq. Band (GHz)	Data Prote-ction	Power use
Bluetooth	10	8	2.4	16 bit CRC	High
Wi-fi	100	32	3.1-10.6	32 bit CRC	High
Zigbee	10-200	>25400	868MHz-2.4GHz	16 bit CRC	low

So, to overcome the problem of power, our paper gives an idea for equal power distribution using Zigbee wireless network

The main objectives of this project are:
1. To monitor energy consumption done by different appliances using Zigbee.
2. To monitor the excessive use of power or energy.
3. To save energy by monitoring and controlling it by using Zigbee wireless network.

II. LITERATURE REVIEW

Rajesh v. Sakhareet.al [1] have implemented power management using ARM7 controller. In this paper zigbee's wireless open standard technology is being selected around the as he energy management and efficient technology of choice. Implementing smart meters with a down, ensure interoperability, and future-proof investments made by both utilities and consumers. Consumers and business will see changes. They never dreamed possible. The information collected together smart. Power organised power controlling architecture for power saving purpose. They also provides the discussion of role of Zigbee in transmission line monitoring, real time meter reading and load controlling of electric home appliances.

N. javed.et.al paper [2], they discussed about power utilization, power organizing and power controlling architecture for power saving purpose. They also discussed the role of Zigbee in transmission line monitoring, real time meter reading and direct load controlling of electric home appliances. This paper also describes the user friendly control home appliances for power on\off through internet, PDA using GUI and through GSM cellular mobile phone.

P. Thamarai et.al [3] used PLC & SCADAs is for power monitoring. In this paper readings from n-energy meters are collected automatically by the PLC's, PLC1 to PLC m

and the data from each PLC is sent to a RS485 to Ethernet convertor. From the convertor, the data is fed into a hub, so that many PC's can have access to the data. Further, a copy of data is also sent to the database server to update the database. The database server can then provide the user with front end services through VB. open standard such as Zigbee.
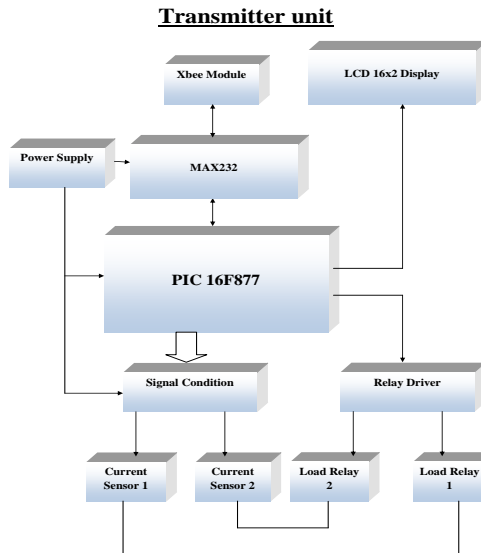
III. BLOCK DIAGRAM

Transmitter unit
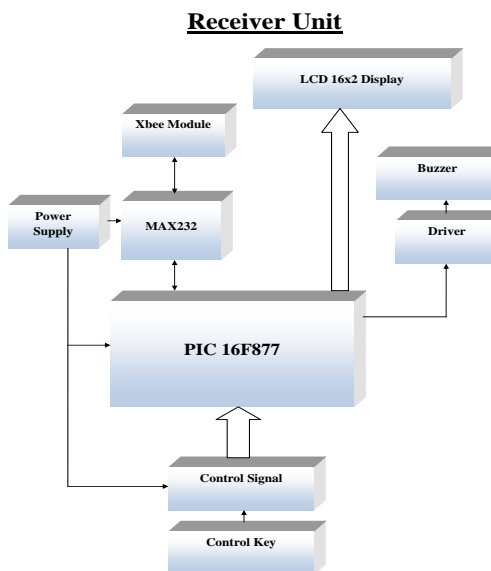

Figure 1 Transmitter Side

Receiver Unit

Figure 2 Receiver Side

Hardware requirement:

A. Microcontroller PIC16F877
- The 16F877 is one of the most popular PIC microcontrollers and it is easy to see why it comes in a 40 pin DIP pin-out and it has many internal peripherals.
- The 40 pins make it easier to use the peripherals as the functions are spread out over the pins.
- This makes it easier to decide what external devices to

- attach without worrying too much if there enough pins to the job.
- One of the main advantages is that each pin is only shared between two or three functions so it is easier to decide what the pin function

B. Zigbee
- Zigbee- enabled meters form a complete mesh network so they can communicate with each other and route data reliably.
- And the Zigbee network can be easily expanded as new homes are built or new services need to be added.

C. MAX 232
- In telecommunications max 232 serial binary data transmission since to connect to the pc a max232 cable is being used.
- In this project it is used to connect pic and Zigbee module.

D. Relay
- Relay is used as a switch to provide the connection between the microcontroller and gun.
- The trigger of gun is shorted with the relay.
- On receiving high signal from the microcontroller the relay switches to gun.

E. Buzzer
- Buzzer is an electromagnet used as alarm.
- It is an electric signalling device that produces a buzzing sound when the power reached at certain limit.

F. BC547
- BC547 is an NPN bi-polar junction transistor.
- It's used commonly to amplify current.
- Here it's used as driver.

Software requirement:

A. MPLAB
- MPLAB is a free integrated development environment for the development of embedded applications on PIC & microcontrollers.
- MPLAB X is the latest edition of MPLAB.
- They both supports project management, code editing, debugging & programming of Microchip 8-bit, 16-bit & 32-bit PIC microcontrollers.

B. ExpressPCB
- The Express PCB is software used for circuit board layout.
- It is a rapid prototyping house which provides the suitable PCB circuit layout by selecting the required components.

C. Proteus
- The Proteus Design Suite is wholly unique in offering the ability to co-simulate both high and low-level micro-controller code in the context of a mixed-mode SPICE circuit simulation.
- With this Virtual System Modelling facility, you can transform your product design cycle, reaping huge rewards in terms of reduced time to market and lower costs of development.

IV. PROPOSED SYSYEM

Figure 1 shows the proposed system. There are two units in proposed system transmitter unit and receiver unit which consists of (a)a transducer for sensing the current from the device, (b) a microcontroller (PIC16F877) for Analog to Digital conversion and serial transmission, (c) a pair of ZigBee based wireless transceivers, and (d) another microcontroller unit with LCD panel for RMS reading.
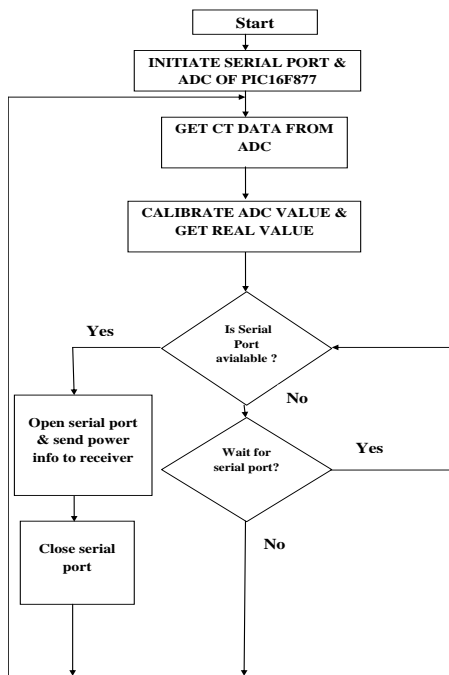
V. FLOW OF THE SYSTEM

Figure 3 Flow Chart

VI. WORKING OF SYSTEM

A. Transmitter section:
Transmitter section of system is shown in above fig. the loads are connected to the current sensors so as the current sensors sense the change in current.in above block diagram we are using 2 loads i.e. 2 load relay and relay driver to drive that relay. Then the sensors convert or express that current in the form of voltage. As we know the change in current sense by current sense by current sensor may have negligible value, so the output of current sensors is given to signal condition. The signal condition multiplies the value of voltage in such a way that it dives the microcontroller. Here we are using PIC16F877 controller.

Output of signal condition i.e. voltage value is given to the PIC microcontroller. PIC converts that voltage value which is in the form of analog signal into digital format using inbuilt ADC. This digital value of voltage is given to the LCD display, which having size 16x2. Here LCD display is used for displaying the voltages at user or consumer side.

We are interfacing the Zigbee module to the microcontroller using MAX232 IC. As we know that Zigbee is used for communication and it supports digital language i.e. 0 1 format. And PIC controller uses TTL language. So MAX232 IC is used for interfacing PIC controller with Zigbee. It converts TTL language into digital form and vise-versa.

Here PIC 16F877 microcontroller required the 5v DC supply, then signal condition, relay driver each requires the power supply of 12v. So we need to design the power supply as per our requirement.

The voltage information of all devices connected to the load is transferred to the receiver side through Zigbee.

B. Receiver section:
Receiver unit is also shown in above fig. the Zigbee at the receiver side collects the information of voltage transmitted from the Zigbee at the transmitter side. The information from Zigbee module is transmitted to the PIC controller through MAX232. The function of MAX232 IC is same as transmitted side.

The threshold values of load are already set into the pic controller. It compares all the voltage readings with that threshold value then buzzer gets turn on and automatically the supply of that particular load is disconnected and the device connected across that load will turn off.

LCD display also infrared with the microcontroller to display the voltage. Control keys are also provided so as if we need then manually we can able to turn off particular device connected across the load.

Control keys are worked as switches. By pressing these keys we can on the device. And this signal is given to PIC controller through control signal. And this information is given to the transmitted side. In transmitted side there is a driver connected to the load to perform specific task.

VII. ADVANTAGES AND DISADVANTAGES

Advantages:
 i. Zigbee is an efficient wireless protocol in terms of power consumption, scalability.
ii. It also provides suitable data rate for controlling and monitoring purpose.

Disadvantages:
 i. Limited range up to 100meters
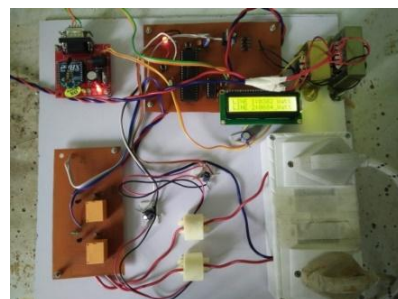ii. Continuous power supply is required

VIII. SYSTEM PROTOTYPE

Figure 4 Transmitter Side

There are two on off switches at transmitter side for each load. When key is pressed each having own unique code, the microcontroller gives code to x bee and it transmits through air. At receiver side Zigbee receives code and gives to microcontroller.

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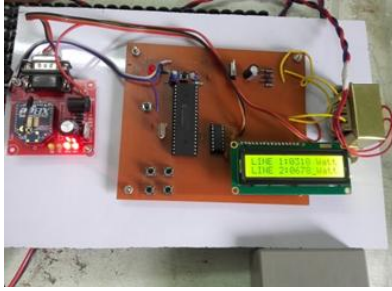*Vol. 4, Issue 3, March 2016*

Figure 5 Receiver Side

Power of loads is shown on LCD display which is present at both the Tx and Rx sides. When voltage of load exceeds above the threshold voltage value which is set at microcontroller then the device will get turn off automatically.

IX. CONCLUSION

From this project we can monitor the exact energy requirement of appliances connected to Zigbee network.
Due to which if excessive energy may be acquired by any device then user as well as power control unit gets alert about it. After alerting automatically the control unit activated to control the excess flow of energy. Overall we can save the energy.

X. FUTURE SCOPE

In many countries the increase in demand is growing at a faster rate than transmission capacity and also the cost of providing power is also increasing due to the higher coal prices and deficiency of fuel. Therefore to control the excess use of power and saving the power is going to be the most important issue in future. For which power monitoring and controlling system like this will be very efficient. In this project the range is limited up to 100m but we can increase it as per requirement. Also the number of loads can be increase in future.

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