International Journal of Engineering Research and Applications (IJERA) ISSN: 2248-9622
International Conference on Industrial Automation and Computing (ICIAC- 12-13th April 2014)

RESEARCH ARTICLE OPEN ACCESS

A Real-Time Multiple Parameter Monitoring System Using Wireless ZigBee Network

Navlesh G. Dose[1], Kishor A. Ingle[1], Nita Nimbarte[2]
[1]UG student of Electronics and Telecommunication Engg. Dept, Yashwantrao Chavan College of Engg. Nagpur .
[2] Assit. Professor Electronics and Telecommunication Engg. Dept, Yashwantrao Chavan College of Engg. Nagpur.
[1]dosenavlesh@gmail.com
[2] kishor.ingle1@gmail.com
[3]nitangp@gmail.com

Abstract—
This paper deals with the design of a Multiple node Zigbee Wireless Sensor Network "WSN" for better Interactive Industrial Automation. It consists of a Coordinator and the sensor nodes. The coordinator is a centralized unit which is attached to the monitoring PC. It collects the information from all other nodes on demand and provides a control signal to control different parameter. The sensor nodes are made intelligent for controlling the plant. These nodes are attached with the Zigbee for remote controlling in case of changing the preset values and handling any issues. The coordinator is implemented using the PIC18LF4620 controller and the Sensor Nodes are implemented as same microcontroller. The Sensor nodes are programmed using the Embedded C.The three parameter is monitor by each zigbee of wireless network node.All above areachieved and to measuring in real environment to prove the design is reasonable, reliable, low power consumption, low cost, targeted towards automation and fully wireless simple GUI to monitor and control parameter from one place .

Keywords— ZIGBEE, WSN, parameter monitoring, Embedded C, low power, low cost

I. INTRODUCTION

This project presents a comparison of different configurations of a wireless sensor system for capturing various physical parameters. The systems consist of sensor elements which wirelessly transfers values of parameter data to a multiple trans-receiver element. The sensor elements consist of a microcontroller, sensor(s) and a radio transceiver. The receiver element consists of a Zigbee connected through a microcontroller to a other zigbee modules for real time data acquisition. The wireless transmission between the sensor elements and the receiver element is based on the low rate IEEE 802.15.4/ZigBee(XBEE) standard. A configuration with number of sensors are connected by wire to a wireless sensor element. The study shows that it would be feasible to connect 3 sensors in the given setups. In this project we are going to interface various sensors, process carried out at various locations, which will be monitored by a wireless network and also it shares all the data with each other, which helps us to monitor all the data regarding various operations within the wireless network at any of the wireless network module.

For project we are using 3 Xbee module connected with a microcontroller based hardware, which monitors and controls physical parameters like temperature, humidity, flow, etc and share all the monitored data with each other.

Alarms, fan, LEDs are used to indication when process variables exceed preset levels. Security and privacy are important in the industrial automation. Reliability is an important factor where some measurable difference in implementation is required. Industrial wired networks are generally expected to deliver power to each node, as well as to carry the network signals. In many process plants, the network is also expected to be intrinsically safe, meaning that a cable break will not cause flammable gases to ignite. Wireless networks definitely have the advantage of not using wire and are inherently safe.[1],[2]

II. ZIGBEE TECHNOLOGY

ZigBee is a wireless standard based on IEEE802.15.4 that was developed to address the unique needs of most wireless sensing and control applications. ZigBee technology is low cost, low power, a low data rate, highly reliable, highly secure

wireless networking protocol targeted towards automation and remote control applications. Fig.1 depicts two key performance characteristics – wireless radio range and data transmission rate of the wireless spectrum. Comparing to other wireless networking protocols such as Bluetooth, Wi-Fi, UWB and so on, ZigBee shows excellent transmission ability in lower transmission rate and highly capacity of network.[2]

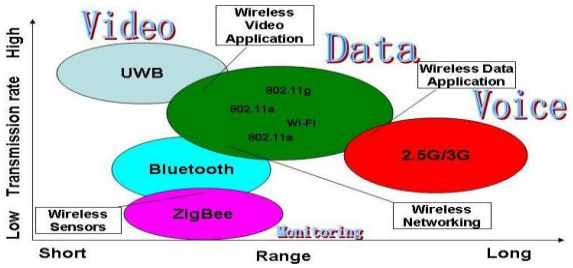

Fig.1 The wireless landscape

III. ZIGBEE FREAMWORK

ZigBee framework is made up of a set of blocks called layers. Each layer performs a specific set of services for the layer above. As shown in Fig.3. The IEEE 802.15.4 standard defines the two lower layers: the physical (PHY) layer and the medium access control (MAC) layer. The ZigBee Alliance builds on this foundation by providing the network and security layer and the framework for the application layer.[8]

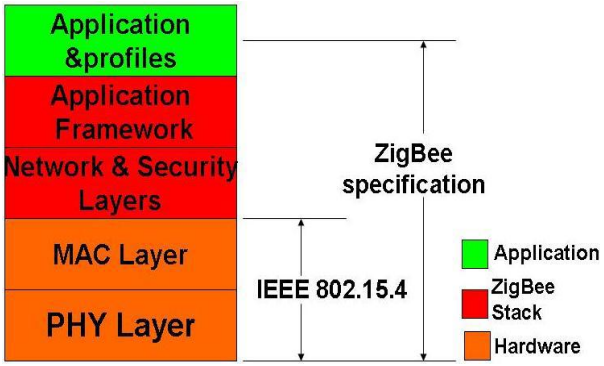

Fig.2 ZigBee framework

Based on the IEEE802.15.4 standard physical layer (PHY)and media access control layer (MAC)which ZigBee defines a system of high-level, including the network layer (NWK), application layer (APL) and security services specification. Each layer is responsible for completion of the task, and provide services to upper layer, the interface between the layers communicate by the defined logical link, of which application layer also provides many other services to enhance the properties of the network self-organization, dynamic management features and security. ZigBee's frequency bands is 2.4GHZ, Europe(868MHZ) and the United States (915MHZ)are free to apply band ZigBee can establish a reliable, open and global standards. As the duty cycle is very short, send and receive messages with lower power consumption, so under normal circumstances, two 1.5V batteries can be support to six months to two years. It achieves energy-saving effect and provides a rich application space.[8]

IV. ZIGBEE TOPOLOGY

The ZigBee network layer supports star, tree, and mesh topologies, as shown in Fig.3. In a star topology, the network is controlled by one single device called ZigBee coordinator. The ZigBee coordinator is responsible for initiating and maintaining the devices on the network. All other devices,known as end devices, directly communicate with the ZigBee coordinator. In mesh (Fig.3) and tree (Fig4) topologies, the ZigBee coordinator is responsible for starting the network and for choosing certain key network parameters, but the network may be extended through the use of ZigBee routers. In tree networks, routers move data and control messages through the network using a hierarchical routing strategy. Mesh networks allow full peer-to-peer communication.

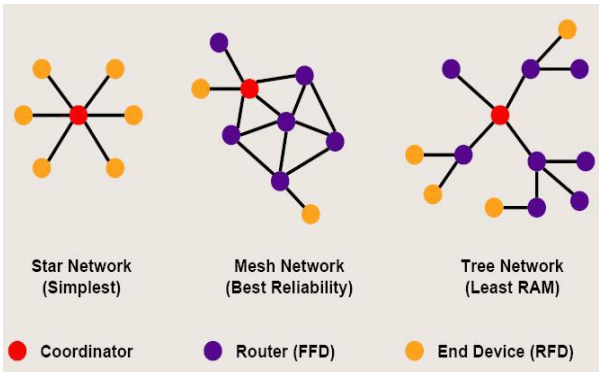

Fig.3ZigBee's topologies

Fig.4 is a ZigBee network model, it shows that ZigBee supports both single-hop star topology constructed with one coordinator in the centre and the end devices, and mesh topology. In the ZigBee network, the intelligent nodes are composed by Full Function Device (FFD) and Reduced Function Device (RFD). Only the FFN defines the full ZigBee functionality and can become a network coordinator. Coordinator manages the network; it is to say that coordinator
can start a network and allow other devices to join or leave it. Moreover, it can provide binding and address-table services, and save messages until they can be delivered.

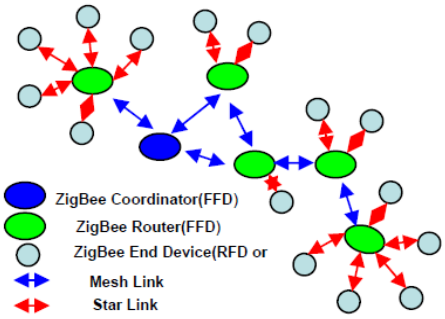

Fig.4ZigBee network model

On our project we are using above concept about Meshes basically we are just build connectivity of three ZigBee module from which one is coordinator and two are subordinate which sends the sense data of different parameter of and industry like temp, level, vibration, flow, light etc.[8]

V. OVER ALL DESIGN OF ZIGBEE NETWORK

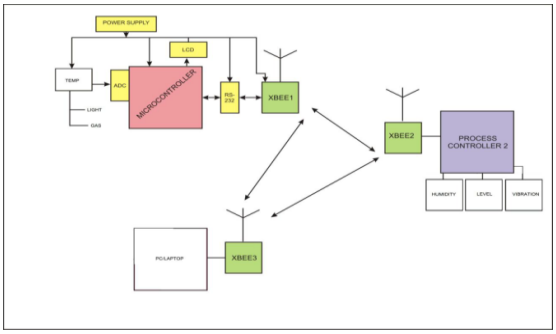

Fig.5 Blockdig.Of ckt.

A TCP/IP based Modbus protocol implementation (Modbus/TCP) concept we are using . The possible network setups are not governed by the specification; it is possible to setup multi-master systems or realize bidirectional communication (i.e. have nodes that are master and slave at the same time) . However, the user should be well aware that there are implications from deviations of the Master/Slave scheme. But we are using two slave who monitoring the parameter and one is master who generate the control signals as well as display the parameter on the PC on which the simple GUI interface which build by VB. As fig.6 shows the three ZigBee in which two are monitoring parameter like temp, flow, humidity, vibration, level, light. Third is connect on PC.
For controlling the above parameter there are connect buzzer, fan, LED etc. shown in fig.7.[7]

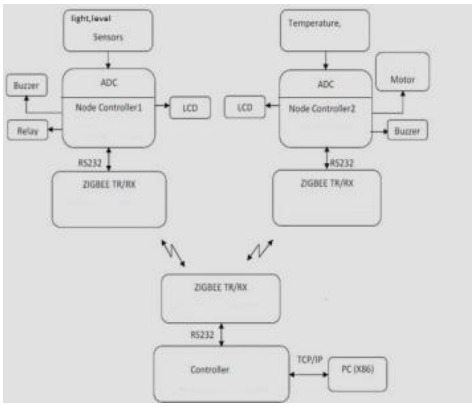

Fig.6 Block design with cotroling parameter[7]

VI. HARDWARE CIRCUIT

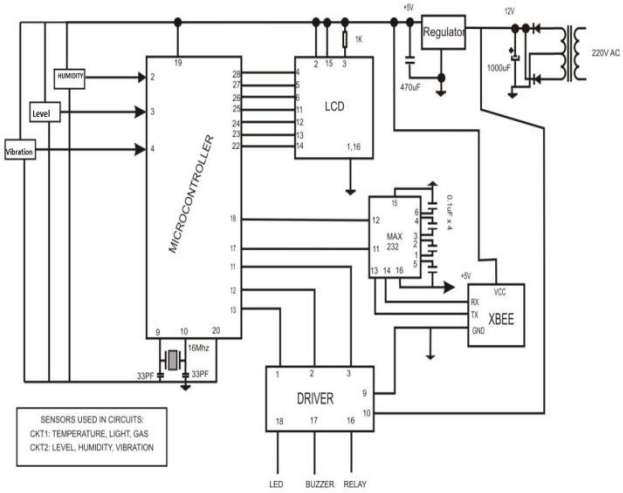

Fig.7 Circuit Dig. Of first ZigBee module

This application relies on a wireless sensor network (WNS) which allows simultaneous, real-time measurement of indoor temperature, humidity, level, vibration and intensity.

The system comprises of different type of sensors for different type of physical parameter which has to be measure, PIC-microcontroller, max232,drive ic, power supply. ,the parameters which has to be measure is sense by the sensors and gives to the PIC. PIC has the enbuild ADC and CPU. the data sense by the sensor is the analog data, this analog data is converted into the digital data by using this ADC and some mathematical or logical operations is perform by the CPU. So there is no need of the separate ADC and it reduces complicity of the circuit. The data present at the PIC microcontroller is display on LCD by simply interfacing LCD with the PIC microcontroller. Only the four data pins of the LCD is connected to the PIC to avoid the use of another port of the microcontroller to interface LCD. So by logically the 8-bit data is converted into the two 4-bit data i.e.4LSB & 4MSB. The Zigbee is interface with the PIC through the MAX232.Zigbee

cannot be interface directly to the microcontroller because the driving capacity of the PIC is the 5volt and the Zigbee is also work on the 5volt. If we connect the Zigbee to the PIC by the wire then there may a voltage drop due to the resistance of the wire and signal may be of less than 5v in that case the Zigbee cannot be work. MAX232 convert this TTL(5v)signal into the cmos(12v)signal and gives to the ZIgbee .Zigbee has on chip max232 which again convert the cmso signal to the TTL signal and provide the constant 5v supply to the ZIgbee. Then Zigbee is use for further communication as a Transmitter and Receiver. Here also a Driver IC is connected to the microcontroller. If any parameter increase after some limit we have to give the indication. So we are using buzzer, LED, FAN etc.
We cannot connect this devices directly to the microcontroller as it required more operating voltage. So the Driver IC provide this extra supply.

The remaining node is build on the same circuit only difference is that parameter which has to be measure is different. So the circuit and working of circuit is same.

The parameter measured at both the node is display at the third node. The circuit for the third node is simply a display device connected to the Zigbee module through the Max232. The power supply for the working of the circuit is derive from regular ac power supply by using step-down Transformer and rectifier.

VII. CONCLUSION:

In the present work, Zigbee wireless sensor network based on the Modbus protocol has been designed successfully. The Coordinator is successfully connected to the TCP/IP network. The Node Controllers are monitoring the Sensor nodes reducing the number of requests to the server. The wireless sensors system is of high convenience in the course of the system installation. The Zigbee technology makes the power consumption very low because of Modbus usage. The wireless sensor Nodes and Server system are easy to install. This paper presents an improved wireless sensor network based on ZigBee technology, through the theoretical analysis ,hardware and software designing, and experimental environment test, which has been confirmed that the improved design of the ZigBee wireless sensor network system is reasonable, the hardware system performance normal, and the software designing improved the working efficiency This designing is very suitable for the large scale wireless network. The application prospect of this design is very optimistic in future.

VIII. ACKNOWLEDGMENT:

It is a pleasure to recognize the many individual who have helped us in completing this technical paper. We sincerely express our gratitude Pravin Jain to for their constant guidance, encouragement and valuable advises throughout this process. Special thanks to Lukesh Rinait, Animesh Bhaiswar and Samiksha Admane to help in everything.

REFERENCES:

[1] IEEE STD 802.15.4. www.zigbee.org.
[2] ZigBee Alliance. ZigBee Specification www.zigbee.org.
[3] Research on ZigBee Wireless Sensors Network Based on ModBus Protocol, SciRes,Wireless Sensor Network, 2009, 1, 1-60.
[4] Li Jian Zhong Gao Hong. Development of wireless sensor network technology . Computer Research and Development.
[5] An Improved Design of ZigBee Wireless Sensor Network..paper by Liu Yanfei Wang Cheng Qiao Xiaojun Zhang Yunhe [IEEE]
[6] Design of the temperature monitoring system based on ZigBee wireless sensor network by Wang Qing hui,Bian Li juan, Pang Yu jun College of Information Engineering Shenyang University of Chemical Technology[IEEE]
[7] Zigbee Wireless Sensor Network For better interactive industrial Automation By Manoj Kollam, S.R. Byagya Shree Shree….Dept. of A.T.M.E Mysore, India[IEEE]
[8] ZigBee Wireless Sensor Network in Environmental Monitoring Applications