Wireless Supervisory Control and Data Acquisition System for Multiple Sensors

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Abstract— Wireless sensor networks have been very popular research field for the last couple of years. ZigBee is a new technology now being deployed for wireless sensor networks. It is a low data rate wireless network standard defined by the ZigBee Alliance and based on the IEEE 802.15.4. This project presents the implementation of a wireless sensor network (point to point) to communicate through different Zigbee modules. The different physical parameters such as temperature, light, pH etc. will then be measured through the sensors and the measured values will then be displayed on the LCD. The PIC microcontroller which has been used in the circuit has various advantages over other microprocessors as well as microcontrollers. Unlike the ARM processor, PIC microcontroller can be replaced on the PCB. The other advantages of PIC is that it has an on board analog to digital converter which is required while receiving the analog data from various sensors as the converter converts the analog data into digital data unlike other microcontrollers such as 8051 etc. MAX 232 has been used in this project as an interface between PIC and Zigbee as it converts the serial data of PIC into parallel data and provide it to Zigbee which then transmits it wirelessly. After acquiring the data on the LCD, Zigbee can transmit it on the laptop or desktop from where we can send it to various parts of the world through the use of internet communication.

Keywords: *Wireless Sensor Network, Zigbee, Multiple sensors, PIC18F2XK20*

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I. INTRODUCTION

This project presents a comparison of different configurations of a wireless sensor system for capturing various physical parameters. The values of parameter data to a receiver element are being wirelessly transfers to the systems consist of sensor elements. The sensor elements consist of a microcontroller, sensor(s) and a radio transceiver. A radio receiver connected through a Micro-controller to another Zigbee module 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 standard. A configuration with number of sensors are connected by wire to a wireless sensor element is compared to using multiple wireless sensor elements within each. The study shows that it would be feasible to connect 3 sensors in the given setups.Sensor data processing can be done in either the receiver element or in the sensor element. For various reasons it can be reasonable to implement some sensor data processing in the sensor element. The project also looks at how much time that typically would be needed for a simple pre-processing task. After that, the sensors compute the values of different parameters and the result is displayed on the LCD. This concept is applicable for both industrial as well as medical applications. In industries, it can be applied inside a boiler whose various parameters such as temperature, light and level can detected, monitored and controlled through it. Medically, it can be used to measure the various physical parameters of a human body such as pH level, temperature and heart beat and after the measurement the doctor can monitor various patients' condition by sitting at one place rather than going to every patient's bed because of which a lot of human effort and time will be saved.

II. System Overview

The project wireless supervisory control and data acquisition system for multiple sensors consists of various components such as PIC microcontroller, driver IC, MAX232, LCD, Zigbee, regulator IC 7805 and sensor unit along with interfacing IC. The components selected for this project is based on their cost, power consumption, their voltage rating and various other factors which will make the project more feasible. The physical parameters to be analyzed for monitoring are temperature, light, pH value, level by using PIC microcontroller. The biggest reason behind using PIC microcontroller is that it has an 8 bit inbuilt A/D converter which converts the analog data of the sensors into digital data which is then used by the microcontroller to measure the various parameters. After measuring the value of the parameters, it will be displayed on the LCD. The data from the LCD is sent to the laptop or PCs through the wireless protocol

i.e. Zigbee. Three zigbee has been used where two of them have been connected to two PCBs and one is connected to the laptop. The five sensors connected are used for detection and measurement of various parameters. The value of parameters will be detected by the help of PIC micro-controller and the values will be displayed on the LCD. RS 232 is connected as an interfacing unit between micro controller and Zigbee. It increases the communication distance and convert the parallel data to serial data. This collected data will be further send to laptop which could be situated at any part of world through internet communication for various purposes.
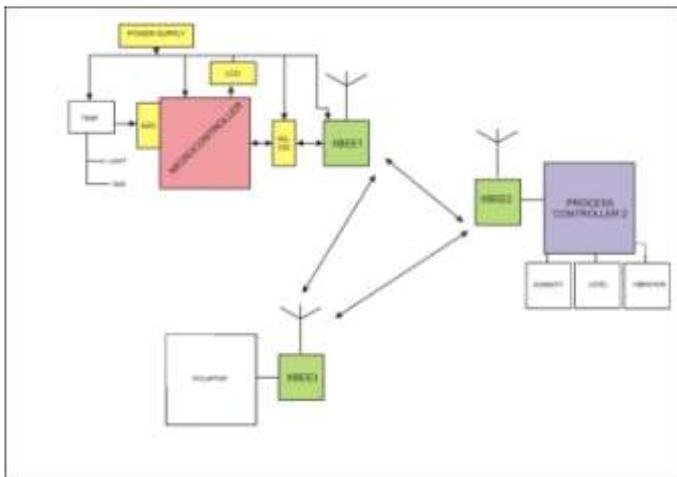
III. Wireless Sensor Network

A collection of, self-contained, millimeter-scale, micro-electro-mechanical devices Known to be a part of WSN Technology. These devices have computational processing ability , sensors, , wireless transmitter and receiver technology and a power supply. In a physical geographic area nodes usually span large number of sensor . Typical WSNs communicate directly with a centralized controller or a satellite, thus communication between the sensor and controllers is based on a single hop. For example, the prototype of a future sensor node (mote) in the Smart Dust project, performs the wireless communication function, the sensor function, the power supply unit, and the information processing function on the Micro Electro Mechanical System) chip, which has a scale only of several milli-meters. By forming a multi-hop radio network and maintaining connectivity in a decentralized manner with that by forming an ad hoc network in future aspect, a WSN could be a collection of autonomous nodes or terminals that communicate with each other. WSNs could change their topology dynamically when connectivity among the nodes varies with time due to node mobility. But current, real-world deployment usually consists of stationary sensor nodes. The combination of processing power, storage and wireless communication also means that data can be assimilated and disseminated using smart

algorithms. The vast number of sensor nodes planned for many applications also implies a major portion of these networks would have to acquire self- organization capability. WSNs are intelligent compared with traditional sensors, and some WSNs are designed to use in-network processing, where sensed data can be gathered in situ and transformed to more abstract and aggregated high-level data before transmission. sometimes, a denser infrastructure would create a more effective sensor network. A denser network can also lead to collisions during transmission, and network congestion if it does not handle properly. This will no doubt increase latency and reduce efficiency in terms of energy consumption. One distinguishing characteristic of WSNs is their lack of strong boundaries between sensing, communication and computation[6]. Unlike the Internet, where data generation is mostly the province of end points, in sensor networks every node is both a router and a data source[6].

IV. Overview on Zigbee

In this paper point to point communication is established with ZigBee connectivity for DC motor speed control. ZigBee is one of the wireless protocols for wireless personal area networks (WPANs). It is designed to use in embedded applications requiring low data rates and low power consumption. ZigBee is a low-cost, low-power, wireless mesh network standard targeted at wide development of long battery life devices in wireless control and monitoring applications. Zigbee devices have low latency, which further reduces average current. ZigBee chips are typically integrated with radios and with microcontrollers that have between 60-256 KB flash memory. ZigBee operates in the industrial, scientific and

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medical (ISM) radio bands: 2.4 GHz in most jurisdictions worldwide; 784 MHz in China.
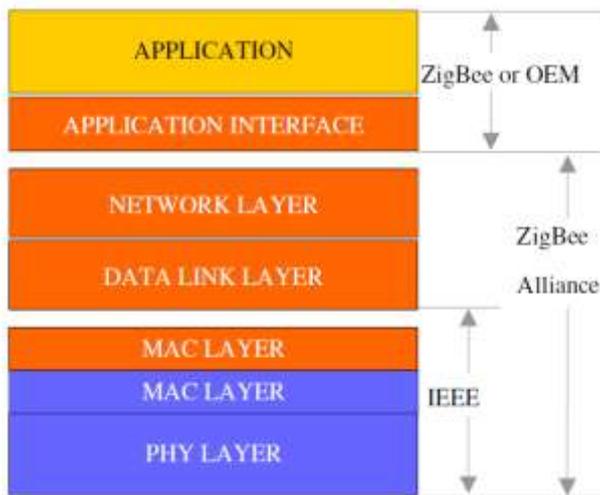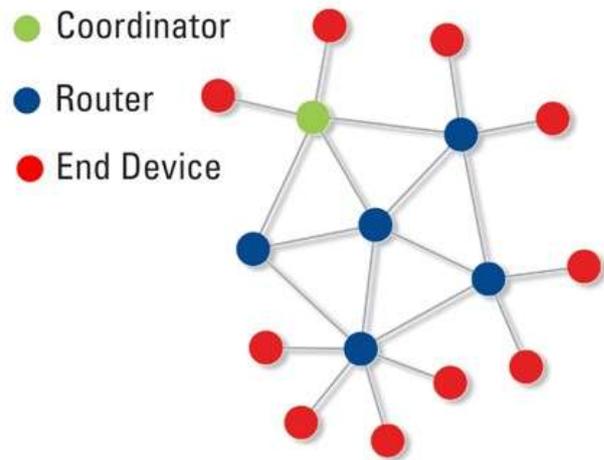
1. Zigbee Architecture

Fig 5.1 ZigBee's Protocol Stack

2. Zigbee Technology

3. Zigbee Network

V.   PIC Controller(PIC18F2XK20)

We used a PIC micro controller to execute the no of operations. It is a 8 bit micro controller having 32 KB flash ROM, 2KB of EEPROM, and 1.2KB of RAM. It has28 pins, out of them 25 pins are usable as digital input/output as well as all the pins have various functions like ADC, Comparator, Timers etc. The on board ADC of the micro controller is one of the biggest advantage of micro controller because it saves the cost of an analog to digital converter. It consumes less power and is not as costly as other micro controllers. It has various advantages over ARM processor, one of which is that we can replace it over the PCB .
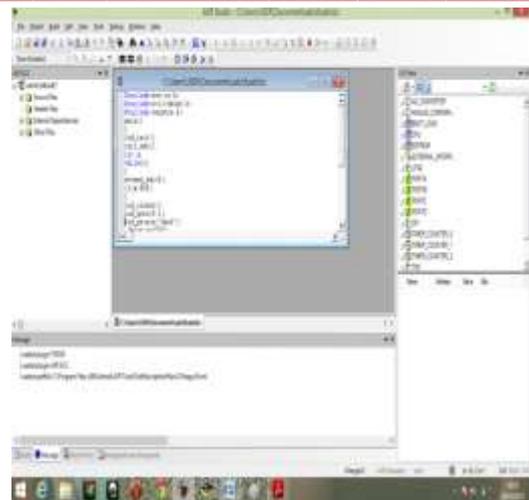
FEATURES

- ◉ **10 bit inbuilt A/D converter**
- ◉ **Power consumption is low**
- ◉ **Inexpensive microcontroller**
- ◉ **Memory Endurance**
- ◉ **Self- programmability**
- ◉ **Extended Instruction set**
- ◉ **Multiple idle mode**
- ◉ **Extended WDT**
- ◉ **Inbuilt PWM generator and comparator**

• Memory Endurance: The Flash cells for both program memory and data EEPROM are rated to last for many thousands of erase/write cycles – up to 10K for program memory and 100K for EEPROM. Data retention without refresh is conservatively estimated to be greater than 40 years.

• Self-programmability:

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• Extended Instruction Set:

• Enhanced CCP module:

• Enhanced Addressable USART:

• 10-bit A/D Converter:

• Extended Watchdog Timer (WDT):

VII.   Results of System
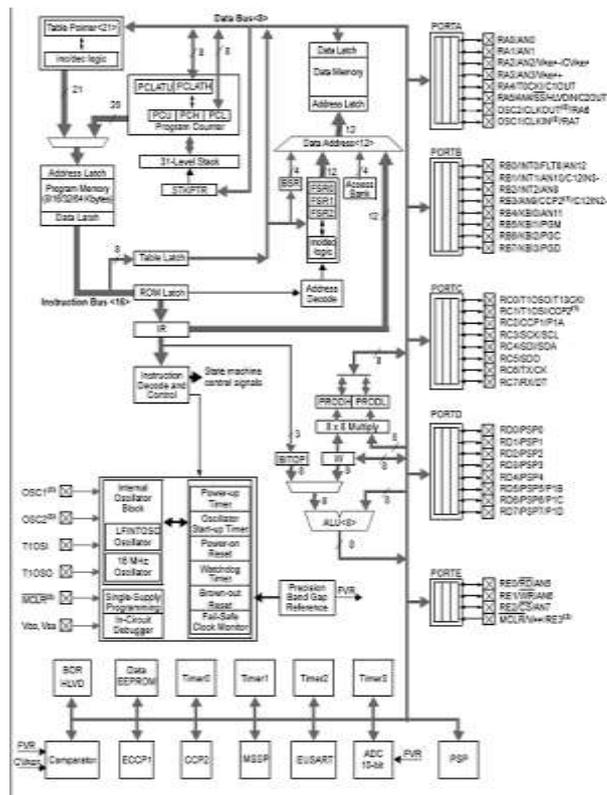
VI.   System development using Embedded C

Historically, embedded C programming requires non-standard to extensions to the C language in order to support exotic features such as fixed-point arithmetic, multiple distinct memory banks, and basic I/O operations.In 2008, C standard committee extended the C language to address these issues by providing a common standard for all implementations to adhere to. It includes a number of features not available in normal C, such as, fixed-point arithmetic, named address spaces, and basic I/O hardware addressing.Embedded C uses most of the syntax and semantics of standard C, e.g. main ( ) function,variable definition,datatypes declaration, conditional statements (if,switch,case), loops (while, for), functions, arrays and strings, structures and union , bit operations, macro,

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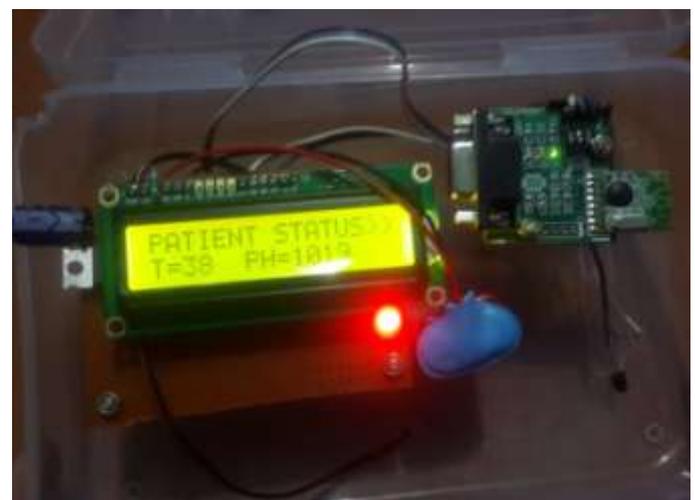
VIII.   Conclusion And future scope

From this project we can conclude that this can be one of the best methods for monitoring of physical parameters such as light, temperature, pH level, level in the industrial as well as medical fields. In medical field it is applicable where the doctors can analyze the subject condition from where they are sitting and hence proper and timely Medicare can be provided to the patients so that the quality of medical services improves. Wireless supervisory control and data acquisition system has been successfully designed.The system is capable of detecting various sensors such as pH level sensor and temperature sensor. Both the sensor are capable of sensing the signal and given to the micro-controller.These signals are then transmitted via zigbee from one place to another. With the above mentioned system, keeping this as the basic foundation in medical fields we can deal with a more robust system that is integration of patient services creating user networks example: tele-pathology, case conference and research oriented continued medical education.

References

[1] . Monahan, Torin, Mokos, Jennifer T. (2013). "Crowd sourcing Urban Surveillance: The Development of Homeland Security Markets for Environmental Sensor   Networks" (pdf). *Geoforum* **49**:   279– 288. doi:10.1016/j.geoforum.2013.02.001.

[2] Jump   Up^Billings   S.A.”Nonlinear   System Identification:Narmax   Methods   In   The Time,Frequency   and   Spatio-Temporal Domains”.Willey,2013.

[3] Jump Up^Mackay,D.J.Information Theory,Inference and   Learning   Algorithms,Cambridge,(2003-2004).Isbn 0-521-64298-1

[4] R.G.Landaeta,O.casas,and   R.P.Areny,”Heart   rate detection   from   Plantar   bioimpedance measurements”,28thIEEE   EMBS   Annual International Conference,USA,2006,pp.5113-5116.

[5] Wikipedia,”Heartrate”,Availableat:http:/enwikipedia. org/wiki/Heart rate(December 27,2009).

[6]   ‘A survey of Wireless Sensor Network technologies: research trends and middleware’s role’ by Eiko Yoneki and Jean Bacon University of Cambridge Computer Laboratory

[7] Cambridge CB3 0FD, United Kingdom.

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