Remote monitoring of Greenhouse Parameters using Zigbee Wireless Sensor Network

[1.] Ms. Vaishali Shankar Katti, [2.] Prof. A. C. Pise
[1.] Department of Electronics S.K.N.Sinhgad College of Engineering
Korti, Pandharpur(Maharashtra)
[2.]Department of Electronics
(SKNSCOE,Kort)

***Abstract*--A wireless sensor network (WSN) is an infrastructure comprised of sensing, Computing and communication components that permits the administrator control & management of the required parameters within the network [1]. Monitoring and control of greenhouse surroundings play a vital role in greenhouse production and management. The management of this type of farms needs data acquisition in every greenhouse and their transfer to a control unit that is typically placed in control room, separated from the production space [2]. To monitor the greenhouse environment parameters effectively, it is necessary to design a measurement and control system.The objective of this paper is to design a simple, easy to install, microcontroller-based circuit to monitor and record the values of temperature, humidity, soil moisture of the natural environment that are continuously modified and controlled in order optimize them to achieve maximum plant growth and yield. An integrated Liquid crystal display (LCD) is also used for real time display of data acquired from the various sensors and the status of the various devices.**

Also this paper further describes ZWSN nodes for measuring the temperature, humidity, and Soil moisture in greenhouse. Zigbee is the wireless communication protocol based on IEEE 802.15.4. Zigbee is most commonly used for WSN.

Keywords – Wireless sensor network, Zigbee technology, Greenhouse Monitoring, Environment Parameter

I. INTRODUCTION

A wireless sensor network (WSN) is a computer network consisting of spatially distributed autonomous devices using sensors to cooperatively monitor physical or environmental conditions, like temperature, Humidity, Soil moisture at completely different locations. [1]

Recent advances have resulted in the ability to integrate sensors, radio communications, and digital electronics i nto a single integrated circuit (IC) package. This capability is enabling networks of very low price sensors that are in a position to communicate with each other using low power wireless data routing protocols. A wireless sensing element network (WSN) typically consists of base station which will communicate with variety of wireless sensors via a radio link. Data is collected at the wireless sensing element node, compressed, and transmitted to the base station directly or, if needed, uses alternative wireless sensing element nodes to forward data to the base Station. The transmitted data is then presented to the system by the Base station connection. There are completely different wireless sensor networks available like Bluetooth, Wi-fi, zigbee etc. out of those networks Zigbee (ZWSN), is a quite short-range, low-rate wireless networking technology, solves the shortages of traditional greenhouse atmosphere monitoring system and improves the performance of the entire system [3]. It has its own radio standards, realizing the thousands of tiny sensors to achieve mutual communication with very little requirement of energy. The self-configuring and self-healing nature of ZWSN makes deployment simple and ensures reliable communications no matter how the environment changes. It additionally provides flexibility, permitting radio nodes and their associated controllers to be added, removed, or resettled without the necessity for traditional network cabling work. Zigbee technology has been widely utilized in industry, medicine, and military. Agricultural ZWSN has additionally become in an inevitable development direction. At present, ZWSN applications are still in the domestic of the experimental stage and didn't develop a wireless sensor networks system that is completed and appropriate for greenhouse characteristics [4-6]. The system used the ZWSN technology and designs multiple sensing element nodes to gather the information of temperature, air relative humidity and Soil moisture within a greenhouse. The performance of system and also the battery life were major problems.

II. ZIGBEE TECHNOLOGY

Zigbee relies upon the IEEE Std. 802.15.4 which, in turn, is a standard that defines the low level protocols that intends to ensure property among portable, low cost, low complexity and low power devices. The IEEE Std. 802.15.4 defines the Physical and also the Media Access control (MAC) layers. Zigbee adds over IEEE Std. 802.15.4 the definition of protocols for the Network and the Application layers.

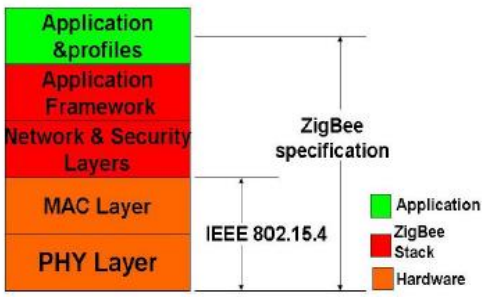

Fig.1 Zigbee Framework

Zigbee framework is made up of a set of blocks called layers. 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 [7]. The IEEE 802.15.4 has two PHY layers that operate in two separate frequency ranges: 868/915 MHz and 2.4GHz. Moreover, MAC sub-layer controls access to the radio channel using a CSMA-CA mechanism. Its responsibilities may also include transmitting beacon frames, synchronization, and providing a reliable transmission mechanism

III. GREENHOUSE SYSTEM ARCHITECTURE

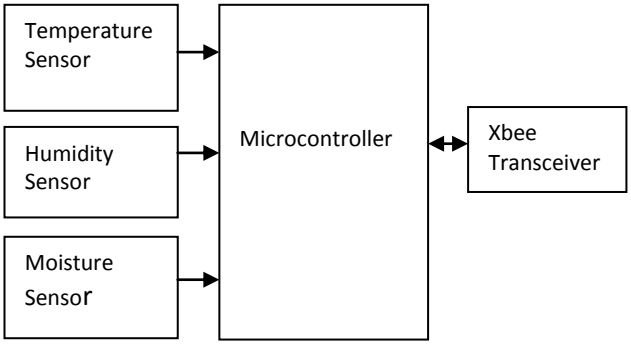

Fig.2 Local Station

The management of the greenhouse investigated in this paper consists of many distributed control stations and one central station. Every local station is responsible for getting the greenhouse climate parameters by three sensors for the temperature, humidity and moisture. These sensors are connected to a PIC16F877A microcontroller that consists of embedded ADCs [8]. A Zigbee transceiver is directly connected to the microcontroller to produce a wireless connection with a central station. A computer is used to implement the central station at that the set value for every parameter is measured and compared to those received from each local station. Based on the measure and set values of the parameters the central station provides the specified management action at every location. These control actions are sent back to the local stations via ZigBee module. Finally, once the control actions received by the local station, the microcontroller can provide the necessary control signals and coordinate their operation.LM35 is used to measure the temperature within the greenhouse.
The LM35 series are precision integrated-circuit Calibrated directly in ° Celsius (Centigrade) Linear + 10 mV/°C Scale Factor temperature sensors, with an output voltage linearly proportional to the Centigrade temperature. When it comes to humidity sensing technology, there are three types of humidity sensors: capacitive, resistive and thermal conductivity humidity sensors. We used Capacitive Humidity Sensors (CHSs) module which are widely used in industrial, commercial, and weather telemetry applications. CHSs consist of a substrate on which a thin film of polymer or metal oxide is deposited between two conductive electrodes. The sensing surface is coated with a contamination and exposure to condensation. The substrate is typically glass, ceramic, or silicon. The changes in the dielectric constant of a CHS are nearly directly proportional to the relative humidity of the surrounding environment. CHS are able to function in high temperature environments (up to 200°C), near linear voltage output, wide RH (Relative Humidity) range, high condensation tolerance, reasonable resistance to chemical vapors and contaminants, minimal long-term drift, high accuracy, small size and low cost.

Moisture sensor works on a principle of conductance's of electricity. Sensor consists of two electrodes parallel to each other which are inserted in materials of plaster of Paris and saw dust, in proportional of 2:1. Zigbee is a short distance, simple-structured, low power, and low transmission rate wireless communication technology. It has a transmission range of 120 m and uses ISM 2.4GHz transmission frequencies. . Zigbee is expected to provide low cost and low power connectivity for equipment that needs battery life as long as several months to several years but does not require data transfer rates as high as those enabled by Bluetooth. Zigbee module CC2530 is a low cost true single chip 2.4GHz transceiver designed for very low power wireless applications.

The circuit is intended for the ISM (Industrial, Scientific and Medical) and porous metal electrode to protect it from SRD (Short Range Device) frequency band at 2400-2483.5 MHz. The RF transceiver is integrated with a highly configurable baseband modem. The modem supports various modulation formats and has a configurable data rate up to 500 kbps.CC2530 provides extensive hardware support for packet handling, data buffering, burst transmissions, clear channel assessment, link quality indication and wake-on-radio. It can be interfaced with the microcontroller or a PC using serial port with the help of appropriate level converter.Fig.3 shows the Communication between Zigbee and PC.

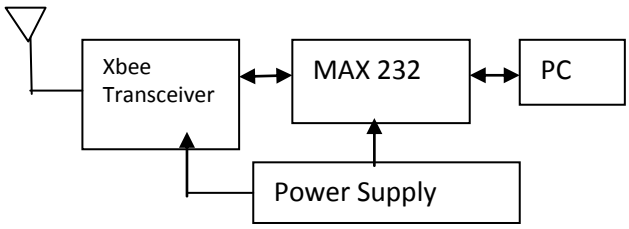

Fig.3 Base Station

V.CONCLUSION

In green house technology, the automation of agricultural Parameters becomes a necessary part. Therefore wireless Communication with simple hardware and user friendly. Software is shown to be an economical solution for automated green house. In this paper a precision Greenhouse management approach to monitor and control the climate is demonstrated. It's proved to be a boon for Hi tech agricultural field. The proposed approach incorporates a great potential for remote crop monitoring and control

using WSN technology for large scale green house. The system presented here is user friendly, low cost and can be easily implemented.

REFERENCES

[1] I.F. Akyildiz, W. Su, Y. Sankarasubramaniamm, and E. Cayirci, "*Wireless sensor networks: a survey*," Computer Networks, ElsevierScience B.V., 2002, pp. 393–422.

2] Zhiwei Li, Shuanxi Wang, Changzhen Gao, Zhang, Qinghe Chu, "*Research and application of autocontrol system for solar greenhouse comprehensive environment with temperature as principal parameter*," Transactions of CSAE. March 2002, vol. 18, pp. 68-71.

[3] Ruiz G L, Barreiro P, Robla J I, "*Performance of ZigBee- Based wireless sensor nodes for real-time monitoring of fruit logistics," JURNAL OF FOOD ENGINEERING*. 2009, vol. 97, pp.405-415

[4] Ning Wang, Naiqian Zhang, Maohua Wang, *"Wireless sensors in agriculture and food industry—Recent development and future perspective*,"*Computers and electronics in agriculture*. 2006, vol. 50, pp. 1-14.

[5] Yihua Cai, Gang Liu, Li Li, Hui Liu, "*Design and test of nodes for farmland data acquisition based on wireless sensor network*," *Transactions of the CSAE*. April 2009, vol. 25, pp.176-178

[6] Huafeng Han Kemin ,Du, Zhongfu Sun, "*Design and application of ZigBee based telemonitoring system for greenhouse environment data acquisition*," Transactions of the CSAE.July 2009, vol. 25.

[7] Zigbee Alliance Board of Directors, "*ZigBee Specification*,"Jan. 2008 pp: 29~30

[8] Martin P.Bates, "*Programming 8-Bit PIC Microcontrollers in C with interactive hardware simulation*," Edition 2008, Elsevier Ltd