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Automatic Monitoring and Controlling of Greenhouse System using Zigbee

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***Abstract*: -- The usage of Wireless Sensor Networks has become really important in recent years because of their ability to manage real-time data for various novel services. In this paper a ZigBee based automatically monitored and controlling system for greenhouse system is designed and implemented. This system utilizes an ARM7 processor, various sensors and ZigBee communication module. The entire system is powered by using a solar plate, placed outside the greenhouse system. Sensors gather various physical data from the field in real time and transmit it to the processor and to the end user via ZigBee communication module. Then necessary actions are initiated to perform action on behalf of people to reduce or eliminate the need of human labor. Necessary threshold values for each sensor measurement have been included in the program, so that the essential parameters necessary for plant growth can be accurately controlled. The proposed system has been tested for a week and reasonable results have been observed, which indicate that this system is very much useful for automatic greenhouse system monitoring and control.**

***Keywords*— Sensors, Automatic control, Zigbee, Agriculture, communication, solar plate and greenhouse.**

I. INTRODUCTION

Due to the recent developments in wireless communication technologies, Nano electronics and Micro Electro Mechanical Systems (MEMS) a lot of improvements happened in the area of Wireless Sensor Networks (WSN). A wireless sensor network typically consists of a number of sensor nodes (few tens to thousands) operating together to monitor a specific region to obtain various physical data about the current environment and based on some local decision process, they can transmit the sensed data to the user. Each such sensor node consists of main parts such as a battery, a radio transceiver with an antenna, a microcontroller, an actuator and an electronic circuit for interfacing with the sensors. All these electronic components are embedded in a single small case. Actually these sensors are tiny and are inexpensive, with very limited processing and computing resources. There are a variety of sensors such as biological, chemical, magnetic, mechanical and thermal to measure the physical properties of the environment. Since the sensor nodes have limited memory and are typically deployed in difficult to access locations, a wireless radio technology is implemented to transfer the data to a computer system, which is called a base station. The primary source to power the electronic circuit is the battery, besides solar panels can also be added to the sensor node depending on the environment where the sensor is deployed. Also depending on the application and the type of sensors, actuators may be installed along with the sensors. Basically there are two types of wireless sensor networks: Structured and Unstructured. An Unstructured wireless sensor network is one in which several sensor nodes are interconnected in a dense manner and are installed randomly in the measuring environment. Once installed, the network is left unattended to perform monitoring and report the measured variables. Also network maintenance such as managing connectivity and detecting failures becomes very difficult since there are so many number of nodes. In a Structured wireless sensor network, all or some of the sensor nodes are arranged in a pre-planned manner. The main advantage of a structured wireless sensor network is that fewer nodes can be installed at specific required locations with minimum network maintenance and management cost, whereas still less number of nodes can be arranged randomly to cover the regions of not interest. Wireless sensor networks have become increasingly important because of their ability to monitor and manage situational information for various intelligent services. Therefore wireless sensor networks have been functioning in many fields such as biomedical health monitoring, military target tracking and surveillance, hazardous environment exploration, natural disaster relief and seismic sensing. Specific examples such as in biomedical applications, surgical implants of sensors can help monitor a patient's health, military applications include spatially-correlated and coordinated troop and tank movements, natural disaster relief applications include collection and detection of environmental data for prediction of disasters before they occur and seismic sensing applications include random installation of sensors along the volcanic area to detect earth quakes and volcanic eruptions. A wireless sensor network consists of the transport layer, application layer, data link layer, network layer, physical layer. Also WSN contains

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mobility management plane, power management plane and the task management plane.

A greenhouse also referred as a glasshouse is a structure or complex in which plants are grown. These structures range in size from small cabins to industrial-sized buildings. A miniature greenhouse is known as a cold frame. Greenhouses allow for greater control over the growing environment of plants. Depending upon the various technical parameters of a greenhouse, vital factors such as temperature around the plants, levels of light and shade, moisture content, application of fertilizers, and atmospheric humidity will be effectively controlled.

Recent advances in semiconductor technologies and in wireless sensor networks have made maintaining and functioning of agro-based industries like Greenhouse, Floriculture and Horticulture etc. easier than ever before. The need for intelligent farming has grown to a larger extent in the production of various crops. Nowadays the greenhouse agriculture is emerging very fast with the rising demand of various fresh vegetables and crops in the large and medium cities. A greenhouse is a kind of place in which it can change the plant growth environment, create optimum condition for plant growth, and keep out of the environment changes and the influence of terrible weather. The main purpose of using greenhouse concept is to increase crop yield, regulate growth cycle, improve its quality and improve economic benefit. By utilizing natural resources, various physical parameters such as temperature, humidity, intensity of illumination and carbon dioxide content can be improved in a greenhouse system. However a wireless sensor network has some challenges in its design and applications. Firstly, the sensors operate from a limited power source i.e. a battery. Secondly the sensors operate in short communication range and have limited processing and storage capabilities in each node. Also the size of the network varies with the monitoring environment. For indoor environments, fewer nodes are required to form a network in a limited space whereas outdoor environments may require more nodes to cover a larger area. In this paper, a ZigBee based automatic monitoring and controlling of greenhouse system model is designed and implemented.

This paper is organized as follows. Various works related to the existing system are shown in Section II. Hardware design and implementation of greenhouse system is discussed in Section III. The hardware results and discussions are presented in Section IV. Finally, conclusions are drawn in Section V.

II. RELATED WORKS

Stipanicev et al [1] studied network embedded greenhouse monitoring and control based on a TINI embedded web server unit which gathers and routes data from local sensor/actuator networks to a global network-Internet. Gill et al [2] proposed ZigBee based home automation system that can control and monitor home appliances. The proposed system is composed of a home network device and a home gateway. M. Haefke et al [3] developed a ZigBee based smart sensing platform for monitoring environmental parameters. Ahonen et al [4] monitored the environment of a greenhouse using a WSN and assessed the network using collected data. Li et al [5] designed a remote monitoring system for the greenhouse environment. They deal with the software of the embedded web remote monitoring system for greenhouse environments. Sun et al [6] designed an embedded database system for temperature and humidity control in the greenhouse. Lokesh Krishna et al [7] presented a ZigBee based energy efficient environmental monitoring, alerting and controlling system. The proposed system alerts and controls various physical parameters in the greenhouse system. A prototype hardware model is developed and tested. Kang et al [8] developed an automatic greenhouse environment monitoring and control system and studied the development of environmental monitoring sensor nodes and a monitoring system in greenhouses.

Currently the development of the Greenhouse industries is rising. Almost 95% of the existing greenhouse monitoring and controlling systems are operated manually. They use wired communication, for controlling the entire process. The major problems with the wired communication are that it requires high cost for installation and maintenance, any broken node is more likely to cause the entire controlling system out of work. By using wireless communication we can overcome these kinds of problems. The wireless communication does not require any type of wiring. Wireless communication module can be used to collect the monitored values from various sensors and then communicate between the centralized control server and the actuators located in the different places of the greenhouse. The ZigBee (IEEE 802.15.4 standard) technology is chosen for networking and communication in this paper, because it has low-cost characteristics and operates at low-power. Compared to the existing related research works, in this paper, an energy

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efficient automatic monitoring and controlling system using ZigBee wireless communication technology is designed and implemented.

III. HARDWARE IMPLEMENTATION

Monitoring and controlling of greenhouse system parameters play a significant role in greenhouse production and management. The proposed Greenhouse system is used to measure the various physical parameters like Temperature, Humidity and Light and displays them on a LCD as well as the measured data is transmitted to the server through Zigee. ARM7 Microcontroller controls these parameters and keeps them at some predefined levels using relay interface. Appropriate environmental conditions such as efficient use of water, pesticide usage and other resources are necessary for optimum plant growth and improved crop yield.

The proposed automatic greenhouse system consists of transmitter section and the monitoring section. The block diagram of the transmitter section is shown in figure 1. The transmitter section consists of microcontroller (LPC2148), various sensors such as Temperature sensor, Humidity sensor, Soil Moisture sensor, CO2 sensor and LDR sensor, power supply section connected with solar plate, ZigBee transmitter, Water sprinkler, and DC motor. The monitoring section consists of a ZigBee receiver and a Laptop with application language. The block diagram of receiving section is shown in figure 2.

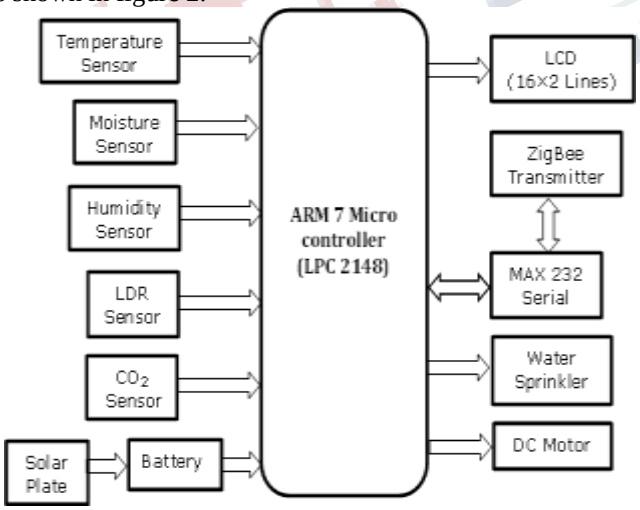

Fig. 1 Block diagram of the Transmitter section

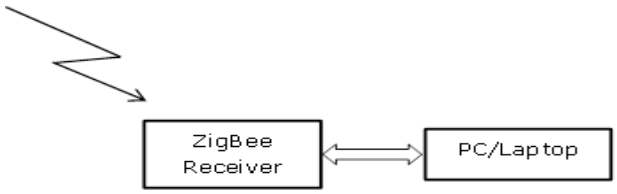

Fig. 2 Block diagram of the Monitoring section

The main hardware components used in the system are

A. Microcontroller

The ARM7TDMI-S is a general purpose 32-bit microprocessor, which offers high performance and very low power consumption. The ARM architecture is based on Reduced Instruction Set Computer (RISC) principles, and the instruction set and related decode mechanism are much simpler than those of micro programmed Complex Instruction Set Computers (CISC). This simplicity results in a high instruction throughput and impressive real-time interrupt response from a small and cost-effective processor core.

B. Temperature Sensor

The LM35 sensor series are precision integrated-circuit temperature sensors, whose output voltage is linearly proportional to the Celsius (Centigrade) temperature.

C. Humidity Sensor:

The Moisture Sensor detects the moisture of the soil around the sensor, which is ideal for monitoring the plants or the soil moisture.

D. CO2 Sensor

The CO2 Gas Sensor measures the gaseous carbon dioxide levels by monitoring the amount of infrared radiation absorbed by carbon dioxide molecules. It has two settings: low range (0–10,000 ppm) and high range (0–100,000 ppm).

IV. RESULTS

Real time measurements have been carried out using various sensors such as humidity sensor, temperature sensor and moisture sensor. The monitored results were obtained, recorded and plotted. Figure 3 shows a prototype view of the hardware implementation of the system. Table 1, shows the various monitored values in the greenhouse system. recorded

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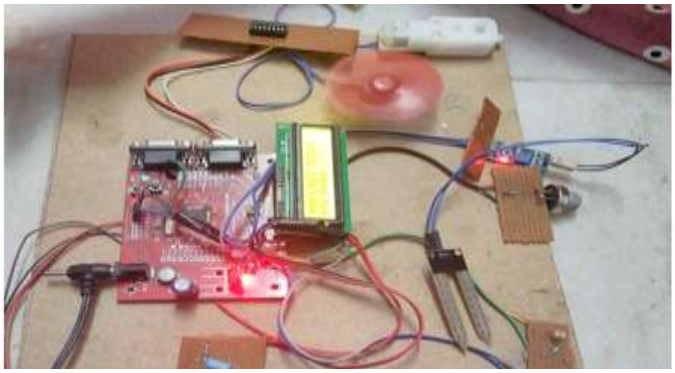

Fig.3 Prototype of the Transmitter section

Tab.1 various sensor readings monitored on a given day

S.No:	Date and Time	Temperature in °C	Humidity in %	Moisture in mV
1	21-02-2017 09:00:00AM	32.1	54	186
2	21-02-2017 09:30:00AM	33.4	52	185
3	21-02-2017 10:00:00AM	36.3	49	183
4	21-02-2017 10:30:00AM	37.8	45	182
5	21-02-2017 11:00:00AM	38.2	43	180
6	21-02-2017 11:30:00AM	39.1	41	172
7	21-02-2017 12:00:00PM	40.1	40	164
8	21-02-2017 12:30:00PM	40.5	39	155
9	21-02-2017 01:00:00PM	41.8	37	143
10	21-02-2017 01:30:00PM	41.3	36	138
11	21-02-2017 02:00:00PM	41	33	132
12	08-01-2016 02:30:00PM	40.6	31	126
13	21-02-2017 03:00:00PM	39.6	29	121

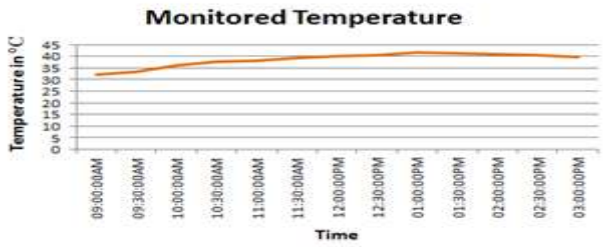

Fig.4 Monitored Temperature values

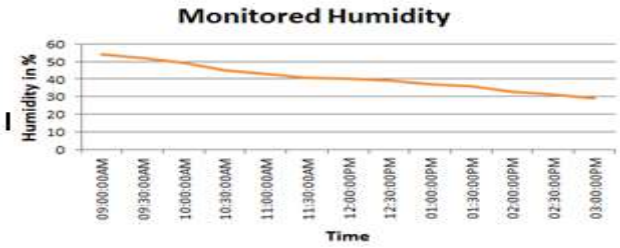

Fig.5 Monitored % Humidity values

V. CONCLUSIONS

In today's greenhouse system, many essential parameters are required to be monitored and controlled for the good quality and better crop yield. To get better crop yield the important parameters to be considered are Temperature, Humidity, Light and Water. Considering these important parameters, an automatic greenhouse monitoring and controlling system is implemented using ARM7 microcontroller. The proposed system is highly efficient for growing good quality plants and obtaining better crop yield. Water is automatically turned ON whenever the sensed moisture content falls below a given threshold value. Also the windows are automatically opened whenever brightness level falls below a predetermined level. The proposed system is capable of controlling the essential parameters necessary for plant growth, viz. soil moisture level, watering using sprinkler, temperature, light intensity, and humidity, etc. Also the proposed system is found to be economical, portable, operates with less maintenance cost and can be operated with persons having no technical knowledge.

REFERENCES

[1] Stipanicev, D., Marasovic, J. Networked Embedded Greenhouse Monitoring and Control. In Proceedings of the 2003 IEEE International Conference on Control

Applications, Istanbul, Turkey, 23–25 June 2003; pp. 1350-1355.
[2] K. Gill, S.-H. Yang, F. Yao, and X. Lu, "A Zigbee-based home automation system," IEEE Trans. Consumer Electron., vol. 55, no. 2, pp. 422-430, May 2009.
[3] M. Haefke, S. Mukhopadhyay and H. Ewald, "A Zigbee Based Smart Sensing Platform for Monitoring Environmental Parameters", IEEE Conference on Instrumentation and Measurement Technology, pp. 1–8, May 2011.
[4] Ahonen, T.; Virrankoski, R.; Elmusrati, M. Greenhouse Monitoring with Wireless Sensor Network. In Proceedings of the IEEE/ASME International Conference on Mechatronic and Embedded Systems and Applications, Beijing, China, 12–15 October 2008; pp. 403-408.
[5] Li, X.; Sun, Z.; Huang, T.; Du, K.; Wang, Q.; Wang, Y. Embedded Wireless Network Control System: An Application of Remote Monitoring System for Greenhouse Environment. In Proceedings of the IMACS Multiconference on Computational Engineering in Systems Applications, Beijing, China, 4–6 October 2006; pp. 1719-1722.
[6] Sun, R.-G.; Wan, Z.; Sun, D.-C. Greenhouse Temperature and Humidity Intelligent Control System. In Proceedings of the 3rd WSEAS International Conference on Circuits, Systems, Signal and Telecommunications, Ningbo, China, 10–12 January 2009; pp. 120-125.
[7] K. L. Krishna, J. Madhuri and K. Anuradha, "A ZigBee based energy efficient environmental monitoring alerting and controlling system," 2016 International Conference on Information Communication and Embedded Systems (ICICES), Chennai, 2016, pp. 1-7.
[8] Kang, B.J.; Park, D.H; Cho, K.R.; Shin, C.S.; Cho, S.E.; Park, J.W. A Study on the Greenhouse Auto Control System Based on Wireless Sensor Network. In Proceedings of the International Conference on Security Technology, Sanya, China, pp. 41-44, 13–15 December 2008.