"A ZIGBEE BASED SMART WIRELESS SENSOR NETWORK FOR MONITORING AN AGRICULTURAL ENVIRONMENT"

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ABSTRACT

India is an agricultural country and most of the people are farmers. Farmers are cultivating different types of crop. Different crops require different type of Temperature, water providation, etc. In conjunction with the population growth over last century, the need for finding new, more efficient, and sustainable methods of agricultural cultivation and food production has become more critical. To facilitate this process, we are designing, building, and evaluating a system for precision agriculture which provides farmers with useful data about the soil, the water supply, and the general condition of their fields in a user friendly. The main objective of the present paper is to develop a smart wireless sensor network (WSN) for an agricultural environment. Monitoring agricultural environment for various factors such as soil moisture, temperature and humidity. This paper investigates a remote monitoring system using Zigbee. These nodes send data wirelessly to a central server, which collects the data, stores it and will allow it to be analyzed then displayed as needed and can also be sent to the client mobile.

Keyword: - Sensors, Microcontroller, ZigBee Module, Agricultural Environment

1. INTRODUCTION

Agriculture is one of the most important sources for human. It provides food for human and makes financial security and also plays a major vital role in the economy of the country. In the last few years, the occurrences of natural Changes in atmosphere is a have been becoming the cause for the Fungus, Bacterial attacks on the agricultural. If such changes are not aware in time to us the precautions cannot be taken and there will be bad affect on the agricultural production In this project, we present a system that can be used to monitor various parameters like Temperature, Humidity, Soil moisture, water level sensor[3]

We are using a wireless sensor network based on Zigbee/IEEE802.15.4 standard is utilized as a weather station network sending weather information.[4] This paper focuses on developing devices and tools to manage, display and alert the weather warnings using the advantages of a wireless sensor network system. For this ARM7 based 16/32-bit microcontroller LPC2138 whose core is a 32 bit embedded RISC processor which provides the best performance in power and area characteristics.[4] It has UART serial communication which allows us to design a ZigBee network, inbuilt analog to digital converters which can be directly interfaced to the sensors which have analog values[4]. Soil moisture sensor, temperature and humidity sensor are used to measure the climatic parameters in agriculture land. LCD used to display the sensed parameters.

The ZigBee standard is built on top of the IEEE 802.15.4 standard. The IEEE 802.15.4 standard defines the physical and MAC (Medium Access Control) layers for low-rate wireless personal area networks. The physical layer supports three frequency bands with different gross data rates[7].
For implementing a network in medium range with low cost and low power ZigBee is suitable, for extreme long range monitoring[4]

Features	**Wi-Fi**	**Bluetooth**	**ZigBee**
Radio	DSSS	FHSS	DSSS
Data rates	11Mbps	1Mbps	250Mpbs
Slave enumeration latency	Upto 3 S	Upto 10 S	30 ms
Range (m)	100	10	70
Exendability	Roaming Possible	No	Yes
Battery Life	Hour	1 week	>1 year
Complexity	*Complex*	Very Complex	Simple

Table 1: Comparison between Wi-Fi, Bluetooth and ZigBee [4]

2. LITERATURE SURVEY

1] PG Scholar,Dundigal Rangareddy, "A Smart Wireless Sensor Network for Monitoring and Agricultural Environment using Embedded System" International Journal of scientific Engineering and ResearchVolume.03,Issueno.2,September2014,pages:4120-4122. In this paper ,Water level sensor ,Temperature sensor and Humidity sensor is used in our paper we used additional soil moisture sensor to detect either the soil needs water or not. and Ultrasonic sensor to detect boundries [10]

2]Gopalakrishna Moorthy. K,Dr.C. Yaashuwanth,"Wireless Monitoring of Soil Moisture, Temperature & Humidity Using Zigbee in Agriculture", International Journal of Engineering and Innovative Technology (IJEIT) Volume 2,Issue8,Februvary 2013.according to this paper for boundry detection they used nothing,in our paper we used ultrasonic sensor for it.[6]

3] Prof C. H. Chavan,Mr. P. V.Karande on 10 may 2014."Wireless Monitoring of Soil Moisture, Temperature & Humidity Using Zigbee in Agriculture", International Journal of Engineering Trends and Technology (IJETT) – Volume 11 Number 10 - May 2014, They used AVR Microcontroller, LCD, remote monitoring for temperature and humidity they used different sensors

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4] On 4 april 2015 in Bhidavan institute of Technology & science. They used Microcontroller and ADC(0808).

5] Chaitanya,P.Aruna Kumari. "Zigbee based Wireless Sensing Platform for Monitoring Agriculture Environment" International Journal of Computer Applications (0975 – 8887) Volume 83 – No 11, December 2013. They used different sensors to measure Temperature and Humidity.

6] Q. Wang, A. Terzis and A. Szalay, "A Novel Soil Measuring Wireless Sensor Network", *IEEE Transactions on Instrumentation and Measurement*, pp. 412–415,August 2010.We used additional Ultrasonic sensor.

7]] M. K. 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.In this paper we used LPC 2148 microcontroller and ultrasonic additional sensor.

8] I. Singh and M. Bansal, "Monitoring Water Level in Agriculture using Sensor Networks", *International Journal of Soft Computing and Engineering*, pp. 202–204, November 2011.In this paper only waret level is monitored in our paper we monitor different parameters like Temperature, Humidity, Soil moisture.

3. DISCRIPTION:

The system can be represented using block diagram as shown below.[3]

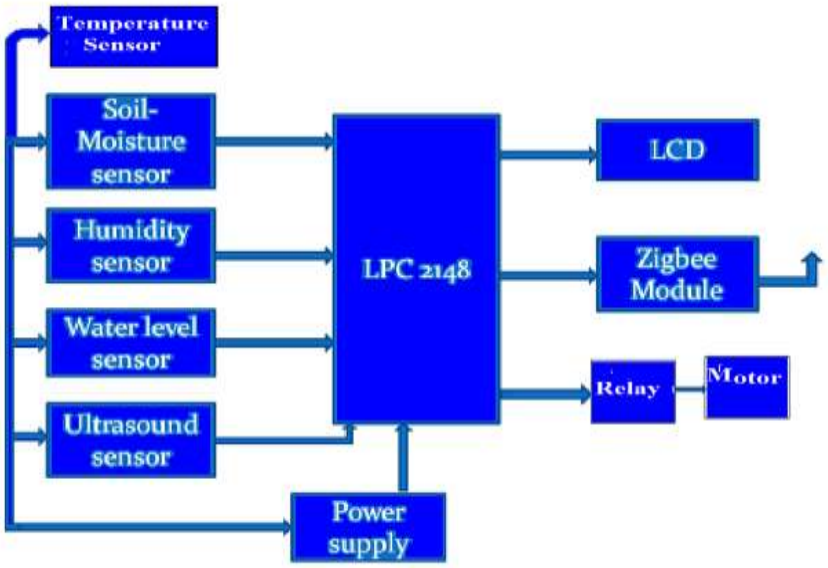

Fig.1 Transmitter block diagram

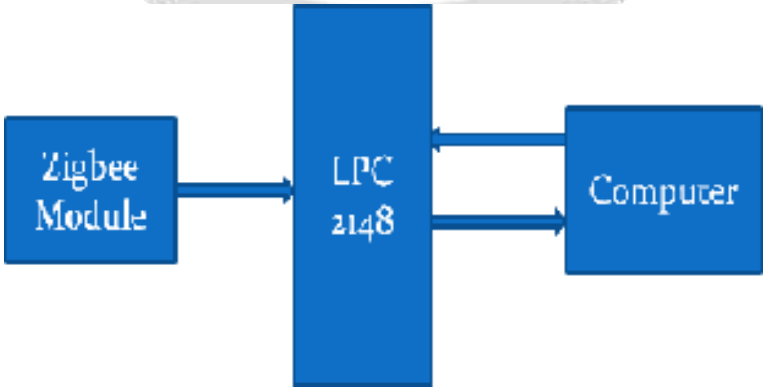

Fig. 2 Receiver block diagram

1) Soil Moisture Sensor :

It is mainly used to detect the presence of moisture in the soil. Soil moisture sensor gives the output in two different forms i.e. analog and digital. In digital mode the sensor reads the value and compares it with the threshold voltage, if the value is above threshold then it gives 0V digital output. if the value read by the sensor is below the threshold voltage, a high output voltage of 3.3 or 5V will be generated in this way we can directly read the current soil moisture if it is above threshold or not. In analog mode the accurate dryness of the soil is read in percentage[4].

2) Temperature Sensor (LM 35):

The LM35 series are precision integrated-circuit temperature sensors, whose output voltage is linearly proportional to the Celsius (Centigrade) temperature. The LM35 does not require any external calibration or trimming to provide typical accuracies of ±¼°C at room temperature and ±¾°C over a full -55 to +150°C temperature range. Low cost is assured by trimming and calibration at the wafer level. The LM35's low output impedance, linear output, and precise inherent calibration make interfacing to readout or control circuitry especially easy[3].

3) Humidity sensor (HS 220) :

This module converts the relative humidity to the corresponding output voltage. Operating humidity: 30 – 90%RH, standard output: DC 1980mV (at 250C, 60%RH), accuracy: +/-5%RH (at 250C, 60%RH)[3]

4) WL400 Water Level Sensor :

WL400 Water Level Sensor submersible pressure transducer consists of a solid state pressure sensor encapsulated in submersible stainless steel 13/16" diameter housing. The water level gauge uses a marine grade cable to connect the water pressure sensor to the monitoring device. Each of Global Water's pressure transducers has a two-wire 4-20 mA high level output, five full scales ranges, and is fully temperature and barometric pressure compensated. Water level sensor level ranges of 0-3, 0-15, 0-30, 0-60, 0-120, 0-250 and 0-500 ft are available[5].

5) Ultrasound sensor :

We used Ultrasonic sensor to detect the boundaries of the crop field. With this feature we able to take the data of entire crop field. Ultrasonic sensor provide precise, non-contact distance measurements from 2 cm to 3 meter. It is very easy to connect to BASIC stamp microcontrollers, requiring only i/o pins.

6) Microcontroller 2148 :

ARM7 LPC2148 has the following features which are required for monitoring agriculture environment.

1. 16/32- bit ARM7 TDMI-S microcontroller
2. In-system programming / In-Application programming (ISP/IAP)
3. 40kB of on-chip static RAM and 512kB of on-chip flash memory
4. Two 10-bit ADCs provide a total of 14 analog inputs, with conversion time as low as 2.44μs per channel
5. Multiple serial interfaces including two UARTs
6. 48 of 5V tolerant fast general purpose I/O pins
7. CPU operating voltage range of 3.0V to 3.6V (±10%) with 5V tolerant I/O[3]

7)ZigBee Module :

It is the only standards-based wireless technology designed to address the unique needs of low-cost, low power wireless sensor and control networks in just about any market. Since ZigBee can be used almost anywhere, is easy to implement and needs little power to operate, the opportunity for growth into new markets, as well as innovation in existing markets, is limitless.[5]

8) LCD:

LCD is used in a project to visualize the output of the application. We have used 16x2 LCD which indicates 16 columns and 2 rows. So, we can write 16 characters in each line. So, total 32 characters we can display on 16x2 LCD.[6]

4. SOFTWARE USED:

1. For programming keilμ4 and for dumping the code flash magic are used.
2. For configuring Xbee modules X-CTU software is used.

Keil compiler is software used where the machine language code is written and compiled. After compilation, the machine source code is converted into hex code which is to be dumped into the microcontroller for further processing. Keil compiler also supports c language code[4].

5. FLOWCHART:

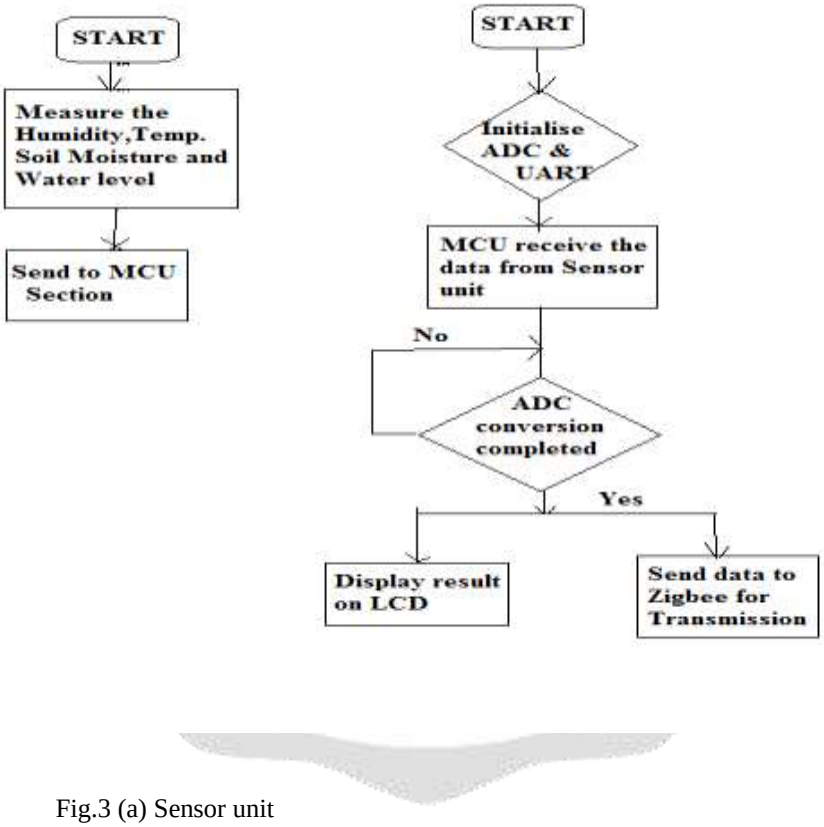

Fig.3 (a) Sensor unit

(b) Microcontroller section

6.WORKING:

At Transmitter side, Initially power is on. After this system is reset. Then all sensors senses the data from environment. e.g soil moisture sensor sense the moisture in soil, Humidity sensor sense the humidity in environment temperature sensor sense the temperature of environment, also Water level sensor gives information about level of Water in Soil. In this way all data in analog form is given to 8 bit ADC of microcontroller which can convert the all incoming data into digital form. This digital data is display on LCD. and also transmit to receiver side through wireless ZigBee module through Tx and Rx pin.

At receiver side ZigBee come into picture. There is only one Tx and Rx pins Signal is send to LPC 2148 and parameters like temperature, soil moisture and humidity are monitored. These parameters are monitored on computer using RS-232 port. This data can be used for precision farming. All data with respect time and date are stored in computer**.**

7.CIRCUIT DIAGRAM:

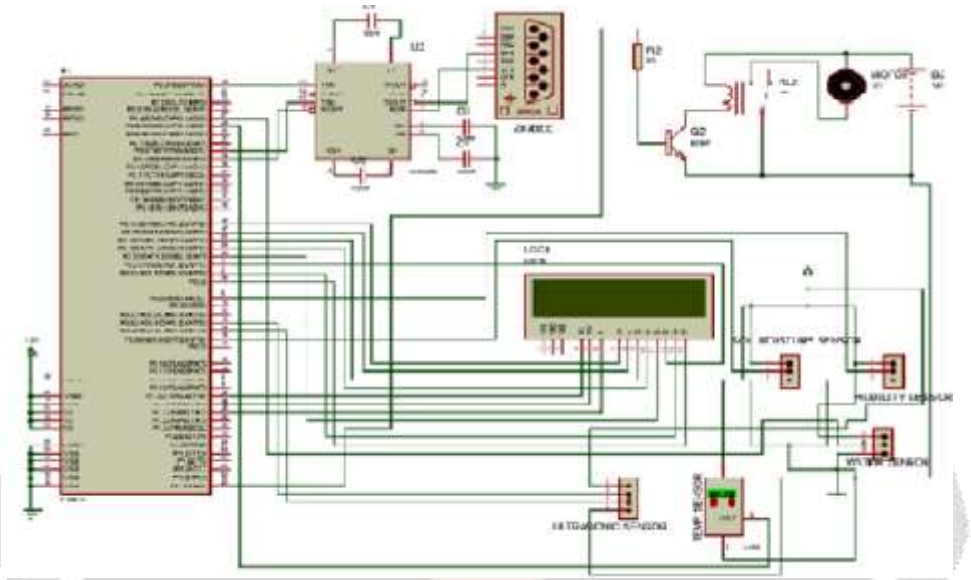

Fig.4 Circuit diagram

8.ADVANTAGES:

1) Highly sensitive, Low cost and reliable circuit.
2) Works according to the commands.
3) System can be switched into manual mode whenever required.

9.RESULT:

The following monitoring results are obtained using temperature, humidity and moisture sensor. These real times monitoring results are recorded on server

In proposed system, temperature sensor, soil moisture, water level and Ultrasonic sensor .All these sensors senses the data in analog form and gives to microcontroller for further processing. After that that output send to receiver side through ZigBee module .also it displays on LCD and saved in computers.

Fig.5 Result of Proposed system

Humidity	Temperature	SoilDry
39	30	56
38	30	63
37	31	82
37	31	68
37	32	57
37	32	73
36	33	60
36	33	60
36	34	60

Table no.2.Observed value of Proposed system

10.CONCLUSION

Zigbee-based agriculture monitoring system serves as a reliable and efficient system for monitoring agricultural parameters. The corrective action can be taken. Wireless monitoring of field not only allows user to reduce the human power, but it also allows user to see accurate changes in it. It is cheaper in cost and consumes less power. The GDP per capita in agro sector can be increased. This project can be extended for cattle monitoring.

11. REFERENCES

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