Zigbee Wireless Sensor Network Technology Study for Paddy Crop Field Monitoring

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ABSTRACT
Sensors are the hopeful device for precision agriculture. By forming wireless sensor network we can make good monitoring system in the paddy crop field area. This paper proposed idea about monitoring the crop field area without man power. The fundamental concept of this paper is to provide a highly enabled monitoring of paddy crop field. In this paper we have detailed about how to utilize the sensors in paddy crop field area and explained about Wireless Sensor Network (WSN), Zigbee technology, Protocol stack of zigbee. We checked out the zigbee technology with two different commercial modules (Xbow and Xbee).We did the analysis of battery life under sensor deployed in the water conditions and the evaluation of the reliability of communications and measurements.

General Terms
GSM node, Xbow node, Xbee node

Keywords: Wireless Sensor Network, Zigbee, Crop Field monitoring

1. INTRODUCTION

1.1Wireless Sensor Network
Wireless sensor network is a network in which several types of sensor nodes are deployed. Wireless sensor network is scalable and consumes very little power, software programmable and fast data acquisition. A WSN (wireless sensor network) generally consists of base station (or) gateway that can communicate with a number of wireless sensors via a radio link. WSN can eliminate the cost of installation, maintenance and eliminates connectors [1].Wireless sensor networks are used in many applications such as environmental monitoring, habitat monitoring military surveillance, inventory, tracking, smart spaces and all. Wireless sensor networks are essential for monitoring the agricultural field area, such as paddy crop field area, fruit field area for get real time datas. Gateway is used for to connect separate networks. By using wireless sensor network we can get real time datas such as temperature, pressure, humidity.

1.2 Zigbee Technology
Zigbee is mainly famous for its mesh topology. In this crop field monitoring we used mesh topology. The various sensed data from various sensors goes to the central Global System for Mobile (GSM) node. From that the sensed data is given to the personal computer, which is used by a farmer [2], [3].Zigbee is a low power wireless sensor network technology based on IEEE 802.15 Zigbee operates in the industrial, scientific and medical(ISM) radio bands. In paddy crop field monitoring we used 2.4 GHZ operating frequency nodes for study purpose.

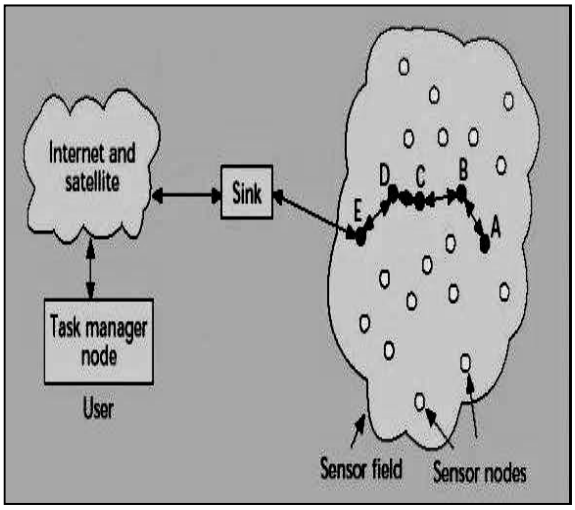

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Fig 1: Wireless sensor network

2. PROPOSED SYSTEM ARCHITECHTURE
The architecture of proposed system has several types of nodes deployed in the paddy crop field area. It captures the physical phenomenon such as pressure, humidity, water level, temperature, pH can be monitoring in a paddy crop field monitoring.

The sensed data from various places of crop field area is transmitted to the central global system of mobile (GSM) node or coordinator node. From that GSM node sensor the datas are sending to the personal computer through gateway.

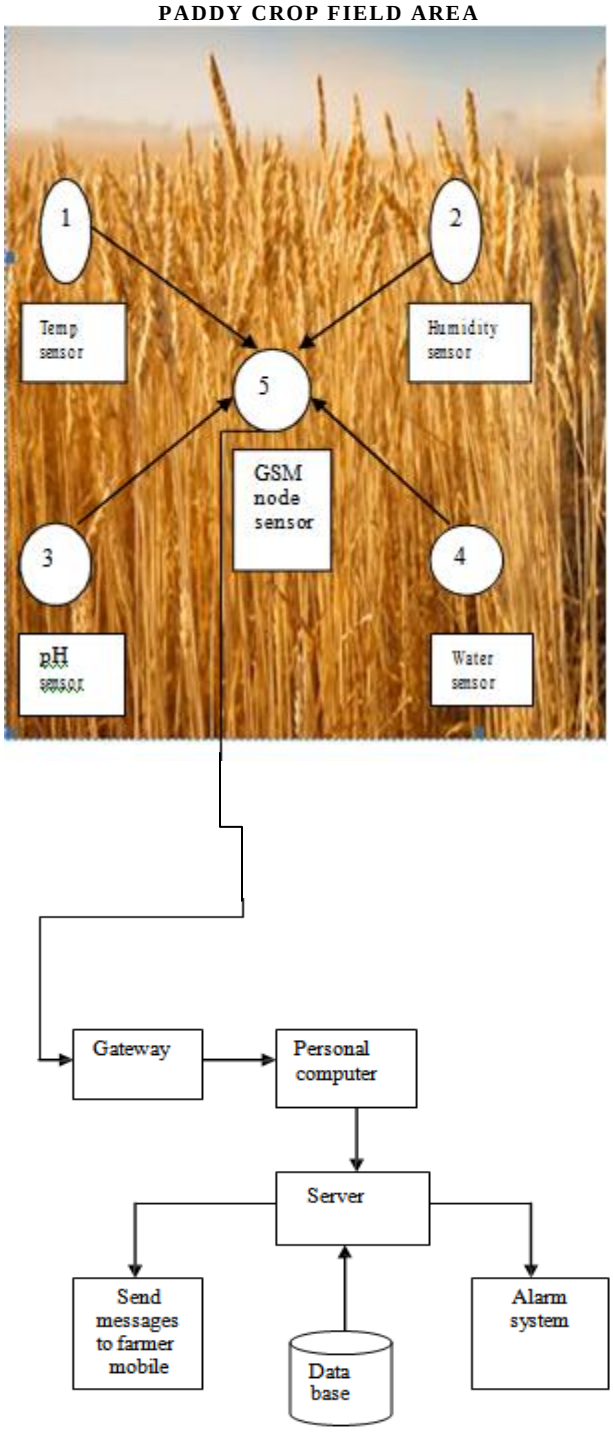

Fig 2: Real time paddy crop field monitoring using zigbee

A Gateway is the device which can be used to connect two networks of different protocols. Some systems require a gateway or coordinator to establish time synchronization. From that gateway the datas are sending to the personal computer.

A server is connected to the database, which having minimum and maximum threshold values of temperature, water level, Ph level. If the sensed data attends maximum or minimum threshold levels stored in the data base, the alarm unit will give alarm sound to the farmer and also we can make message deliver to the farmer mobile. From that the farmer may get attention about the crop field.

2.1 Flow Chart

In paddy crop field we have to irrigate the water full area of the land. After some periods of farming it is not need to irrigate the water fully to the crop field land .We have to irrigate the water depending upon the soil, ups and downs of the land and have to irrigate the water where it needs. In present era there is no mechanism for Irrigate the water where it will be need. In this project we make zigbee wireless sensor network for monitoring the crop field area by deploying water sensors in the land and detect the places, where the water level is low[4].

From those results we irrigate the water to that place only. From the above methodology we can save the water and minimize the problem of water logging in the land. We used humidity sensor to sense the weather. From that the farmer can get idea about the climate. If there is any chance arise for rainfall farmer need not irrigate the water to the crop field. It gets water from naturally by rainfall. Because of that we can save the water and also power due to reduce the running of motors [4].

Nowadays in the crops the fertilizer level is increasing, due to that more problems arise to the people. By using pH Sensors we get the information about the soil and we can get and analyze the acid level of the soil. From that we can put fertilizer to the place where it needs. From that we can avoid over fertilization of the crops.

Temperature is a randomly varying quantity in the environment of paddy field. Temperature reading sometimes gives more helpful to the farmer. By using temperature sensors we can detect the temperature, from that we can irrigate the water to the crop field area [4].

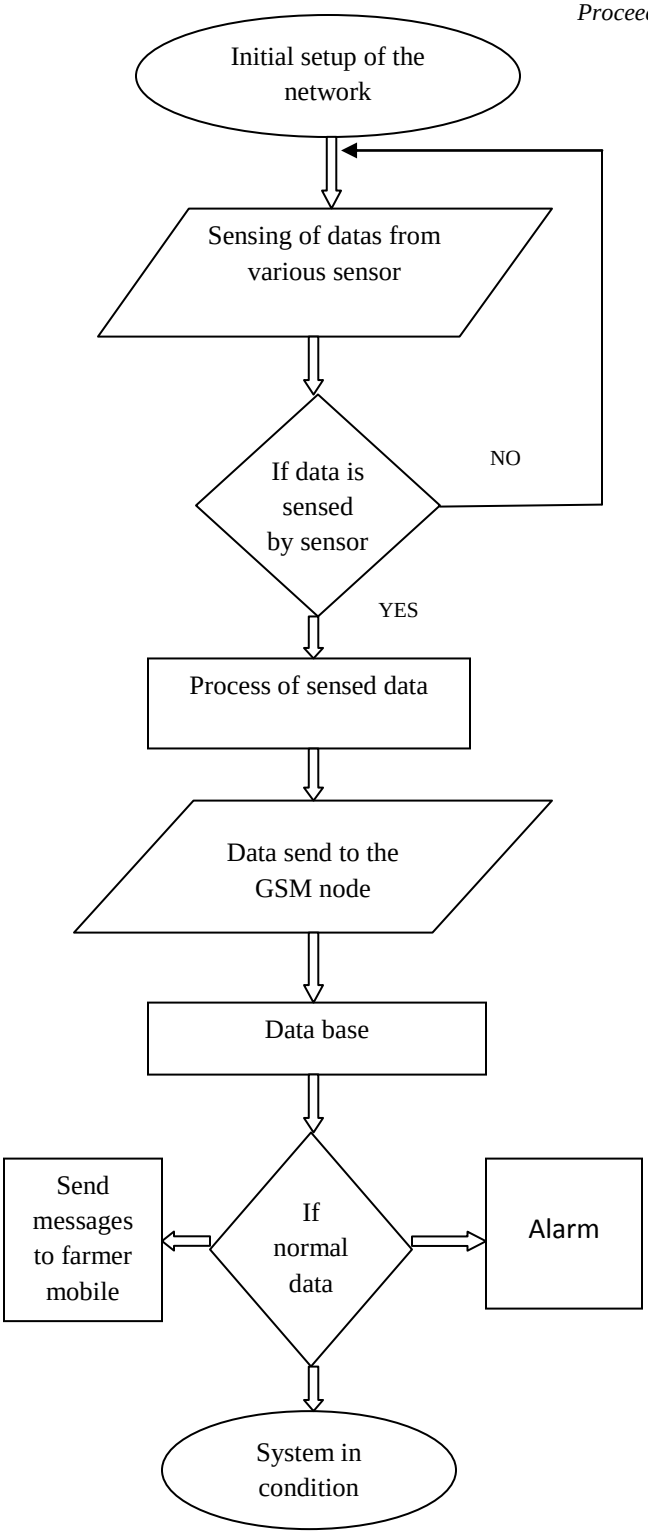

Fig 3: Flow chart

3. COMMERCIAL ZIGBEE MOTES:

We used two different types of ZigBee motes: Xbee-PRO (Xbee) and Crossbow (Xbow). In Xbow system, one sensor node (transmitter), and one base station (receiver), has been tested and in xbee-PRO system four zigbee nodes has been tested.

The Xbow motes are having microcontroller board (Micaz) with sovereign transducer board (MTS420) attached by means of a 52 pin connector. The Micaz mote works with the Tiny Operating System (TinyOS).

Micaz has a radio device Chipcon CC2420 operated with 2.4 GHz and data rate of 250 Kbps. The Radio Frequency power in the Micaz can be vary from -24 dBm to 0 dBm. Two AA alkaline batteries are used for to give power supply. For some of the experiments, we were used two D type batteries.

The transducer board hosts a variety of sensors: That are;

- Temperature and relative humidity (Sensirion SHT),
- Light intensity (TAOS TSL2550D), barometric pressure (Intersema MS5534B),
- Easily removed two-axis accelerometer (ADXL202JE) and GPS (Leadtek GPS-9546).
- A laptop is used as the receiver module, and communicates with the nodes through a Micaz mounted on the MIB520 Zigbee/USB gateway board.

The XBee-PRO RF module works with the Zigbee/IEEE 802.15.4. The configuration can be changed by using AT commands (Hayes command set). According to the manufacturer, it uses 60 mW (18 dBm), 100 mW EIRP (Equivalent isotropic ally radiated power) power output (up to 1.6 km range) [5], [6].

4. EXPERIMENTS DONE WITH XBOW NODES:

By using Xbow zigbee node Different types of experiments were conducted in order to verify the performance of Zigbee wireless nodes (see Table1).

Some were carried out in an experimental in paddy crop field area. In the main parameters considered were the ratios of battery life.

Here battery life time was considered for the reliability measurements. The WSN motes have been tested at the paddy crop field area with two battery types, three different set points and at several locations inside the crop field (see Table 1).

TABLE: 1(XBOW MOTES READING)

S.No	experiment	Description	Mote type	Battery type	set point
1	In paddy crop	Empty land	Xbow	alcaline 2*AA GPS	0ºC 29ºC 33ºC
2	In paddy crop	Empty land	Xbow	alcaline 2*D GPS	0ºC 29ºC 33ºC
3	In paddy crop	Land with water	Xbow	alcaline 2*AA GPS	0ºC
4	In paddy crop	Land with water	Xbow	alcaline 2*D without GPS	5ºC

Sampling rate 11S; the RF power in the Xbow motes was set to 0 dBm. Each transmission referred to as a one packet transmission.

5. DATA ANALYSIS

5.1Battery Life

For AA batteries the time for duration decreases from 915±72 minutes at 33ºC to 813±68 at 29ºC and 286±41 at 0ºC. From the above results we can know that battery life was clearly affected by temperature. While using D type we got battery life 70% greater than the AA batteries. While using GPS the battery life of Xbow motes increasing up to 4300 min at 0ºC with 2AA batteries and falls below 250 minutes when GPS was mounted.

5.2 AA Battery

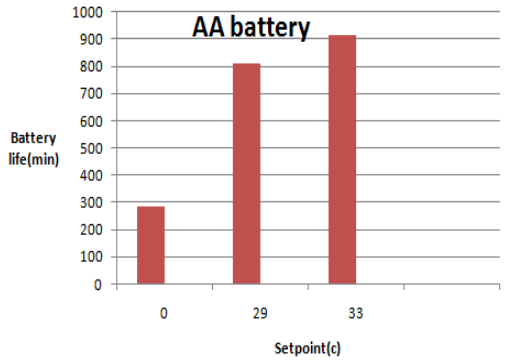

Fig 4: AA Battery Life time

The above graph shows about the battery life time of the Xbow with AA battery attached with the Xbow node.

5.3 D Battery

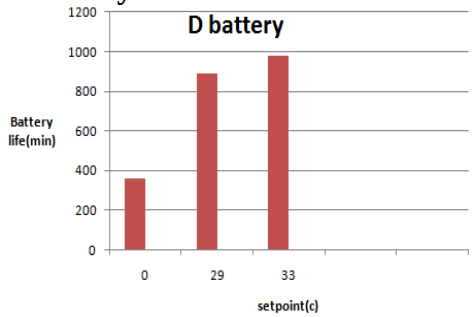

Fig 5: D Battery time life

6. EXPERIMENTAL SETUP OF XBEE NODES:

For Xbee-PRO node measurement we used four Zigbee nodes to form a zigbee network. Temperature sensor and pressure sensor were connected to two zigbee device via microcontroller and humidity sensor was connected to another zigbee via microcontroller.

power supply which may be either external power One zigbee node act as a router and one act as a coordinator, another one act as a end device. All sensed data are sent to the coordinator node which is connected to the personal computer via gateway. By using this network we can sense the data such as temperature, Humidity, water level, PH level, from crop field area. Lot of wired system proposed for this type of monitoring theoretically and practically. We used Zigbee wireless sensor network. The sensing unit consists of sensor and supply or battery operated one. The sensed data from the sensor feed to the processing unit where the controller processes the data which is then passed to the node for transmission over wireless network.

The Zigbee node receives the data and scan for available node to transmit the data to the coordinator node. The coordinator

receives the data, process it and transmit to the monitoring unit, which is going to be observed by a farmer.

Fig 6: x-bee Hardware setup

7. RESULT AND ANALYSIS:

The below result was getting from the temperature sensor. Temperature sensor was connected to the coordinator node, which was connected to personal computer. The above result was taken at real time in our college lab. The result shows about the temperature readings gave by temperature sensor, which was connected via zigbee to the coordinator node.

Graph shows the temperature readings while implemented the nodes in real time environment. From that we know that Temperature is a varying quantity in the paddy crop field area.

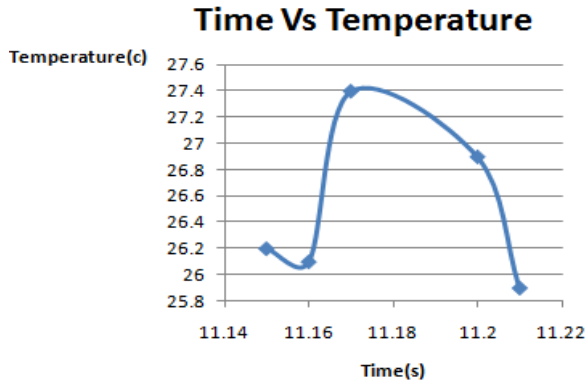

Fig 7: Temperature analysis

8. CONCLUSION:

In this paper discussed about study of zigbee technology for the paddy crop field area with implementing of zigbee networks in real time environment and gives proposed architecture for real time paddy crop field monitoring. Analysis about real time readings of temperature sensor deployed in paddy crop field with Xbee nodes and Xbow nodes. Results show that zigbee wireless sensor network is resourceful for paddy crop field monitoring. Now we are studying in the part how to resend the packets when packet loss occurs and also studying about simulation for more number of nodes implementing in the paddy crop field environment.

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