PROTOTYPING OF WIRELESS SENSOR NETWORK FOR PRECISION AGRICULTURE

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ABSTRACT

Now-a-days the climatic conditions are not same and predictable. More over the wireless sensor network [1] carved path in many applications. There are many manual methods to cultivate a healthy crop which involves a lot of manpower. Hence there is a need to design a system for precision agriculture. Precision agriculture means giving the correct input to the crops at the right time. This paper explains how the real input is given to the crops according to the environment change [2]. This system design uses Arduino Uno .The values which are measured by the sensors are transmitted to a centralized device which is Zigbee (coordinator). After the values received by the Zigbee, according to those values precise decision will be taken by the experts.

KEYWORDS

Arduino, Zigbee, Wireless Sensor Network, Xbee, Precision agriculture.

1. INTRODUCTION

Now-a-days cultivating crops are becoming a very hectic task for the farmers because of the unpredictable climate and expense cost of the seeds. Due to the unpredictable and sudden change of the climate the damage ratio will be high and even the loss rate will be high. The solution for this problem is to adopt the techniques of precision agriculture. Precision Agriculture [9] is a process of giving a correct set of inputs to the crops or lands according to the environment changes. Precision Agriculture follows a defined set of rules. They are collecting the data , processing the data , sending the data to the centralized machine and according to the data received, the decisions will be taken by the expert.

The protection of the crops is very essential. So there is a need for monitoring of the data and that data should be real. In order to provide instant solution to the crops the data should be collected in a smart way. To achieve smartness we have to adopt wireless communication techniques.

In telecommunication and computer science, wireless sensor networks are the active area of research. It plays a major role in many areas of research. Applications are health care monitoring, Area monitoring, quality management, Air pollution monitoring, Nature disaster prevention, data logging etc. In the present work the design consists of a processor board, a group of sensor and a transceiver.

The main object of this paper is to provide quality crop cultivation procedure in a predefined standard i.e. using ZigBee technology [8]. In a network nearly 65500 devices can be connected and synchronized for the monitoring. A network contains many nodes and each node will be deployed in a specified and predefined places. In this several nodes, one node acts as the coordinator that is connected to the centralized machine. Each node consists of a processor i.e. Arduino, sensors to measure the following parameters soil moisture, humidity, temperature, light intensity and a ZigBee which acts as the end device. In order the data has to be routed to many places and reach the destination, in between many router ZigBee are connected in order to complete the network without any packet transmission errors.

1.1 Motivation

The present scenario where the farmers are facing problem is with the input for the crop. If the input like water level, light intensity level to which the plant has to be exposed etc. these are some parameters which should be examined at starting level itself. If parameters are maintained properly the yield will be more. So to provide correct input to the crop and to increase the yield here we are designing a system which is real.

1.3 Domain

Here if we use wired communication, the system becomes complex and sometimes to send data delays may occur and if any damages occurs to the wire the communication struts. To avoid these errors in our system we are adopting wireless communication which is reliable and flexible.

2. OVERVIEW OF ZIGBEE TECHNOLOGY

ZigBee is an IEEE based standard for wireless communication. The difference between the ZigBee and 802.15.4, 802.15.4 has only Mac and physical layer but layer above that is present in the ZigBee which makes the communication very effective. As it has additional layers when compared to 802.15.4 it supports the mesh network topology which is very effective to construct a network. In order to complete a network it needs a coordinator, router and an end device. Each device has its own address and PAN ID (permanent area network identification). The PAN ID of the devices in a network should be same.

Coordinator collects the data from all the nodes and saves in a database. It assigns the PAN ID. Router collects the data from the nodes, it helps the network to grow and it also routes the data in the network. This joins the PAN ID before it transmits the data. End device it collects the data from the processor board. Coordinator can communicate with any Zigbee device in a network. The end device can't communicate directly with another end device [3].

The Xbee modules can be configured in both AT and API modes. Here in order to form a network, API mode is used for both point-to-point and mesh network communication .

API FRAME: The communication between the two Xbee are done in a structured way, where it has to follow the same format throughout the network.

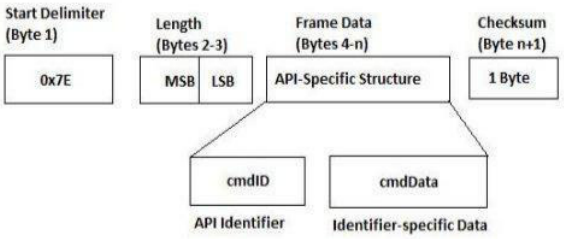

Fig 1. Frame format.

3. DESIGN IMPLEMENTATION

To design a wireless sensor network (WSN), the components required are a processor board, sensors and transceiver, which are explained below.

Sensor unit: The parameters which are going to measure here in this work are Soil moisture, temperature, humidity and light intensity [4]. The soil moisture is measured because some crops require lot of water flow and some plants doesn't require water flow. To maintain the water present in the soil the moisture sensor is used. The light intensity is measured because some plants don't require lot of sunlight and some require more. So by evaluating all the requirements for the crop cultivation it is clear that if we have these sensors it's enough for monitoring. If the plant requires pH monitoring then we can also go for pH sensor also. *Microcontroller Unit*: Here in this work an Arduino Uno is used. It consists of Atmel AVR microcontroller. As Arduino has standard connections i.e. that can be connected to the CPU directly the ease of programming is high. It has 14 digital I/O pins, 6 Analog inputs, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header and a reset button. Its operating voltage is 5V. The data from the sensors are captured and processed by the Arduino and it is kept in the data frame of the X Bee (API) [5].

Transceiver: To generate communication between two nodes here X Bee PRO is used [8]. This is the PRO Series 2 ZigBee protocol 63mW with wire antenna. It supports point-to-point, mesh networks and multi networks. It has Indoor/Urban range up to 300 ft (90 m). Dimensions are 24mm x 33mm x 9mm (0.94in x 1.3in x 0.3in)[6].

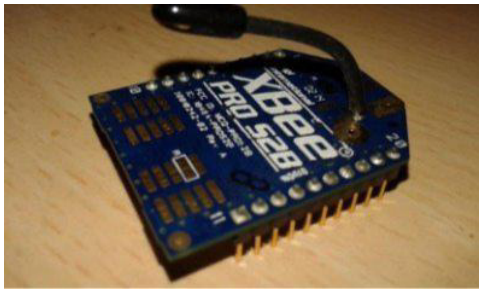

Fig 2. X Bee Module

The data from the sensor are transmitted to the destination using this ZigBee end devices, routers and reaches to the coordinator where the coordinator transmits the data to the centralized centre. The block diagram of a node is represented in fig 3 and the receiving end i.e. coordinator block diagram is represented in the Figure 4

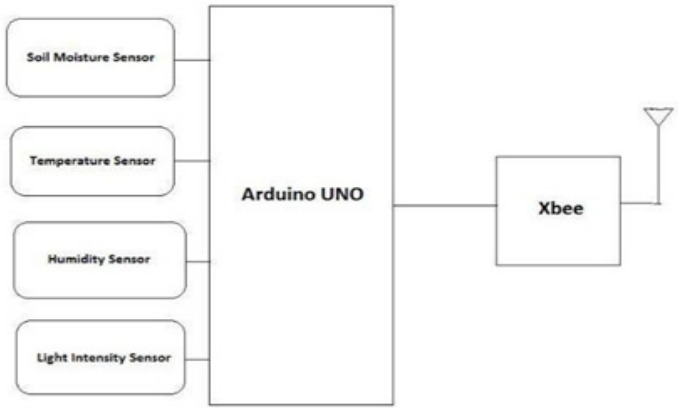

Fig 3. Wireless sensor network (end device)

Fig. 4: Receiver Section.

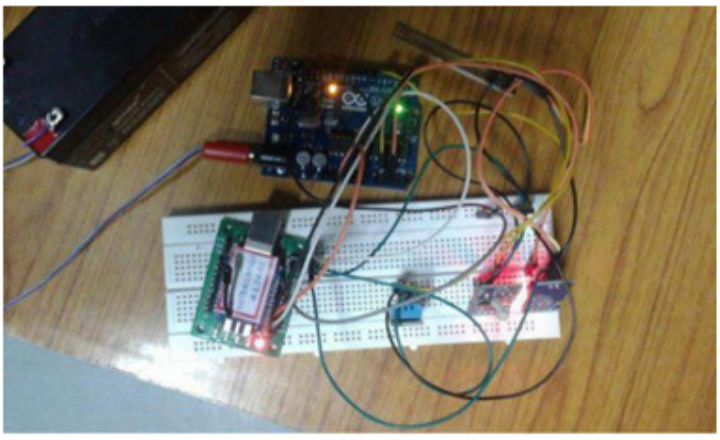

Fig. 5: Total set up of a node.

4. RESULTS

A reliable wireless sensor network is implemented. The output of the total setup designed can be observed in the computer to which the coordinator (receiver X Bee module) is connected. The output values of each sensor are displayed in the computer which is represented in the figure 6.

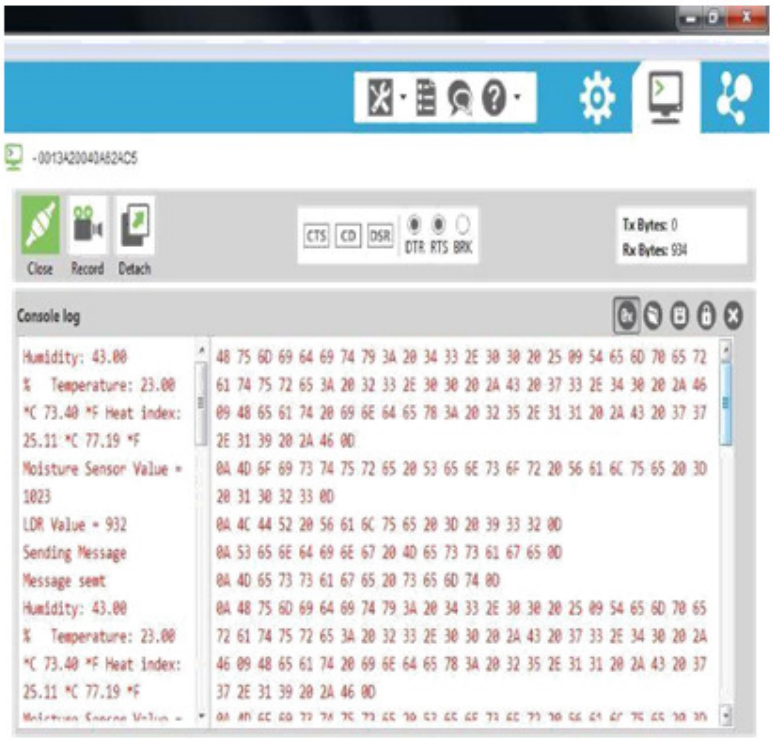

Fig. 6: The output of the work seen at the coordinator level.

Table 1: The values of the sensors

Sl no	Humidity	Temperature	Moisture	Light intensity
1	43.00	23.00	1023	932
2	57	30.00	523	995

5. FUTURE SCOPE

In this work, only one wireless sensor network is designed and implemented. For Precision agriculture, sensor values should be continuously tracked in a predefined time instances. The nodes should be kept in a predefined place. Those nodes should be synchronized and communicated properly in order to get effective results. If the crop needs pH [7] value then pH sensor should be added to the sensor node. The performance of the network depends on the performance of the node so the node should be arranged in an effective way where the nodes power consumption should be less [11].

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