

Auto-Irrigation in precision Agriculture Using Zigbee in wireless sensor network

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Abstract: *In current scenario, wireless sensor networks are widely being used in most of the fields in world. Precision agriculture is one of the fields. The main idea is to understand the concept of data transmission with the help of wireless sensor networks (WSN) along with the monitoring system. This paper reviews an ZigBee based automated irrigation system using controllable parameters such as humidity, temperature, moisture in the soil etc. for auto irrigation.*

Keywords: *wireless sensor network, PIC microcontroller, temperature sensors, humidity sensors, Zigbee*

I. Introduction

Developing countries like India are mainly dependent on farming and agriculture. So the parameter related information of the agriculture and farming sector like regarding the suitable temperature for the crops, humidity, soil moisture etc becomes very important for the purpose as this data help keeping farmers updated about the next requirement for the crops so as to increase the productivity of good quality in sufficient quantity. This information gathering requires lots of power consumption so to overcome this problem; 'Zigbee technology' is used. The discussed system Auto-Irrigation in precision agriculture using ZigBee helps knowing the condition of soil parameters for irrigation. Sensors are used for collecting information and aggregated data are matched with the threshold values which is necessary for the auto-irrigation. Wireless sensor network provides the suitable help to the farmers for a well developed agriculture and farming so as to increase the productivity and gaining more profit [1]. The sensors deployed into the agriculture field forms wireless sensor network for sensing and transmitting the various related parameters like temperature, soil moisture, humidity etc. which are necessary for making the field fertile[2]. Wireless sensor network like Hybrid sensor network are designed to communicate with the soil.[3]. A wireless communication device called 'ZigBee' operates under the same frequency and transmits data from and to the sensing elements compares the

value.[4]. Wireless sensor network IEEE 802.15.4/ZigBee coordinates with the whole network and optimizes the consumption of the power by using PAN coordinator.[5]. For WSN in monitoring and controlling process, MAC protocols plays an important role.[6]. Wireless sensor network based on Beacon provides with real time agriculture monitoring.[7]. Optimization of the cost of the intensive computation and hardware devices is possible using sensor networks which are small in size and precise with value.[8]. With the help of wireless mobile sensor network the conservation of the battery can be possible which may increase the battery life, increasing the overall life time of the network.[9]. The modeling and optimization of the transmission schemes can be used for sustaining and increasing the network lifetime and reducing the consumption of the energy in the transmitting circuit for the data transmission[10]. In this paper a system using Aurdino microcontroller with moisture sensor and water flow sensor is used for auto-irrigation system. Aurdino microcontroller senses the soil moisture content and data is transmitted using ZigBee protocol. As the moisture level reaches the pre-set level, water flow in pipe is adjusted accordingly. A database of all the information is updated regarding the temperature, soil moisture etc along with the time through which the soil parameters and motor running time on display and also on views the methodology for establishing large scale auto-irrigation using ZigBee as a wireless technology optimizing the use of the required resources. The coordinator in Zigbee wireless sensor network, hardware architecture etc is discussed here [12]. Multifunctional probes(MFPz) are discussed here for the measurement of the various soil parameters. ZigBee based multihop ad-hoc fashioned network are used in the various farms. IEEE 802.15.4 radio device based microcontroller is used as a core of MFPz device. [13]. In this study the details of the design with instrumentation of variable rate irrigation, a software for real time in-field sensing, wireless sensor network and control of site specific precision linear move irrigation system has been discussed [14]. An auto irrigation system was

developed for the optimization of the water resource for better crop production. Gateway unit relayed on microcontroller controls water quantity[15]. The system searches the water deficient area in the farm and informs the farmers through text messages [16]. The water used efficiency is increased in drip irrigation with the help of various sensors. The signals are transmitted to irrigation control centre through ZigBee [17].

II. Design

This system is divided in sequence in two methods, one is top- down and other is bottom up method. The design process is divided into six levels as follows:

i. REQUIREMENT LEVEL:

It is the first level in the design process in auto irrigation system which is further divided into two parts:

a. Functional Requirements

This requirement includes all the technical details, manipulation of data and its processing, sensing and indicator. Automatic indication is used for detecting an automatic operation FAN(ON/OFF), Motor pump, Buzzer etc.

b. Non Functional Requirements

this requirements includes the monitor and control of the water level in the soil, humidity and temperature of the environment. This depends on the set threshold value of the particular crop which is when crossed, the automatic operation of the system starts like pumping, buzzer etc.

ii. SPECIFICATION LEVEL:

| Sr. No. | Devices | Specification |
|---------|----------------------------|--|
| 1. | Sensors | LM-35, SY-HS-220, Soil Moisture |
| 2. | ZigBee Module | 10-100m Range |
| 3. | Microcontroller PIC 18F458 | CAN bus, Inbuilt ADC, high performance |
| 4 | Display | LCD(16*2), LCD(16*4) |

Fig.1 Specification Table
 this gives the detailed assessments of the required tools and the devices to be used.

iii. ARCHITECTURE LEVEL:

The architecture comprises of three nodes; Node1, Node2 and Node3. Node 1 and 2 are the sensing nodes and Node 4 is the receiver node which has a vital role in the auto-irrigation system. Node 1 and 2 performs same operation but their destination addresses are different which is set on the destination node. Node 1 and 2 senses the required parameters information and transmit it to ADC. ADC converts the analog data to digital and send it to UART for serial communication which is inbuilt into the PIC microcontroller 18F458. The wireless transmission of the data is done through ZigBee. The data is displayed onto the LCD as well as PC. To monitor the particular crop, the crop type is entered and the threshold values displays onto the LCD and PC which gets compared with the running value and if required the auto –irrigation gets started.

iv. COMPONENT LEVEL

It is the independent part of the architecture which performs the functions. It comprises of hardware components and software components:

a. Hardware components

Hardware is the physical device which is the part of the system connecting other components and providing input and output of the application. The hardware components of the system here are the Temperature sensors, Humidity sensors, PIC microcontroller, ZigBee, buzzer, Relay, Motor pump etc.

b. Software components

The interfacing of the software components is done between the hardware and PC.

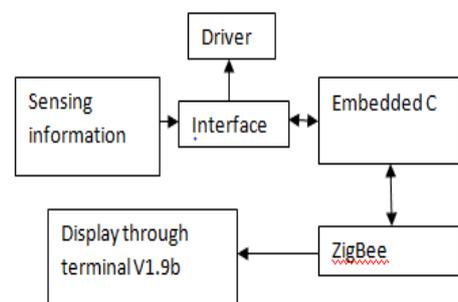


Fig 2. Diagram of software component

v. INTEGRATION LEVEL

The integration level in the system connects all the components together to form a proper structure. The sensor in the system gives signals to the microcontroller. There are generally three types of sensors in the system which are temperature sensors, moisture and humidity sensors. The received information is digitized using ADC and then displayed on the LCD. After where the information is transmitted to ZigBee UART which compares the sensor output with the threshold value for the automatic irrigation to take place. The data are transmitted to ZigBee using UART to the master node. It collects data from node 1 and 2. The relays are used for Buzzer, Fan, and Pump Motor. This relay is interfaced to Pin RA0, RA1, RA2, BC547 is used to control more power create by a coil of the relay and it amplifies the signal of PIC 17F458 microcontroller. The information displays from Master Node LCD 16*4 and PC.

vi. APPLICATION LEVEL

The system is deployed to the fields for the various parameter measurements for the auto-irrigation to take place. The system helps in precise agriculture process which helps in optimizing the required resources and increase the productivity.

III. Conclusion

In this system we came to understand that a farmer can use ZigBee based wireless technology and connect this system to his computer and select the crop type data and hence accordingly monitor it and can automate the irrigation system by controlling the parameters like temperature, soil moisture, humidity, light intensity etc. hence it can be concluded that ZigBee technology in wireless sensor network has been succeeded in precision agriculture process for great crop yield and increased productivity.

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