International Journal of Current Engineering and Technology
E-ISSN 2277 – 4106, P-ISSN 2347 – 5161

Available at http://inpressco.com/category/ijcet

Review Article

Automated Agriculture Monitoring using ZigBee in Wireless Sensor Network-A Review

Surabhi Singh†*, Neetika† and Satish Kumar†

†Department of Electronics and Communications Engineering, Amity University, Lucknow, India

Accepted 25 Jan 2016, Available online 31 Jan 2016, **Vol.6, No.1 (Feb 2016)**

Abstract

In the present scenario wireless sensor technology is used almost everywhere. In growing technical world wireless sensor network helps in upgrading the systems. In research field ZigBee technology helps to overcome the power efficient time issues in wireless sensor network. The basic idea behind this is to study the flow of data through a wireless transmission making use of wireless sensor network and monitoring system. This paper is about implementation of wireless sensing technology in an automated precision agriculture monitoring system by controlling typical parameters like temperature, humidity and soil moisture.

Keywords*: Wireless sensor network, ZigBee, temperature sensor, humidity sensor, soil moisture sensor, power consumption*

1. Introduction

In a developing nation like India, it is necessary to make some greater advancement in agricultural field as well. Immense amount of power is required for improving an existing technology. Due to deforestation and industrial setups, farmers are facing a lot of difficulties in maintaining crop quality which in turn is affecting the healthy crop production. To overcome these issues, 'ZigBee technology' can be used. This proposed system of 'Automated agriculture monitoring using ZigBee' will help the farmers to control the different parameters of a good quality crop production. There are sensors used for measuring temperature, humidity and soil moisture which can be compared and controlled within a range of threshold values for maintain the proper cultivation and to carry the irrigation automatically.

2. The Related Work

Generally farmers experience a huge financial loss because of inefficient weather forecasts and ineffective methods of crop cultivation (Soledad Escolar *et al,* 2011). With the latest advancements in wireless sensing technology, it is now possible to automatically monitor and control the environmental parameters of irrigation field for precision agriculture (Aqeel-ur-Rehman *et al,* 2011).

To evaluate the different parameters of soil hybrid sensor networks are used (W.Su *et al,* 2002). IEEE 802.15.4/ZigBee wireless sensor network operates in 2.4 GHz worldwide frequency band and is a type of 'wireless personal-area network'. It coordinates the entire network and optimizes the power consumption with the help of PAN coordinator (Francesca Cuomo *et al,* 2013). MAC protocols in WSN play a vital role in monitoring the soil conditions and controlling its various parameters (M.Nassau Sudha *et al,* 2011). Real time agricultural monitoring can be provided by using Beacon based wireless sensor network (Young-onk kim *et al,* 2011).

The cost of intensive computation and hardware devices can also be optimised using wireless sensor networks which are smaller in size and have a precise value (Shanshan Li *et al,* 2013). A wireless mobile network can be implemented to keep track of the battery usage of sensors and can enhance the overall lifetime of the system by changing the positions of some redundant sensors (Chu-fu Wang *et al,* 2010). The transmission schemes are modelled to improve the network sustainability and energy utilization in the transmitter circuitry (Ritesh Madan *et al,* 2007). In the proposed paper, Audrino microcontroller having soil moisture sensor and water flow sensor is implemented for an automated irrigation system. The level of moisture in the soil is recorded by the Audrino microcontroller and the collected data is value hits the threshold value of soil moisture, the water flow is adjusted in the pipeline accordingly. Each and every parameter like water flow, pressure, moisture, etc. gets updated in database by the time one checks the moisture content and motor working time on the display or a mobile using GSM(Rani *et al,* 2014).

*Corresponding author: **Surabhi Singh**

This paper gives a layout to implement a large scale automated agricultural irrigation system using ZigBee as a wireless sensing technology with efficient utilization of resources. Architectural layout, software algorithm, accessible controller and coordinator in ZigBee are discussed here in detail (Yiming Zhore *et al,* 2007). In the proposed paper, to measure the different attributes of soil like moisture, water flux, conductivity, etc ; Multifunctional Probes [MFP] were used. For a larger irrigation field, a multi-hop ad-hoc network with ZigBee technology has been employed for MFPz (Valente A. *et al,* 2007). This paper tells about the designing and instrumentation details of a network with wireless sensing technology and variable rate irrigation and provides a software platform for precision agriculture (Yunseop Kim *et al,* 2008). An automatic network for field irrigation has been developed through this paper. It optimizes the water usage for crop cultivation. It contains a multiuser wireless sensor network deploying fixed moisture and temperature sensors in the roots of crops. The water level is controlled by a microcontroller gateway unit (Joaquin Gutierrez *et al,* 2009). This paper develops an efficient agricultural crop monitoring system. It looks for precise places where water is required and conveys this information to the farmers on mobile via GSM. It uses a dedicated network of wireless sensors (Rahim Khan *et al,* 2013). The main aim of this paper is to render the farmers an effective an optimum system to continuously monitor their fields and control various parameters which are affecting the quality of crop production. This technique of precision agriculture helps the farmers to grow larger quantities of quality crops with minimal financial losses.

3. Layout

The system layout is discussed in two series methods: 1. Top-down and 2. Bottom-up. There are six levels in designing this system:

A. Requirement
B. Specification
C. Architecture
D. Component
E. Integration
F. Application

The design sequence is shown in the figure 1.

A. Requirement level: At this level, the technical details, data processing and manipulation, sensing and indication are considered.

B. Specification level: It shows the detailed assessment of system requirements. Specifications of the used devices are given in the table below:

Table 1: Device's Specifications

S.No.	Devices	Specifications
1	ZigBee module	10-100m range
2	Microcontroller PIC 18F458	CAN bus, inbuilt ADC, high performance
3	Display	LCD(16*2), LCD(16*4)
4	Sensors	LM-35, SY-HS-220, soil moisture

C. Architectural level: This level deals with the hardware partition, performance and analysis. It consists of 3 nodes. Node 1 and Node 2 are sensor nodes and Node 3 is receiving node.it consists of an ADC for analog to digital conversion and an UART for serial communication. Receiving node transmits information to PIC microcontroller and display the result on LCD.

D. Component level: it consists of two parts:

1. Hardware component: Temperature sensor, humidity sensor, soil moisture sensor, ZigBee, PIC microcontroller, fan, relay, buzzer, etc.
2. Software component: it provides an interface between hardware and controlling device.

E. Integration level: This level integrates all the hardware and software components together and builds a structural network for performing the monitoring of various parameters like soil moisture, humidity, temperature etc.

F. Application level: at this level the system developed is implemented to the agricultural field and the task of precise monitoring and control is carried out for maintain the crop quality and production.

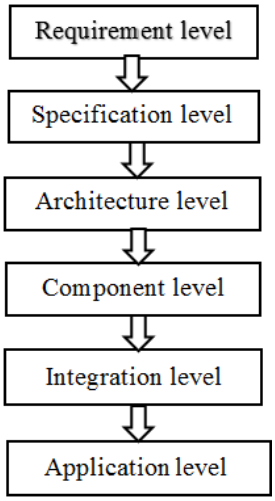

Fig 1: Design Sequence of proposed automatic irrigation system

Conclusion

In this paper, an effective technology has been developed for the benefit of farmers. This system gives the power to monitor and control various factors that affect crop production in an agricultural field. Farmers can now use their resources as per requirements and can control the humidity and temperature in their fields. This helps in minimising unnecessary financial losses and result in high quality crop production.

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