IEEE 802.15.4 ZIGBEE BASED WIRELESS SENSOR TECHNOLOGY IN AGRICULTURE-A SURVEY

Surabhi Singh[1], Satish Kumar[2]

[1,2]*Dept. of Electronics & Communication Engineering, A.S.E.T.,*

Amity University Uttar Pradesh, Lucknow, (India)

ABSTRACT

The prime focus of this paper is to create an Intelligent Farming Technology using wireless sensor network (WSN). In present research work, a survey is done to study the wireless sensor technology, its standards and implementation in agricultural fields. In a country like India, which is developing at a faster rate, this technology is a boon. A ZigBee based wireless sensor network can be helpful in keeping track of various environmental factors like weather, temperature, soil- moisture, weed-diseases, etc., that effect the crop growth rate and quality. The precision agriculture monitoring is the need of the hour.

Keywords: Precision agriculture monitoring, ZigBee, Wireless sensor network.

I. INTRODUCTION

The precision agriculture monitoring, provides power to the farmers to control and manage the input of water, fertilizers, pesticides and other elements in order to ensure good quality crop production. This would help the farmers to minimise the risk of crop failure and prevent their financial losses. This wireless sensor network will increase the production of healthy crops and will be beneficial for the farmers as well as the nation. ZigBee is a small technology that can be easily employed in the fields and provides various information to the farmers using different sensors and GSM technology. Farmers will get all the information via text message on their mobile phones.

II. THE RESEARCH WORK

Wireless sensor networks are a group of various transducers which senses the environment and gives the output. These sensors are small in size, low on cost and consumes very less power. These networks can be installed very easily. The fundamental units of a sensor mote are: data acquisition unit, memory and processing unit, communication unit and power unit[1].The design sequence is shown in the figure below:
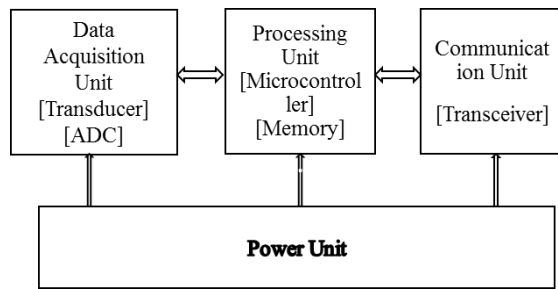
Fig 1: Structure of a Sensor mote

Hybrid sensor networks are deployed to measure various parameters of the field. A ZigBee wireless sensor network is a customisable personal area network which has a worldwide operating frequency of 2.4 GHz. It relates the entire network and manages the consumption of power using PAN coordinator[2]. An important consideration for wireless sensor network is the operating system as it consumes the power and energy in terms of memory and operation. Small operating systems are used in sensors to minimise the size and cost of fabrication. The most popular OS is the tinyOS which is an event based lightweight operating system. It requires less memory and lesser energy consumption[3].

III. ZIGBEE PROTOCOL AND CHALLENGES RELATEDTO AGRICULTURE

Wireless sensor network for agriculture requires a low cost, low power and low data rate type of network. In order to achieve these requirements, zigbee alliance has developed an open global standard called Zigbee [4]. Zigbee consists of four layers namely, physical layer, Medium Access Control layer (MAC), Network layer and Application layer. Physical layer and MAC layer are defined by IEEE 802.15.4 standard and the network and applicationlayer are defined by zigbee. Application layer consists of two sub layers, the top sub layer is meant for public profile that allows OEM vendors to create interoperable products like Home automation, Precision agriculture, Building automation, Smart energy etc.
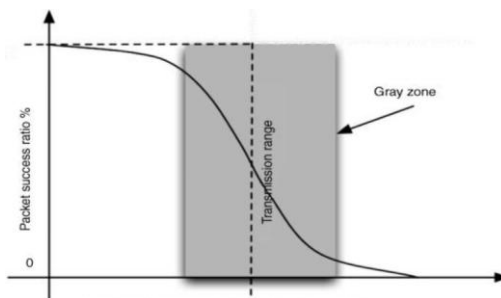
The other sub layer in application layer is defined for manufacturers to develop their own proprietary profiles[5]. In a large irrigation field, a multi-hop ad-hoc network is employed with ZigBee technology. It consists of a multiple user wireless sensor network having a fixed moisture and temperature sensor for measuring the respective parameters. These sensors are deployed in the roots of the crops. The water content level is monitored using a microcontroller gateway unit[6].

This network of various sensors create an automatic crop monitoring system that enables the farmers to keep track of their fields from anywhere. This technology helps the farmers to control the amount of various input materials required for the proper growth of the crops which results in healthy crop production and prevent the farmers from bearing unnecessary losses[7].

IV.APPLICATION OF ZIGBEE IN AGRICULTURE

To enhance the crop yield and quality, ZigBee wireless sensor network is an effective technology. Using the sensing and GSM technology any individual can keep an eye on different environmental factors that are affecting his fields. This would help to monitor the soil continuously, measure the quantity of elements that are essential and control the excessive amounts of elements to prevent the crops from decay. The system not only easy to deploy but also very energy efficient[8].

In Xinjian Xiang, a zigbee wireless sensor network was designed using fuzzy control for drip irrigation. They have measured four parameters, soil moisture, temperature and light intensity and electrical conductivity for drip irrigation decision making[9].

V. CONCLUSION

In this paper, an intelligent farming system has been developed for the betterment of the farmers. This technology will help them to monitor and control the crop yield, to maintain the quality of crops and to minimise their risk of crop failure. This will enable them to reduce the chances of incurrinf unnecessary financial losses and maintain a healthy production.

REFERENCES

[1]   Andrade-Sanchez, P.; Pierce, FJ.; Elliot, T.V performance assessment of wireless sensor networks in agricultural settings. In 2007 ASAB E Annual International Meeting Minneapolis, MN, USA, 2007.

[2]   Zigbee Alliance, Zig8ee specifications, version 1.0, April 2005.

[3]   Tate, R.F.; Hebel, M.A.; Watson, D.G. WSN link budget analysis for precision agriculture. In 2008 ASABE Annual International Meeting, Providence, RI, USA, 2008.

[4]   Haneveld, P.K. Evading Murphy: A Sensor Network Deployment in Precision Agriculture; Delft, Netherlands, June 28, 2007.

[5]   Hebel, M.A. Meeting wide-area agricultural data acquisition and control challenges through Zig Bee wireless network technology. In 4th World Congress Conference on Computers in Agriculture and Natural Resources, Orlando, FL, USA, 2006.

[6]   Zhang, Z. Investigation of wireless sensor networks for precision agriculture. In 2004 ASAE/CSAE Annual International Meeting, Ottawa, ON, Canada, 2004.

[7]   Hebel, M.A; Tate, R.F.; Watson, D.G. Results of wireless sensor network transceiver testing for agricultural applications. In 2007 ASABE Annual International Meeting, Minneapolis, MN , USA, 2007.

[8]   Goense, D.; Thelen, 1. Wireless sensor networks for precise phytophthora decision support. In ASAE Annual International Meeting; Tampa, FL, USA, 2005.

[9]   Xinjian Xiang, "Design of Fuzzy Drip Irrigation Control System 8ased on Zig8ee Wireless Sensor Network", springerlink, IFlP Advances in Information and Communication Technology, 20 11.

[10]   Goense, D.; Thelen, J. Wireless sensor networks for precise phytophthora decision support. In ASAE Annual International Meeting; Tampa, FL, USA, 2005.