BIUST Research and Innovation Symposium 2017 (RDAIS 2017)
Botswana International University of Science and Technology
Palapye, Botswana, 12-14 June 2017

ISSN: 2521-229X
ISBN: 978-99968-0-608-7

Real Time Monitoring of Field Crops Using Zigbee

Thabo Molwantwa
UG Scholar, ECT
BIUST
Botswana

S.Ravi
Faculty of ECT
BIUST
Botswana

Bakary Diarra
Faculty of ECT
BIUST
Botswana

Abid Yahya
Faculty of ECT
BIUST
Botswana

Abstract—**Agricultural parameters need constant controlling and monitoring to ensure that the crop fields are well taken care of. With the use of wireless sensor network technology crop fields can be continuously controlled and monitored. Therefore a proposed idea is to establish a system which consists of multiple mobile base stations forming a network to control and monitor field crops over a large area or different locations. The connection between different sensor nodes will be through wireless sensor network and between different base stations will be through Ethernet. The sensors are wirelessly interfaced with each other so they can communicate and form a network. This system is advantageous as it enables the farmers or users to control and monitor crop fields in faraway areas, reduces the consumption of energy, easy to implement and effectively saves the lifetime of a sensor network.**

Keywords— Agriculture, Wireless Sensor Network, Base Station, Ethernet, Crop Field.

I. INTRODUCTION

Wireless sensor network is an evolving technology for wide range of wireless environments all over the world. A wireless sensor network is a group of intelligent sensor nodes with a communications capability and infrastructure for monitoring and recording conditions at remote locations. Commonly monitored parameters are temperature, humidity, pressure, wind direction and speed, gas content, vibration intensity, sound intensity, power-line voltage, chemical concentrations, pollutant levels and vital body functions [2]. A sensor network is a deployment of several devices equipped with sensors that perform a collaborative measurement process. Any value is measured from a sensor such as temperature sensor and any protocol is used to communicate the measured information such as Zigbee with its wireless communication modules. Lastly an external system is used up to show the data which is recorded. Normally these sensor nodes consist of three components the sensing, processing and communicating parts.

Some advantages of using Wireless Sensor Networks include:

- It is easy to implement.
- It is cheap or affordable.
- It uses less power consumption.
- It is environment user friendly

The Fig.1 illustrates a typical wireless sensor network composed of multiple sensor nodes:

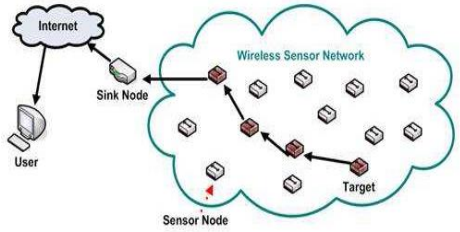

Fig.1. Typical Wireless Sensor Network [3]

In agriculture, wireless sensor network can be used to enhance in optimum production. The modern technology used is applicable in almost every aspect including medical, home, industries etc. most countries including Botswana rely mostly in agriculture especially field crops. Therefore, a system which will be used to control and monitor agricultural parameters over a large area or different locations is suggested. The user will be able to get real time data faraway.

A. Why mobile base stations?

Sensor nodes which are close to the base station and are one hop away from the base station, their energy gets depleted more as compared to other distributed sensor nodes [1]. They relay information for other nodes to the base station through it. When the energy gets depleted, many sensor nodes will not be able to communicate with the base station therefore network not operational [1]. By moving our base stations it will be able to have close access to other sensor nodes and the hop count between them to the base station will be less. This reduces energy consumption of the sensor node close to the base station at that time.

B. Why multiple base stations?

Deployment of multiple base stations to the network reduces the average number of hops between the sensor nodes and their corresponding base stations. Using a single base station in the network the average hops taken by a sensor node

ISSN: 2521-229X
ISBN: 978-99968-0-608-7

far away from the base station are more. Therefore deploying multiple base stations in the network as proposed reduces the average hops taken by the sensor nodes. That is, it reduces the energy spent by sensor node when relaying sensed data from other nodes towards the base station. Sensor nodes will be able to send their data to any of the base stations. This results in increased network lifetime as well as improved throughput [2].

C. *Why Zigbee technology?*

In this present communication world there are various high communication standards available. Most of them require being of low energy consumption and latency. Zigbee technology is best suited as it provides a cheaper and offers best communication. It characteristics makes it suitable for most applications including home automation, industrial control, smart metering, smart grid metering etc. Zigbee communication technology operates in short distances and provides a safe and reliable. Various parameters are collected using sensors and transmitted to the base station for analysis.

II. Literature Review

Current researches show that Wireless Sensor Network is a technology that has been applicable for many years and it is being used in different applications. The sensor technology provides a solution to design and develop many types of wireless sensor applications including the military, homes, agriculture, medical and environment monitoring [3]. It assists and improves work performance both in the field of industry and our daily life. Wireless sensor network technology is equipped with devices that can measure or detect any changes or different parameters such as humidity, gas content, temperature, water content etc. These devices are called sensor nodes. They have found applicability in agriculture where it can be used to monitor field crops. Within the agricultural sector wireless sensor network is used and according to different authors there is a use sensor nodes, battery as the power supply, use of different microcontrollers to process the measured parameters , use of Zigbee transceiver modules and personal computer for data visualization.

Traditionally, researchers in memory have aimed to keep procedures for the different wireless sensor network systems not to be different. However, such a narrow focus enables new ideas to be used like the proposed idea of powering with solar panels to cater when it is night. It has been researched that monitoring agricultural parameters like crop fields is not improving. Therefore, a number of researchers have come up with different ideas on how to monitor crop field parameters to optimize crop production. These parameters include pH, water content and temperature. Some of the ideas are summarized as follows. In this paper, it was proposed to implement an ARM7 microprocessor with multiple sensors such as temperature, humidity and water level sensor, Zigbee wireless, battery and GSM modem. If the values captured by the sensors reach a certain threshold ARM processor indicates an alarm. Parameters are sent to farmer in a form of text message. This system aims at bringing desirable results to future farmers [4]. This paper presents an intelligent system, which is an automatic irrigation system which is based on sensor nodes. The main aim of the proposed idea is to monitor paddy crop fields in a wireless manner. It uses Matlab application to analyse the results [5]. The development of GSM based intelligent wireless automatic system is based on the use of wireless sensor network real time monitoring. It introduces the use of different kinds of sensors like temperature, humidity and also a based remote control of irrigation automation [6]. The proposed system for monitoring farm fields in real time in [7] uses greenhouse automation system. It involves adding more sensors to the network which will detect more parameters including flood monitoring, wind speed and wind direction. The drawback of the system is that the network does not reduce the energy consumption used by sensor nodes within the network. Introducing more sensors means more energy consumption by the sensor nodes near to the base station.

In [8], the proposed system uses Zigbee technology. The system is an automatic irrigation system which helps to detect the conditions of the soil for irrigation. If the sensed data matches the threshold values the, then the irrigation starts automatically. The system proves to be effective as the results show that farmers can use it to monitor their field crops in remote areas. The system for monitoring crops in [9], proposes a system which is automatic. It determines the soil moisture of the crops and maintains the moisture level at a particular level. The proposed system in [10], introduces Precision Agriculture (PA). The system enables the farmer to keep track of the environmental conditions including temperature, humidity etc. The paper in [10], proposes an embedded system for automatic irrigation which makes use of Wireless Sensor Networks. The system is placed in the roots of the plant for real time infield sensing and control of an irrigation system. The parameters to be monitored are temperature and soil moisture. The system is found to be feasible and come as a benefit to the farmers in terms of time and cost.

III. Proposed System

This project is about controlling and monitoring agriculture parameters for field crops. Therefore a proposed idea is to establish a system which consists of multiple mobile base stations forming a network to control and monitor field crops over a large area or different locations. The connection between different base stations will be through Ethernet. The Ethernet will be connected to the internet that users can access in remote areas and get real time information. This system is efficient as it is most suitable for non-reachable places like rural areas. It is also suitable as it effectively saves energy consumption and increase the lifetime of the available sensor network. The following Fig.2 shows the proposed system transmitter block diagram. The Fig.3 shows the proposed system receiver block diagram.

BIUST Research and Innovation Symposium 2017 (RDAIS 2017)
Botswana International University of Science and Technology
Palapye, Botswana, 12-14 June 2017
ISSN: 2521-229X
ISBN: 978-99968-0-608-7

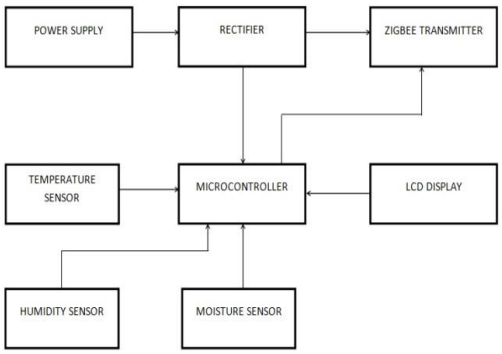

Fig.2. Transmitter Block Diagram

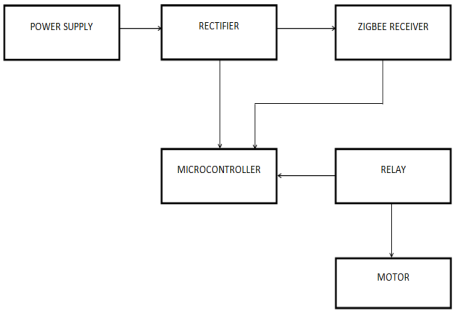

Fig.3. Receiver Block Diagram

The power supply to be used will be powering several nodes including the microcontroller and the three sensors. A rectifier is an electrical device used to convert an alternating current to direct current. It will be used to convert the power supplied to be used by the nodes. The sensors to be used are the temperature, humidity and moisture which will be placed in the fields for collecting the sensed data. Soil moisture sensor is a device used to measure the volumetric of water content of the soil [11]. It gives readings of the water in the soil and makes it ideal for the farmer to take necessary action. The microcontroller to be used is the PIC16F877A with 20MHz operating frequency. The microcontroller is suitable because it is powerful and yet easy to program with 368 bytes of data memory. It operates at 2V to 5.5V of voltage. It has an analog to digital converter, 8 channels of 10-bit Analog-to-Digital (A/D) converter.

The data sensed will be transmitted through separate boards including the transmitter module to the receiver module. No other components like the MAX 232 and MAX233 are needed. These features make it suitable for automotive, industrial applications. It will be used to collect some environmental information and perform some data conversion. It is also responsible for managing other nodes in the system. This microcontroller is suited for remote applications especially with low power consumption and high speed capabilities [10]. The sensed information is displayed on the LCD display showing the results obtained. The sensed information is converted into digital with the help of converter and it is transmitted to LCD to display. Then this information is carried to the ZigBee transmitter node. The Fig.4 shows the transmitter circuit diagram. The Fig.5 shows the receiver circuit diagram.

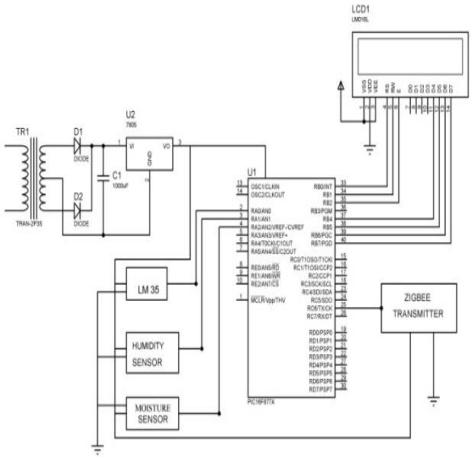

Fig.4. Transmitter Circuit Diagram

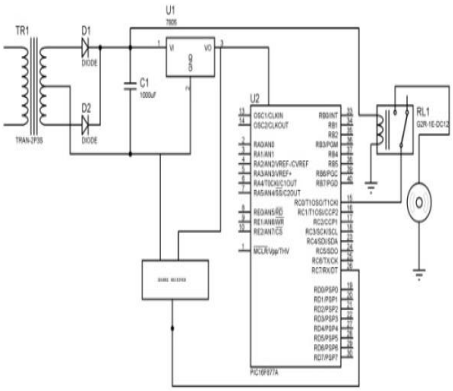

Fig.5. Receiver Circuit Diagram

IV. RESULTS

The system works in two parts being the transmitter and the receiver. They called as transmitter and receiver parts. The Hardware model for the transmitter section is shown in Fig.5 and the receiver section is shown in Fig.6

ISSN: 2521-229X
ISBN: 978-99968-0-608-7

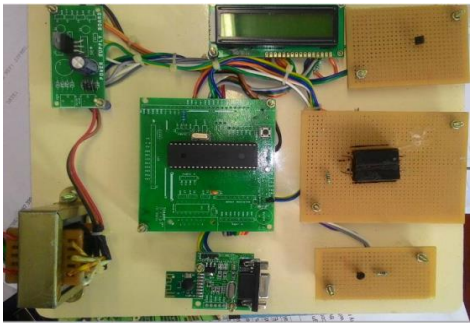

Fig.6. Transmitter Prototype

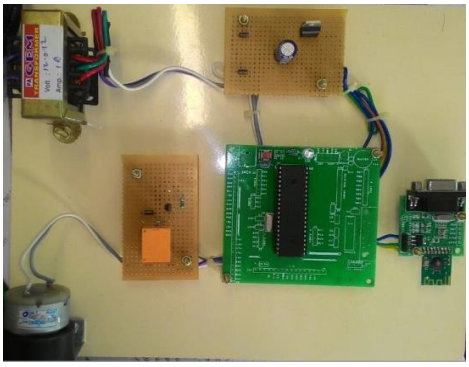

Fig.7. Receiver Prototype

V. Conclusion

The proposed system includes cheap crop field monitoring system that is able to help farmers or users to achieve maximum productivity. A system that monitors and controls field crops over a large area or different locations with multiple mobile base stations. This project is expected to yield good results and an intelligent system for farmers to appreciate. The use of wireless sensor network in agriculture will help farmers to have exact values and make decisions based on them to improve productivity.

References

[1] R. C. D. R. K. Alka Kalra, "Role of Zigbee Technology in Agriculture Sector," Chandigarh, INDIA, 19-20 March 2010.

[2] Wireless Sensor Networks: http://www.searchdatacenter.techtarget.com.

[3] H. K. A. B. Nidhi Patel, "Wireless Sensor Network Using Zigbee," IJRET: International Journal of Research in Engineering and Technology, vol. 02, no. 06, pp. 1038 - 1042, Jun-2013.

[4] F. Y. E. S.Shanthini, "Real Time Application Of Paddy Field Monitoring Using Zigbee Network," International Journal of Applied Theoretical Science and Technology, vol. 1, no. 2, pp. 35-37, July 2015.

[5] Rashmi Jain, "Automatic Irrigation System For Agriculture Field Using Wireless Sensor Network (WSN)," International Research Journal of Engineering and Technology (IRJET), vol. 03, no. 04 , pp. 1602 - 1605, Apr-2016.

[6] Gulhane, "Survey of Implementation of Wireless Sensor Network for Real Time Monitoring System," International Journal of Engineering Research and Management Technology, vol. Volume 3, no. Issue 2, pp. Pg 3914 - 3920, 2016 March

[7] D. Mehetre, "An Automatic Irrigation System using Zigbee in WSN".

[8] P. Patil, "Wireless Sensor Network for Precision Agriculture," in IEEE, 2011.

[9] S. T. Kiruthika M, "Parameter Monitoring for Precision Agriculture," October 2015.

[10] R. A. P. Nilesh D. Kuchekar, "GSM Based Advanced Water Development System for Irrigation using a Wireless Sensor Networks and Android Mobile," International Journal of Electrical, Electronics and Data Communications, vol. Volume 3, no. Issue 8, p. Pg 52 to 57, August 2015.