International Journal of Innovative Research in Computer Science & Technology (IJIRCST)
ISSN: 2347-5552, Volume-2, Issue-3, May 2014

Wireless Sensor Network Based Farm Stations

Kanchan Renake , Prof. Virendra V. Shete, Prof. S.B. Somani

Abstract— **Precision agriculture is a technology which learns the variations, record the variations, manage and preserve the resources accordingly. Increasing population is demanding more food supply and lands. Precision agriculture is the best solution to fulfill the need of more food supply. Wireless sensor network plays key role in precision agriculture. This paper presents the architecture which is able to communicate with each other and delivers the real data collection. The proposed architecture will help the farmers about the current scenario of farming field with which farmer can take necessary action.**

***Index Terms*—Base Station, Precision Agriculture, Wireless sensor Network.**

I. INTRODUCTION

Precision agriculture optimizes the yield and protects the environment by proper use of natural resources. Precision agriculture lowers the input cost and by precise use of resources we will get better output. It is defined as the art and science of utilizing advanced technologies for enhancing crop production while minimizing potential environmental pollution [1]. This technology recognizes the inherent spatial variability that is associated with most fields under crop production [2].

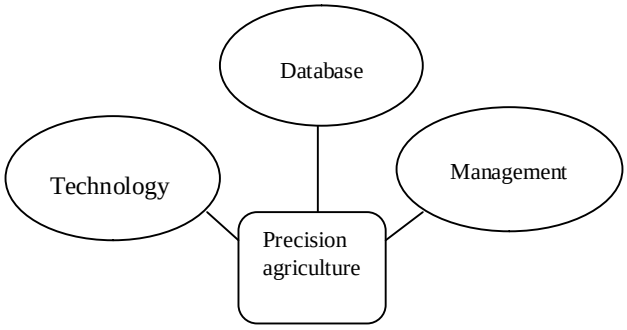

Fig 1: Components of Precision Agriculture

.

Manuscript Received May 26,2014.
KanchaRenake,E&TC Dept, MIT-CollegeOf Engineering, Kothrude Pune. India,9689729956,(e-mail: kanchanrenake@gmail.com)
Prof.Dr.Virendra Shete, E&TC Dept, MIT-College Of Engineering, Kothrude Pune,India,9421056408,(e-mail:virendra.shete@mitcoe.edu.in)
Prof.Sunil Somani, E&TC Dept, MIT-College Of Engineering, KothrudePune,India,9422850556 ,(e-mail:sunil.somani@mitcoe.edu.in)

Fig.1 shows the basic components of Precision Agriculture which contains database, technology, management

A) Database: contains variable data coming from various spots on the field like water level, soil properties, insect and weed population etc. All this data is collected from the sensors and one database of the information is created.

B)Technology: To monitor soil, crop condition the new technologies are developed nowadays. This technologies includes GPS(Global positioning system),GSM(Global System for mobile

communication), GIS(Geographic Information System) and many more. These new technology make simple way to monitor, measure different characteristics of soil, leaf condition and make accurate results.

3) Management: with the help of data collected a message is sent to the farmer with which he will be able to make the decisions. The farmer then manages all the resources accordingly. This will give the farmer a better yield.

Precision agricultural mainly does the following function:

1) Sensing the parameters from the farm field.

2) Data gathering from different parts of the farm field.

3) Transferring data from crop field to Base station for decision

making.

4) Based on sensed data control decision is taken.

II. SYSTEM REQUIREMENTS

The demand of food and water is increasing extensively due to increase in the rate of population ; so we need such a system which minimizes use of fertilizers and chemicals . To achieve this wireless sensor network has done a key role in the agricultural field.

System needs multi hop routing protocol which will suit the monitoring and controlling application. To decide which routing protocol is needed we need thorough knowledge of factors that affect the specific networks.

According to the type of crop all the requirements will also vary like moisture level and fertilizers .Energy efficient model is required to implement real time data system.

The farmer needs robustness, user friendliness and reliability.

III. METHODOLOGY

This paper proposes a system which can communicate with the farmer so that he can use the water supply and fertilizers precisely. The proposed model contains several sensors

namely temperature sensor, moisture sensor, soil pH sensor, atmospheric pressure sensors are used. The value of pH sensor, temperature and moisture sensor is sent to the base station via Zigbee module. This information is processed at the base station and accordingly the soil pH value and the other details are sent via SMS using GSM model. As the farmer gets the information; he can take the decision based on the valid data and actual condition of the field.

Farm Station is actually the place where the farmer seats and he gets the all information on his personal computer or on his cellular phone. At the farm house there is one transceiver which communicates with the base station and if farmer has any queries he can immediately ask that to the base station where it will get cleared.

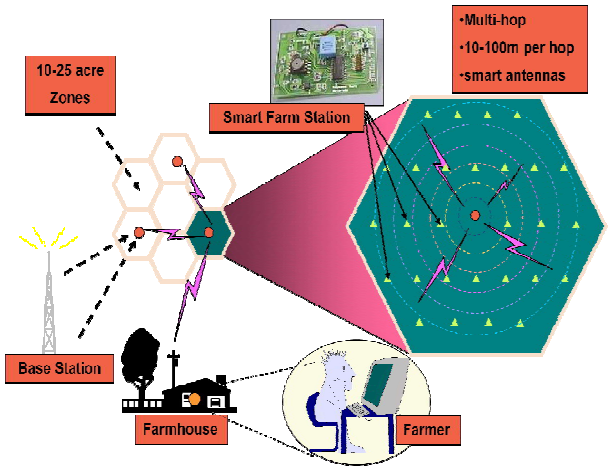

Fig 2: Proposed System Architecture

Fig.2 shows the proposed system architecture in which following component are important:

1) Smart Farm Stations
2) Base Station
3) Farm House

Here the smart farm station consists of Zigbee module, different sensors, microcontroller etc. Sensor senses the different parameters like soil moisture, temperature, humidity, leaf wetness etc . Such data is sent to the base station. At the base station the data is processed and then the result is obtained.

The result contains the information like for how much time we have to give water supply to the crops, which fertilizer we must use. Such kind of messages is sent on the farmers mobile phones so that he gets the accurate guidance to take the decision.

IV. HARDWARE DESIGN

The system architecture consist of sensor node ,base station and a GSM system.

A. Sensor node

Each sensor node consist of Zigbee transreceiver, The PIC16F877A microcontroller, Soil pH sensor, Atmospheric pressure sensor, Moisture sensor and Temperature sensor.

Zigbee Transreceiver of Digi International is used with RF data rate of 250 kbps. It needs frequency band of 2.4 GHz.MAC allows networks to handle any number of devices. This attribute is critical for massive sensor arrays and control networks. It has Simple protocol, global implementation. ZigBee's protocol code stack is estimated to be about 1/4th of Bluetooth's or 802.11's. Simplicity is essential to cost, interoperability, and maintenance. The IEEE 802.15.4 PHY adopted by ZigBee has been designed for the 868 MHz band in Europe, the 915 MHz band in N America, Australia, etc; and the 2.4 GHz band is now recognized to be a global band accepted in almost all countries.

The 16F877A microcontroller is a high performance RISC unit operating at the speed of 20 MHz clock input, wide operating range of 2 to 5.5 V and has the program memory of 143Kbytes. Selection of controller board for WSN is very crucial stage. Power parameters and processing capacity are two main judgement parameters. Cost is also one of the important parameter to decide. Looking at the proposed positioning and sensors used for this research base station is equipped with ARM LPC2148 processor and sensor node have PIC16F877A PIC controller. At sensor nodes we have used low cost, energy efficient PIC16F877A controller. It is 40 pin package with up to 8 ADC interfaces.

The Soil moisture sensor consist of Vantage pro company the PR2/4, measuring at 4 depths: 10, 20, 30 & 40cm.

LM35 is used as temperature sensor Calibrated directly in ˚ Celsius (Centigrade) Linear + 10.0 mV/˚C scale factor ,0.5˚C accuracy guarantee able (at +25˚C)Rated for full −55˚ to +150˚C range, Suitable for remote applications, Low cost due to wafer-level trimming Operates from 4 to 30 volts, Less than 60 µA current drain, Low self-heating, 0.08˚C in still air.

pH Sensor is used having pH Reading: 0 to 14mV ,Solution Temperature:0to 100C,Ambient Temperature: -40 to 70C(0C to 70C at rated accuracy).

The pressure sensor used is consist of a DC excitation of 5V.The pressure in reference chamber is about 25 mTorr (3.33 Pa). All the temperature coefficients are given in percentage of full-scale range (FS) and over a temperature range of 100 °C.

B. Base Station

The base station consist of ARM controller (LPC 2148),IC MAX232

For communication . LPC2148 offers very high performance and very low power consumption. The ARM architecture is based on

Reduced Instruction Set Computer (RISC) principles, and the instruction set and related decode mechanism are much simpler than those of micro programmed Complex Instruction Set Computers. The oscillator output frequency is called FOSC and the ARM processor clock frequency is referred to as CCLK for purposes of rate equations, etc. elsewhere in this document. FOSC and CCLK are the same value unless the PLL is running and connected.

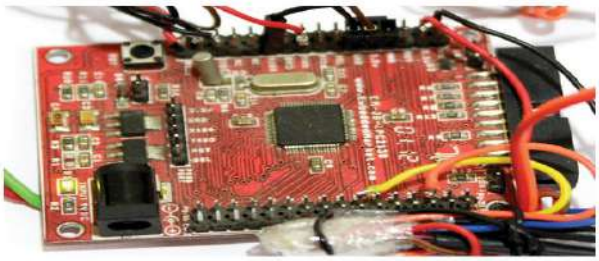

Fig.3 Real Image of LPC 2148

C.GSM system

After receiving data at base station, it is responsibility of GSM module to transmit the data from base station to end user/end device. GSM module was completely designed for SIM900 (2G, GPRS+GSM) from SIMCOM and SIM5230 (3G).

GSM module is connected with ARM board with serial communication and commands are shared through serial communication method.

SIM 900 is 68 pin module with ability to perform GSM and GPRS operations. GSM here means sending and receiving SMS. General Packet Radio Service (GPRS) extends ability to communicate with server or sending packet data over IP . It communicates serially with controller board with the help of MAX232 interface. Though for current research we have limited use of SIM module but it can be used in different ways. SIM900 is 80 pin module which provides most application to customer.

SIM900 is quad band GSM/GPRS/EDGE and dual band UMTS/HSDPA that works on frequencies of GSM 850MHz, EGSM900MHz, DCS1800MHz,
Quad-Band 850/ 900/ 1800/ 1900 MHz, 00/1900MHz)Dimensions: 24*24*3mm , Weight: 3.4g , Control via AT commands (GSM 07.07 ,07.05 and SIMCOM enhanced AT Commands) **.**

V. SOFTWARE ENVIORNMENT

A.Keil µVision4

Keil µVision 4 is an IDE (Integrated Development Environment) that helps to write, compile, and debug embedded programs. The Keil µVision 4 has C compiler for the ARM 7 is used to solve the complex problems facing embedded software developers. It provides more features than any other 8051 C compiler available today. The ARM controller applications that are written in C and once complied using the µvision 4 compiler have the efficiency and speed of the assembly language.

This Keil µVision 4 compiler generates fast compact codes for the ARM 7 and its derivatives. It supports a number of C language extensions that have been added to support ARM architecture like data types, pointers, memory types, Interrupts.

B.MPLAB

It is a 32-bit application on Microsoft Windows. Also used for application development, hardware emulation and debugging. MPLAB IDE also serves as a single, unified graphical user interface for additional Microchip and third-party software and hardware development tools.

Both Assembly and C programming languages can be used with MPLAB IDE v8. Others may be supported through the use of third-party programs. MPLAB IDE v8 does not support Linux, Unix or Macintosh operating systems.

C.X-CTU

X-CTU is a Windows-based application provided by Digi international. This program was designed to interact with the firmware files found on Digi's RF products and to provide a simple-to-use graphical user interface to them.

.

VI. RESULTS

All the experiment set up is placed in our demo farm and then different variations of the sensors are monitored continuously and that data is then sent to our farm base station. The experiments results contain the graphical representation of the temperature, moisture and pressure sensor.

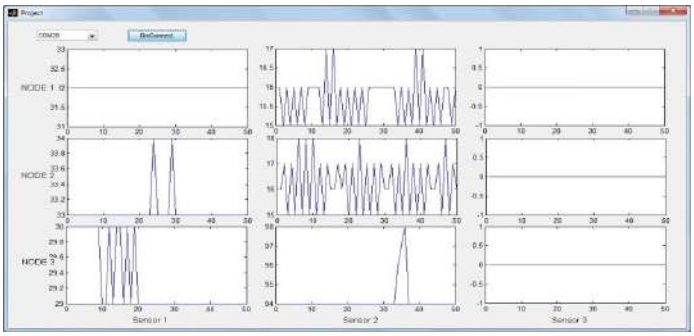

Fig.4: Output Graph showing the temperature, moisture and pressure sensor data placed in the farm using MATLAB software.

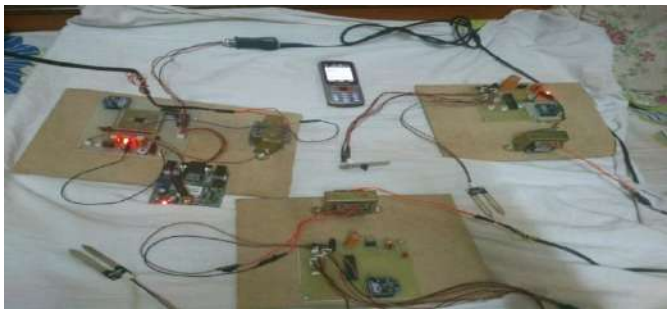

Fig 5 : Laboratory Setup of the project design.

VII. CONCLUSION

In this paper we proposed a agriculture system which can easily be installed and handled by the end user. The end user with the help of this project can achieve the increased yield production.

This paper includes one method of precision agriculture recognizes and quantifies the variability in fields and manages this variability by applying inputs at specific amounts, when and where they are needed.

VIII. REFERENCES

[1] Muhamad Azman Miskam, Azwan bin Nasirudin, Inzarulfaisham Abd. Rahim ,"Preliminary Design on the Development of Wireless Sensor Network for Paddy Rice Cropping Monitoring Application in Malaysia" , European Journal of Scientific Research ISSN 1450-216X VoU7 No.4 (2009), pp.649-657.

[2] V. Lakshmi Narasimhan, Alex A. Arvind, and Ken Bever, "Greenhouse Asset Management Using Wireless Sensor-ActorNetworks", Proceeding of In!. Conf. on

Mobile Ubiquitous Computing, Systems, Services and Technologies, pp: 9-14, 2007.
[3] H.Q Luo, X. Zhang, E. Liu, x.J. Qiao, Y.H. Zhang, "The Design of Wireless Sensor in Greenhouse Environment Measurement"" . Sensor World, Vol. 12, No.5, pp. 45-48, 2006.
[4] Wang Yang, Huang Liusheng, Wu Junmin, Xu Hongli, Wireless Sensor Networks for Intensive Irrigated Agriculture, Proceeding of In!. Conf on Consumer Communications and Networking, pp: 197-201, .Ian. 2007M. Young, The Technical Writer's Handbook. Mill Valley, CA: University Science, 1989.

Pursuing ME
(VLSI &EMB.SYSTEMS),MIT-COE.

Professor & Dean of exam section at MIT-COE.He has keen interest in the area of fuzzy systems, Neural networks, signal processing. Prof. Shete has more than Twenty One of experience in teaching undergraduate as well as postgraduate students.

Associate Professor & ME Co-ordinator at MIT-COE. He has keen interest in the area of advance communication ,microwave engg, mobile communication .He as Twenty of experience in teaching undergraduate as well as postgraduate students.