ISSN: 2277-9655
(I2OR), Publication Impact Factor: 3.785

IJESRT

INTERNATIONAL JOURNAL OF ENGINEERING SCIENCES & RESEARCH TECHNOLOGY

DISTRIBUTED WIRELESS SENSOR NETWORKS FOR REMOTE SENSING AND CONTROL IN AGRICULTURE

Miss. Shinde Mohini Ramesh*, Mr. Kharat G.U.
* Dept of E&Tc Engineering,Sharadchandra Pawar College of Engg,Otur, Maharashtra, India.
Dept of E&Tc Engineering,Sharadchandra Pawar College of Engg,Otur, Maharashtra, India.

ABSTRACT

Irrigation system and water management are the major issues to be handled. Particularly in some low rainfall area and dry area it is important to save water as well as to improve productivity. Temperature, moisture and humidity are the important factors in agriculture. These factors affect the growth of crops and its quality. Irrigation system with the help of sensor nodes can provide a suitable solution. Use of irrigation has been increasing across the humid areas. Humidity has straight influences on the water relations of plant. In agriculture it is necessary to know the atmospheric temperature at the different timings. Soil pattern varies according to area. Different types of soil have different water handling capacity. According to this capacity, irrigation system should be managed. For this purpose the concept of wireless sensor network using a current communication system namely ZigBee is described in this project. Temperature sensor , humidity sensor and CO2 sensors are distributed across the field to sense changes in atmosphere like temperature, humidity and CO2 respectively. Level sensor is also used to detect the water level in the well& Motion sensor is also used which is used for security purpose. LDR is used to avoid power consumption, if there is no light falls on the LDR then all the components are off excluding microcontroller and energy is saved. These nodes interface using wireless communication technology using ZigBee module. All the sensed parameters are feed to the irrigation control station that is monitored using PC and stored using visual basic. A GSM module is implemented in the project which is accessed with the help of mobile device for continuously readings. SMS (Short Message Service) send through the GSM on the users mobile number regarding different environmental parameters, water level and security .

KEYWORDS: water level monitoring, wireless sensor Networks, Precision Agriculture, GSM.

INTRODUCTION

As we know India is an agricultural country in which near about 70% population is dependent on agricultural sector. The food and employment has been made available by virtue of agriculture. As the agriculture sector contributes more importance as compared to other sources in Indian economy, therefore to improve Indian economy we have to use advanced technology or advanced methods in agriculture. The uncertain rain fall is major parameter which affects the process of agriculture. So we have to use available source of water in efficient way to improve the crop yield or crop production. By considering above facts some of the researchers have made the effective and new ideas day by day. The precision agriculture defined as it is completely covering system designed to optimize agricultural production by carefully modification of soil and crop management to respond to the condition found in each field while maintaining environmental quality by Blackmore *et al.* [1]. In Europe the Lofar Agro project is a study of precision agriculture that includes tailored management of crop. This contains monitoring soil, crop and climate conditions in a field, making generalized the result and providing decision support systems for taking actions such as real time variation of fertilizer application [3]. Miranda et al [4] used a closed loop irrigation system and determined irrigation amount based on soil water measurement. The radio transmission for soil moisture data from data logger to central computer logging side has studied by Shock et al [2]. The smart soil moisture sensor and sprinkler valve controllers implement plug and play technology and proposed architecture of distributed sensor network for site specific irrigation is used by Wall and King [5]. Perry et al [6] has compared the uniformly of sprinkler irrigation with and without sprinkler cycling on and off and design sprinkler cycling for variable water applications. Sprinkler irrigation system by using aided design software that allows the design of simplified layout of irrigation system is design and simulated by Abreu and Perirria [7]. The coordination of control and instrumentation data is managed with the help of data network and micro

controller [3]. By using standard interface for sensor and actuators allows reuse a common hardware and protocol as a interface and control algorithm software has to be maintained RS 232 serial voltage based and RS 485 current based communication protocols widely used for integrating sensors, actuators. It is not possible to hard wire the system for long distances from field sensing stations to base sensing stations because it takes extensive time and cost to install and maintained. To avoid this here we are using wireless data communication system which provides cost free relocation and dynamic mobility. This is possible with the help of Radio Frequency technology which provide number of opportunities to use wireless signal communication in agricultural system. This article explains the design of distributed wireless sensor network for controlling environmental conditions of agricultural to improve the productivity of farm in terms of quantity as well as quality. The system developed is Distributed Wireless Sensor Networks with Remote Sensing & Control in Agriculture monitors atmospheric parameters like temperature ,humidity and CO2 along with power saving and controls the irrigation .Also measured information can be employed or early-warning via diverse types of services. A GSM module is implemented in the project which is accessed with the help of mobile device for continuously readings .SMS (Short Message Service) send through the GSM on the users mobile number regarding different environmental parameters, water level and security .all the three sensor nodes designed work correctly which are seen on LCD and GUI implemented using VB at the base station

SYSTEM DISCRIPTION

The system is divided in two stations Field station, and irrigation control station. The field station contains three sensors such as temperature sensor, humidity sensor & CO_2 sensor which continuously monitors different environmental parameters like temperature, humidity & CO_2.Field station also contains motion sensor for security & level sensor to monitor water level of water tank. All these data are transferred wirelessly to Irrigation control station by using wireless communication technology zigbee transmitter. This field sensory data is processed in irrigation control station and updated in irrigation control stations for real time monitoring and take suitable control action. Based on control signal the irrigation control station operates motor to apply specified depth of water after equal interval of time. The total system consists of two stations field station & irrigation control station.

Hardware Requirements

1. Zigbee Transmitter & Zigbee receiver should be in the specified range so that data can be collected properly
2. GSM should send sms instantly as action is being taken by controller
3. Power consumption should be less than 2W.
4. Current requirement for overall system is 400mA
5. Voltage requirement is 5V for all digital section
6. Voltage required for relay section is 12V.
7. For GSM module voltage required is 12V, & current requirement is 1Amp
8. Reset time should be below 120 m Sec.
9. Clock frequency for controller is 12 MHz
10. Frequency requirement of Zigbee Module is 2.4GHz
11. Delay time should not exceed 2 n Sec.
12. LCD consumption should be 100mAmp

Field station

Field station contains six sensors like temperature sensor, CO_2 sensor, Humidity sensor, level sensor, moisture sensor and motion sensor. Fig. 1 show the block diagram of field station .For seeding of any cellular crop temperature & humidity are important factors at the time seeding particular humidity is required and this relative humidity is sensed by humidity sensor. The use of level sensor is to find out the level of water in well which is used in field .If the level of water in well is so less to run motor then it is not affordable to run the pump in dry condition. Hence the use of level sensor is that to sense the level of water in well, when suitable level of water is present in well the actuating signal will be sent to motor and water is supplied to the field. The presence of any unwanted suspicious object or animal will harm the field or in field crops, for that purpose the motion sensor is used which can sense the occurrence of such unwanted suspicious object or animal in the field. This sensor contains the transmissions system which sense motion of unwanted object or animal and send this to receiver for monitoring of the motion .If any unwanted object or animal appears in between transmitter and receiver section then the buzzer will alarm and it will send data towards control room. As the name indicates the CO_2 sensor is used for the measurement of CO_2

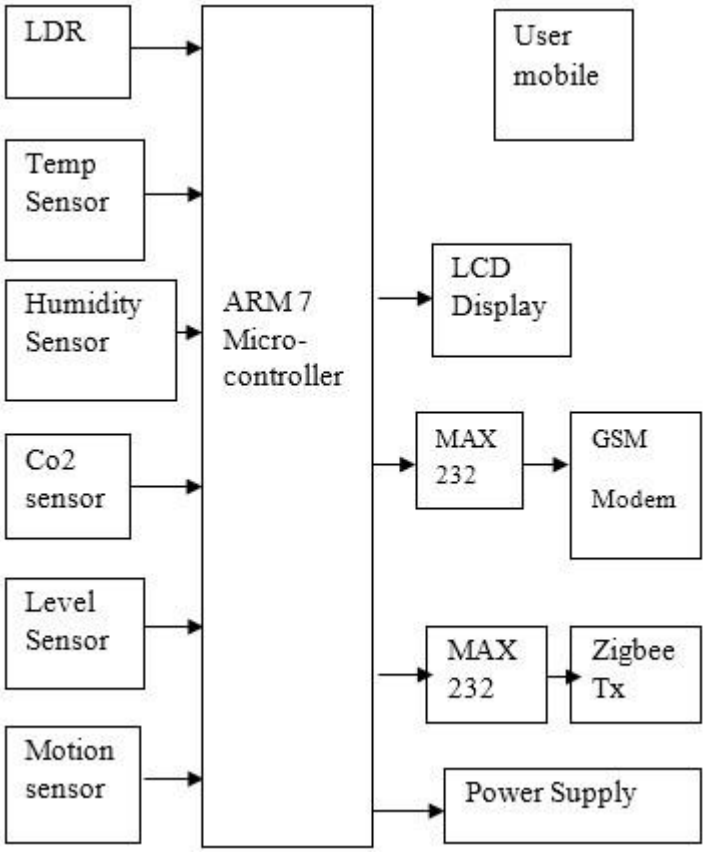


Fig.1 Field Station

The main controlling & processing unit of the proposed system is ARM controller. The reason why ARM is selected because of its low power, less area, high speed, better accuracy and cost. LPC is a 32-bit microcontroller and based on ARM7TDMI-S.It is designed using Von Neumann architecture. This architecture is a design for an electronic digital computer. ARM represents Advanced RISC Machine. In TDMI T stands for thumb instruction set, D is debug interface, M is multiplier, I is interrupt and S is synthesizable. It has 32kB of RAM and 512kB FLASH. There are dual 10-bit ADC and DAC. Also has two UART and I2C bus. LPC 2138 has two modes of operation; Idle and Power down. The GSM modem contains the GSM operated SIM card like mobile phones with its unique phone number. We can use RS232 port of GSM modem for communication and also develop the application of embedded system. Some of the applications of GSM modem are send/receive SMS, make/receive voice calls, data transfer and remote control with data logging. In GPRS mode we can also connect this GSM modem to any remote FTP server and upload files for data logging. This GSM modem is a highly flexible GSM modem for direct and easy integration to support RS232 applications. Following are some of the specifications of the GSM modem.

i) Specifications of GSM :

1) 24*7 operations with matched antenna.
2) Operating Frequency: 850/900/1800/1900 MHz.
3) Supports all GSM operator SIM cards.
4) SIM 900D reliable wireless module.
5) Good performance for voice, SMS, data &fax.
6) Low power consumption.
7) Operating temperature:-40°c to +85°c.

ii) Power Consumption:

The power saving is made possible with the help of light dependent resistor (LDR).Total system is working in the day and in night it is off excluding microcontroller. In day light falls on the LDR, therefore microcontroller and

all the system is on. In night light does not fall on it therefore all the system excluding microcontroller is off. Therefore power required for continuous monitoring is reduced & overall power consumption is also less.

C) Irrigation control station

The irrigation control station has to process all the data coming from field station and it has to take a suitable control action by this data.

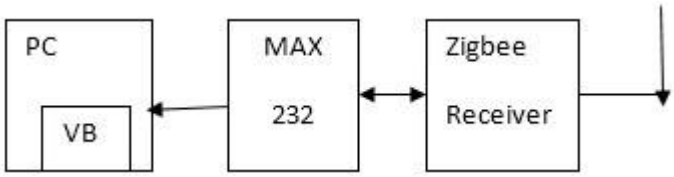


Fig .2: Block Diagram of Control Station

The irrigation control station contains zigbee receiver & main computer. The zigbee receiver receives the data which is send by the field station through zigbee transmitter & gives this data to main computer through max 232. By collecting environmental parameters from the farm on regular basis one can monitor climate timely. This data is maintained in the PC so that by comparing productivity & climatic condition it will be beneficial to analyze it for different crops. So that maximum quality as well as quantity can be maintained. Following are the some specifications of the zigbee module.

ii) Specifications of zigbee module:

1) Range :10-100 meters.
2) Networking topology: Ad-hoc, peer to peer, star, mesh.
3) Operating Frequency: 868 MHz (Europe) ,900-928 MHz (NA), 2.4 GHz (worldwide).
4) Complexity: Low.Power.
5) Consumption: very low.
6) Security: 128 AES plus application layer security
7) Data Transfer Rates: upto 250Kbps

SYSTEM ANALYSIS

This design is mainly based on Wireless Sensor Node which helps in monitoring the environmental conditions like temperature, humidity, moisture content of soil from different parts of farm. It gives timely & accurately reflects climatic conditions so that we can analyze the data can take preventive actions depending on the requirement. Conditions to turn on or off the motor are given in the following table. The motor will automatically turn on if one of the parameter is high above the specified limit.

Specified or maximum values of environmental parameters is given below :

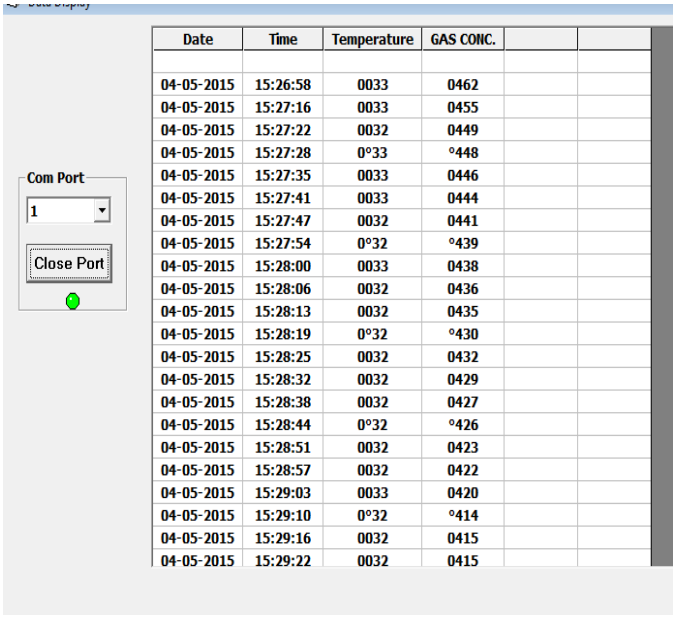
1) Temperature = 35 °C
2) Humidity=60 %
3) CO_2Gas concentration=300 PPM

TABLE 1: Conditions to turn on or off the motor

Parameters → / Reading	**Temp In °C ↓**	**Humidity In %**	CO_2 **Conc. In PPM**	**Motor Status**
1	39	69	179	ON
2	30	75	385	ON
3	33	59	235	ON
4	29	80	282	OFF

5	36	55	310	ON

From above table 1, If temperature is above 35 °C then message will be send on the user mobile and motor will automatically turn on. If humidity is below the 60 % then message will be send on user mobile and motor will automatically turn on. If CO_2 Gas concentration is above 300 ppm then message will be send on user mobile and motor will turn on. It all the parameters are less than specified limit then motor will be off .



Date	Time	Temperature	GAS CONC.
04-05-2015	15:26:58	0033	0462
04-05-2015	15:27:16	0033	0455
04-05-2015	15:27:22	0032	0449
04-05-2015	15:27:28	0°33	°448
04-05-2015	15:27:35	0033	0446
04-05-2015	15:27:41	0033	0444
04-05-2015	15:27:47	0032	0441
04-05-2015	15:27:54	0°32	°439
04-05-2015	15:28:00	0033	0438
04-05-2015	15:28:06	0032	0436
04-05-2015	15:28:13	0032	0435
04-05-2015	15:28:19	0°32	°430
04-05-2015	15:28:25	0032	0432
04-05-2015	15:28:32	0032	0429
04-05-2015	15:28:38	0032	0427
04-05-2015	15:28:44	0°32	°426
04-05-2015	15:28:51	0032	0423
04-05-2015	15:28:57	0032	0422
04-05-2015	15:29:03	0033	0420
04-05-2015	15:29:10	0°32	°414
04-05-2015	15:29:16	0032	0415
04-05-2015	15:29:22	0032	0415

Fig. 3 GUI Window of Environmental parameters

The environmental parameters from the farm are collected on regular basis so one can monitor climate timely. Graphical user interface window of environmental parameter is as shown in fig.3. This data is maintained in the PC so that by comparing productivity & climatic condition.

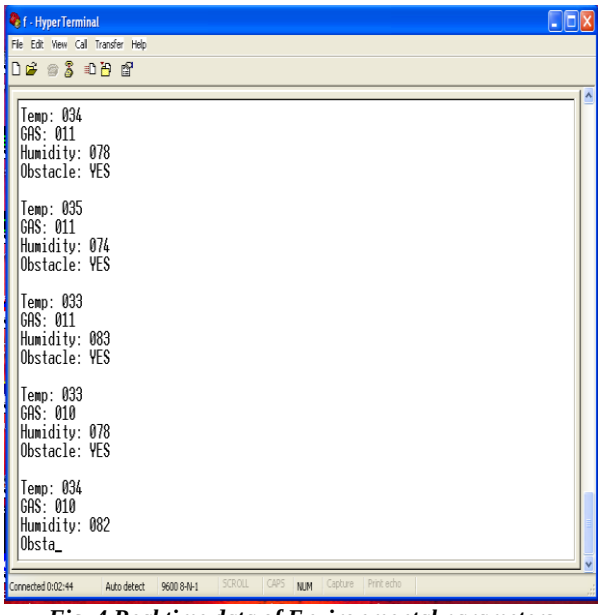


Fig .4 Real time data of Environmental parameters

The environmental parameters from the farm also can be seen on PC by using serial port or hyper terminal. Real time data of Environmental parameter is as shown in fig .4

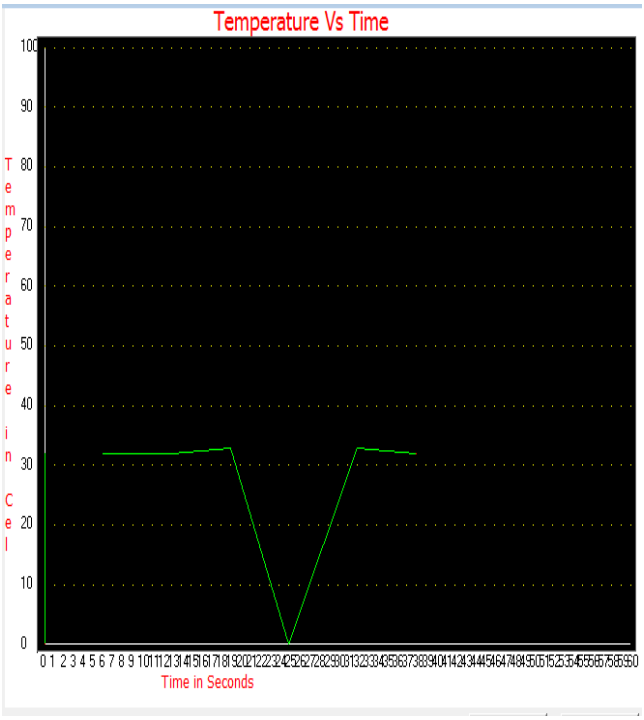


Fig .5 Graph of Temperature verses Time

Temperature sensor gives temperature reading for different time. The graph of Temperature verses Time is as shown in fig.5 which shows the variation in temperature sensor reading with respect to time.

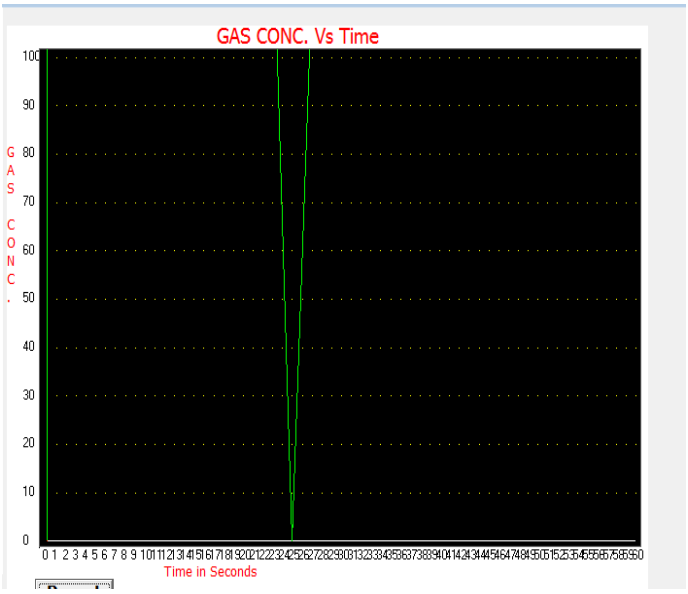


Fig.6 Graph of Gas Concentration (CO_2) verses Time

Gas sensor gives CO_2 gas concentration reading for different time. The graph of gas concentration (CO_2) verses time is shown in fig.6 which shows the variation in CO_2 gas concentration sensor reading with respect to time.

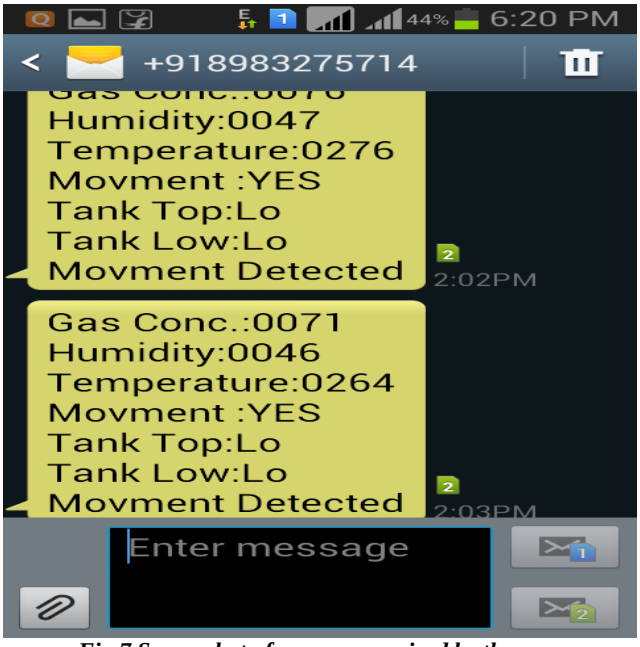


Fig.7 Screenshot of message received by the user

The information regarding environmental parameters, motor status ,water tank level, movement detected at the gate is send on user mobile phone. The screenshot of message received by the user is as shown in fig.7. Therefore farmer can monitor total system at remote location via sms.

CONCLUSION

The prototype hardware including the sensors for monitoring temperature, humidity and CO_2 along with circuitry is successfully implemented. The solution of Zigbee based wireless sensor network reduces the energy consumption due to its self-configuration and self-healing nature. This system meets the real time transmission by using the low power consumption processor LPC 2138, whose basic job is to process and collect the data, which is send to the other node through zigbee module.

This project is to improve the agricultural sector by using advanced techniques in simple way. So that farmer will be able to operate system easily to develop agricultural land. By collecting environmental parameters from the farm on regular basis one can monitor climate timely. This data is maintained in the PC so that by comparing productivity & climatic condition it will be beneficial to analyze it for different crops. So that maximum quality as well as quantity can be maintained. Farmer can have information regarding environmental condition on his mobile phone in case he will be out of station. Not only farmer is getting data on mobile but also he will be having control on the system via sms

Thus this system is very helpful to farmer to monitor & develop the agricultural sector which is very simple to implement & operate.

REFERENCES

[1] S. Blackmore, “Precision Farming: An Introduction,” Outlook on Agriculture Journal, Vol. 23, 1994, pp. 275- 280.
[2] C. C. Shock, R. J. David, C. A. Shock, and C. A. Kimberling, “Innovative, automatic, low-cost reading of Watermark soil moisture sensors,” in Proc.Irrig. Assoc. Tech. Conf., Falls Church, VA, 1999, pp. 147–152.
[3] I. F. Akyildiz and W. Xudong, “A Survey on Wireless Mesh Networks,” IEEE Communication Magazine, Vol. 43, 2005, pp. S23-S30.
[4] F. R. Miranda, R. Yoder, and J. B. Wilkerson, “A site-specific irrigation control system,” presented at the ASAE Annu. Int. Meeting, Las Vegas, NV, Jul. 27–30, 2003, Paper No. 031129.

[5] R. W. Wall and B. A. King, "Incorporating plug and play technology into measurement and control systems for irrigation management," presented at the ASAE/CSAE Annu. Int. Meeting, Ottawa, ON, Canada, Aug. 1–4, 2004, Paper No. 042189.
[6] C. D. Perry, M. D. Dukes, and K. A. Harrison, "Effects of variable-rate sprinkler cycling on irrigation uniformity," presented at the ASAE/CSAE Annu. Int. Meeting, Ottawa, ON, Canada, Aug. 1–4, 2004, Paper No. 041117.
[7] V. M. Abreu and L. S. Pereira, "Sprinkler irrigation systems design using ISADim," presented at the ASAE Annu. Int. Meeting, Chicago, IL, Jul. 27–31, 2002, Paper No. 022254.
[8] Y. Kim, R. G. Evans, and J. D. Jabro, "Optimal site-specific configuration or wireless in-field sensor-based irrigation," presented at the 26th Annu. Irrigation Association Int. Irrigation Show, Phoenix, AZ, Nov. 6–8, 2005, Paper IA05-1307.
[9] H. J. Farahani and G. W. Buchleiter, "Temporal stability of soil electrical conductivity in irrigated sandy fields in Colorado," Trans. ASAE, vol. 47, no. 1, pp. 79–90, 2004.[10]R. Kulkarni, Technologies for Building Wireless Industrial I/OSystems.Austin, TX: Nat. In strum., May 3, 2005.
[10] G. Pottie, "Wireless sensor networks," in Proc. IEEE Int. Inf. Theory Workshop, Killarney, Ireland, Jun. 22–26, 1998, pp. 139–140.
[11] R. G. Evans and W. M. Iversen, "Combined LEPA and MESA irrigation On a site specific linear move system," presented at the 26th Annu. Irrigation Association Int. Irrigation Show, Phoenix, AZ, Nov. 6–8, 2005,Paper IA05-1298.
[12] P. E. Drummond, C. D. Christy, and E. D. Lund, "Using an automated penetrometer and soil EC probe to characterize the rooting zone," in Proc.5th Int. Conf. Precision Agriculture, Bloomington, MN, Jul. 16– 19, 2000.
[13] J. D. Jabro, R. G. Evans, Y. Kim,W. B. Stevens, and W.M. Iversen, "Characterization of spatial variability of soil electrical conductivity and coneindex using coulter and penetrometertype sensors," Soil Sci., vol. 171,no. 8, pp. 627–637, 2006.
[14] GPS 16/17 Series Technical Specifications, Garmin Int., Inc., Olathe, KS, 2002. rev. B.S.Yi"The Short-Distance Wireless Communication and Network Technology," National Academies Press, Washington D.C, Vol. 2, 2009.
[15] Z. Zhang, "Investigation of wireless sensor networks for precision agriculture," presented at the ASAE/CSAE Annual Internal Meeting, Ottawa,Canada, Aug. 1–4, 2004, Paper No. 041154.
[16] N. Wang, N. Zhang and M. Wang, "Wireless Sensors in Agriculture and Food Industry: Recent Development and Future Perspective," Computers and Electronics in Agri- culture Journal, Vol. 50, 2006, pp. 114-120.
[17] I. F. Akyildiz and W. Xudong, "A Survey on Wireless Mesh Networks" IEEE Communication Magazine, Vol. 43, 2005, pp. S23-S30.