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Web Design Irrigation in Wireless Sensor Network Using Raspberry Pi

K. Bhaskara Rao[1] | Mahesh Babu Marneni[2]

[1]Associate Professor, Department of ECE, SVR Engineering College, Nandyal, Andhra Pradesh, India
[2]PG Scholar, Department of ECE, SVR Engineering College, Nandyal, Andhra Pradesh, India

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ABSTRACT

This paper presents an automation of farm irrigation system using a wireless sensor network (WSN) and embedded Linux board. The system provides a web interface to the user so that the user can control and monitor the system remotely. Embedded Linux board makes the communication with all distributed sensor nodes placed in the farm through ZigBee protocol and itself act as a coordinated node in the wireless sensor network. The goal of coordinator node is to collect the parameters like soil moisture and soil temperature wirelessly. Each sensor node consists of soil moisture and soil temperature sensor and one ZigBee RF antenna device for communication with the coordinator node.The system will work according to the algorithm developed for watering the crop. Hence coordinator collects the data over ZigBee wireless communication protocol and allow user to monitor the data from a web browser. User can make the irrigation system ON or OFF remotely. The system will reduce the water consumption and giving uniform water to the crop results in increasing yield.

KEYWORDS: *Wireless sensor network; Raspberry Pi (Rpi); Zigbee; Embedded linux. Web Design; Irrigation.*

I. INTRODUCTION

Irrigation is the application of water to the land or soil. It is an essential in all agriculture cropping systems. Agriculture requires usage of plenty of water. There is abundant of water on our planet. However, about or less than 1 % of the water is available for human use and approx. 70% is used for irrigation. Therefore, it becomes important to minimize the water waste. There are many irrigation systems are available, but most of them requires a lot of power that makes difficult for the farmers to gain information regarding soil or weather conditions. As a result, farmers suffer a lot. To over come this issue, wireless sensor network and ZigBee technology is used. A WSN is a distributed network of tiny, lightweight wireless nodes that are implemented with sensors which provide real-time monitoring and controlling solutions. Sensor nodes are the basic part of the wireless sensor network. A typical node of wireless sensor network consists of a transceiver, sensors, memory and power source and it has the ability to sense, process the sensed data and communicate with each other. Therefore, the sensor node plays an important role in agriculture. It is a reliable, high performance and cost effective solution through which many parameters can be controlled such as temperature, humidity, soil moisture and much more. ZigBee is IEEE 802.15.4 standard technology, used for short range WSN with small, low-power digital radios. It was selected for battery operated sensor network because it is simpler, less expensive, low power consumption and greater

useful range as compared to other wireless networks (WPANs) such as Bluetooth or Wi-Fi. ZigBee devices can transmit the data over long distance through mesh networking where intermediate devices are used to reach more distant ones. The ZigBee communication protocol is basically useful for low data rate applications such as control and monitoring systems that require long battery life, short range and secure networking.

Features:

- Low battery consumption. The ZigBee devices can operate for months or even years without battery replacement.
- Low cost.
- The low data rate, maximum data rate is 250Kbps.
- Easy to implement.
- Supports up to 65,535 nodes connected in a network.
- More reliable as Channel access using Carrier Sense Multiple Access with Collision Avoidance (CSMA - CA).
- A ZigBee end device can be in sleep mode and still keep its association with its network.

II. Related Work

WSNs have been widely used in many irrigation systems to obtain accurate results. Each application has its own characteristics and objectives. [15] Proposed an economical and generic automatic irrigation control system using GSM and Bluetooth. This paper gives a detailed survey of various remote monitoring and control systems based on different technologies. In the proposed system, both GSM and Bluetooth modules are interfaced with the 8-bit microcontroller. GSM is used for remote monitoring and controlling the devices via messages and Bluetooth was also used for the same purpose but within a range of few meters which eliminates the cost of network usage to a great extent. If the moisture or temperature exceeds the predefined threshold values then the system informs the user via SMS from the GSM Module to the user's smartphone and actions will be taken by the user accordingly. But this system was not efficient for strong real-time monitoring. [2] Proposed, the ARM control based Drip irrigation system for sensing various parameters of the soil. The proposed system utilizes micro sensors for N, P, K measurement, temperature, humidity, soil moisture, soil PH for the agriculture environment and interfaced with ARM LPC2148 Microcontroller. The content measurement of N, P, K elements helps to decide fertilizers requirement and also useful to manage the content of these elements in chemical mixing during the formation of fertilizers. This system uses a wired communication network to control the valves of the drip irrigation system. [5] Proposed, an automatic irrigation system using ZigBee and WSN to make effective utilization of water resources for agriculture. It consists of distributed wireless sensor system consisting soil moisture and temperature sensors fixed near roots of the plants and all the components are powered by a solar panel for charging the battery so that need not to worry about the battery replacement every time. All the data received from the wireless sensor unit is identified, recorded, analysed and the information is transferred to the web server via GPRS Module. The farmer can set crop types such as Wheat, Bajra, Rice, and Jowar in the master node. Moisture, temperature and humidity value required for a particular crop are set in the microcontroller as a threshold value. The actual values are compared with the threshold values. If the actual value crosses the threshold values then corresponding pump, buzzer, fan is switched on. In future mobile can be used to receive messages directly instead of PC. Gutierrez, Jessica, et al.[1] proposed an automated irrigation system using GPRS Module for the effective utilization of water in agriculture. It consists of distributed wireless sensor unit with soil moisture and temperature sensors deployed in plant root zones. The data from the wireless sensor unit is transferred to the main controller where the data is identified, recorded and analysed. This main controller permits the automated activation of irrigation when the threshold value of soil moisture and temperature are reached. The communication between the sensor node and the main controller is via ZigBee protocol under the IEEE 802.15.14WPAN.The receiver unit also has a duplex communication link based on a cellular-Internet interface, using general packet radio service (GPRS) protocol, which is a packet-oriented mobile data service used in 2G and 3G cellular global system for mobile communications (GSM)[1]. The data is allowed to transfer to the web server in real time through the internet, where the soil moisture and temperature levels are graphically displayed and stored in a database server. Patel, Nirmit, and NilsehDesai[4] proposed a system that aims in designing an automatically operated system which is capable of

controlling the electrical devices based on sensor unit. The system uses solar panel for power supply and charging battery for WSN. The entire system is divided into two parts one is WSU (wireless sensor unit) and another is WUI (wireless information unit). WSU contain all sensors and ZigBee transmitter which is located in the field section of the soil. WIU contain ZigBee receiver, Wi-Fi module and electrical devices coolant fan and motor pump and buzzer which is located in the monitoring section of control room. Whenever the sensors unit gets the input from respected sensors like temperature LM35 sensor, water level indicator sensor LM324 and Gas leakage detector these inputs are fed to the ARM 7 microcontroller and the controller takes the responsibility to transmit the monitored data to the monitoring section using ZigBee module. The Another ZigBee module which is located at monitoring section receives the data and fed as input to another ARM-7 Microcontroller performs an appropriate task related to the data received like motor ON/OFF control, fan as coolant control system. The data is also transmitted directly to thepredefined web page using router connected to Wi-Fi wireless network. The monitored data displays the status directly to the webpage.

Limitations of the Existing System.

- All the proposed systems have used the star topology. This topology consists of a central node to which all other nodes are connected. But if the central node fails then the entire system is affected.
- PC incurs additional cost, although one can monitor and control devices remotely from any part of the world
- Provided internet access is available. Normally farms are very far from the house so the farmers have to travel to the farm for irrigating the crops.
- Which cause inconvenience, takes time and requires fuel consumption. There should be a way through which user can perform various actions remotely. Security is always a major concern in everywhere. In dry or hot season, the outsider can use the water tank to
- Irrigatetheir own crops. Low-cost product with more features always a requirement.
- If the farmer is out of his farm then in any emergency he should be notified automatically
- As the farmers does not know the technical details of the device. Data is displayed in terms of values which
- Are difficult for the farmers to understand.

III. Implementation

The objective is to make use of wireless sensor network and communication technologies like ZigBee, GSM in industrial field to design a remote control and monitoring system for farmers that would graphically represent the soil condition of the crop distantly using ZigBee. At any abnormal condition, an alarm is raised and an alert message is sent to the user via GSM so that user can remotely perform an action by sending a message.

A. System Architecture

Fig 1 shows, the designed system with two nodes i.e. Sensor node and Coordinator node, linked by radio transceivers that allow the transfer of sensor data using ZigBee technology. The coordinator node receives, analyse and store the data to the database

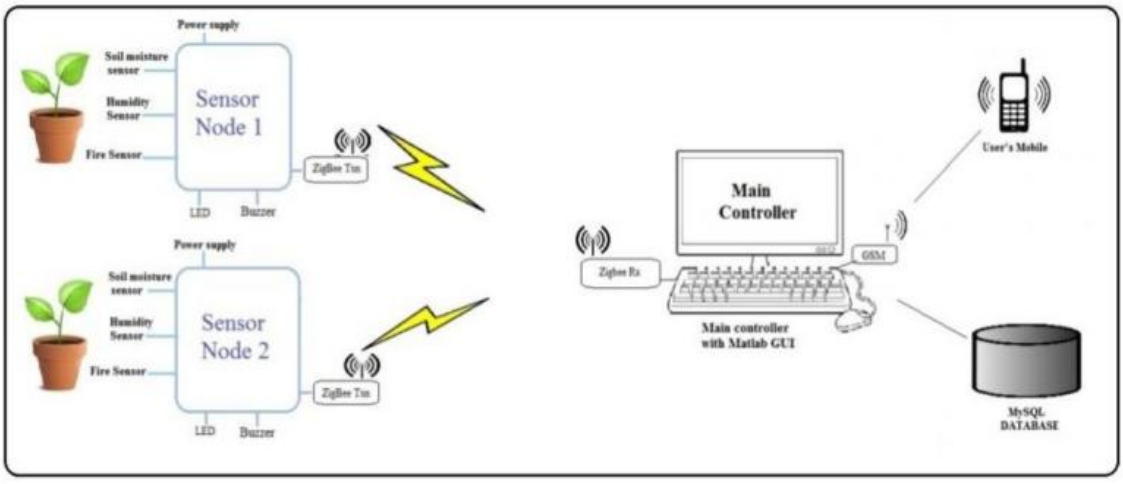

Figure 1: Architecture of Automated Irrigation System

1) Sensor Node: A node is comprised of RF transceiver, Sensors, a microcontroller and Power sources. The number of WSUs can be deployed in the field to configure a distributed sensor network. Each unit is cable to route the sensor data with some delay of seconds to the Coordinator node via ZigBee. The sensor unit supports sleep mode to decrease power consumption by transmitting data at one-minute interval. For our implementation, AVR microcontroller is used which is a 32-bit RISC microcontroller with Harvard architecture. AVR is selected due to its high performance and lower power consumption functionality and offers wide range of innovative technical features. AVR also have some standard features such as on-chip 32K program ROM, 2K data RAM, 1K data EEPROM, 3 timers and 32 I/O pins. It also has some additional features like Analogto Digital converter (ADC), PWM and different serial interface such as UART, SPI, I2C, CAN, USB. The AVR is preferred because it is easy to program in embedded C and inexpensive with low power consumption. The system utilizes different sensors to control and monitor the various parameters of the soil such as Soil temperature sensor, Humidity sensor, soil moisture sensor. Fire sensor is used for fire detection. Grove soil moisture sensor, DHT11 humidity sensor and Fire sensor is used. Measuring soil moisture is important to get the information regarding the exact quantity of the water needed to irrigate the crops. Humidity sensor gives two parameters; humidity and air temperature. The sensor has a crucial role in plants growth; low temperature causes a decrease in the absorption and movement of water in the plants and low humidity causes fast transpiration. Fast transpiration means the plants using lots of water (nutrients).

2) Coordinator Node: The soil moisture, humidity and temperature data from the WSU are transferred to the Wireless information unit via ZigBee receiver. The PC with GSM and ZigBee is used as a Coordinator node to identify and analyze the data. Farmers can easily visualize the condition of the soil through graph. The collected data is updated to the MySQL database by which one can easily check the previous day's data and make an appropriate decision for the crops. The user is allowed to set the threshold value for the particular crop. If the running value crosses the threshold value then a warning message is sent to the user mobile device via GSM. In case of fire, an alert message is displayed on the screen as well as send to the user's mobile. The user can also perform an action through an on/off message.

IV. Experimental Work

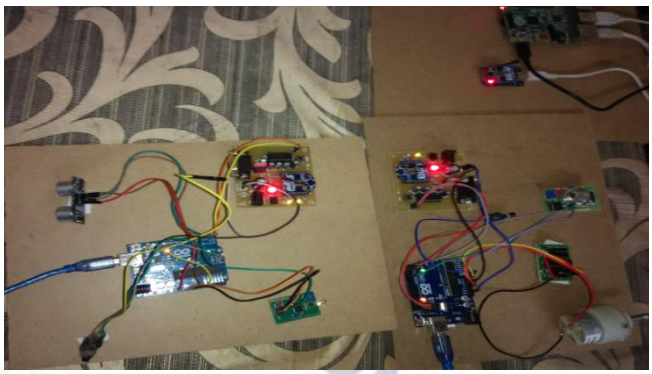

Fig 2: System Hardware Architecture1.

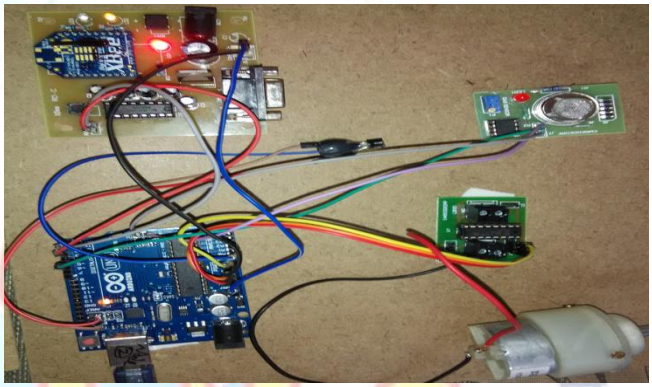

Fig 3: System Hardware Architecture2.

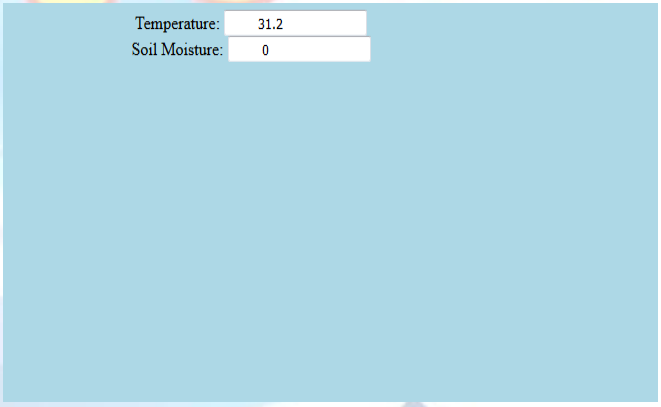

Fig 4: System Web page for temperature and soil measure count.

Fig 5: System Web page having node information along with pump off or on.

V. Conclusion

This paper designs the automated wireless irrigation system using WSN and embedded Linux board. In this we have used A89S52 controller as an embedded Linux board which allows collecting the sensor information from sensor node continuously, store it in a database and providing the web interface to the user. The system is watering to the crop uniform by analyzing the soil parameters, it will help to reduce the fresh water consumption. By providing the web interface and automation user can easily monitor the system and it will minimize the human intervention. The ZigBee protocol is used here for wireless communication it will create network easily.

References

[1] Gutierrez, J.; Villa-Medina, J.F.; Nieto-Garibay, A.; Porta-Gandara, M.A., "Automated Irrigation System Using a Wireless Sensor Network and GPRS Module," Instrumentation and Measurement, IEEE Transactions on , vol.63, no.1, pp.166,176, Jan. 2014.

[2] Yunseop Kim; Evans, R.G.; Iversen, W.M., "Remote Sensing andControl of an Irrigation System Using a Distributed Wireless Sensor Network," Instrumentation and Measurement, IEEE Transactions on , vol.57, no.7, pp.1379,1387, July 2008.

[3] W. A. Jury and H. J. Vaux, "The emerging global water crisis: Managingscarcity and conflict betweenwater users," Adv. Agronomy, vol. 95, pp. 1–76, Sep. 2007.

[4] Mirabella, O.; Brischetto, M., "A Hybrid Wired/Wireless Networking Infrastructure for Greenhouse Management," Instrumentation and Measurement, IEEE Transactions on , vol.60, no.2, pp.398,407, Feb. 2011.

[5] Wark, T.; Corke, P.; Sikka, P.; Klingbeil, L.; Ying Guo; Crossman, C.; Valencia, P.; Swain, D.; BishopHurley, G., "Transforming Agriculture through Pervasive Wireless Sensor Networks," Pervasive Computing, IEEE , vol.6, no.2, pp.50,57, April-June 2007.

[6] Rani, M.U.; Kamalesh, S., "Web based service to monitor automatic irrigation system for the agriculture field using sensors," Advances in Electrical Engineering (ICAEE), 2014 International Conference on , vol., no., pp.1,5, 9-11 Jan. 2014.

[7] Genghuang Yang; Yuliang Liu; Li Zhao; Shigang Cui; QingguoMeng; Chen HongDa, "Automatic irrigation system based on wireless network," Control and Automation (ICCA), 2010 8th IEEE International Conference on , vol., no., pp.2120,2125, 9-11 June 2010.

[8] Zhang Feng, "Research on water-saving irrigation automatic control system based on internet of things," Electric Information and Control Engineering (ICEICE), 2011 International Conference on , vol., no., pp.2541,2544, 15-17 April 2011.

[9] Yan Xijun; Lu Limei; XuLizhong, "The Application of Wireless Sensor Network in the Irrigation Area Automatic System," Networks Security, Wireless Communications and Trusted Computing, 2009.NSWCTC '09. International Conference on , vol.1, no., pp.21,24, 25-26 April 2009.