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AUTOMATIC IRRIGATION SYSTEM USING A WIRELESS SENSOR NETWORK AND GPRS MODULE

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ABSTRACT

Automatic irrigation system was used to reduce water usage in the agricultural system. The automatic irrigation system has consists of wireless sensor unit and wireless information unit and webpages. Wireless sensor unit is the combination of Soil-moisture and Temperature probe put in the root of the plant and it also consist of XBee Transceiver to send the information from WSU to WIU. Microcontroller takes the information form the sensor, and it will send to the WIU.WIU consist of microcontroller and GPRS module and XBee transceiver, In microcontroller set the threshold values in the microcontroller and compare it with the data coming from WSU to control the motor. The GPRS module has a two way communication based on a cellular-Internet interface that allowed to inspect the data in the web page.

There are different methods to get done water of smaller size in different farming the years produce, from basic one to more technology-wise increased ones. watering system systems can also be control through information on water What is in of using soil moisture sensors to control actuators and but for water, instead of a preselected watering system list of details at one time of the day and with a special time.

KEYWORDS: cellular networks, irrigation system, wireless sensor network.

INTRODUCTION

Agriculture needs 85% of available freshwater resources worldwide, and this much of water will go on to be chief in water taking a good because of population is increased, so increase in food request. We have to make come into existence designs based on science and technology to get changed to other form the use water, including special to some science or trade, agronomic, to do with managing, and institutional getting better.

There are different systems to get done water savings in different farming the years produce, from basic ones to more technology-wise increased. For example, in one WSU plant water position was checked and watering system listed based on temperature distribution of the plant, which was gotten with thermal imaging. In addition, other systems have been made to list of details watering system of crops to optimize water use with the help of a short haircut water conditions making things hard list of words in a book (CWSI) careful way. The based on experience CWSI careful way was first formed over 30 years earlier.

A system developed for malting barley cultivations in large areas of land allowed for the optimizing of irrigation based on decision support software and its integration with an field wireless sensor network (WSN) driving an irrigation system converted to make sprinkler nozzles controllable. Each of the sensing stations contained a data logger with two soil water reflectometers, a soil temperature sensor, and Bluetooth communication. Using the network information and the irrigation machine positions through a differential GPS, the software controlled the sprinkler with application of the appropriate amount of water. Software dedicated to sprinkler control has been variously discussed.

In environmental applications, sensor networks have been used to monitor temperature and soil moisture of environmental parameters or conditions in marine, soil, and atmospheric contexts. Environmental parameters like humidity, pressure, temperature, soil water content with different spatial and temporal resolution and for event detection such as disaster monitoring, pollution conditions, floods, forest fire, and debris flow is continuously monitored. Applications in agriculture have been used to provide data for appropriate management, such as monitoring of environmental conditions like temperature, soil moisture, fertility, mineral content.

In this paper, the development of an automated irrigation system based on microcontrollers and wireless networks at experimental scale within rural areas is presented. The aim of the project is to explain the automatic irrigation can be used to reduce water use. The implementation of automated irrigation system that consists of a wireless network that consists of soil moisture and temperature sensors depleted in the plant root zones. Each sensor node combined a soil-moisture probe, and a temperature probe, a microcontroller for data acquisition, and a radio transceiver; the sensor measurements are transmitted to a microcontroller-based receiver.

AUTOMATED IRRIGATION SYSTEM

The automated irrigation system has consisted of two components (Fig 2.1), they are wireless sensor units (WSUs) and a wireless information unit (WIU). That allowed the transfer of soil moisture and temperature data can be transferred from WSU to WIU that uses ZigBee technology. The WIU has also consisted of GPRS module to transmit the data to a web page via the mobile network. The information can be regularly monitored online through application through Internet access devices.

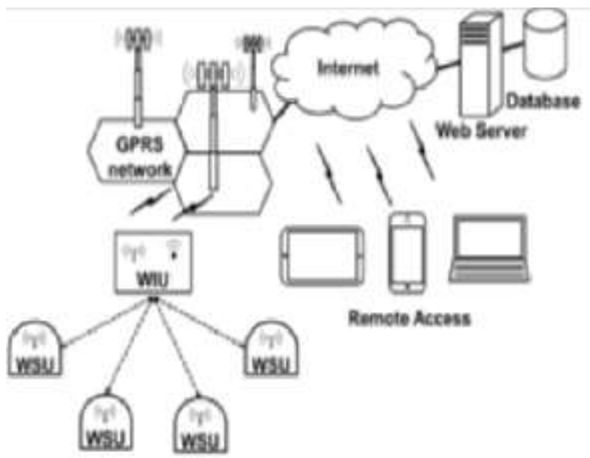

Fig 2.1 Block diagram of automated irrigation system using WSN and GPRS Module

Wireless Sensor Unit:

A WSU consist of a RF transceiver, temperature sensors, and soil moisture sensor and a microcontroller. WSUs can be .depleted in the field to configure a distributed wireless sensor network for the automated irrigation system. Each unit is based on the microcontroller PIC24FJ64GB004 (Microchip Technologies, Chandler, AZ) that controls the ZigBee module XBee S2 and process the information from the soil-moisture sensor, and the temperature sensor DS1822 (Maxim Integrated, San Jose, CA).

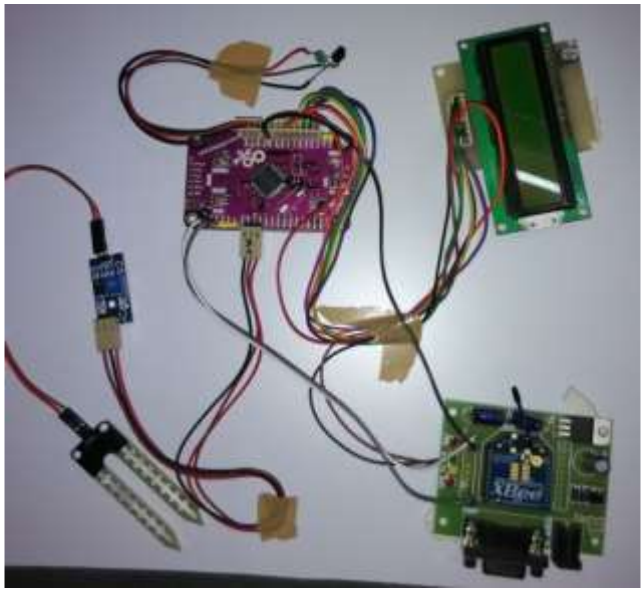
Fig 2.2 Wireless sensor unit

PIC24FJ64GB004 Microcontroller:
PIC24FJ64GB004 is a 16-bit microcontroller with 44-pins and Nano Watt XLP technology that can works in the range 2.0 to 3.6 V at 8 MHz with internal oscillator. It has consist of 25 digital input/output ports, 13 analog to- digital converters (ADC), 2 serial peripheral interface modules, 2 I2C, two UART, 5 16-bit timers, 64 KB of program memory, 8 KB of SRAM, and also consist of one hardware real-time clock/calendar (RTCC). This microcontroller is suitable for this application, because of its low-power operating current, which are 175 μA at 2.5 V at 8 MHz and 0.5μA for standby current in sleep mode including the RTCC.

The microcontroller was programmed in C compiler with the appropriate Algorithm for monitoring the soil-moisture probe with op-amp to convert analog-to-digital port of microcontroller and the temperature sensor through another digital port of microcontroller, implemented in 1-Wire communication protocol.

ZigBee Modules:
ZigBee (over IEEE 802.15.4) technology is operates on short range of Wireless Sensor Network because of it is low cost, low power consumption, and good usability with this range in comparison with other wireless technologies like Bluetooth (over IEEE 802.15.1), UWB (over IEEE 802.15.3), and Wi-Fi (over IEEE 802.11). The ZigBee device works in the range 2.4 GHZ in industrial, scientific, and medical applications and allows the network to operate in a mesh networking architecture.

From a wide range of commercial ZigBee devices, the XBee S2 is an appropriate original equipment manufacturer module to establish communication between a WSU and the WIU because of its long-range operation and reliability of the sensor networking architecture. The XBee S2 is a RF modem with integrated chip antenna, 20-pins, and 13 general purpose input/output (GPIO) ports available of which four are ADC. It can operate up to a distance of 90m in outdoor line-of-sight with 45mA of TX peak current and 50 mA for RX current at 3.3 V and power-down current of 3.5 μA.

The XBee radio modem of each WSU is powered at 3.3 V through a voltage regulator ADP122AUJZ-3.3-R7 (Analog Devices, Norwood, MA) and interfaced to the host microcontroller through its serial port, a logic-level asynchronous serial, and voltage compatible UART configured baud rate of 9600.

The WSUs were configured such as end devices to deploy a networking topology point-to-point based on a coordinator that was implemented by the XBee radio modem of the WIU. The ZigBee device has the following characteristics: 1) it must join a ZigBee module before it can transmit or receive data, 2) cannot allow other devices to join the network, 3) always transmit and receive data from one node to another node, 5) it can enter low power modes to conserve power and. The least significant byte of the unique 64-bit address is used to store the information of the soil moisture and temperature for each WSU in the network.

Soil Sensor Array:
The soil sensor array consists of two sensors; those are soil moisture sensor and temperature sensor that are inserted in the root zone of the plant. The soil moisture sensor was used to obtain the soil moisture. Soil temperature measurements were made through the digital thermometer DS1822. The sensor converts temperature to a 12-bit digital word and is stored in 2-B temperature registers, corresponding to increments of 0.0625 °C. The temperature is required through a reading command and transmitted using 1-Wire bus protocol implemented in the microcontroller through one digital port. The thermometer has accuracy of ±2.0 °C in the temperature range of −10 °C to +85 °C and a unique 64-bit serial number.

Wireless Information Unit:
The data coming from the soil moisture sensor and temperature sensor of WSU are received by the WIU, and it can identify the values, and store the values, and analyzed in the WIU. The WIU consists of a microcontroller PIC24FJ64GB004, an XBee radio modem, a GPRS module (SIM900).

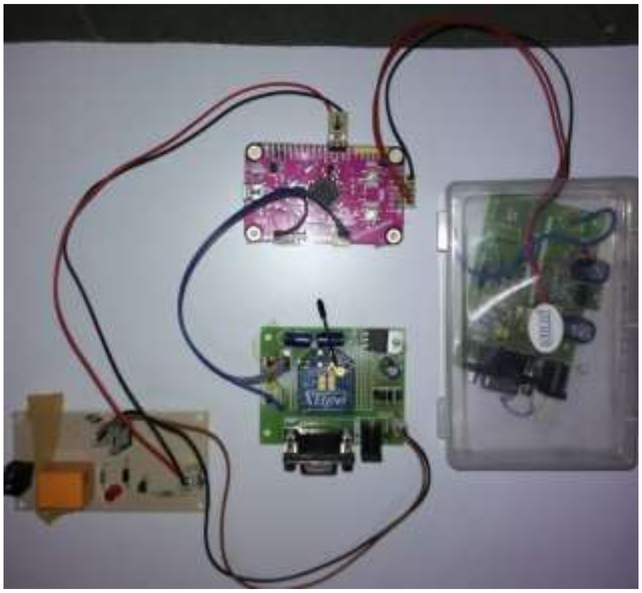

Fig 2.3 Wireless information unit

PIC24FJ64GB004 Microcontroller:
The working of the WIU is based on this microcontroller, which is programmed to perform different tasks. The first task of the microcontroller is to download the date and time from a web server through the GPRS module. The WIU is ready to transmit the date and time for each WSU through the ZigBee when WSU once powered. Then, the microcontroller receives the information from the WSU and it will compare the values with the threshold value and send this information to the webpage using GPRS module.

GPRS Module:
The SIM900 is a quad-band GSM/GPRS engine that works on frequencies GSM 850MHZ, EGSM 900MHZ, DCS 1800MHZ and PCS 1900 MHZ with GPRS multi-slot class10/Class 8 performance and also supports coding scheme cs-1,cs-2,cs-3,cs-4. SIM 900 is a 68 pin SMT pad is used to connect physical interface between module and customer. This GPRS module is transfer speeds up to 85.6 K b/s and can be interfaced directly to a UART or microcontroller using AT commands. In each connection, the microcontroller sends AT commands to the GPRS module; it inquires the received signal strength indication, which must be greater than −89 dBm to guarantee a good connection. In addition, it establishes the communication with the URL of the web server to upload and download data.

Web Application:
Graphical user interface software was used for real time monitoring and. software application permits the user to check the data in the values with the time from WSU online using any device with Internet. All the information is stored in a database.

IRRIGATION SYSTEM OPERATION

The automated irrigation system was used to irrigate only 600 m2, The WSU unit was used to measure the soil moisture and temperature in the area where the traditional irrigation practices were employed. The units were located in beds 1to operate the automated irrigation system with their corresponding soil moisture and temperature sensors situated at a depth of 10 cm in the root zone of the plants. This unit allowed data redundancy to ensure irrigation control. The algorithm considered the values from the WSU if one reached the threshold values the automated irrigation was performed.

Temperature sensor and soil moisture sensor are connected to Microcontroller (Tx), along with the XBee connected in the Field. Ds1822 sensor measures the temperature and it will send the data to the microcontroller and displays on LCD display. Soil moisture sensor measures the soil moisture is low or high, and sends Soil moisture sensor information to the microcontroller and it display on the LCD display soil moisture measurements and temperature along with motor status message is packed in a string buffer and sent to receiver over ZigBee wireless communication. Soil moisture sensor default output value is digital high, so when the soil is dry then it sends the value 1 to the microcontroller. When it's inserted in wet soil or water then its output goes to low, it means it sends the 0 to the microcontroller.

Automatic Irrigation System using Wireless Sensor Networks

Parameters	Value
Water Level	LOW
Motor Status	ON
Temperature Reading	27.93

Fig 3.1 Status of Automatic irrigation system in the Webpage.

Receiver microcontroller is connected with XBee, Relay board and GPRS modem. The power supply to microcontroller is taken from XBee board as it's having 3.3v regulator. GSM modem is given separate power supply as it requires dedicated 1 amp power supply. Receiving microcontroller gets data from XBee in the form of string. Based on the string contents it turns ON/OFF the relay. The values of temperature, Motor status and Water level are sent to website over GPRS modem. Webpage displays the live parameters of Water Level, Motor Status and Temperature. We are also logging the live parameters for historic data purpose. It stores previous value on website in text format. These historic values are useful for future forecasting and R&D purpose. This project also lets us know about the rain fall (indirectly) status by monitoring the motor status and water level ratio. We also get to know the historic temperatures values for a specific geo location.

Water Level : LOW, Motor Status : ON, Live Temperature : 28.93 , Date and Time: 2015-09-09 17:45:48

Water Level : LOW, Motor Status : ON, Live Temperature : 28.93 , Date and Time: 2015-09-09 17:46:00

Water Level : LOW, Motor Status : ON, Live Temperature : 28.93 , Date and Time: 2015-09-09 17:46:12

Water Level : LOW, Motor Status : ON, Live Temperature : 28.93 , Date and Time: 2015-09-09 17:46:24

Water Level : LOW, Motor Status : ON, Live Temperature : 27.93, Date and Time: 2015-09-12 16:50:43

Water Level : LOW, Motor Status : ON, Live Temperature : 27.93, Date and Time: 2015-09-12 16:50:50

Water Level : LOW, Motor Status : ON, Live Temperature : 27.93, Date and Time: 2015-09-12 16:51:02

Water Level : LOW, Motor Status : ON, Live Temperature : 27.93, Date and Time: 2015-09-12 16:51:14

Water Level : LOW, Motor Status : ON, Live Temperature : 27.93, Date and Time: 2015-09-12 16:51:25

Water Level : LOW, Motor Status : ON, Live Temperature : 27.87, Date and Time: 2015-09-12 16:51:38

Fig 3.2 the Previous records of the Automatic irrigation system in the web page.

CONCLUSION

The made automatic watering system instrumented was discovered to be possible to give effect to and price working well for making feeble, poor water resources for farming producing. This watering system let's helping grow in places with In short of supply in water thereby is getting (making) better power to do of water. The made automatic watering system developed gets knowledge of that the use of water can be made lower less, so that given amount of time to get somewhat cold biomass producing. The watering system can be useful to the range of special the years produce needs and it will have need of least possible or recorded support. The modular form of a thing of the made automatic watering system lets it to be used for larger fields and open fields only.

In addition, other applications such as goes on looking at of temperature it can be easily got clearly that which the years produce is right. The internet controlled duplex news system provides a powerful decision making apparatus idea for rains coming for a year so that we can map how much water is needed for helping grow process. In addition, the internet lets the user to check the information through things not fixed telecommunication apparatuses, such as a computer-helped telephone.

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