GSM BASED ADVANCED WATER DEPLOYMENT SYSTEM FOR IRRIGATION USING A WIRELESS SENSOR NETWORK & ANDROID MOBILE

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Abstract- an advanced water deployment system was developed to optimize water use for agricultural crops. Agriculture utilizes most of the fresh water, since the atmospheric parameters vary from place to place in large field, it makes very difficult to maintain the uniformity in all places of farm field manually. Hence the irrigation based modern agriculture is the recent requirement in every part of agriculture in India. So a combined action of wireless sensor network & embedded system is used in the irrigation. This paper demonstrates implemented embedded system for automatic irrigation which has a wireless sensor network placed in root zone of the plant for real time infield sensing & control of an irrigation system. In the developed system the temperature, soil moisture will be measured and it will be displayed for information of further action taken in consideration. This system helps the farmer to save water as well as reduce effort of the farmer for irrigation. It is observed that for the first time an android app inventor used in the irrigation system, which give the facilities of displaying & storing parameter database. Android mobile phones have almost become an integral part of human life serving multiple needs of humans. This application makes use of GSM (Global System for Mobile Communication) to inform the user about the exact field condition. The information is passed in the form of SMS.

Index Terms- GSM Module (Mobile), Android, SMS, Wireless Sensor Network, Automatic Irrigation, Zigbee, Sensors, Microcontroller, Regulated Power Supply.

I. INTRODUCTION

The Irrigation is the artificial application of water to the soil for assisting in growing crops. It minimizes the use of water & fertilizer by allowing water to drip slowly to the roots of plants, either onto the soil surface or directly onto the root zone due to which a large quantity of water is saved & also the fertilizer which comes to the plant with the water. In agriculture, various parameters including soil type and temperature vary dramatically from one region to the other and therefore any irrigation system must be flexible. [3].

Agriculture uses freshwater resources worldwide, which is dependent on the monsoons, and it is not a reliable source of water, so there is an urgent need for water deployment system to sustain use of water & provide water to the farms according to their moisture, temperature and soil types & fertilizers.[3]

In this project, a wireless sensor network based intelligent system is implemented and applied for monitoring of soil, temperature & humidity. The motivation of developing this system came from the countries where economy is depends on agriculture and the climatic conditions lead to lack of rains. The farmers working in the farm lands are dependent on the rains and bore wells.

The network consists of sensing stations & a weather station. Each of the sensing station contained data logger, a soil temperature sensor & zigbee communication. The development of WSN based on

microcontrollers & communication technologies can improve the current methods of monitoring to support the response in real time. The aim of implementation was to demonstrate that the water deployment system can be used to reduce water use. The soil moisture & temperature sensors deployed in plant root zones. The sensor measurements are transmitted to a microcontroller based receiver. This gateway permits the automated activation of irrigation when the threshold values of soil moisture & temperature are reached. The communication between the sensor nodes & data receiver is via Zigbee protocol. Zigbee is the new wireless technology it uses 2.4 GHz frequency band with having IEEE 802.15.4a protocol. When we are receiving this information from the wireless sensor network we want to monitor the parameters & control this parameter wirelessly form remote station. The internet connection allows the data inspection in real time on a website, where soil moisture & temperature levels are displayed through an application interface & store in database server. [1], [4]

II. IMPLEMENTAION

Advanced Water Deployment system And System Description

Fig.2.1 shows Configuration of the Advanced Water Deployment system, i.e. the whole system architecture, which consists of two components, wireless sensor units (WSUs) and a wireless information unit (WIU), and linked by radio transceivers that allowed the transfer of soil moisture

and temperature data, implementing a WSN that uses ZigBee Technology. The WIU has also a GSM module to transmit the data to a smart phone via the public mobile network. The information can be remotely monitored online through graphical application through Internet access devices. [1].

FIG2.1: Configuration Of The Advanced Water Deployment System

• HARDWARE DESIGN OF WSU

A. Wireless Sensor Unit:

A WSU is comprised of a RF transceiver, sensors, a microcontroller, and power sources. Several WSUs can be deployed in-field to configure a distributed sensor network for the advanced water deployment irrigation system. Each unit is based on the microcontroller PIC16F877 that controls the radio modem ZigBee and processes information from the soil-moisture sensor and the temperature sensor. These components were selected to minimize the power consumption for the implemented application. [4]

FIG2.2: Block Diagram Of The Wireless Sensor Unit

1. PIC16F877 Microcontroller:

8-bit microcontroller with 40-pins flash microcontroller that operate in a range 2.0 to 5.5 V at 20 MHz with internal oscillator. It has high performance RISC CPU, interrupt capability, direct, indirect and relative addressing modes, 8K flash Program Memory, 368 bytes of data Memory (RAM), 256 EEPROM data Memory, Programmable code protection, power saving sleep mode, 8-bit analog to digital converters (ADC), serial peripheral interface modules, USRT, 3 timers & 5 ports. The microcontroller is well suited for this remote application, because of its low-power consumption, high speed, power on reset facility, in circuit programming & debugging. [1].

2. Zigbee Modules :

ZigBee (over IEEE 802.15.4) technology is based on short range WSN and it was selected for this sensor network because of its low cost, low power consumption, and greater useful range in comparison with other wireless technologies. The ZigBee devices operate in industrial, scientific, and medical 2.4-GHz radio band and allow the operation in a networking architecture. From a wide range of commercial ZigBee devices, the ZigBee-PRO 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. [1], [4].

3. Soil Moisture Sensor :

Soil moisture sensor is a sensor connected to an irrigation system controller that measures soil moisture content in the active root zone. It is used to measure volumetric content of soil & measure the loss of moisture over time due to evaporation & plant intake. [4].

4. Humidity Sensor SY-HS-220 :

This sensor module converts relative humidity (30-90 % RH) to voltage & can be used in weather monitoring application. It has high accuracy, rated voltage is 5.0v DC, current consumption is less than 3.0 ma, operating humidity range (30-90 % RH) & standard output voltage is DC 1.980mv. This sensor is suitable for this remote application because of its high accuracy, less current consumption, high operating temperature and humidity range. [1].

5. Temperature Sensor LM 35 :

LM35 Series are precision integrated temperature sensors, with an output voltage linearly proportional to the centigrade temperature. It does not require any external calibration or trimming to provide typical accuracies. It has low cost, low output impedance, linear output, precise inherent calibration, linear scale factor, suitable for remote application. it operates from 4 to 30V, rated for -55°C to 150°C range, require less than 60μA drain current, low self-heating 0.08°C in

still air & low output impedance 0.1Ω for 1ma load. [1].

• HARDWARE DESIGN OF WIU

A. Wireless Information Unit:

The soil moisture and temperature data from each WSU are received, identified, recorded, and analyzed in the WIU. The WIU consists of a master microcontroller ARM7 LPC2138, a Zigbee radio modem, a GSM module SIM900, an RS-232 interface. The WIU can be located up to 100-m line-of-sight from the WSUs placed in the field. All the WIU processes can be monitored through the RS-232 port. The WIU includes a function that synchronizes the WSUs at noon for monitoring the status of each WSU.

FIG2.3: Block Diagram Of The Wireless Information Unit

1. Master Microcontroller ARM7LPC 2138:

ARM7 LPC 2138 designed to enable easy development of real time applications, testing & monitoring of various solutions. The LPC 2138 μC are based on a 32/16 bit ARM7 TDMI CPU with real time emulation & embedded trace support, that combines the μC with 32 KB, 64 KB & 512 Kb of embedded high speed flash memory. Due to their tiny size & low power consumption this μC are ideal for this application. [2].

2. GSM Module SIM900:

The SIM900 is a complete quad band GSM/GPRS solution in a SMT module which can be embedded in the customer applications. It can communicate with controllers via AT commands. This module support software power on & reset. It is designed with a very powerful single chip processor & it has low power consumption. [3].

III. CIRCUIT DIAGRAM

Orcad software tool suite used primarily for electronic design automation. In this implemented project version 9.1 of the orcad suite is used to create circuit schematics. It includes a schematic editor, a circuit simulator and a PCB designer. In orcad 9.1 a project

manager format is used. Capture is the head unit from which all schematic work is done. The schematic created for transmitter & receiver by using this suite is shown in fig.

FIG 3.1: Circuit Diagram Of Transmitter

FIG3.2: Circuit Diagram Of Receiver

IV. WORKING

The system works in two parts:

- 1) Transmitter
- 2) Receiver

FIG 4.1: Prototype Of Transmitter

Transmitter:

Initially when power is on, signals are read by different sensors like temperature, humidity, soil moisture and its output is given to microcontroller. Output of microcontroller from sensors is taken through ADC pins and then it is given to zigbee

module through Rx & Tx pins. Then it will transmit these data wirelessly to the receiver side.

FIG 4.2: Prototype Of Receiver

Receiver:

At receiver side both GSM & zigbee come into picture. The data transmitted by transmitter are received at the receiver & it will display the parameter. It is possible to made no. of slave unit. In this project, I have implemented two slave units. At the receiver both slave units parameter will be displayed. Then these parameters are transmitted to smart phone by using GSM module. This is how total working takes place of advanced water deployment system. [4]. The total hardware implementation of WSU & WIU with GSM module is shown in fig.4.3

FIG4.3: Hardware Setup

V. SIMULATION

Proteus is one of the most famous simulators. It can be used to simulate almost every circuit on electrical fields. It is easy to use because of the GUI interface. Proteus PCB design combines the ISIS 7.7 SP2 with advanced simulation schematic capture and ARES PCB layout programs to provide a powerful, integrated and easy to use suite of tools for professional PCB. It is a handy tool to test programs & embedded design.

Proteus is one of the must tools for circuit designing & simulation which includes application framework, common parts database, live net listing, 3D viewer, VM studio & many more features. Thus it is good solution for reasonably complex design.

IRRIGATION ACTION-1

FIG 5.1 ISIS Schematic View Of IA-1

Proteus is used as simulation tool. The ISIS schematic view of irrigation action-1 is shown in fig 5.1. The LM 35 will sense the temperature at the root zone of the plant continuously. The temperature value shown in fig is 10.5°C.

The ISIS schematic view of power supply is shown below:

FIG 5.2 ISIS Schematic View Of Power Supply

VI. ADVANTAGES & DISADVANTAGES

6.1 Advantages

The Advanced Water Deployment system is relatively simple to design & install. This system works according to soil condition; it is highly sensitive, feasible & reliable circuit. This system reduces water consumption & operating expenses for irrigation management. It is safest and saves lot of time of the former also work can be carried out quickly. This irrigation system can be adjusted to a variety of specific crop needs & temperature monitoring in compost production can be easily implemented.

6.1 Disadvantages

This system mostly applicable for only large size farms. It requires frequent maintenance for efficient operation. Sometimes this system has limited life due

to deterioration of the component in a hot, arid climate when exposed to ultraviolet light.

VII. RESULT & DISCUSSION

7.1 System initiation:

At the time of system initiation it shows the following display.

7.2 Slave unit initiation:

7.3 Temperature, humidity & moisture values indication (in Percentage):

7.4 Master unit initiation:

7.5 Master unit received parameter indication:

Then these parameters are transmitted on the android smart phone by using GSM module.

The app inventor is a visual, drag & drop tool for building mobile apps on the android platform. App inventor is used to design the user interface of an app using a web-based graphical user interface builder, and then it specifies the app's behavior by piecing

together “blocks”. The app is a text “answering machine”. It is used to launch it when we’re driving & it auto responds to the texts you receive. It is possible to immediately see & interact with the app building on the phone, it is freely available for anyone to use, and it runs online & is accessible from any browser so it is used in this project. The schematic view of an android app created for AWDS is shown in fig.7.6 [5].

FIG7.6: APP Inventor Schematic View

At the time of parameter receiving on smart phone it shows the following display.

FIG7.7: Smart Phone Displaying Actual Parameter

CONCLUSION

The implemented advanced water deployment system for irrigation was found to be feasible & cost effective for optimizing water resources for agricultural

production. This system has an advantage of using both GSM & zigbee technology which eliminates the cost of network usage to a great extent. By using Zigbee technology it is possible to send as well as receive all the information easily.

The microcontroller based this irrigation system using wireless techniques monitor the activities of irrigation system efficiently. This application of sensor based irrigation has some advantages such as diminishing of excessive water usage, saves time of farmer, can be adjusted to variety of specific crop needs & preventing moisture stress of trees.

The advanced water deployment system developed proves that the use of water can be diminished. It avoids over irrigation, under irrigation & top soil erosion. The implemented system can be used for agricultural, horticultural lands, parks, gardens irrigation. The configuration of the irrigation system allows it to be scaled up for larger greenhouses or open fields. Thus, this system is reliable & efficient when compared to other type of irrigation system.

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REFERENCES

- [1] Joaquin Gutiérrez, Juan Francisco Villa-Medina, Alejandra Nieto-Garibay, and Miguel Ángel Porta-Gándara, “Automated Irrigation System Using a Wireless Sensor Network and GPRS Module “, IEEE TRANSACTIONS ON INSTRUMENTATION AND MEASUREMENT, VOL. 63, NO. 1, JANUARY 2014.
- [2] Chandrika Chanda¹, Surbhi Agarwal², Er. B.Persis Urbana Ivy, “A Survey of Automated GSM Based Irrigation Systems” International Journal of Emerging Technology and Advanced Engineering Website: www.ijetae.com (ISSN 2250-2459, Volume 2, Issue 10, October 2012)
- [3] Aniket H. Hade, Dr. M.K. Sengupta, “Automatic control of Drip Irrigation System & Monitoring of soil by Wireless” IOSR Journal of Agriculture and Veterinary Science (IOSR-JAVS) e-ISSN: 2319-2380, p-ISSN: 2319-2372. Volume 7, Issue 4 Ver. III (Apr. 2014), PP 57-61.
- [4] Million Mafuta, Marco Zennaro, Antoine Bagula, Graham Ault, Timothy Chadza, “Successful Deployment of a Wireless Sensor Network for Precision Agriculture in Malawi-WiPAM”, An Electrical Engineering Department, University of Malawi .
- [5] Pavithra D. S1, M. S .Srinath², “GSM based Automatic Irrigation Control System for Efficient Use of Resources and Crop Planning by Using an Android Mobile”, IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE) e-ISSN: 2278-1684, p-ISSN: 2320-334X, Volume 11, Issue 4 Ver. I (Jul- Aug. 2014), PP 49-55 www.iosrjournals.org.

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