ISSN: 2277-9655
Scientific Journal Impact Factor: 3.449
(ISRA), Impact Factor: 1.852

IJESRT
INTERNATIONAL JOURNAL OF ENGINEERING SCIENCES & RESEARCH TECHNOLOGY

Automatic Irrigation System using WSNs

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Abstract

During the entire, I went through various electronics equipment for the project. I learned about Controller 8051, Contact type sensors, Comparator and a little about other electrical equipments. Irrigation systems are as old as man itself since agriculture is the foremost occupation of civilized humanity. To irrigate large areas of plants is an onerous job. In order to overcome this problem many irrigation scheduling techniques have been developed which are mainly based on monitoring the soil, crop and weather conditions. Irrigation scheduling engrosses when to irrigate and how much water to be applied. Currently most of the irrigation scheduling systems and their corresponding automated hardware are fixed rate. Variable rate irrigation is very essential not only for the improvement of irrigation system but also to reduce the irrigation cost and to increase crop yield. The heart of automatic irrigation system (fixed rate or variable rate) is its control unit: as it controls irrigation time and water flow.

Keywords: Wireless Sensors, Soil Moisture, Irrigation Regulator.

Introduction

Punjab occupies only 1.57% geographical area of India, it contributes more than 50 % grain in the central grain pool. More than 83% of land in Punjab is under agriculture as compared to 40.38% of national average. The cropping pattern of wheat and paddy rotation has led to manifold increase in irrigation water demand. Injudicious surface water irrigation policies, indiscriminate / excessive ground water pump-age due to free electricity coupled with irrational irrigation and agricultural practices have led to situation wherein fresh ground water resources of the state have depleted at an alarming rate in most parts of the state. In major part of the state, ground water levels are in the range of 10 to 20 meters. However around major cities like Jalandhar, Ludhiana, Patiala, Amritsar and Sangrur, water levels are 20 to 40 meters deep. The long term water level fluctuation data indicates that water levels in major parts of the state have declined drastically. The fall in water table in Punjab has been a serious issue. One of the main reasons for it has been the early transplanting of rice (before mid-June), which means severe withdrawal of groundwater, as the monsoon is still far away, temperatures are very high and evapo-transpiration rate (ETR) is maximum. Several water management strategies have been suggested e.g. drip irrigation and on-farm management practices, change in cropping pattern, banning early plantation of paddy etc

New technologies and practices based on WSNs are being developed and implemented in agriculture around the whole world, but their deployment in Punjab is still at the beginning stage. So there is a great challenge before us to implement these technologies practically in the fields. In this paper, I have taken a step towards the deployment of WSN based irrigation regulator system.

Literature review

Xinjian Xiang [6] introduced an automatic control drip irrigation system based on ZigBee WSN and Fuzzy Control. This system uses (CC2430) ZigBee module for WSN node design, selecting soil moisture, temperature and light intensity information and sending the drip irrigation instructions by the wireless network.

Izzat Din Abdul Aziz et al [3] developed a system that can remotely monitor and predict changes of temperature level in agricultural greenhouse. The objective of the research is to develop a remote temperature monitoring system using wireless sensor and Short Message Service (SMS) technology. The

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proposed system has a measurement which capable of detecting the level of temperature. This system also has a mechanism to alert farmers regarding the temperature changes in the greenhouse so that early precaution steps can be taken. In this research, several tests had been conducted in order to prove the viability of the system. Test results indicated that the reliability of the system in propagating information directly to the farmers could be gained excellently in various conditions. But it not happens in capacitance behavior as firmness change. The capacitances were decreased as firmness improved. In traditional method of farming, human labors were required to visit the greenhouse at specific time and need to check the humidity level and temperature level manually. This conventional method is considered time consuming and needs a lot of work and effort. Robert Coates et al developed a Valve Control hardware and software to be compatible with a commercial wireless sensor node. The work was conducted in collaboration with a wireless network vendor such that the research results and the product itself could ultimately be available to growers. The valve actuation system included development of custom node firmware, actuator hardware and firmware, an internet gateway (base computer) with control, and communication and web interface software. Single hop radio range (line-of-sight) for the mesh network reached 1610 m. Thirty-four valve actuators were installed in the field to control 54 valves and monitor 6 water meters.

In this paper, it is proposed to automate and regulate the irrigation process using a WSN. The proposed system shall be using wireless sensor nodes to check the moisture content close to the roots and recommend irrigation when it goes below a particular level. In this way it would help to save ground water and electricity and at the same time also prevent crop damage. The aim is to develop a system using minimum resources, less cost.

Project description

Introduction

The Project presented here waters your plants regularly when you are out for vocation.The circuit comprises sensor parts built using op-amp IC LM324. Op-amp's are configured here as a comparator. Two stiff copper wires are inserted in the soil to sense the whether the Soil is wet or dry. The Microcontroller was used to control the whole system it monitors the sensors and when more than two sensors sense the dry condition then the microcontroller will switch on the motor and it will switch off the motor when all the sensors are in wet. The microcontroller does the above job it receives the signals from the sensors, and this signals operated under the control of software which is stored in ROM. The controller consists of the control unit, power unit, wireless communication unit, relay boost driver unit and sensing units.

Project Outline

· A brief introduction to Wireless Sensor Networks.
· An over view of programming of microcontroller.
· An overview on assembly language.
· An overview on mechanical arrangement.
· Stepper motor interfacing with microcontroller.

Block Diagram

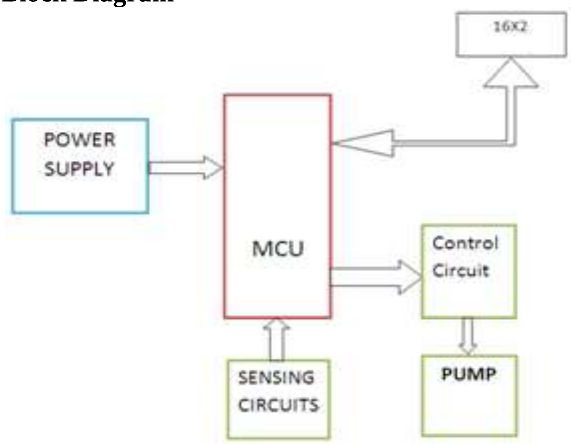

Fig.1 Block diagram of Automatic Irrigation System using WSNs.

Interfaces Used

· Serial communication used for downloading the hex code.
· Stepper motor Interfacing.
· Wireless Sensors Circuit Interface.
· LCD interfacing

Softwares Used

· A Cross compiler for compiling and linking the code written for AT89C51.
· Serial communication software for downloading code to AT89C51.
· Operating system: Windows 2000.

Components required

1. Transformer

A transformer is a static piece of apparatus by means of which electric power in one circuit is transformed into electric power of the same frequency in another circuit. It can raise or lower the voltage in a circuit but with a corresponding decrease or increase in current.

In brief, a transformer is a device that

· Transfers electric power from one circuit to another.
· It does so without a change of frequency.
· It accomplishes this by electromagnetic induction

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· The two circuit are in mutual inductive influence of each other.

2. Sensing Devices

Sensing Devices Ltd (SDL) offers a wide range of complementary products for the accurate measurement and/or control of temperature. SDL is a world renowned supplier of the ceramic wire wound type of platinum resistance temperature detectors to some of the largest industrial groups, in a huge and highly competitive process sector.

In addition to supplying the primary sensing element, SDL supplies a huge variety of different types of temperature sensors for industrial applications ranging from medical to nuclear engineering.

The company supplies custom made probes in large or small batch sizes to fulfil the most demanding of specification requirements. As well as conventional types of sensors, the company offers specially designed RTD's for use in stator slot windings of large electric motors & generators.

3. Transmitter and receiver

The TWS-434 and RWS-434 are extremely small, and are excellent for applications requiring short-range RF remote controls. The transmitter module is only 1/3 the size of a standard postage stamp, and can easily be placed inside a small plastic enclosure.

TWS-434: The transmitter output is up to 8mW at 433.92MHz with a range of approximately 400 foot (open area) outdoors. Indoors, the range is approximately 200 foot, and will go through most walls.

The TWS-434 receiver accepts digital inputs, can operate from 1.5 to 12 Volts-DC, and makes building a miniature hand-held RF transmitter very easy. The TWS-434 is approximately the size of a standard postage stamp.

4. Pump set

The pump used is submersible cooler pump, which is fabricated using superior quality of ABS body. This pump is used to throw water and is well known for its longer service life.

5. Relay

A relay is a simple electromechanical switch made up of an electromagnet and a set of contacts. Relays are found hidden in all sorts of devices. In fact, some of the first computers ever built used relays to implement Boolean gates.

Snapshots of the project

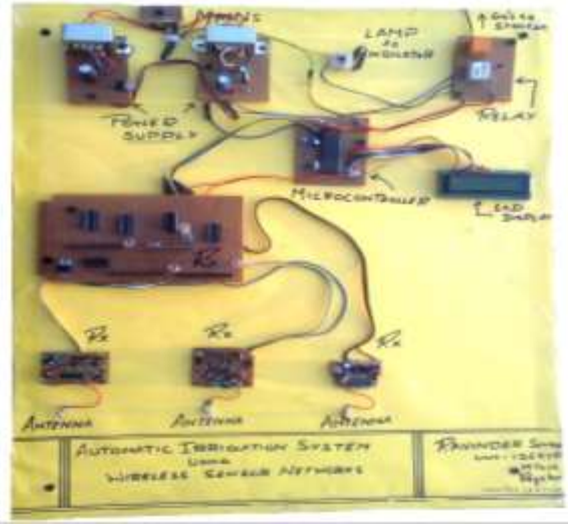

Fig.2 Base Station with four Receiver sets

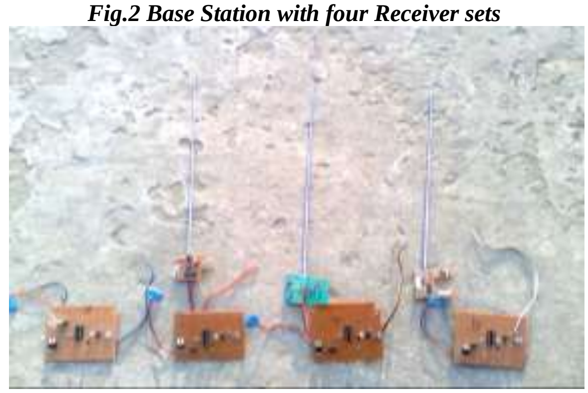

Fig.3 Four Sensing units with individual Transmitters

Future scope

Automatic Irrigation System using WSNs has been developed. Although a lot of efforts have been made for the development of the system, still it can be further improved with some small modification. Following points may be considered for the improvement of the system in future.

A. Sensor node can be made to work on solar energy.

B. Number of sensor nodes can increase to make the system more efficient.

C. High range RF module can be used to cover a larger area.

D. Further the system can use weather forecast information to forbid watering the fields if rainfall is expected in the next couple of days.

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