AUTOMATIC IRRIGATION SYSTEM

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ABSTRACT

The project is designed to develop an automatic irrigation system which switches the pump motor ON/OFF on sensing the moisture content of the soil. In the field of agriculture, use of proper method of irrigation is important. The advantage of using this method is to reduce human intervention and still ensure proper irrigation. The project uses an 8051 series microcontroller which is programmed to receive the input signal of varying moisture condition of the soil through the sensing arrangement. This is achieved by using an op-amp as comparator which acts as interface between the sensing arrangement and the microcontroller. Once the controller receives this signal, it generates an output that drives a relay for operating the water pump. An LCD display is also interfaced to the microcontroller to display status of the soil and water pump. The sensing arrangement is made by using two stiff metallic rods inserted into the field at a distance. Connections from the metallic rods are interfaced to the control unit.

Keywords*: *Irrigation System, Sensing Arrangement, Microcontroller

I. INTRODUCTION

In the fast paced world human beings require everything to be automated. Our life style demands everything to be remote controlled. Apart from few things man has made his life automated. In the world of advance electronics, life of human beings should be simpler. Hence to make life simpler and convenient, we have made "AUTOMATIC IRRIGATION SYSTEM". A model of controlling irrigation facilities to help millions of people. This model uses sensing arrangement technology with microcontroller to make a smart switching device.

The continuous increasing demand of food requires the rapid improvement in food production technology. In a country like India, where the economy is mainly based on agriculture and the climatic conditions are isotropic, still we are not able to make full use of agricultural resources. The main reason is the lack of rains & scarcity of land reservoir water.

Irrigation has always been an ancient practice which has evolved through so many stages over the years. Our ancestral farmers in a bid to irrigate their farm sought for various methodologies. Manual irrigation using buckets and watering cans, flood irrigation, drip irrigation, sprinkler irrigation were and are still being used today. The existing system has several limitations; leaching off of soil nutrients, erosion due to flooding, loss of water from plant surfaces through evaporation, water wastage which can result to water scarcity in drought areas and production of unhealthy crops. This problem can be rectified if we use microcontroller based automated irrigation system in which the irrigation will take place only when there will be acute requirement of water.

II. LITERATURE SURVEY

Automation of irrigation system refers to the operation of the system with no or minimum manual interventions. Irrigation automation is justified where a large irrigated area is divided into Small segments called irrigation blocks and segments are irrigated in sequence to match the discharge available from the water source. In this regard, the works that we have surveyed describe the different types of automatic irrigation techniques, how they actually have served the purpose and the primary difference between our project and those literatures that we have contemplated.

On this detail, the existing works "Applied engineering in agriculture"[1], "Data acquisition system and irrigation controller"[12] and "Automation in Micro-Irrigation" [13], employs subsurface drip irrigation using two drip tapes and are time based systems in which irrigation time clock controllers, or timers, are an integral part of an automated irrigation system. A timer is an essential tool to apply water in the necessary quantity at the right time. Timers can lead to under or over-irrigation if they are not correctly programmed or the water quantity is calculated incorrectly. Time of operation is calculated according to volume of water required and the average flow rate of water a timer starts and stops the irrigation process. It automatically schedules irrigation at random events by using timers where in the automation for the system and displays were not implemented.

The papers titled " Feedback Control for Surface Irrigation Management "[2] and "Control and Automation in Citrus Micro-irrigation Systems" [16], employs open loop systems in which the operator makes the decision on the amount of water to be applied and the timing of the irrigation event. The controller is programmed correspondingly and the water is applied according to the desired schedule. Open loop control systems use either the irrigation duration or a specified applied volume for control purposes. Open loop controllers normally come with a clock that is used to start irrigation. Termination of the irrigation can be based on a pre-set time or may be based on a specified volume of water passing through a flow meter. In an open loop system, the operator makes the decision on the amount of water that will be applied and when the irrigation event will occur. This information is programmed into the controller and the water is applied according to the desired schedule. Open loop control systems use either the irrigation duration or a specified applied volume for control purposes. The drawback of open loop systems is their inability to respond automatically to changing conditions in the environment. In addition, they may require frequent resetting to achieve high levels of irrigation efficiency.

The papers titled, " Drip irrigation scheduling of tomato"[4] and "Design of a Micro-Irrigation System Based on the Control Volume Method" [15], employ volume based systems. The pre-set amount of water can be applied in the field segments by using automatic volume controlled metering valves. It's depicted that the volume control systems are more advantageous than time control systems. The amount of water these systems supply is fixed irrespective of continuous electricity availability but still time controlled systems are more popular as they are less expensive. Here volume meters are connected, which emits a pulse after delivering a specific amount of water and the controller measures these pulses to keep a check on the supply. The papers titled, "Irrigation and water use efficiency"[10], "Presentation of an Irrigation Management Model for a Multi-cropping and Pattern Setting"[14] and "Productivity of irrigation technologies" [17], present a spreadsheet model, that not only provides water budgeting and forecasting for a multi-plot fields, but also optimizes the acreage of each plot ensuring that all the crops can be irrigated daily to meet current demands utilizing all the available water and time during an extended simulation and the prioritization of plots to be irrigated based on raw deficit and net revenue.

The papers titled," Pressurised Irrigation systems and Innovative adaptions "[18] and "Analysis of application uniformity and pressure variation of microtube emitter of trickle irrigation system"[19] describe and characterize the different pressurised irrigation technologies and conduct comparative analysis of their productivity, application uniformity and pressure variations of microtube emitters used in trickle irrigation systems.

The proposed system is employed using microcontroller. In this regard, the books, "The 8051 micro controller"[3], "Design with micro controllers "[5], "Hand-Book of micro controllers"[7], "Embedded micro controller systems"[9] and “The 8051 micro controller” [11], give an overview of the 8051 microcontroller. They have even helped us to gain valuable programming knowledge and practical examples of instructions given illustrate how these instructions function. Complex hardware and software application examples are also provided.

On this detail, the book," Introduction to LCD programming tutorial"[6] gives an overview of the LCD and briefs out the LCD programming techniques. The book, "Electronic instrumentation "[8] briefs out the description of the various components required to design the proposed system.

Our project deals with an underground irrigation system. The major drawback of water evaporation taking place at the surface level irrigation which was discussed above is overcome by this method. In this method various sensing arrangements are placed in the ground level to determine the moisture percentage in the soil. This will optimize the water consumption further and will make maximum use of all agricultural resource. The present proposal is a model to modernize the agriculture industries on a small scale with optimum expenditure. Using this system, one can save manpower, water to improve production and ultimately profit.

III. DESIGN METHODOLOGY

This project on "Automatic Irrigation System" is intended to create an automated irrigation mechanism which turns the pumping motor ON and OFF on detecting the damspness content of the earth. In the domain of farming, utilization of appropriate means of irrigation is significant. The continuous extraction of water from earth is reducing the water level due to which lot of land is coming slowly in the zones of un-irrigated land. The benefit of employing this technique is to decrease human interference and still make certain appropriate irrigation. The circuit comprises of sensing arrangement parts built using op-amp IC LM358. Op-amp’s are configured here as a comparator. Two stiff copper wires are inserted in the soil to sense whether the soil is wet or dry. The Microcontroller is used to control the whole system by monitoring the sensing arrangement and when sensing arrangement senses the dry condition then the microcontroller will send command to relay driver IC the contacts of which are used to switch on the motor and it will switch off the motor, if the sensing arrangement senses the soil to be wet. The microcontroller does the above job as it receives the signal from the sensing arrangement through the output of the comparator, and these signals operate under the control of software which is stored in ROM

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of the Microcontroller. The condition of the pump i.e., ON/OFF is displayed on a 16X2 LCD. The power supply consists of a step down transformer, which steps down the voltage to 12V AC. This is converted to DC using a Bridge rectifier. The ripples are removed using a capacitive filter and it is then regulated to +5V using a voltage regulator which is required for the operation of the microcontroller and other components. The figure below shows the block diagram of Microcontroller based irrigation system that proves to be a real time feedback control system which monitors and controls all the activities of the irrigation system efficiently.

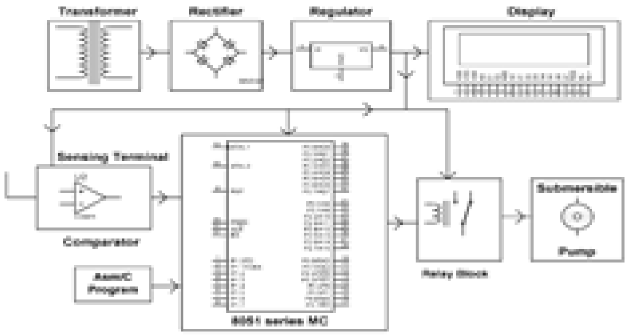

Figure1: The block diagram of the Automatic Irrigation System

The block diagram of the automatic irrigation system consists of the following components

3.1 Transformer

Step down transformer converts 230V from AC mains into 12V AC by using a center tap transformer. Transformer selection is based on the fact that regulator ICs require around 11v as input considering dropout voltage, in order to obtain 12v power supply. Transformer steps down ac voltage from 230v ac to 12v ac. It is then given to bridge rectifier. Bridge rectifier converts ac voltage into pulsating dc. It is then given to regulator ICs which output constant dc voltage.

3.2 Microcontroller

AT89S52 is an 8-bit microcontroller and belongs to Atmel's 8051 family. AT89S52 has 8KB of Flash programmable and erasable read only memory (PEROM) and 256 bytes of RAM. AT89S52 has an endurance of 1000 Write/Erase cycles which means that it can be erased and programmed to a maximum of 1000 times.

3.3 Bridge Rectifier

Rectifier converts ac voltage into dc voltage. 4 diodes are connected in bridge. Its input is from transformer and output is given to the voltage regulator IC's.

3.4 Comparator

Soil sensing arrangement is used to measure the volumetric water content of soil. It consists of two prongs, which must be inserted in the soil, an LM358, which acts as a comparator and a pot to change the sensitivity of the sensing arrangement.

3.5 Submersible Pump

A pump is a device used to move fluids, such as liquids, gases or slurries. A pump displaces a volume by physical or mechanical action, this pump requires 12V DC of power supply. A submersible pump (or electric submersible pump (ESP)) is a device which has a hermetically sealed motor close-coupled to the pump body. The whole assembly is submerged in the fluid to be pumped. The main advantage of this type of pump is that it prevents pump cavitations, a problem associated with a high elevation difference between pump and the fluid surface. Submersible pumps push fluid to the surface as opposed to jet pumps having to pull fluids. Submersibles are more efficient than jet pumps.

3.6 Voltage Regulator

The LM7805 is a three-terminal positive regulator that is available in the TO-220/D-PAK package and with 5V as fixed output voltage. It employs internal current limiting, thermal shutdown and safe operating area protection, making it essentially indestructible. If adequate heat sinking is provided, it can deliver over 1A output Current. Although designed primarily as fixed voltage regulators, these devices can be used with external components to obtain adjustable voltages and currents.

3.7 Led

LEDs are semiconductor devices that are made out of silicon. When current passes through the LED, it emits photons as a byproduct. Normal light bulbs produce light by heating a metal filament until its white hot. LEDs posses many advantages over traditional light sources including lower energy consumption, longer lifetime, improved robustness, smaller size and faster switching.

3.8 LCD

A liquid-crystal display (LCD) is a flat panel display, electronic visual display, or video display that uses the light modulating properties of liquid crystals. Liquid crystals do not emit light directly. LCDs are available to display arbitrary images, such as preset words, digits, and 7-segment displays as in a digital clock.

3.9 Relay

A relay is an electrically operated switch. Many relays use an electromagnet to operate a switching mechanism mechanically, but other operating principles are also used. Relays were used extensively in telephone exchanges and early computers to perform logical operation.

3.9.1 Hardware Requirements

- Micro controller unit (AT89S52)
- Sensing arrangement
- Voltage Regulator 4. LCD display

3.9.2 Software Requirement

- Keil compiler
- Language: Embedded C

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3.10 Working

The soil moisture sensors which are nothing but copper strands are inserted in the soil. The soil sensing arrangement measures the conductivity of the soil. Wet soil will be more conductive than dry soil. The soil sensing arrangement module has a comparator in it. The voltage from the prongs and the predefined voltage are compared and the output of the comparator is high only when the soil condition is dry. This output from the soil sensing arrangement is given to the analogue input pin of the microcontroller. The microcontroller continuously monitors the analogue input pin. When the moisture in the soil is above the threshold, the microcontroller displays a message mentioning the same and the motor is off. When the output from the soil sensing arrangement is high i.e. the moisture of the soil is less. This will trigger the microcontroller and displays an appropriate message on the LCD and the output of the microcontroller, which is connected to the base of the transistor, is high. When the transistor is turned on, the relay coil gets energized and turns on the motor. The LED is also turned on and acts as an indicator. When the moisture of the soil reaches the threshold value, the output of the soil sensing arrangement is low and the motor is turned off.

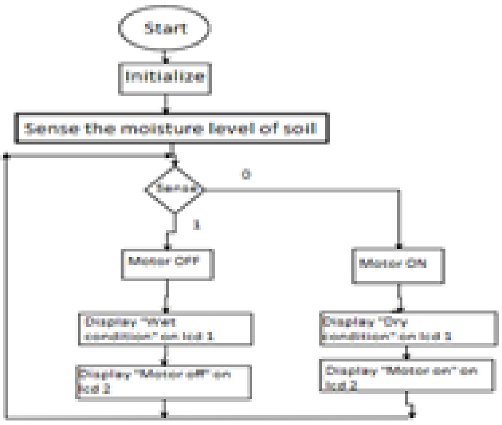

Figure 2: The Flow Chart of the Embedded C code

IV. RESULTS

Mechanism of the system starts with switching on of the power supply followed by resetting the microcontroller then the copper wires (which act as sensing arrangement) which will be connected to comparator will sense the dampness of the soil.

The output of the comparator will control the operation of the system. If the output of the comparator is logic low then the motor will be turned on and the status of the motor as on and that of the soil as dry will be displayed on the 1st and 2nd line of the LCD respectively. Else if the output of the comparator is logic high then the motor will be turned off and the status of the motor as off and that of the soil as wet will be displayed on the 1st and 2nd line of the LCD respectively.

Figure 3: Motor on condition

When the soil is dry, the soil resistance between the positive supply and the non inverting input is high resulting in positive supply to the non-inverting input less than the inverting input making comparator output as logic low. This command is given to microcontroller. In this condition the microcontroller outputs logic high that switches on a relay driving transistor due to which the relay is switched on and the pump motor is in ON condition. Thus water flow is started

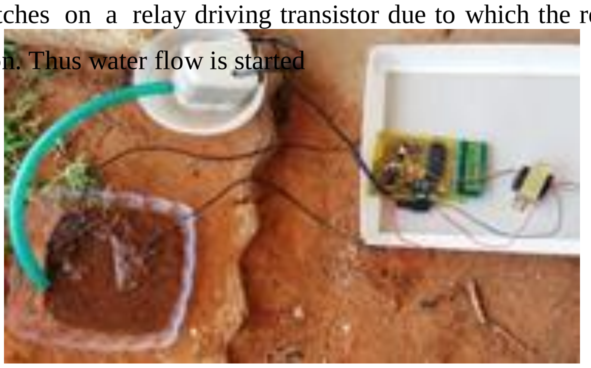

Figure 4: Motor off condition

Then, while the soil goes sufficiently wet, the soil resistance decreases making available a voltage to the non-inverting input higher than inverting input, so that the output of comparator is logic high which is fed to microcontroller. In this condition microcontroller outputs logic low to a transistor which conducts by making the relay OFF and the pump motor stops.

V. CONCLUSION & FUTURE SCOPE

The system provides several benefits and it can operate with less manpower. The system supplies water only when the humidity in the soil goes below the reference. Due to the direct transfer of water to the roots water conservation takes place and also helps to maintain the moisture to soil ratio at the root zone constant to some extent. Thus the system is efficient and compatible to changing environment.

The concept in future can be enhanced by adopting DTMF technology. This project is basically dependent on the output of the sensing arrangement. Whenever there is need of excess water in the desired field then it will not be possible by using sensing arrangement technology.

For this we will have to adopt the DTMF technology. By using this we will be able to irrigate the desired field in desired amount.

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