INTELLIGENT IRRIGATION SYSTEM

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ABSTRACT

Irrigation in India to maximum extent is dependent on the monsoons, which are not a reliable source of water. Depending on the soil type, plants are to be provided with water, which is called as intelligent irrigation system. This paper discusses the prototype design of microcontroller based Intelligent irrigation system which will allow irrigation to take place in zones where watering is required, while bypassing zones where adequate soil moisture is indicated. Other feature of this prototype is pesticide sprinkling system where the mixture is prepared in required proportion deserved by the plants automatically (required ratio is preloaded), there by preventing the human mistakes to maximum extent. At present cost-saving technology, labor-saving are the addressing key issues in irrigation.

KEYWORDS: Irrigation System, Microcontroller, Moisture Sensors, Pesticide Sprinkling System

INTRODUCTION

Agriculture plays the important role in the economy and development of the country like India. In our country, the farmers have been using manual control techniques for irrigation. Land is irrigated only at the regular intervals/seasons. In this process, few plants in the zone receive more water and for few other zone plants water reaches late due to which the crops get dried.

There is a need in the residential/commercial irrigation industry for an irrigation controller that responds to soil moisture sensors in individual zones as a way of conserving water. An ideal controller should be "user friendly", i.e., easy to program and requiring a minimum number of keys or push-buttons to operate the controller. It should also allow irrigation to take place in zones where watering is required, while bypassing zones where adequate soil moisture is indicated- To add flexibility, it should be possible to selectively deactivate any of the moisture sensors to thereby override the modification to the controller Performance caused by sensor inputs. The pesticide sprinkling mechanisms in this system sprays the pesticide mixture in the ratio deserved by the plants. Moreover, the system should be easy to trouble shoot in the event of faults in any of the plurality of zones.

LITERATURE SURVEY

Irrigation may be defined as the science of artificial application of water to the land or soil. It is used to assist in the growing of agricultural crops, maintenance of landscapes, and re-vegetation of disturbed soils in dry areas and during periods of inadequate rainfall. Additionally, irrigation also has a few other uses in crop production, which include protecting plants against frost, suppressing weed growing in grain fields and helping in preventing soil consolidation. In contrast, agriculture that relies only on direct rainfall is referred to as rain-fed or dry-land farming. Irrigation is often studied together with drainage, which is the natural or artificial removal of surface and sub-surface water from a given area. G. K. Banerjee and Rahul Singhal [1] proposed a method using microcontroller for the control of temperature and relative humidity inside a poly house. In the proposed method, the greenhouse controller senses the change in temperature...
and relative humidity with the help of input sensors and process the output to take appropriate control action. The proposed system is a low cost and user friendly system with high stability and reliability.

**METHODOLOGY**

The Irrigation using soil moisture sensors and Microcontroller is an exclusive instrument that can automatically feed plants with water according to their need without farmer’s interference. Design of an intelligent irrigation system will manage flow of water into the field and sprinkle the pesticide mixture uniformly in the desired ratio deserved by the plants automatically, hence maintain turf. The system comprises of Soil moisture sensors to know the status of the water level in the farm; Solenoid valves for controlling water flow to the farm; Sprinklers for spraying of the pesticide mixture; and a controller for the data processing and to control all the operations.

**SYSTEM ARCHITECTURE**

System architecture is shown in the block diagram (Figure 1). The operation of the instrument has been categorized into two classes Irrigation control and Pesticide control.

![Block Diagram](image)

**Figure 1: Block Diagram**

**Irrigation Control**

As shown in block diagram, the water flows through the pipes (p1, p2, p3) to their respective fields. When a field obtains its required moisture level, then the particular control valve will be made to close the flow to the particular field and if watering is required again the valve is made open. When all the fields acquire sufficient water levels, then the system is programmed to shut off the main motor.

**Pesticide Control**

In order to mix and spray the fertilizers to the plants in a definite proportion, this system sprinkles the fertilizers automatically according to the given input ratio. For this mechanism, two motors are needed in order to pump the water and pesticides to a tank where it can be mixed thoroughly from which the mixture can be sprinkled on the field uniformly. Here initially all sprinklers will be in off state. When a particular ratio is given as input then that particular sprinkler should sprinkle the pesticide mixture to the particular field. In this system we have considered:
• For (1:4) ratio, A1 sprinkler should be on for required duration of time
• For (2:4) ratio, A2 sprinkler should be on for required duration of time
• For (3:4) ratio, A3 sprinkler should be on for required duration of time.

Block Diagram

The main blocks of this circuit diagram are Micro controller, LCD Display, PC, Regulated power supply (RPS), Led indicator, Soil moisture sensor, LM 324 Comparator, DC Motors and Dc motors drivers, Solenoid valves and Switch-pad. Figure 2 represents the photograph of the prototype system and Figure 3 shows the circuit diagram.

Figure 2: Prototype of Intelligent Irrigation System

Micro-Controller

Microcontroller ATMEL 89S52 is the heart of the system. It is a single chip Microcomputer with I/O ports, timer, clock generator, data memory, program memory, serial ports, and external hardware interrupts. It can be used for many control applications like motor speed control, waveform generation etc.

The software can be implemented in assembly level language or high level language and entered into the program memory (flash memory) using programmer. 8052 is an 8-bit processor, meaning that the CPU can work on only 8 bits of data at a time. Data larger than 8 bits has to be broken into 8-bit pieces to be processed by the CPU. 8052 is available in different memory types such as UV-EPROM, Flash and NV-RAM.

LCD Display

16x2 LCD Display is used for the AFI module. Each letter is in 7x5 matrix form. It is a low cost, low power device, capable of displaying text and images. ASCII values are used for displaying text and numbers.
Regulated Power Supply (RPS)

A RPS is an embedded circuit, or stand alone unit, the function of which is to supply a stable voltage (or less often current), to a circuit or device that must be operated within certain power supply limits. The output from the regulated power supply may be alternating or unidirectional, but is nearly always DC (Direct Current).

Soil Moisture Sensor

Most soil moisture sensors are designed to estimate soil volumetric water content based on the dielectric constant (soil bulk permittivity) of the soil. The dielectric constant can be thought of as the soil’s ability to transmit electricity. The dielectric constant of soil increases as the water content of the soil increases. This response is due to the fact that the dielectric constant of water is much larger than the other soil components, including air. Thus, measurement of the dielectric constant gives a predictable estimation of water content. Soil moisture sensors measure the water content in soil. A soil moisture probe is made up of multiple soil moisture sensors. One common type of soil moisture sensors in commercial use is a Frequency domain sensor such as a capacitance sensor. Another sensor, the neutron moisture gauge, utilize the moderator properties of water for neutrons. Cheaper sensors -often for home use- are based on two electrodes.
measuring the resistance of the soil. Sometimes this simply consists of two bare (galvanized) wires, but there are also probes with wires embedded in gypsum.

**LM324 Comparator**

A comparator circuit compares two values and sets an output depending on those values. A comparator is commonly available in IC form. The LM324 IC is a typical example. The LM324 is a general purpose operational amplifier circuit that can be used for many purposes. For now, we will only discuss its use as a comparator circuit.

The comparator sets a reference voltage using a voltage divider. Then one sends the input signal to the comparator and it will compare the input voltage to the ref voltage. If the input voltage is equal to or greater than the ref voltage then the comparator’s output will be HIGH.

**DC Sprinklers**

Most of the agricultural sprinklers are the hammer-drive, slow rotating impact type, single or twin nozzle. The sprinklers shoot jets of water into the air and spread it to the field in the form of raindrops in a circular pattern. They are available in various nozzle sizes, flow discharges, operating pressures and wetted diameters or diameter coverage, full circle or part circle. They are classified as low, medium and high pressure/capacity, as shown in Table 5; according to the height of the water jet above the nozzle, they are divided into low angle (4º-11º), or high Angle (20º-30º).

They are made of brass or high engineering plastics with internal or external threaded connections of _-1_ in. They are installed vertically on small diameter riser pipes, 60 cm above ground, fitted on the laterals. The sprinkler spacing in the field is rectangular or triangular at distances not exceeding 60 percent of their diameter coverage.

Micro-sprinklers are small plastic sprinklers of low capacity with flow rates less than 300 litres/h. Their main characteristics are their rapid rotation/whirling, less than a minute per rotation, the very small size of the water drops and the low angle of the water jet above nozzle. They have only one nozzle, of about 2.0 mm. They discharge 150-250 litres/h at 2.0 bars operating pressure.

They are full circle and the wetted diameter is only 10-12 m. Mounted at a height of 60 cm on metallic or plastic rods inserted into the ground, they are connected to PE laterals (25 or 32 mm) through small flexible tubes 7 mm in diameter and 80 cm long. The spacing arrangement in the field is the same as for conventional sprinklers. The spacing does not exceed 6.0 m, i.e. 50 percent of the wetting diameter. The filtration requirements are about 60 mesh (300 microns).

Spitters, micro-jets and sprayers are small plastic emitters with a low water discharge at a low angle in the form of fine drops in a sectorial or full circle pattern. They are mainly used for tree crops. They are of various mechanisms with a wide range of flow rates and water diameters.

They have a small passage diameter, thus filtration of the water is essential. Their main performance characteristics are operating pressure: 1.5-2.0 bars; flow rate: 35-250 litres/h (generally 150 litres/h); wetting diameter: 3-6 m; precipitation rate: 2-20 mm/h (generally 4-8 mm/h); and filtration requirements: 60-80 mesh (250-200 microns).

**DC Motor Drives**

A dc motor uses electrical energy to produce mechanical energy, very typically through the interaction of magnetic fields and current-carrying conductors the reverse process, producing electrical energy from mechanical energy, is accomplished by an alternator/generator or dynamo. Many types of electric motors can be run as generators, and vice versa. The input of a DC motor is current/voltage and its output is torque (speed).
Solenoid-Valve

A solenoid valve is an electromechanical valve for use with liquid or gas. The valve is controlled by an electric current through a solenoid coil. Solenoid valves may have two or more ports: in the case of a two-port valve the flow is switched on or off; in the case of a three-port valve, the outflow is switched between the two outlet ports. Multiple solenoid valves can be placed together on a manifold. A solenoid valve has two main parts: the solenoid and the valve. The solenoid converts electrical energy into mechanical energy which, in turn, opens or closes the valve mechanically.

A solenoid is an electromechanical device which allows for an electrical device to control the flow of a gas or liquid. The electrical device causes a current to flow through a coil located on the solenoid valve. This current flow in turn results in a magnetic field which causes the displacement of a metal actuator. The actuator is mechanically linked to a mechanical valve inside the solenoid valve. The valve then changes state, either opening or closing to allow a liquid or gas to either flow through or be blocked by the solenoid valve.

Software

The operation of the instrument can be best understood by the flow chart shown in figure 4 & 5. Keil compiler is software used where the machine language code is written and compiled. After compilation, the machine source code is converted into hex code which is to be dumped into the microcontroller for further processing. Keil compiler also supports C language code.

![Flow Chart - Irrigation Control](image1)

![Flow Chart - Pesticide Control](image2)
RESULTS & CONCLUSIONS

The results of this work are shown in the pictures.

Figure 6 & 7: Represents Water Flow through the Pipes

Figure 8 & 9: Indicates the Mixture Being Sprinkled through the Pipes

Thus an irrigation system which controls the flow as per the requirement along with automation in the pesticide sprinkling system is designed and results are achieved satisfactorily. With the use of low cost sensors and the simple circuitry makes this instrument a low cost product, which can be bought even by a poor farmer. This work is best suited for places where water is scarce and has to be used in limited quantity.

Future Enhancements

- Data can be transmitted using radio frequency signals where each valve is provided with radio receiver and decoding circuit. Here data (code to distinguish each valve) are broadcast and received by every valve and decoded and only the valve having same code can be turned ON.
- To increase the performance, acknowledgment from each valve to system must be obtained, so that in case of any error in data or malfunction in valve, it can be detected and can be informed to the farmer.
- To provide power for each valve, re-chargeable batteries can be connected to hybrid power generation.
REFERENCES


