

Microcontroller-based Automatic Irrigation System with Moisture Sensors

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Abstract—Indian agriculture is dependent on the monsoons which is not a reliable source of water. Therefore there is a need for an irrigation system in the country which can provide water to the farms according to their soil types. This paper represents the prototype design of microcontroller based automatic irrigation system which will allow irrigation to take place in zones where watering is required, while bypassing zones where adequate soil moisture is indicated.

Keywords: irrigation system, microcontroller, moisture sensors.

INTRODUCTION

In a country like India, the agriculture plays the important role in the economy and development of the country. At the present era, the farmers have been using irrigation technique in India through the manual control in which the farmers irrigate the land at the regular intervals. This process sometimes consumes more water or sometimes the water reaches late due to which the crops get dried [1].

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 [2]. 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. Moreover, the system should be easy to trouble shoot in the event of faults in any of the plurality of zones.

II. MICROCONTROLLER BASED IRRIGATION SYSTEM

A. *Description of the Circuit Diagram.*

The heart of the automatic irrigation system is the 80C51 microcontroller. The Intel 80C51 incorporates therein a 128x8 read/write data memory, which has 4K bytes of EPROM and is expandable to 64K bytes via RAM module [3]. The microcontroller also includes four 8-bit ports (32 I/O lines), two 16-bit timer/counters, a high performance, full-duplex serial channel and on-chip oscillator and clock circuits. Eight of the I/O lines comprising Port 0 function as an address bus 20 and a data bus. Address information at Port 0 may be applied, via an address latch, to the address bus. A moisture sensor is associated with each of the plurality of zones. Each such sensor is periodically interrogated by a pulse signal provided by the microcontroller via a driver or buffer circuit. This interrogation signal causes the moisture sensors to output an analog voltage which is proportional to the amount of moisture in the soil in which the sensors are embedded.

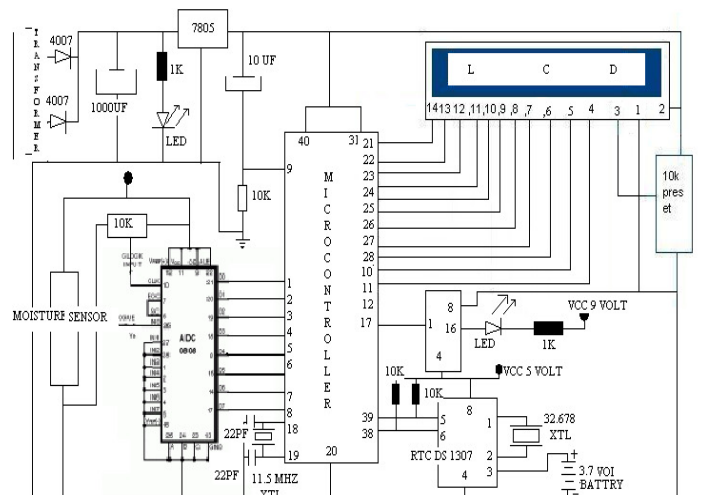


Fig.1: Circuit diagram of microcontroller based irrigation system.

The analog signal is fed to an analog/digital converter which operates to create a digital representation of the measured analog quantity on the data bus leading to the microcontroller. An analog-to-digital converter suitable for use in the system is ADC 0809[4]. It comprises a monolithic CMOS device with an 8-bit A/D converter, an 8-channel multiplexer and microcontroller compatible control logic. Using successive approximation as the conversion technique, this 8-bit A/D converter is readily interfaced to its associated microcontroller by the latched and decoded multiplexer address inputs and latched TTL tri-state outputs. Fig. 1 represents the circuit diagram of the microcontroller based irrigation system and Fig. 2 represents the photograph of the prototype system.

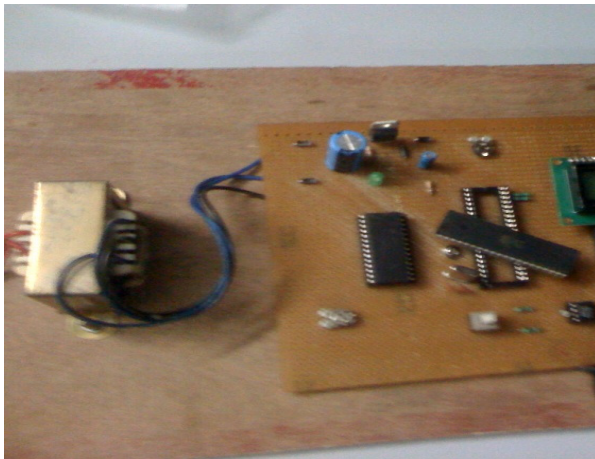


Fig.2: Photograph of the prototype system

B. Working of the system

The area which is to be irrigated will be divided into a plurality of discrete zones of possible different soil conditions, where each zone includes at least one sprinkler head, soaker hose or other water dispensing device and a solenoid valve having an "on" state and an "off" state for controlling the flow of water to such device for that zone and which comprises a moisture sensor disposed in the soil in each of the zones and, when interrogated, produces an electrical signal proportional to the level of moisture in the soil proximate that sensor- A microcontroller is coupled in controlling relationship to the

solenoid valves in each of the plural zones and is effective to periodically transmit the interrogation signals to each of the moisture sensors. The moisture sensors then respond by transmitting the aforementioned electrical signal to the microcontroller. The microcontroller includes circuitry and software for selectively actuating the solenoid valves in the plurality of zones to an "on" state at predetermined times during a weekly period, unless the moisture sensor for that given zone indicates a predetermined sufficient level of moisture present. Thus, the microcontroller activates each of the solenoid valves on a given watering day for a predetermined watering interval beginning with the pre-programmed start time and lasting for a pre-programmed interval unless that interval is shortened in a particular zone where the moisture sensor for that zone indicates that the predetermined sufficient level of moisture has been reached.

C. Flow chart of the software.

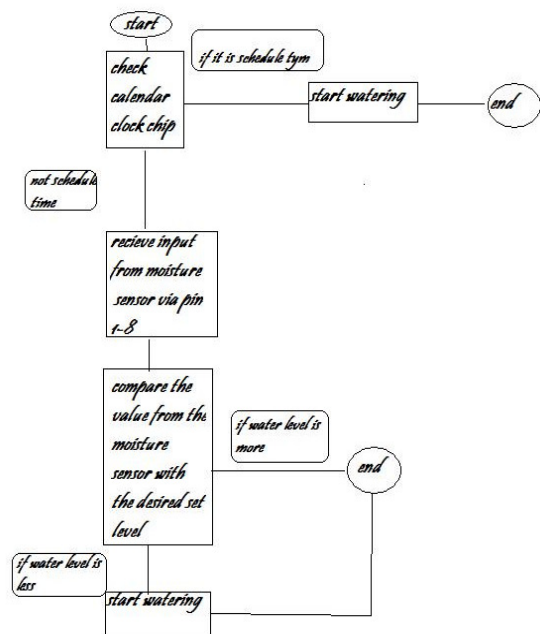


Fig.3: Flow chart for the software

III. CONCLUSION

It can be seen that the combination of hardware and software provides a irrigation controller that can be implemented at relatively low cost and which is extremely user friendly because it requires only eight keys in all to carry out a myriad of operations and the operator is, at all times, apprised by the display of just what needs

to be done to complete the programming of the system so that the solenoid water valves will be made to operate in a desired mode.

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