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AUTOMATED IRRIGATION SYSTEM USING SOLAR POWER

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Abstract: This paper proposes a model of variable rate automatic microcontroller based irrigation system. The field of agriculture, use of proper method of irrigation is important because the main reason is the lack of rains & scarcity of land reservoir water. 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.. A microcontroller is used to control the whole system by monitoring the sensors and when sensors sense dry condition of soil, 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 when the soil is in wet condition. The microcontroller does the above job as it receives the signal from the sensors through the output of the comparator, and these signals operate under the control of software which is stored in ROM of the microcontroller. The condition of the pump i.e., ON/OFF is displayed on a 16X2 LCD which is interfaced to the microcontroller.

1. INTRODUCTION

Irrigation is the 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. When a zone comes on, the water flows through the lateral lines and ultimately ends up at the irrigation emitter (drip) or sprinkler heads. Many sprinklers have pipe thread inlets on the bottom of them which allows a fitting and the pipe to be attached to them. The sprinklers are usually installed with the top of the head flush with the ground surface. When the water is pressurized, the head will pop up out of the ground and water the desired area until the valve closes and shuts off that zone. Once there is no more water pressure in the lateral line, the sprinkler head will retract back into the ground. Emitters are generally laid on the soil surface or buried a few inches to reduce evaporation losses.

Water is a resource that all living species need. It is therefore very precious and has to be used with moderation to be preserved for the generations to come. Agriculture is an industry that uses a lot of water. Most of the time, this resource is not used efficiently and substantial amounts of water are wasted. In the near future, these wastes will represent a large sum of money. The ones who manage this resource efficiently will be winning time and money.

In this project, an automated irrigation system is suggested to minimize the water input and human intervention, while satisfying the plants needs. First, the details of the problem are summarized. The objective and the scope of the project are described. Some

general approaches to the design are reviewed. The results An automatic irrigation system does the operation of a system without requiring manual involvement of persons. Every irrigation system such as drip, sprinkler and surface gets automated with the help of electronic appliances and detectors such as computer, timers, sensors and other mechanical devices. Healthy plants can transpire a lot of water, resulting in an increase in the humidity of the greenhouse air. A high relative humidity (above 80-85%) should be avoided because it can increase the incidence of disease and reduce plant transpiration. Sufficient venting or successive heating and venting can prevent condensation on plants surfaces and the greenhouse structure. The use of cooling systems during the warmer summer months increases the greenhouse air humidity. During periods with warm and humid outdoor conditions, humidity control inside the greenhouse can be a challenge. Greenhouses located in dry, dessert environments benefit greatly from evaporative cooling systems because large amounts of water can be evaporated into the incoming air, resulting in significant temperature drops.

Since the relative humidity alone does not tell us anything about the absolute water holding capacity of air, a different measurement is sometime used to describe the absolute moisture status of the soil. The vapor pressure deficit is a measure of the difference between the amount of moisture the air contains at a given moment and the amount of moisture it can hold at that temperature when the air would be saturated. Pressure deficit measurement can tell us how easy it is for plants to transpire: higher values stimulate transpiration (but too high can cause wilting), and lower values inhibit transpiration and can lead to condensation on leaf and surfaces.

II. DESCRIPTION OF PROPOSED MODEL

The increasing demand of the food supplies requires a rapid improvement in food production technology. In many countries where agriculture plays an important part in shaping up the economy and the climatic conditions are isotropic, but still we are not able to make full use of agricultural resources. One of the main reasons is the lack of rains & scarcity of land reservoir water. Extraction of water at regular intervals from earth is reducing the water level as a result of which the zones of un-irrigated land are gradually increasing.

Also, the unplanned use of water inadvertently results in wastage of water. In an Automated Irrigation System using ATMega328, the most significant advantage is that water is supplied only when the moisture in soil goes below a pre-set threshold value. This saves us a lot of water. In recent times, the farmers have been using irrigation technique through the manual control in which the farmers irrigate the land at regular intervals by turning the water-pump on/off when required. This process sometimes consumes more water and sometimes the water supply to the land is delayed due to which the crops dry out. Water deficiency deteriorates plants growth before visible wilting occurs. In addition to this slowed growth rate, lighter weight fruit follows water deficiency.

This problem can be perfectly rectified if we use Automated Irrigation System in which the irrigation will take place only when there will be intense requirement of water, as suggested by the moisture in the soil.

Microcontroller

A microcontroller is a highly integrated chip which performs controlling functions. A microcontroller, or embedded controller, is similar to a microprocessor as used in a personal computer, but with a great deal of additional functionality combined onto the same monolithic semiconductor substrate. Microcontrollers, sometimes referred to as one-chip microcomputers, are used to control a wide range of electrical and mechanical appliances. Since they were first introduced, microcontrollers have evolved to the point where they can use for increasing complex applications. Some microcontrollers in use today are also programmable, expanding the number of application in which they can be used.

Sensors

This is an Electrical resistance Sensor. The sensor is made up of two electrodes. This soil moisture sensor reads the moisture content around it. A current is passed across the electrodes through the soil and the resistance to the current in the soil determines the soil moisture. If the soil has more water resistance will be low and thus more current will pass through. On the other hand when the soil moisture is low the sensor module outputs a high level of resistance. This sensor has both digital and analogue outputs. Digital output is simple to use but is not as accurate as the analogue output.

Soil Moisture Sensor Has the Following Specifications

Table 1: Soil Moisture Sensor Specifications

Soil Moisture Sensors Equation

A soil moisture sensor is a device that measures the volumetric water content (VWC) of soil. Mathematically VWC, θ, is given as follows;

$$\theta = \frac{V_w}{V_T}$$

Where: Vw is the water volume and

VT is the total volume (soil volume + water volume).

Soil moisture sensors are classified according to how they measure the soil moisture content. Two methods are used in determining the volumetric water content (VWC); direct and indirect. The direct method entails drying a known volume of soil in an oven and weighing it. The direct method of measuring VWC is done using the following mathematical notation:

$$\theta = \frac{m_{wet} - m_{dry}}{\rho_w \cdot V_b}$$

Where:

a) M_{wet} is soil sample before drying in the oven
b) M_{dry} is soil sample after drying in the oven
c) ρw is water density

A soil moisture sensor is a device that measures the
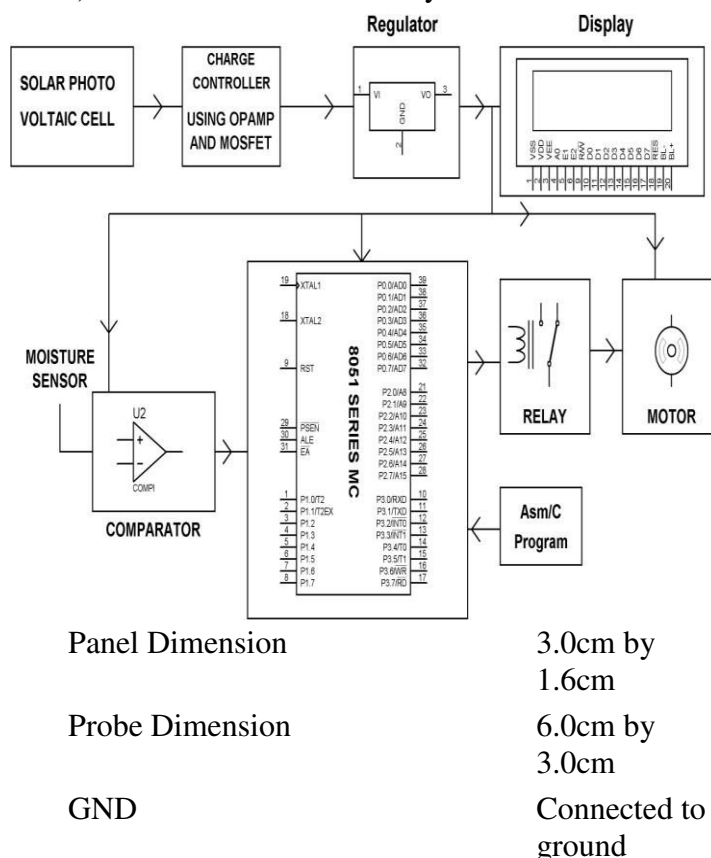
Panel Dimension	3.0cm by 1.6cm
Probe Dimension	6.0cm by 3.0cm
GND	Connected to ground

d) V_b is the volume of soil sample before

ATmega328P

Features:

i. 28-pin AVR Microcontroller

ii. Flash Program Memory: 32 Kbytes

iii. EEPROM Data Memory: 1 Kbytes

iv. SRAM Data Memory: 2 Kbytes

v. I/O Pins: 23

vi. Timers: Two 8-bit / One 16-bit

vii. A/D Converter: 10-bit Six Channel

viii. PWM: Six Channels

ix. RTC: Yes with Separate Oscillator

x. MSSP: SPI and I²C Master and Slave Support

xi. USART: Yes

xii. External Oscillator: up to 20MHz

Figure 1 ATMEGA 328 (Pin Configuration)

Proposed Hardware Setup:

Figure.2. Block diagram of the proposed hardware setup

Hardware setup components used in the project:
- POWER SUPPLY BLOCK

- MICROCONTROLLER (AT89S52/AT89C51)

- LCD DISPLAY

- LM358 (COMPARATOR)

- SOLAR PANEL

- MOC3021

- BC547

- IN4007

- LED

- RESISTORS

- CAPACITORS

Software Requirements:

- Keil compiler

- Languages: Embedded C or Assembly

Relay Switching Circuit/Connection

This is an electromagnetic switch which is activated when a current is applied to it. A relay uses small currents
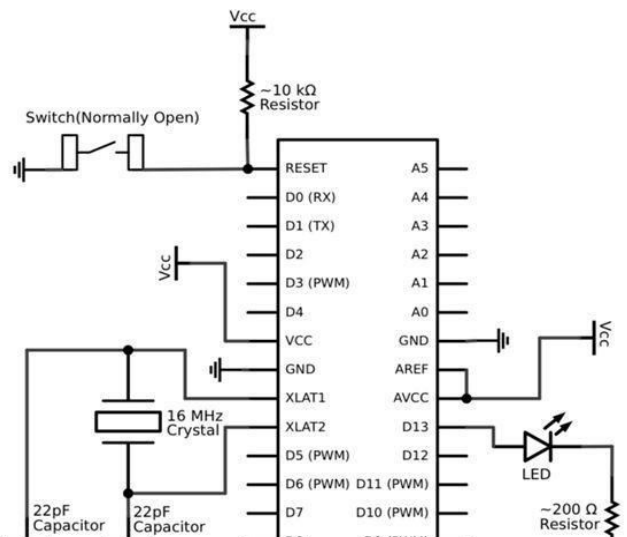

SNo	Voltage range	Soil condition	Q	Amplifier output (digital)	Relay reference pin voltage	Relay 'NO' contact	Water pump operation
1	> 5V	Excess wet	0	1	1	open	OFF
2	< 5V & > 3V	Optimally Wet	0	1	1	open	OFF
		Optimally Dry	1	0	0	closed	ON
3	< 3V	Dry	1	0	0	closed	ON

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to switch huge currents. Most relays use principle of electromagnetism to operate but still other operating principles like solid state are also used. A contactor is a type of relay which can handle a high power required to control an electric motor or other loads directly. Solid state relays have no moving parts and they use semiconductor devices to perform switching.

Figure 3. 5VDC Coil Relay

The working of the relay for various test conditions is tabulated below

Flow chart of the system

Figure.4.Flow chart of program excuted by Microcontroller

Figure.5. Hardware setup of the proposed irrigation system using solar power
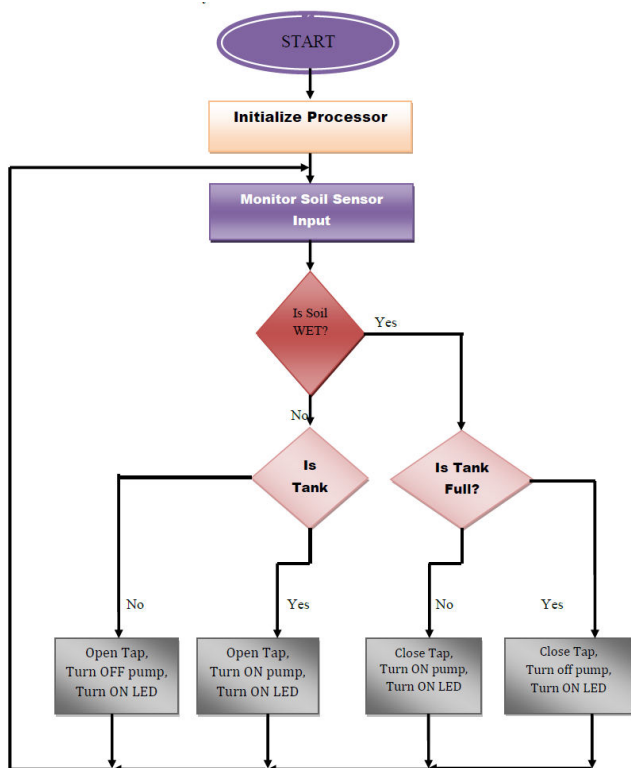

Figure.6. Operation of the Hardware setup of the proposed irrigation system using solar power under soil dry condition

Figure.7. Operation of the Hardware setup showing

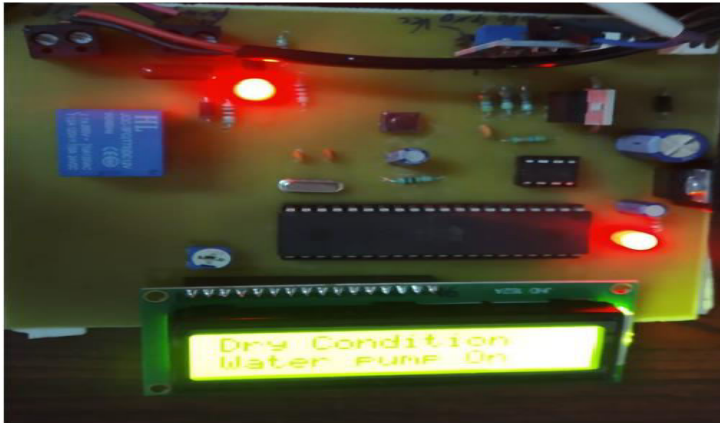soil dry condition and status of the pump in ON condition

Figure.8. Operation of the Hardware setup of the proposed irrigation system using solar power under soil wet condition

Figure.9. Operation of the Hardware setup

showing soil wet condition and status of the pump in OFF condition

CONCLUSION

Thus, the Automatic Soil Moisture Sensor Irrigation System Using Microcontroller has been designed and tested successfully. The system has been tested to function automatically. The moisture sensors measure the moisture level

(water content) of the different plants. If the moisture level is found to be below the desired level, the moisture sensor sends the signal to the IC (Microcontroller) which triggers the Water Pump to turn ON and supply the water to respective plant using the Rotating Platform/Sprinkler. When the desired moisture

level is reached, the system halts on its own and the Water Pump is turned OFF. Thus, the functionality of the entire system has been tested thoroughly and it is said to function successfully.

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