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AUTOMATIC IRRIGATION SYSTEM

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Abstract-In India, agriculture plays an important role for development in food production. In some countries, agriculture depends on the monsoon which is not sufficient source of water. India's population is reached beyond 1.2 billion and the population rate is increasing day by day then after 25-30 years there will be serious problem of food, so the development of agriculture is necessary. In Irrigation system, depending upon the soil type, water is provided to plant. The main objective of this paper is to provide an automatic irrigation system which switches the pump motor ON/OFF on sensing the moisture content of the soil. The advantage of using this method is to reduce human intervention and still ensure proper irrigation thereby saving time, money, power of the farmer & optimise water use for agricultural crops. It uses a 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. Network of soil-moisture and temperature sensors placed in the root zone of the plants. The automated system was tested in a sage crop held for 136 days and water savings of up to 90% compared with traditional irrigation practices of the agricultural zone were achieved. "An automatic plant irrigation system ", not only helps farmers but also others for watering their gardens as well.

Keywords: Irrigation, LM7805 Regulator, Microcontroller, Soil Moisture Sensor

1. INTRODUCTION

Agriculture is only the source to provide continuously increasing demand of food necessities. It is important to rapid improvement in production of food technology. Agriculture plays the important role in the economy and development, like India. Agriculture uses 85% of available freshwater resources worldwide, and this percentage will continue to be dominant in water consumption because of population growth and increased dynamic demand in food production. There is an urgent need to create strategies based on science and technology for sustainable use of water, including technical, agronomic, managerial, and institutional improvements. 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. Irrigation is defined as artificial application of water to land or soil. Irrigation process can be used for the cultivation of agricultural crops during the span of inadequate rainfall and for maintaining landscapes. In agriculture, there is two things is very important, first to get information of about fertility of soil and second is to measure moisture content in soil. Nowadays for irrigation different Techniques are available which is used to reduce the dependency of rain. And mostly this technique is driven by electrical power and on/off scheduling controlled. An automatic irrigation system does the operation of a system without requiring manual involvement of persons. An automatic irrigation system does the work quite efficiently and with a positive impact on the place where it is installed. Once it is installed in the agricultural field, the water distribution to crops and nurseries becomes easy and doesn't require any human support to perform the operations permanently. In modern drip irrigation systems, a large quantity of water is saved. But the farmers have been using irrigation techniques in India through manual control in which farmers irrigate the land at the regular intervals. We use automatic microcontroller based irrigation system in which the irrigation will take place only when there will be acute requirement of water.

The automatic irrigation system on sensing soil moisture is intended for the development of an irrigation system that switches submersible pumps on or off by using relays to perform this action on sensing the moisture content of the soil. The main advantage of using this irrigation system is to reduce human interference and ensure proper irrigation.

Need of Automatic Irrigation: - 1. Simple and easy to install and configure. 2. Saving energy and resources, so that it can be utilised in proper way and amount. 3. Farmers would be able to smear the right amount of water at the right time by automating farm or nursery irrigation. 4. Avoiding irrigation at the wrong time of day, reduce runoff from overwatering saturated soils which will improve crop performance. 5. Automated irrigation system uses valves to turn motor ON and OFF.

Improving irrigation efficiency can contribute greatly to reducing production costs of vegetables, making the industry more competitive and sustainable.

2. IRRIGATION

Irrigation is defined as artificial application of water to land or soil. Irrigation process can be used for the cultivation of agricultural crops during the span of inadequate rainfall and for maintaining landscapes. Irrigation system uses valves to turn irrigation ON and OFF. These valves may be easily automated by using controllers and solenoids. Automating farm or nursery irrigation allows farmers to apply the right amount of water at the right time, regardless of the availability of labour to turn valves on and off. In addition, farmers using automation equipment are able to reduce runoff from over watering saturated soils, avoid irrigating at the wrong time of day, which will improve crop performance by ensuring adequate water and nutrients when needed. The conventional irrigation methods like overhead sprinklers, flood type feeding systems usually wet the lower leaves and stem of the plants. The entire soil surface is saturated and often stays wet long after irrigation is completed. Such condition promotes infections by leaf mould fungi. Control in highly specialised greenhouse vegetable production and it is a simple, precise method for irrigation. It also helps in time-saving, removal of human error in adjusting available soil moisture levels and to maximise their net profits. Irrigation is the artificial application of water to the soil usually for assisting in growing crops. In crop production, it is mainly used in dry areas and in periods of rainfall shortfalls, but also to protect plants against frost.
Types of Irrigation 1.Surface irrigation 2. Localised irrigation 3.Drip Irrigation 4. Sprinkler irrigation.
Here is explained about important parameters to be measured for automation of irrigation system are soil moisture. The entire field is first divided into small sections such that each section should contain one moisture sensor. These sensors are buried in the ground at required depth. Once the soil has reached desired moisture level the sensors send a signal to the microcontroller to turn on the relays, which control the motor. In proposed system, automated irrigation mechanism which turns the pumping motor ON and OFF on detecting the moisture of the earth. In the domain of farming, utilisation of appropriate means of irrigation is significant. The benefit of employing these techniques is to decrease human interference.

3. SOIL MOISTURE

Soil moisture is an important component in the atmospheric water cycle, both on a small agricultural scale and in large-scale modelling of land/atmosphere interaction. Vegetation and crops always depend more on the moisture available at root level than on precipitation occurrence. Water budgeting for irrigation planning, as well as the actual scheduling of irrigation action, requires local soil moisture information. Knowledge of the degree of soil wetness helps to forecast the risk of flash floods, or the occurrence of fog. Soil water content is an expression of the mass or volume of water in the soil, while the soil water potential is an expression of the soil water energy status. The relation between content and potential is not universal and depends on the characteristics of the local soil, such as soil density and soil texture. The basic technique for measuring soil water content is the gravimetric method. Because this method is based on direct measurements, it is the standard with which all other methods are compared. Unfortunately, gravimetric sampling is destructive, rendering repeat measurements on the same soil sample impossible. Because of the difficulties of accurately measuring dry soil and water volumes, volumetric water contents are not usually determined directly.
The capacity of soil to retain water is a function of soil texture and structure. When removing a soil sample, the soil being evaluated is disturbed, so its water-holding capacity is altered. Indirect methods of measuring soil water are helpful as they allow information to be collected at the same location for many observations without disturbing the soil-water system. Moreover, most indirect methods determine the volumetric soil water content without any need for soil density determination. The new soil moisture sensor uses Immersion Gold which protects the nickel from oxidation. Electrodes nickel immersion gold (ENIG) has several advantages over more conventional (and cheaper) surface plating such as HASL (solder), including excellent surface planarity (particularly helpful for PCB's with large BGA packages), good oxidation resistance, and usability for untreated contact surfaces such as membrane switches and contact points. A soil moisture sensor can read the amount of moisture present in the soil surrounding it. It's a low tech sensor, but ideal for monitoring an urban garden, or your pet plant's water level. This is a must have tool for a connected garden. This sensor uses the two probes to pass current through the soil, and then it reads that resistance to get the moisture level. More water makes the soil conduct electricity more easily (less resistance), while dry soil conducts electricity poorly (more resistance).

3.1 Soil Moisture Sensor

Soil moisture sensors measure the volumetric water content in soil indirectly by using some other property of the soil, such as electrical resistance, dielectric constant, or interaction with neutrons, as a proxy for the moisture content. The relation between the measured property and soil moisture must be calibrated and may vary depending on environmental factors such as soil type, temperature, or electric conductivity. When Soil is Dry then generate low signal and High signal when moisture contain. Reflected microwave radiation is affected by the soil moisture and is used for remote sensing in hydrology and agriculture.

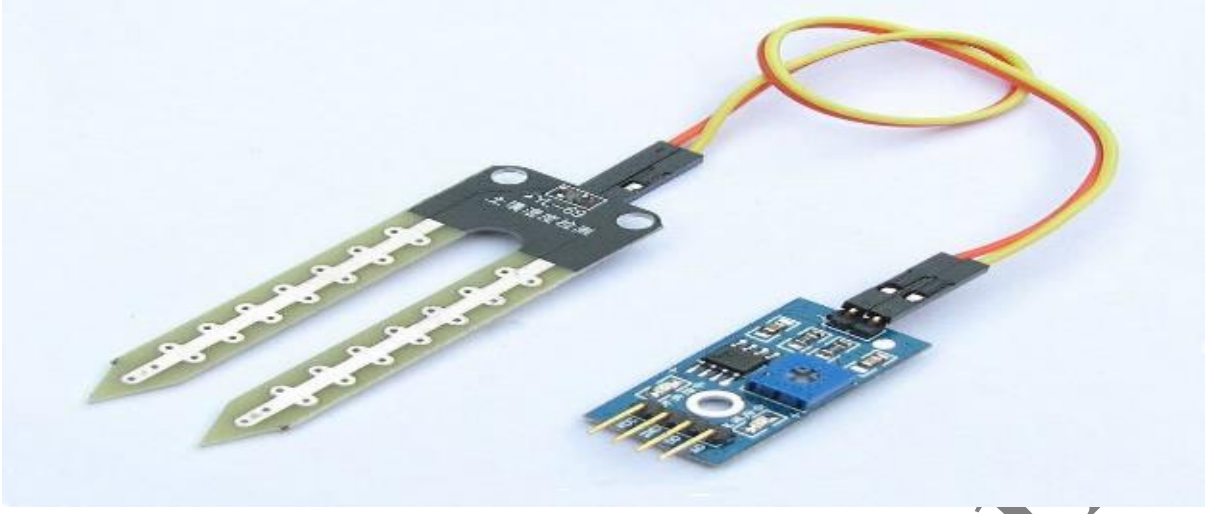

Fig. 3.1 Soil Moisture Sensor

Table-3.1 Sensor Rating

Sensor	Soil humidity (HL-69)
Current measuring	0~ 35mA
Signal output voltage	0~ 4.2V
Operating voltage	3.3 V ~ 5 V (DC)
Output format	Digital and analogue (Ohms)
Current for LM393	0.4 mA

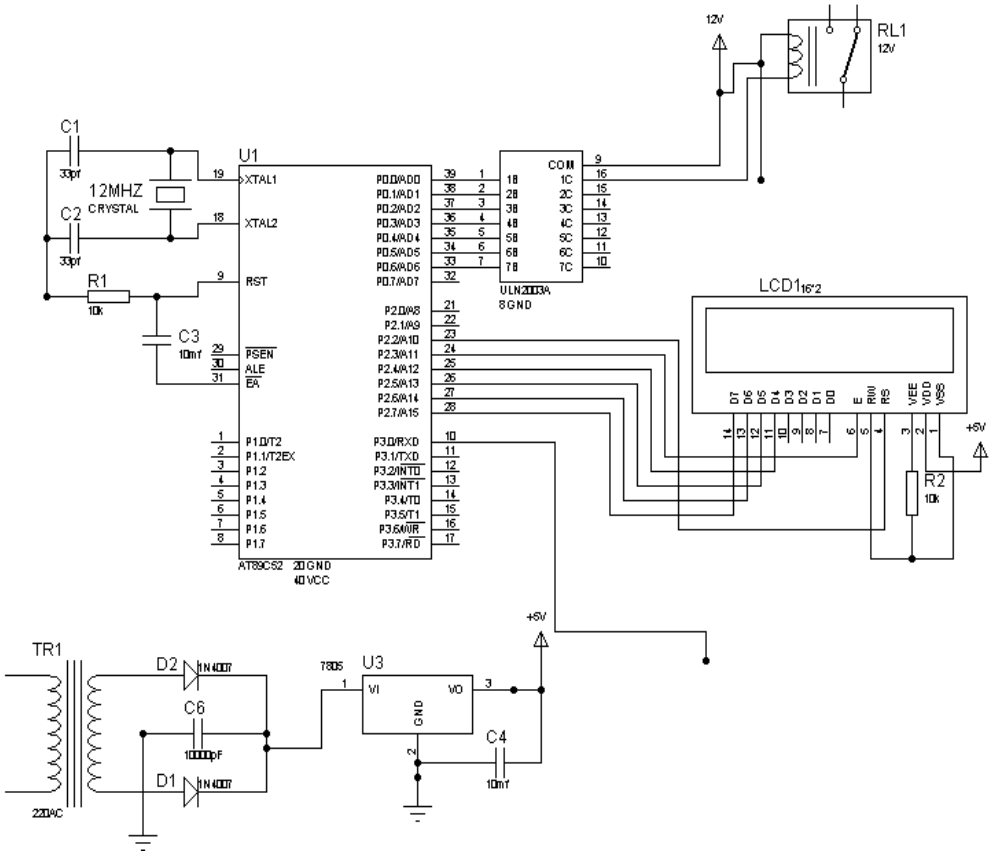

Fig. 3.2 Block Diagram of the Automatic Irrigation System

The above Fig. shows Microcontroller based irrigation system proves to be a real-time feedback control system which monitors and controls all the activities of irrigation system efficiently. The present proposal is a model to modernise the agriculture industries on a small scale with optimum expenditure. Using this system, one can save manpower, water to improve production and ultimately profit.

4. AT89C51 MICRO CONTROLLER

The AT89C51 is a low-power, high-performance CMOS 8-bit microcomputer with 4 Kbytes of Flash Programmable and Erasable Read Only Memory (PEROM). The device is manufactured using Atmel's high-density non-volatile memory technology. The on-chip Flash allows the program memory to be reprogrammed in-system or by a conventional non-volatile memory programmer. By combining a versatile 8-bit CPU with Flash on a monolithic chip, the Atmel AT89C51 is a powerful microcomputer which provides a highly flexible and cost-effective solution to many embedded control applications. The AT89C51 provides the following standard features: 4 Kbytes of Flash, 128 bytes of RAM, 32 I/O lines, two 16-bit timer/counters, five vector two-level interrupt architecture, a full duplex serial port, and on-chip oscillator and clock circuitry.

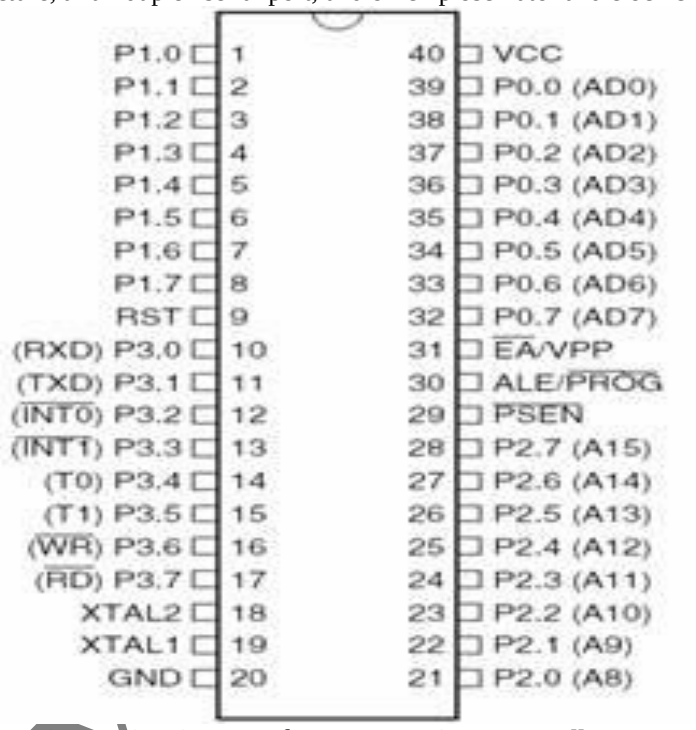

Fig. 4.1Pin Diagram of AT89C51 Micro Controller

4.1 LM7805 Regulator

IC7805 is a voltage regulator integrated circuit. It is a member of 78xx series of fixed linear voltage regulator ICs. The voltage source in a circuit may have fluctuations and would not give the fixed voltage output. The voltage regulator IC maintains the output voltage at a constant value. The xx in 78xx indicates the fixed output voltage it is designed to provide. 7805 provides +5V regulated power supply. Capacitors of suitable values can be connected at input and output pins depending upon the respective voltage levels.

Table-4.1 Operating Voltage

Microcontroller	ATmega2560
Operating voltage	5V
Input voltage	7~ 12 V
Input voltage limits	6~ 20V DC
DC current per I/O pin	40 mA
DC current for 3.3V pin	50mA
Flash memory	256 kb
Bootloader SRAM	8 kb
EEPROM	4 kb
Clock speed	16 MHz

5. WORKING

First of all the input supply for entire circuit is 9V. But since the entire circuit work on 5V so that is why firstly a voltage regulator is used to regulate this power supply to 5V. Now, this supply gives power to LCD, microcontroller, and other devices. Moisture sensor senses the moisture content in the soil and sends signal high or low to the microcontroller. Now if it sends the signal LOW means there is no moisture and pump needs to start. So this low signal will be sent to microcontroller who will send this signal to relay for on or off operation. If the signal from the microcontroller is low, relay driver will turn on the relay and relay will turn on the pump. Relay Driver IC ULN 2003 used in between microcontroller and relay, just because microcontroller does not operate directly to relay. This is called relay driver because it drives or on/off the relay. There is a crystal oscillator is presently connected to the microcontroller. This crystal oscillator will give a clock square pulse to the microcontroller. The frequency of this is 11.0592MHz. Since we need a constant clock pulse but any problem in circuit or crystal oscillator is not giving square pulse or disturbance so we will use two filtering capacitors of 33pf for converting perfect square pulse. Now we need to run our device again and again so for this we need an automatic reset after each time we run the circuit so that we can set it to starting position. This is done with the help of a resistance and a capacitor. The rating of this resistor is 10k ohm and capacitor is 10microferad. Resistor and capacitor automatic reset at start position when coding end. Now to check whether there is power in the circuit or not so for this we will use a LED and a resistor of 1kohm is connected into series it. There is a filtering capacitor is used of 100microferad. There is a manual reset button is used to reset the entire circuit whenever we want to the starting position manually. There is a LCD is connected to the microcontroller which shows the moisture level in the soil.

6. EXTENSION

In this project, we have used five sensors which enabled us to run the project, even if one or two sensors stopped working. Suppose while irrigating the field one sensor malfunctioned or stopped working and the sensor will continue to ask for water even if it reaches the threshold condition and should send the signal to stop the pump. Or due to any reason, one part of the field where one sensor is placed gets enough water and it trips the relay but the other areas where the water is not supplied in sufficient quantity will remain dry. To overcome such problems we have done coding in such manner that the relay will not trip and keep on irrigating plants with water until the majority of sensors gives the signals and thus stop the supply.

CONCLUSION & FUTURE SCOPE

In automatic plant irrigation system, we can control their flow of water and also give required water to plant by checking moisture level of soil by soil the moisture sensor. The working of above irrigation system is basically dependent on the output of the soil moisture sensor. Whenever there is need of excess water in the desired field then it will not be possible by using sensor technology. For this, we will have to adopt the DTMF (dual tone multi-frequency) technology. At present day GSM based, Drip based, wireless etc. much technology is growing. By using this we will be able to irrigate the desired field & in the desired amount. In present days especially farmers are facing major problems in watering their agriculture fields, it's because they have no proper idea about when the power is available so that they can pump water. Even after then they need to wait until the field is properly watered, which makes them stop doing other activities. Here is an idea which helps not only farmers even for watering the gardens also, which senses the soil moisture and switches the pump automatically when the power is ON.

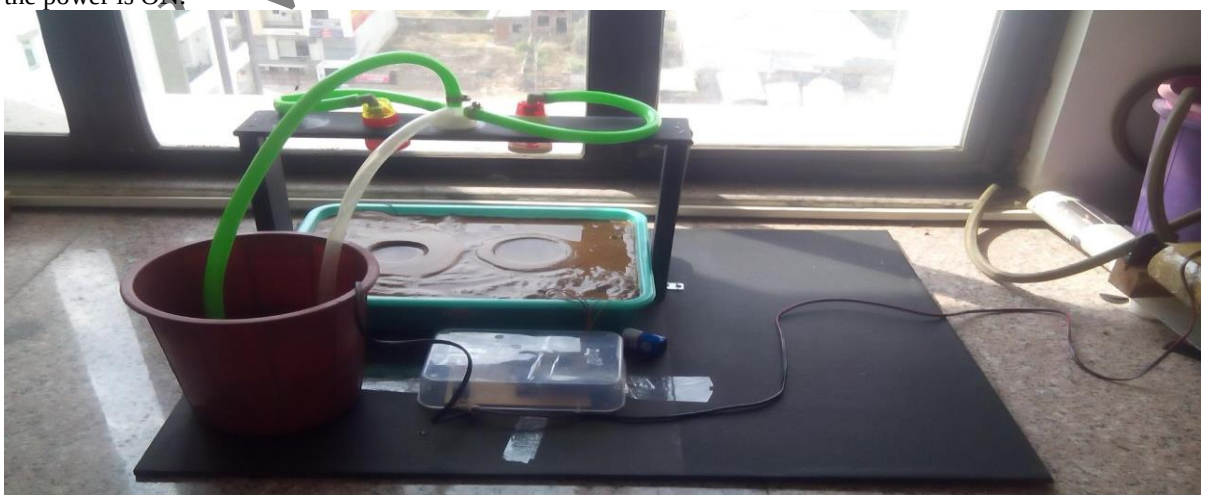

Fig. (a) Automatic Plant Irrigation System

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