An Intelligent and Automated Drip Irrigation System Using GSM

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Abstract—The maintain of this project is to design an accurate & cost effective Microcontroller Based Automatic Drip Irrigation System .Indian economy is mainly depends on agriculture. In India, the continuous increase in population demands for better improvement in food production technology. Hence automatic drip irrigation system is presented. Relay and solenoid valveare used to control drip irrigation system. A 16×2 LCD can be connected to the microcontroller, which will displays the soil moisture level and ambient temperature. This system can be performed on a real time basis & the control law can be easily replaced by any advanced control laws without changing hardware setup. Sensors are used to monitor the moisture content of the soil and depending on that the valves of the system are turned ON or OFF automatically. Soil moisture sensor and temperature sensor will sense the condition of the weather and will send the same information to microcontroller. Microcontroller will send the information to the relay then on/off of the motor is done. There will be serial communication between microcontroller and GSM (Global System for Mobile Communications). So the information from the microcontroller can be sent as SMS through GSM. This paper presents a fully automated drip irrigation system which is controlled and monitored by using PIC Microcontroller. This will help the user to use water wisely in future.

Keywords—Soil Moisture Sensor, Temperature Sensor, PIC Microcontroller, Solenoid Valve, GSM.

I. INTRODUCTION

Water is the resource that all living species needed. Water is needed for everyone like human beings, animals, plants, etc.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. Hence proper planning of water usage is needed. The demand for new water saving techniques in irrigation is increasing rapidly right now. The lack of rain water and scarcity of land water also results in decrement in volume of water on earth. The main aim of farmer is to produce “more crop per drop”, hence there is need to find theirrigation techniques which consumes less fresh water. In the drip irrigation technique, the water is provided to the root zone of plants drip by drip due to which the large amount of water can be saved. Fig. 1 shows typical drip irrigation system. At the Present time, the farmer’s use the irrigation technique in country manually in which the farmers must irrigate the lands at every regular interval. This technique may require additional amount of water or sometimes the water provide latterly to roots of the plants because of which the crops may be get dried. Because of this growth rate becomes slow, lighter weight of fruits etc. like problems are arises. This problem can be perfectly rectified if we use automatic drip irrigation system. Today the availability of carrying agricultural activity is less; therefore automation in agriculture is needed.

Fig.1. Drip Irrigation [9]

Proposed irrigation system uses valves to turn ON or OFF automatically. Drip irrigation can be applied under a wide range of field conditions. The simple Drip irrigation assembly is shown in fig. 2 below.

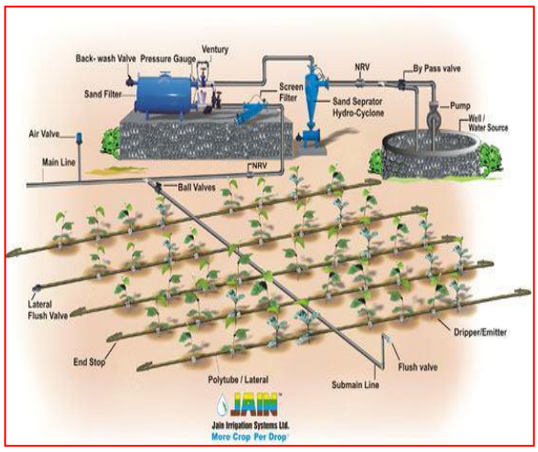

Fig.2 Drip Irrigation Assembly [8]

A. Components:

The components of Microcontroller Based Automatic Drip Irrigation System are as follows:

1. Pump
2. Water Filter
3. Solenoid Valve
4. Drip lines with Emitters
5. Soil Moisture and Temperature Sensors.
6. Microcontroller Unit (The brain of the system).
7.GSM (Global System for Mobile Communication)

B. Methodology

There are mainly three methods used for Automation:

1. **Time-based system:** In this system, time is the basis for operation. The basic aim is to prepare a schedule based on crop water requirements. The operation sequence will be set by user as desired.
2. **Volume-based system:** In this type, every section will receive the preset volume of water.
3. **Sensor (Priority)-based system:** In this system, sensors give feedback to controller, depending on which the controller initiates various actions as required.

In this paper the above mentioned three methods (Time based, Volume based and Priority based) are combined in one system.

II. IRRIGATION

The artificial method of providing water to the soil for growing crops is called as irrigation.Water is considered to be basic need of human beings, animals, plants, etc.Agriculture is one of the fields where water is required in very large quantity. Nowadays, water shortage is becoming one of the biggest problems in the world. Hence to overcome this problem, microcontroller based automatic drip irrigation system is presented.

Types of irrigation:

There are mainly three types of irrigation and can be explained as follows.

1. Surface Irrigation (conventional irrigation)
2. Drip Irrigation
3. Sprinkler Irrigation

1. **Surface irrigation:** Surface irrigation is the irrigation technique in which water is applied and distributed over the surface by gravity. A surface type irrigation system wets the lower leaves and stem of the plants. When irrigation is done by using such methods the soil surface is often saturated and stays wet for long time. These conditions lead to infectionto the plants. The surface irrigation methods consume large amount of water. In order to solve this problem the drip or trickle irrigation is used.
2. **Drip irrigation:** It is also known as trickle irrigation or micro irrigation or localized irrigation, is an irrigation method which saves water by allowing water to drip slowly to the roots of plants, either onto the soil surface or directly onto the root zone, through a network of valves, pipes, tubing, and emitter. Drip irrigation at plant's root zone is shown in Fig. 1.
3. **Sprinkler irrigation**: This is an irrigation system based on overhead sprinklers, sprays or guns, installed on permanent risers. You can also have the system buried underground and the sprinklers rise up when water pressure rises, which is a popular irrigation system for use on golf courses and parks.

III. SYSTEM ARCHITECTURE

The block diagram of microcontroller based automatic drip irrigation system is as shown in fig. 3 below which consists of various blocks. Function of each block is explained as follows:

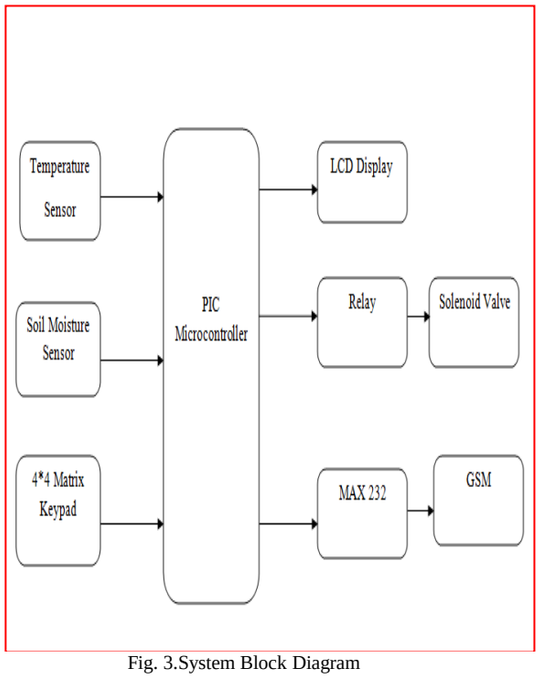

Fig. 3.System Block Diagram

1. Sensors:A sensor is an object or device whose purpose is to detect events or changes in its environment, and then provide a corresponding output.

1.1 Temperature sensor: A temperature sensor is a device which provides for temperature measurement through an electrical signal.The LM35 sensor is used to measure the temperature. The LM35 series are precision integrated-circuit. Output voltage is linearly-proportional to the Centigrade temperature.

1.2 Soil moisture sensor: Soil moisture sensors measure the volumetric water content in soil. Measuring soil moisture is important for agricultural applications to help farmers manage their irrigation systems more efficiently.

Sensors should be buried in the root zone of the plants to be irrigated.

2 Liquid crystal display (LCD): The LCD will display the alphabets, numbers, characters and symbols on the LCD screen. The LCD used here is eight bit parallel type and the display size is 16*2. It is used for displaying the temperature and moisture value on display screen.

3.Solenoid Valve: A solenoid valve is an electromechanically operated valve. The valve is controlled by an electric current through a solenoid. It converts the input electrical energy into mechanical energy which, in turn, opens or closes the valve mechanically. In the case of a two-port valve the flow is switched on or off; in case of a three-port valve, the outflow is switched between the two outlet ports.

4. GSM: GSM (Global System for Mobile Communications), is a standard developed by the European Telecommunications Standards Institute (ETSI) to describe the protocols for second-generation (2G) digital cellular networks used by mobile phones. There will be serial communication between microcontroller and GSM. So the information from the microcontroller can be sent as SMS through GSM.

5. PIC Microcontroller: PIC is a family of modified Harvard architecturemicrocontrollers made by Microchip Technology. The name PIC initially referred to Peripheral Interface Controller. In this project, PIC 16F877A microcontroller is used. The important features of PIC16F877 series is given below.

General Features of PIC 16F877A:

1. High performance RISC CPU.
2. Only 35 simple word instructions.
3. All single cycle instructions except for program branches which are two cycles.
4. Operating speed: clock input (200MHz), instruction cycle (200nS).
5. Up to 368×8bit of RAM (data memory), 256×8 of EEPROM (data memory), and 8k×14 of flash memory.
6. Interrupt capability (up to 14 sources).
7. Different types of addressing modes (direct, Indirect, relative addressing modes).
8. Power on Reset (POR).
9. Wide operating voltage range (2.0 – 5.56)volts.

6. Power Supply: A power supply is an electronic device that supplies electric energy to an electrical load. Power supply unit converts input power to DC power required by various parts of project.

IV. RESULTS AND DISCUSSIONS

The output of LM35 is in the form of analog. The input supply voltage is 5 volts. The output will be in the form of voltage.

Table 1: Output of LM 35 Temperature Sensors

Temp (^{O}C)	Output voltage (Vout) in mv
30	300
31	310
32	320
33	330
34	340

The soil moisture sensor is directly connected to the microcontroller. The output is in the digital form and data is sent directly to PIC microcontroller. The output of microcontroller is displayed on LCD screen.

Table 2: Output of Soil Moisture Sensor

Moisture level (%)	Output voltage (volt)
20	2.75
40	2.10
60	1.40
80	0.70

When moisture level of soil is low, the solenoid valve is turned on automatically. When the desired level of water in soil is reached valve is closed automatically.

1. Time based control mechanism:

In time based system large amount of water is available since we can irrigate land depending up on crop condition.

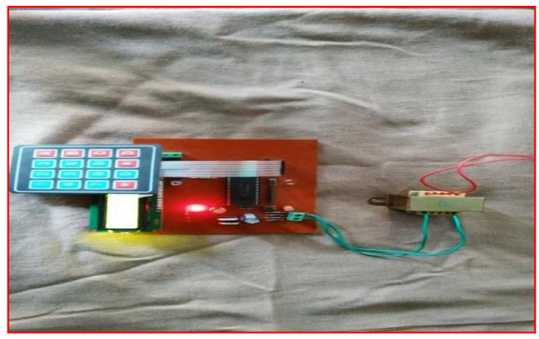

Fig.4.Time Based Control Mechanism

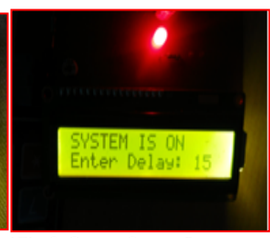

Fig.5. Outputs Screen 1Fig.6. Output Screen 2

Fig.7. Output Screen 3

2. Priority based control mechanism:

Priority is assigned depending upon dry condition of field.

Table 3: Observation table of priority based control system

System	Dry	Priority
1	50%	2
2	90%	1
3	30%	3

V. CONCLUSION

The main aim of this paper is to design a fully automated drip irrigation system. The microcontroller based automatic drip irrigation system is implemented and found to be feasible and cost effective. It will be advantageous over manual control as it uses mechanism like time based control mechanism, volume based control mechanism and sensor based control mechanism. As this is sensor-based irrigation, it has advantages such as preventing moisture stress of trees, diminishing of excessive water usage, ensuring rapid growth of plants, increase of soil fertility.

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