Microcontroller Based Automation of Drip Irrigation System

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Abstract-*The green house based modern agriculture industries are the recent requirement in every part of agriculture in India. In this technology, the humidity and temperature of plants are precisely controlled. Due to the variable atmospheric circumstances these conditions sometimes may vary from place to place in large farmhouse, which makes very difficult to maintain the uniformity at all the places in the farmhouse manually. Therefore, there is an intense need to develop such Microcontroller based embedded system, which could maintain the physical parameters uniform and also could keep the records for analytical studies. We present in this paper, to the best of our knowledge for the first time an auto-control network for agriculture industry, which could give the facilities of maintaining uniform environmental conditions. The second part of the paper will explain the concepts of irrigation systems. The third part will explain the design*.

Key words: ***Microcontroller, Sensors, GSM module.***

I.INTRODUCTION

The continuous increasing demand of the food requires the rapid improvement in food production technology. In a country like India, where the economy is mainly based on agriculture and the climatic conditions are isotropic, still we are not able to make full use of agricultural resources. 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. Another veryimportant reason of this is due to unplanned use of water due to which a significant amount of water goes waste. In the modern drip irrigation systems, the most significant advantage is that water is supplied near the root zone of the plants drip by drip due to which a large quantity of water is saved. 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. Water deficiency can be detrimental to plants before visible wilting occurs. Slowed growth rate, lighter weight fruit follows slight water deficiency. This problem can be perfectly rectified if we use automatic microcontroller based drip irrigation system in which the irrigation will take place only when there will be intense requirement of water.

Fig 1.0: Root zone dripping

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 labor 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. Automatic Drip Irrigation is a valuable tool for accurate soil moisture control in highly specialized 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 maximize their net profits.

The entire automation work can be divided in two sections, first is to study the basic components of irrigation system thoroughly and then to design and implement the control circuitry. So we will first see some of the basic platform of drip irrigation system.

II. Concept of Modern Irrigation System

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 mold fungi. The flood type methods consume large amount of water and the area between crop rows remains dry and receives moisture only from incidental rainfall. On the contrary the drip or trickle irrigation is a type of modern irrigation technique that slowly applies small amounts of water to part of plant root zone. Drip irrigation method is invented by Israelis in 1970s. Water is supplied frequently, often daily to maintain favorable soil moisture condition and prevent moisture stress in the plant with proper use of water resources.

Fig2: Dripper

A wetted profile developed in the plant's root zone. Its shape depends on soil characteristics. Drip irrigation saves water because only the plant's root zone receives moisture. Little water is lost to deep percolation if the properamount is applied. Drip irrigation is popular because it can increase yields and decrease both water requirements and labor.

Drip irrigation requires about half of the water needed by sprinkler or surface irrigation. Lower operating pressures and flow rates result in reduced energy costs. A higher degree of water control is attainable. Plants can be supplied with more precise amounts of water. Disease and insect damage is reduced because plant foliage stays dry. Operating cost is usually reduced. Field operations may continue during the irrigation process because rows between plants remain dry. Fertilizers can be applied through this type of system. This can result in a reduction of fertilizer and fertilizer costs. When compared with overhead sprinkler systems, drip irrigation leads to less soil and wind erosion. Drip irrigation can be applied under a wide range of field conditions. A typical Drip irrigation assembly is shown in figure () below.

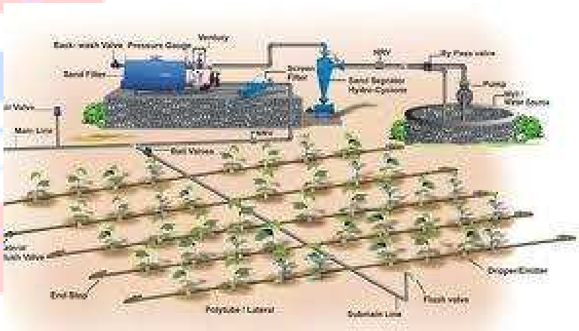

Fig3: Drip Irrigation

III.Design of Microcontroller Based Drip Irrigation System

The key elements that should be considered while designing a mechanical model: -.

[1] *Flow*: You can measure the output of your water supply with a one or five-*gallon* bucket and a stopwatch. Time how long it takes to fill the bucket and use that number to calculate how much water is available per hour. Gallons per minute x 60=number of gallons per hour.

[2] *Pressure* (The force pushing the flow): Most products operate best between 20and 40 pounds of pressure. Normal household pressure is 40-50 pounds.

[3] *Water Supply & Quality*: City and well water are easy to filter for drip irrigationsystems. Pond, ditch and some well water have special filtering needs. The quality and source of water will dictate the type of filter necessary for your system.

[4] *Soil Type and Root Structure*: The soil type will dictate how a regular drip ofwater on one spot will spread. Sandy soil requires closer emitter spacing as water percolates vertically at a fast rate and slower horizontally. With a clay soil water tends to spread horizontally, giving a wide distribution pattern. Emitters can be spaced further apart with clay type soil. A loamy type soil will produce a more even percolation dispersion of water. Deep-rooted plants can handle a wider spacing of emitters, while shallow rooted plants are most efficiently watered slowly (low gph emitters) with emitters spaced close together. On clay soil or on a hillside, short cycles repeated frequently work best. On sandy soil, applying water with higher gph emitters lets the water spread out horizontally better than a low gph emitter.

[5] *Elevation*: Variations in elevation can cause a change in water pressure withinthe system. Pressure changes by one pound for every 2.3-foot change in elevation. Pressure-compensating emitters are designed to work in areas with large changes in elevation.

[6] *Timing*: Watering in a regular scheduled cycle is essential. On clay soil orhillsides, short cycles repeated frequently work best to prevent runoff, erosion and wasted water. In sandy soils, slow watering using low output emitters is recommended. Timers help prevent the too-dry/too-wet cycles that stress plants and retard their growth. They also allow for watering at optimum times such as early morning or late evening.

Watering Needs: Plants with different water needs may require their ownwatering circuits. For example, orchards that get watered weekly need a different circuit than a garden that gets watered daily. Plants that are drought tolerant will need to be watered differently than plants requiring a lot of water.

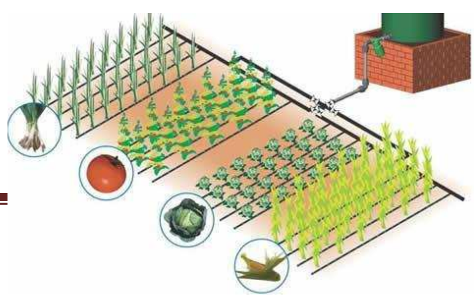

Fig4: Different modes of dripping

The components of microcontroller based drip irrigation system are as follows: -

7.1) Pump

7.2) Water Filter

7.3) Flow Meter

7.4) Control Valve

7.5) Chemical Injection Unit

7.6) Drip lines with Emitters

7.7) Moisture and Temperature Sensors.

7.8) Microcontroller Unit

The microcontroller unit is now explained in detail: -

AT89C51 is an 8-bit microcontroller and belongs to Atmel's 8051 family. **ATMEL89C51** has 4KB of Flash programmable and erasable read only memory (PEROM) and128 bytes of RAM. It can be erased and program to a maximum of 1000 times.

The automated control system consists of moisture sensors, temperature sensors, Signal conditioning circuit, Digital to analog converter, LCD Module, Relay driver, solenoid control valves, etc. The unit is expressed in Figure – (3) below.

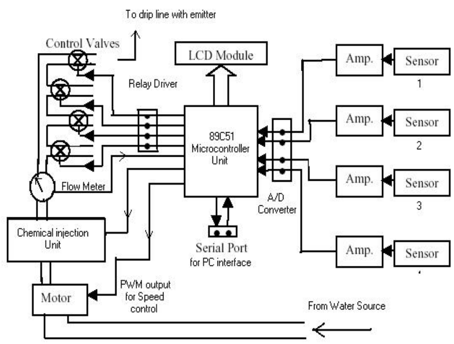

Fig5: Circuit diagram

The important parameters to be measured for automation of irrigation system are soil moisture and temperature. The entire field is first divided in to small sections such that each section should contain one moisture sensor and a temperature sensor. RTD like PT100 can be used as a temperature sensor while Tensiometer can be used as the moisture sensor to detect moisture contents of soil. 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 off the relays, which control the valves.

Fig6: PT100 (platinum resistance temperature detector)

The signal send by the sensor is boosted up to the required level by corresponding amplifier stages. Then the amplified signal is fed to A/D converters of desired resolution to obtain digital form of sensed input for microcontroller use.

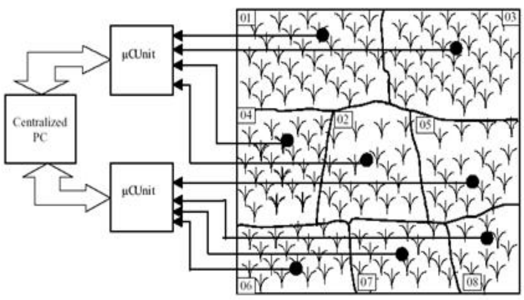

Fig7: Irrigation diagram

A 16X1 line LCD module can be used in the system to monitor current readings of all the sensors and the current status of respective valves. The solenoid valves are controlled by microcontroller though relays. A Chemical injection unit is used to mix required amount of fertilizers, pesticides, and nutrients with water, whenever required. Varying speed of pump motor can control pressure of water. It can be obtained with the help of PWM output of microcontroller unit. A flow meter is attached for analysis of total water consumed. The required readings can be transferred to the Centralized Computer for further analytical studies, through the serial port present on microcontroller unit. While applying the automation on large fields more than one such microcontroller units can be interfaced to the Centralized Computer.

Fig8: Sensors used such as Tensiometers

The microcontroller unit has in-built timer in it, which operates parallel to sensor system. In case of sensor failure the timer turns off the valves after a threshold level of time, which may prevent the further disaster. The microcontroller unit may warn the pump failure or insufficient amount of water input with the help of flow meter.

V. CONCLUSION

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

VI. REFERENCES

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