DRIP IRRIGATION SYSTEM USING EMBEDDED SYSTEMS: AN INITIATIVE OF SAVING WATER

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Abstract

Water is one of the basic needs of all living beings. Fresh water is less than 1% on Earth [I] and the usage of water is increasing day by day. Agriculture practices alone requires huge amount of water. In this paper, the basic motive is to save water and prevent wastage of water by using drip irrigation technology. In Drip irrigation the water is poured just above the roots in the form of droplets. Water is given to the roots drop by drop which not only saves water but also prevents the plants from flooding and decaying due to excessive water released by irrigation methods like flood irrigation- border irrigation, furrow irrigation, check basin irrigation [II].

In this paper, microcontroller based drip irrigation method is proposed, which controls, monitors, automatically ON/OFF the water pump and gives feedback.

Drip irrigation using embedded systems is one of the most efficient techniques used to save water as well as saving time and energy of the farmers. Using embedded technology in farming practices would ease the farming and farmers will be able to keep check on the crops.

Keywords: Drip irrigation, ATmega32 microcontroller, moisture sensors, temperature sensors and GSM Module.

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1. INTRODUCTION

Drip irrigation is done in two ways: manually and automatically. The system is proposed in this paper is automated using ATmega32 microcontroller, a 32-bit ATMega32A with features of 32kB single flash memory, 2kB SRAM and three 32 bit timers and 8 channel 10 bit ADC. A solenoid valve which converts electrical energy into mechanical energy is used to ON/OFF the water flow with the help of its 2-port valve. The sensors which are placed atleast 5 feet above the roots for avoiding high moisture areas [II]. Using 10 HS coded pre-calibrated Soil Moisture Sensor of Decagon because of its low power consumption as it required 10-12mA and runs with 3-15 V DC giving an output of 0.60-12Volts. This sensor could reduce 50% of the water consumption [II]. When drip irrigation is created the important parameters are temperature, humidity, carbon dioxide, ground water and light [III]. Field conditions are also necessary to be studied. The field chosen in this paper is flat areas where the field is monitored through sensors and the information is wirelessly transmitted to the base station and to GSM based mobile phone.

The whole system is divided into four essential parts: i) Base Station Unit (BSU) ii) Valve Unit (VU) iii) Sensor Unit (SU).
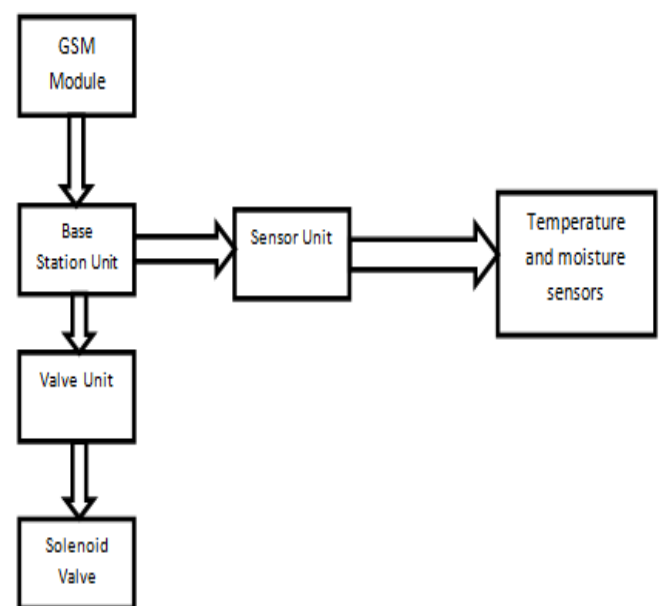

Fig 1: Basic block diagram.

1.1 Why to Use Drip Irrigation?

1) Weed growth is controlled
2) Soil erosion is prevented
3) Each plant gets equal amount of water
4) Save water
5) Prevention from flooding
6) Easy to install and simple to use.

2. DESIGN PROCESS

The steps involved during the design process of the drip irrigation system are shown in figure 2. Two methods can be used during the design process i.e. Top down design and Bottom up method. Top down process design is chosen in our case.
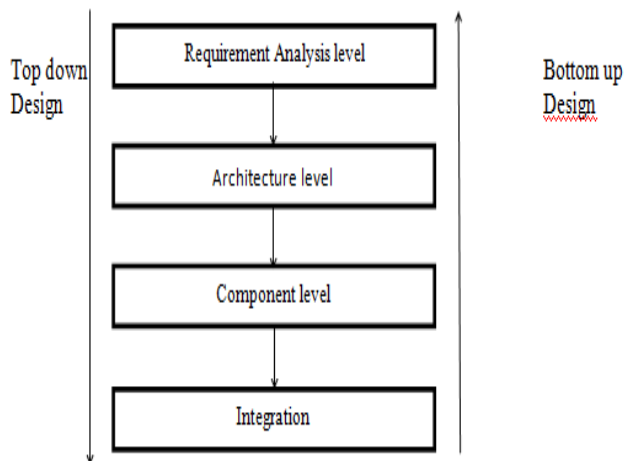

Fig 2: Design process steps using Top down design methodology.

2.1 Requirement Analysis

Requirement analysis is the first stage which gives a basic idea of the drip irrigation system designing process as well as the requirements needed during the implementation of the system in the field area.

Table 1: Requirements in the designing and their descriptions

Requirements	Description
Purpose	Irrigation practices using sensors and controlling water level
Input	Temperature sensors, Moisture sensors, GSM module
Output	GSM module, LCD[16*2] display, Relays, Solenoid valves
Functions	Sensing the moisture & temperature level and controlling water level
Power	12V

2.2 Architecture Level

Architecture level is the second stage, consisting of the planning and the base of the drip irrigation system, giving shape to our work process of third stage i.e. component level. Architecture level mainly explains the function of i) Base Station Unit (BSU) ii) Valve Unit (VU) iii) Sensor Unit (SU) iv) GSM Module. GSM Module sends and

receives the signals, sent and received from the base station. Base station is heart of the system plays an important role of medium between sensor unit and GSM module. The valve unit consists of relays and ON/OFF solenoid valves and water pump.
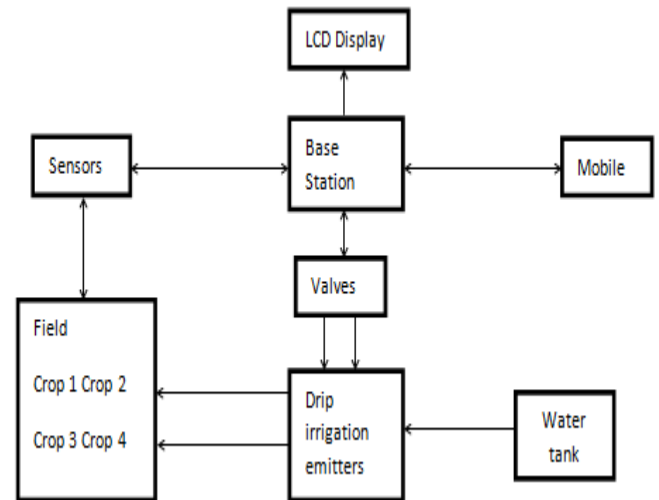

Fig 3: Preparation and planning stage of the drip irrigation system.
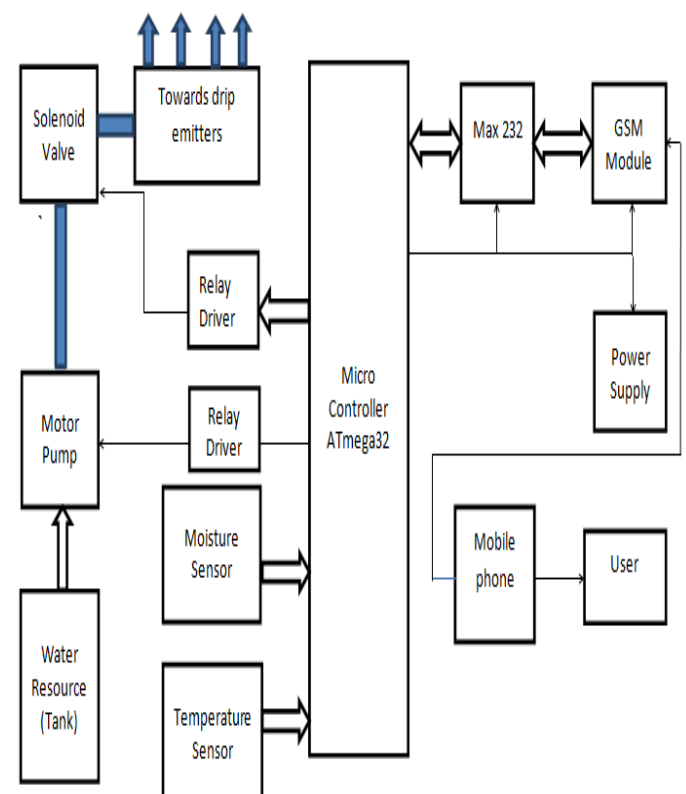
2.3 Component Level

Fig 4: Components used in the drip irrigation system using embedded technology

2.3.1 Moisture and Temperature Sensor

Temperature sensor used us LM35. LM35 ranges from -54 ˚C to 150 ˚C but our motive is to set the temperature of sensor between 25˚C-35 ˚C. Moisture sensor 10HS coded pre-calibrated soil moisture sensor of Decagon which senses the moisture content present in the soil. Moisture sensor used is low power consumption and can reduce 50% of the water consumption [IV]. Whenever the temperature increases above 35 ˚C and the moisture of the soil lowers a message in the form of SMS (Short Message Service) is sent to the GSM module through microcontroller. The measurements of the sensors can be altered as per requirement and the type of crop in the field [V].

2.3.2 Relay

Relay have two main functions i) to be an intermediate between microcontroller and the solenoid valve ii) to switch ON/OFF the solenoid valve and motor pump. Whenever GSM module send SMS for switching ON the water supply the relay interfaced with microcontroller switches ON the solenoid valve as well as the motor pump.

2.3.3 Solenoid Valve

Solenoid valve is an electromechanical ON/OFF device. Solenoid valve controls the pressure and amount of water pumped into the pipes. Relay switch it ON/OFF as per requirement, the benefit of solenoid valves in drip irrigation is that they can be opened and closed depending upon the crop and the water requirement. Mix farming can also be encouraged using solenoid valves for irrigation and drip emitters over root of each crop [V].

2.3.4 Motor Pump

Motor pump is switched ON/OFF through relay and from the water tank the water is released towards the field. The released water passing through the pipes and drip emitters water the root of each crop plant drop by drop. Motor pump used is centrifugal pump, the most efficient water pump which has a capability to pump out water upto 200 feet [VI].

2.4 Integration

Integration involves two main steps: i) interfacing all the components together ii) debugging. The programming done in microcontroller (base station) is in embedded C, in base stations debugging is foremost important. Also, controlling and setting the temperature and moisture parameter in accordance to the crops. LCD display interfaced with the base station for the readings displayed, further the readings sent to base station. Base station, compare the readings with the set parameters and then send further information to the GSM module in form of SMS. The farmer/user then with the help of SMS sends instruction to open/close valves.

3. ADVANTAGES AND FUTURE SCOPE

i)   Saves 50% of the water that is used in flood irrigation [II].
ii) Growth of fungi, mould lessened hence the usage of harmful and strong pesticides and insecticides reduces, which reduces soil and air pollution.
iii) Weed growth reduces to almost zero, usage of weedicides gets reduced.
iv) Recently introduced in Southern-East India where water crisis is higher.
v)   Scope of drip irrigation system is seen in cultivating the cash crops and other horticulture plants like cherry orchards, cardamom, viniculture etc [VIII].

4. CONCLUSION

In this paper we have discussed how drip irrigation would bring revolution in farming techniques. Using least amount of water, improves quality, increasing productivity of crops, making irrigation practices automatic and accurate.

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