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Embedded Controlled Drip Irrigation System

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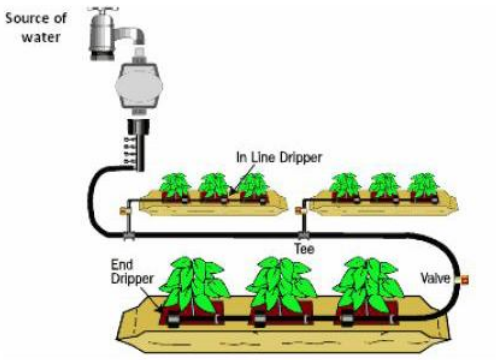
Abstract: ***The conventional irrigation methods like overhead sprinklers, flood type feeding systems usually wet the lower leaves and stem of the plants. The entire soil surface is saturated and often stays wet long after irrigation is completed. Such condition promotes infections by leaf mold fungi. 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. In the developed system the temperature will be measured and it will be displayed for information of further action taken in consideration. Also measure the moisture and display the moisture condition for the further action taken this system help the farmer to save the water as well as reduce effort of the farmer of water control action for the irrigation. According to the parameter reading and this information is given to the embedded system then embedded system will take which valves are closed and which valve will be open.***

Keyword: Irrigation method, plant root, control valve, embedded system

1.1 Introduction:

Drip irrigation helps the freshwater resources in agricultural areas has a crucial importance., because of highly increasing demand for freshwater, optimal usage of water resources has been provided with greater extent by automation technology. Traditional instrumentation based on discrete and wired solutions, presents many difficulties on measuring and control systems especially over the large geographical areas. The developing system describes an application of a wireless sensor network for low-cost wireless controlled irrigation solution and real time monitoring of water content of soil. The obtained irrigation system not only prevents the moisture stress of trees and salification, but also provides an efficient use of fresh water resource. In addition, the developing irrigation method removes the need for workmanship for flooding irrigation. [1]

Agriculture has, throughout History, played a major role in human societies endeavors to be self-sufficient in food. Irrigation is an essential component of crop production in many areas of the world. In cotton for example, recent studies have shown that proper timing of irrigation is an important production factor and that delaying irrigation can result in losses. Automation of irrigation system has the potential to provide maximum water use efficiency by monitoring soil moisture at optimum level. The control unit is the pivotal block of entire irrigation system. It controls the flow of water and therefore enables the grower to acquire optimized results.



Greenhouses form an important part of the agriculture and horticulture sectors in our country as they can be used to grow plants under controlled climatic conditions for optimum production. Automating a greenhouse envisages monitoring and controlling of the climatic parameters which directly or indirectly govern the plant growth and hence their production.

Drip irrigation has its roots in agriculture, where in many parts of the world it was the only option available for harsh climates with limited water supplies. Its development depended on advancements in polyethylene tubing, and its growth was most rapid in arid and drought-plagued regions. Beginning in the late 1960's farmers discovered that by using drip irrigation they could increase yields while lowering water use. The 80's saw drip irrigation making the transition into commercial landscape with mixed success. In today's market, drip irrigation is well-trusted and used extensively in agriculture, and is actively utilize in commercial landscape and residential gardens sites, providing a possible solution to some of our water management problems.[2]

Dripper Water Flow Drip Irrigation is the slow application of water directly to the plants root zone. Maintaining an optimum moisture level in the soil at all times results in less water lost to the sun and the wind. No water is wasted on non-growth areas, and the root zone is maintained at its ideal moisture level, combining the proper balance of water and air for a very efficient irrigation system. Unlike drippers, micro sprinklers throw the water over a wide area, and are designed to be used in areas where drippers are not practical, such as large areas of ground cover or flower beds. Like drippers, micro sprinklers have many of the same benefits . All of these

factors will result in deeper roots and more abundant foliage. The DIG line of low volume irrigation products is the ideal solution for most commercial landscape and residential sites. Low volume irrigation offers some key advantages and benefits to both contractors and home owners.[3]

1.2 Recent Trends and Development in this field:

Recently farmers are thinking about advanced farming techniques to save the money, time and also to increase the quality and the quantity. In the farming different techniques are used.

For Irrigation

- Drip Irrigation System
- Sprinkle irrigation system

For Green House

- Temperature controlling
- Soil Analysis
- Humidity controller

For Robotics In Farming

- For Plugging
- For Cropping

For Fertigation

- To Provide Fertilizers and water

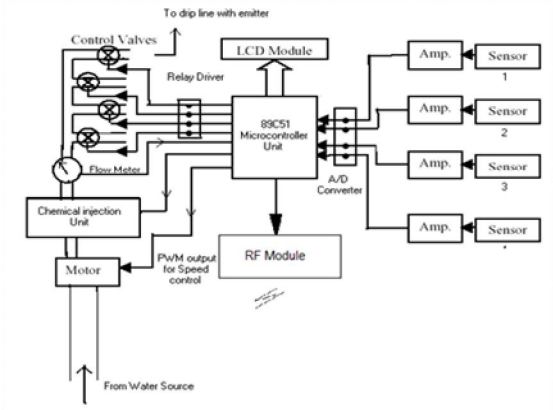
For Chemigation

- To Provide pesticides, Fungicides etc

Due to above mentioned developments and recent trends the farming has been fully atomized and made economical. The manpower required reduced significantly. The quality and the quantity of the products also increased.

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

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. Diseaseand insect damage is reduced because plant foliage stays dry. Operating cost is usually reduced. Federations 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 wetted profile developed in the plant's root zone is as shown in Figure (1). 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 proper amount is applied. Drip irrigation is popular because it can increase yields and decrease both water requirements and labour.



2.1 Methodology:

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 sectionshould 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 micro controller to turn off the relays, which control the valves.

The signal send by the sensor is boosted upto 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.

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 on the receiver side for further analytical studies, through the wireless mode i.e. using RF module connected to the microcontroller unit. Using this technique the data can be transferred to the remote place.So the user can access the data sitting at his Home or Office. While applying the automation on large fields more than one such microcontroller units can be interfacedwirelessly to the Centralized Computer.

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.

2.2 Project Specification:

1. All the components will work on the +5v power supply.
2. 16-bit/32-bit ARM7TDMI-S microcontroller in a tiny LQFP64 package.
3. 8 kB to 40 kB of on-chip static RAM and 32 kB to 512 kB of on-chip flash memory.
4. RF module will operate on the 2400-2483.5 MHz ISM/SRD band systems.
5. It has High sensitivity (–104 dBm at 2.4 kBaud)
6. RF module has Flexible support for packet oriented systems: On-chip support for sync word detection, address check, flexible packet length, and automatic CRC handling.

3.1 Hardware Description:

The ARM7TDMI-S LPC2148 processor also employs a unique architectural strategy known as THUMB, which makes it ideally suited to high-volume applications with memory restrictions, or applications where code density is an issue. The key idea behind THUMB is that of a super-reduced instruction set. Essentially, the ARM7TDMI-S processor has two instruction sets:

- The standard 32-bit ARM instruction set.
- A 16-bit THUMB instruction set.

The THUMB set‘s 16-bit instruction length allows it to approach twice the density of standard ARM code while retaining most of the ARM‘s performance advantage over a traditional 16-bit processor using 16-bit registers. This is possible because THUMB code operates on the same 32-bit register set as ARM code.

3.2 Processor Description:

- ARM is one of the most licensed and thus widespread processor cores in the world
- Used especially in portable devices due to low power consumption and reasonable performance (MIPS / watt)
- Several interesting extensions available or in development like
- Thumb instruction set and Gazelle Java machine
- Processor cores: ARM6, ARM7, ARM9, ARM10, ARM11

3.2 Sensors

3.2.1 LM 35 Temperature sensorSpecifications:

- Calibrated directly in ° Celsius (Centigrade)
- Linear + 10.0 mV/°C scale factor
- 0.5°C accuracy guarantee (at +25°C)
- Rated for full −55° to +150°C range
- Suitable for remote applications.
- Operates from 4 to 30 volts
- Low impedance output, 0.1 W for 1 mA load

3.2.2 Moisture sensorSpecifications:

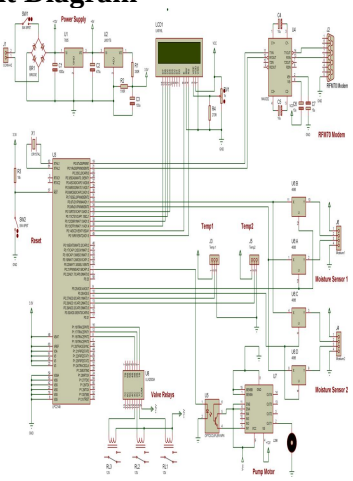
- Detection- 0 to 100% saturation
- Analog output- 4 to 20 mA% saturation, temperature of oil, RH Alarm
- Power- 12 to 30V DC < 1 watt
- Maximum fluid pressure- 10Bar (145psi)
- Fluid temperature- 40 to 100°C (-40 to 212°f)

3.3 Relay Driver (ULN2803)

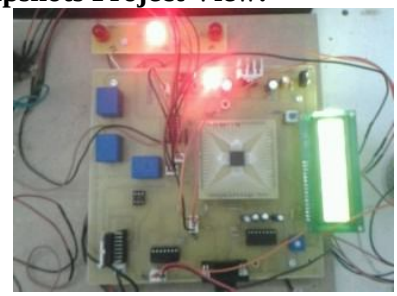
The eight NPN Darlington connected transistors in this family of arrays are ideally suited for interfacing between low logic level digital circuitry (such as TTL, CMOS or PMOS/NMOS) and the higher current/voltage requirements of lamps, relays, printer hammers or other similar loads for a broad range of computer, industrial, and consumer applications. All devices feature open–collector outputs and freewheeling clamp diodes for transient suppression.

The ULN2803 is designed to be compatible with standard TTL families while the ULN2804 is optimized for 6 to 15 volt high level CMOS or PMOS.

4.1.Circuit Diagram



4.2 Snapshots Project View:



2.

5.1 Software:

5.2 Software Detail

The programming in C language that will convert in assembly using keilsoftware.It is basically used for coding of controller.

5.2.1 Introduction to Keil Micro Vision (IDE)

Keil an ARM Company makes C compilers, macro assemblers, real-time kernels, debuggers, simulators, integrated environments, evaluation boards, and emulators for ARM7/ARM9/Cortex-M3, XC16x/C16x/ST10, 251, and 8051 MCU families. Keil development tools for the 8051 Microcontroller Architecture support every level of software developer from the professional applications engineer to the student just learning about embedded software development. When starting a new project, simply select the microcontroller you use from the Device Database and the µVision IDE sets all compiler, assembler, linker, and memory options for you.Keil is a cross compiler. So first we have to understand the concept of compilers and cross compilers. After then we shall learn how to work with keil.

5.2 Flowchart of the system:

Flow chart shown in fig.6 shows flowchart of the system. First block is initialization of the system. Then read the parameters if soil moisture contains less than the threshold the it indicates the requirement of the water for plants. Then turn on water supply from the particular valve.

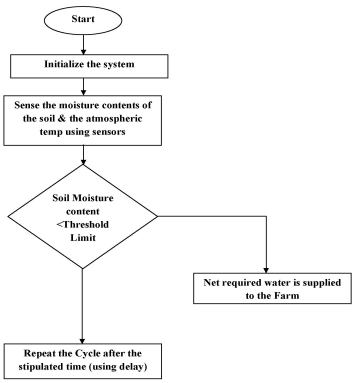


Fig 6. Flowchart of system

6.2 Advantages And Disadvantages:

6.2.1 Advantages

1. The Automized Drip Irrigation system is relatively simple to design and install. This system is very useful to all climatic conditions any it is economic friendly. This system makes increase in productivity and reduces water consumption. It is safest and no manpower is required after the system installation. Permits other yard and garden work to continue when irrigation is taking place, as only the immediate plant areas are wet.The drip system reduces soil erosion.

6.2.2 Disadvantages

This system is only applicable for large size farms. It requires frequent maintenance for efficient operation.There are temporary installations and must be expanded or adjusted to the drip line as plants grow.This system has limited life after installation due to the deterioration of the plastic components in a hot, arid climate when exposed to ultraviolet light.

7.1 Results:

7.1.1 System Initiation:

At the time of initialize the system it shows the following display.

7.1.2 Moisture and Temperature Values Indication (In Percentage):

Conclusion:

The Microcontroller based automizeddrip irrigation systemusing wireless technique 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 cansave manpower, water to improve production and ultimately profit. The developed irrigation automation system can beproposed to be used in several commercial agricultural productions since it was obtained in low cost and in reliable operation. This application of sensor-based site- Specific irrigation has some advantages such as preventing moisture stress of trees, diminishing of excessive water usage, ensuring of rapid growing weeds and derogating salification. If different kinds of sensors (that is, temperature, humidity, and etc.) are involved in such irrigation in future works, it can be said that an internet based remote control of irrigation automation will be possible. The developed system can also transfer fertilizer and the other agricultural chemicals (calcium, sodium, ammonium, zinc) to the field with adding new sensors and valves.

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