"WATER IRRIGATION SYSTEM"

Submitted in partial fulfilment of the

Requirements for the award of the degree of

BACHELOR OF TECHNOLOGY

IN

ELETRONIC COMMUNICATION Engineering

By

NAME	REG NO.	ROLL NO
KIMMI RANI	EC0405/13	13 EC0404
PRIYANKA KUMARI	EC0408/13	13 EC0407
SHREYA KAVITA	EC0412/13	13 EC0413
SHANTI KUMARI	ECL598/14	13 ECL0595
AMIT KUMAR	ECL596/14	13 ECL0593

Under The Guidance of

Prof. RAKHI RANI

ASSISTANT PROFESSOR

DEPARTMENT OF ECE Eng.

NILAI EDUCATIONAL TREST'S GROUP

OF INSTITUTIONS

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NILAI EDUCATIONAL TRUST'S GROUP

OF INSTITUTIONS

THAKURGAON

RANCHI, JHARKHAND

CERTIFICATE

This is to certify that the work presented in the dissertation entitled *"WATER IRRIGATION SYSTEM"* in partial fulfilment of the requirement of the award of degree of Bachelor of Technology in ECE ENGINEERING of NILAI EDUCATIONAL TRUST'S GROUP OF INSTITUTIONS *is an authentic work carried out by*

NAME	REG.NO.	ROLL NO.
SHREYA KAVITA	EC0412/13	13EC0413

Under supervision and guidance of Prof. RAKHI RANI. To the best of my knowledge, the content of this dissertation does not from a basis of the award of any previous degree to anyone else.

Rakhi Rani
Guide

Rakhi Rani
H.O.D.

Principal

External Examiner

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CONTENT

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DECLARATION

We do hereby declare that the Project Report entitled, *"WATER IRRIGATION SYSTEM* being submitted to NILAI EDUCATIONAL TRUST'S GROUP OF INSTITUTIONS in partial fulfilment of the requirements for award of the degree of BACHELOR OF TECHNOLOGY in ECE ENGINEERING is of our own.

Further, we declare that it has not been submitted earlier to any institution for award of any degree.

KIMMI RANI

PRIYANKA KUMARI

SHREYA KAVITA

SHANTI KUMARI

AMIT KUMAR

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ACKNOWLEDGMENT

Completing a job has never been an easy go for a single person. Often it is the result of invaluable contributions from our mentor, friends.

At the outset, we convey my deep gratitude to my guide and supervisor prof. R VIKTH RANI for his learned tips and wise counsel to improvise upon the thesis.

Exchange of ideas generates a new object to work in a better way apart of the ability, labour and time guidance and co-operation at the two pillars for the success of this project. Whenever a person is helped and co-operated by others, his heart is bound to pay gratitude to them.

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Finally we think all our friends and peers who have been instrumental in successful completion of the work.

We deliberate my profound sense of gratitude to him.

KIMMI RANI

PRIYANKA KUMARI

SHREYA KAVITA

SHANTI KUMARI

AMIT KUMAR

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ABSTRACT

In the field of agriculture, use of proper method of irrigation is important and it is well known that irrigation by drip is very economical and efficient. In the conventional drip irrigation system, the farmer has to keep watch on irrigation timetable, which is different for different crops. The project makes the irrigation automated. With the use of low cost sensors and the simple circuitry makes these project a low cost product, which can be bought even by a poor farmer. This project is best suited for places where water is scares and has to be used in limited quantity. Also, third world countries can afford this simple and low cost solution for irrigation and obtain good yield on Crops. The heart of the project is the Intel 89c2051microcontroller. The humidity sensors are constructed using aluminum sheets and housed in easily available materials. The aim is to use the readily available material to construct low cost sensors. Five relays are controlled by the microcontroller through the transistor BC547. One relay is used to shut-off
the main motor which is used to pump the water to the field.

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INTRODUCTION

Water is a very precious resource and must be properly utilized. Agriculture is one of those areas which consume a lot of water. Irrigation is a time consuming process and must be done on a timely basis.

The aim of the article is to develop an auto irrigation system which measures the moisture of the soil and automatically turns on or off the water supply system.

The project requires very less human involvement once installed. The circuit is based on 8051 microcontroller and also a soil moisture sensor.

A properly configured soil moisture sensor can save up to 60 percent of water used in irrigation. The designed system can be used in turf grass or with small garden plants.

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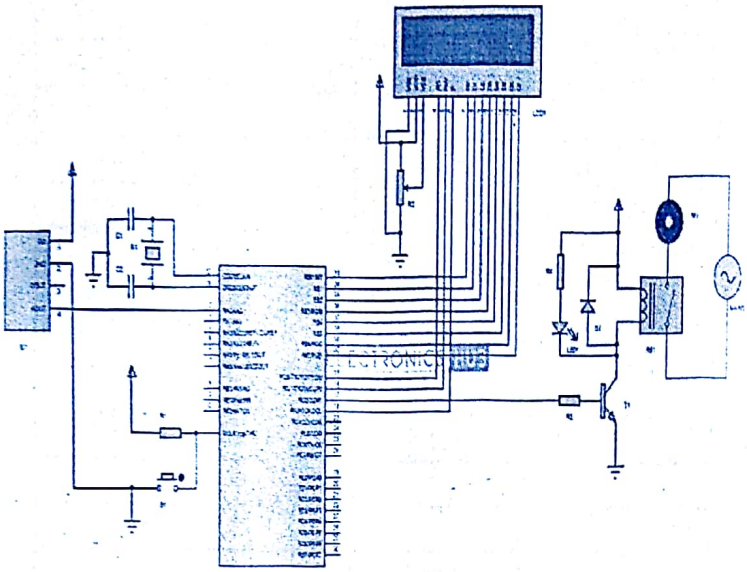
Circuit Diagram



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Components Required

Component	*Part No / Value / Keyword*
IC1	and digital out)
IC2	PIC 16F877A Microcontroller
X1	12 MHz Crystal Oscillator
C1 and C2	33 pF
R1	4.7 KΩ
R2	10 KΩ Pot
R3	2.2 KΩ
R4	1 KΩ
B1	Push Button
T1	BC547
D1	1N4007
RE1	12V Relay (JQC-3F)
LED1	Red LED
M1	Motor
LCD1	16X2 LCD Display

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Component Description

8051 MICROCONTROLLER

The Intel 8051 microcontroller is one of the most popular general purpose microcontrollers in use today. The Intel 8051 is an 8-bit microcontroller which means that most available operations are limited to 8 bits. There are 3 basic "sizes" of the 8051: Short, Standard, and Extended. The Short and Standard chips are often available in DIP (dual in-line package) form, but the Extended 8051 models often have a different form factor, and are not "drop-in compatible".

All these things are called 8051 because they can all be programmed using 8051 assembly language, and they all share certain features (although the different models all have their own special features).

Some of the features that have made the 8051 popular are:

- 64 KB on chip program memory.
- 128 bytes on chip data memory (RAM).
- 4 register banks.
- 128 user defined software flags.
- 8-bit data bus
- 16-bit address bus
- 32 general purpose registers each of 8 bits
- 16 bit timers (usually 2, but may have more, or less).
- 3 internal and 2 external interrupts.
- Bit as well as byte addressable RAM area of 16 bytes.
- Four 8-bit ports. (short models have two 8-bit ports).
- 16-bit program counter and data pointer.

TYPICAL APPLICATIONS

8051 chips are used in a wide variety of control systems, telecom applications, and robotics as well as in the automotive industry. By some

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estimation, 8051 family chips make up over 50% of the embedded chip market.

PIN DIAGRAM

The 8051 microcontroller consists of 40 pins. These pins are well represented by the pin-diagram below. A further detailed description of these pins and their functions is given in the following sections.

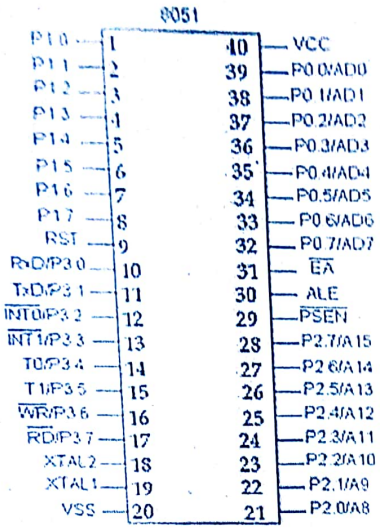

Figure 5.2.a.(i) Pin Diagram of 8051 Microcontroller

Pins 1-8: Each of these pins can be configured as an input or an output.

Pin 9: *RST* A logic one on this pin disables the microcontroller and clears the contents of most registers. In other words, the positive voltage on this pin resets the microcontroller. By applying logic zero to this pin, the program starts execution from the beginning.

Pins10-17: *Port 3* Similar to port 1, each of these pins can serve as general input or output. Besides, all of them have alternative functions:

Pin 10: *RXD* Serial asynchronous communication input or Serial synchronous communication output.

Pin 11: *TXD* Serial asynchronous communication output or Serial synchronous communication clock output.

Pin 12: *INT0* Interrupt 0 inputs.

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Pin 13: *INT1* Interrupt 1 input.

Pin 14: *T0* Counter 0 clock input.

Pin 15: *T1* Counter 1 clock input.

Pin 16: *WR* Write to external (additional) RAM.

Pin 17: *RD* Read from external RAM.

Pin 18, 19: *X2, X1* Internal oscillator input and output. A quartz crystal which specifies operating frequency is usually connected to these pins. Instead of it, miniature ceramics resonators can also be used for frequency stability. Later versions of microcontrollers operate at a frequency of 0 Hz up to over 50 Hz.

Pin 20: *GND* Ground.

Pin 21-28: *Port 2* If there is no intention to use external memory then these port pins are configured as general inputs/outputs. In case external memory is used, the higher address byte. i.e. addresses A8-A15 will appear on this port. Even though memory with capacity of 64Kb is not used, which means that not all eight port bits are used for its addressing, the rest of them are not available as inputs/outputs.

Pin 29: *PSEN* If external ROM is used for storing program then a logic zero (0) appears on it every time the microcontroller reads a byte from memory.

Pin 30: *ALE* Prior to reading from external memory, the microcontroller puts the lower address byte (A0-A7) on P0 and activates the ALE output. After receiving signal from the ALE pin, the external register (usually 74HCT373 or 74HCT375 add-on chip) memorizes the state of P0 and uses it as a memory chip address. Immediately after that, the ALU pin is returned its previous logic state and P0 is now used as a Data Bus. As seen, port data multiplexing is performed by means of only one additional (and cheap) integrated circuit. In other words. this port is used for both data and address transmission.

Pin 31: *EA* By applying logic zero to this pin. P2 and P3 are used for data and address transmission with no regard to whether there is internal memory or not. It means that even there is a program written to the microcontroller. it will not be executed. Instead. the program written to external ROM will be executed. By applying logic one to the EA pin, the microcontroller will use both memories. first internal then external (if exists).

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Pin 32-39: *Port 0* Similar to P2, if external memory is not used, these pins can be used as general inputs/outputs. Otherwise, P0 is configured as address output (A0-A7) when the ALE pin is driven high (1) or as data output (Data Bus) when the ALE pin is driven low (0).

Pin 40: VCC +5V power supply.

INPUT AND OUTPUT PORTS (I/O PORTS)

All 8051 microcontrollers have 4 I/O ports each comprising 8 bits which can be configured as inputs or outputs. Accordingly, in total of 32 input/output pins enabling the microcontroller to be connected to peripheral devices are available for use.

Pin configuration, i.e. whether it is to be configured as an input (1) or an output (0), depends on its logic state. In order to configure a microcontroller pin as an input, it is necessary to apply a logic zero (0) to appropriate I/O port bit. In this case, voltage level on appropriate pin will be 0.

Similarly, in order to configure a microcontroller pin as an input, it is necessary to apply a logic one (1) to appropriate port. In this case, voltage level on appropriate pin will be 5V (as is the case with any TTL input). This may seem confusing but don't loose your patience. It all becomes clear after studying simple electronic circuits connected to an I/O pin.

Port 0

The P0 port is characterized by two functions. If external memory is used then the lower address byte (addresses A0-A7) is applied on it. Otherwise, all bits of this port are configured as inputs/outputs. The other function is expressed when it is configured as an output. Unlike other ports consisting of pins with built-in pull-up resistor connected by its end to 5 V power supply,pins of this port have this resistor left out. This apparently small difference has its consequences. If any pin of this port is configured as an input then it acts as if it "floats". Such an input has unlimited input resistance and undetermined potential.

When the pin is configured as an output, it acts as an "open drain". By applying logic 0 to a port bit, the appropriate pin will be connected to ground (0V). By applying logic 1, the external output will keep on "floating". In order to apply logic 1 (5V) on this output pin, it is necessary to built in an external pull-up resistor.

Port 1

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P1 is a true I/O port, because it doesn't have any alternative functions as is the case with P0, but can be configured as general I/O only. It has a pull-up resistor built-in and is completely compatible with TTL circuits.

Port 2

P2 acts similarly to P0 when external memory is used. Pins of this port occupy addresses intended for external memory chip. This time it is about the higher address byte with addresses A8-A15. When no memory is added, this port can be used as a general input/output port showing features similar to P1.

Port 3

All port pins can be used as general I/O, but they also have an alternative function. In order to use these alternative functions, a logic one (1) must be applied to appropriate bit of the P3 register. In terms of hardware, this port is similar to P0, with the difference that its pins have a pull-up resistor built-in.

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INTERNAL BLOCK DIAGRAM OF 8051 MICROCONTROLLER

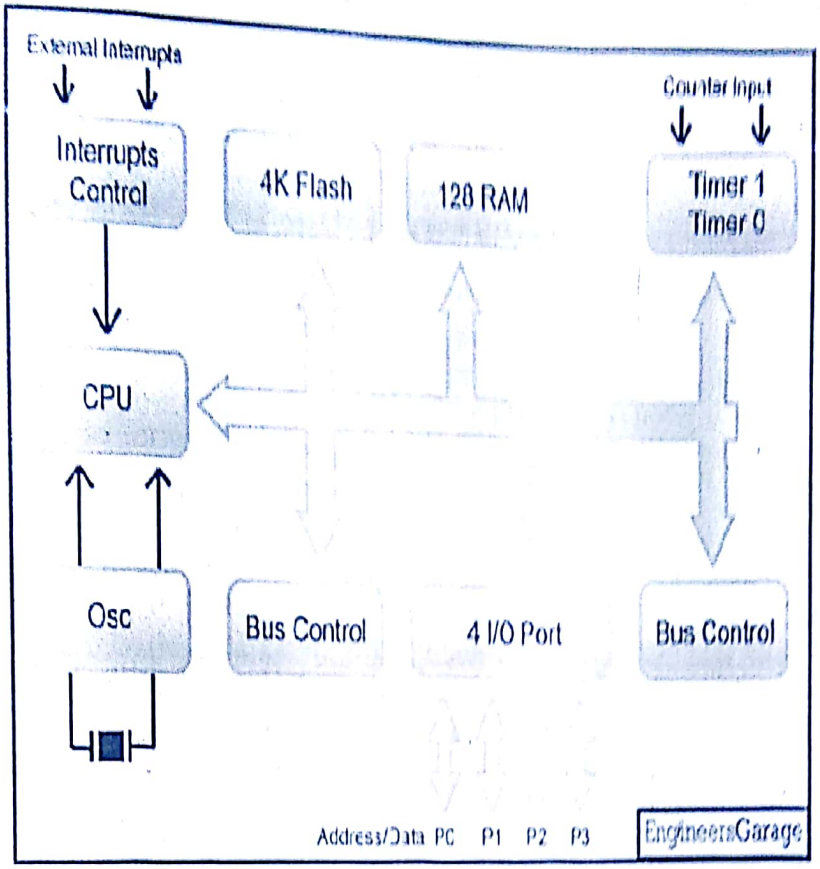

Figure 5.2.c.(i) Internal block diagram of 8051 Microcontroller

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MEMORY ARCHITECTURE

The 8051 has two types of memory and these are Program Memory and Data Memory. Program Memory (ROM) is used to permanently save the program being executed, while Data Memory (RAM) is used for temporarily storing data and intermediate results created and used during the operation of the microcontroller. Depending on the model in use (we are still talking about the 8051 microcontroller family in general) at most a few Kb of ROM and 128 or 256 bytes of RAM is used.

All 8051 microcontrollers have a 16-bit addressing bus and are capable of addressing 64 kb memory. It is neither a mistake nor a big ambition of engineers who were working on basic core development. It is a matter of smart memory organization which makes these microcontrollers a real "programmers' goody".

Program Memory

The first models of the 8051 microcontroller family did not have internal program memory. It was added as an external separate chip. These models are recognizable by their label beginning with 803 (for example 8031 or 8032). All later models have a few Kbyte ROM embedded. Even though such an amount of memory is sufficient for writing most of the programs, there are situations when it is necessary to use additional memory as well. A typical example are so called lookup tables. They are used in cases when equations describing some processes are too complicated or when there is no time for solving them. In such cases all necessary estimates and approximates are executed in advance and the final results are put in the tables (similar to logarithmic tables).

Data Memory

As already mentioned, Data Memory is used for temporarily storing data and intermediate results created and used during the operation of the microcontroller. Besides, RAM memory built in the 8051 family includes many registers such as hardware counters and timers, input/output ports, serial data buffers etc. The previous models had 256 RAM locations, while for the later models this number was incremented by additional 128 registers. However, the first 256 memory locations (addresses 0-FFh) are the heart of memory common to all the models belonging to the 8051 family. Locations available to the user occupy memory space with addresses 0-7Fh, i.e. first 128 registers. This part of RAM is divided in several blocks.

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The first block consists of 4 banks each including 8 registers denoted by R0-R7. Prior to accessing any of these registers, it is necessary to select the bank containing it. The next memory block (address 20h-2Fh) is bit-addressable, which means that each bit has its own address (0-7Fh). Since there are 16 such registers, this block contains in total of 128 bits with separate addresses (address of bit 0 of the 20h byte is 0, while address of bit 7 of the 2Fh byte is 7Fh). The third group of registers occupy addresses 2Fh-7Fh, i.e. 80 locations, and does not have any special functions or features.

Additional RAM

In order to satisfy the programmers' constant hunger for Data Memory, the manufacturers decided to embed an additional memory block of 128 locations into the latest versions of the 8051 microcontrollers. However, it's not as simple as it seems to be... The problem is that electronics performing addressing has 1 byte (8 bits) on disposal and is capable of reaching only the first 256 locations.

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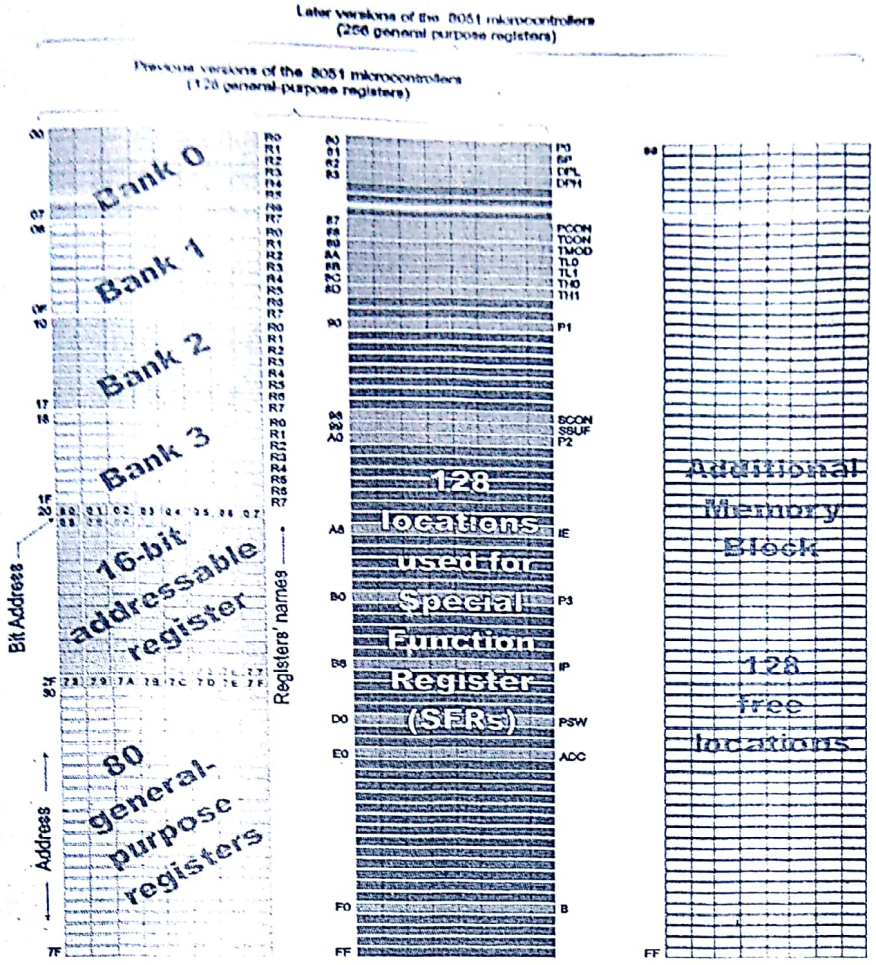

Figure 5.2.d. Memory Banks in 8051 Microcontroller

Addressing

While operating, the processor processes data as per program instructions. Each instruction consists of two parts. One part describes WHAT should be done, while the other explains HOW to do it. The latter part can be a data (binary number) or the address at which the data is stored. Two ways of addressing are used for all 8051 microcontrollers depending on which part of memory should be accessed:

Direct Addressing

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On direct addressing, the address of memory location containing data to be read is specified in instruction. The address may contain a number being changed during operation (variable). For example:

Since the address is only one byte in size (the largest number is 255), only the first 255 locations of RAM can be accessed this way. The first half of RAM is available for use, while another half is reserved for SFRs.

MOV A,33h; Means: move a number from address 33 hex. to accumulator

Indirect Addressing

On indirect addressing, a register containing the address of another register is specified in instruction. Data to be used in the program is stored in the letter register. For example:

Indirect addressing is only used for accessing RAM locations available for use (never for accessing SFRs). This is the only way of accessing all the latest versions of the microcontrollers with additional memory block (128 locations of RAM). Simply put, when the program encounters instruction including "@" sign and if the specified address is higher than 128 (7F hex.), the processor knows that indirect addressing is used and skips memory space reserved for SFRs.

MOV A,@R0; Means: Store the value from the register whose address is in the R0 register

into accumulator

On indirect addressing, registers R0, R1 or Stack Pointer are used for specifying 8-bit addresses. Since only 8 bits are avilable, it is possible to access only registers of internal RAM this way (128 locations when speaking of previous models or 256 locations when speaking of latest models of microcontrollers). If an extra memory chip is added then the 16-bit DPTR Register (consisting of the registers DPTRL and DPTRH) is used for specifying address. In this way it is possible to access any location in the range of 64K.

Special Function Registers (SFRs)

Special Function Registers (SFRs) are a sort of control table used for running and monitoring the operation of the microcontroller. Each of these registers as well as each bit they include, has its name, address in the scope of RAM and precisely defined purpose such as timer control, interrupt control, serial communication control etc. Even though there are

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128 memory locations intended to be occupied by them, the basic core shared by all types of 8051 microcontrollers has only 32 such registers. Rest of locations intentionally left unoccupied in order to enable the manufacturers to further develop microcontrollers keeping them compatible with the previous versions. It also enables programs written a long time ago for microcontrollers which are out of production now to be used today.

A Register (Accumulator)

A register is a general-purpose register used for storing intermediate results obtained during operation. Prior to executing an instruction upon any number or operand it is necessary to store it in the accumulator first.

All results obtained from arithmetical operations performed by the ALU are stored in the accumulator. Data to be moved from one register to another must go through the accumulator. In other words, the A register is the most commonly used register and it is impossible to imagine a microcontroller without it. More than half instructions used by the 8051 microcontroller use somehow the accumulator.

B Register

Multiplication and division can be performed only upon numbers stored in the A and B registers. All other instructions in the program can use this register as a spare accumulator (A).

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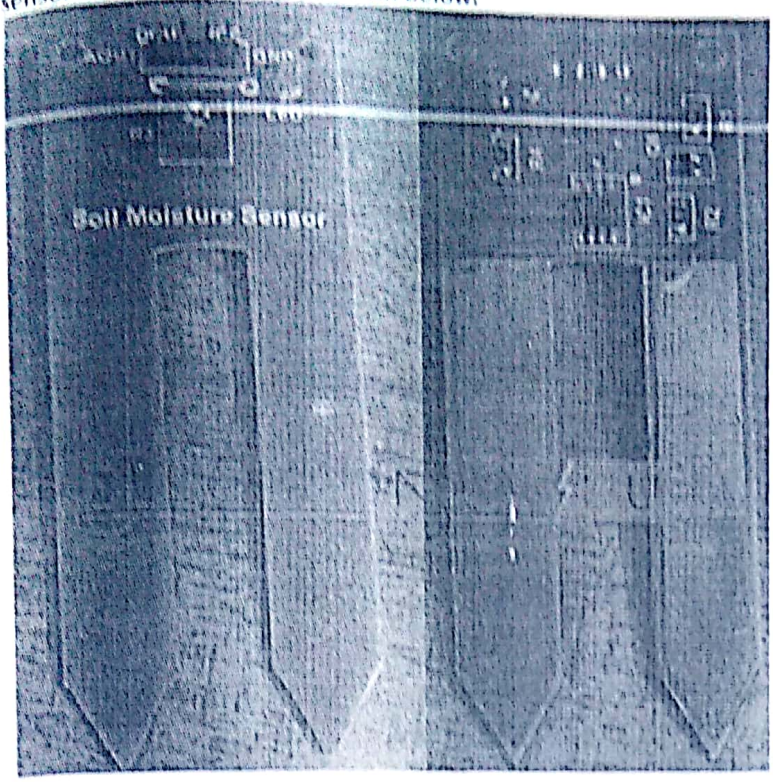
Soil Moisture Sensor Module

A soil moisture sensor is used to measure the volumetric water content of soil. The sensor used in the project is shown below.



It consists of two prongs, which must be inserted in the soil, an LM358, which acts as a comparator and a pot to change the sensitivity of the sensor.

If the soil moisture sensor is not available, the following circuit can be used as an alternative. The circuit shown below has a fixed sensitivity.

This can be changed by implementing a pot in place of one of the resistors connected to the non-inverting terminal of the comparator.

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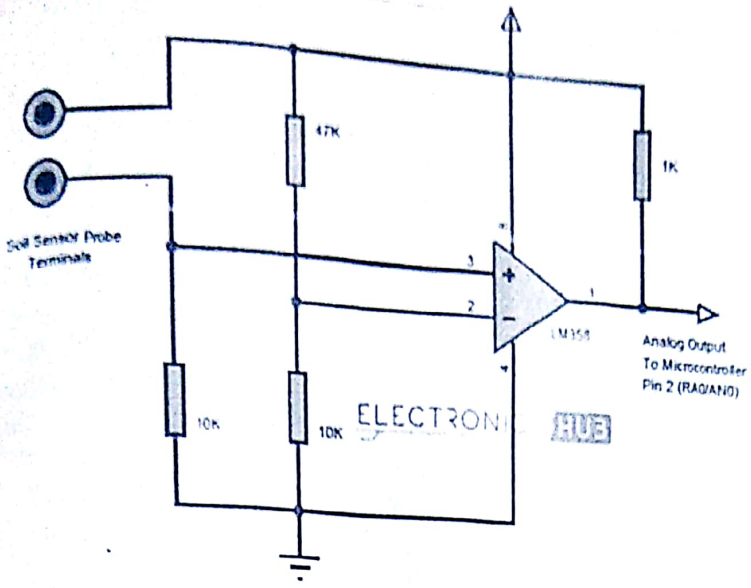

Circuit Design of Auto Irrigation System using Soil Moisture Sensor

The aim of the project is to control a motor based on the moisture in the soil. The design of the circuit is as follows. 8051 is the main processing IC.A 11.0592 MHz crystal oscillator is connected across OSC1 and OSC2 (Pins 18 and 19). The crystal is connected with two 33pF capacitors.

The Master Clear pins is normally connected to Vcc via a pull-up resistor. A bypass button is connected to ground. This button is used to reset the microcontroller.The output of the soil moisture sensor is given to P1.1 (Pin 2) of the 8051 microcontroller.

An LCD is used to display the key messages. The data pins of the LCD are connected to Port B of the 8051 (Pins 33 – 40). The control pins of the LCD are connected to the Port C.

The connections are as follows: RS pin of LCD to RC0 (Pin 15) of 8051, RW to RC1 (Pin 16) and E to RC3 (Pin 18).

In order to drive the relay which is connected to the motor, a transistor is used. The input to the transistor is given from RC2 (Pin 17) of 8051 microcontroller.

One terminal of the relay coil is supplied with a 12 V DC. The other end of the coil is connected to the collector of the transistor. The contacts of the relay are given to the motor and AC supply.

An LED is connected between the DC supply and the collector and glows only when the motor is running.

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Working of the Circuit

The idea of the project is to implement an automatic irrigation system by sensing the moisture of the soil. The working of the circuit is as follows.

The soil moisture sensor is inserted in the soil. Depending on the quality of the sensor, it must be inserted near the roots of the plant. The soil moisture sensor measures the conductivity of the soil.Wet soil will be more conductive than dry soil. The soil moisture sensor module has a comparator in it.The voltage from the prongs and the predefined voltage are compared and the output of the comparator is high only when the soil condition is dry.This output from the soil moisture sensor is given to the analogue input pin (Pin 2 – RA0) of the microcontroller. The microcontroller continuously monitors the analogue input pin.

When the moisture in the soil is above the threshold, the microcontroller displays a message mentioning the same and the motor is off.When the output from the soil moisture sensor is high i.e. the moisture of the soil is less. This will trigger the microcontroller and displays an appropriate message on the LCD and the output of the microcontroller, which is connected to the base of the transistor is high.When the transistor is turned on, the relay coil gets energized and turns on the motor. The LED is also turned on and acts as an indicator.When the moisture of the soil reaches the threshold value, the output of the soil moisture sensor is low and the motor is turned off.The system is also designed to warn when the moisture is very high than the threshold and the soil is too wet, which is dangerous for the plant.

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Applications

- The circuit can be used to measure the loss of moisture in the soil over time due to evaporation and intake.
- Minimizes water waste and improves plant growth.
- The circuit is designed to work automatically and hence, there is no need for any human intervention.
- The project is intended for small gardens and residential environment. By using advanced soil moisture sensor, the same circuit can be expanded to large agricultural fields.

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Conclusion

The 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 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

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```
#include<regx51.h>
#include<lcd.h>
#include<delay.h>
void main()
{
    while(1)
    {

    if (P1_1==1&&P1_2==1) // wet state
    {

        P3_3=0;  // red led
        P3_2=1; //green led
        P3_5=0;
        P3_4=0;// Buzzer on

            while(P1_1==1&&P1_2==1); // dry state
    }
    if (P1_1==0&&P1_2==0)// Normal state
    {

        P3_3=1;// red led
        P3_2=0;//green led
        P3_4=0; // Buzzer off
        P3_5=0;
```

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```
            while(P1_1==0&&P1_2==0); // wet state
        }
if(P1_1==1&&P1_2==0)// dry state soil & water
        {

            P3_3=1;// red led
            P3_2=0;//green led
            P3_4=1; // Buzzer off
            P3_5=1;
            while(P1_1==1&&P1_2==0); // wet state
        }
if(P1_1==0&&P1_2==1)// Normal state soil & water
        {

            P3_3=1;// red led
            P3_2=0;//green led
            P3_4=0; // Buzzer off
            P3_5=1;
            while(P1_1==0&&P1_2==1); // wet state
    }}}
```

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