SMART IRRIGATION SYSTEM

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BONAFIDE CERTIFICATE

Certified that this project report entitled "**SMART IRRIGATION SYSTEM"** is a bonafide work of ANIRUDH.R(20BEC1276),PEMMAREDDY SREEVARDHAN(20BEC1251),SUKRITDEBNATH(20BEC1079),ANNAMBAKA HARIKA (20BEC1119) who carried out the Project work under my supervision and guidance.

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ABSTRACT

Water is becoming increasingly valuable as a result of the lack of clean water for residential purposes, including irrigation. The need for a method to establish water discussion is urgent in order to maximise the usage of water. Additionally, in order to optimise water utilisation, eliminate water waste, and incorporate current technology in agricultural systems, automation in agricultural systems is required. Soil moisture sensor is a new technology that measures the moisture content of the soil and, with the right mechanism, allows water to be irrigated based on that moisture content. The use of an automated irrigation system allows for the flow or cessation of water to the plants. The device is made up of an Arduino board, which is a microcontroller that controls the water pump and the Rotating Platform Sprinkler that delivers water to the plants. Pumping water is accomplished with the help of a submersible motor pump. This device has a low power usage and can pump up to 100 litres of water per hour. Depending on the amount of water consumed, necessary tunings for pumping and supplying water are made.

The production of food goods is hampered by a shortage of rainwater, scarcity of water in reservoirs, and ineffective water conservation methods. This inspires us to conduct considerable study on water conservation in agriculture. Wireless sensor networks have made it possible to detect a variety of elements such as soil moisture, temperature, and humidity. We can save water for irrigation by putting sensors in farm fields to monitor. This project describes the Automated Irrigation System with Soil Moisture Sensor in detail. The moisture content data is updated in the proposed system to regulate the water pump.

`ACKNOWLEDGEMENT

We wish to express our sincere thanks and deep sense of gratitude to our project guide, **Dr. Vigneswaran T,** Associate Professor Senior, School of Electronics Engineering, for his consistent encouragement and valuable guidance offered to us in a pleasant manner throughout the course of the project work.

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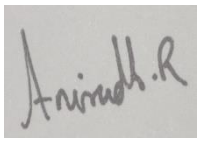
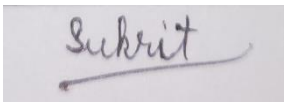
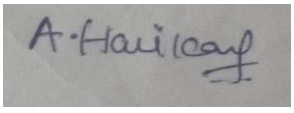
We thank our parents, family, and friends for bearing with us throughout the course of our project and for the opportunity they provided us in undergoing this course in such a prestigious institution



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1.INTRODUCTION

1.1 OBJECTIVES AND GOALS

- Design the automatic irrigation system Smart that can optimize water levels based on things such as soil moisture .
- Design an irrigation system which switches motor ON or OFF for a certain period of time based on the moisture content of the soil.
- Design the irrigation system using 8051 microcontroller developer kit and moisture sensor.

1.2 BENEFITS

- The main advantage of smart irrigation system is its ability to save water.
- One of the advantag is to help agricultural crop growth, landscape maintenance, reduce the effect of inadequate rainfall .
- It is to reduce human interference and ensure proper irrigation.

1.3 FEATURES

- For the monitoring and controlling the water pump , soil moisture sensor is used.
- This system is used for monitoring and controlling the water pump .
- Soil moisture sensor to detect moisture level of the soil.
- Microcontroller used is Texas Instruments low-cost low power controller named as 8051.
- The efficient coding in the software tool called as Keil µVision 5.

2. RELATED WORKS:

There are many related works. we can enlist them as follows:

- Smart Irrigation System Using Edge Computing and IoT.
- Smart irrigation system based on weather conditions.

3. SMART IRRIGATION SYSTEM

3.1 BRIEF DESCRIPTION OF WORKING PRINCIPLE

A microprocessor and a soil moisture sensor are used in the circuit. A correctly set soil moisture sensor can save up to 60% of irrigation water. The developed method can be employed with tiny garden plants or turf grass.

The goal of the project is to install an autonomous irrigation system that detects soil moisture. The circuit's operation is as follows:

The soil moisture sensor is placed in the ground. The sensor must be implanted near the plant's roots, depending on its quality. The conductivity of the soil is measured by the soil moisture sensor. Wet soil will carry electricity better than dry dirt. A comparator is included in the soil moisture sensor module.

The voltage from the prongs is compared to a predetermined voltage, and the comparator's output is high only when the soil is dry. The microcontroller's analogue input pin (Pin 2 – RA0) receives the output from the soil moisture sensor. The analogue input pin is constantly monitored by the microcontroller.

The microcontroller shows a message indicating that the moisture in the soil has exceeded the threshold, and the motor is turned off.

When the soil moisture sensor output is high, the soil moisture is low. This activates the microcontroller and displays an appropriate message on the LCD, and the microcontroller's output, which is connected to the transistor's base, is high.

When the transistor is activated, the relay coil is energised, which causes the motor to turn on. The LED is also activated and serves as an indicator. When the moisture level in the soil reaches the threshold, the output of the soil moisture sensor drops and the motor is turned off.

The system is also intended to warn when the moisture level exceeds the threshold and the soil becomes too wet, which is hazardous to the soil.

We have used the circuit diagram below as a reference circuit diagram in order to implement this project.

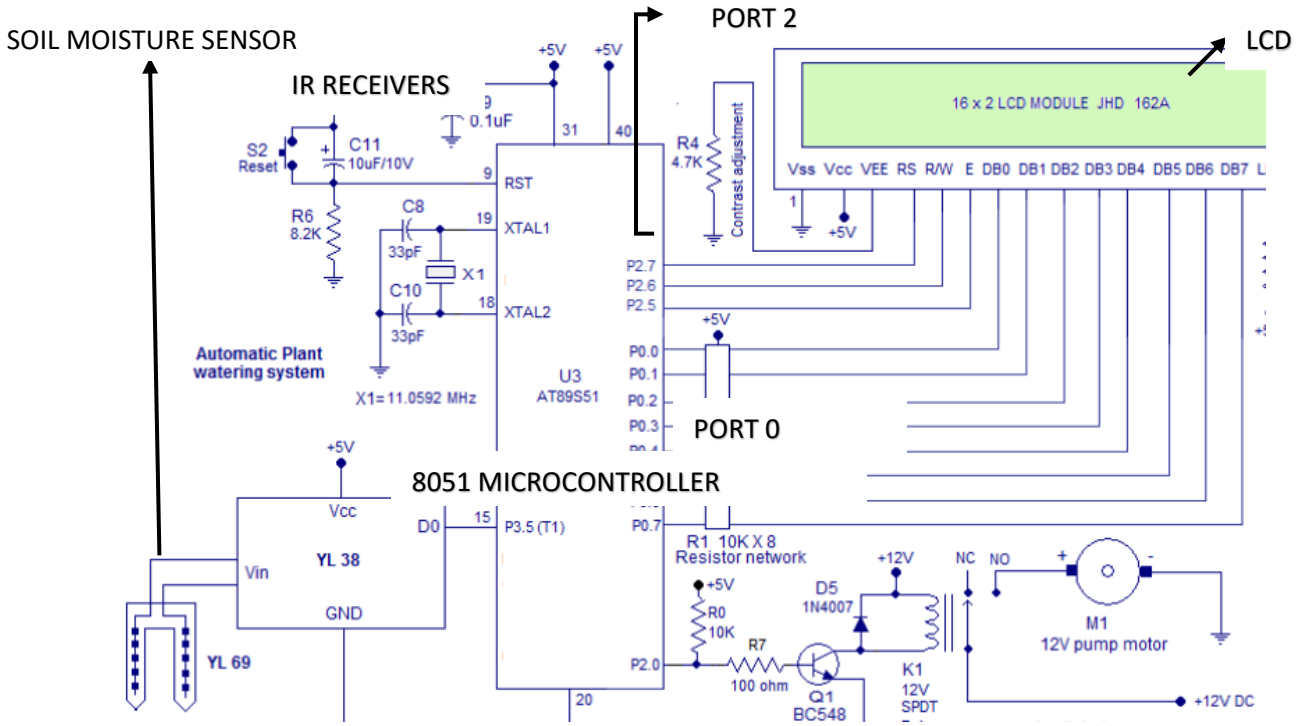

Fig. 1. Model Circuit Diagram used for implementing this project **.**

3.2 BLOCK DIAGRAM

The four main features of the basic block diagram (Fig. 2) are

- The Microcontroller used – 8051
- Soil moisture sensor
- LCD
- Relays

The main circuit also consists of the crystal oscillator.

The figure below is a general block diagram of this project. It can be observed that the microcontroller receives data or input from the soil moisture sensors. According to the data received the motor will start.

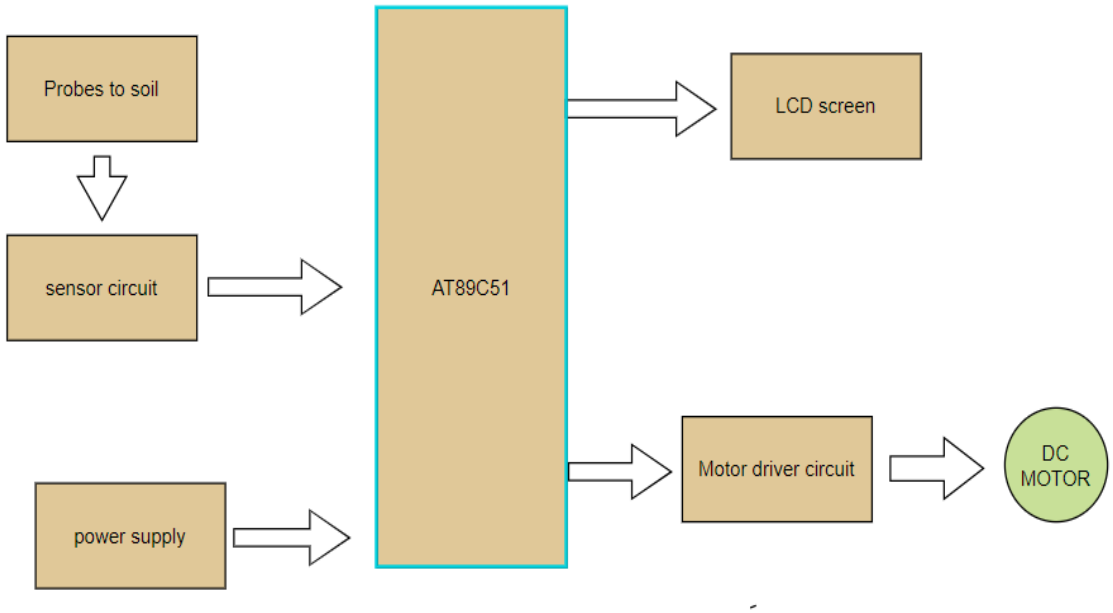

Fig.2. Block Diagram

Fig. 2 shows the block diagram for smart irrigation system that works based on soil moisture.

3.3 REQUIRED EQUIPMENTS

- 8051 microcontroller developer kit
- Power supply
- Soil moisture sensor
- YL 38 comparator module
- Wire
- Relay

3.4 HARDWARE ANALYSIS

The breadboard is made up of the power supply and the soil moisture sensor, both of which are linked to the microcontroller. The power supply provides the necessary voltages to all of the other units. The Microcontroller 8051 will receive the signal from the soil moisture sensor and send it to the motor to turn it on or off. The comparator module's output pin (D0) is connected to the 8051 microcontroller's P3.5 pin.

3.4.1 MICROCONTROLLER 8051

8051 microcontroller is designed by Intel in 1981. It is an 8-bit microcontroller. It is built with 40 pins DIP (dual inline package), 4kb of ROM storage and 128 bytes of RAM storage, 2 16-bit timers. It consists of are four parallel 8-bit ports, which are programmable as well as addressable as per the requirement. An on-chip crystal oscillator is integrated in the microcontroller having crystal frequency of 11MHz.

PIN DESCRIPTION

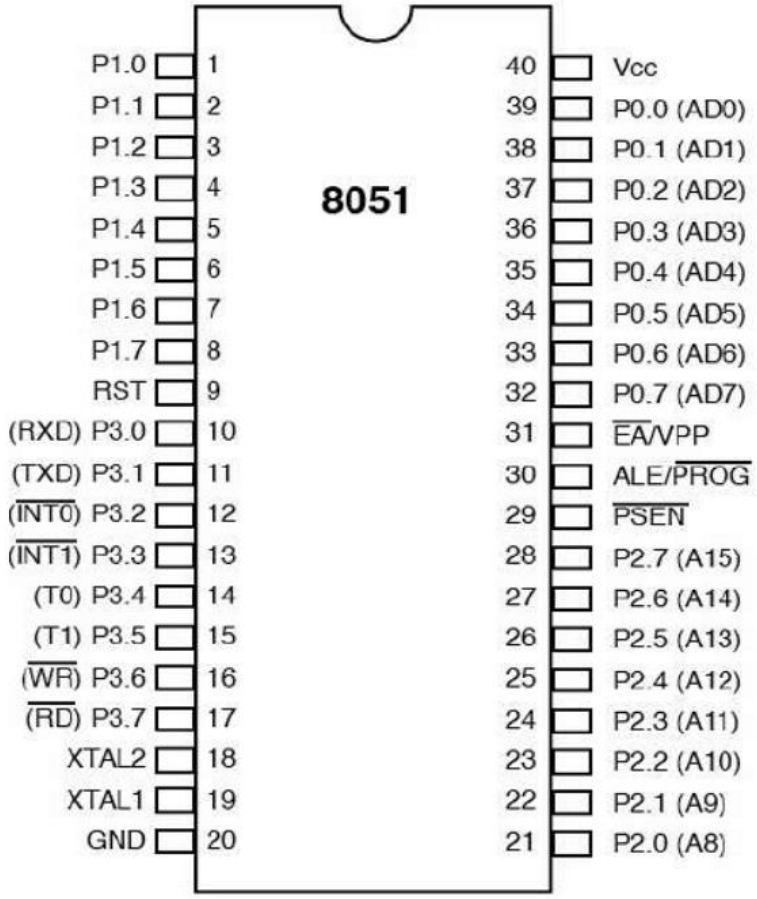

Fig. 3. Pin diagram of 8051. **Note:** From Microcontrollers -8051 Pin Description,tutorialspoint.com(https://www.tutorialspoint.com/microprocessor/microcontrollers_8051_pin_description.htm

Pins 1 to 8 − These pins are known as Port 1(Refer Fig 3). This port doesn't serve any other functions. It is internally pulled up, bi-directional I/O port.

Pin 9 − It is a RESET pin, which is used to reset the microcontroller to its initial values.

Pins 10 to 17 − These pins are known as Port 3. This port serves some functions like interrupts, timer input, control signals, serial communication signals RxD and TxD, etc.

Pins 18 & 19 − These pins are used for interfacing an external crystal to get the system clock.

Pin 20 − This pin provides the power supply to the circuit.

Pins 21 to 28 − These pins are known as Port 2. It serves as I/O port. Higher order address bus signals are also multiplexed using this port.
Pin 29 − This is PSEN pin which stands for Program Store Enable (Refer Fig. 3). It is used to read a signal from the external program memory.

Pin 30 − This is EA pin which stands for External Access input. It is used to enable/disable the external memory interfacing.

Pin 31 − This is ALE pin which stands for Address Latch Enable. It is used to demultiplex the address-data signal of port.

Pins 32 to 39 − These pins are known as Port 0. It serves as I/O port. Lower order address and data bus signals are multiplexed using this port.

Pin 40 − This pin is used to provide power supply to the circuit.

8051 microcontrollers have 4 I/O ports each of 8-bit, which can be configured as input or output. Hence, total 32 input/output pins allow the microcontroller to be connected with the peripheral devices.

Port 0

The P0 (zero) port is characterized by two functions −

- When the external memory is used then the lower address byte (addresses A0-A7) is applied on it, else all bits of this port are configured as input/output.
- When P0 port is configured as an output then other ports consisting of pins with built-in pull-up resistor connected by its end to 5V power supply, the pins of this port have this resistor left out.

Port 1

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

Port 2

P2 is similar to P0 when the external memory is used. Pins of this port occupy addresses intended for the external memory chip. This port can be used for higher address byte with addresses A8-A15. When no memory is added then this port can be used as a general input/output port similar to Port 1.

Port 3

In this port, functions are similar to other ports except that the logic 1 must be applied to appropriate bit of the P3 register.

Here, in this project we are using a microcontroller developer board (Fig. 4). This board consists of the 8051 Microcontroller (AT89S52), LCD display, DS1307 IC, and LEDs to indicate port status.

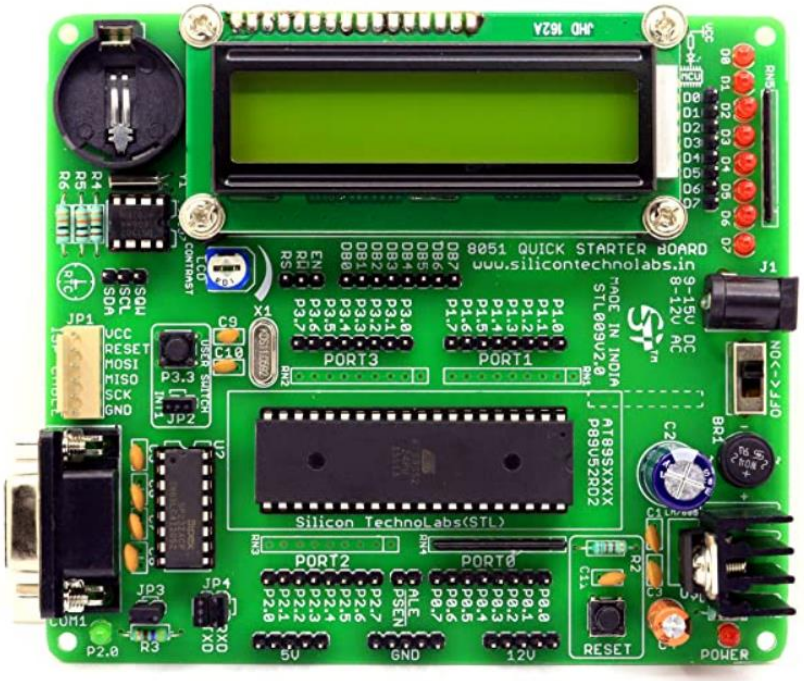

Fig. 4. Microcontroller developer board (AT89S52)

Note: From Silicon TechnoLabs ATMEL 8051 Quick Starter Development Board On-Board AT89S52, amazon.in (https://www.amazon.in/Silicon-TechnoLabs-Development-P89V51RD2-SST89E516RD/dp/B01E7BDUD6 ,)

3.4.2. RELAY

- A relay is an electromagnetic switch operated by a relatively small electric current that can turn on or off a much larger electric current. The heart of a relay is an electromagnet (a coil of wire that becomes a temporary magnet when electricity flows through it).
- We can think of a relay as a kind of electric lever: switch it on with a tiny current and it switches on ("leverages") another appliance using a much bigger current.
- Why is that useful? As the name suggests, many sensors are incredibly sensitive pieces of electronic equipment and produce only small electric currents. But often we need them to drive bigger pieces of apparatus that use bigger currents.

Relays bridge the gap, making it possible for small currents to activate larger ones. That means relays can work either as switches (turning things on and off) or as amplifiers (converting small currents into larger ones).

Pin configuration of relay

- The relay switch connections are usually labelled as COM ,normally closed (NC) and normally open (NO)(Fig 5.).
- COM/POLE= Common, NC and NO always connect to this, it is the moving part of the switch. NC = Normally Closed, COM/POLE is connected to this when the relay coil is not magnetized. NO = Normally Open, COM/POLE is connected to this when the relay coil is MAGNETIZED and vice versa[4].

General purpose relays operate with AC or DC current, at common voltages such as 12V, 24V, 48V, 120V and 230V, and they can control currents ranging from 2A30A. These relays are economical, easy to replace and allow a wide range of switch configuration.

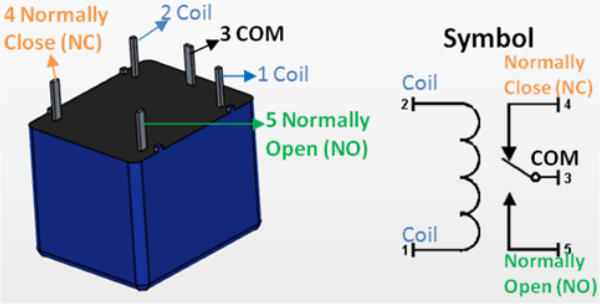

Fig. 5. Pin Configuration of relay. **Note:** From **5V 5-Pin Relay,** components101.com (https://components101.com/switches/5v-relay-pinout-working-datasheet, ©Components101).

YL 38 comparator Module:

YL 38 comparator module is used in this project. It is a single channel opamp comparator based on L393 IC. This module just compares the output voltage of the sensing probe with a reference voltage and switches its voltage appropriately for the microcontroller to read. Circuit diagram of the YL 38 comparator module is shown below.

Fig. 6. YL c38 comparator module

Note: From Generic(Unbranded)4-Channel Relay Control Board Module With Optocoupler, 4 Way Relay, amazon.in (https://www.amazon.in/Generic-unbranded-relay-module-optocoupler/dp/B00C59RNPE , © 1996-2021, Amazon.com, Inc. or its affiliates)

3.4.3. SOIL MOISTURE SENSOR

The soil moisture sensor is one kind of sensor used to gauge the volumetric content of water within the soil. As the straight gravimetric dimension of soil moisture needs eliminating, drying, as well as sample weighting. These sensors measure the volumetric water content not directly with the help of some other rules of soil like dielectric constant, electrical resistance, otherwise interaction with neutrons, and replacement of the moisture content.

The relation among the calculated property as well as moisture of soil should be adjusted & may change based on ecological factors like temperature, type of soil, otherwise electric conductivity. The microwave emission which is reflected can be influenced by the moisture of soil as well as mainly used in agriculture and remote sensing within hydrology.

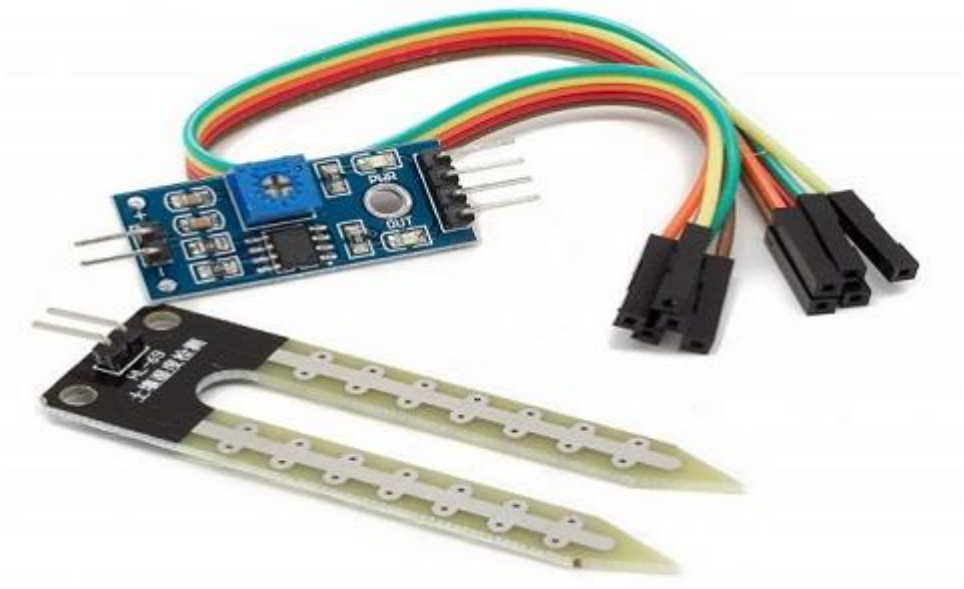

Fig. 8. Soil moisture sensor

Soil Moisture Sensor Pin Configuration

The FC-28 soil moisture sensor includes 4-pins

- VCC pin is used for power
- A0 pin is an analog output
- D0 pin is a digital output
- GND pin is a Ground

3.4.4. POWER SUPPLY

The power supply will be the standard 220V- 240V that we use normally. The power supply will connect to all the other components through the breadboard and wires.

3.5 SOFTWARE ANALYSIS

Simulation software is based on the process of modelling a real phenomenon with a set of mathematical formulas. It is, essentially, a program that allows the user to observe an operation through simulation without actually performing that operation.ISIS is the software used to draw schematics and simulate the circuits in proteus.The simulation allows human access during run time,thus providing real time simulation.

3.5.1 CIRCUIT SOFTWARE REQUIREMENTS

- **Keil µVision 5**
- **Proteus 8 Professional**

3.5.2 KEIL µVISION 5

The µVision IDE combines project management, run-time environment, build facilities, source code editing, and program debugging in a single powerful environment. µVision is easy-to-use and accelerates your embedded software development.

The **Keil** 8051 Development Tools are designed to solve the complex problems facing embedded **software** developers. 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.

Key Features

- The **Project** window shows application source files and selected software components. Below the components you will find corresponding library and configuration files.
- **Projects** support multiple **targets**. They ease configuration management and may be used to generate debug and release builds or adoptions for different hardware platforms.
- The **Manage Run-Time Environment** window shows all software components that are compatible with the selected device. Inter-dependencies of software components are clearly identified with validation messages.
- The **Configuration Wizard** is an integrated editor utility for generating GUI-like configuration controls in assembler, C/C++, or initialization files.
- The **Functions** window gives fast access to the functions in each C/C++ source code module.
- The **Code Completion** list and **Function Parameter** information helps you to keep track of symbols, functions, and parameters.
- **Dynamic Syntax Checking** validates the program syntax while you are typing and provides real-time alerts to potential code violations before compilation.

3.5.3 PROTEUS 8 PROFESSIONAL

The Proteus Design Suite combines ease of use with a powerful feature set to enable the rapid design, test and layout of professional printed circuit boards. The simulation of the circuit was performed using the Proteus software. Due to the absence of an infrared sensor representation in the Proteus software, switches were used to represent the IR transmitter and receiver pairs. The circuit diagram (Fig.10) represents the simulation done in this software.

3.6 CIRCUIT BLOCK DIAGRAM

The figure below (Fig. 9) is the block diagram of the circuit that we have implemented.

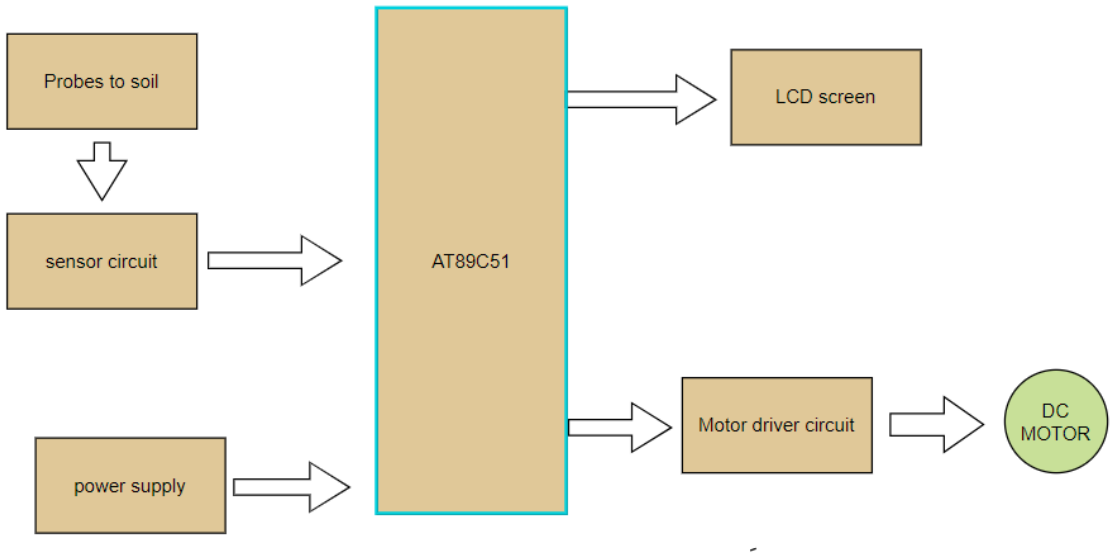

Fig. 9. Block Diagram of the circuit implemented

CIRCUIT DIAGRAM:

In the Circuit Diagram (Fig. 10) if the moisture level in the soil is low it display a message on lcd as "**moisture control low pump on**" and once if the the moisture level reaches the range the lcd will again display a message "**moisture control high pump off**"(Fig.11)
This has been implemented with the help of Proteus software.

- **When the moisture level is low**

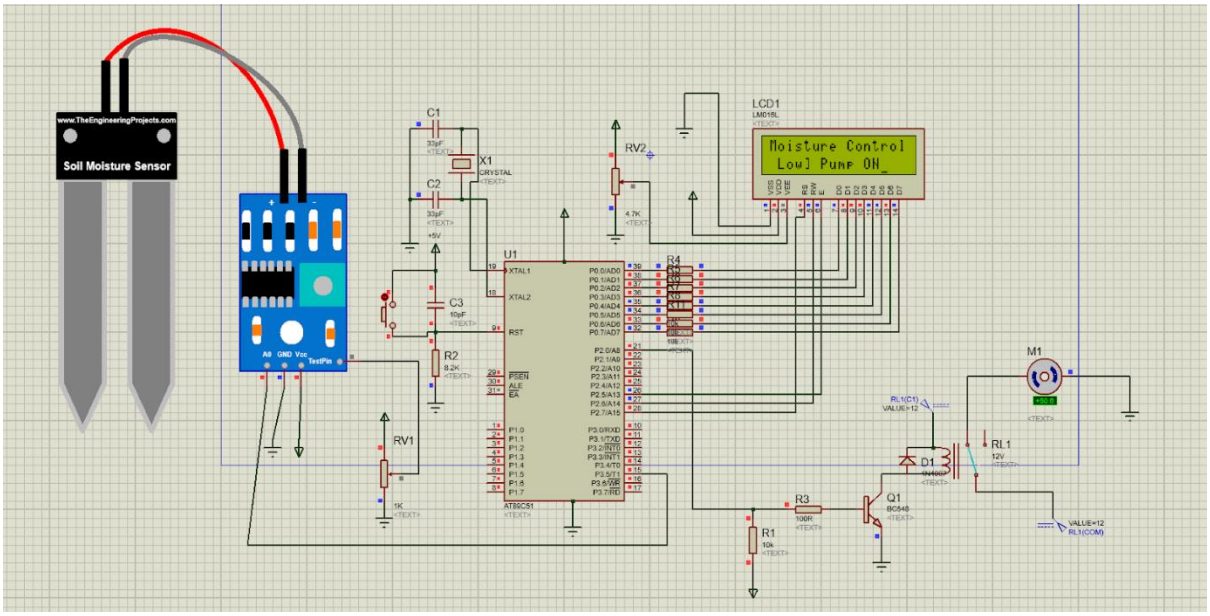

Fig. 10. Circuit diagram when moisture level is low

- **When the moisture level is high**

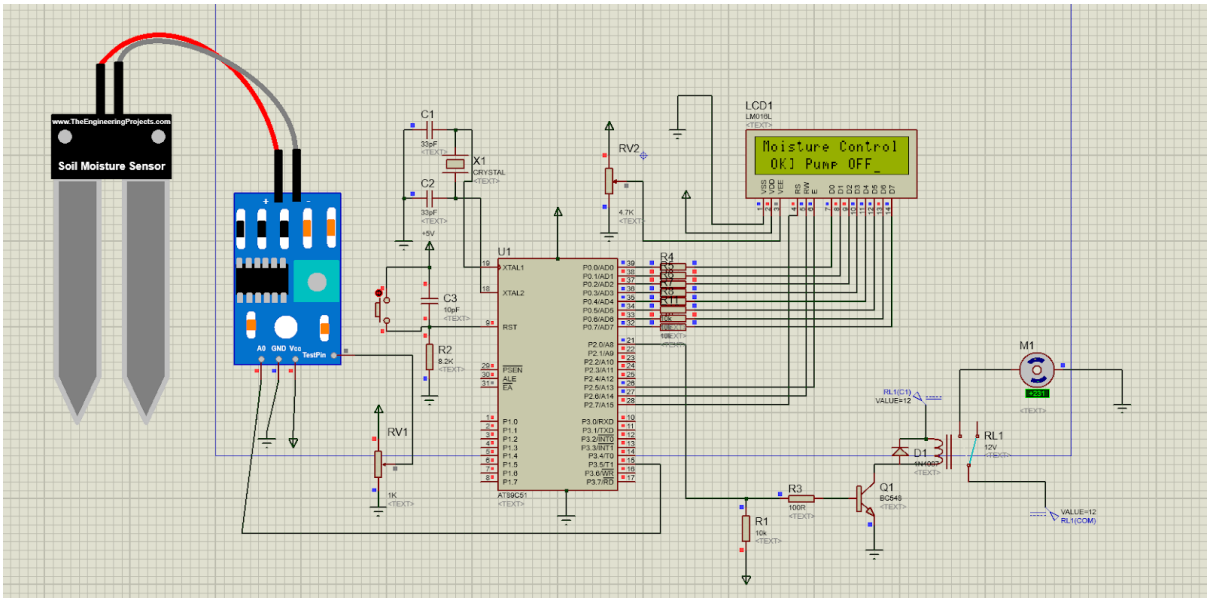

Fig. 11. Circuit diagram when moisture level is high

3.6.1 Smart irrigation system circuit Diagram

This project consists of a microcontroller, relays, soil moisture sensor and YL 38 comparator. Here 8051 microcontroller is used. It is an 8-bit microcontroller and it requires supply voltage of 5V DC. For the above circuit additionally it needs to connect reset circuit and crystal circuit to the controller to work properly.

V_{cc} pin is connected to the 5V and GND pin is connected to ground. Interrupt pin is also grounded. Microcontroller section senses the status of the comparator

module and switches the irrigation motor appropriately. It also displays the status of the pump on the LCD screen. The power supply unit and the motor driver unit are incorporated in this section. Output pin of the comparator module (D0) is connected to P3.5 pin of the 8051 microcontroller. The microcontroller monitors the moisture level by polling the status of the P3.5 pin which is the output of the comparator.

3.7 ALGORITHM

Step 1. START

Step 2. Soil moisture sensor is connected to port 3.5 of the microcontroller to know the moisture level of soil.

Step 3. if the moisture level in the soil is low then it display a message on lcd as "**moisture control low pump on**" and motor turns on if the the moisture level reaches the range the lcd will again display a message "**moisture control high pump off**"

Step 4. if the the moisture level reaches the range the lcd will again display a message "**moisture control high pump off**" and the motor will turn off.

Step 5. STOP

3.8. PROGRAM CODE

```
RS EQU P2.7
RW EQU P2.6
E  EQU P2.5

ORG 00H
SETB P3.5
MOV TMOD,#00000001B
MAIN:ACALL DINT
    ACALL TEXT1
    JB P3.5, NEXT
    ACALL LINE2
    ACALL TEXT2
    CLR P2.0
    SJMP EXIT
NEXT:ACALL LINE2
    ACALL TEXT3
```

```
    SETB P2.0
    EXIT:ACALL DELAY1
SJMP MAIN


DELAY1:MOV R0,#15D
BACK1: MOV TH0,#00000000B
      MOV TL0,#00000000B
      SETB TR0
HERE2: JNB TF0,HERE2
      CLR TR0
      CLR TF0
      DJNZ R0,BACK1
      RET



TEXT1: MOV A,#"M"
   ACALL DISPLAY
   MOV A,#"o"
   ACALL DISPLAY
   MOV A,#"i"
   ACALL DISPLAY
   MOV A,#"s"
   ACALL DISPLAY
   MOV A,#"t"
   ACALL DISPLAY
   MOV A,#"u"
   ACALL DISPLAY
   MOV A,#"r"
   ACALL DISPLAY
   MOV A,#"e"
   ACALL DISPLAY
   MOV A,#" "
   ACALL DISPLAY
   MOV A,#"C"
   ACALL DISPLAY
   MOV A,#"o"
   ACALL DISPLAY
   MOV A,#"n"
   ACALL DISPLAY
   MOV A,#"t"
```

```
    ACALL DISPLAY
    MOV A,#"r"
    ACALL DISPLAY
    MOV A,#"o"
    ACALL DISPLAY
    MOV A,#"l"
    ACALL DISPLAY
    RET

TEXT2: MOV A,#"["
    ACALL DISPLAY
     MOV A,#"O"
    ACALL DISPLAY
    MOV A,#"K"
    ACALL DISPLAY
    MOV A,#"]"
    ACALL DISPLAY
    MOV A,#" "
    ACALL DISPLAY
    MOV A,#"P"
    ACALL DISPLAY
    MOV A,#"u"
    ACALL DISPLAY
    MOV A,#"m"
    ACALL DISPLAY
    MOV A,#"p"
    ACALL DISPLAY
    MOV A,#" "
    ACALL DISPLAY
    MOV A,#"O"
    ACALL DISPLAY
    MOV A,#"F"
    ACALL DISPLAY
    MOV A,#"F"
    ACALL DISPLAY
    RET

TEXT3: MOV A,#"["
    ACALL DISPLAY
    MOV A,#"L"
    ACALL DISPLAY
    MOV A,#"o"
    ACALL DISPLAY
```

```
    MOV A,#"w"
    ACALL DISPLAY
    MOV A,#"]"
    ACALL DISPLAY
    MOV A,#" "
    ACALL DISPLAY
    MOV A,#"P"
    ACALL DISPLAY
    MOV A,#"u"
    ACALL DISPLAY
    MOV A,#"m"
    ACALL DISPLAY
    MOV A,#"p"
    ACALL DISPLAY
    MOV A,#" "
    ACALL DISPLAY
    MOV A,#"O"
    ACALL DISPLAY
    MOV A,#"N"
    ACALL DISPLAY
    RET


 DINT:MOV A,#0CH
    ACALL CMD
    MOV A,#01H
    ACALL CMD
    MOV A,#06H
    ACALL CMD
    MOV A,#80H
    ACALL CMD
    MOV A,#3CH
    ACALL CMD
    RET

LINE2:MOV A,#0C0H
    ACALL CMD
    RET

CMD: MOV P0,A
    CLR RS
    CLR RW
    SETB E
```

```
    CLR E
    ACALL DELAY
    RET

DISPLAY:MOV P0,A
    SETB RS
    CLR RW
    SETB E
    CLR E
    ACALL DELAY
    RET

DELAY: CLR E
    CLR RS
    SETB RW
    MOV P0,#0FFH
    SETB E
    MOV A,P0
    JB ACC.7,DELAY
    CLR E
    CLR RW
    RET

 END
```

3.9 HOW THIS PROJECT WORKS?

1. Write the program to the Keil software and create .hex file.
2. Load the hex file in the microcontroller
3. Now give the connections as per the circuit diagram.
4. Use the soil moisture sensor to know the moisture level of soil.
5. Switch on the supply.
6. Send data to display the message on lcd .

The setup (Fig.12) is made according to the circuit diagram (Fig. 11).

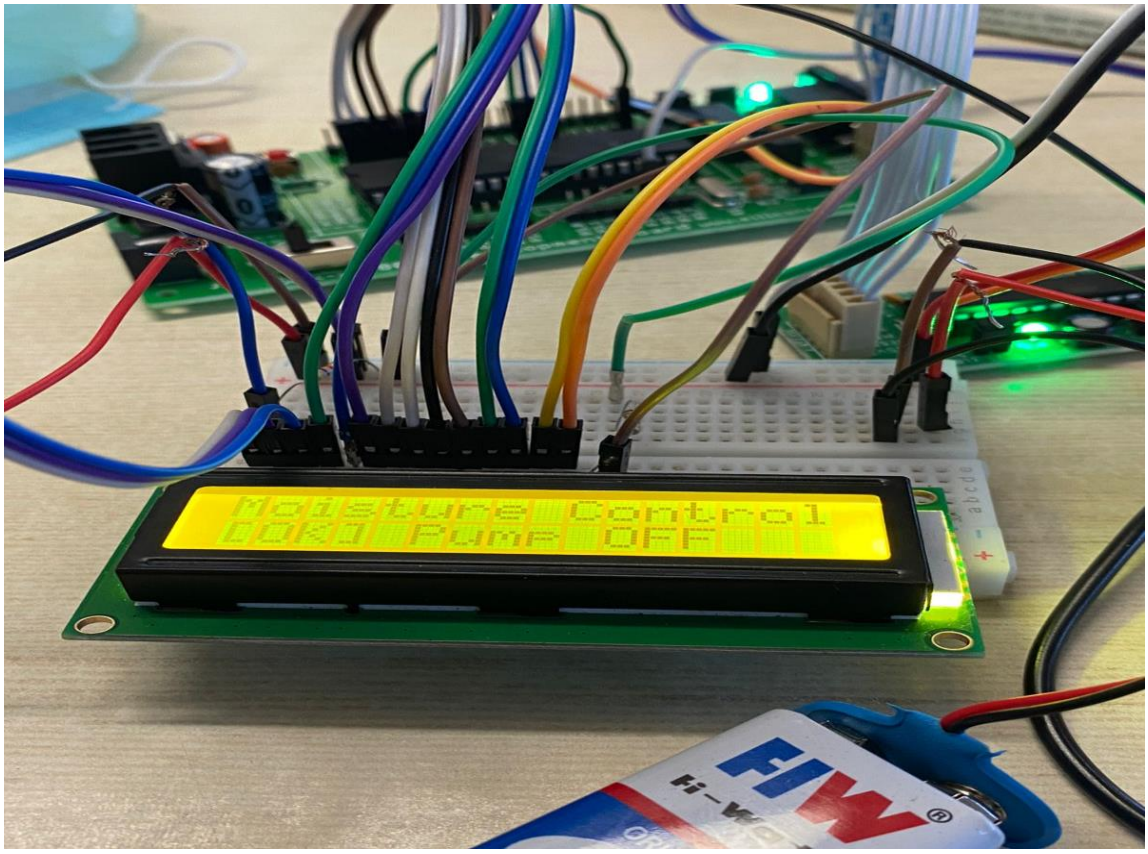

Fig. 12. Total circuit consisting of the microcontroller, soil moisture sensor

The soil moisture sensor are connected to the microcontroller through the relay module. so if the moisture level in the soil is low it display a message on lcd as "**moisture control low pump on**"(Fig.14) and once if the the moisture level reaches the range the lcd will again display a message "**moisture control high pump off**"
(Fig. 13).

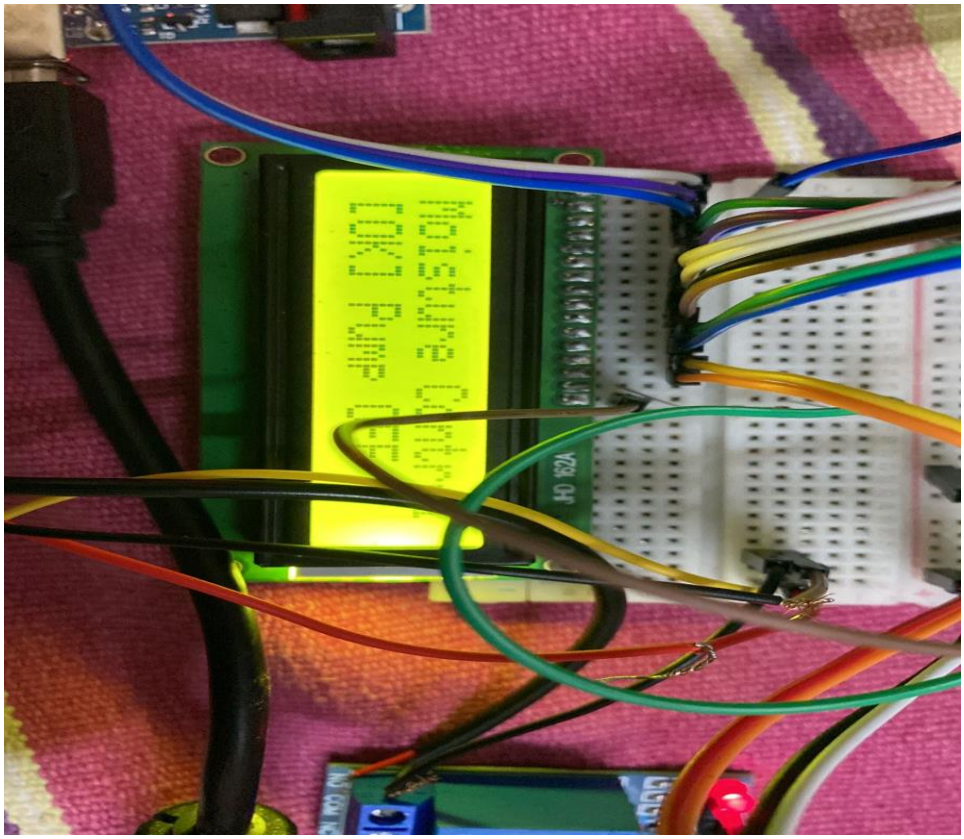

Fig 13. Circuit diagram when moisture level is high

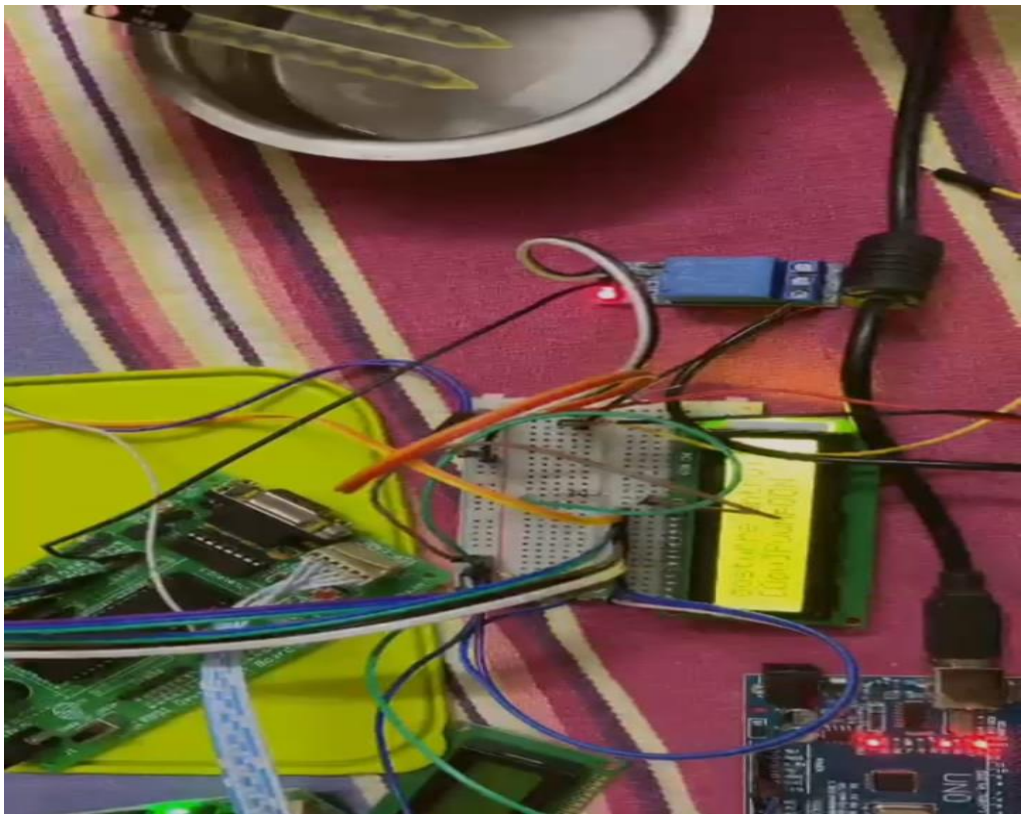

Fig 14. Circuit diagram when moisture level is low

4. LIMITATIONS OF PROJECT:

- It requires probe to be inserted in the soil. It requires labor to collect the data and maintain the measurement processes
- It requires initial evaluation of site specific conditions before selection of appropriate moisture sensor.
- Watermark sensors provide less accuracy in sandy soils due to large particles.

5. APPLICATION AND ADVANTAGES:

- It can provide high accuracy water supply and avoid water from wastage.
- Due to automatically handling, user requires less man power.
- With the help of the sensors, it can accurately determine the soil moisture levels.
- This system helps to produce good quality of crops and improves economic condition.
- 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.

6. CONCLUSION:

A system to monitor moisture levels in the soil was designed and the project provided an opportunity to study the existing systems, along with their features and drawbacks. The proposed system can be used to switch on/off the motor according to soil moisture levels thereby automating the process of irrigation which is one of the most timeconsuming activities in farming. Agriculture is one of the most water-consuming activities. The system uses information from soil moisture sensors to irrigate soil which helps to prevent over irrigation or under irrigation of soil thereby avoiding crop damage.

it can be concluded that there can be considerable development in irrigation . Thus this system is a solution to the problems faced in the existing process of irrigation.

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