ISSN 2277-2685
IJESR/July-Sep. 2025/ Vol-15/Issue-3/543-565
Mohammed Shareefuddin *et. al.*, / International Journal of Engineering & Science Research

An Effective Moisture Control Based Modern Irrigation System with Arduino Uno

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Abstract

This project involves the development of an advanced irrigation system using Arduino, soil moisture sensor, raindrop sensor, LCD, relay, buzzer, and a DC pump. The purpose of this project is to automate irrigation based on real-time soil moisture and weather conditions, enhancing water efficiency and crop health. The system monitors soil moisture, and rainfall, then uses this data to control the irrigation pump via a relay. The Arduino processes sensor data and updates the LCD display, while the buzzer provides immediate alerts when necessary.

I. Introduction

The main aim of this project was to provide water to the plants or gardening automatically using microcontroller (Arduino Uno). We can automatically watering the plants when we are going on vacation or don't we have to bother my neighbours, Sometimes the neighbours do too much of watering and the plants end up dying anyway. There are timer based devices available in India which waters the soil on set interval. They do not sense the soil moisture and the ambient temperature to know if the soil actually needs watering or not. Assimilation is that the artificial application of water to the land or soil It is used to assist in the growing of agricultural crops [3], maintenance of landscapes, and re vegetation of disturbed soils in dry areas and during periods of inadequate rainfall.

When a zone comes on, the water flows through the lateral lines and ultimately finally ends up at the irrigation electrode (drip) or mechanical device heads. Several sprinklers have pipe thread inlets on the lowest of them that permits a fitting and also the pipe to be connected to them. The sprinklers are usually used in the top of the head flush with the ground surface [9]. As the method of dripping will reduce huge water losses it became a popular method by reducing the labour cost and increasing the yields. When the components are activated, all the components will read and gives the output signal to the controller, and the information will be displayed to the user (farmer). The sensor readings are analog in nature so the ADC pin in the controller will convert the analog signals into digital format [8]. Then the controller will access information and when the motors are turned On/Off it will be displayed on the LCD Panel, and serial monitor windows [10]. There are many systems are available to water savings in various crops, from basic ones to more technologically advanced ones. For instance, in one system plant watering status was monitored and irrigation scheduled based on temperature presents in soil content of the plant.

II. Literature Review:

Software design for wireless sensor-based site-specific irrigation Compute

Y. Kim and R. G. Evans, May 2009.

In-field sensor-based site-specific irrigation management is of benefit to producers for efficient water management. Integration of the decision making process with the controls is a viable option for determining when and where to irrigate, and how much water to apply. This research presents the design of decision support software and its integration with an in-field wireless sensor network (WSN) to implement site-specific sprinkler irrigation control via Bluetooth wireless communication. Wireless in-field sensing and control (WISC) software was designed by four major design factors that provide real-time monitoring and control of both inputs (field data) and outputs (sprinkler controls) by simple click-and-play menu using graphical user interface (GUI), and optimized to adapt changes of crop design, irrigation pattern, and field location. The WISC software provides remote access to in-field micrometeorological information from the distributed WSN and variable-rate irrigation control. An algorithm for nozzle sequencing was developed to stagger nozzle-on operations so as evenly distributed over the 60-s cycle. Sensor-based closed-loop irrigation was highly correlated to catch can water with r2 = 0.98.

A low-cost microcontroller-based system to monitor crop Temperature and water status

D. K. Fisher and H. A. Kebede, 2010.

A prototype system was developed and constructed for automating the measurement and recording of canopy-, soil-, and air temperature, and soil moisture status in cropped fields. The system consists of a microcontroller-based circuit with solid-state components for handling clock/calendar, sensor power, and data storage and retrieval functions. Sensors, including an analog soil moisture sensor, analog and digital temperature sensors, and a digital infrared thermometer, are widely available and inexpensive. The circuit board and sensor assemblies require approximately 4 h to construct and test, and material costs totalled approximately US$84. Systems were built and tested during the 2009 growing season in a corn field to evaluate performance and suitability under local conditions. The sensors performed according to manufacturers' specifications, with accuracies of ±0.4 °C, ±1.4 °C, and ±0.3 °C for air-, soil-, and canopy-temperature measurements, respectively. Soil moisture sensors were calibrated and provided measurements within ±2 kPa of the manufacturer's values. Reliability of data collection and storage averaged 91%, with most bad or missing data occurring during periods of inclement weather and electrostatic interference.

Execution of Cloud Scheduling Algorithms

K.Srikar, M.Akhil, V.Krishna reddy, 2017.

Cloud is an efficient way for the provision of the shared services. It is accessed by the various types of users for the shared services. These will be on the basis of pay per use. It helps in providing the cost effective services to the client. User can access and share the services on the basis of demand. People can increase and decrease the demand for the resources on the basis of the requirements. This sometimes pressurize the resources. Under such circumstances the time for the services will be increased. These require various corrective scheduling schemes which can schedule the resources amongst the users so that the response time, waiting time and the total turnaround time can be reduced. Various researchers has suggested various scheduling techniques for the scheduling of the resources. These techniques are based on soft computing where optimal resource is identified. Which is most suitable for the given request by the user.

Wireless lysimeters for real-time online soil water Monitoring

Y. Kim, J. D. Jabro, and R. G. Evans, 2011.

Identification of drainage water allows assessing the effectiveness of water management. Passive capillary wick-type lysimeters (PCAPs) were used to monitor water flux leached below the root zone under an irrigated cropping system. Wireless lysimeters were developed for web-based real-time online monitoring of drainage water using a distributed wireless sensor network (WSN). Twelve PCAP sensing stations were installed across the field at 90 cm below the soil surface, and each station measured the amount of drainage water using two tipping buckets mounted in the lysimeter and continually monitored soil water contents using two soil moisture sensors installed above the lysimeter. A weather station was included in the WSN to measure micrometeorological field conditions. All in-field sensory data were periodically sampled and wirelessly transmitted to a base station that was bridged to a web server for broadcasting the data on the internet. Communication signals from the in-field sensing stations to the base station were successfully interfaced using low-cost Bluetooth wireless radio communication. Field experiments resulted in high correlation between estimated and actual drainage with $r^2 = 0.95$ and confirmed a reliable wireless communication throughout the growing season. A web-linked WSN system provided convenient remote online access to monitor drainage water flux and field conditions without the need for costly time-consuming supportive operations.

A hybrid wired wireless networking infrastructure for green house management

O. Mirabella and M. Brischetto, 2011.

This paper represents the modelling and optimizations on advanced GSM (800–900MHz)-WSN (IEEE 802.15.4) based greenhouse monitoring and controlling with SMS terminal. The proposed system includes sensor station and base station terminals performing various conditioning functions. PIC18F4520 controller is used for better conditioning of climate parameters in the greenhouse. The sensor station is equipped with several sensor elements including temperature, humidity, and light and soil moisture. The communication between the sensor station and base station is achieved via ZigBee wireless modules and base station to user is achieved via GSM network. By employing GSM Terminal access to proposed system, field parameter has been accessed by using conventional SMS facility. Solar panel is employed to energize the whole assembly in greenhouse. The wireless sensor stations in the greenhouse measures temperature, humidity, light, soil moisture etcetera with their relative standards. By relating the variation in set points of sensors, proposed parameters in greenhouse has been conditioned.

Wireless sensor network survey

J. Yick, B. Mukherjee, and D. Ghosal, 2008.

A wireless sensor network (WSN) has important applications such as remote environmental monitoring and target tracking. This has been enabled by the availability, particularly in recent years, of sensors that are smaller, cheaper, and intelligent. These sensors are equipped with wireless interfaces with which they can communicate with one another to form a network. The design of a WSN depends significantly on the application, and it must consider factors such as the environment, the application's design objectives, and cost, hardware, and system constraints. The goal of our survey is to present a comprehensive review of the recent literature since the publication of [I.F. Akyildiz, W. Su, Y. Sankarasubramaniam, E. Cayirci, A survey on sensor networks, IEEE Communications Magazine, 2002]. Following a top-down approach, we give an overview of several new applications and then review the literature on various aspects of WSNs. We classify the problems into three different categories: (1) internal platform and underlying operating system, (2) communication protocol stack, and (3) network services, provisioning, and deployment. We review the major development in these three categories and outline new challenges.

Theoretical and practical aspects of military wireless sensor networks

M. Winkler, K.-D. Tuchs, K. Hughes, and G.Barclay, 2008.

Wireless sensor networks can be used by the military for a number of purposes such as monitoring militant activity in remote areas and force protection. Being equipped with appropriate sensors these networks can enable detection of enemy movement, identification of enemy force and analysis of their movement and progress. The focus of this article is on the military requirements for flexible wireless sensor networks. Based on the main networking characteristics and military use-cases, insight into specific military requirements is given in order to facilitate the reader's understanding of the operation of these networks in the near to medium term (within the next three to eight years). The article structures the evolution of military sensor networking devices by identifying three generations of sensors along with their capabilities. Existing developer solutions are presented and an overview of some existing tailored products for the military environment is given. The article concludes with an analysis of outstanding engineering and scientific challenges in order to achieve fully flexible, security proved, ad hoc, self-organizing and scalable military sensor networks. Keywords— wireless sensor networks, military sensor applications, joint intelligence surveillance reconnaissance (JISR), military sensors, energy efficient routing, WSN generations.

Wireless sensor networks for conservation and monitoring cultural assets

M. C. Rodríguez-Sánchez, S. Borromeo, and J.A. Hernández-Tamames, 2011.

Recently, technology has become more attractive for industry by paving the way to new applications, which go well beyond traditional sensor applications. These applications can be classified in different categories: monitoring, alerting, healthcare assistance, and actuating, among others. A Wireless Sensor Network (WSN) is feasible for the heritage scenarios protection and for monitoring because its specificity, autonomy, self-configurability, lasting lifetime, and mobility. However, their services, protocols, and architectures have constraints to support new issues for monitoring cultural assets: geographical dispersion, insufficient resources, and not enough staff to protect all the monuments and to provide tourist information broadcasting. We propose a modular system. It consists of three elements: a WSN, a "Central System," and a novel platform named "Local

Node Gateway." It allows the coexistence of different wireless technologies in order to provide actuation, processing and communication functionalities. This proposal takes a new approach to solve these heritage-monitoring problems.

"LOBIN: E-Textile and wireless sensor network based platform for healthcare monitoring in future hospital environments",

G. López, V. Custodio, and J. I. Moreno, 2010.

This paper describes a novel healthcare IT platform developed under the LOBIN project, which allows monitoring several physiological parameters, such as ECG, heart rate, body temperature, etc., and tracking the location of a group of patients within hospital environments. The combination of e-textile and wireless sensor networks provides an efficient way to support non-invasive and pervasive services demanded by future healthcare environments. This paper presents the architecture, system deployment as well as validation results from both laboratory tests and a pilot scheme developed with real users in collaboration with the Cardiology

III. Proposed System

The proposed modern irrigation system utilizes an Arduino to automate and optimize irrigation based on real-time soil moisture and weather conditions. The system uses a soil moisture sensor to measure soil moisture levels, a temperature sensor to monitor ambient conditions, and a raindrop sensor to detect rainfall. The Arduino processes this data and controls a relay to operate a DC pump, ensuring precise irrigation. An LCD provides real-time status updates, and a buzzer alerts nearby individuals when abnormal conditions are detected. Our approach integrates multiple sensors for comprehensive monitoring and uses automation to reduce human intervention.

The proposed system aims to overcome the limitations of conventional and earlier automated irrigation methods by introducing a smart and efficient irrigation system based on the Arduino Uno microcontroller. Arduino Uno is a compact, cost- effective, and highly capable platform that serves as the brain of the system. It is responsible for processing sensor data, making real-time decisions, and controlling the irrigation components accordingly. With built-in analog-to-digital conversion (ADC) capabilities and multiple digital/analog input-output pins, it provides a versatile foundation for sensor-based applications like smart irrigation.

Another major enhancement is the inclusion of a raindrop sensor, which detects the presence of rainfall. If rain is detected, the system halts irrigation even if the soil moisture is low. This prevents water wastage during rainy conditions and makes the system more adaptive to natural weather changes. Unlike older systems that irrigate based only on time or soil moisture, this dual-check mechanism significantly improves efficiency and environmental compatibility.

To provide the user with real-time system feedback, a 16x2 LCD display is incorporated into the design. This display shows the current status of the system, including moisture readings and rain detection status. It enables the user to monitor the functioning of the irrigation system without needing to access a computer or external monitoring system.

The system also includes a buzzer alert mechanism that provides audible signals under specific conditions, such as extremely dry soil or fault detection. This feature improves the reliability of the system, especially in unattended fields or gardens, by notifying users of issues that require attention.

Overall, the proposed system is low-cost, modular, and scalable, making it suitable for small-scale farms, gardens, and even educational or research applications. The design is flexible and can be upgraded in the future with features like wireless connectivity, mobile app control, or solar power integration.

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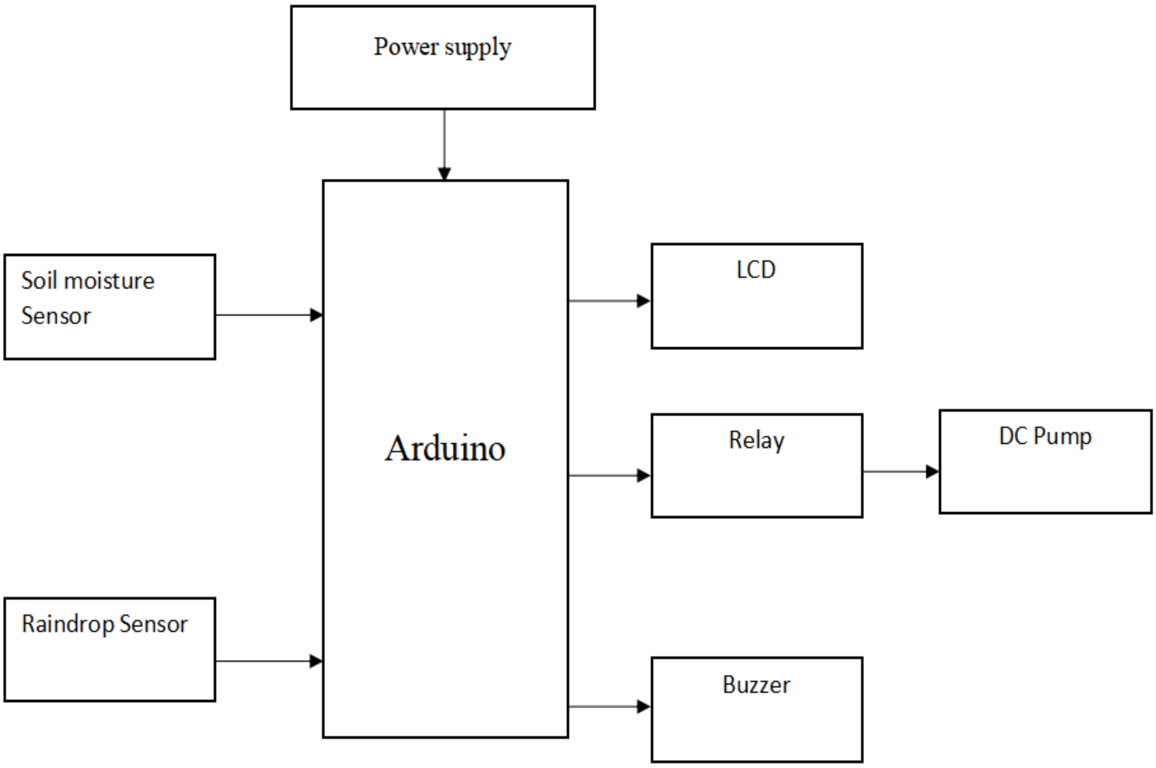
IV. Block Diagram



Block diagram of An Effective Moisture Control Based Modern Irrigation System with Arduino Uno

Arduino Uno:

The Arduino is one of the most popular and widely used Arduino boards. It's based on the ATmega328P microcontroller and offers a good balance of features, performance, and affordability, making it suitable for a wide range of projects, from simple to moderately complex.

Most electronic devices involve circuit-making using hardware components. The purpose of introducing Arduino was to make an easy-to-use device that can offer the feature of programming along with circuit making. Therefore, Arduino is a programmable device that is used mostly by artists, designers, engineers, hobbyists, and anyone who wants to explore programming in electronics.

The Arduino uses its components to gather information from the surroundings and generate a precise output accordingly. The information is gathered using some components like sensors, and input pins, and an output is generated depending on the programming done. This output can range from illuminating an LED to turning the motors on.

Arduino are great devices that can be used for creating interactive projects. They can either be used alone to create basic projects or they can be integrated with Arduino, Raspberry Pis, NodeMCU, or nearly anything else using some programming in their software to create some advanced level of projects. It is good to know the specifications of different Arduino so that you can select the right Arduino for your project.

Arduino Hardware:

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Let us look at the hardware components of Arduino:

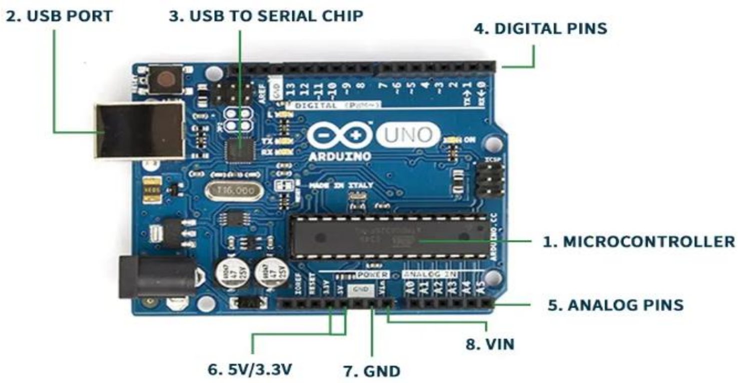

Fig- Arduino Uno

- Microcontroller: The Microcontroller controls the execution of all the programs and codes uploaded on Arduino. The microcontroller is equipped with components that can perform different functions.
- USB port: This port is used to establish a connection between the computer and the Arduino board.
- USB to Serial chip: The USB to Serial port is used for adding data from the computer to the microcontroller. This is how the code is uploaded from the computer to the Arduino board.
- Digital pins: These pins are used for turning the LEDs on and off by using digital logic ('0' and '1').
- Analog pins: These pins are used for taking analog input.
- 5V / 3.3V pins: These pins are used for supplying power to devices.
- GND: This pin is used for setting a reference level.

Arduino Pins:

Fig- Arduino Uno Pinout

Types of Arduino Pins:

Let’s dive into the details of each type of pin commonly found on Arduino boards:

1. Digital Pins:

Definition: Digital pins on an Arduino board can be used for both input and output operations. They are primarily used for working with binary (on/off) signals.

Numbering: Digital pins are typically labelled with numbers (e.g., D2, D7).

Usage: You can use digital pins to read digital signals (HIGH or LOW) from external sensors or devices, control LEDs, toggle relays, and more.

Functions: Digital pins can be configured as INPUT for reading external signals or OUTPUT for controlling external components. They can also be used as INPUT_PULLUP, which activates an internal pull-up resistor.

2. Analog Pins:

Definition: Analog pins are used for reading analog signals, such as voltages, from external sensors and devices.

Numbering: Analog pins are labelled with numbers (e.g., A0, A3) and may also have digital equivalents (e.g., A0 is equivalent to D14 on some Arduino boards).

Usage: Analog pins are essential for reading sensor data that produces continuous voltage levels, like temperature sensors, light sensors, and potentiometers.

Resolution: Arduino boards typically have a 10-bit ADC (Analog-to-Digital Converter), allowing for 1024 discrete values (0 to 1023) to represent analog signals.

3. PWM (Pulse-Width Modulation) Pins:

Definition: PWM pins are a subset of digital pins capable of simulating analog output by rapidly switching between HIGH and LOW states to control the average voltage.

Numbering: PWM pins are often marked with a tilde symbol (~) next to their digital pin numbers (e.g., ~D3, ~D9).

Usage: PWM pins are commonly used to control the brightness of LEDs, the speed of DC motors, and to generate audio tones.

Resolution: Arduino boards typically have an 8-bit PWM resolution, which means they can produce 256 discrete levels of analog-like output.

4. Special Pins:

Definition: Special pins serve unique purposes beyond digital and analog I/O. These include pins for serial communication (TX and RX), power supply (5V, 3.3V, GND), and a reset pin (RESET).

Numbering: Special pins may have specific labels, such as “TX” and “RX” for transmitting and receiving serial data.

Usage: RX and TX pins are used for serial communication with other devices, such as computers. Power and ground pins provide voltage and ground connections to external components, while the reset pin resets the microcontroller.

Considerations: Be cautious when using the RX and TX pins, as they are often used for programming and debugging, and connecting them incorrectly can disrupt communication.

5. Power Pins:

5V Pin:

Definition: The 5V pin provides a regulated 5-volt power supply. It can be used to power external components that require 5V.

Usage: You can use the 5V pin to supply power to sensors, displays, or other components that require a 5V input.

Voltage: The voltage on this pin is stable and regulated to 5V.

3.3V Pin:

Definition: The 3.3V pin provides a regulated 3.3-volt power supply. It is suitable for components that operate at 3.3V.

Usage: Some sensors and modules, especially those designed for lower power consumption, may require a 3.3V supply. Use the 3.3V pin to provide power to such components.

Voltage: The voltage on this pin is stable and regulated to 3.3V.

VIN (Voltage In) Pin:

Definition: The VIN pin is used to supply an external voltage to the Arduino board, typically when the board is not powered via USB or an external power jack.

Usage: When powering the Arduino from an external source, like a battery or an external power supply, you can connect it to the VIN pin to provide power to the board.

Voltage: Ensure that the external voltage supplied to the VIN pin falls within the acceptable voltage range for your specific Arduino board.

6. IOREF (Input/output Reference) Pin:

Definition: The IOREF pin provides a reference voltage that indicates the voltage level at which the microcontroller operates.

Usage: It’s used as a reference for components that need to interface with the microcontroller, particularly in situations where voltage compatibility is important.

Voltage: The voltage level on the IOREF pin depends on the operating voltage of the microcontroller (e.g., 5V for most Arduino boards). It helps external components adapt to the board’s voltage level.

Understanding these different types of pins and their capabilities is crucial for effectively using Arduino boards in your projects. Each type of pin has specific functions and applications, and mastering their use will enable you to create a wide range of electronic projects.

Rain Drop Sensor Module:

The rain drop sensor module is a smart and low-cost rain sensing device. It has two parts i.e. a rain sensing pad and a control board. The sensitive sensing pad detects any water present on it while the control board reads these signals and can also binarize them. The rain drop module has a major application in the automobile industry. It can be used to monitor the rain and send closure requests to shutters or windows whenever the rain is detected. The post is a guide to help make your own smart project

Fig -: Rain Drop Sensor

Rain Drop Pin out:

The rain drop control sensor is embedded with LM393 voltage comparator, current limiting resistors to adjust signal states and divide the voltage and capacitors as biasing elements. The pin out of the Rain Drop Sensor module is as shown:

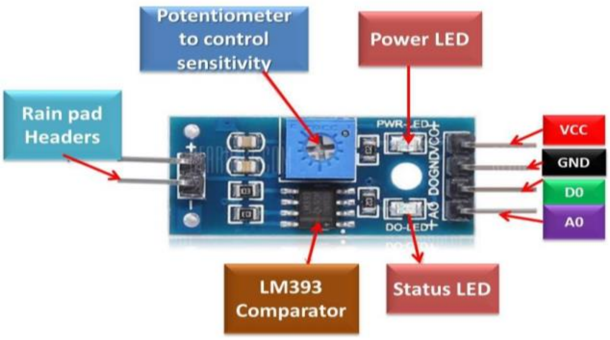

Fig: Rain Drop Pin out

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.

These sensors normally used to check volumetric water content, and another group of sensors calculates a new property of moisture within soils named water potential. Generally, these sensors are named as soil water potential sensors which include gypsum blocks and tensiometer.

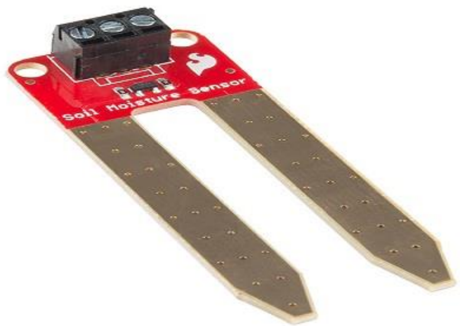

Fig- Soil Moisture Sensor Device

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

This module also includes a potentiometer that will fix the threshold value, & the value can be evaluated by the comparator-LM393. The LED will turn on/off based on the threshold value.

Relay

A Relay is a simple electromechanical switch. While we use normal switches to close or open a circuit manually, a Relay is also a switch that connects or disconnects two circuits. But instead of a manual operation, a relay uses an electrical signal to control an electromagnet, which in turn connects or disconnects another circuit.

Fig- Relay

Relays can be of different types like electromechanical, solid state. Electromechanical relays are frequently used. Let us see the internal parts of this relay before knowing about working of relay. Although many different types of relay were present, their working is same.

Every electromechanical relay consists of an consists of an

1.Electromagnet

2.Mechanically movable contact

3.Switching points and

4.Spring

ISSN 2277-2685
IJESR/July-Sep. 2025/ Vol-15/Issue-3/543-565

Electromagnet is constructed by wounding a copper coil on a metal core. The two ends of the coil are connected to two pins of the relay as shown. These two are used as DC supply pins.

LCD

LCD is a flat display technology, stands for "Liquid Crystal Display," which is generally used in computer monitors, instrument panels, cell phones, digital cameras, TVs, laptops, tablets, and calculators. It is a thin display device that offers support for large resolutions and better picture quality. The older CRT display technology has replaced by LCDs, and new display technologies like OLEDs have started to replace LCDs. An LCD display is most commonly found with Dell laptop computers and is available as an active-matrix, passive-matrix, or dual-scan display. The picture is an example of an LCD computer monitor.

The Liquid Crystal library allows you to control LCD displays that are compatible with the Hitachi HD44780 driver. There are many of them out there, and you can usually tell them by the 16-pin interface.

Fig- Output of the sketch on a 16x2 LCD

The LCDs have a parallel interface, meaning that the microcontroller has to manipulate several interface pins at once to control the display. The interface consists of the following pins:

- A **register select (RS) pin** that controls where in the LCD's memory you're writing data to. You can select either the data register, which holds what goes on the screen, or an instruction register, which is where the LCD's controller looks for instructions on what to do next.
- A **Read/Write (R/W) pin** that selects reading mode or writing mode
- An **Enable pin** that enables writing to the registers
- 8 **data pins (D0 -D7)**. The states of these pins (high or low) are the bits that you're writing to a register when you write, or the values you're reading when you read.

There's also a display contrast pin (Vo), power supply pins (+5V and GND) and LED Backlight (Bklt+ and BKlt-) pins that you can use to power the LCD, control the display contrast, and turn on and off the LED backlight, respectively.

The process of controlling the display involves putting the data that form the image of what you want to display into the data registers, then putting instructions in the instruction register. The Liquid Crystal Library simplifies this for you so you don't need to know the low-level instructions.

The Hitachi-compatible LCDs can be controlled in two modes: 4-bit or 8-bit. The 4-bit mode requires seven I/O pins from the Arduino, while the 8-bit mode requires 11 pins. For displaying text on the screen, you can do most everything in 4-bit mode, so example shows how to control a 16x2 LCD in 4-bit mode.

LCD Pin Description:

The LCD requires 3 control lines (RS, R/W, and EN) and 8(or 4) data lines. The number of data lines depends on the mode of operation. If operated in 8-bit mode then 8-bit data lines are required. And if the operation is in 4-bit mode then 4-bit data lines are required. The 8-bit mode is faster than the 4-bit mode. In 8-bit mode, LCD uses a total of 14 pins including 8 data lines, 3 control lines, and 3 power supply lines (Vee Vss and Vee)

1. Power Supply: The LCD discussed here uses three power supply pins (Vcc, Vss, and Vee) Vcc and Vss pins are used to provide +5V and ground respectively. The pin Vee is used for controlling LCD contrast.

2. Control Lines: There are three control lines in the LCD. These three are used to control the LCD operations There are two very important registers inside the LCD: the command register and the data register. The RS (Register select) pin is used to select the register out of these two. If RS = 0 the command register is selected and the user is allowed to send the command to the LCD. If RS = 1, the data register is selected and the data sent by the user is displayed on the LCD.

R / W (Read/ Write) pin allows the user to read/write the information (data or code) to/ from the LCD. R /W = 1 when reading and R/W=0 when the writing operation is performed.

Another control pin EN (Enable) is used to latch the data present on the data pins. A high-low signal is required to latch the data. The LCD interprets and executes the commands at the instant the EN line is brought low.

3. Data lines: The 8-bits data pins. D (0)-D (7) are used to send the information to the LCD or read the contents of the LCD's internal register.

LCD Interfacing:

The LCD can be interfaced to the microprocessor 8085 using the programmable peripheral interface (PPI-8255) IC. To display letters and numbers. ASCII code for the letters A to Z, a to 7, and numbers 0 to 9 is sent to the data lines (D0 -D7). These codes may be sent to LCD data lines through one port of 8255 (PPI), port A is used as the output port and send the data to the LCD. The EN pin and RS pin are connected to port B of the 8255. Since it is used as a normal display R/W is made low by connecting to the ground directly. Power supply connections are provided to Vcc and Vss pins. The Vee pin is connected to the EE moving node of the potentiometer which is connected between the Vcc and Vss pins. By moving the potentiometer the contrast of the LCD can be changed.

Buzzer

An audio signalling device like a beeper or buzzer may be electromechanical or piezoelectric or mechanical type. The main function of this is to convert the signal from audio to sound. Generally, it is powered through DC voltage and used in timers, alarm devices, printers, alarms, computers, etc. Based on the various designs, it can generate different sounds like alarm, music, bell & siren.

Buzzer Pin Configuration

The pin configuration of the buzzer is shown below. It includes two pins namely positive and negative. The positive terminal of this is represented with the '+' symbol or a longer terminal. This terminal is powered through 6Volts whereas the negative terminal is represented with the '-'symbol or short terminal and it is connected to the

ISSN 2277-2685
IJESR/July-Sep. 2025/ Vol-15/Issue-3/543-565
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GND terminal.

POWER SUPPLY:

REGULATED POWER SUPPLY

Virtually every component of an electronic system converts DC electricity. Therefore, the DC power source will be necessary for each of these stages. A battery can power any system that uses little electricity. However, batteries may not be the most straightforward or affordable option for gadgets that need constant power. An unregulated power supply, which includes a filter, rectifier, and transformer, is the most effective option. Down below, you can see the diagram.

The electrical circuits inside any given device must be capable of supplying a consistent DC voltage within the device's specified power supply limit. Both the voltage and the current may only go as high as this DC supply allows. The problem is that the electrical devices are vulnerable to breakdowns caused by fluctuations in the mains supply.

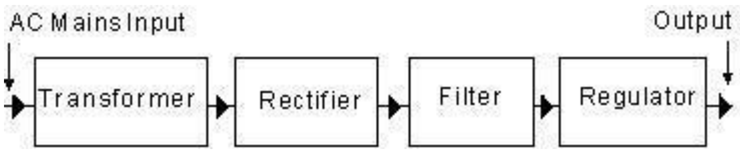

Fig 3.5 Block diagram of Regulated power supply

The DC power supply must reach a certain operating point, sometimes called the Q-point or quiescent point, for all electronic devices, active and passive. To lower the voltage to a level that electronics can handle, a step down transformer is used. A 230 volt 1 Ø supply is accessible in India. After passing through a rectifier, the sinusoidal AC voltage that the transformer produces becomes pulsing DC.

This output is used to reduce AC ripples by sending the DC components via a filter circuit. But there are several downsides to using an uncontrolled power source.

No matter what happens to the mains alternating current (ac) or how much the load fluctuates, a regulated power supply electrical circuit will keep the voltage between the load terminals at a constant direct current (dc).

Simply said, a regulated power supply is an ordinary power supply with a voltage regulator connected to it, as seen in the image. A conventional power supply supplies current to a voltage regulator, which in turn produces the desired output. An output voltage remains constant regardless of changes to either the ac input voltage or the output (or load) current..

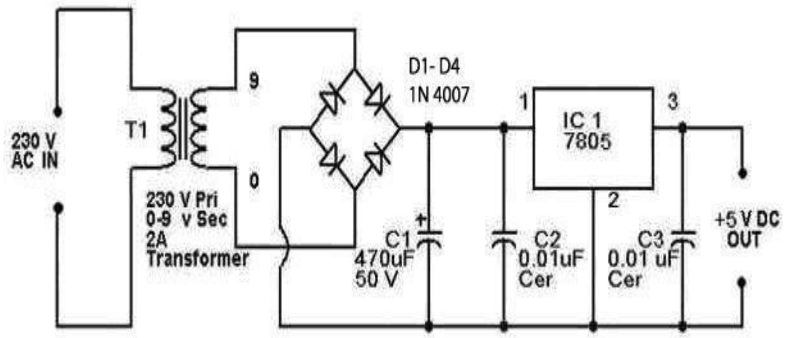

Fig 3.6 Circuit diagram of Regulated power supply

TRANSFORMER

Simply said, a transformer is a static device that aids in the conversion of electrical power from one circuit to another, while maintaining the same frequency. In a circuit, changing the voltage requires changing the current ratings in a direct proportional fashion.

TRANSFORMER WORKING PRINCIPLE

A transformer operates on the principle of mutual inductance, which occurs when two circuits linked by a common magnetic flux experience a change in current. Two electrically separate coils that are inductively linked are magnetically coupled via a reluctance channel to make a basic transformer. To better grasp the operation of the transformer, refer to the diagram provided below.

Below, you can see the primary and secondary windings of a power transformer. In the core's cross-section, you can make see the little spaces that exist between the lamination strips. Imbricated is the word that best defines these staggered joints. The two coils have a rather large mutual inductance.A mutual electromotive force is induced in the transformer by the coil, which is connected to an alternating voltage source, via the alternating flux that builds up in the laminated core.

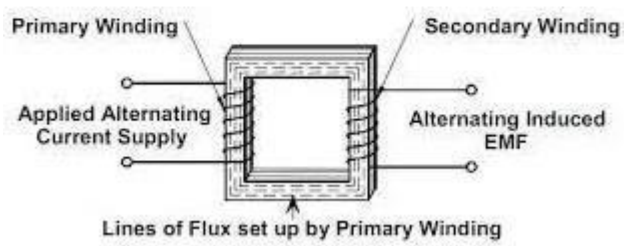

Fig 3.7 Working principle of Transformer

The majority of the alternating current generated by this coil is coupled with the other coil, resulting in the production of the electromotive force that is produced mutually. Using Faraday's equations of electromagnetic induction, we can describe the so-produced electromotive force as

$e=M*dI/dt$

- A current runs through the second coil circuit while it is closed, allowing electrical energy to be magnetically transferred from the first coil to the second.The first coil, often known as the main winding, receives the alternating current source. Another name for the second coil, which is where the energy is extracted, is the secondary winding.
- To summarise, a transformer is responsible for the following tasks:
- The movement of current from one electrical circuit to another.
- The conveyance of electrical energy with no alteration to the frequency.
- Use electromagnetic induction as a means of transfer.
- Two electrical circuits are connected by the principle of mutual induction.

CLASSIFICATION OF TRANSFORMER

- Step-Up Transformer
- Step-Down Transformer

Step-Down Transformer

Typically, a step down transformer will reduce the voltage from a higher level or phase arrangement to a lower one. They may have functions for control and instrumentation, power distribution, and electrical isolation. The conversion of voltage and/or current levels is accomplished by step down transformers by use of the magnetic induction concept between coils. As an example, consider a 2:1 ratio of 100 main turns to 50 secondary turns. Simply said, step down transformers are devices that convert voltages.

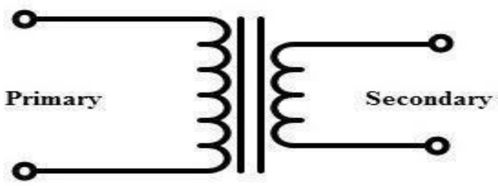

Fig 3.8 Step Down Transformer

Step-Up Transformer

A step-up transformer's secondary coil has more turns of wire, resulting in a higher induced voltage. The transformer is referred to as a step up transformer due to the fact that the voltage output exceeds the input voltage. The design of a step-up transformer is characterised by a secondary voltage that is higher than the primary voltage, in this case 110v 220v. When used with a higher voltage, this transformer "steps up" the current. To operate a 220v appliance in a nation that uses a 110v power source, for example, a step up transformer is required. Transforming one voltage into another is the job of a step up transformer, which can handle alternating current (AC) of 110v to 220v. It is able to "step-up" or "step-down" voltage and operates on the concept of magnetic induction; it does not have any moving components. Accordingly, voltage may be increased using a step-up transformer and decreased using a step-down transformer.

ISSN 2277-2685
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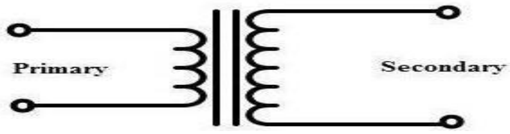


Fig 3.9 Step Up Transformer

FULL WAVE RECTIFIER

If a waveform has both positive and negative cycles, a full wave rectifier will rectify both of them. The average output of this full-wave rectifier is greater than that of a half-wave rectifier, which is one of its advantages. The output has fewer alternating current (AC) components than the input.

There are essentially many subtypes of full wave rectifiers.

- Centre Tapped Full Wave Rectifier
- Full Wave Bridge Rectifier

The bottom half of the transformer will be positively correlated with the top half during the subsequent cycle. Which means that diodes D2 and D3 are forward biassed during this cycle. The current travels down route 3-2 before turning around and heading back up path 4-1.Reverse bias is present in diodes D1 and D4. Therefore, pathways 1-2 and 3-4 do not carry any current.This fixes the negative cycle, and it shows up throughout the load.

Components involved in filter Circuit

The inductor and capacitor are the standard components of a filter circuit. A capacitor only lets current flow in one direction, whereas an inductor only lets direct current (DC) through. This means that inductors and capacitors, when combined, may filter the signal effectively for different applications.

CAPACITOR FILTER

A high-value capacitor, positioned across the load resistor, makes up this filter. This capacitor is charged during the conducting phase and then used to provide energy to the load when it is not conducting. By doing so, the ripple component is greatly reduced and the time length that the current travels through the load resistor is increased.

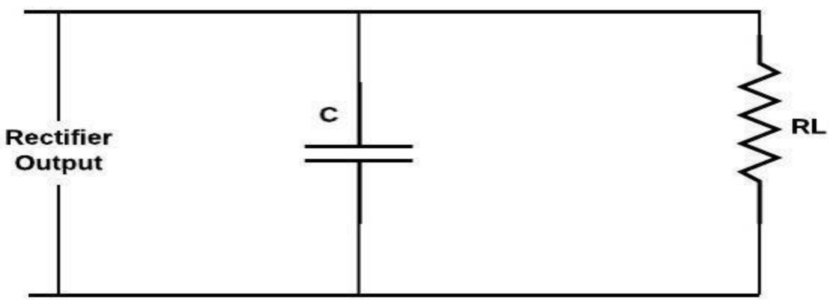


Fig 3.14 Capacitor Filter

The function of the capacitor filte may be viewed in terms of

Impedance $\frac{1}{2\pi + f + C}$ to the ripple component of frequency f. this ripple, component of current, therefore, gets bypassed through C and only dc component flows through the load resistor R_L.

VOLTAGE REGULATOR

A voltage regulator is a kind of electrical regulator that is specifically designed to automatically keep the voltage level constant. A combination of active and passive electrical components, as well as an electromechanical mechanism, might be used. A number of AC or DC voltages may be controlled by it, depending on its architecture.

The purpose of a voltage regulator is to "regulate" the voltage level automatically. It takes the input voltage and reduces it to the required level, then maintains that level throughout the supply. As a result, the voltage remains constant regardless of the supplied load.

All three of these pins are regulators..

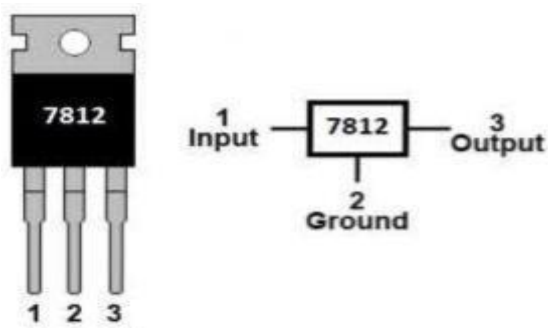
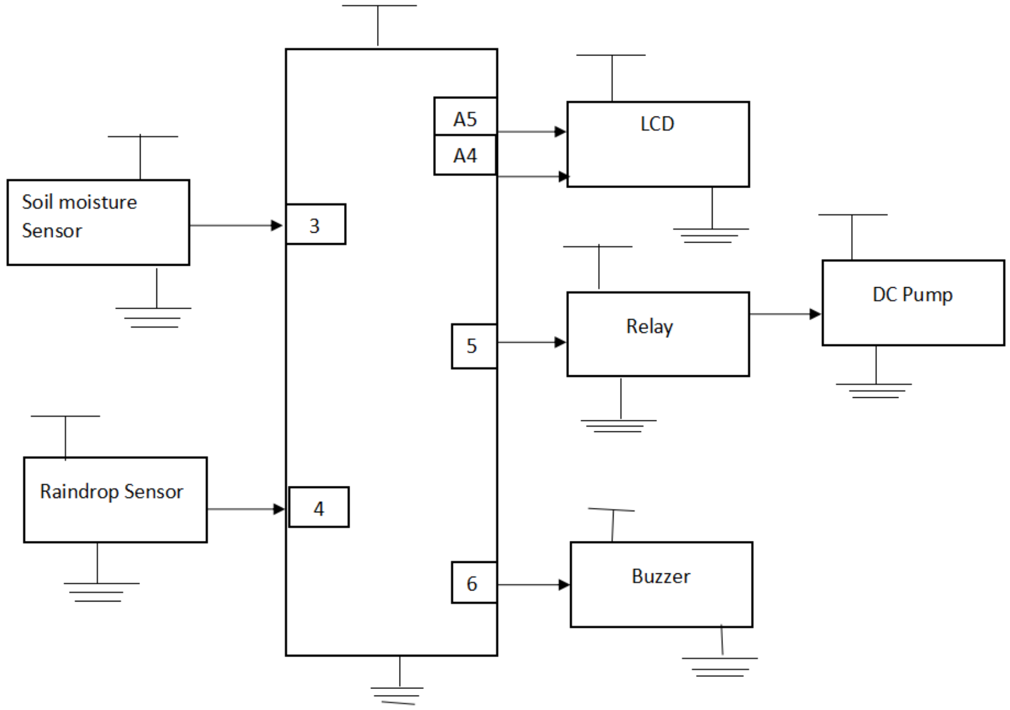


Fig 3.15 12 V Voltage Regulator

There are two types of regulator are they.

- Positive Voltage Series (78xx) and
- Negative Voltage Series (79xx)

V. Schematic Diagram



VI. Result

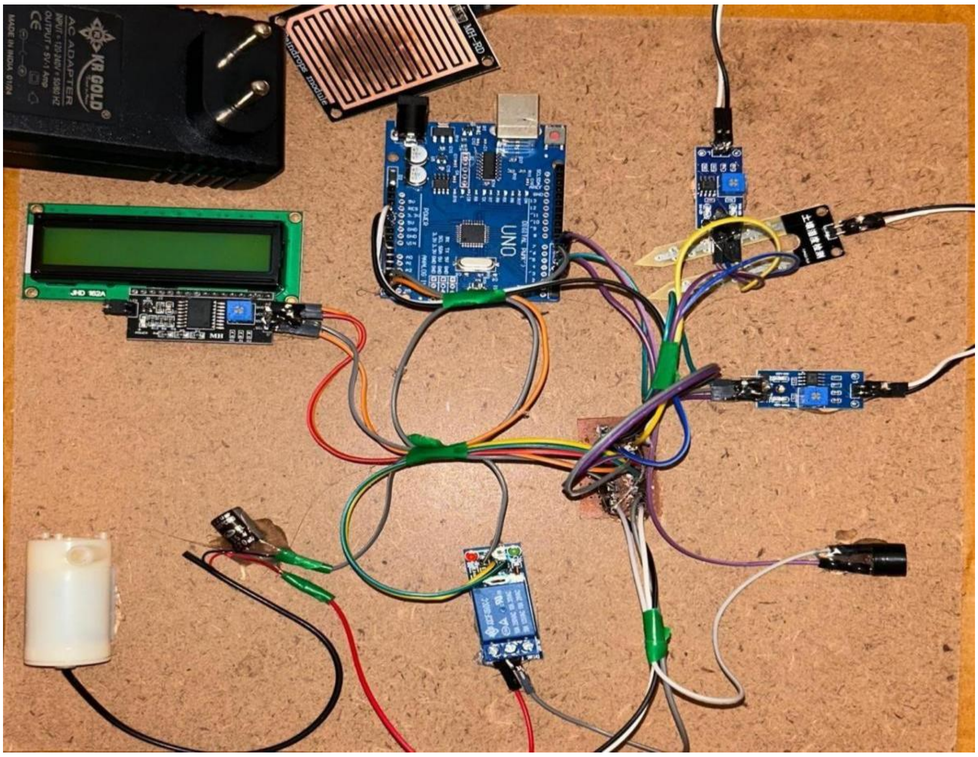


Fig 7.1- Hardware Kit

ISSN 2277-2685
IJESR/July-Sep. 2025/ Vol-15/Issue-3/543-565
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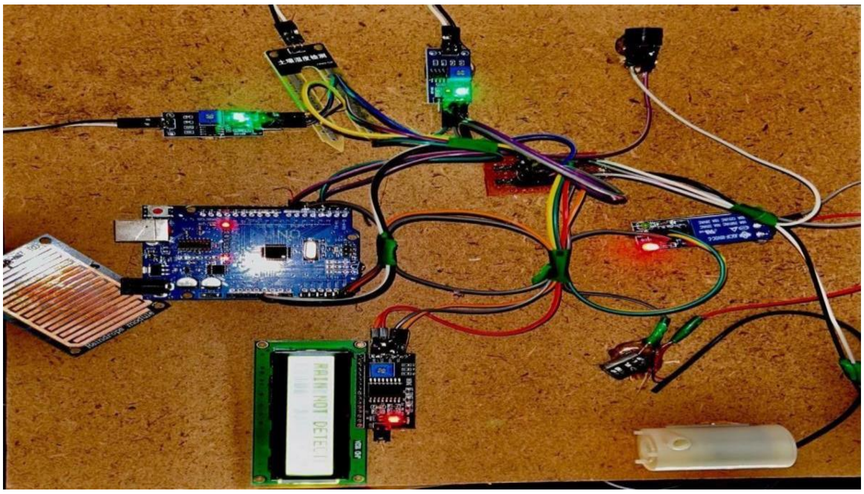

Fig 7.2- Hardware Kit When Supply is ON

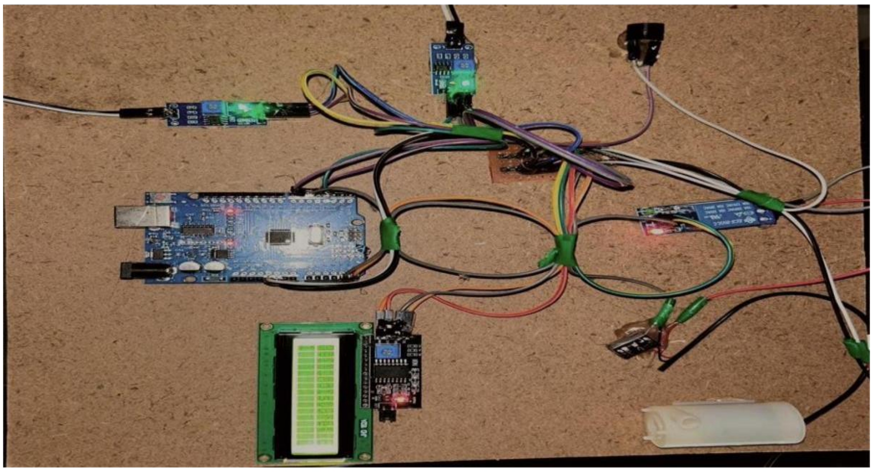

Fig 7.3- Soil Moisture Sensor is Activated

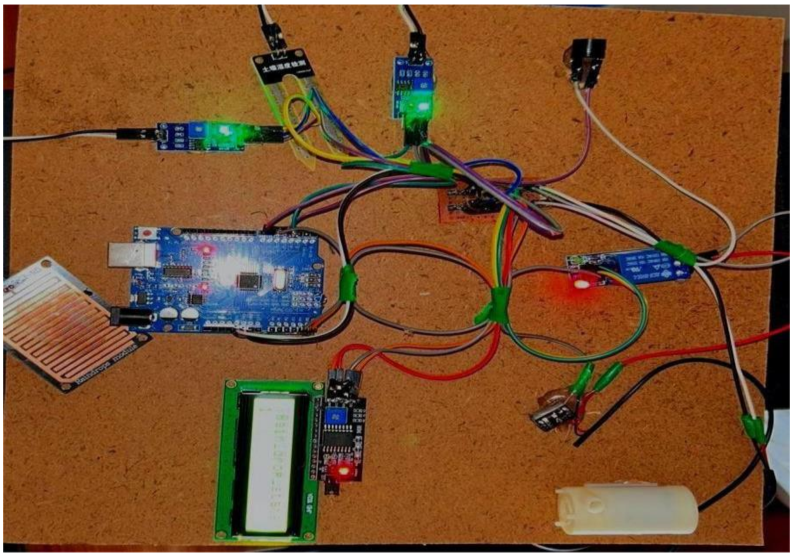

Fig 7.4- Rain Drop Sensor Detected Rain

Results:

The working principle of this project is based on the automated monitoring and control of irrigation using real-time data from environmental sensors. The system is designed to detect the moisture level in the soil and the presence of rainfall, and based on these inputs, it decides whether to activate or deactivate the water pump.

At the heart of the system is the Arduino Uno microcontroller, which continuously receives analog signals from a soil moisture sensor. This sensor measures the water content in the soil and sends a voltage signal corresponding to the moisture level. When the moisture content falls below a predefined threshold value (indicating dryness), the Arduino interprets this as a signal to initiate irrigation.

Before activating the pump, the system checks for rainfall using a raindrop sensor. If no rain is detected, the Arduino sends a signal to a relay module, which in turn powers the DC water pump. This allows water to be supplied to the soil automatically. If rain is detected by the raindrop sensor, the pump remains off, thereby avoiding unnecessary watering.

Throughout the operation, the system provides live updates on a 16x2 LCD display, which shows information such as the moisture level, rain detection status, and pump activity. In addition, a buzzer is included to produce an audible alert when the soil is extremely dry or when irrigation is triggered, enhancing user awareness and system interactivity.

Once the soil moisture reaches the desired level, the Arduino automatically turns off the pump to stop irrigation. This closed-loop control ensures optimal water usage and eliminates the need for manual supervision. The combination of sensor input, real-time processing, and actuator control forms a reliable and intelligent irrigation system.

This working mechanism ensures that water is supplied only when necessary, thus conserving water, improving crop health, and reducing labor effort.

The system is scalable, and the logic can be further extended to support larger areas or more advanced monitoring techniques using additional sensors or wireless communication modules.

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