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PROJECT REPORT

SMART IRRIGATION SYSTEM USING THE ARDUNIO UNO

Submission presented to

Hemchandracharya North Gujarat University, Patan

FOR THE DEGREE OF MASTER OF SCIENCE IN PHYSICS BY

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"CERTIFICATE"

THIS IS TO CERTIFY THAT THE PROJECT WORK ENTITLED **"SMART IRRIGATION SYSTEM USING THE ARDUNIO UNO"** IS CARRIED OUT BY STUDENTS MENTIONED BELLOW, INPARTIAL FULFILLMENTS FOR THE AWARD OF DEGREE OF MASTER OF SCIENCE IN PHYSICS DURING THE ACADEMIC YEAR 2022-2023.

THE PROJECT HAS BEEN APPROVED REQUIREMENTS IN RESPECT OF PROJECT WORK PRESCRIBED FOR THE MASTER OF SCIENCE

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1.0 ABSTRACT

Current global technology plays an important role in the field of agriculture. Automation is the technology with which a procedure or process is executed without human assistance. The main objective of this work is to determine how a person can use the automatic irrigation system of his own moderately economical facilities in a few hours to connect some electronic components and other materials. An automatic irrigation system based on sensor-based systems has been designed and implemented as one of the most widely used and advantageous automatic systems. This will help people in their daily activities, thus saving them time and hard work. This system uses sensor technology with the microcontroller, relay, DC motor and battery. Behave as an intelligent switching system that detects the soil moisture level and irrigates the plant if necessary. The ON / OFF motor will automatically be based on the dryness level of the soil. This type of irrigation system is easily controlled and controlled using a computer. In general, this system applies automatically for small and large gardens, nurseries, greenhouses and green roofs. This will also save time and energy, as well as minimize water loss. It will also help the farmer to benefit from the plantation without solving irrigation planning problems.

Keywords: Smart irrigation, agriculture, engineering, intelligent switching, sensor-based systems.

1.1 INTRODUCTION TO IRRIGATION SYSTEM

Freshwater is needed for crop and energy production, industrial fabrication as well as human and ecosystem needs. According to AQUASTAT database (AQUASTAT, 2016), 69% of the total extracted freshwater is used by agriculture sector, whereas 19% is used by industrial sector and the rest in used by domestic segment. Therefore, water can be considered as a critical need in agriculture sector for future global food security However, continued increase in demand for water by domestic and industrial sectors and greater concerns for environmental quality have create a challenge to every country to reduce the farm water consumption and sustain the fresh food requirement. (Consequently, there is an urgent need to create strategies based on science and technology for sustainable use of water. Industrialist and researchers are working to build efficient and economic automatic systems to control water usage in order to reduces much of the wastage. Irrigation is an artificial application of watering the land for agricultural production. The requirement of water to the soil depends on soil properties such as soil moisture and soil temperature. Effective irrigation can influence the entire growth process and automation in irrigation system using modern technology can be used to provide better irrigation management. In general, most of the irrigation systems are manually operated. These traditional techniques can be replaced with automated techniques of irrigation in order to use the water efficiently and effectively. Conventionally, farmers will present in their fields to do irrigation process. Nevertheless, now a day's farmers need to manage their agricultural activity along with other occupations. A sensor based automated irrigation system provides promising solution to farmers where the presence of a farmer in field is not compulsory during irrigation process. Arduino is a flexible programmable hardware platform and designed to control the circuit logically. Central to the Arduino interface board is the main component of an integrated circuit chip that can be programmed using C++ language. This microcontroller is an AVR type, which produced by Atmel firm. The device can read the input, process the program, and produce many outputs based on project requirements. In this chapter, the development of an automated irrigation system based on Arduino microcontrollers is presented. In this system, a soil moisture sensor is used to detect and check the soil humidity of the plant. Based on the soil moisture level from the soil, the system will let the water pump to automatic water the plant when it is too dry and turn off the water pump when the soil of the plant is wet.

1.2 AUTOMATED WATERING TECHNIQUES

At the previous works, considering to the automated watering techniques, it can be found that the Arduino based sensors have been utilized for the plant watering system and automated irrigation. An Arduino Based Automatic Plant Watering System is proposed in where the authors developed the Arduino microcontroller used to control two functional components which are the moisture sensors and the motor/water pump to automatically water the plant. The moisture sensor's function is to sense the level of moisture in the soil whereas the water pump supplies water to the plants. In a smart drip irrigation system using Raspberry Pi and Arduino is proposed for home automation system. A drip irrigation system makes the efficient use of water where the water is slowly dripped to the roots of the plants through narrow tubes and valves. The water flow from the system can be remotely controlled.

2.0 BLOCK DIAGRAM OF SMART IRRIGATION SYSTEM USING THE ARDUNIO UNO

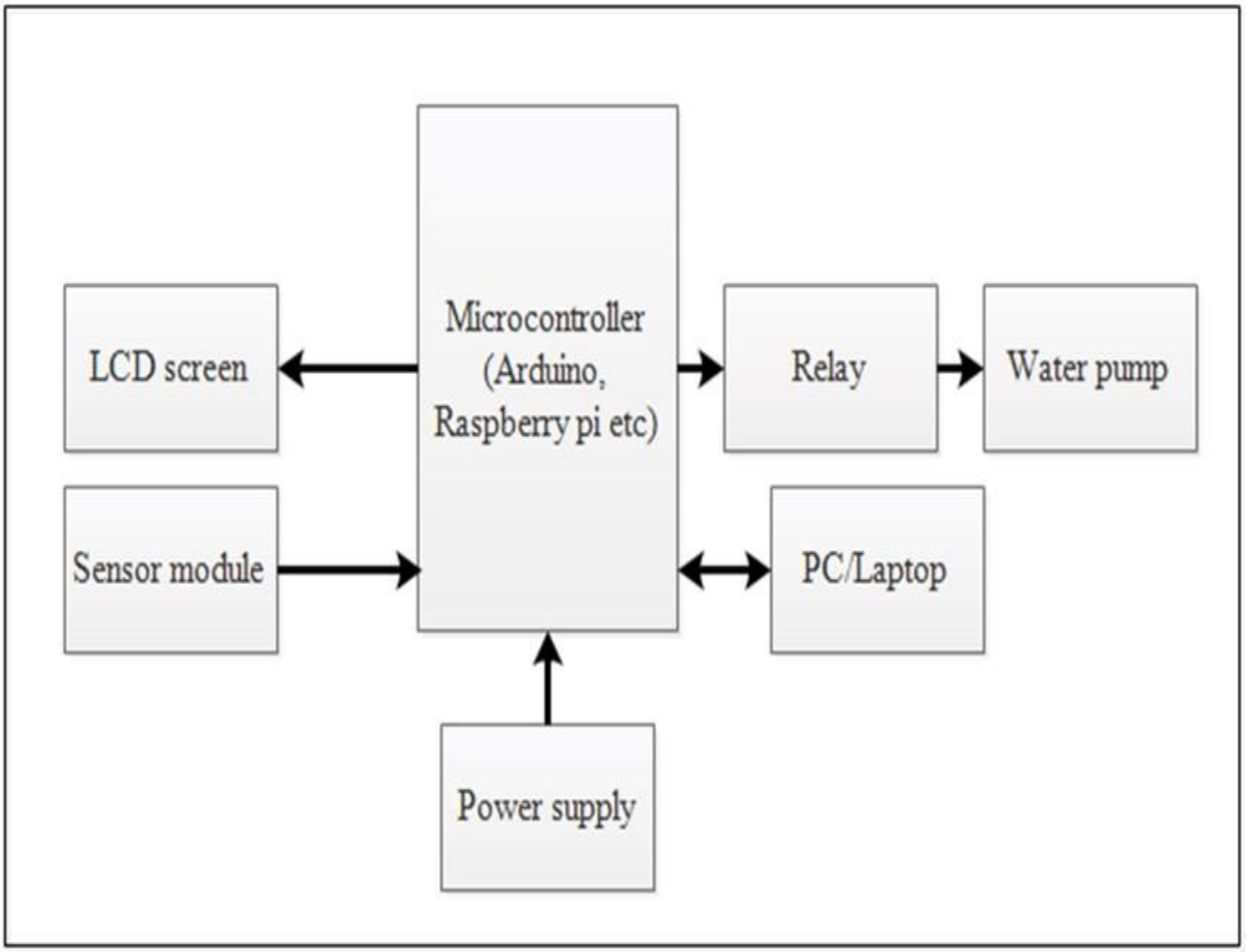

Fig 2.0 BLOCK DIAGRAM OF SMART IRRIGATION SYSTEM USING THE ARDUNIO UNO

2.1 BLOCK DIAGRAM DESCRIPTION

The following hardware and software in used in this system detailed explanation of these component follow in the later sections.

2.2 HARDWARE COMPONENT

1. Arduino UNO
2. Soil moisture sensor
3. Liquid crystal display
4. I2C module
5. Relay module 5v
6. Dc 12V water pump
7. 5 Volts battery
8. Battery cap
9. Jumper wire
10. 12V power supply

2.3 SOFTWARE COMPONENT

(1) Arduino IDE software programming

3.0 SCHEMATIC CIRCUIT DIAGRAM

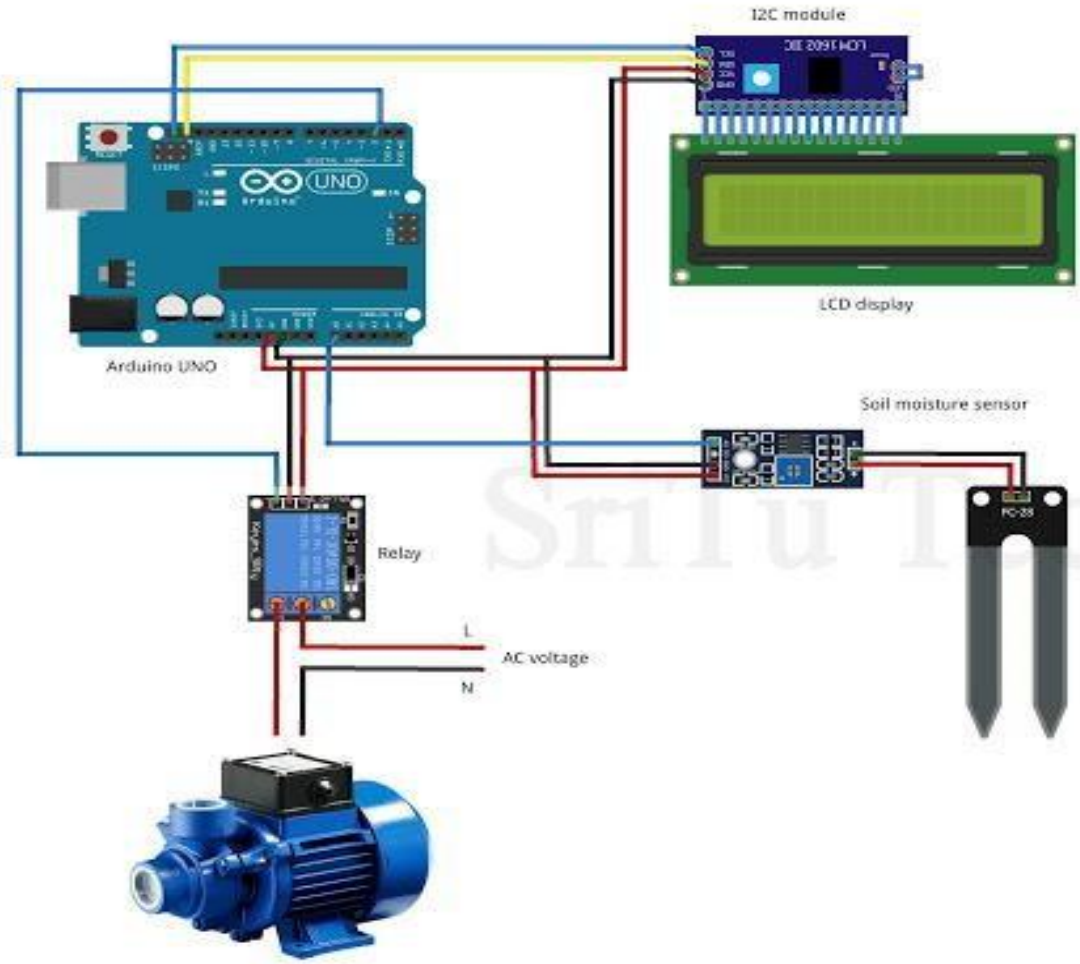

FIG 3.1 SCHEMATIC CIRCUIT DIAGRAM

3.1 WORKING PROCESS

The required connection of the automatic irrigationsystem is
(1) indicates the power supply,
(2) indicates the relay module,
(3) indicates microcontroller,
(4) indicates the soil moisture sensor,
(5) indicates the humidity probes of the soil,
(6) indicates the plant in the pot,
(7) indicates the water pump and
(8) indicates the water container or the water source.

In the first cable of 3 bridges connected to the soil moisture sensor, 3 jumper cables, one connected to GND, one connected to the VCC and the lastoneconnected to the 9port. Therefore, another part of the jumper cables connected to the Arduino board, i.e. the VCC of the bridge cable is connected to the Arduino 5v, the GND connected to the GND and the ground moisture

sensor port 9 is connected to the Pin 9 of the Arduino board. These connections are shared between the soil moisture sensor and the Arduino board. Therefore, the connection between the relay module and the Arduino board has been established. The GND port of the relay goes to ground. The first IN port is connected to an Arduino digital pin and this connection controls the first relay channel. When we connect the battery to the relay, a supply is supplied to a load. There is always a connection between the COM pin and the NC pin even when the relay is switched off. After connecting all the equipment, the main operation begins. The measurement of soil moisture is carried out by the sensor that sends the information and parameters relating to soil moisture to the microcontroller that controls the pump. If the soil moisture levels fall below a certain value, the microcontroller sends the signals to the relay module, which then drives a pump and a certain amount of water is delivered to the system. Once the water has been delivered to the system, the water If the drying value is higher than the given value 400, the pump will turn on and start to irrigate in the system, when the value is equal to or lower than the given value, the pump will switch off and irrigation in the field will be completed. If we want to flood the system or the field, the humidity sensor remains at a higher level or the programming value must be lower than the previous fixed value.

3.2 WORKING PRINCEPLE

In This Plant Watering System, Soil Moisture Sensor checks the moisture level in the soil and if moisture level is low then Arduino switches On a water pump to provide water to the plant. Water pump gets automatically off when system finds enough moisture in the soil. Whenever system switched On or off the pump. This system is very useful in Farms, gardens, home etc. This system is completely automated and there is no need for any human intervention.

(4.0)HARDWARE COMPONENT DESCRIPTION

4.1 ARDUNIO UNO

The **Arduino Uno** is an open-source microcontroller board based on the Microchip ATmega328P microcontroller and developed by Arduino.cc. The board is equipped with sets of digital and analog input/output (I/O) pins that may be interfaced to various expansion boards (shields) and other circuits. The board has 14 digital I/O pins (six capable of PWM output), 6 analog I/O pins, and is programmable with the Arduino IDE (Integrated Development Environment), via a type B USB cable. It can be powered by the USB cable or by an external 9-volt battery, though it accepts voltages between 7 and 20 volts. It is similar to the Arduino Nano and Leonardo. The hardware reference design is distributed under a Creative Commons Attribution Share-Alike 2.5 license and is available on the Arduino website. Layout and production files for some versions of the hardware are also available.

The word "Uno" means "one" in Italian and was chosen to mark the initial release of Arduino Software.The Uno board is the first in a series of USB-based Arduino boards; it and version 1.0 of the Arduino IDE were the reference versions of Arduino, which have now evolved to newer releases. The ATmega328 on the board comes pre-programmed with a bootloader that allows uploading new code to it without the use of an external hardware programmer.

While the Uno communicates using the original STK500 protocol, it differs from all preceding boards in that it does not use the FTDI USB-to-serial driver chip. Instead, it uses the Atmega16U2 (Atmega8U2 up to version R2) programmed as a USB-to-serial converter.

The Arduino Uno board is a microcontroller based on the ATmega328. It has 14 digital input/output pins in which 6 can be used as PWM outputs, a 16 MHz ceramic resonator, an ICSP header, a USB connection, 6 analog inputs, a power jack and a reset button.

As we discussed we know that Arduino Uno is the most standard board available and probably the best choice for a beginner. We can directly connect the board to the computer via a USB Cable which performs the function of supplying the power as well as acting as a serial port.

ARDUNIO UNO PINOUT

As we discussed we know that Arduino Uno is the most standard board available and probably the best choice for a beginner. We can directly connect the board to the computer via a USB Cable which performs the function of supplying the power as well as acting as a serial port.

Vin: This is the input voltage pin of the Arduino board used to provide input supply from an external power source.

5V: This pin of the Arduino board is used as a regulated power supply voltage and it is used to give supply to the board as well as on-board components.

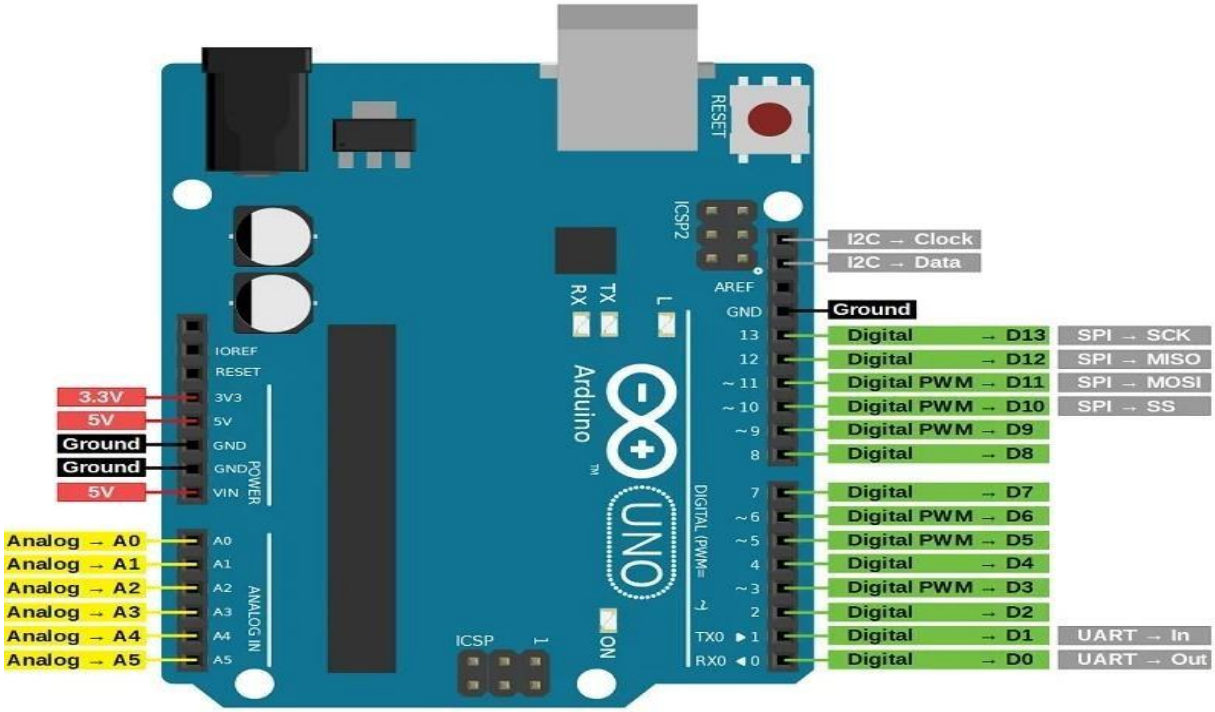

FIG 4.1.1 ARDUNIO UNO

3.3V: This pin of the board is used to provide a supply of 3.3V which is generated from a voltage regulator on the board

GND: This pin of the board is used to ground the Arduino board.

Reset: This pin of the board is used to reset the microcontroller. It is used to Resets the microcontroller.

Analog Pins: The pins A0 to A5 are used as an analog input and it is in the range of 0-5V.

Digital Pins: The pins 0 to 13 are used as a digital input or output for the Arduino board.

Serial Pins: These pins are also known as a UART pin. It is used for communication between the Arduino board and a computer or other devices. The transmitter pin number 1 and receiver pin number 0 is used to transmit and receive the data resp.

External Interrupt Pins: This pin of the Arduino board is used to produce the External interrupt and it is done by pin numbers 2 and 3.

PWM Pins: This pins of the board is used to convert the digital signal into an analog by varying the width of the Pulse. The pin numbers 3,5,6,9,10 and 11 are used as a PWM pin.

SPI Pins: This is the Serial Peripheral Interface pin; it is used to maintain SPI communication with the help of the SPI library. SPI pins include:

1. SS: Pin number 10 is used as a Slave Select
2. MOSI: Pin number 11 is used as a Master Out Slave In
3. MISO: Pin number 12 is used as a Master In Slave Out
4. SCK: Pin number 13 is used as a Serial Clock

LED Pin: The board has an inbuilt LED using digital pin-13. The LED glows only when the digital pin becomes high.

AREF Pin: This is an analogreference pin of the Arduino board. It is used to provide a reference voltage from an external power supply.

Arduino Uno pinout - Power Supply

There are 3 ways to power the Arduino Uno:

Barrel Jack - The Barrel jack, or DC Power Jack can be used to power your Arduino board. The barrel jack is usually connected to a wall adapter. The board can be powered by 5-20 volts but the manufacturer recommends to keep it between 7-12 volts. Above 12 volts, the regulators might overheat, and below 7 volts, might not suffice.

VIN Pin - This pin is used to power the Arduino Uno board using an external power source. The voltage should be within the range mentioned above.

USB cable - when connected to the computer, provides 5 volts at 500mA.

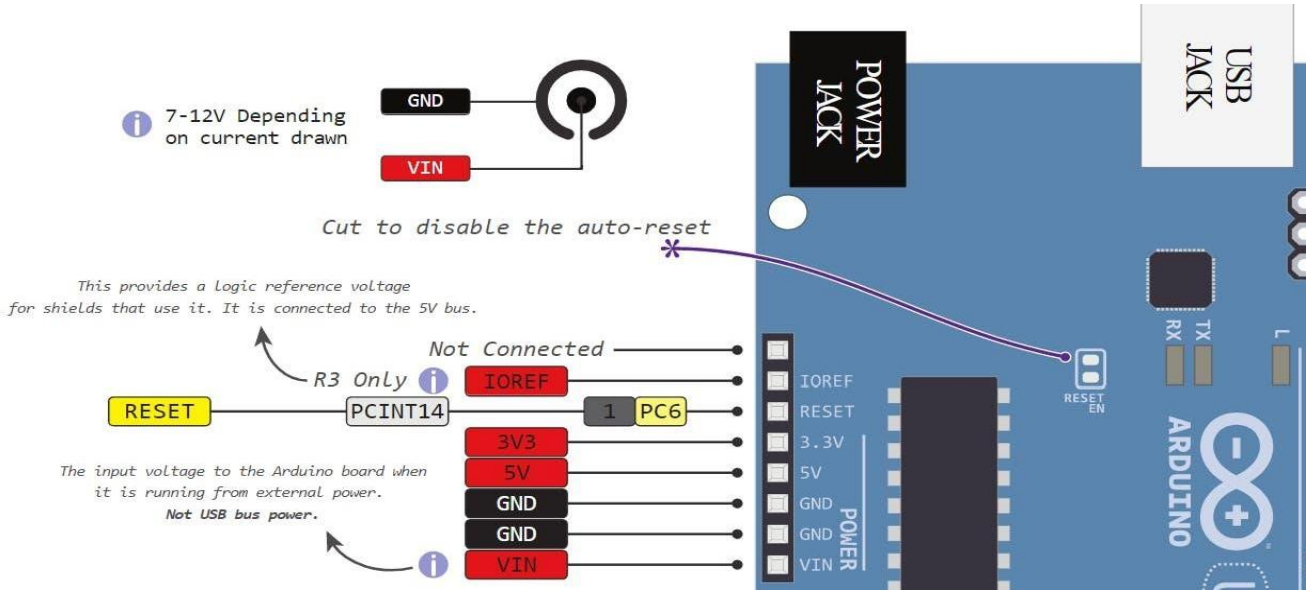

FIG 4.1.2 ARDUINO UNO PINOUT - POWER SUPPLY

There is a polarity protection diode connecting between the positive of the barrel jack to the VIN pin, rated at 1 Ampere.

The power source you use determines the power you have available for your circuit. For instance, powering the circuit using the USB limits you to 500mA. Take into consideration that this is also used for powering the MCU, its peripherals, the on-board regulators, and the components connected to it. When powering your circuit through the barrel jack or VIN, the maximum capacity available is determined by the 5 and 3.3 volts regulators on-board the Arduino.

5v and 3v3

They provide regulated 5 and 3.3v to power external components according to manufacturer specifications.

GND

In the Arduino Uno pinout, you can find 5 GND pins, which are all interconnected.
The GND pins are used to close the electrical circuit and provide a common logic reference level throughout your circuit. Always make sure that all GNDs (of the Arduino, peripherals and components) are connected to one another and have a common ground.

RESET - resets the Arduino

IOREF - This pin is the input/output reference. It provides the voltage reference with which the microcontroller operates.

Arduino Uno Pinout - Analog IN

The Arduino Uno has 6 analog pins, which utilize ADC (Analog to Digital converter).
These pins serve as analog inputs but can also function as digital inputs or digital outputs.

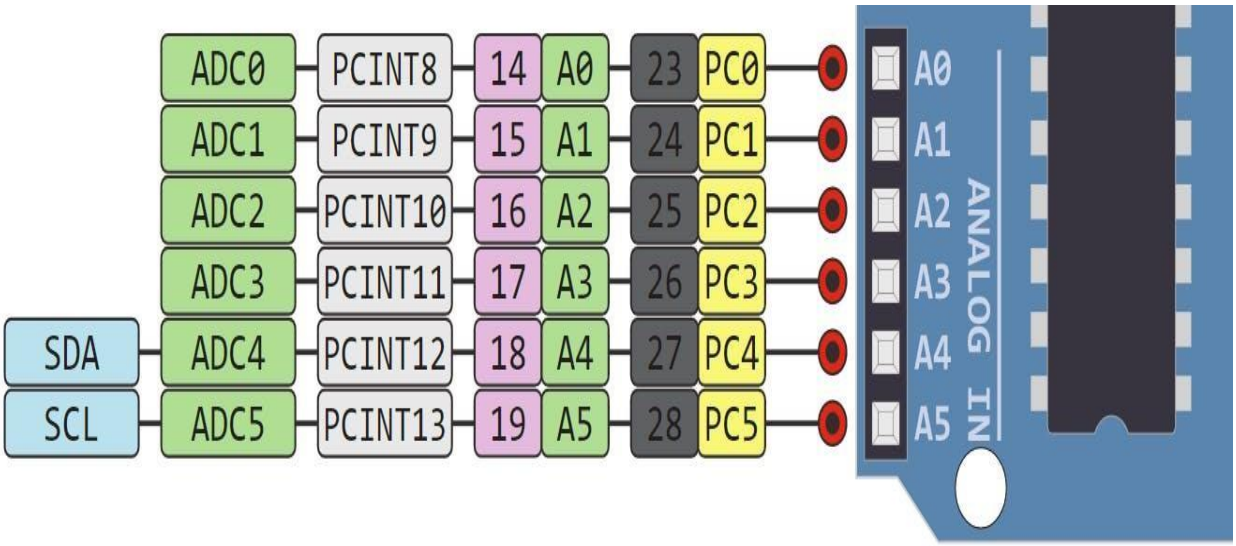

FIG 4.1.3 ARDUINO UNO PINOUT - ANALOG IN

Advantages and Disadvantages of Arduino:

It is very good for carrying out a specific project you may have in mind, especially if you can find the right shield but it doesn't teach you much about microcontrollers and the AVR in particular. For quick results, it is great but it won't help you learn microelectronics or programming.

Advantages

- Not much knowledge required to get started
- Fairly low cost, depending on shields you need
- Lots of sketches and shields available
- No external programmer or power supply needed

Disadvantages

- No understanding of the AVR microcontroller
- Sketches and shields can be difficult to modify
- No debugger included for checking scripts
- You get no experience of C or professional development tools

4.2 SOIL MOISTURE SENSOR

Soil Moisture Sensor Module

This soil moisture sensor module is used to detect the moisture of the soil. It measures the volumetric content of water inside the soil and gives us the moisture level as output. The module has both digital and analog outputs and a potentiometer to adjust the threshold level. MMoisture Sensor Module Pinout Configuration

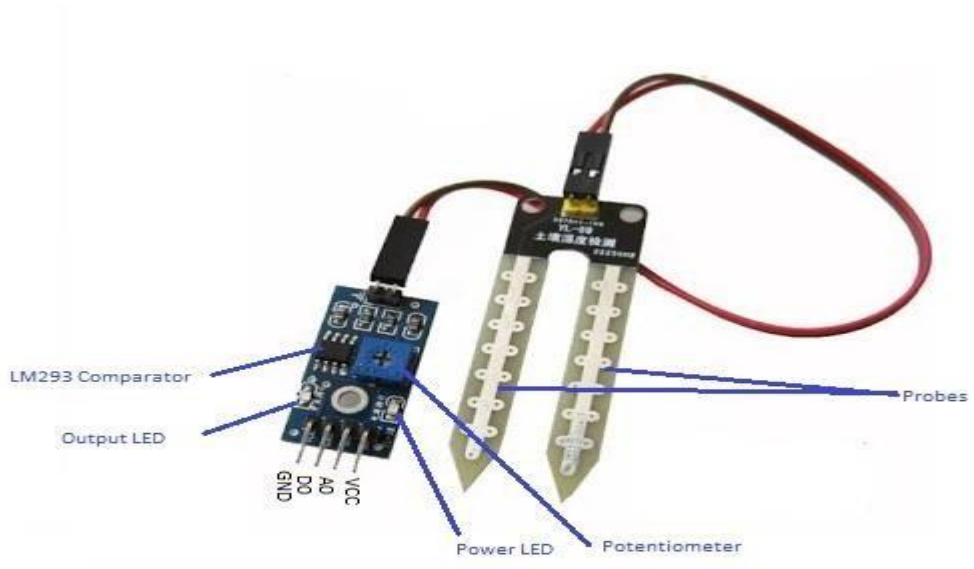

FIG 4.2.1 SOIL MOISTURE SENSOR MODULE

MOISTURE SENSOR MODULE PINOUT TABLE:

Pin Name	Description
VCC	The Vcc pin powers the module, typically with +5V
GND	Power Supply Ground
DO	Digital Out Pin for Digital Output.
AO	Analog Out Pin for Analog Output

Moisture Sensor Module Features & Specifications

- Operating Voltage: 3.3V to 5V DC
- Operating Current: 15mA
- Output Digital - 0V to 5V, Adjustable trigger level from present
- Output Analog - 0V to 5V based on infrared radiation from fire flame falling on the sensor
- LEDs indicating output and power
- PCB Size: 3.2cm x 1.4cm
- LM393 based design
- Easy to use with Microcontrollers or even with normal Digital/Analog IC
- Small, cheap and easily available

Brief about Soil Moisture Sensor Module

- This Moisture sensor module consists of a Moisture sensor, Resistors, Capacitor, Potentiometer, Comparator LM393 IC, Power and Status LED in an integrated circuit.

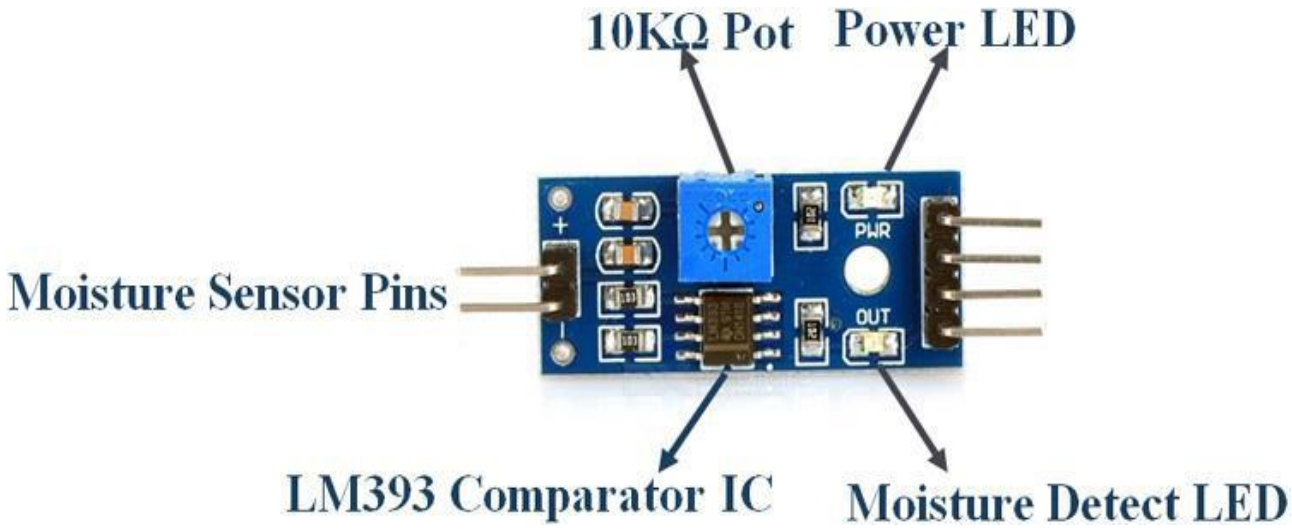

FIG 4.2.2 BRIEF ABOUT SOIL MOISTURE SENSOR

❖ **LM393 IC**

LM393 Comparator IC is used as a voltage comparator in this Moisture sensor module. Pin 2 of LM393 is connected to Pre-set (10KΩ Pot) while pin 3 is connected to Moisture sensor pin. The comparator IC will compare the threshold voltage set using the pre-set (pin2) and the sensor pin (pin3).

❖ **Moisture Sensor**

The moisture sensor consists of two probes that are used to detect the moisture of the soil. The moisture sensor probes are coated with immersion gold that protects Nickel from oxidation. These two probes are used to pass the current through the soil and then the sensor reads the resistance to get the moisture values.

❖ **Preset (Trimmer pot)**

Using the onboard preset you can adjust the threshold (sensitivity) of the digital output.

❖ **How to Use Soil Moisture Sensor Module**

Moisture sensor module consists of four pins i.e. VCC, GND, DO, AO. Digital out pin is connected to the output pin of LM393 comparator IC while the analog pin is connected to Moisture sensor. The internal Circuit diagram of the Moisture sensor module is given below.

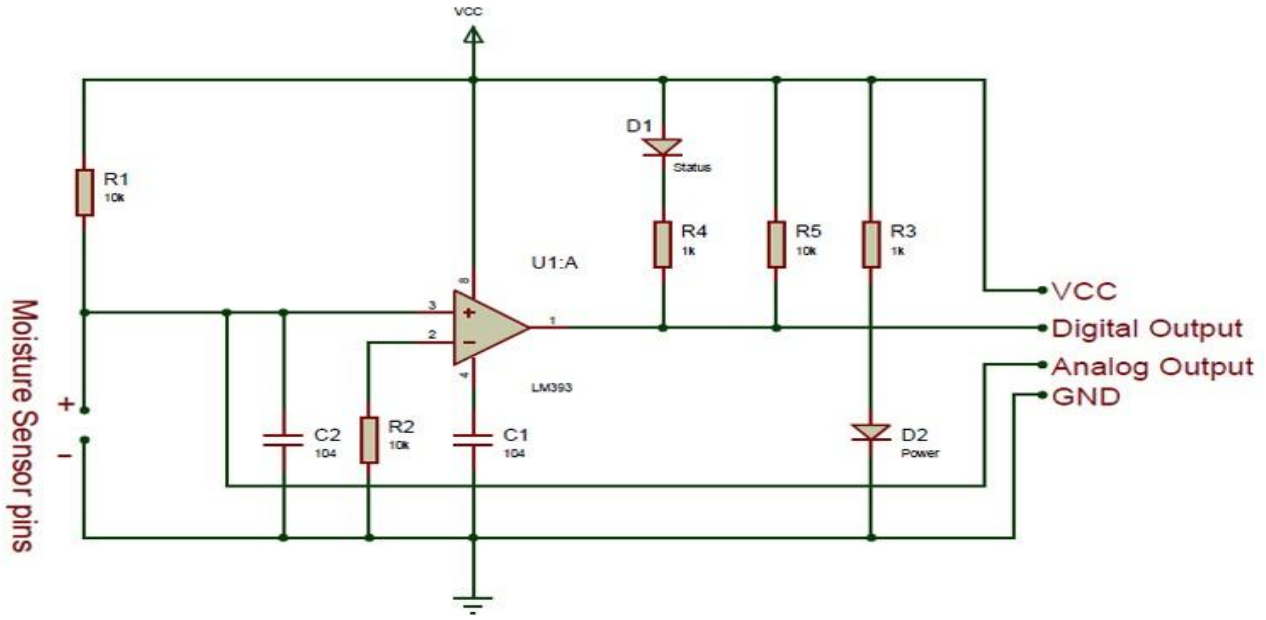

FIG 4.2.3 LM393 COMPARATOR IC

Using a Moisture sensor module with a microcontroller is very easy. Connect the Analog/Digital Output pin of the module to the Analog/Digital pin of Microcontroller. Connect VCC and GND pins to 5V and GND pins of Microcontroller. After that insert the probe inside the soil. When there is more water presented in the soil, it will conduct more electricity that means resistance will be low and the moisture level will be high.

- **Applications of Soil Moisture Sensor**
  - Gardening
  - Irrigation Systems
  - Used in Controlled Environments

- **Advantages of Moisture sensor for soil**

Following are the advantages of Moisture sensor for soil :

- Simple method of measurement.
- It delivers the results immediately.
- Watermark sensors and tensiometers are very low in cost.
- Offers accurate results.
- Watermark sensors offer larger moisture reading range from 0 to 200 cb or kpa.

- **Disadvantages of Moisture sensor for soil**

Following are the disadvantages of Moisture sensor for soil:

- It requires initial evaluation of site specific conditions before selection of appropriate moisture sensor.
- It requires probe to be inserted in the soil. It requires labor to collect the data and maintain the measurement processes.
- The measured values depend on properties of various materials. The correct interpretation and use of moisture data is needed.

- ❖ Watermark sensors provide less accuracy in sandy soils due to large particles.
- ❖ Watermark sensors are required to be calibrated for each soil types. Tensiometers also require periodic service.

4.3 LIQUID CRYSTAL DISPLAY

A liquid-crystal display (LCD) is a flat-panel display or other electronically modulated optical device that uses the light-modulating properties of liquid crystals combined with polarizers. Liquid crystals do not emit light directly, [1] instead using a backlight or reflector to produce images in colour or monochrome. [2] LCDs are available to display arbitrary images (as in a general-purpose computer display) or fixed images with low information content, which can be displayed or hidden, such as present words, digits, and seven-segment displays, as in a digital clock. They use the same basic technology, except that arbitrary images are made from a matrix of small pixels, while other displays have larger elements. LCDs can either be normally on (positive) or off (negative), depending on the polarizer arrangement. For example, a character positive LCD with a backlight will have black lettering on a background that is the colour of the backlight, and a character negative LCD will have a black background with the letters being of the same colour as the backlight. Optical filters are added to white on blue LCDs to give them their characteristic appearance.

LCDs are used in a wide range of applications, including LCD televisions, computer monitors, instrument panels, aircraft cockpit displays, and indoor and outdoor signage. Small LCD screens are common in LCD projectors and portable consumer devices such as digital cameras, watches, digital clocks, calculators, and mobile telephones, including smartphones. LCD screens are also used on consumer electronics products such as DVD players, video game devices and clocks. LCD screens have replaced heavy, bulky cathode ray tube (CRT) displays in nearly all applications. LCD screens are available in a wider range of screen sizes than CRT and plasma displays, with LCD screens available in sizes ranging from tiny digital watches to very large television receivers. LCDs are slowly being replaced by OLEDs, which can be easily made into different shapes, and have a lower response time, wider colour gamut, virtually infinite colour contrast and viewing angles, lower weight for a given display size and a slimmer profile (because OLEDs use a single glass or plastic panel whereas LCDs use two glass panels; the thickness of the panels increases with size but the increase is more noticeable on LCDs) and potentially lower power consumption (as the display is only "on" where needed and there is no backlight). OLEDs, however, are more expensive for a given display size due to the very expensive electroluminescent materials or phosphors that they use. Also due to the use of phosphors, OLEDs suffer from screen burn-in and there is currently no way to recycle OLED displays, whereas LCD panels can be recycled, although the technology required to recycle LCDs is not yet widespread. Attempts to maintain the competitiveness of LCDs are quantum dot displays, marketed as SUHD, QLED or Triluminos, which offer similar performance to an OLED display, but the quantum dot layer that gives these displays their characteristics cannot yet be recycled.

Since LCD screens do not use phosphors, they rarely suffer image burn-in when a static image is displayed on a screen for a long time, e.g., the table frame for an airline flight schedule on an indoor sign. LCDs are, however, susceptible to image persistence. [3] The LCD screen is more energyefficientand can be disposed of more safely than a CRT can. Its low electrical power consumption enables it to be used in battery-powered electronic equipment more efficiently than a CRT can be. By 2008, annual sales of televisions with LCD screens exceeded sales of CRT units worldwide, and the CRT became obsolete for most purposes.

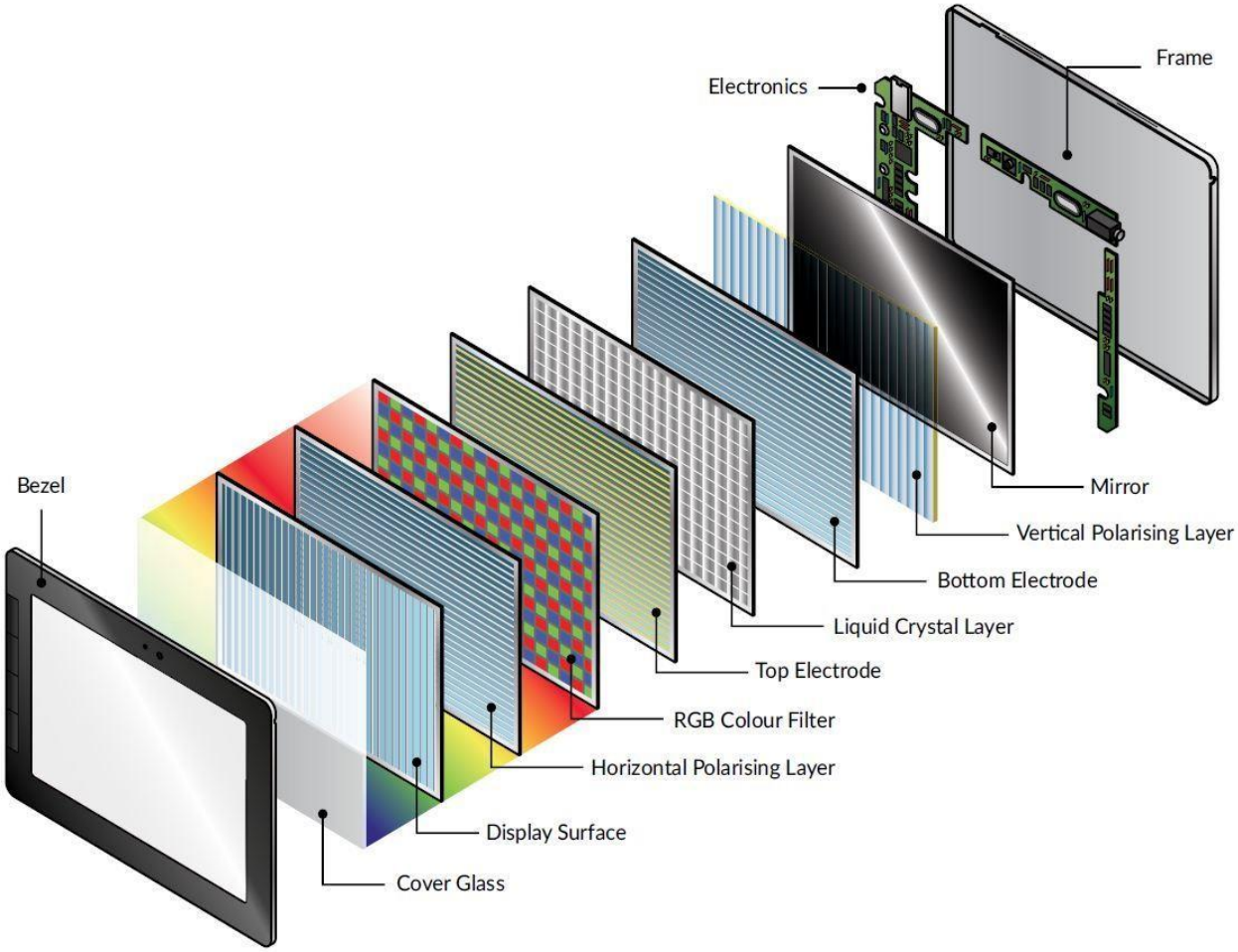

FIG 4.3.0 LIQUID-CRYSTAL DISPLAY (LCD)

16X2 LCD pinout diagram

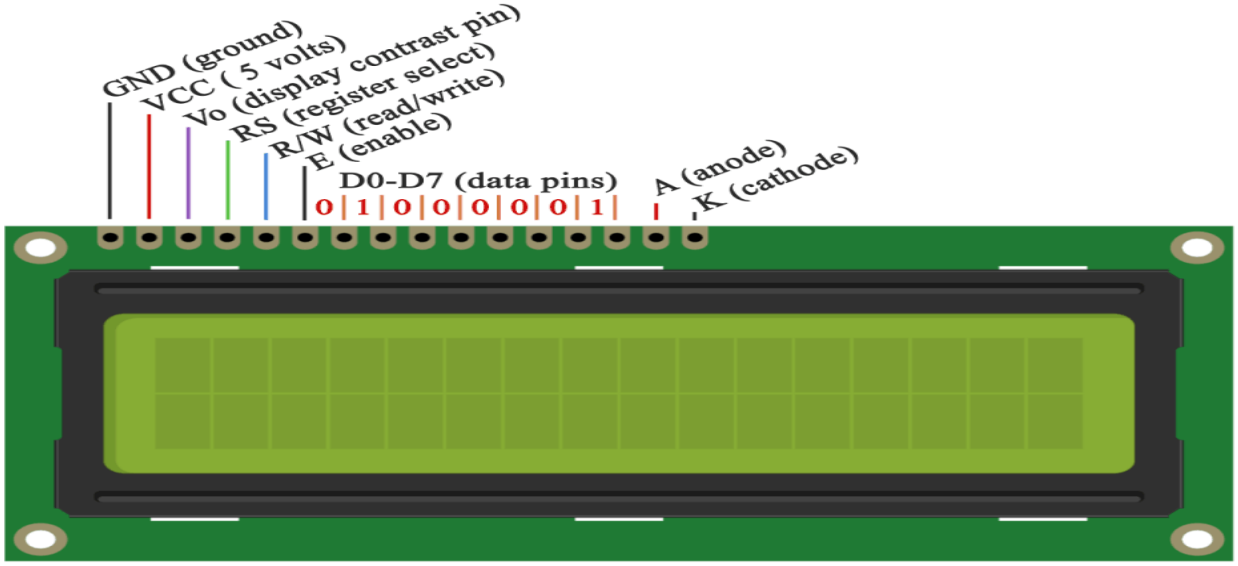

FIG 4.3.1 LIQUID-CRYSTAL DISPLAY (LCD) PINOUT DIAGRAM

❖ **16X2 LCD pinout Table**

Pin no.	Function	Name
1	Ground (0V)	Ground
2	Supply voltage; 5V (4.7V – 5.3V)	Vcc
3	Contrast adjustment; the best way is to use a variable resistor such as a potentiometer. The output of the potentiometer is connected to this pin. Rotate the potentiometer knob forward and backwards to adjust the LCD contrast.	Vo / VEE
4	Selects command register when low, and data register when high	RS (Register Select)
5	Low to write to the register; High to read from the register	Read/write
6	Sends data to data pins when a high to low pulse is given; Extra voltage push is required to execute the instruction and EN(enable) signal is used for this purpose. Usually, we set en=0, when we want to execute the instruction we make it high en=1 for some milliseconds. After this we again make it ground that is, en=0.	Enable
7	8-bit data pins	DB0
8		DB1
9		DB2
10		DB3
11		DB4
12		DB5
13		DB6
14		DB7
15	Backlight VCC (5V)	Led+
16	Backlight Ground (0V)	Led-

TABLE 4.3.0 LCD PINOUT TABLE

❖ **RS (Register select)**

A 16X2 LCD has two registers, namely, command and data. The register select is used to switch from one register to other. RS=0 for command register, whereas RS=1 for data register.

- **Command Register**:

The command register stores the command instructions given to the LCD. A command is an instruction given to LCD to do a predefined task. Examples like:

- initializing it
- clearing its screen
- setting the cursor position
- controlling display etc.

Processing for commands happens in the command register.

- **Data Register:**

The data register stores the data to be displayed on the LCD. The data is the ASCII value of the character to be displayed on the LCD. When we send data to LCD it goes to the data register and is processed there. When RS=1, data register is selected.

There are some advantages of liquid crystal display (LCD) which are given below,

- The LCD can be made in large sizes of over 60 inch or 150 cm diagonal.
- It has no geometric distortion.
- It is very compact, thin, and light CRT displays.
- It does not affect by the magnetic fields.
- Due to low power consumption, small heat emitted during operation.
- It is much thinner than a CRT (cathode ray tube) monitor.

There are some disadvantages of liquid crystal display (LCD) which are given below,

- In high temperature environments there is loss of contrast.
- It is relatively bright but not suitable for very brightly environments.
- It consumed a lot of electricity which produce a lot of heat.
- It has individual liquid crystals which cannot complete all block of the backlight.
- From the viewing angle, the colour and contrast not consistent.

4.4 RELAY MODULE 5V

Relay is an electromechanical device that uses an electric current to open or close the contacts of a switch. The single-channel relay module is much more than just a plain relay, it comprises of components that make switching and connection easier and act as indicators to show if the module is powered and if the relay is active or not.

4.4.1 Single-Channel Relay Module Pin Description

Pin Number	Pin Name	Description
1	Relay Trigger	Input to activate the relay
2	Ground	0V reference
3	VCC	Supply input for powering the relay coil
4	Normally Open	Normally open terminal of the relay
5	Common	Common terminal of the relay
6	Normally Closed	Normally closed contact of the relay

TABLE 4.4.0 RELAY MODULE PIN DESCRIPTION

4.4.2Single-Channel Relay Module Specifications

- Supply voltage – 3.75V to 6V
- Quiescent current: 2mA
- Current when the relay is active: ~70mA
- Relay maximum contact voltage – 250VAC or 30VDC

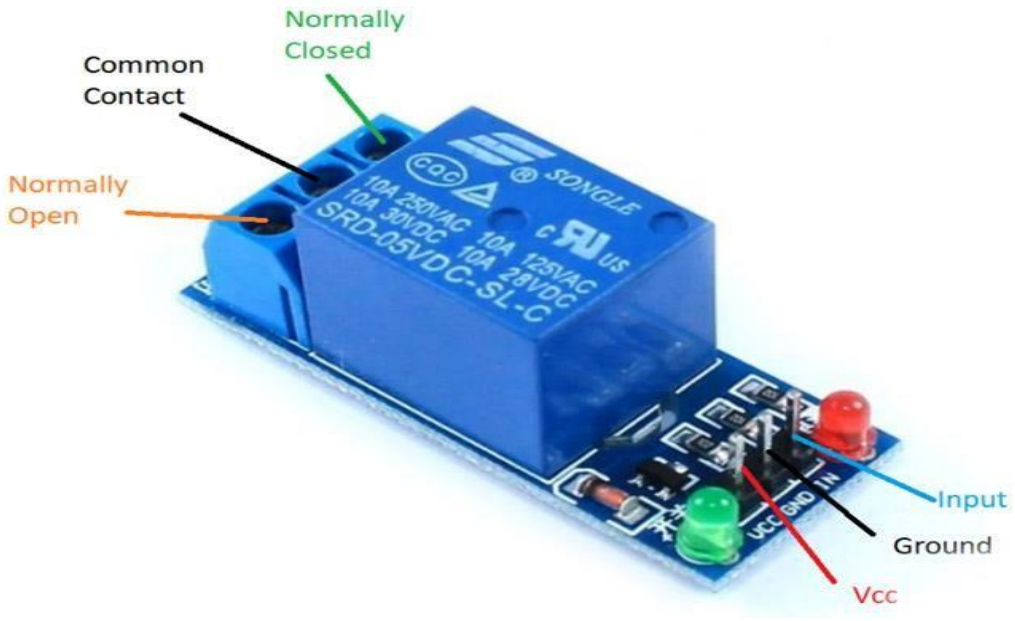

FIG 4.4.0 RELAY MODULE

Types of Relay

- **Solid State Relays (SSR)**

These relays use thyristors and triacs for their operation. The coupling, between the input circuit and the output circuit, is optical. SSR are faster, quieter, smaller, more reliable, and last longer than electromagnetic relays.

- **Industrial relays**

These relays handle high currents and are long lasting.

- **Interlocking relays**

Devices that are activated or deactivated with a voltage pulse. Depending on the polarity of the pulse, the position of the contacts change.

- **Thermal relays**

They are used to protect motors against over-temperature. When the temperature reaches a certain level, it is activated and disconnects the contactor which in turn disables the motor.

- **Reed relays**

This device is very basic and has a small size. It is a fast operating switch design with only one NO contact. Some have glass encapsulation and others with metal encapsulation to prevent external magnetic fields from activating the relay.

- **Mercury relays**

Inside it has a drop of mercury that moistens the contacts, giving them a longer life and avoiding the rebounds that appear when they are activated.

- **Contactors**

These devices have the same principle of operation of relay. The current, voltage or power values are very large and the contactors must have characteristics that withstand these values.

❖ **Advantages**

- It allows to control a remote device. It is not necessary to be near the device to make it work.
- Change contacts easily.
- Isolates the activating part of the actuating part.
- It works well at high temperatures.
- It is activated with low current, however it can activate large machines of great power.
- With a single signal you can control several contacts at once.
- It can switch direct current or alternating current.

❖ **Disadvantages**

- Contacts are damaged over time and continuous use (wear, oxidation, etc.)
- They generate a lot of noise with the activation and deactivation of the contacts.
- Switching time is high

4.5 WATER PUMP

❖ Motor

Electric motor is the electro-mechanical machine which converts the electrical energy into mechanical energy. In other words, the devices which produce rotational force is known as the motor. The working principle of the electric motor mainly depends on the interaction of magnetic and electric field.

Electric motors are broadly classified into two categories as follows:

- AC Motors.
- DC Motors.

❖ Water pump

❖ Description:

This is Micro Submersible Water Pump DC 3V-5V, can be easily integrate to your water system project. The water pump works using water suction method which drain the water through its inlet and released it through the outlet. You can use the water pump as exhaust system for your aqurium and controlled water flow fountain.

❖ Specification:

- Input Voltage: DC 3V-5V
- Flow Rate: 1.2-1.6 L/min
- Operation Temperature: 80 Deg.C
- Operating Current: 0.1-0.2A
- Suction Distance: 0.8 meter (Max)
- Outside diameter of water outlet: 7.5mm
- Inside diameter of water outlet: 5.0 mm
- Diameter of water Inlet : 5.0 mm
- Wire Length: 200 mm
- Size: 45 x 30 x 25 mm
- Weight: 30g

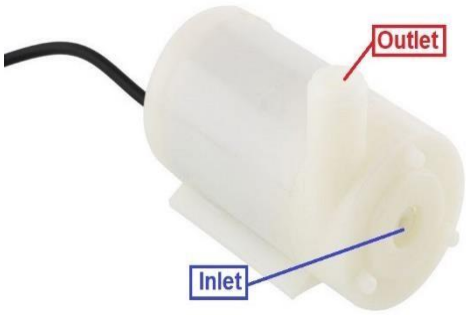

FIG 4.5.0 DC 12V WATER PUMP

❖ **How to Use:**

- Firstly, simply connect the red wire (+) and black wire (-) to a 3V or 5V DC supply.
- Next, make sure the connection is right (+) wire to (+) terminal and (-) wire to (-) terminal.
- Submerge the water pump into the water according to your application preferences.
- When the supply is on, water will flow into the inlet of the pump and flow out through the outlet.

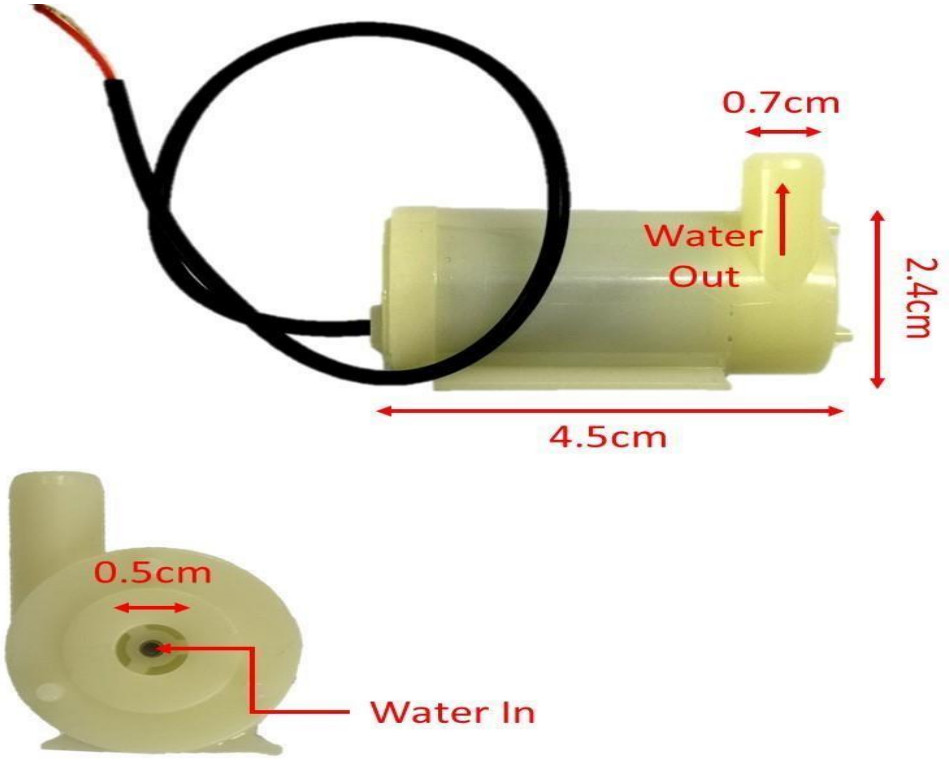

FIG 4.5.1 DC 12V WATER PUMP DESCRIPTIO

❖ **Application:**

- Controlled fountain water flow
- Controlled Garden watering systems
- Hydroponic Systems
- Fresh water intake or exhaust systems for fish aquarium
- Automatic Hand Sanitizer

❖ **Advantages of DC**

- Can be hooked to a battery; portable
- Simpler speed control and operation
- More energy efficient

❖ **Disadvantages of DC**

- Shorter lifespan
- Lower speeds/power

4.6 9 VOLTS BATTERY

The **nine-volt battery**, or **9-volt battery**, is a common size of battery that was introduced for the early transistor radios. It has a rectangular prism shape with rounded edges and a polarized snap connector at the top. This type is commonly used in smoke detectors, gas detectors, clocks, walkie-talkies, electric guitars and effects units.

The nine-volt battery format is commonly available in primary carbon-zinc and alkaline chemistry, in primary lithium iron disulphide, and in rechargeable form in nickel-cadmium, nickel-metal hydride and lithium-ion. Mercury-oxide batteries of this format, once common, have not been manufactured in many years due to their mercury content. Designations for this format include *NEDA 1604* and *IEC 6F22* (for zinccarbon) or *MN1604 6LR61*(for alkaline). The size, regardless of chemistry, is commonly designated **PP3**—a designation originally reserved solely for carbon-zinc, or in some countries, *E* or *E-block*.

9-volt batteries accounted for 4% of alkaline primary battery sales in the United States in 2007, and 2% of primary battery sales and 2% of secondary battery sales in Switzerland in 2008.

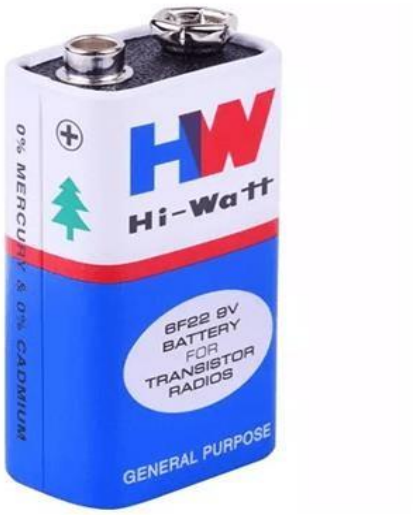

FIG 4.6.0 9 VOLTS BATTERY

4.7 BATTERY CAP

A **battery holder** is one or more compartments or chambers for holding a battery. For dry cells, the holder must also make electrical contact with the battery terminals. For wet cells, cables are often connected to the battery terminals, as is found in automobiles or emergency lighting equipment.

A battery holder is either a plastic case with the shape of the housing moulded as a compartment or compartments that accepts a battery or batteries, or a separate plastic holder that is mounted with screws, eyelets, glue, double-sided tape, or other means. Battery holders may have a lid to retain and protect the batteries or may be sealed to prevent damage to circuitry and components from battery leakage. Coiled spring wire or flat tabs that press against the battery terminals are the two most common methods of making the electrical connection inside a holder. External connections on battery holders are usually made by contacts with pins, surface mount feet, solder lugs, or wire leads.

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FIG 4.7.0 BATTERY CAP

4.8 JUMP WIRE

A **jump wire**(also known as jumper, jumper wire, jumper cable, DuPont wire or cable) is an electrical wire, or group of them in a cable, with a connector or pin at each end (or sometimes without them – simply "tinned"), which is normally used to interconnect the components of a breadboard or other prototype or test circuit, internally or with other equipment or components, without soldering.

Individual jump wires are fitted by inserting their "end connectors" into the slots provided in a breadboard, the header connector of a circuit board, or a piece of test equipment.

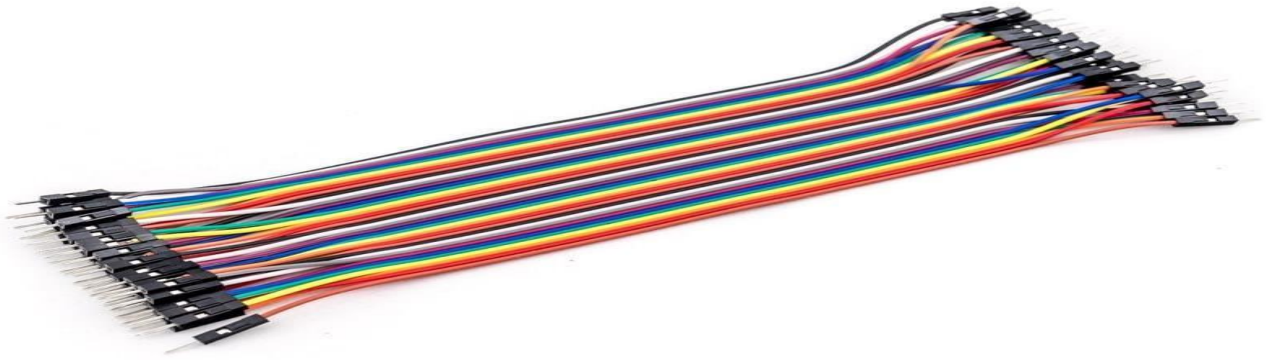

FIG 4.8.0 JUMP WIRE

(5.0) SOFTWARE COMPONANENTS DESCRIPTION

5.1 INTRODUCTION ARDUINO IDE -1.8.8

Arduino IDEis an open source software that is mainly used for writing and compiling the code into the Arduino Module.

It is an official Arduino software, making code compilation too easy that even a common person with no prior technical knowledge can get their feet wet with the learning process.

It is easily available for operating systems like MAC, Windows, Linux and runs on the Java Platform that comes with inbuilt functions and commands that play a vital role for debugging, editing and compiling the code in the environment.

A range of Arduino modules available including Arduino Uno, Arduino Mega, Arduino Leonardo, **Arduino Micro**and many more.

Each of them contains a**microcontroller**on the board that is actually programmed and accepts the information in the form of code.

The main code, also known as a sketch, created on the IDE platform will ultimately generate a Hex File which is then transferred and uploaded in the controller on the board.

The IDE environment mainly contains two basic parts: Editor and Compiler where former is used for writing the required code and later is used for compiling and uploading the code into the given Arduino Module.

This environment supports both C and C++ languages.

5.2 HOW TO DOWNLOAD ARDUINO IDE

You can download the Software from Arduino main website. As I said earlier, the software is available for common operating systems like Linux, Windows, and MAX, so make sure you are downloading the correct software version that is easily compatible with your operating system.

If you aim to download Windows app version, make sure you have Windows 8.1 or Windows 10, as app version is not compatible with Windows 7 or older version of this operating system.

You can download the latest version of Arduino IDE for Windows (Non-Admin standalone version), by clicking below Link:

LINK:- **ARDUINO IDE**

5.3 DETAILS ABOUT SOFTWARE

The IDE environment is mainly distributed into three sections

- Menu Bar
- Text Editor
- Output Pane

As you download and open the IDE software, it will appear like an image below.

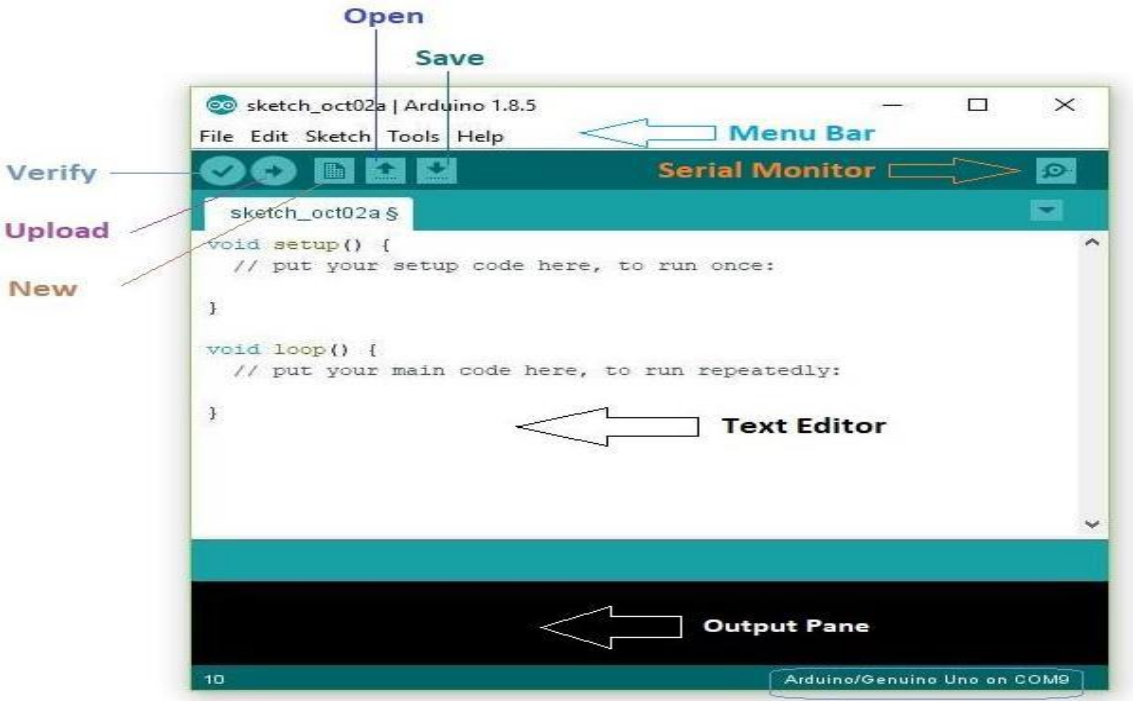

FIG 5.3.0 INTRODUCTION ARDUINO IDE SOFTWARE

The bar appearing on the top is called **Menu Bar** that comes with five different options as follow

File - You can open a new window for writing the code or open an existing one. Following table shows the number of further subdivisions the file option is categorized into.

New	• Creates a new instance of the editor, with the bare minimum structure of a sketch already in place.
Open	• Allows to load a sketch file browsing through the computer drives and folders.
Open Recent	• Provides a short list of the most recent sketches, ready to be opened.
Sketchbook	• Shows the current sketches within the sketchbook folder structure; clicking on any name opens the corresponding sketch in a new editor instance.
Examples	• Any example provided by the Arduino Software (IDE) or library shows up in this menu item. All the examples are structured in a tree that allows easy access by topic or library.
Close	• Closes the instance of the Arduino Software from which it is clicked.
Save	• Saves the sketch with the current name. If the file hasn't been named before, a name will be provided in a "Save as.." window.
Save as...	• Allows to save the current sketch with a different name.
Page Setup	• It shows the Page Setup window for printing.
Print	• Sends the current sketch to the printer according to the settings defined in Page Setup.
Preferences	• Opens the Preferences window where some settings of the IDE may be customized, as the language of the IDE interface.
Quit	• Closes all IDE windows. The same sketches open when Quit was chosen will be automatically reopened the next time you start the IDE.

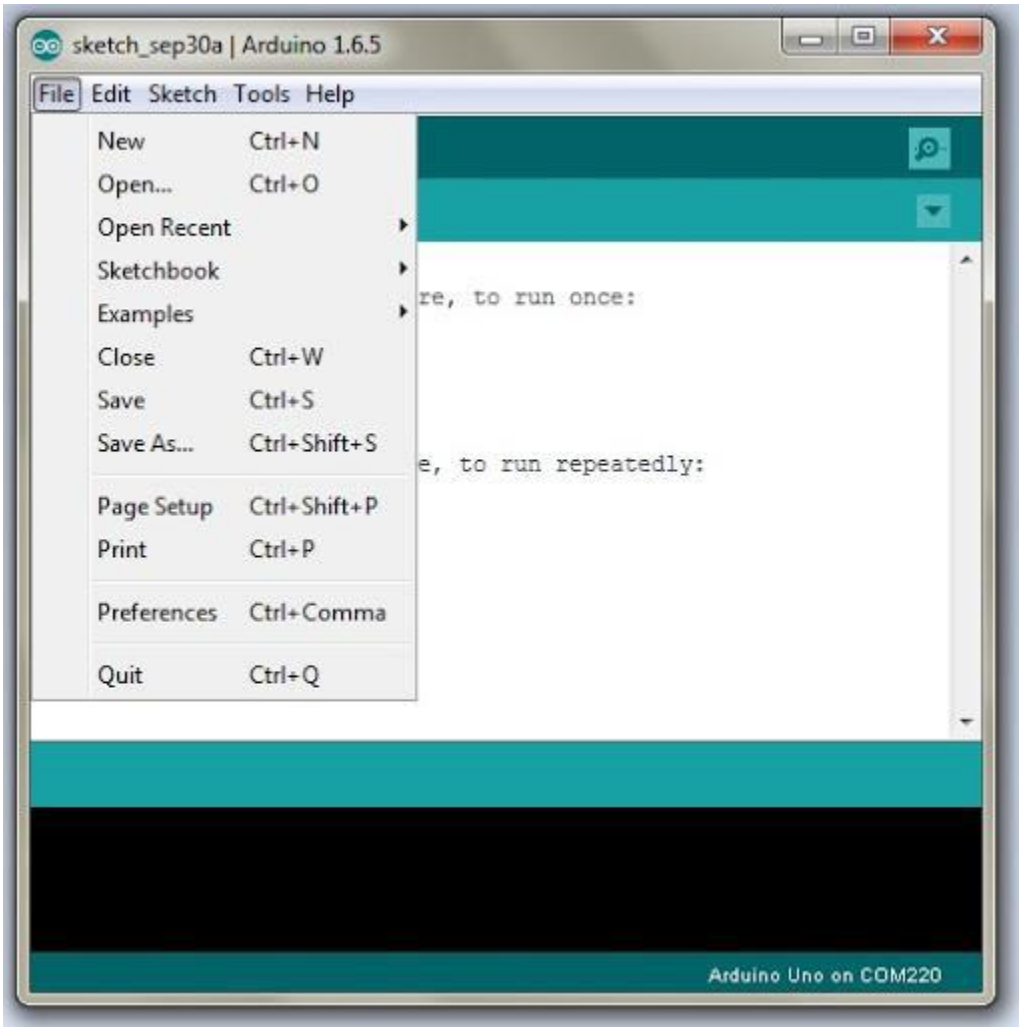

FIG 5.3.2 ARDUINO IDE SOFTWARE MENU BAR

Edit - Used for copying and pasting the code with further modification for font
Sketch - For compiling and programming
Tools - Mainly used for testing projects. The Programmer section in this panel is used for burning a bootloader to the new microcontroller.
Help - In case you are feeling skeptical about software, complete help is available from getting started to troubleshooting.

The **Six Buttons** appearing under the Menu tab are connected with the running program as follow.

FIG 5.3.3 ARDUINO IDE SOFTWARE MENU TAB BUTTON

The check mark appearing in the circular button is used to verify the code. Click this once you have written your code.

- The arrow key will upload and transfer the required code to the Arduino board.
- The dotted paper is used for creating a new file.
- The upward arrow is reserved for opening an existing Arduino project.
- The downward arrow is used to save the current running code.

The button appearing on the top right corner is a **Serial Monitor** - A separate pop-up window that acts as an independent terminal and plays a vital role for sending and receiving the Serial Data. You can also go to the Tools panel and select Serial Monitor, or pressing Ctrl+Shift+M all at once will open it instantly. The Serial Monitor will actually help to debug the written Sketches where you can get a hold of how your program is operating. Your Arduino Module should be connected to your computer by USB cable in order to activate the Serial Monitor.

You need to select the baud rate of the Arduino Board you are using right now. For my Arduino Uno, as you write the following code and click the Serial Monitor, the output will show as the image below.

HOW TO SELECT THE BOARD?

In order to upload the sketch, you need to select the relevant board you are using and the ports for that operating system. As you click the Tools on the Menu, it will open like the figure below

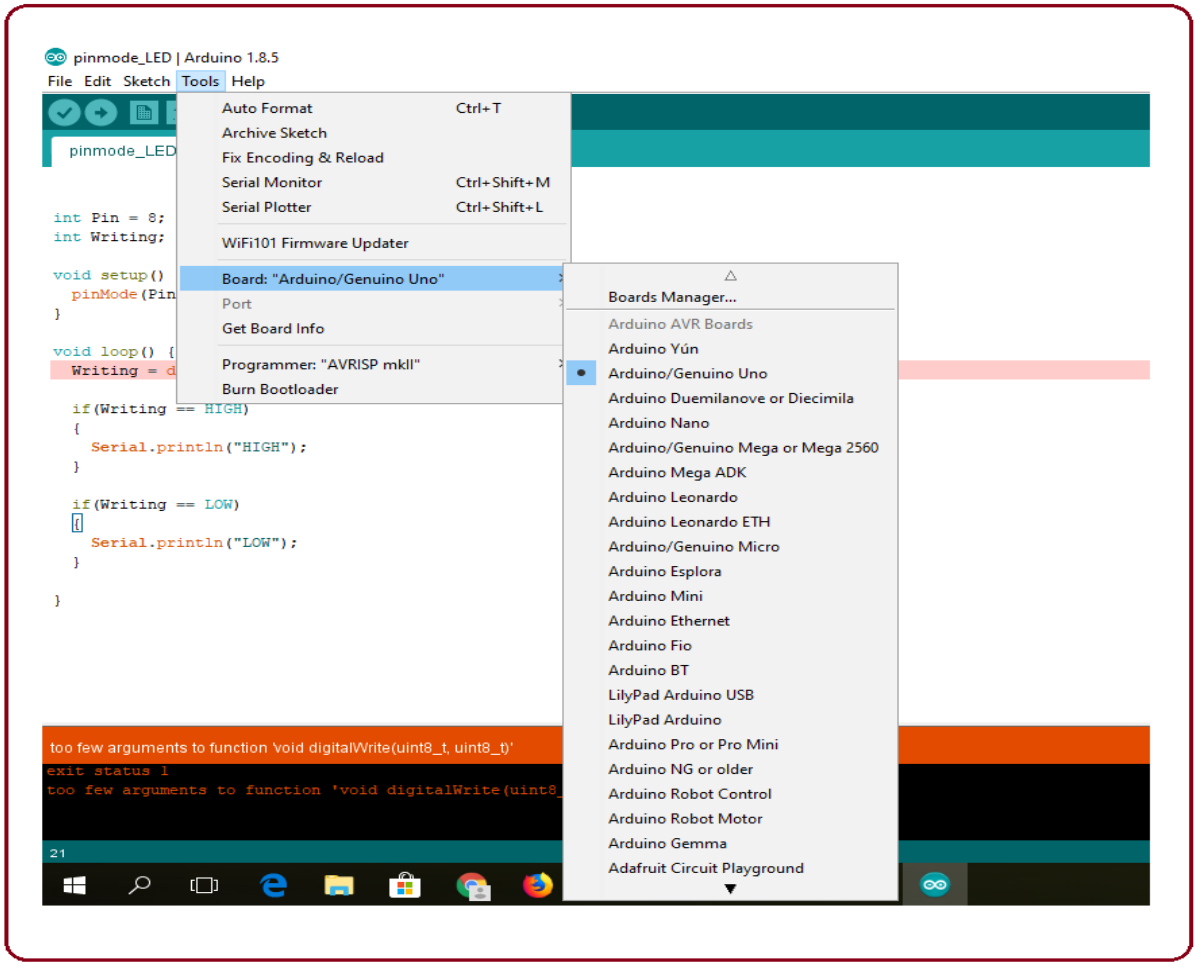

FIG 5.3.4 ARDUINO IDE SOFTWARE SELECT THE BOARD

- Just go to the "Board" section and select the board you aim to work on. Similarly, COM1, COM2, COM4, COM5, COM7 or higher are reserved for the serial and USB board. You can look for the USB serial device in the ports section of the Windows Device Manager.
- Following figure shows the COM4 that I have used for my project, indicating the Arduino Uno with COM4 port at the right bottom corner of the screen.

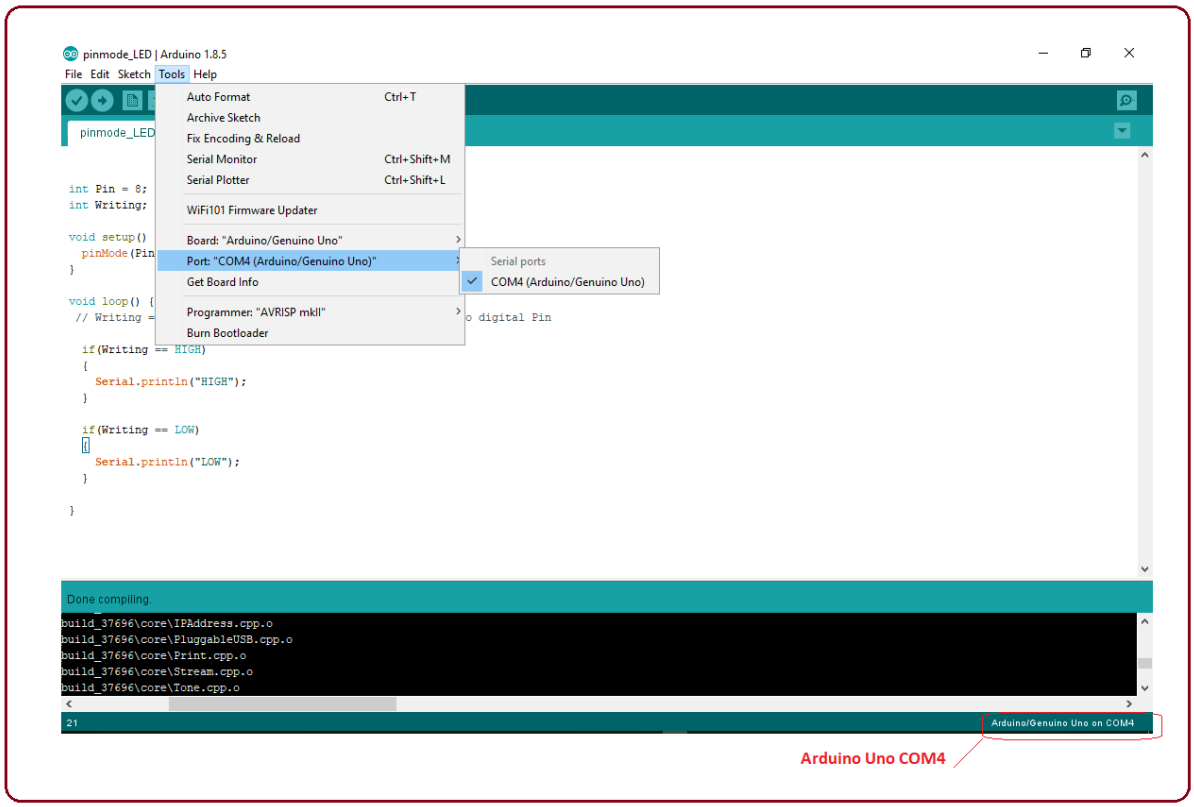

FIG 5.3.5 ARDUINO IDE SOFTWARE SELECT THE SERIAL PORT

- After correct selection of both Board and Serial Port, click the verify and then upload button appearing in the upper left corner of the six button section or you can go to the Sketch section and press verify/compile and then upload.
- The sketch is written in the text editor and is then saved with the file extension .ino.
- It is important to note that the recent Arduino Modules will reset automatically as you compile and press the upload button the IDE software, however, older version may require the physical reset on the board.
- Once you upload the code, TX and RX LEDs will blink on the board, indicating the desired program is running successfully.

(6.0) FEATURES :- ADVANTAGES AND DISADVANTAGES

ADVANTAGES:

- The proposed is system is cost efficient
- It increases the profit for farmers.
- The manures used are natural so it does not have any harmful particles in it.
- Water wastage is less.
- The power supply for the project is from solar energy which is cheap and freely available.

DISADVANTAGES:

- The solar energy is available only in the morning so, the kit must also have an alternative battery for operation
- The farmer must have a phone.
- The software code is programmed; hence it must be changed for every crop with requirement.

6.1 APPLICATIONS

- It can be agricultural fields, lawns & as drip irrigation systems.
- It can be used for cultivation purposes.
- It can be used to provide water in nursery planting arena.
- It can be used for wide range of crops as one can customize reference required for different kind of crops.
- Pond water management and water transfer.

6.2 CODE

```
#include <LiquidCrystal.h>
LiquidCrystallcd(A0,A1,A2,A3,A4,A5 );//********
#define soil 9
Void setup()  {
pinMode(soil, INPUT);
pinMode(10, OUTPUT);
lcd.begin(16, 2);
lcd.print(“ AUTOMATIC “);
lcd.setCursor(0,1);
lcd.print(“IRRIGATION SYSTEM”);
  delay(2000);
}
Void loop()  {
  If(digitalRead(soil)==HIGH)
  {
digitalWrite(10,HIGH);
    // delay(200);
lcd.clear();
lcd.print(“ MOTOR”);
lcd.setCursor(0, 1);
lcd.print(“ ON “);
    delay(300);
  }
else {
          digitalWrite(10,LOW);
          //digitalWrite(fire,LOW);
          lcd.clear();
          lcd.print(“MOTOR”);
          lcd.setCursor(0,1);
          lcd.print(“OFF”);
          delay(200);
}
}
```

6 CONCLUSION

- Using the automated irrigation system optimizes the usage of water by reducing wastage of water.
- The proposed controller eliminates the manual switching mechanism used by the farmers.
- The system can also be designed for temperature sensor based cooling system for temperature sensitive plants.
- The use of this system will be able to contribute to the socio-economic development of the nation.
- It is Fast response & User friendly.
- The smart irrigation system is feasible and cost effective for optimizing water resources for agricultural production.
- This irrigation system allows cultivation in places with water scarcity thereby improving sustainability.
- It proves that the use of water can be diminished.
- The use of solar power in this system is significantly important for organic crops.

7 BIBILOGRAPHY

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(9.0) PHOTO GALLERY


Note cam lite
Address : Sabarkantha, Modasa, 383315, GJ, India
Latitude : 23°27'11.4"N
Longitude : 73°17'26.9"E
Altitude : 147.56 meter
Date : 02/08/2023 12:56 PM
Accuracy : 1.72 meter
Note : C-8 CPEx 2023

(10.0) CERTIFICATES

CHARUSAT
CHAROTAR UNIVERSITY OF SCIENCE AND TECHNOLOGY

CENTER OF EXCELLENCE
GOVT. OF GUJARAT

ONE DAY WORKSHOP
HANDS ON EXPERIMENTS IN NANOSCIENCE AND MATERIAL SCIENCE
Department of Physical Sciences
P D Patel Institute of Applied Sciences
Charotar University of Science & Technology

CERTIFICATE

This is to certify that Mr. /Ms. MISTRI JAYKUMAR NARENDRABHAI from SIR P.T. SCIENCE COLLEGE, MODASA has participated in the One Day Workshop on "Hands on experiments in Nanoscience and Material Sciences" organized jointly by Department of Physical Sciences, P. D. Patel Institute of Applied Sciences (PDPIAS), and Dr. K. C. Patel R & D Centre (KRADLE), Charotar University of Science & Technology (CHARUSAT), Changa – 388 421 Gujarat, India on 21-02-2023.

Dr. C K Sumesh
Coordinator

Shodh: Roller Coaster Ride to Startups & Innovation

Jointly organized by:-

Sir P.T. Science College, Modasa (Managed by: The M.L. Gandhi Higher Education Society)
Shri Kantilal Hirabhai Patel M Ed Institute, Modasa, Shri B.D. Shah College of Education, Modasa SSIP Incubation Center,
Community Science Centre, Aravalli, ESSENCETECH & Gujarat Council on Science and Technology(GUJCOST)

SSIP CSC

Certificate of Participation

This is to certify that Mr./Miss./Dr. MISTRI JAYKUMAR NARENDRABHAI has successfully participated in the ***Shodh: Roller Coaster Ride to Startups & Innovations*** *a webinar, jointly organized by Shri Kantilal Hirabhai Patel M Ed Institute, Modasa, Shri B.D. Shah College of Education, Modasa SSIP Incubation Center, Sir P.T. Science College, Modasa, Community Science Centre, Aravalli, Essencetech and Gujarat Council on Science and Technology (GUJCOST) held from 5th Feb. 2021 to 7th Feb. 2021.*

Dr. Girish Vekaria
SSIP Coordinator
Sir PT Science College, Modasa

Dr. K.P. Patel
Principal
Sir PT Science College, Modasa

Mr. Harshal A. Sanghvi
Incubation Manager, SSIP Incubation Centre
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ONE DAY WORKSHOP

HANDS ON EXPERIMENTS IN NANOSCIENCE AND MATERIAL SCIENCE

Department of Physical Sciences
P D Patel Institute of Applied Sciences
Charotar University of Science & Technology

CERTIFICATE

This is to certify that Mr. /Ms. CHAUDHARY PRATIKKUMAR VINUBHAI from SIR P.T. SCIENCE COLLEGE, MODASA has participated in the One Day Workshop on "Hands on experiments in Nanoscience and Material Sciences" organized jointly by Department of Physical Sciences, P. D. Patel Institute of Applied Sciences (PDPIAS), and Dr. K. C. Patel R & D Centre (KRADLE), Charotar University of Science & Technology (CHARUSAT), Changa - 388 421 Gujarat, India on 21-02-2023.

Dr. C K Sumesh
Coordinator

ETiFON-2021

National Conference on

Emerging Trends in
Functional Oxides and Nanomaterials

CERTIFICATE OF PARTICIPATION

THIS IS TO CERTIFY THAT

CHAUDHARY PRATIKKUMAR V

from

Depaetment of phisics,saurashtra university,rajkot-360005,gujrat,india

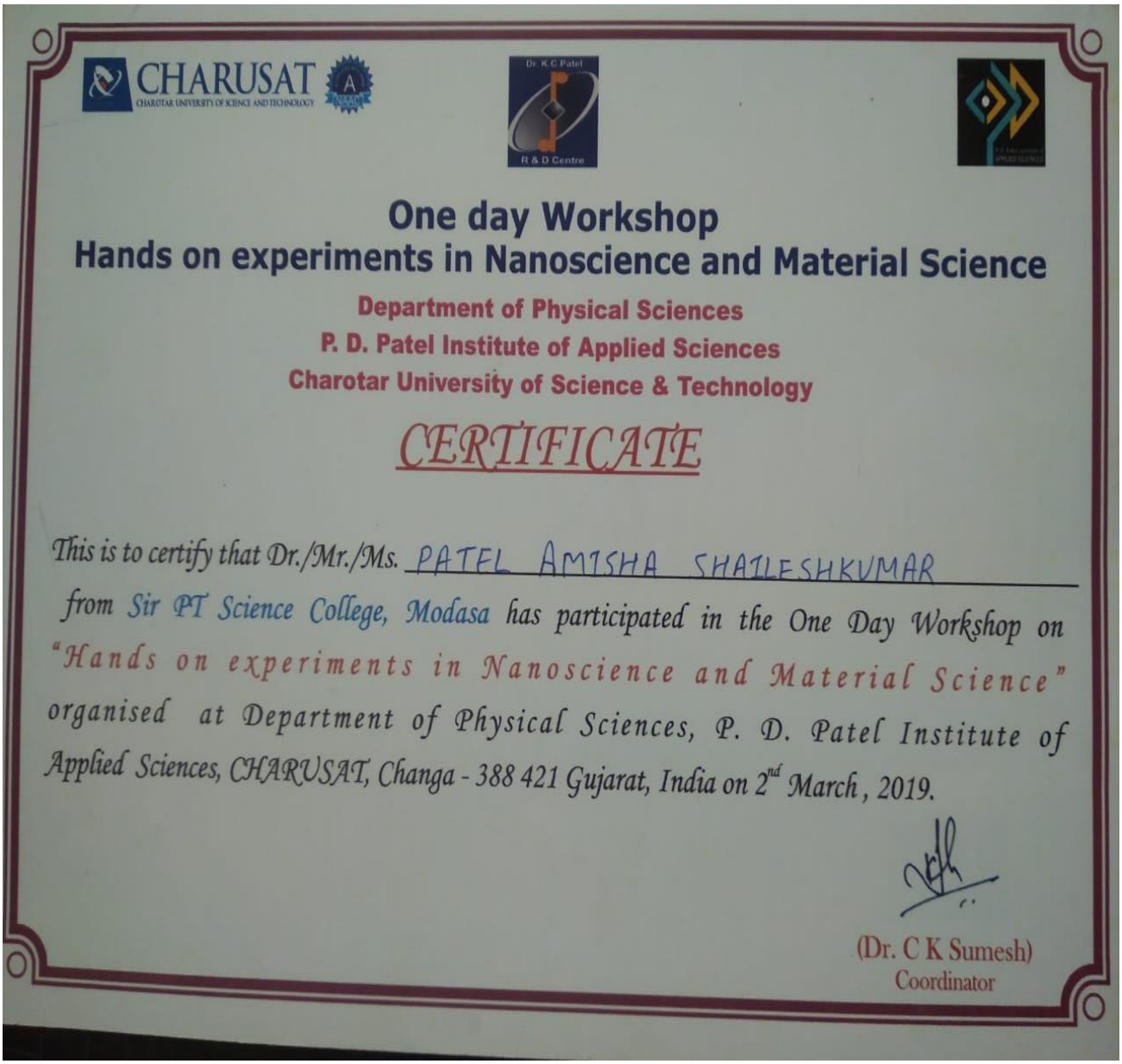
has participated in the National Conference on "Emerging Trends in Functional Oxides and Nanomaterials" (ETiFON-2021) organized by Department of Physics, Saurashtra University, Rajkot, Gujarat, India during October 28-29, 2021.

DR. P.S. SOLANKI
Convener

PROF. N.A. SHAH
Convener

PROF. M.J. JOSHI
Chairman & Head

Certificate ID: ETiFON-par-21443



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Dr. K C Patel R & D Centre

One day Workshop
Hands on experiments in Nanoscience and Material Science

Department of Physical Sciences
P. D. Patel Institute of Applied Sciences
Charotar University of Science & Technology

CERTIFICATE

This is to certify that Dr./Mr./Ms. PATEL AMISHA SHAILESHKUMAR from Sir PT Science College, Modasa has participated in the One Day Workshop on "Hands on experiments in Nanoscience and Material Science" organised at Department of Physical Sciences, P. D. Patel Institute of Applied Sciences, CHARUSAT, Changa - 388 421 Gujarat, India on 2nd March, 2019.

(Dr. C K Sumesh)
Coordinator