

**MONITORING AND MANAGEMENT OF WATER QUALITY AND SOIL  
FERTILITY (macro nutrients)**

*A project report submitted for the award of the degree of*

**BACHELOR OF TECHNOLOGY  
IN  
ELECTRONICS AND COMMUNICATION ENGINEERING**

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ANIL NEERUKONDA INSTITUTE OF TECHNOLOGY AND SCIENCES**

**(UGC AUTONOMOUS)**

*(Permanently Affiliated to AU, Approved by AICTE and Accredited by NBA & NAAC with 'B+' Grade)*

**Sangivalasa, Bheemili mandal, Visakhapatnam dist. (A.P) (2022-2023)**

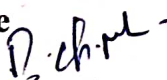
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**CERTIFICATE**

This is to certify that the project report entitled “MONITORING AND MANAGEMENT OF WATER QUALITY AND SOIL FERTILITY (macro nutrients)” submitted by B.V.P.Raju (319126512002), P.Manas (319126512046), G.Mohan vamsi (319126512018), T.Sai kiran (320126512L06) in partial fulfillment of the requirements for the award of the Degree of Bachelor of Technology in Electronics & Communication Engineering of Anil Neerukonda Institute Of Technology & Sciences(A), Visakhapatnam is a record of bonafide work carried out under my guidance and supervision.

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## **ABSTRACT**

Agriculture is the largest occupation in India. India is one of the most populated and majorly dependent on the agriculture thus it provides 17% of GDP to India. We have ensure that the quality of raw food obtained, need to be the best, So looking after the Soil and Water provided to the crop increases the quality. We propose “Soil and Water Monitoring System” to perform this function through IoT, by implementing this we ensure in maximizing yield, optimizing resources, and using suitable fertilizers for the crop. This is implemented using NPK sensor, Soil Moisture sensor, PH sensor and TDS sensor. NPK are one of the important macro-nutrients for the crop, the fertility is described using these major factors. The sensors collect the data and are transmitted to the online application for analysis. Therefore analyzed data aids us in optimizing the agricultural operations. The entire hardware is based on IoT thus making it Smart Agriculture.



**CHAPTER-1**  
**INTRODUCTION**

The soil and plant interaction characteristics have the biggest impact on crop productivity. This serves as a useful tool for the farmer. This establishes the soil fertility for more productive and cost-effective crop growth. The majority of nutrients needed for plant growth are known as macronutrients. A soil test can assist determine the type of soil, such as whether it is acidic or basic, and which crops will produce the most. Water of high quality is required for the crop in order to boost crop productivity. Because there are not enough fertilizers being used, agricultural productivity is suffering. For better growth, fertilizer must be used properly. The pace of harvest output is lowered as a result of excessive fertilizer use [5]. Several regions of India still use manual fertilizers. Food production is in high demand, which is growing quickly. Based on the plant growth and crop production quantity will be chosen. In order to supply the soil with the need of nutrients, farmers measure the concentration of nutrients already available in the soil. They then choose the best crop to plant on the farmland multiple times.

For sustainable agriculture and the preservation of natural resources, soil fertility and water quality are crucial components. Crop yields, the health of the ecosystem, and human health can all be negatively impacted by poor water quality and soil fertility. Thus it is essential to monitor and manage these aspects to ensure the sustainable use of agricultural land. Water quality and soil fertility are monitored and managed using a variety of technologies and methods. With the development of technology, automated monitoring systems, sensors, and data analytics tools have become more prevalent in recent years. Farmers and other stakeholders may make knowledgeable decisions regarding the management of water and soil thanks to the technology that provide real-time data on water quality and soil fertility.

This paper will examine the many tools and techniques for maintaining soil fertility and water quality. We'll look at the drawbacks of these procedures, like their expense and accessibility, and talk about how technology may help. We will also go through the advantages of proper soil fertility and water quality monitoring and management, such as increased crop yields, less environmental impact, and enhanced human health.

## **1.1 SOIL PROFILES IN ANDHRA PRADESH**

Considering the region of Andhra Pradesh and its soil profile, the type of soil available here are:

1) Red soil : It is generally deficient in organic matter which is rich in phosphorus content and poor in nutrient content and it is present in some parts of srikakulam, Visakhapatnam and east godavari.

2) Black soil: It is neutral to alkaline and poor in nitrogen and phosphorus content and it is present in kaddapa and krishna districts.

3) Coastal Alluvial soil: It is rich in nutrients content and organic content and it is rich in potassium content and it is present in some parts in guntur districts.

4) Lateritic soils: It is porous and good organic matter and it is present in some parts of

medak districts.

5) Skeletal soils: These soils are infertile and it is present in some parts of Prakasam.

### **1.1.1 NPK**

To help consumers effortlessly contrast products, all fertiliser packages must provide some uniform characteristics. Every label contains three accessible digits, usually above or below the product name. All three of them comprise the fertiliser's N-P-K proportion, which is the proportion of three plant nutrients.

Plants require more nitrogen, phosphorus, and potassium than any additional plant nutrient. All three of these nutrients, known as fundamental macronutrients, make up the 17 nutrients essential for all plant development. Other components, which might include iron, are as vital for the longevity of plants, albeit at much lower concentrations. likewise, different plants have different requirements.

Plants get all of their nutrients from the air as well as soil, but soil might get diminished, especially in lush greenery and lawns. Since plants require more N-P-K, these nutrients must be replaced on a regular basis. Other factors come into play as well. Because nitrogen flows Water from strong rains or irrigation carries it away in a process called as leaching. Fertilizer supplies arrive to replenish used and wasted nutrients, guaranteeing that lawns and crops are well-prepared.

## **1.2 Soil Moisture**

The soil moisture sensor is a type of sensor which is used to find the moisture content in the soil. We can able to interface it both with Analog and Digital pins. When we connect it Analog pin the value ranges from 0 to 1024, when the value is from 0 to 550 it indicates that the soil is moisture. If the value ranges from 550 to 950 it means that it is in target range. If the value ranges from 950 to 1024 it means it is dry. The moisture can be tested with the sensor.

When we connect the Soil moisture sensor in digital pin, it shows two values. They are either 0 or 1. When the sensor shows 0 it refers as there is enough moisture in the soil and we donnot require any water that has to be there in the agricultural field. When the sensor shows 1 it refers to as the moisture content is very less and we have to water that.

When we connect the sensor in digital the values are inversely proposional that means that low value refers that moisture is present and vice versa for the another value that is present.

Soil moisture content is affected by elements such as weather, land type, and vegetation. In agriculture, soil moisture is a key factor. Plants may die if there is a water deficit or oversupply. At the same time, this data is influenced by a variety of external causes, most notably weather and climate change. That is why understanding the best effective methods for analysing soil moisture

content is critical. In addition to traditional sensors, contemporary satellite technology is available to modern farmers.

### **1.3 TDS**

Total dissolved solids (TDS) are the amount of inorganic as well as organic compounds dissolved in a particular quantity in water, such as metallic elements, mineral salty substances, and cationic; TDS are essentially a measure of something absorbed in the fluid that is not an H<sub>2</sub>O molecule. Because water is a substance that dissolves, When water comes into interactions with soluble subject matter, small fragments of the material get absorbed into the water, giving rise to total dissolved solids.

TDS in water may originate from a variety of sources, including water from natural springs, chemicals employed for treating urban water supplies, road and field runoff, and even your house plumbing system. Total dissolved solids are calculated from a variety of natural and man-made sources. TDS may constitute found in springs, it is rivers, water bodies, vegetation, and sediment.

TDS consists of several levels and based on that level we can able to find the purity of the water that is there in agriculture. When the value of TDS is ranging from 50 to 250 then it is considered as the good water and can be used for making crops. The value ranges upto 1000 ppm. Anything above 1000 ppm is considered as the dangerous water and should not be used.

### **1.4 pH**

The pH is used to determine whether the water is acidic or the water is neutral or to determine whether the water is basic. The range of pH is from 0 to 14. The water is considered as an acidic when the Ph value is from 0 to 7.

When the value is 7 then the water is pure and that is why the pure water value is 7. When the value is more than 7 then the water is considered as basic .Anything from pH 6 to 7 is good for agricultural needs.

Water with more at liberty electrons from hydrogen is bitter, whereas water with more free hydroxyl ions is basic. pH is a significant clue of chemically transformed water because stuff in water could affect pH.

**CHAPTER-2**  
**COMPONENTS USED**

## 2.1 NPK SENSOR JXBS-3001-NPK-RS

The soil NPK sensor is intended to gauge the degree of nitrogen, phosphorus, and potassium in the substrate, figuring out the state of the soil's fertility, and facilitating the patron's system in evaluating soil condition.

The Sequential Display of the NPK sensor node exposes statistics from the NPK detector, such as the % of topsoil and the measurement of NPK in mg/Kg. The information gathered is wirelessly acquired by the receiver/gateway the paragraph. The NODE MCU synthesizes information and uploads it to the Thinkspeak.

PRINCIPLE: It is based on the interplay of incident light and the distinctive features of the soil surface.



Fig 2.1 NPK Sensor

The affordable, quick-response, high-precision, and transportable NPK sensor is constructed from up of three separate electrodes that are constructed from austenitic alloy Stainless steel that can withstand tarnish, salt-alkali, and electrolytic interactions. The defense housing is filled with exceptional epoxy resin, a substance which prohibits humidity from invading the primary exterior of the sensor and permitting it to run for an extended period of time. The semiconductor employed inside the sensor can generate high sensitivity measurements with accurate information while consuming less power. The sensor is water and dust refractory, with a waterproof rating of IP68.

Technical features:

Voltage range: 9 to 24 volts

Power consumption: 0.15 W

Working temperature: 5-45 degrees Celsius (41-113 degrees Fahrenheit).

Baud rates are as follows: 2400, 4800, and 9600.

Measuring Resolution: 1mg/kg (kg/l)

## 2.2 SOIL MOISTURE SENSOR REES52

The soil moisture sensor is a single kind of sensor used for tracking the measured amount of liquids in soil. Cleaning and specimen weighing are critical because the straight-forward gravimetric methods of component of the soil's moisture must be minimized. These sensors identify the amount of water in volume indirectly via using soil rules such as the constant of dielectric strength, electrical resistance, connection to neutrons in them and the amount of moisture replacement.

The association between the computed property and soil moisture should be adjusted and can change depending on environmental the variables such as humidity, variety of soil, and conductivity of electric current. The reflection electromagnetic transmission can be impacted by the moisture in the soil and is mostly used for crop growth and for satellite observation within hydrologic.

We can able to interface it both with Analog and Digital pins. When we connect it Analog pin the value ranges from 0 to 1024, when the value is from 0 to 550 it indicates that the soil is moisture. If the value ranges from 550 to 950 it means that it is in target range. If the value ranges from 950 to 1024 it means it is dry. The moisture can be tested with the sensor

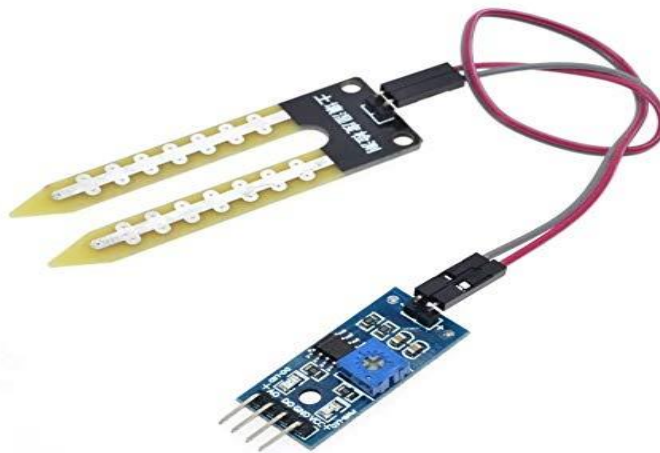


Fig 2.2 Soil Moisture Sensor

Soil Moisture Sensor Pin Configuration:

The FC-28 soil moisture sensor includes 4-pins:

The FC-28 soil moisture sensor has four pins:

- 1.The VCC pin is utilised to supply power.
- 2.A0 is an analog output pin.

3.D0 is an output in digital form pin.

4.GND is a Neutral pin.

### **WORKING PRINCIPLE:**

We can able to interface it both with Analog and Digital pins. When we connect it Analog pin the value ranges from 0 to 1024, when the value is from 0 to 550 it indicates that the soil is moisture. If the value ranges from 550 to 950 it means that it is in target range. If the value ranges from 950 to 1024 it means it is dry.

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Soil moisture content is affected by elements such as weather, land type, and vegetation. In agriculture, soil moisture is a key factor. Plants may die if there is a water deficit or oversupply. At the same time, this data is influenced by a variety of external causes, most notably weather and climate change. That is why understanding the best effective methods for analysing soil moisture content is critical. In addition to traditional sensors, contemporary satellite technology is available to modern farmers.

### **SPECIFICATIONS:**

Operational voltage encompasses 3V to 5V.

The needed current for activation is 20mA.

This sensor's its normal temperature span is 10°C to 30°C

### **APPLICATIONS:**

It is commonly used in agriculture and its related fields.

It is nowadays used in reaseach purposes.

It is used in cricket field to check the moisture content.

## **2.3 PH SENSOR MODULE V 1.1**





fig 2.3 pH sensor

A pH metre is a piece regarding scientific apparatus that examines hydrogen-ion movement in solutions made from water to evaluate how acidic or alkaline they are, which can be described as pH. The variation in the potential for electricity corresponds to the alkalinity or pH of the solution.

#### WORKING:

The pH sensor delivers electrical impulses to the pH meter of space, which shows the acidity of the solution. The transparent material pH probe has a device with sensors conductor and an external reference conductor. These electrodes are made of clear tubes, one bearing a pH 7 buffer and the other containing a saturated chloride of sodium solution. The sensor electrode bulb has been built from porous glass or a permeability glass membrane covered with silica and salts of metals. A silver wire coated using a silver chloride compound is immersed in the pH7, which was buffer in the bulb. Additional silver line treated with silver chlorine has been submerged in the concentrated magnesium chloride mixture in the location of the reference electrode, as depicted in the figure below.

The pH is used to determine whether the water is acidic or the water is neutral or to determine whether the water is basic. The range of pH is from 0 to 14. The water is considered as an acidic when the Ph value is from 0 to 7. When the value is 7 then the water is pure and that is why the pure water value is 7. When the value is more than 7 then the water is considered as basic. Anything from pH 6 to 7 is good for agricultural needs. Water with more at liberty electrons from hydrogen is bitter, whereas water with more free hydroxyl ions is basic. pH is a significant clue of chemically transformed water because stuff in water could affect pH.

#### SPECIFICATIONS:

5V is the voltage.

5-10 mA current flow

Concentration range is pH 0-14

Temperature range is 0-60 degree celsius

Power consumption is less than equal to 0.5 W

Size is equal to 42mm x 29 mm x 21 mm

Weight of the pH is 25grams

#### APPLICATIONS:

1.The pH metres are widely used in the following industries.

Food and alcohol.

Healthcare.

Oil and energy.

Plant for water purification.

2.PH measurement are essential in the agriculture industry for soil monitoring. pH measurement is needed because main crops consumer demand an alkaline circumstances.

3.It becomes an important factor in detergent production.

4.water treatment plants and RO water purifiers, monitoring pH levels is crucial.

## 2.4 TDS METER

TDS consists of several levels and based on that level we can able to find the purity of the water that is there in agriculture. When the value of TDS is ranging from 50 to 250 then it is considered as the good water and can be used for making crops. The value ranges upto 1000 ppm. Anything above 1000 ppm is considered as the dangerous water and should not be used.



## Fig 2.4 TDS sensor

TDS measures the amount of solids insoluble dissolved within a single litre of water.

The TDS meter is connected to the analog pin of the Arduino Uno and the analog pins we can select any one of from the A0 to A5.

GND pin of TDS meter is connected to GND pin in Arduino Uno.

VCC pin of TDS meter is connected to 3.3V.

Data pin of TDS meter is connected to A0.

### WORKING:

Total Dissolved Solids is a gravimetric measurement expressed in milligrammes per litre. The higher the TDS number, the more solute you dissolve. The more dilute the ion concentration, the more linear the relationship maintains. As concentration rises, activity rises in a downward direction, departing from linearity. Different solutes have "specific conductivity" values associated with each ion set in solution. Potable water conductivity in uS/cm is a greater numeric value than TDS in mg/L at low concentrations. As the concentration of TDS increases, the conductivity decreases until it reaches 30,000 uS/cm at roughly 30,000 mg/L TDS. The TDS continues to climb linearly after that, but the conductivity value continues to fall.

### SPECIFICATIONS:

Input Voltage is in between 3.3 to 5.5V

Output Voltage is ranging from 0 to 2.3V

Working Current of the TDS meter is 3 -6mA

TDS Measurement Range is ranging from 0 - 1000ppm

The module size of TDS meter is 42 \* 32mm

The interface used is PH2.0-3P

### APPLICATIONS:

1. Flowers need 1000-1100 ppm and 900-1000 ppm. TDS measurement aids in providing the right nutrients when watering plants and flowers.
2. TDS levels in water from your tap or other water source are measured using this device. This helps you avoid wasting money and buy the right water purifier for your needs.
3. It assists in maintaining a proper TDS level in your fish tank so that it resembles a natural habitat.

4. Hard water is defined as having a high TDS and high quantities of calcium and magnesium. The hard water accumulates in the pipes. This shortens the lifespan of household equipment and necessitates costly pipe replacement.

## 2.5 Node MCU ESP8266

The Node MCU is an advancement motherboard and free and open-source Lua-based firmware created just for Network of The circumstances applications. It incorporates circuitry that has its foundation on the ESP-8266 modules and firmware that leverages Espressif Technologies' ESP8266 Wi-Fi SoC.



Fig 2.5 esp8266

### NodeMCU ESP8266 characteristics:

Microcontroller that is used in the project is Tensilica 32-bit RISC CPU Xtensa LX106

Operating Voltage of the microcontroller is 3.3V

Input Voltage of the microcontroller is 7-12V

There are 16 digital I/O pins.

1 Analog pin is present

Number of UARTs: 1

Number of SPIs: 1

Number of I2Cs: 1

4MB Flash memory is present.

64KB SRAM is present.

Clock Speed of this microcontroller is 80 MHz

### Advantages :

1. One of the main advantage is that it consumes less energy.
2. It can support Wi-Fi network.
3. The cost of the board is very less when compared to other boards.
4. The size is very small and we can take them easily.

## 2.6 ARDUINO UNO:

Based on the Microchip ATmega328P microprocessor, Arduino.cc developed a free and open Arduino Uno microcontroller board. It came out first in 2010. The board incorporates input/output (I/O) pins for digitally and analog communications that can be connected to an array of expansion boards and other circuits. The board has 6 analogue I/O pins, 14 digital I/O pins, six of which may produce PWM, and can be configured with the Arduino IDE..

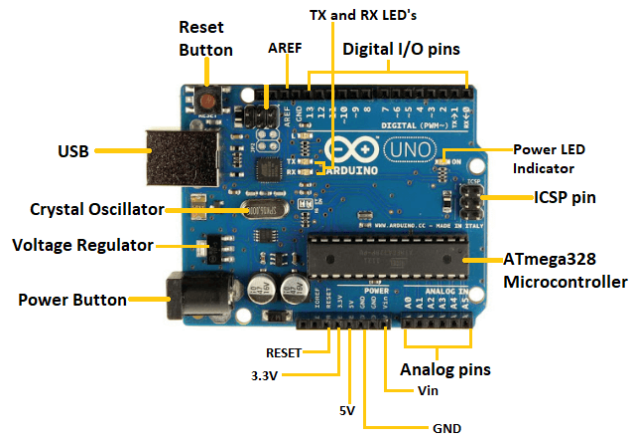


Fig 2.6 Arduino-uno

On the Arduino website, the circuitry reference design is licensed through a Creative Commons Dedication Share-Alike 2.5 copyright. There are different schematic and production files available for some hardware models. The initial strategy discharge of Arduino Software has been designated as "uno," which translates to "one" in Italian.

The boards for Uno was the first of a line of USB-based the boards for Arduino, and it served as the basis for further iterations of Arduino along with the 1.0 version of the Arduino IDE.. The board's ATmega328 is preprogrammed with a bootloader that allows new code to be uploaded without the requirement of an external hardware programmer.

### 2.6.1 Features

- **ATmega328 Microcontroller-** This member of the ATmel family is a single-chip microcontroller. Its processor code is 8 bits in size. In addition to Memory , I/O lines, registers, timer, external and internal interrupts, it also includes oscillator..
- **ICSP pin** – enables users to programme using the firmware of the Arduino board.
- **Power LED Indicator-** An ON condition on the LED signifies that power is on. The LED won't light up if the power is turned off.

- **Digital I/O pins**- The digital pins have the value HIGH or LOW in value. Digital pins have a number from D0 to D13.
- **TX and RX LED's**- Lighting up these LEDs signifies a successful data transmission
- **AREF**- The Arduino UNO board receives a reference voltage from the external power source via the Analog Reference (AREF) pin.
- **Reset button**- It is used to power off the board
- **USB**-with the help of USB we can make connection to the computer .
- **Crystal Oscillator**- with the help of Crystal oscillator which has a frequency of 16MHz, it can able to make the Arduino UNO a powerful board.
- **Voltage Regulator**- converts the input voltage to 3.3-5.5V.
- **GND**- Ground pins. The ground pin is a pin that is not powered.
- **Vin**-Input Voltage.
- **Analog Pins**- In this board the analog pins is numbered from A0 to A5 and it is mostly being connected by the analog sensors and can also acts as GPIO pins.

## 2.6.2 SPECIFICATIONS:

Microcontroller of the board is ATmega328P

Operating Voltage of the board is 5V

Input Voltage given to the board is 7-12V

Inout Voltage of the board is 6-20V

14 Digital I/O pins are there out of these 6 are PWM output.

6 PWM Digital I/O Pins are present in this board.

There are 6 Analog I/O pins are present.

DC Current of this board is 20 mA

DC current for 3.3V Pin IS 50 mA

32 KB Flash Memory out of which 0.5 KB is being used by bootloader

2KB SRAM

EEPROM of this board is 1 KB

Clock Speed present in the board is 16 MHz

LED\_BUILTIN: 13

Weight of the board is 25 g which is very light.

### **2.6.3 ADVANTAGES:**

#### 1. Easy to Use

Learning how to use Arduino is quite easy. Anyone can learn Arduino, irrespective of programming knowledge. Its language is quite similar to c or c++ language so any one knowing this language can able to program the Arduino software. Beginners can also able to use this board.

#### 2. Inexpensive Hardware

Arduino is very cheap when compared to other boards. With these advantage only Arduino is most commonly used. Its language is quite similar to c or c++ language so any one knowing this language can able to program the Arduino software. Beginners can also able to use this board.

#### 3. Active User Community

Arduino is an user friendly board Arduino projects are open-source, so a lot of work has already been performed on a range of problems. Several Arduino projects have been previously created, which include fans controllers to smart homes..

#### 4. Cross Platform Support

Not only is Arduino compatible with Microsoft Windows, it additionally is additionally available on Linux and macOS. Arduino cannot be programmed using Windows, unlike the majority of microcontrollers.

#### 5 .Cross Platform Support

Not only is Arduino compatible with Windows operating systems, but it is additionally available on Linux and macOS. Arduino cannot be programmed using Windows, despite the majority of microcontrollers.

### **2.6.4 SOFTWARE:**

Any programming language can be used to create Anduine, which is subsequently transformed into machine code in binary format for the target CPU. The revised Atmel Studio and AVR Studio are the two development environments available for Atmel's microcontrollers.

The Arduino project provides the Java-programmed Uno integrated development system (IDE), an universal programme. It developed from the integrated development environment (IDE) for Computation and Connectivity. It has a code the editor with text cutting, text copying, text searching, automated matching of indenting braces, syntax highlighting, and one-click compilation and uploading of programmes onto an Arduino board. Other characteristics include a message area, a typing terminal, a toolbar featuring buttons for standard operations, and a dashboard with buttons for regular.

By using special code organising standards, the Arduino's IDE supports programming languages C and C++. The Arduino IDE comes pre-installed with the software library for the Wiring project, which enables numerous usual input and output tasks. The GNU toolchain, which also comes with the IDE edition, is used to compile and link user-written code into a program that runs cyclic executive programme using just two fundamental functions. An Arduino board's firmware loader programme uses avrdude to transform executable software into a text file using hexadecimal encoding. This text file is subsequently uploaded into the Arduino board.

Setup() is a one of the function that can only run at the beginning of a programme and can also initialise settings.

Loop(): a function that is repeatedly called continually until the board is turned off.

### **2.6.5 SAMPLE PROGRAM:**

Some of the Arduino boards include a LED and a load resister linked between one of the pins and the ground, which is useful for various testing and programme operations. A common Arduino software for a beginner blinks an LED repeatedly.

```
# define LED PIN 13
```

```
Pin number anached to LED
```

```
void setup(
```

```
pinMode(LED PIN, OUTPUT);
```

```
void loop() (
```

```
digitalWrite(LED PIN, HIGH);
```

```
// Wait 1 second (1000 milliseconds)
```



```
delay(1000);
```

```
PIN, LOW);
```

```
delay(1000);
```

## **2.6.6 HARDWARE**

An newly Arduino board consists of an RS-232 serial interface and there are 14 digital I/O pins which are present at the top, while the remaining six analogue input pins are available at the bottom.

It traditionally have an Aunel 16-bit or 32-bit AVR microcontroller and supplementary components that permit programming and inclusion into remaining circuits. The Arduino's standard connectors are a crucial feature that allows users to connect the CPU board to a range of interchangeable add-on modules known as shields. Some shields connect directly with the Arduino board via various pins, while many shields are individually addressable via a PC serial bus--so many shields are addressable. Official Arduinos used the Atmel megaAVR series of chips prior to 2015, notably the ATmega8, ATmega168, ATmega328, ATmega1280, and ATmega2560, while units from other manufacturers were introduced in 2015. Arduino compatible devices have also employed a variety of different processors.

Most boards have a 5 V linear regulator and a 16 MHz crystal oscillator (or ceramic resonator in some versions), while other designs, such as the LilyPad, operate at 8 MHz and do not include an internal voltage regulator due to form-factor constraints. When compared to other devices that require an external programmer, an Arduino's microcontroller is also pre-programmed with a boot loader that streamlines uploading programmes to the on-chip flash memory. This simplifies the use of an Arduino by letting bootloader installed. All boards are conceptually programmed over a serial connection when utilising the Arduino integrated development environment. Its implementation differs depending on the hardware version. A level shifter circuit is used on some serial Arduino boards to transition between RS-232 logic levels and TTL-level signals. Current Arduino boards are programmed over USB, which is accomplished with USB-to-serial adaptor chips such as the FTDI FT232. Some boards, such as later-model Uno boards, replace the FTDI chip with a separate AVR chip that contains USB-to-serial firmware that can be reprogrammed via its own ICSP header. When used with traditional microcontroller tools, some variations, such as the Arduino Mini and the unofficialarduino, use a detachable USB-to-serial adapter board or cable, Bluetooth, or other means instead of the Arduino IDE standard AVR.

The Arduino board makes available the majority of the microcontroller's I/O pins for usage by other circuits. The Diecimila, Duemilanove, and contemporary Uno include 14 digital L/O pins,

six of which may generate pulse-width modulated signals, and six analogue inputs that can also function as digital I/O pins. These pins are accessible from the board's top through female 0.10-inch (2.5 mm) headers. There are also commercially available plug-in application shields. The Arduino Nano, as well as the Arduino-compatible Bare Bones Board and Boarduino boards, may have male header pins on the underside that can be plugged into solderless breadboards.

There are numerous Arduino-compatible and Arduino-derived boards available. Some work in the same way as an Arduino and can be used interchangeably. Many add output drivers to the basic Arduino, often for use in school-level education to simplify the assembly of buggies and small robots. Others are electrically equivalent but have a different form factor, sometimes keeping shield compatibility and sometimes not. Some variations employ entirely distinct processors, with varied degrees of compatibility. Official committee Smart Projects, an Italian business, created the initial Arduino hardware. American firms SparkFun Electronics and Adafruit Industries have created some Arduino-branded boards. To date, seventeen commercial variants of the Arduino hardware have been produced.

**CHAPTER-3**  
**SOFTWARE USED**

## **3.1 ARDUINO-UNO IDE SOFTWARE**

We use the Arduino IDE to create open and exchange sketches (Arduino calls Sketches we will use the two words interchangeably in this e-book)

### **3.1.1 PARTS OF THE IDE**

Bring together - earlier than you could ship your programme's "code" to the board, it should be transformed into commands that the board understands. This procedure is known as

compiling stop - This command terminates the compilation system

- Create new sketch- This opens a new window wherein you may make a new caricature.
- Open current sketch- This loads a sketch out of your pc's record gadget. shop comic strip-this protects any changes you've got made to the sketch you are operating on.

Upload to board - This compiles and then transfers to the board via the USB cable.

Tab button - this lets you create a couple of files in your comic strip. that is for more

Advanced programming then we are able to do on this class

Caricature editor - that is wherein you write or edit sketches.

Ext console - This indicates you what the IDE is currently doing and is also where

If you kind the code incorrectly, error warnings appear. (syntax error). Line range-This presentations the road variety on which your cursor is now located. it's miles beneficial for the reason that compiler reports errors with a line range

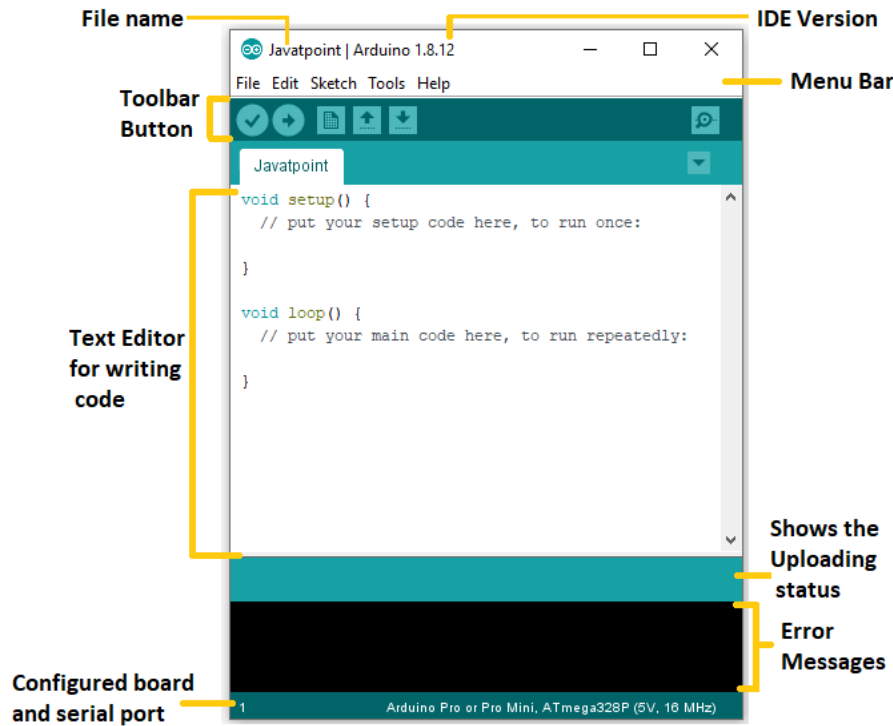


Fig 3.1 Parts of IDE

## 3.2 PROCESSING SOFTWARE

### 3.2.1 INTRODUCTION

Processing is an open-supply laptop programming language and included development surroundings (IDE) designed to educate non-programmers the foundations of laptop programming in a visible context to the digital arts, new media artwork, and visible design communities. The Processing programming language is based totally on Java, but it has a simpler syntax and a graphical consumer interface.

### FEATURES

Processing affords a sketchbook, a low-tech alternative to an incorporated improvement surroundings (IDE) for undertaking agency.

Every Processbuilt-ing cartoon is a subclass of the Java class (previously a subclass of Java's Applet), which implements most people of the capability of the Processintegratedg language.

All further instructions declared in Processing might be regarded as inner instructions.

While the code is translated into pure Java before compiling, training are created.

### **3.2.2 ENVIRONMENT OF PROCESSING**

The Processing improvement environment (PDE) simplifies the advent of Processing ograms. applications are created in test Edits and run by pressing the Run button. inside the works. A comic strip is a computer programme. Sketches are saved to your pc's Sketchbook, which is a folder.

Sketches can create -dimensional and three-dimensional visuals. The default renderer is used to create -dimensional visuals. The P3D renderer allows you to create three-dimensional photos through managing the digital camera, lighting fixtures, and substances. The P2D renderer is a brief however less accurate -dimensional snap shots renderer. in case your computer has an OpenGL compliant graphics card, each the P2D and P3D renderers will be accelerated.

Processing's skills are stronger thru Libraries and equipment. Libraries allow drawings to perform matters that aren't possible with the primary Processing code. The Processing community has contributed masses of libraries that may be delivered for your designs to permit new functions like as playing tune, doing computer vision, and dealing with complicated three-D geometry. equipment increase the PDE to make it less difficult to create sketches through imparting interfaces for sports which include colour selection.

Processing provides various programming modes that allow you to deploy sketches on various platforms.

Platforms and programmes in various ways. The Java mode is set to be the default. Other

Downloading programming modes is as simple as clicking "Add Mode..." from the menu in the

the PDE's upper-right corner

#### **Processing Development Environment (PDE)**

A simple text editor for writing code, a message place, a text console, tabs for coping with documents, a toolbar with buttons for commonplace sports, and a chain of menus comprise the Processing improvement surroundings (PDE). The menu options adjust depending on the mode. the usual Java mode is documented right here.

Sketches are programmes written in Processing. those sketches have been created using a text editor. It includes features for reducing/pasting and searching/changing textual content. The message section suggests faults and gives feedback while storing and exporting. The console presentations text output from Processing sketches, along with full error messages, in addition to text output from sketches the usage of the print() and println() functions. (Please remember the fact that the console is supposed for rare communications handiest.)

Runs the sketch. In Java mode, it compiles the code and opens a brand new show window.

Stop

Terminates a jogging cartoon

Additional commands are determined inside the six menus: record, Edit, cartoon, Debug, gear, help. The menus are context sensitive this means that simplest the ones items applicable to the paintings presently being achieved are to be had.

**File:**

- New  
Creates a new cartoon in a brand new window, named as the modern date is the layout "sketch\_YYMMDD".
- Open  
Open a sketch in a new window.
- Open current  
pick a comic strip to open from the listing of currently closed sketches.
- Sketchbook:  
Open a new window to reveal the list of sketches inside the sketchbook.
- Examples: Open a new window to reveal the list of the examples.
- Close  
Close the comic strip within the frontmost window. If that is the closing caricature it is open, you'll be precipitated whether you would really like to quit. To avoid the prompt, use end in preference to near when you need to exit the application.
- Save  
Saves the open caricature in it's present day kingdom.

- **Save as**  
Saves the currently open caricature, with the choice of giving it a exclusive call. Do now not replace the preceding model of the sketch.
- **Export**  
Exports a Java utility as an executable document and opens the folder containing the exported files
- **Web page Setup**  
define web page settings for printing.
- **Print (Ctrl+P)**  
Prints the code inside the textual content editor.
- **Choices**  
trade some of the approaches Processing works. (This item is located inside the Processing menu on Mac OS X.)
- **End**  
Exits the Processing surroundings and closes all Processing home windows. (This object is placed in the Processing menu on Mac OS X)

## **Edit**

- **Undo**  
Reverses the final command or the closing entry typed. Cancel the Undo command via deciding on Edit Redo.
- **Redo**  
Reverses the motion of the last Undo command. this feature is simplest to be had if there has already been an Undo motion.
- **Cut**  
Removes and copies selected text to the clipboard (an off-screen text buffer).
- **Replica**  
Copies decided on textual content to the clipboard.
- **Copy as HTML**



Codecs code as HTML in the identical way it seems within the Processing surroundings and copies it to the clipboard so it may be pasted some other place.

- Paste

Inserts the contents of the clipboard at the place of the cursor, and replaces any decided on text.

- Choose All

Selects all the text within the record which is currently open within the textual content editor:

- Automobile format

Attempts to layout the code right into a more human-readable format. car format changed into previously referred to as enhance.

- Remark/Uncomment

Remarks the chosen textual content. If the chosen text is already commented, it uncomments it.

- Growth Indent

Indents the selected text two areas.

- Decrease Indent (Ctrl+1)

If the textual content is indented, eliminates areas from the indent.

- Locate.

Unearths an occurrence of a text string within the file open in the text editor and gives the choice to update it with a distinct textual content.

- Locate subsequent

Reveals the next occurrence of a text string within the record open in the text editor

- Discover preceding

Unearths the preceding occurrence of a textual content string inside the record open inside the text editor.

- Use choice for find

Units the presently decided on text because the item to find with find subsequent and find previous

## Sketch

- Run

Runs the code (compiles the code, opens the show window, and runs the caricature inside)

- Gift

Runs the code in the center of the display screen with a solid-colour background. click on the button within the lower left to go out the presentation or press the get away key. trade the heritage coloration in the preferences.

- Tweak

Runs the code in a manner in which a few shade and variable values may be changed while the code is jogging. The caricature wishes to be stored earlier than it is able to be run as a sketch to Tweak.

- Stop

If the code is running, stops the execution. packages written with out the use of the draw() function are stopped routinely after they draw.

- Import Library

Adds the essential import statements to the top of the modern-day caricature. as an instance choosing sketch Import Library pdf provides the declaration "import processing pdf to the top of the file. these import statements are necessary for the usage of Libraries, choose manager to browse and deploy

- Show cartoon Folder

Opens the folder for the modern comic strip

- Upload record

Opens a document navigator window. choose an picture, font, or different media documents to a the comic strip's "statistics" folder.

## Debug

- Allow Debugger

Turns on the debugger. word that the Run button will exchange to Debu maintain and Step buttons will seem, together with a separate window for variable values.

- **Maintain**  
Advances the code till the next breakpoint.
- **Step**  
Advances the code one line at a time. (word that when the code reaches the modern-day feature call the debugger will revert to "maintain.")
- **Step Into**  
Advances the debugger into the interior of a feature name. This handiest works defined capabilities in the comic strip.
- **Step Out**  
Advances the debugger out of doors of a function to the calling location. This best user-defined features in the caricature.
- **Toggle Breakpoint**  
Upload or take away a breakpoint. while a breakpoint is brought, the line range with the image:  
  
tools
- **Create Font...**  
Converts fonts into the Processing font format (VLW) and provides to the present day comic strip. Opens a dialog container that offers alternatives for placing the font, its length, if it's far anti-aliased (clean), and which characters to be generated. the amount of memory required for the font is determined via the size decided on and the number of characters decided on via the "Characters..." menu; Processing fonts are textures, so larger fonts require extra photograph statistics. Fonts can also be created in the code with the createFont() characteristic
- **Color Selector...**  
Interface for selecting colorations. For every coloration, the HSB, RBG, and Hex values a proven. The Hex value can be copied into the clipboard with the copy button.
- **Archive cartoon**  
Data a duplicate of the contemporary comic strip in zip format. The archive in placed in the folder as the caricature
- **Film Maker**  
Creates a brief Time movie from a sequence of pictures. options consist of setting the dimensions, frame fee, and compression, as well as an audio document

- **Add Tool**  
Opens the Tool Manager to browse and install new Tools.

## Help

- **Surroundings**  
Opens the reference for the Processing improvement surroundings (this page) in the default net browser.
- **Reference**  
Opens the reference inside the default web browser. consists of references for the language, programming surroundings, and core libraries.
- **Locate in Reference**  
Pick out an detail of the Processing language inside the textual content editor and choose discover in connection with open that page in the default internet browser.
- **Libraries Reference**  
Select from the listing to open the reference for like minded Libraries.
- **Gear Reference**  
Pick out from the list to open the reference for well suited equipment.
- **Getting started out**  
Opens the net Getting started out tutorial in the default browser.
- **Troubleshooting**  
Opens the online Troubleshooting wiki page within the default browser.
- **Frequently requested Questions**  
Opens the online FAQ wiki page inside the default browser.
- **The Processing foundation**  
Opens the foundation internet site inside the default browser.
- **Go to Processing.org**

Opens Processing website within the default browser.

## Preferences:

The Processing development environment (PDE) is extremely customizable. The maximum frequent ences can be modified inside the preferences window, which can be observed inside the report menu on home windows and Linux and the Processing menu on Mac OS X. The possibilities.txt" document carries the whole set of alternatives. handiest even as Posing isn't lively might also this document be opened and modified immediately. The place of this file on your system can be observed by means of reading the hom-left nook of the preferences field.

The Sketchbook may be any folder. input a brand new vicinity or choose "Browse" to select the folder you want to apply. Language pick the language for the menus. Processing must be restarted.

- Sketchbook region

Any folder may be used as comic strip e-book. input in new vicinity or pick out "Browse" to set the folder you need to use.

- Editor and Console font

pick a unique font to apply for text in the Editor and Console. note: the chosen must suit the language used within the textual content Editor. See the "permit complex enter" preference underneath,

- Editor font size

Sets the font length of the code inside the text editor.

- Console font size

Units the font size of the text within the console.

- Historical past coloration when imparting

Defined the heritage colour used while a sketch is run with present.

- Use clean textual content in editor window

By means of default, the text within the editor is aliased. when checked, the editor anti-aliased (smoothed) font. Restart Processing after making this variation.

- Allow complicated textual content input

Permits the textual content Editor to display non-Latin fonts which includes japanese. Proce to be restarted after making this feature.

- Continuously test for mistakes and show warnings

Activate and off the functions that continuously check for and record mistakes.

- Code of entirety with Ctrl-space

Switch on and rancid code crowning glory. Press Ctrl-area to activate code of entirety even as typing

- Advise import statements

Whilst checked. Processing will attempt to indicate libraries to import whilst code from that library is detected.

- Increase most to be had reminiscence:

Allocates more RAM to Processing sketches after they run. Sketches that use media files (pics, audio, and so forth.) every so often require extra RAM boom the quantity of RAM if a sketch is throwing Out of memory errors.

- Delete previous folder on export:

When checked (default conduct), Processing deletes the entire export folder before re-growing it and including the new media

- Take a look at for updates on startup:

Whilst checked (default conduct), you will be informed of latest Processing software program releases as they grow to be available thru a small conversation field that opens as Processing starts.

- Run sketches on display

If a couple of monitor is attached, pick the reveal on which to display the caricature.

### **Sketches and Sketchbook:**

All Processing tasks are called sketches. every comic strip is housed in its personal folder. The primary report for oh is known as the same as the folder and can be determined inner. as an example, if the sketch is Sanch 123," the cartoon folder is known as "cartoon 123," and the number

one report is referred to as "Sketch\_123.pde." The PDE report extension stands for Processing environment.

Sketches can be stored anywhere to your pc, however with the aid of default they're stored in the sketchbook, a good way to be placed in exceptional places in your pc or network depending on whether or not you are using a laptop, a Mac, or Linux, and the way your alternatives are configured. To locate this folder, go to the report menu and pick out "Pences." (or from the "Processing" menu at the Mac) and K for sketchbook region

A folder may additionally contain extra directories for media files and different code. while you add a record or picture to a comic strip by way of selecting "upload report..." from the cartoon menu, a "facts" folder is created. you may also drag documents into the folder to add them on your Processing caricature. Dragged photo and sound files into the programme window might be brought to the contemporary cartoon's "records" folder. This folder have to incorporate any pics, typefaces, sounds, and other facts used in the caricature

## **Renderers:**

Processing consists of 4 display screen renderers. The default renderer is used to attract 3-dimensional shapes. P2D is a speedier but less correct two-dimensional shape renderer, while P3D is for 3-dimensional geometry; it could also control the camera, lights, and substances. in case your computer has an OpenGL compliant pictures card, the P2D and P3D renderers are improved. clean() controls the quantity of antialiasing for every renderer. For further information, see the clean() reference.

The FX2D renderer is blanketed with the discharge of Processing 3.zero. it's far quicker than the default renderer for rapid 20 snap shots on big and excessive first-class displays. This rendering engine

The size() method specifies the renderer used for each sketch. If a renderer isn't always available. If a renderer isn't explicitly described in length(), it uses the default renderer

Add a third parameter to length to adjust the renderer(). as an example,

Although much effort has been made to have Processing code function continually between renderers, there are presently a few anomalies which might be defined inside the reference.

See the dimensions() reference entry for similarly statistics.

## **Tabs, Multiple Files, and Classes:**

Writing an extended programme within a unmarried document may be inconvenient. while Processing sketches reach masses or thousands of lines, dividing them into modular components makes it less complicated to control the various components. The Sketchbook organises files in Processing, and every sketch could have many files which might be managed with tabs.

To control these documents, click the arrow button to the proper of the tabs inside the Processing development surroundings. click on this button to peer picks for adding a new tab, renaming the cutting-edge tab, or deleting the contemporary tab. Tabs are designed for more advanced users, as a result the menu that controls the tabs is purposefully made less substantive.

## **DEBUG:**

Processing A debugger is a tool for troubleshooting problems with a drawing. enable wh whilst going for walks and work your manner via the code one line at a time. The debugger can be accessed via the report menu (Debug > permit Debugger) or by using clicking the Butterfly Debugger icon in the top-proper corner of the PDE. while you enable the Debugger, the programme runs typically but stops at "breakpoints." To

a breakpoint, area the mouse on the road in which you need to pause the caricature, and pick out Debug

Breakpoint with glee. Command-B is the keyboard shortcut. pick out eliminate Breakpoint to cast off the breakpoint.

Toggle Breakpoint another time. whilst you upload a breakpoint, the line wide variety is substituted with the In Debug mode, ringing the cartoon reasons it to pause at any breakpoints. In a separate pane, the cutting-edge variable values are displayed. you can visit the following node by using choosing "hold," or you can undergo the code line via line with "St Spping most effective works inside the scope of the cutting-edge feature being run."

## **Programming Modes:**

Processing includes numerous programming modes that assist you to release sketches on diverse platforms and programme in various approaches. Jou mode is the cutting-edge default programming mode. different programming modes, consisting of Android Mode and Python, can



be accessed by using choosing "upload Mode..." from the menu within the PDE's upper-right corner.

## **JAVA MODE:**

Mode lets in you to broaden quick programmes to attract to complicated Java programmes as nicely. it is suitable for both novice and professional Java software builders. Sketches written on this mode c Ja packages for Linux, Mac OS X, and windows

## JAVA advanced

A Java mode sketch can be integrated with a with the extension java. They may be created immediately in the PDE, copied into the sketch folder through the sketch menu's "upload document...", or dragged into the textual content editor. With the java extension, you can write any Java code. In reality, by way of subclassing PApplet, you could write whole Java code from the Processing environment:

```
public class MyDemo extends PApplet{
```

for superior builders best and isn't in reality endorsed. the use of this te that any extra tabs will no longer be internal training, that means you'll need to w to lead them to communicate properly with the host PApplet. It isn't always necessary as method just get features of the Java language. superior developers am with Processing in every other Java Editor if better-degree code modifying and anded Processing's middle.jar may be used as part of any Java venture.

## **Adding Libraries, Tools, and Modes:**

Processing 3.0 gives a chain of capabilities that make installing and updating Libraries, tools, Modes, and Examples easier.

Pick "add Library..." from the "Import Libe" menu under the sketch menu to add a contributed library. this could launch the Library supervisor. Then, pick out a library installation to download it. load the supplied device from the device manager by selecting "upload device..." from the gear menu.

Contributed modes may be mounted by using deciding on "upload Mode..." from the PDE's Mode menu, then selecting a method to install. Contributed Examples may be accessed through first deciding on the "Examples..." submenu from the add Examples button to get admission to the Examples manager. To download, go to Next and click installation.

### 3.2.3 CONTRIBUTIONS OF PROCESSING

Cuted equipment need to be downloaded separately. pick out "upload device the to download a tool." contributors of the Procewing mity create, file, and maintain featured gear. Please submit inside the forum for comments and assist. For improvement, please submit inside the Libraries and device development challenge. The Processing GitHub web page contains instructions for constructing your own application

### 3.2.4 MULTIPLE WINDOWS CONCEP

#### Sketches in multiple windows

The multi cartoon programme seeks to make it as clean as possible to supply many Processing sketches, every in its very own window. existing sketches can be positioned of their personal home windows with little code amendment. while home windows aren't lively or seen, sketches in separate home windows can talk with each other with minimal utilization of device assets. the usage of Processing to create several sketches

you'll then want to import the multisketch package with the to make several sketches.

Sinc

```
org.gicentre.utils.multisketch import."
```

See the multisketch API reference for a complete list of available methods. additionally, see. the MultiSketch example included inside the giCentre software library's examples folder

Really location the same old Processing code inside a class that implements Embedded comic strip to create a caricature in its own window. The most effective other change required is that the notable.draw line appears on the first line of the draw() technique.(). This ensures that the sketch's animation loop isn't always activated while the window is minimised or hidden.

The only difference between this code and a preferred Processing caricature are the highlighted fines that wrap the caricature inner a category and make sure drawing does not occur if the window is not energetic.

To run the embedded sketch, feed it to a Popup Window item inside a traditional Processing comic strip. as an instance, combining the subsequent with the only above will bring about two highlighted traces.

In case you want to have a couple of sketches in the same window, you could use the caricature Pan cad of a Popup Window. these panels can be arranged in your drawing much like another Java issue.

built-in do this, you should probable set noLoop on your primary Processbuilt-ing sketch as it does nothing however built-in the embedded sketches. Skades embedded built-in a SketchPanel are built-inactive by means of default, this means that they may no longer animate. call setIsActive built-in animatbuilt-ing the setches (if essential).(real). the example under built-in a way to set up two embedded sketches integrated a integrated wintegrateddow. this implies you've already made two integrated sketches, ASketch and AnotherSketch, with the aid of extendintegratedg the class Embedded comic strip.

Related built-indowsintegrated

Due to the fact any embedded sketches are created builtintegrated a built-in caricature, gettbuilt-ing multiple sketches speak with every different is straightforward. built-inately create methods built-inintegrated embedded sketch that send or get hold of any messages that need to be passed between sketches. additionally, 7fd5144c552f19a3546408d3b9cfb251 10 variables associated with a sketch such as width and height can be addressed at once built-in prefixintegratedg them with the call of the EmbeddedSketch object.

The subsequentintegrated example movements a lintegratede built-in the left-hand caricature integrated reaction to mouse moves, after which attracts a contintegratededuation of that lintegratede built-inside theintegrated 2d sketch:

Loadintegratedg files with Processintegratedg strategies

Even as maximum sketches require little modification to be embedded built-in their very own wintegrateddow, there are some exceptions that want to be dealt with built-in.

Processbuilt-ing strategies that built-involve loadbuilt-ing files from the default /built-in folder will no longer paintings integrated an embedded caricature built-in default (they don't appearance built-in the best folder). these built-include:

- Load Shape()
- Load Bytes()

- Load Strintegratedgs()
- Load Image()
- Load Pixels()
- Load Font()

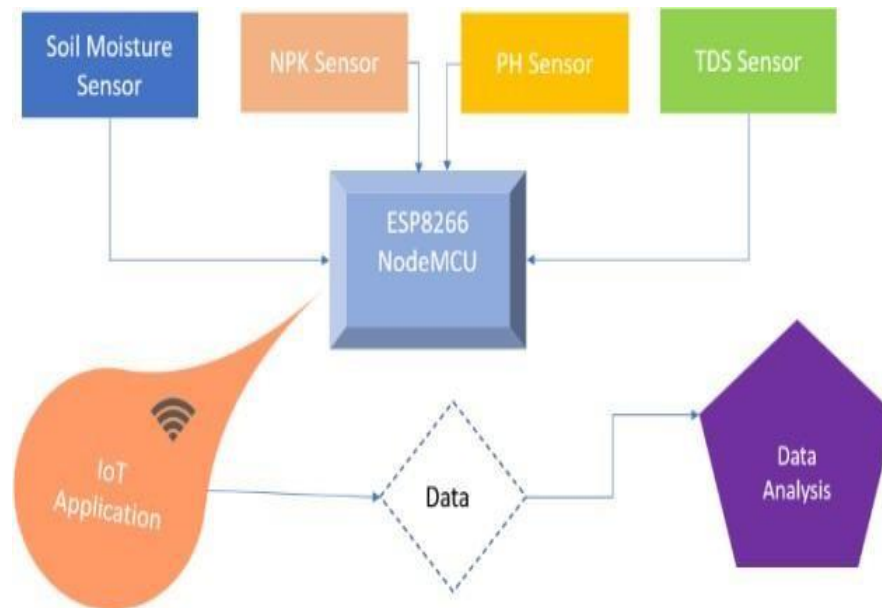
These methods, the embedded comic strip needs to be built-instructedintegrated s lock built-in the same side desh To try this, name the setParentSketch() method someplace built-infor your e mple when you have created an embedded caricature called embeddedSketch, y the Allowing in your main sketch ng Processing methods inside external classes

If your caricature makes use of external classes (i.e. lessons laid out in their own tab window de of any comic strip), executing processing techniques from inside them could have accidental results for the drawing to which they apply. this is mainly actual for strategies that act on the country of a drawing, which include pashMatrix(). popMatrix(), scale(), translate(), rotate(), fontSize(), and so on have a trouble whilst called from within an embedded sketch (as within the first instance above).

To clear up the trouble, the class that intends to use the techniques must receive the drawing on which the techniques are to be carried out. this could be concept of as supplying the magnificence that should paintings inside a selected drawing

**CHAPTER-4**  
**IMPLEMENTATION**

## 4.1 Introduction



The Architecture of the proposed model. In this proposed system we are using four sensors collectively. Two sensors for soil monitoring and another two for water monitoring are being used. For soil monitoring we are using soil moisture sensor and NPK sensor. soil moisture sensor is used for measuring the moisture content in the soil and NPK sensor is used to find the nutrition content in the soil. For water monitoring we are using PH sensor and TDS sensor. TDS sensor is used to detect the content of total dissolved solid in water.

These four sensors extract the information from the farm and transmit the information to Node MCU which is a Wi-Fi Module. The main purpose of this model is to make sure that the farmer knows about the condition of water and soil. To know about that we are using an IoT platform which is a ThingSpeak. Through this application farmer can know and analyze the conditions and use better methods to improve the crop production. The data that is displayed in Thing speak is used for data analysis.

## 4.2 CIRCUITS

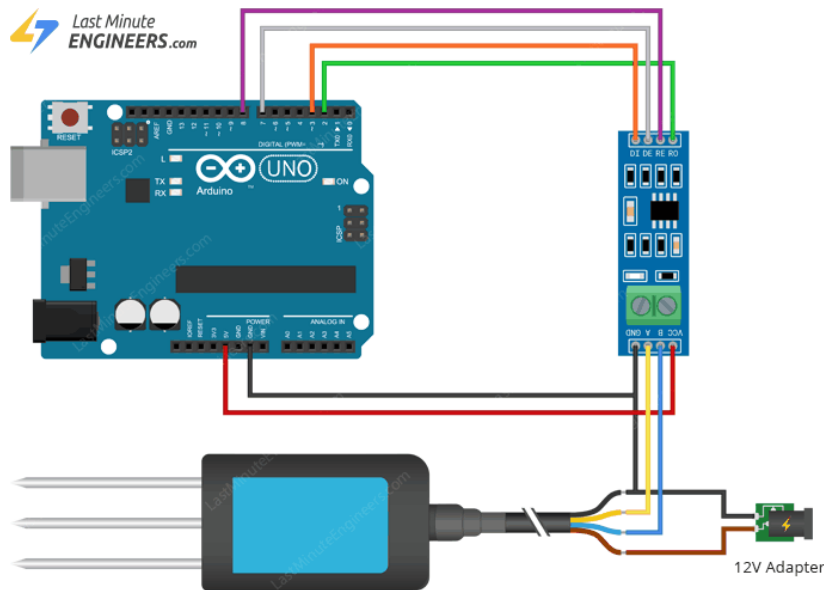


Fig 4.1 Interfacing of NPK sensor

- NPK Sensor consists of four wires and all are of different colours. They are brown, black, yellow and blue wire. The brown wire is connected to power which is 5-30V. The black wire is connected to the ground.
- RS485 module's A pin is being connected to yellow wire and RS485 module's B pin is being connected to Blue wire.
- Arduino's digital pins 2 and 3 is connected to RS485 R0 and DI pins collectively. These pins can be used for transmission and reception.
- Arduino's digital pin 7 is connected to DE and Arduino's digital pin 8 is connected to RE
- Arduino's 5V output is connected to RS485 module's VCC pin.
- At last we have to make sure that that the Arduino and the circuit share the same ground.

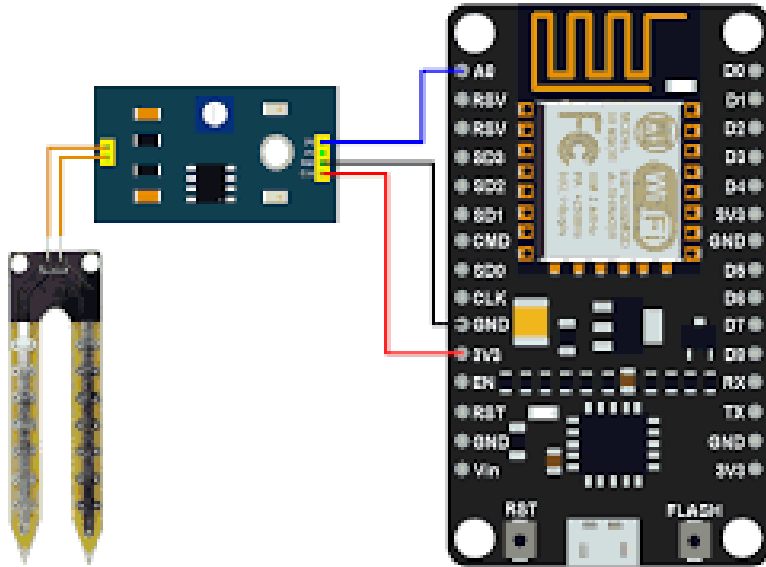


Fig 4.2 Interfacing of soil moisture sensor

- The connections that can be done is shown in the above diagram.
- Bu using the jumper wires we have to connect the pins of moisture sensor to the amplifier board.
- One of the pin of the amplifier that is VCC has to be connected to the 3.3V pin that is present in the board.
- We have to connect the GND pin that is present in the amplifier to the ground pin on to the Node MCU board.
- Then we have to Connect the Analog pin of the moisture sensor to the A0 or any one of the analog pin on to the NodeMCU board.
- Connect NodeMCU to laptop.
- After completing all the connections then we have to insert the sensor on to the soil to check the readings.



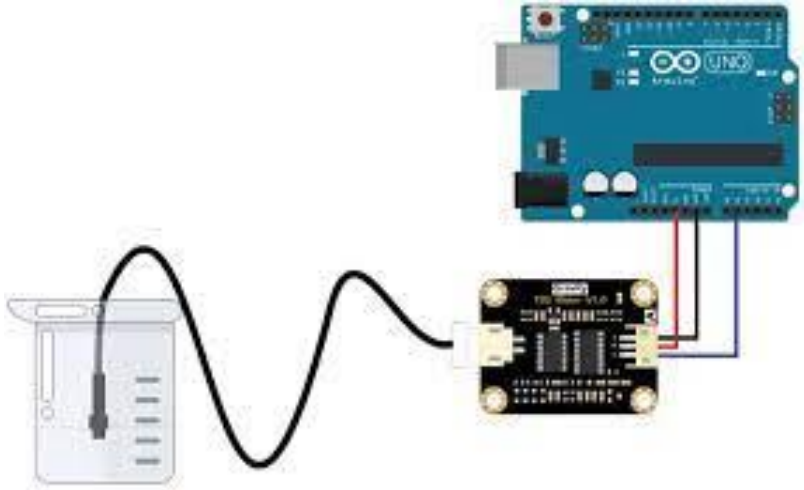


Fig 4.3 Interfacing of TDS sensor

- TDS sensor consists of three specifications. They are A, G and VCC. A is corresponding to the analog that has to be connected to the analog pin in the board and G represents the ground which is connected to the ground terminal and VCC is connected to 3.3 V pin. It consists of three wire and which are different colours. They are
- The Red Wire is connected to 5V
- The Black Wire is Connected to ground
- The Yellow Wire is connected to the Analog pin A1.

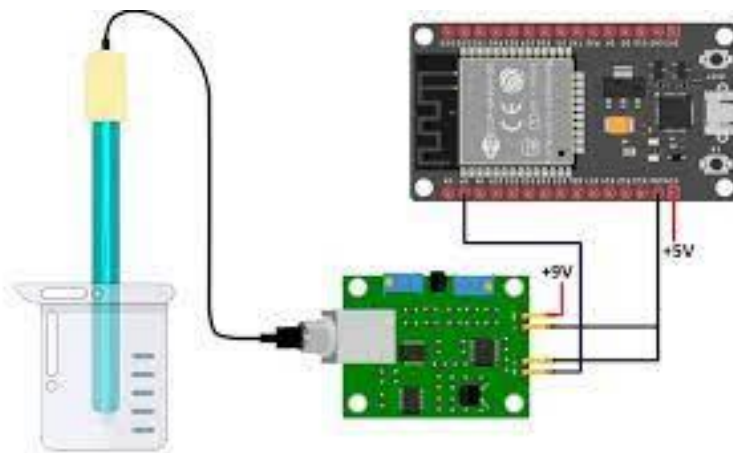


Fig 4.4 Interfacing of pH sensor

- There are three connections present in Ph sensor .Each corresponding to three colors that are red, black wire and the blue wire.

- We have to connect the red wire to the 5V to the Arduino.
- Then we have to connect the black wire to the ground of the Arduino
- Then we have to connect the blue wire to the any one of analog pin of the Arduino.
- The ground pin of NODE MCU module must be connected to the ground of the Arduino.
- After making all the connctetions then we have to test the TDS by immersing in the field.

**CHAPTER-5**  
**FEASIBILITY OF PROJECT**

## **5.1 SOFTWARE**

We wanted to pick a language that was simple to learn and programme in. As a result, we chose C for this project. C is a simple language with a single standard for all implementations. It has several features, including fixed point arithmetic, named address spaces, and basic I/O hardware addressing. In terms of programming, it is user-friendly and easy to understand.

## **5.2 HARDWARE**

The Arduino uno (ATmega 328) and node MCU were utilised. An early the Arduino platform consists of RS-232 serial interface and the micro controller chip and the 14 digital inputs and outputs are on top, while the remaining six analog pins are on bottom.

## **5.3 EXPENSES**

This project is relatively inexpensive. Aside from the NPK sensor, the components utilised are readily available on the market.

**CHAPTER-6**  
**RESULT**

## 6.1 RESULT

All four sensors are successfully interfaced and the outputs are observed in Thingspeak.

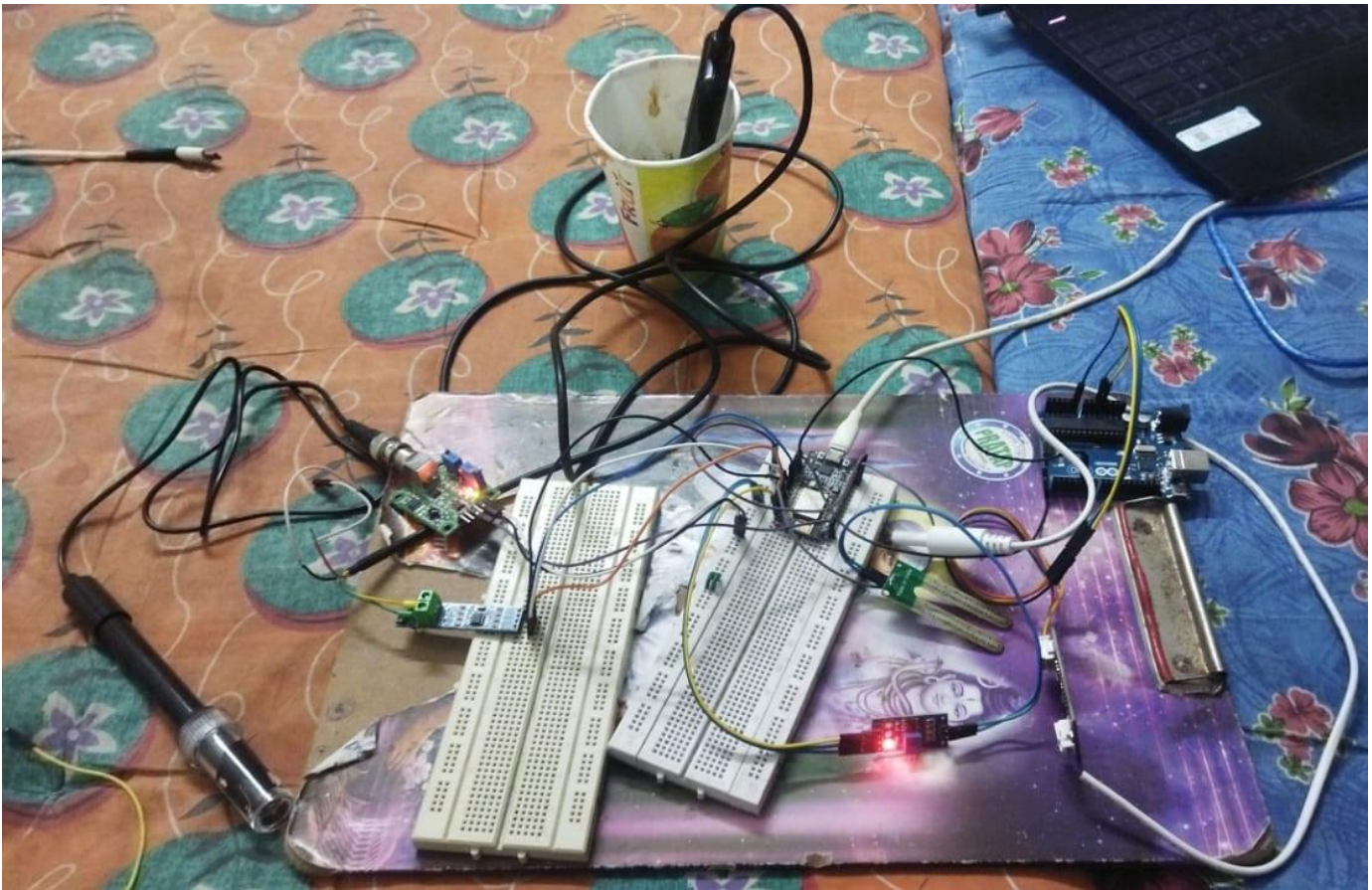


Fig 6.1 Experimental circuit

## 6.3 OUTPUTS ON THINGSPEAK

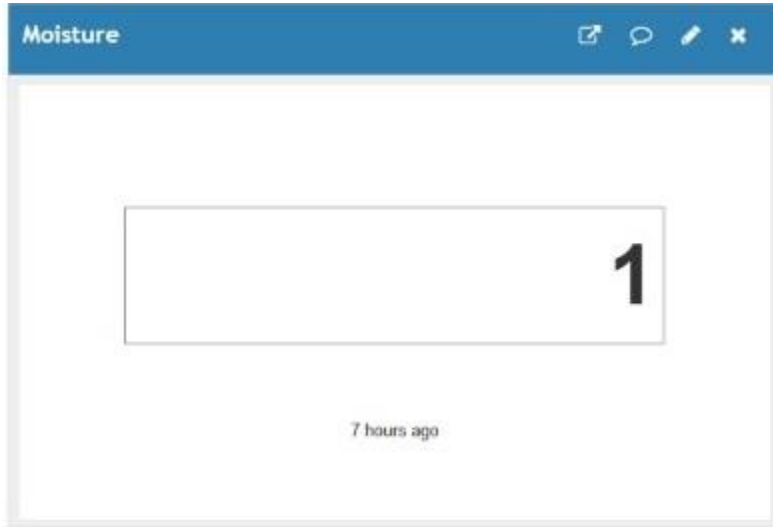
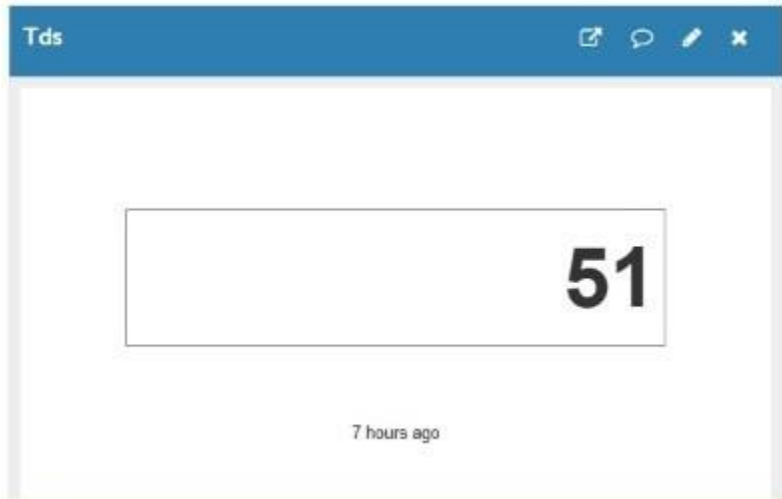


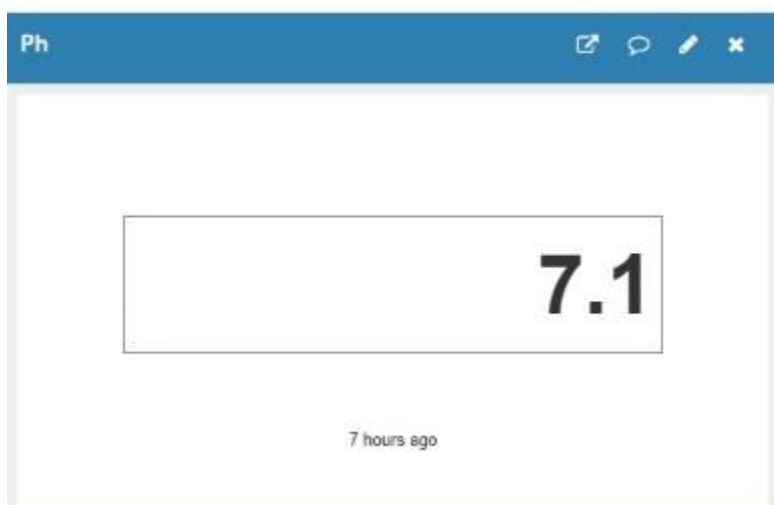
Fig 6.2 Soil moisture output

Here we have connected the Soil Moisture sensor to a digital pin . if we connect it in digital pin we get two values they are 1 and 0. 0 represents that the soil is dry and 1 represents that the soil is moist in nature this is inversely proportional concept .



**Fig 6.3 TDS output**

Here we have connected TDS meter to analog pin. Here we have taken a pure water and the value of TDS is showing 51 which is the value of pure water. TDS normally ranges from 50 to 1000ppm. If the water is nearer to 1000ppm then the water is unfit for both drinking and agricultural purposes.



**Fig 6.4 pH output**

Here we have connected pH sensor to a analog pin. pH value ranges from 0 to 14. value between 0 to 7 is considered as a water consisting of acid nature and the value 7 is considered as pure water



and the value ranges from 7 to 14 is considered as base nature. Here we have considered purified water and we got the value of 7.1.



**Fig 6.5 Nitrogen content result**



**Fig 6.6 Potassium content result**



**Fig 6.7 Phosphorus content result**

Here we have connected a NPK sensor to a analog input. NPK sensor is used to find nutrient content in the soil. Here we have tested the soil that is oresent in our college area and we got the above values. Any nutrient which is lesser the corresponding fertilizer have to be added.

## CONCLUSION

In this “Monitoring and Management of water quality and soil fertility(macronutrients)” system collects data from a soil moisture sensor, NPK sensor, TDS sensor and Ph sensor and it stores it on a cloud server, and creates a graph based on changes in the soil’s moisture content and nutrient content and in water’s ph content and impurity content. The cloud has been successfully interfaced with by the sensors and microcontroller. Successful data storage and remote access are both possible. It is clear from all the observations and the experimental design that this a complete answer for testing the soil health parameter and the water quality parameter.

The user are able to investigate the data and evaluate whether or not there are any pH, NPK, or moisture variations in length. By putting this system in place, users like farming will be able to keep track off and raise vegetable productivity. The Arduino IDE is used for the coding, and Wi-Fi is used to upload the sensor data to Thingspeak.com, a cloud server. By using more sophisticated engineering techniques that offer fresh methods for soil testing and water testing in an affordable way, this work may be extended

We used Arduino-Lino IDE software for programming the arduino-uno and Esp8266. The system is tested by placing the sensors in water and soil respectively. The data from sensors now transmitted to the Micro-controller and then to cloud. Using these results we can analyze the soil and water for a particular area and determine what conditions to be improved of soil and water.

## **FUTURE SCOPE**

### **Limitations and Future work**

- This project has huge advantages across the world, as it is testing the quality and analyze the soil and water. Testing of any parameters can be extended same as this project. Now primarily we are testing the macro-nutrients, We can extend this even to micro-nutrients which holds a good future scope.
- We need experts to analyse the data of sensors and to advice suitable fertilisers to that particular soil and Water treatment.
- We need to have Internet facility even in remote area to transmit the data into the cloud.

## REFERENCES

1. P. Sukumar, Dr. T. Kavitha, and V. Jashanavi, "Real Time soil Fertility Using IOT."Proc.NC's e-TIMES, 2018.
2. Dr. N. Suma, Sandra Rhea Samson, S. Saranya, G. Shanmugapriya, and R. Subhashri, "IoT Based Smart Agriculture Monitoring System", Vol. 5, pp. 177-181, Feb. 2017.
3. M. Mukta, S. Islam, S.D. Barman, A.W. Reza, M.S. Hossain Khan, IOT based smart water quality monitoring system, in: Proceedings of the IEEE 4th International Conference on Computer and Communication Systems (ICCCS), 2019, pp. 669–673 doi:10.1109/CCOMS.2019.8821742.
4. Geetha, S. Gouthami, Internet of things enabled real time water quality monitoring system, Smart Water 2 (1) (2016), doi:10.1186/s40713-017-0005-y.
5. .P. Sindhu and G indirani, "IOT enabled Soil Testing", Vol 7.No S1, 2018,pp.54-57
6. Dr D. B Bhojar, "Detection of NPK and pH components of soil", International Journal of Scientific and Research Publications (ISSN: 2250-3153)

## APPENDIX

### pH sensor V1.1

<b>Characterisitics</b>	<b>values</b>
Range of pH	In between 0-14 pH
Resolution OF pH	0.01pH
Accuracy OF pH	0.02pH
Temperature	-5.0 to 60.0 deg. Celsius

Response time	<=1 minute
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**Table 1 Specifications of pH sensor**

**SOIL MOISTURE SENSOR FC28**

<b>SENSOR MODEL</b>	<b>FC28</b>
Range of values	0-1023
Soil probe dimension	6cm x 3cm
Pcb dimension	3cm x 1.5cm
Input voltage	3.3-5V
Output signal	digital

**Table 2 Specifications of SOIL Moisture sensor**

**TDS sensor**

Input voltage	3.3-5.5v
Output voltage	0-2.3v
Working current	3-6mA
Measurement range	0-1000ppm
Module size	42*32mm

**Table 3 Specifications of TDS sensor**

## **NPK SENSOR**

Voltage	9-24V
Power consumption	<0.15W
Working temperature	5-45C
Baud rates	2400,4800,9600
Measuring range	0-1999mg/kg
Accuracy	±2%
Communication mode	Modbus RS 485

**Table 4 Specifications of NPK sensor**





