

A SENSOR BASED IOT FOR PRECISION AGRICULTURE

Submitted in partial fulfilment of the requirements for the award of
Bachelor of Engineering degree in
Electronics and Communication Engineering

by

GARTAM KALYAN BABU (Reg. No. 38130067)
B.V.S.S MANEENDRA (Reg. No. 38130023)



DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING
SCHOOL OF ELECTRICAL AND ELECTRONICS ENGINEERING

SATHYABAMA

**INSTITUTE OF SCIENCE AND TECHNOLOGY
(DEEMED TO BE UNIVERSITY)**

Accredited with Grade "A" by NAAC

JEPPIAAR NAGAR, RAJIV GANDHI SALAI, CHENNAI - 600 119

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BONAFIDE CERTIFICATE

This is to certify that this Project Report is the bonafide work of GARTAM KALYAN BABU (38130067), B V S S MANEENDRA (38130023) who carried out the project entitled "**A SENSOR BASED IOT FOR PRECISION AGRICULTURE**" under our supervision from December 2021 to May 2022.

Internal Guide

Dr. A.SAHAYA ANSELIN NISHA M.E., Ph.D.

Head of the Department

Dr. T. RAVI, M.E., Ph.D.

Submitted for viva voce Examination held on-----

Internal Examiner

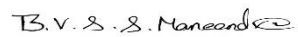
External Examiner

DECLARATION

We GARTAM KALYAN BABU (Reg. No. 38130067), B.V.S.S.MANEENDRA (Reg. No. 38130023) hereby declare that the Project Report entitled "A SENSOR BASED IOT FOR PRECISION AGRICULTURE" done by us under the guidance of Dr. A. SAHAYA ANSELIN NISHA M.E., Ph.D. is submitted in partial fulfilment of the requirements for the award of Bachelor of Engineering degree in Electronics and Communication Engineering.

DATE: 29.04.2022

PLACE: Chennai

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SIGNATURE OF THE CANDIDATES

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ABSTRACT

Internet is experiencing a completely explosive boom these days with the quantity of the gadgets connecting to it. Earlier we had simplest non-public computers (PCs) and Mobile handset linked to internet however now with Internet of Things i.e. IOT concept of connecting matters with internet; hundreds of thousands of device are connecting with it. This improvement of IOT results in the concept of device to device communication this means that that machines can talk to every different and additionally all of the statistics which changed into formerly with personal server can now could be to be had on net so the person can get right of entry to it remotely.

Precision agriculture is essentially an idea which insists to offer proper quantity of assets at and for specific period of time. These assets may be any matters which include water, light, insecticides etc. To put into effect precision agriculture the advantages of IOT has been applied.

The essential concept is to feel all of the required parameter from the agriculture area and take required choice to govern the actuator. These agriculture parameters are Soil Moisture, Temperature & Relative Humidity around plant, rain sensor. Based at the analyzing sensed through the sensor appropriate motion is taken i.e. irrigation valve is actuated primarily based totally on soil moisture readings, valve for fog is actuated primarily based totally at the Relative humidity(RH) readings etc.

Internet of Things (IoT) technology has brought revolution to each and every field of common man's life by making everything smart and intelligent. IoT refers to a network of things which make a self-configuring network. The development of Intelligent Smart Farming IoT based devices is day by day turning the face of agriculture production by not only enhancing it but also making it cost-effective and reducing wastage. The product being proposed is tested on Live Agriculture Fields giving high accuracy over 98% in data feeds.

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CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

The agriculture sector is the primary pillar of the economy of many countries and it deserves technological amelioration within a shoestring budget. Internet of Things (IoT) offers a new dimension in the major of health monitoring of soil leading towards smart agriculture and farming. The amalgamation of traditional farming methodology with advanced technologies such as IoT and wireless sensor networks (WSN) can lead to sustainable agriculture. With this rationale, we have designed and developed an IoT-enhanced device – FarmFox, which can analyze the sensed information and transmitting it to the user via the internet. In comparison to the existing IoT-driven agricultural solutions, FarmFox thrives in real-time data collection, soil health monitoring via in-situ analysis, and controlling the whole architecture from a remote location.

1.2 SCOPE OF THE PROJECT

The aim of our project is to maximize the yield with minimal area of cultivation by implementing IOT in the agriculture. With the adoption of the IoT in various areas like Industry, Home, and even cities, huge potential is seen to make everything intelligent and smart. Even the agricultural sector is also adopting IoT technology these days and this in turn has led to the development of “AGRICULTURAL Internet of Things (IoT)”

1.3. EXISTING SYSTEM

In existing method, agriculture field is monitored manually and also the sensors are not used for monitoring the field and there may be a lot of resources are consumed.

1.3.1 EXISTING SYSTEM DISADVANTAGES

Huge water resources are consumed. And also Manual monitoring leads to high human resource.

1.4. LITERATURE SURVEY

A Ruby Roselin et.al (2017) proposed Smart agro system using wireless sensor networks. Around the globe, agriculture plays a vital role in framing up the economy. Though, India one of the biggest producer of agricultural products, the growth in agricultural products has been stagnant for past several years. Thereby, requiring technologies to improve the efficiency of the agricultural productivity. Hence, the key objective of the proposed project is to making agriculture smart using IoT technologies. The important feature of this project includes the prevention of crops from spoilage during rain and efficiently recycling the rain water for irrigation. Secondly, it includes intruder alarm/buzzer which is used to detect any human/animal intruder into the farm. Finally, the operation will be performed by interfacing Wi-Fi module, GSM module and sensors with Arduino. With the proposed work, current problems related to farming are solved by reducing human efforts, wastage of water and updating the farmer about the live condition of the field on the mobile device.

P Rekha,K Sumathi et.al (2020) proposed Sensor based waste water monitoring for agriculture using IoT. The monitoring of urban waste water for agriculture use provides a smart solution for testing the quality of water by using array of sensors and the measured value is displayed in LCD. The major objective of this paper includes the estimation of water quality parameters, for instance, pH, Turbidity, Temperature, BOD, TDS that helps to identified the deviations in the parameters and provides an alert messages when there is an abnormal level i.e., the value exceeds the predefined threshold or the standard value set in the Arduino Mega 2560 Controller. These extreme values indicated chemical spills, treatment plant issues or the problems in supply pipes which may causes severe problem in terms of the cultivation of crops and quality of the soil anomaly detection of water quality setup using a GSM module, the data is stored in a cloud and server is connected with an IoT to sent message to the government and provides a remedial measure to over come these problems and helps the farmers to improve the sales and business processes.

Kunal Singh, Raman Kumar et (2021) proposed Design of a Low-Cost Sensor-Based IOT System for Smart Irrigation. The purpose of this chapter is to discuss the design and construction of a smart irrigation system, sensor-based system powered by an IOT (Internet of Things) chip (ESP8266). The design of this irrigation system can be divided into two parts: one is the hardware arrangement which is a low-cost rope and pulley arrangement elegantly designed to cover the crop fields to control the moisture of soil along with other actuators discussed in detail in this chapter, and the other part is an intelligent low-cost IOT-based control system, which can be programmed based on the moisture requirement of a particular crop. The feedback to this control system is sent through moisture, temperature, and rain sensors situated in the crop field, the data of which can also be wirelessly accessed through any open-source IOT platform which can be a desktop or mobile application. The system has also been designed to store the sensor data on a memory card integrated itself in the control system, which is helpful for future research and study of environmental factors on crop production. The system is designed to maintain constant level of moisture in the field by analyzing environmental conditions such as rain or change in temperature of the soil.

Sercan Aygün, Ece Olcay Güneş, Mehmet Ali Subaşı, Selim Alkan et.al (2019) proposed Sensor Fusion for IoT-based Intelligent Agriculture System. Sensor Fusion for IoT-based Intelligent Agriculture System . Sensors in agriculture are in use from weather monitoring to autonomous watering. Using low-cost sensors allows designers to create a prototype for a hardware environment to implement data acquisition and mining process. Thus, the relation between sensors can be understood and a test environment for sensor fusion can be created. In this paper, different input devices are synchronized by using a microcontroller system and each data, obtained from the sensors, are sent wirelessly by an (Internet of Things) IoT device to the cloud, by recording and monitoring from the graphical user interface on the web as a real-time environment to apply data mining algorithms thereafter. This study uses the regression trees to obtain the sensor data relations from 8 different data related to light, temperature, humidity, rain, soil moisture, atmospheric pressure, air quality, and dew point. Each sensor data has a different effect on the agricultural monitoring,

however, reducing the number of sensors can reduce the cost of a system, by giving still accurate observations via sensor substitution proposed. Therefore, by using the regression trees, the classification of sensor data is inspected in this study. A test prototype of the hardware together with the software design is created for data monitoring and sensor fusion in different combinations. In the end, after fusion tests for all possible cases, outstanding results for each sensor substitution is presented. Temperature and dew point can be obtained using other sensors by fusing the train data on the regression tree by 92% and 84% accuracy respectively with a 5% numerical error margin in the leaf nodes on the regression tree

Sahitya Roy, Rajarshi Ray et.al (2017) proposed IoT, big data science & analytics, cloud computing and mobile app based hybrid system for smart agriculture. Here we presents AgroTick, an innovative hybrid system for smart agriculture. AgroTick is an IoT based system supported with mobile interface and designed using technology modules like cloud computing, embedded firmware, hardware unit and big data analytics. AgroTick is architected and designed to improve the efficiency of agriculture, build a well-connected farming network and create a knowledge sharing platform for farmers. In a longer run, AgroTick will address two key issues plaguing agriculture in India - harvesting rainwater and groundwater, and predicting effective utilization of the same.

1.5.PROPOSED SYSTEM

In proposed method, as IoT gadget focusing on Live Monitoring of Environmental data in terms of Temperature, Moisture and other types depending on the sensors integrated with it. The system provides the concept of “Plug & Sense” in which farmers can directly implement smart farming by as such putting the System on the field and getting Live Data feeds on various devices like Smart Phones, Tablets etc. and the data generated via sensors can be easily shared and viewed by agriculture consultants anywhere remotely via Cloud Computing technology integration. The system also enables analysis of various sorts of data via Big Data Analytics from time to time

1.5.1.PROPOSED SYSTEM ADVANTAGES

The following are the benefits of IoT in Agriculture:

- IoT enables easy collection and management of tons of data collected from sensors and with integration of cloud computing services like Agriculture fields maps, cloud storage etc., data can be accessed live from anywhere and everywhere enabling live monitoring and end to end connectivity among all the parties concerne
- IoT is regarded as key component for Smart Farming as with accurate sensors and smart equipment's, farmers can increase the food production by 70% till year 2050 as depicted by experts
- With IoT productions costs can be reduced to a remarkable level which will in turn increase profitability and sustainability and efficiency level would be increased in terms of usage of Soil, Water, Fertilizers, Pesticides etc. and also various factors would also lead to the protection of environment.

CHAPTER:2

PROJECT DESCRIPTION

2.1 INTRODUCTION

The agriculture sector is the primary pillar of the economy of many countries and it deserves technological amelioration within a shoestring budget. Internet of Things (IOT) offers a new dimension in the major of health monitoring of soil leading towards smart agriculture and farming. The amalgamation of traditional farming methodology with advanced technologies such as IOT and wireless sensor networks (WSN) can lead to sustainable agriculture. With this rationale, we have designed and developed an IOT enhanced device – FarmFox, which can analyze the sensed information and transmitting it to the user via the internet. In comparison to the existing IOT drove agricultural solutions, FarmFox thrives in real-time data collection, soil health monitoring via in-situ analysis, and controlling the whole architecture from a remote location. Compared to existing devices, FarmFox is an economic alternative as it utilizes Arduino based hardware. Turbidity and pH, these two parameters are first incorporated in FarmFox. The results confirm the success of soil health in terms of the four parameters. We also present a qualitative sustainability analysis of FarmFox which shows its robustness. It is expected that the real-life implementation of FarmFox will lead towards a cost effective smart solution for Sustainable Agriculture.

The objectives of this work are to proposed IoT based Smart Farming System which will enable farmers to have live data of soil moisture environment temperature at very low cost so that live monitoring can be done. The structure of the report is as follows: chapter I will cover over of overview of IoT Technology and agriculture-concepts and definition, IOT enabling technologies, IOT application in agriculture, benefits of IOT in agriculture and IOT and agriculture current scenario and future forecasts. Chapter II will cover definition of IOT based smart farming system.

2.2.EXISTING BLOCK DIAGRAM

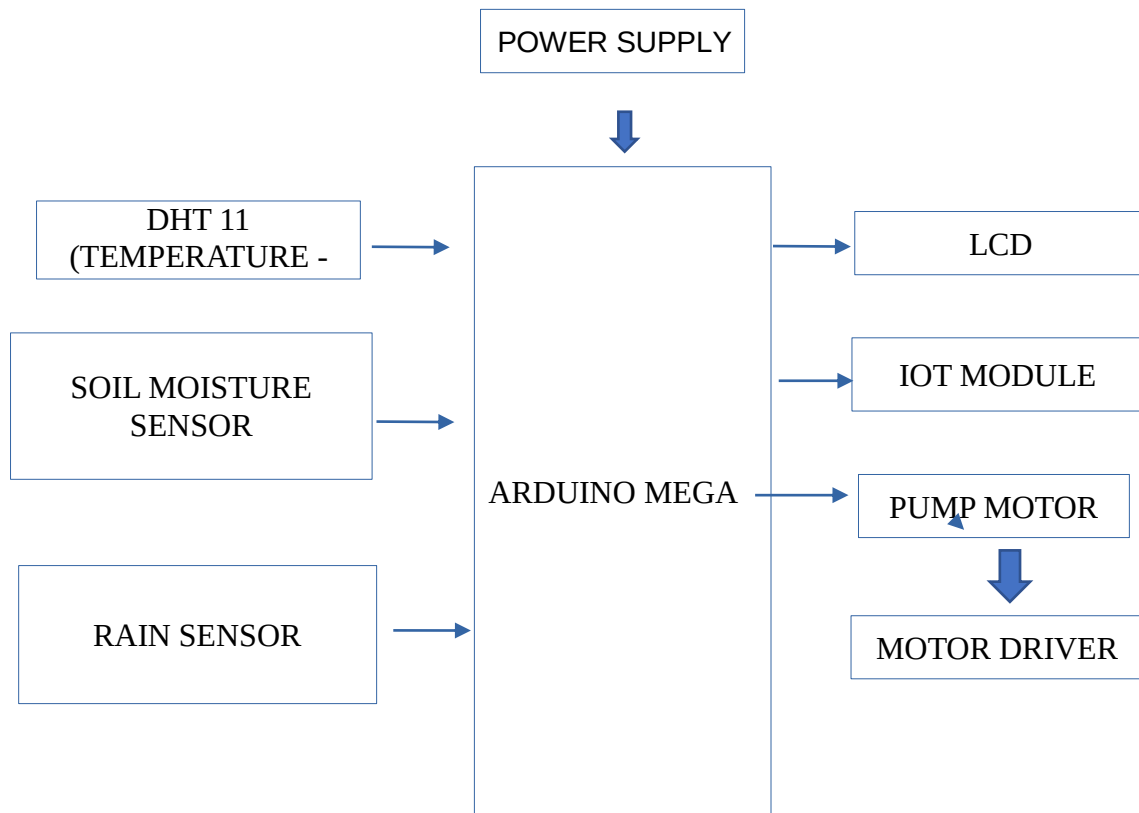


Fig:2.1:Existing block diagram

2.3 WORKING PRINCIPLE

In this proposed method, Arduino MEGA microcontroller is used to interface with the sensors and to the communication devices. The temperature sensor and humidity sensor is used to monitor the weather condition on the agriculture field area. The soil moisture sensor and rain sensor is used to monitor the soil moisture and rainfall .The LCD is used to display the updated value from the sensors. The IOT module ESP8266 is used to update the information of sensors to the cloud. The end result can be monitored in webpage. The water pump motor is activated based on the soil moisture level by automated or manually controlled from the webpage.

2.4 MODULES NAME AND DESCRIPTION

- ❖ COLLECT THE DATA FROM FIELD AREA
- ❖ MAINTAIN THE CROPS
- ❖ MONITOR THE FIELD AREA

2.5 COLLECT THE DATA FROM FIELD AREA

Use of the sensor based technology we gradually collect the needed information from field area. The embedded system sensors and microcontroller is helped the user to collect the information and update the information in LCD. The collection data like temperature, humidity, soil moisture, rain sensor.

2.6 MAINTAIN THE CROPS

Based on the soil moisture and rain sensor values the pump motor condition ON/OFF. If the soil is dry and the rain is not powering the pump motor will turn on and fulfil the crop requirements. If the rain is powering the soil automatically get the moisture the pump motor will not run.

2.7 MONITOR THE FIELD AREA

Monitor the field area through our remote location anywhere in the world. And we can get the all the sensor information from the webpage. Based on the sensor values we will maintain the agriculture field.

CHAPTER: 3

HARDWARE AND SOFTWARE DESCRIPTION

3.1 HARDWARE DESCRTION

3.1.1 ARDUINO

Arduino is an open-source electronics platform based on easy-to-use hardware and software. are able to read inputs - light on a sensor, a finger on a button, or a Twitter message - and turn it into an output - activating a motor, turning on an LED, publishing something online. You can tell your board what to do by sending a set of instructions to the microcontroller on the board.

Over the years Arduino has been the brain of thousands of projects, from everyday objects to complex scientific instruments. A worldwide community of makers - students, hobbyists, artists, programmers, and professionals - has gathered around this open-source platform, their contributions have added up to an incredible amount of accessible knowledge that can be of great help to novices and experts alike.

Arduino was born at the Ivrea Interaction Design Institute as an easy tool for fast prototyping, aimed at students without a background in electronics and programming. As soon as it reached a wider community, the Arduino board started changing to adapt to new needs and challenges, differentiating its offer from simple 8-bit boards to products for IOT applications, wearable, 3D printing, and embedded environments. All Arduino boards are completely open-source, empowering users to build them independently and eventually adapt them to their particular needs. The software, too, is open-source, and it is growing through the contributions of users worldwide.

There are many other microcontrollers and microcontroller platforms available for physical computing. Parallax Basic Stamp, Netmedia's BX-24, Phidgets, MIT's Handyboard, and many others offer similar functionality.

All of these tools take the messy details of microcontroller programming and wrap it up in an easy-to-use package. Arduino also simplifies the process of working with microcontrollers, but it offers some advantage for teachers, students, and interested amateurs over other systems:

- **Inexpensive** - Arduino boards are relatively inexpensive compared to other microcontroller platforms. The least expensive version of the Arduino module can be assembled by hand, and even the pre-assembled Arduino modules cost less than \$50.
- **Cross-platform** - The Arduino Software (IDE) runs on Windows, Macintosh OSX, and Linux operating systems. Most microcontroller systems are limited to Windows.
- **Simple, clear programming environment** - The Arduino Software (IDE) is easy-to-use for beginners, yet flexible enough for advanced users to take advantage of as well. For teachers, it's conveniently based on the Processing programming environment, so students learning to program in that environment will be familiar with how the Arduino IDE works.
- **Open source and extensible software** - The Arduino software is published as open source tools, available for extension by experienced programmers. The language can be expanded through C++ libraries, and people wanting to understand the technical details can make the leap from Arduino to the AVR C programming language on which it's based. Similarly, you can add AVR-C code directly into your Arduino programs if you want to.
- **Open source and extensible hardware** - The plans of the Arduino boards are published under a Creative Commons license, so experienced circuit designers can make their own version of the module, extending it and improving it. Even relatively inexperienced users can build the breadboard version of the module in order to understand how it works and save money.

3.1.2 ARDUINO MEGA

The MEGA 2560 is designed for more complex projects. With 54 digital I/O pins, 16 analog inputs and a larger space for your sketch it is the recommended board for 3D printers and robotics projects. This gives your projects plenty of room and opportunities.



Fig:3.1: Arduino mega

The **Arduino Mega 2560** is a microcontroller board based on the ATmega2560. It has 54 digital input/output pins (of which 15 can be used as PWM outputs), 16 analog inputs, 4 UARTs (hardware serial ports), a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with an AC-to-DC adapter or battery to get started. The Mega 2560 board is compatible with most shields designed for the Uno and the former boards Duemilanove or Diecimila.

3.1.2.1 TECHNICAL SPECIFICATIONS:

Table 3.1: Technical specifications

Microcontroller	<u>ATmega2560</u>
Operating Voltage	5V
Input Voltage (recommended)	7-12V
Input Voltage (limit)	6-20V
Digital I/O Pins	54 (of which 15 provide PWM output)
Analog Input Pins	16
DC Current per I/O Pin	20 mA
DC Current for 3.3V Pin	50 mA
Flash Memory	256 KB of which 8 KB used by boot loader
SRAM	8 KB
EEPROM	4 KB
Clock Speed	16 MHz
LED_BUILTIN	13
Length	101.52 mm
Width	53.3 mm
Weight	37 g

3.13 POWER SUPPLY

This section describes how to generate +5V DC power supply

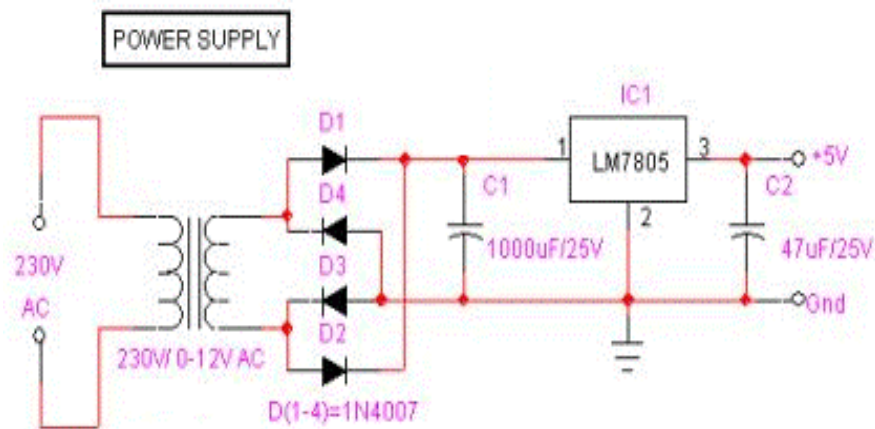


Fig:3.2: Power supply

The power supply section is the important one. It should deliver constant output regulated power supply for successful working of the project. A 0-12V/1 mA transformer is used for this purpose. The primary of this transformer is connected in to main supply through on/off switch& fuse for protecting from overload and short circuit protection. The secondary is connected to the diodes to convert 12V AC to 12V DC voltage. And filtered by the capacitors, which is further regulated to +5v, by using IC 7805.

3.14 LCD:

LCD screen is an electronic display module and find a wide range of applications. A 16x2 LCD display is very basic module and is very commonly used in various devices and circuits. These modules are preferred over seven segments and other multi segment LEDs. The reasons being: LCDs are economical; easily programmable; have no limitation of displaying special & even custom characters (unlike in seven segments), animations and so on. A **16x2 LCD** means it can display 16 characters per line and there are 2 such lines. In this LCD each character is displayed in 5x7 pixel matrix. This LCD has two registers, namely, Command and Data. The command register stores the command instructions given to the LCD. A command is an instruction given to LCD to do a predefined task like initializing it, clearing its screen, setting the cursor position, controlling display etc. 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. Click to learn more about internal structure of a LCD.



Fig:3.3:LCD

We come across LCD displays everywhere around us. Computers, calculators, television sets, mobile phones, digital watches use some kind of display to display the time. An LCD is an electronic display module which uses liquid crystal to produce a visible image. The 16x2 LCD display is a very basic module commonly used in projects. The 16x2 translates to a display 16 characters per line in 2 such lines. In this LCD each character is displayed in a 5x7 pixel matrix.

TABLE 3.2: LCD

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 make it en=0 and 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 - 14	8-bit data pins	DB0 – DB7
15	Backlight VCC (5V)	Led+
16	Backlight Ground (0V)	Led-

3.1.4.1 DISPLAYING CUSTOM CHARACTERS ON 16X2 LCD:

Generating custom characters on LCD is not very hard. It requires the knowledge about custom generated random access memory (CG-RAM) of LCD and the LCD chip controller. Most LCDs contain Hitachi HD4478 controller. CG-RAM is the main component in making custom characters. It stores the custom characters once declared in the code. CG-RAM size is 64 byte providing the option of creating eight characters at a time. Each character is eight byte in size.

CG-RAM address starts from 0x40 (Hexadecimal) or 64 in decimal. We can generate custom characters at these addresses. Once we generate our characters at these addresses, now we can print them on the LCD at any time by just sending simple commands to the LCD. Character addresses and printing commands are below.

In the table above you can see starting addresses for each character with their printing commands. The first character is generated at address 0x40 to 0x47 and is printed on LCD by just sending simple command 0 to the LCD. The second character is generated at address 0x48 to 0x55 and is printed by sending 1 to LCD.

Table 3.3: Displaying custom characters

CG-RAM Characters	CG-RAM Address (Hexadecimal)	Commands to display Generated Characters
1 st Character	0x40	0
2 nd Character	0x48	1
3 rd Character	0x56	2
4 th Character	0x64	3
5 th Character	0x72	4
6 th Character	0x80	5
7 th Character	0x88	6
8 th Character	0x96	7

3.1.5 DHT11 SENSOR:

This DHT11 Temperature & Humidity Sensor features a temperature & humidity sensor complex with a calibrated digital signal output. By using the exclusive digital-signal-acquisition technique and temperature & humidity sensing technology, it ensures high reliability and excellent long-term stability. This sensor includes a resistive-type humidity measurement component and an NTC temperature measurement component, and connects to a high-performance 8-bit microcontroller, offering excellent quality, fast response, anti-interference ability and cost-effectiveness. Each DHT11 element is strictly calibrated in the laboratory that is extremely accurate on humidity calibration. The single-wire serial interface makes system integration quick and easy.

3.1.5.1 Technical Specifications:

- Relative humidity
- Resolution: 16Bit
- Repeatability: $\pm 1\%$ RH
- Accuracy: At 25? $\pm 5\%$ RH
- Interchangeability: fully interchangeable
- Hysteresis: $< \pm 0.3\%$ RH
- Long-term stability: $< \pm 0.5\%$ RH / yr in
- Temperature
- Resolution: 16Bit
- Repeatability: $\pm 0.2\%$
- Response time: 1 / e (63%) 10S

3.1.5.2 Electrical Characteristics:

- Power supply: DC 3.5?5.5V
- Supply Current: measurement 0.3mA standby 60 μ A
- Sampling period: more than 2 seconds

3.1.5.3 Features:

- Simple design
- One wire interface
- High accuracy
- Internal pull out

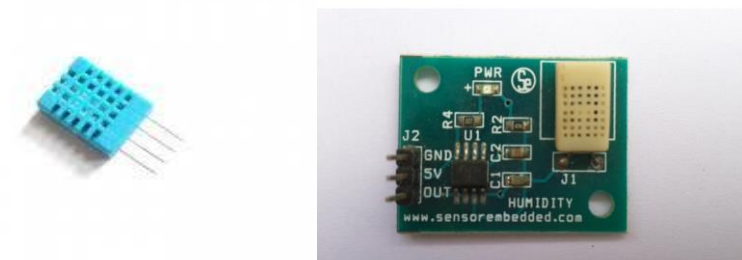


Fig.3.4: Temperature & Humidity Sensor

3.1.6 SOIL MOISTURE SENSOR

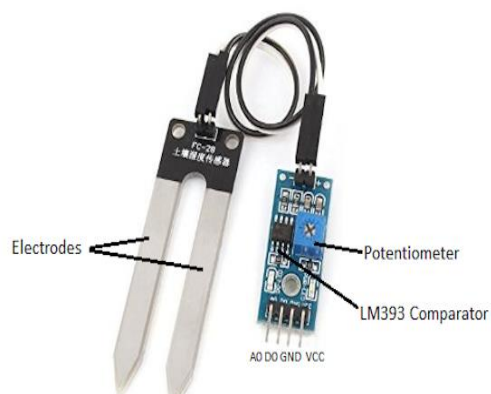


Fig 3.5.moisture sensor

3.1.6.1FC-28 soil moisture sensor

This sensor can be used to test the moisture of soil, when the soil is having water shortage, the module output is at high level, and else the output is at low level. By using this sensor one can automatically water the flower plant, or any other plants requiring automatic watering technique. Soil moisture sensors measure the volumetric water content in soil. Since the direct gravimetric measurement of free soil moisture requires removing, drying, and weighing of a sample, soil moisture sensors measure the volumetric water content indirectly by using some other property of the soil, such as electrical resistance, dielectric constant, or interaction with neutrons, as a proxy for the moisture content. Module triple output mode, digital output is simple, analog output more accurate, serial output with exact reading.

3.1.6.2 Working principle:

This is an easy to use digital soil moisture sensor. Just insert the sensor in the soil and it can measure moisture or water level content in it. It gives a digital output of 5V when moisture level is high and 0V when the moisture level is low in the soil.

The sensor includes a potentiometer to set the desired moisture threshold. When the sensor measures more moisture than the set threshold, the digital output goes high and an LED indicates the output. When the moisture in the soil is less than the set threshold, the output remains low. The digital output can be connected to a micro controller to sense the moisture level. The sensor also outputs an analog output which can be connected to the ADC of a micro controller to get the exact moisture level in the solid. This sensor is great for making water gardening projects, water sensing, etc.

3.1.6.3 Usage:-

- Soil moisture module is most sensitive to the ambient, generally used to detect the moisture content of the soil.
- When the module cannot reach the threshold value, DO por
- t output high, when the soil humidity exceeds a set threshold value, the module DO output low;

3.1.6.4 Specifications

The specifications of the FC-28 soil moisture sensor are as follows:

- Input Voltage: 3.3–5V

3.1.6.5 Pin-out

The FC-28 soil moisture sensor has four pins:

- VCC: Power
- A0: Analog Output
- D0: Digital Output
- GND: Ground

3.1.6.6 Analog Mode

To connect the sensor in the analog mode, we will need to use the analog output of the sensor. When taking the analog output from the soil moisture sensor FC-28, the sensor gives us a value from 0 to 1023. The moisture is measured in percentages, so we will map these values from 0 to 100, and then show them on the serial monitor. You can set different ranges of the moisture values and turn the water pump on or off according to it.

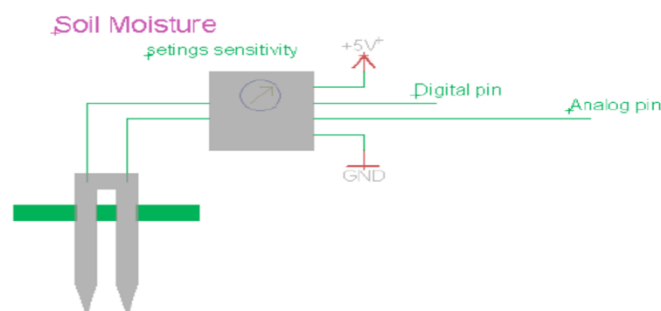


Fig 3.6 Soil moisture sensor

3.1.6.7 Circuit Diagram

The connections for the FC-28 soil moisture sensor and the Arduino in digital mode are as follows:

- VCC of FC-28 to 5V of Arduino
- GND of FC-28 to GND of Arduino
- D0 of FC-28 to pin 12 of Arduino
- LED positive to pin 13 of Arduino
- LED negative to GND of Arduino

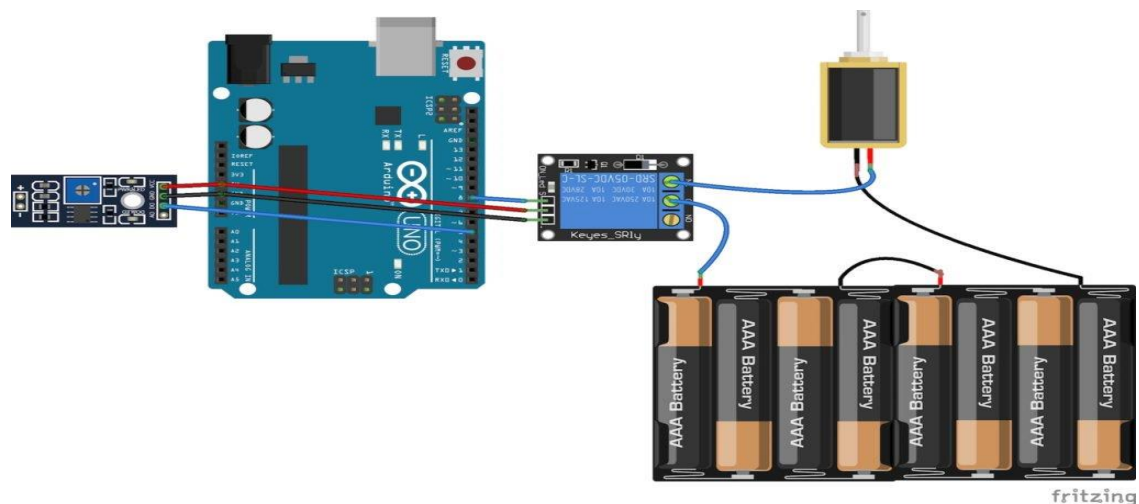


Fig 3.7 circuit diagram

3.1.6.8 APPLICATIONS

1. Agriculture

Measuring soil moisture is important for agricultural applications to help farmers manage their irrigation systems more efficiently. Knowing the exact soil moisture conditions on their fields, not only are farmers able to generally use less water to grow a crop, they are also able to increase yields and the quality of the crop by improved management of soil moisture during critical plant growth stages.

2. Landscape irrigation

In urban and suburban areas, landscapes and residential lawns are using soil moisture sensors to interface with an irrigation controller. Connecting a soil moisture sensor to a simple irrigation clock will convert it into a "smart" irrigation controller that prevents irrigation cycles when the soil is already wet.

3. Research

Soil moisture sensors are used in numerous research applications, e.g. in agricultural science and horticulture including irrigation planning, climate research, or environmental science including solute transport studies and as auxiliary sensors for soil respiration measurements.

3.1.7 RAIN DETECTION SENSOR



Fig 3.8 Rain Detector

An YL-83 Rain Detector OR RAIN SENSOR is one kind of switching device which is used to detect the rainfall. It works like a switch and the working principle of this sensor is whenever there is rain, the switch will be normally closed.

Nowadays, conserving water as well as its proper usage is essential in everyone's life. Here is a sensor namely rain sensor which is used to detect the rain and generate an alarm. So, we can conserve water to use it later for different purposes. There are several methods available for conserving water like harvesting, etc using this method we can increase the level of underground water.

These sensors are mainly used in the field like automation, irrigation, automobiles, communication, etc. This article discusses a simple as well as reliable sensor module which can be available at low cost in the market.

3.1.7.1 Working Principle

The YL-83 operates via droplet detection rather than by signal level threshold. A special delay circuitry allows about two-minute interval between raindrops before assuming an OFF (no rain) position. This enables the sensor to accurately distinguish between rain cessation and light rain. The YL-83 also features an analog Rain Signal for estimating rain intensity. Since this signal is proportional to the percentage of moist or wet area on the sensor plate, rain intensity has a direct impact on the amplitude and variation of this analog signal. The YL-83 sensor is positioned at a 30° angle. This design, together with the internal heating element, ensures that the surface dries quickly, an essential factor in calculating intensity.

The same heating element also protects the surface from fog and condensed moisture, and is activated at low temperatures in order to melt snow, thus allowing snow detection. Sensor performance is not affected by reasonable amounts of dirt and dust due to droplet detection. It is intended to be used in areas with only rain or wet/moist snow precipitation.

3.1.7.2. Testing

To test the Rain Sensor and ensure that it is working correctly connect the VCC to a 5v power source and GND. Try placing a few droplets of water on the Rain sensor detection board and the digital output LED should light up.

3.1.7.3. Rain Sensor Module

Raindrop sensor is basically a board on which nickel is coated in the form of lines. It works on the principal of resistance. Rain Sensor module allows to measure moisture via analog output pins and it provides a digital output when a threshold of moisture exceeds.

The module is based on the LM393 op amp. It includes the electronics module and a printed circuit board that “collects” the rain drops. As rain drops are collected on the circuit board, they create paths of parallel resistance that are measured via the op amp. The sensor is a resistive dipole that shows less resistance when wet

and more resistance when dry. When there is no rain drop on board it increases the Resistance so we get high voltage according to $V=IR$.

When rain drop present it reduces the resistance because water is a conductor of electricity and presence of water connects nickel lines in parallel so reduces resistance and reduces voltage drop across it



Fig 3.9 Rain sensor module

- Pin1 (VCC): It is a 5V DC pin
- Pin2 (GND): it is a GND (ground) pin
- Pin3 (DO): It is a low/ high output pin
- Pin4 (AO): It is an analog output pin

3.1.7.4 PinOut

The device consists of three parts :measuring probe, detector's module and wires . The probe needs to be combined with the main module using wires. potentiometer located in the module ,allows you to adjust the sensitivity of the sensor

The sensor has a digital output DO that indicates the occurrence of precipitation and analog AO to measure the strength of the rain .On the board are also two LEDS: first- to indicate a correct power connection and the second – indicating the occurrence of precipitation.

3.1.7.5 The digital output D0

After detecting the precipitation, the D0 output is changed from a high to a low status ,Sensitivity ,that is , the voltage threshold can be adjusted using the potentiometer. The D0 pin can be connected directly with a microcontroller or development kit or , for example , a module of a buzzer ,which will signal the emergence of precipitation.

3.1.7.6 Analog output A0

The sensor also has an analog output A0 which must be connected to the pin of the converter A/D(analog input in Arduino).It allows for the reading of the measured intensity of precipitaion.

- Adopts high quality of RF-04 double sided material.
- Area: 5cm x 4cm nickel plate on side,
- Anti-oxidation, anti-conductivity, with long use time;
- Comparator output signal clean waveform is good, driving ability, over 15mA;
- Potentiometer adjust the sensitivity;
- Working voltage 5V;
- Output format: Digital switching output (0 and 1) and analog voltage output AO;
- With bolt holes for easy installation;
- Small board PCB size: 3.2cm x 1.4cm;
- Uses a wide voltage LM393 comparator.

Table 3.4 Specification

Pin	Description
Vcc	+5 Volts Power Source
GND	Ground or negative power source
D0	Digital Output. Goes low when moisture exceeds set threshold.
A0	Analog Output – Zero to five volts. The lower the voltage, the greater the moisture
POWER LED	Indicates that power is applied
OUTPUT LED	Illuminates when moisture has exceeded threshold set by sensitivity adjustment.
Sensitivity	Clockwise is more sensitive. Counterclockwise is less sensitive.

3.1.7.7 Rain sensor interfacing with Arduino

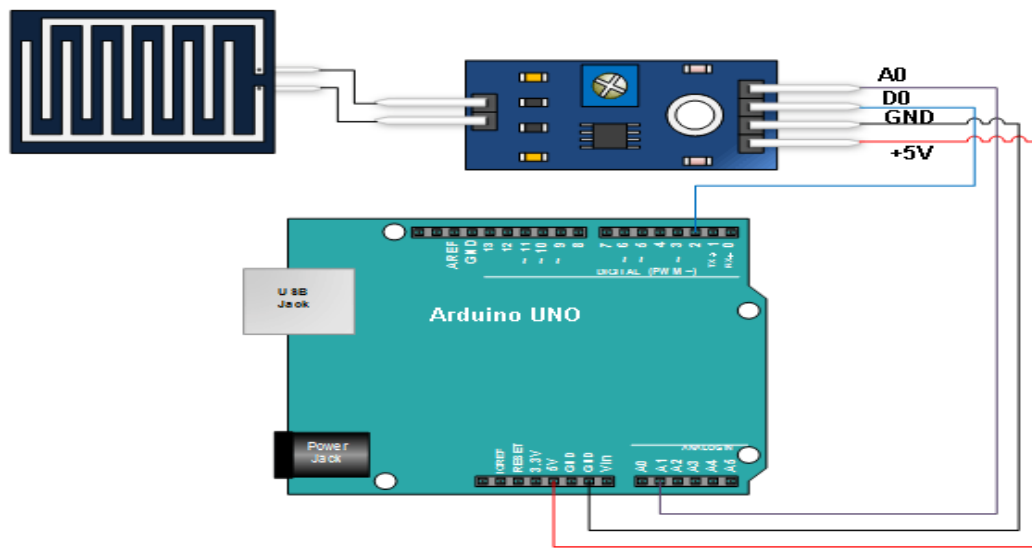


Fig 3.10: Rain sensor interfacing with arduino

Make connections according to the above circuit diagram.

- Connect VCC pin of sensor to 5V power supply of Arduino.
- Connect GND pin of sensor to GND of Arduino .
- Connect Analog output pin of sensor to A0 pin of Arduino.

The applications of rain sensor include the following.

- This sensor is used as a water preservation device and this is connected to the irrigation system to shut down the system in the event of rainfall.
- This sensor is used to guard the internal parts of an automobile against the rainfall as well as to support the regular windscreen wiper's mode.

3.1.8 MOTOR DRIVER IC:

Common DC gear head motors need current above 250mA. There are many integrated circuits like ATmega16 Microcontroller, 555 timers IC. But, IC 74 series cannot supply this amount of current. When the motor is directly connected to the o/p of the above ICs then, they might damage. To overcome this problem, a motor control circuit is required, which can act as a bridge between the above motors and ICs (integrated circuits). There are various ways of making H-bridge motor control circuit such as using transistor, relays and using L293D/L298.

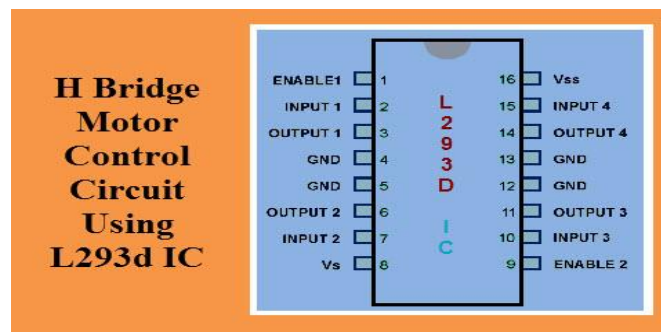


Fig 3.11 H Bridge Motor Control Circuit Using L293d IC

3.1.8.1 H-BRIDGE CIRCUIT:

An H bridge is an electronic circuit that allows a voltage to be applied across a load in any direction. H-bridge circuits are frequently used in robotics and many other applications to allow DC motors to run forward & backward. These motor control circuits are mostly used in different converters like DC-DC, DC-AC, AC-AC converters and many other types of power electronic converters. In specific, a bipolar stepper motor is always driven by a motor controller having two H-bridges.

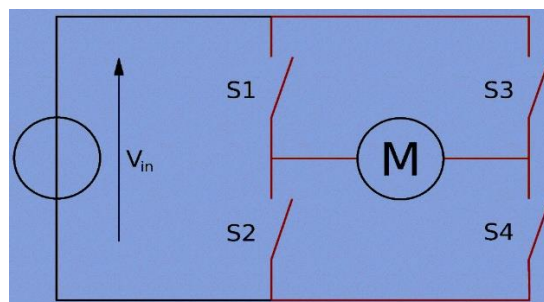


Fig 3.12 H-Bridge circuit

An H-bridge is fabricated with four switches like S1, S2, S3 and S4. When the S1 and S4 switches are closed, then a positive voltage will be applied across the motor. By opening the switches S1 and S4 and closing the switches S2 and S3, this voltage is inverted, allowing invert operation of the motor.

Generally, the H-bridge motor driver circuit is used to reverse the direction of the motor and also to break the motor. When the motor comes to a sudden stop, as the terminals of the motor are shorted. Or let the motor run free to a stop, when the motor is detached from the circuit. The table below gives the different operations with the four switches corresponding to the above circuit.

3.1.8.2 FEATURE

- Wide Supply-Voltage Range: 4.5 V to 36 V
- Separate Input-Logic Supply
- Internal ESD Protection
- High-Noise-Immunity Inputs
- Output Current 1 A Per Channel (600 mA for L293D)
- Peak Output Current 2 A Per Channel (1.2 A for L293D)
- Output Clamp Diodes for Inductive Transient Suppression (L293D)

3.1.8.2 APPLICATIONS:

- Stepper Motor Drives.
- DC Motor Drivers.
- Latching Relay Drivers.

3.1.9 WATER PUMP MOTOR

3.1.9.1 GENERAL DESCRIPTION

As the name implies, water pumps pump water. Whether that is in a vehicle, at a business, in the home, or in a well, shoppers can probably find a water pump to fit their vehicle or to help them draw water from the ground in a self-dug well to be used in pressure tanks within the location. Vehicle water pumps help regulate the flow of water through a vehicle's cooling system; when the seal on these go bad, the whole pump must be replaced. Located within the home or business, pressure water pumps regulate the water pressure year round, controlling water flow to different areas of the location.

3.1.9.2 PRODUCT DESCRIPTION

A pump motor is a DC motor device that moves fluids. A DC motor converts direct current electrical power into mechanical power. DC or direct current motor works on the principal, when a current carrying conductor is placed in a magnetic field; it experiences a torque and has a tendency to move. This is known as motoring action. Pumps operate by some mechanism (typically reciprocating or rotary), and consume energy to perform mechanical work by moving the fluid. Pumps operate via many energy sources, including manual operation, electricity, engines, or wind power, come in many sizes, from microscopic for use in medical applications to large industrial pumps.



Fig 3.13 Pump motor

3.1.9.3 FEATURES

- Reduced noise
- Available in DC and AC
- Supply voltage: +12VDC
- Supply voltage: 230V AC

3.1.9.4 APPLICATIONS

- Priming a pump
- To pump water supply, including pneumatic systems and in places where no suction lift is required
- Pump motor as public water supply
- In domestic water supply system

3.1.10 INTERNET OF THINGS

The **internet of things (IoT)** is the network of physical devices, vehicles, buildings and other items embedded with electronics, software, sensors, actuators, and network connectivity that enable these objects to collect and exchange data. In 2013 the Global Standards Initiative on Internet of Things (IoT-GSI) defined the IoT as "the infrastructure of the information society. The IoT allows objects to be sensed and controlled remotely across existing network infrastructure, creating opportunities for more direct integration of the physical world into computer-based systems, and resulting in improved efficiency, accuracy and economic benefit. When IoT is augmented with sensors and actuators, the technology becomes an instance of the more general class of cyber-physical systems, which also encompasses technologies such as smart grids, smart homes, intelligent transportation and smart cities. Each thing is uniquely identifiable through its embedded computing system but is able to interoperate within the existing Internet infrastructure.

3.1.10.1 INFRASTRUCTURE:

The Internet of Things will become part of the fabric of everyday life. It will become part of our overall infrastructure just like water, electricity, telephone, TV and most recently the Internet. Whereas the current Internet typically connects full-scale computers, the Internet of Things (as part of the Future Internet) will connect everyday objects with a strong integration into the physical world.

1. Plug and Play Integration

If we look at IoT-related technology available today, there is a huge heterogeneity. It is typically deployed for very specific purposes and the configuration requires significant technical knowledge and may be cumbersome. To achieve a true Internet of Things we need to move away from such small-scale, vertical application silos, towards a horizontal infrastructure on which a variety of applications can run simultaneously.

2. Infrastructure Functionality

The infrastructure needs to support applications in finding the things required. An application may run anywhere, including on the things themselves. Finding things is not limited to the start-up time of an application. Automatic adaptation is needed whenever relevant new things become available, things become unavailable or the status of things changes. The infrastructure has to support the monitoring of such changes and the adaptation that is required as a result of the changes.

3. Physical Location and Position

As the Internet of Things is strongly rooted in the physical world, the notion of physical location and position are very important, especially for finding things, but also for deriving knowledge. Therefore, the infrastructure has to support finding things according to location (e.g. geo-location based discovery). Taking mobility into account, localization technologies will play an important role for the Internet of Things and may become embedded into the infrastructure of the Internet of Things.

4. Security and Privacy

In addition, an infrastructure needs to provide support for security and privacy functions including identification, confidentiality, integrity, non-repudiation authentication and authorization. Here the heterogeneity and the need for interoperability among different ICT systems deployed in the infrastructure and the resource limitations of IoT devices (e.g., Nano sensors) have to be taken into account.

3.1.10.2 Data Management

Data management is a crucial aspect in the Internet of Things. When considering a world of objects interconnected and constantly exchanging all types of information, the volume of the generated data and the processes involved in the handling of those data become critical. A long-term opportunity for wireless communications chip makers is the rise of Machine-to-Machine (M2M) computing, which one of the enabling technologies for Internet of Things. This technology spans abroad range of applications. While there is consensus that M2M is a promising pocket of growth, analyst estimates on the size of the opportunity diverge by a factor of four [16]. Conservative estimates assume roughly 80 million to 90 million M2M units will be sold in 2014, whereas more optimistic projections forecast sales of 300 million units. Based on historical analyses of adoption curves for similar disruptive technologies, such as portable MP3 players and antilock braking systems for cars.

it is believed that unit sales in M2M could rise by as much as a factor of ten over the next five years, see Figure 2.29 [16]. There are many technologies and factors involved in the “data management” within the IoT context. Some of the most relevant concepts which enable us to understand the challenges and opportunities of data management are:

- Data Collection and Analysis
- Big Data
- Semantic Sensor Networking
- Virtual Sensors
- Complex Event Processing.

3.1.10.2 ESP-12E BASED NODEMCU

The ESP8266 is the name of a micro controller designed by Espressif Systems. The ESP8266 itself is a self-contained Wi-Fi networking solution offering as a bridge from existing micro controller to Wi-Fi and is also capable of running self-contained applications. This module comes with a built in USB connector and a rich assortment of pin-outs. With a micro USB cable, you can connect NodeMCU devkit to your laptop and flash it without any trouble, just like Arduino. It is also immediately breadboard friendly.

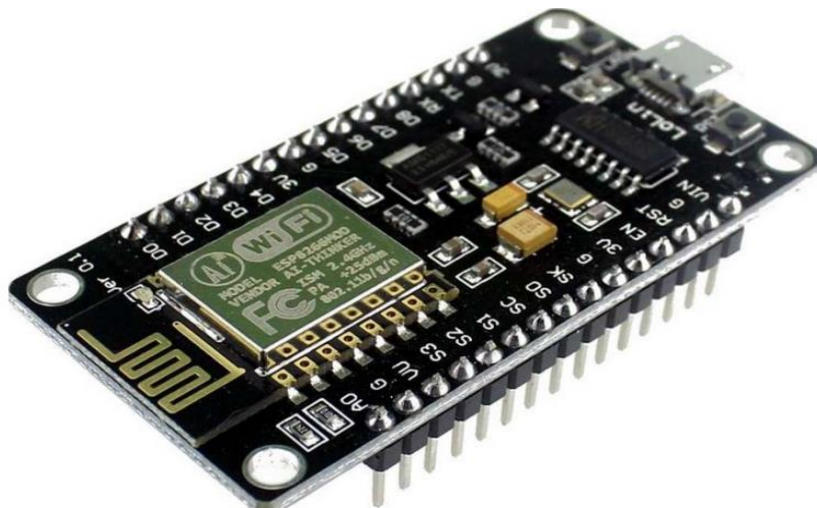


Fig 3.14 ESP-12E BASED NODEMCU

ESP-12E Wi-Fi module is developed by Ai-thinker Team. core processor ESP8266 in smaller sizes of the module encapsulates Tensilica L106 integrates industry-leading ultra-low power 32-bit MCU micro, with the 16-bit short mode, Clock speed support 80 MHz, 160 MHz, supports the RTOS, integrated Wi-Fi MAC/BB/RF/PA/LNA, on-board antenna. The module supports standard IEEE802.11 b/g/n agreement, complete TCP/IP protocol stack. Users can use the add modules to an existing device networking, or building a separate network controller. ESP8266 is high integration wireless SOCs, designed for space and power constrained mobile platform designers. It provides unsurpassed ability to embed Wi-Fi capabilities within other systems, or to function as a standalone application, with the lowest cost, and minimal space requirement.

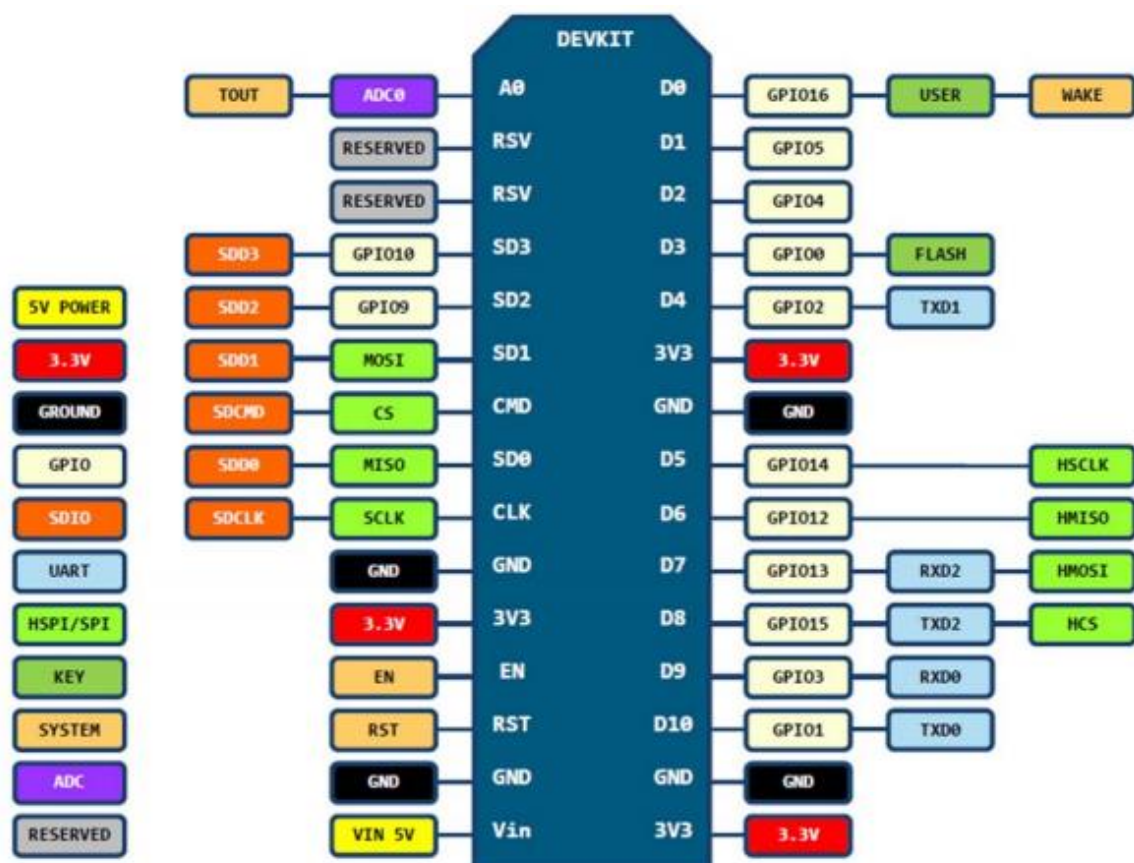


Fig 3.15 NODEMCU PIN CONFIGURATION

3.1.10.3 PIN DESCRIPTION

Table 3.5 Pin description

NO.	PinName	Function
1	RST	Reset the module
2	ADC	A/D Conversion result.Input voltage range 0-1v,scope:0-1024
3	EN	Chip enable pin.Active high
4	1016	GPIO16; can be used to wake up the chipset from deep sleep mode.
5	1014	GPIO14; HSPI_CLK
6	1012	GPIO12; HSPI_MISO
7	1013	GPIO13; HSPI_MOSI; UART0_CTS
8	VCC	3.3V power supply (VDD)
9	CSO	Chip selection
10	MISO	Salve output Main input
11	109	GPIO9
12	1010	GPIO10
13	MOSI	Main output slave input
14	SCLK	Clock
15	GND	GND
16	1015	GPIO15; MTDO; HSPICS; UART0_RTS -
17	102	GPIO2; UART1_TXD
18	100	GPIO0
19	104	GPIO4
20	105	GPIO5
21	RXD	UART0_RXD;GPIO3
22	TXD	UART0_TXD;GPIO1 -

3.1.10.4 SINGLE-CHIP USB-TO-UART BRIDGE

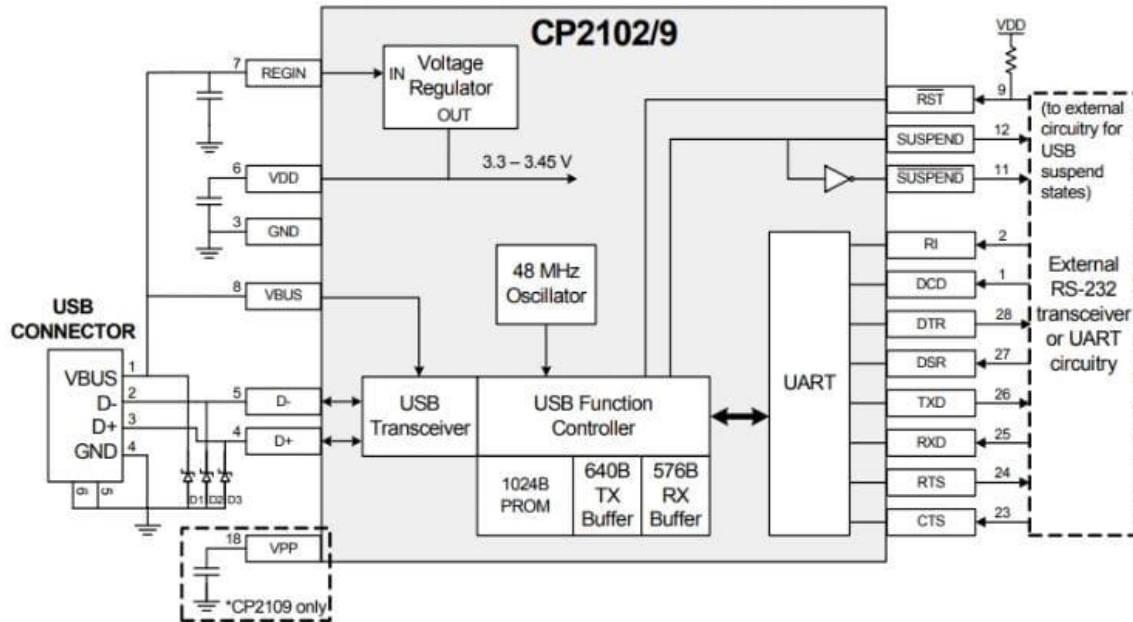


Fig 3.16 SINGLE-CHIP USB-TO-UART BRIDGE

The CP2102/9 is a highly-integrated USB-to-UART Bridge Controller providing a simple solution for updating RS232 designs to USB using a minimum of components and PCB space. The CP2102/9 includes a USB 2.0 full speed function controller, USB transceiver, oscillator, EEPROM or EPROM, and asynchronous serial data bus (UART) with full modem control signals in a compact 5 x 5 mm QFN-28 package. No other external USB components are required. The on-chip programmable ROM may be used to customize the USB Vendor ID, Product ID, Product Description String, Power Descriptor, Device Release Number, and Device Serial Number as desired for OEM applications. The programmable ROM is programmed on-board via the USB, allowing the programming step to be easily integrated into the product manufacturing and testing process. Royalty-free Virtual COM Port (VCP) device drivers provided by Silicon Laboratories allow a CP2102/9-based product to appear as a COM port to PC applications. The CP2102/9 UART interface implements all RS-232 signals.

3.2. SOFTWARE REQUIREMENTS:

3.2.1 EMBEDDED C

Embedded C is most popular programming language in software field for developing electronic gadgets. Each processor used in electronic system is associated with embedded software.

Embedded C programming plays a key role in performing specific function by the processor. In day-to-day life we used many electronic devices such as mobile phone, washing machine, digital camera, etc. These all device working is based on microcontroller that are programmed by embedded C.

Let's see the block diagram representation of embedded system programming:

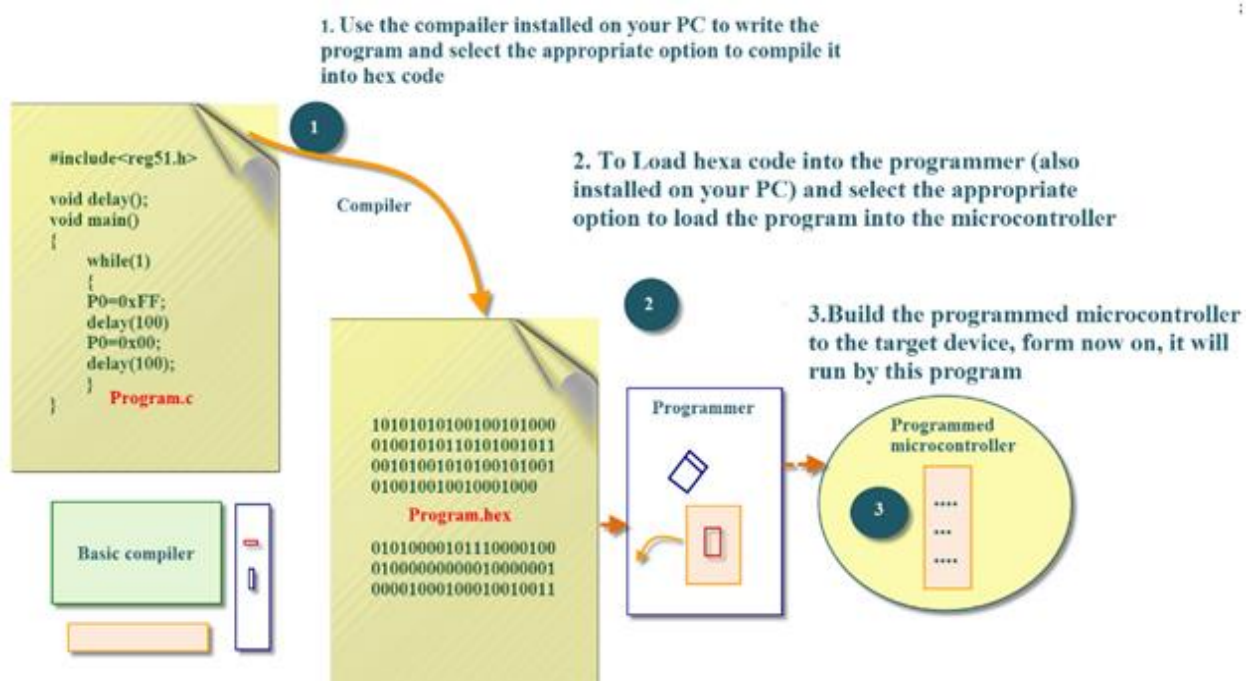


Fig 3.17 block diagram

The Embedded C code written in above block diagram is used for blinking the LED connected with Port0 of microcontroller.

In embedded system programming C code is preferred over other language. Due to the following reasons:

- Easy to understand
- High Reliability
- Portability
- Scalability

3.2.1.1 SYSTEM PROGRAMMING:

1 Basic Declaration

Let's see the block diagram of Embedded C Programming development:

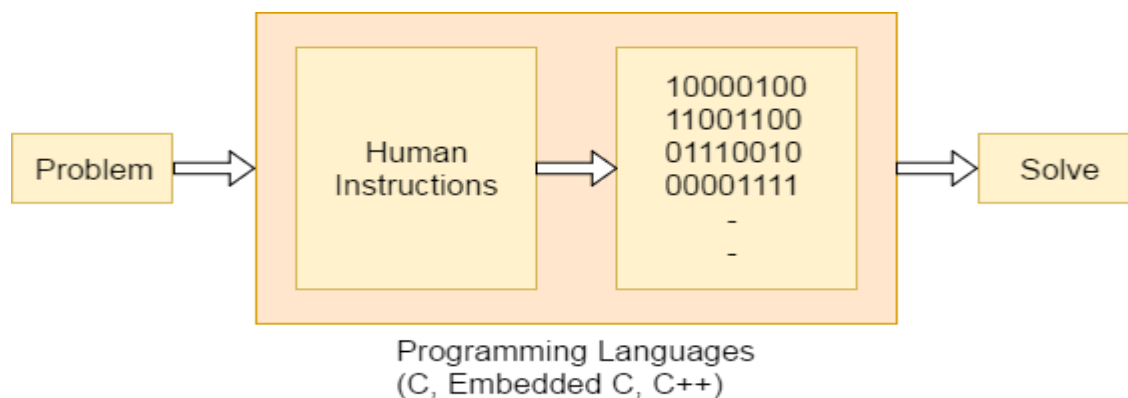


Fig 3.18 block diagram

Function is a collection of statements that is used for performing a specific task and a collection of one or more functions is called a programming language. Every language is consisting of basic elements and grammatical rules. The C language programming is designed for function with variables, character set, data types, keywords, expression and so on are used for writing a C program.

The extension in C language is known as embedded C programming language. As compared to above the embedded programming in C is also have some additional features like data types, keywords and header file etc is represented by `#include<microcontroller name.h>`.

2 BASIC EMBEDDED C PROGRAMMING STEPS:

Let's see the block diagram representation of Embedded C Programming Steps:

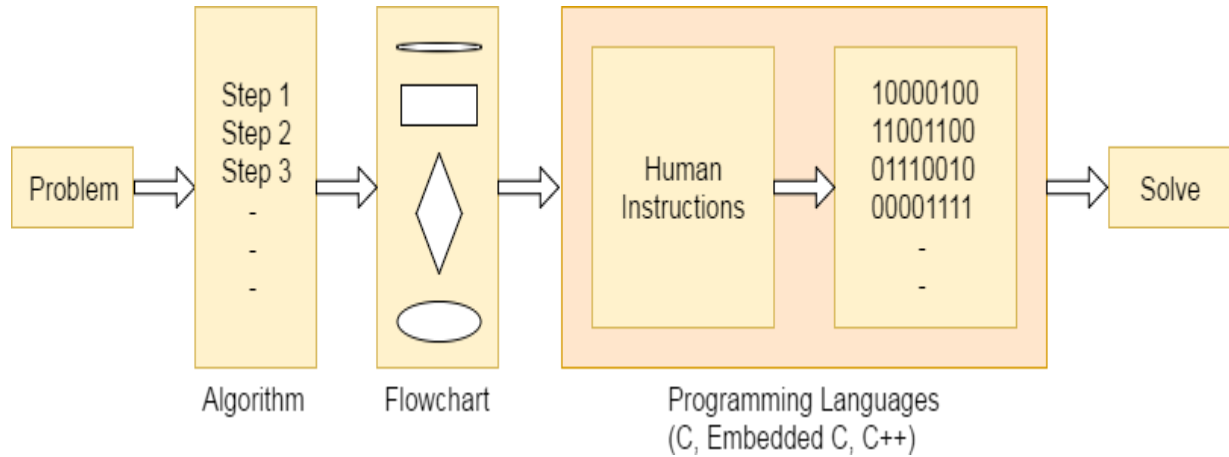


Fig 3.19 block diagram

The microcontroller programming is different for each type of operating system. Even though there are many operating system are exist such as Windows, Linux, RTOS, etc but RTOS has several advantage for embedded system development.

3.2.1.2 EMBEDDED SYSTEMS:

Embedded System is a system composed of hardware, application software and real time operating system. It can be small independent system or large combinational system.

Our Embedded System tutorial includes all topics of Embedded System such as characteristics, designing, processors, microcontrollers, tools, addressing modes, assembly language, interrupts, embedded c programming, led blinking, serial communication, lcd programming, keyboard programming, project implementation

3.2.1.3 SYSTEM:

System is a way of working, organizing or performing one or many tasks according to a fixed set of rules, program or plan.

It is an arrangement in which all the unit combined to perform a work together by following certain set of rules in real time computation. It can also be defined as a way of working, organizing or doing one or many tasks according to a fixed plan.

An Embedded System is a system that has software embedded into computer-hardware, which makes a system dedicated for a variety of application or specific part of an application or product or part of a larger system.

An embedded system can be a small independent system or a large combinational system. It is a microcontroller-based control system used to perform a specific task of operation.

An embedded system is a combination of three major components:

- **Hardware:** Hardware is physically used component that is physically connected with an embedded system. It comprises of microcontroller based integrated circuit, power supply, LCD display etc.
- **Application software:** Application software allows the user to perform varieties of application to be run on an embedded system by changing the code installed in an embedded system.
- **Real Time Operating system (RTOS):** RTOS supervises the way an embedded system work. It act as an interface between hardware and application software which supervises the application software and provide mechanism to let the processor run on the basis of scheduling for controlling the effect of latencies.

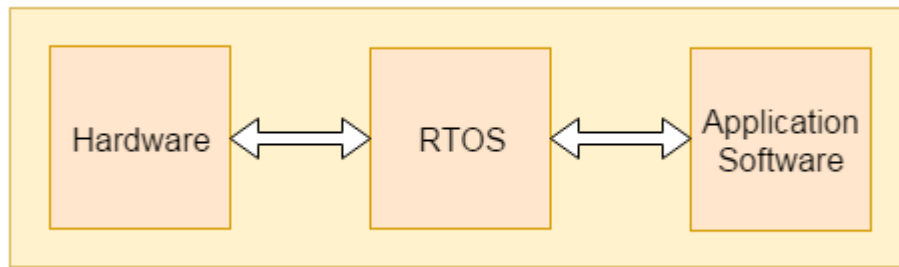


Fig 3.20 block diagram

3.2.1.4 CHARACTERISTICS OF EMBEDDED SYSTEM:

- An embedded system is software embedded into computer hardware that makes a system dedicated to be used for variety of application.
- Embedded system generally used for do specific task that provide real-time output on the basis of various characteristics of an embedded system.
- Embedded system may contain a smaller part within a larger device that used for serving the more specific application to perform variety of task using hardware-software intermixing configuration.
- It provides high reliability and real-time computation ability.

3.2.1.5 Advantages:

- Same hardware can be used in variety of application.
- Lesser power requirement
- Lower operational cost of system
- Provide high performance and efficiency

3.2.1.6 Disadvantages:

- Developing a system required more time. Due to functional complexity.
- Skilled engineers required because one mistake may result in destroying of complete project.

3.2.1.7 PERIPHERAL DEVICES IN EMBEDDED SYSTEMS:

Communication of an embedded system with an outside environment is done by using different peripheral devices as a combination with microcontroller.

Let's see the different peripheral devices in embedded system are:-

- Universal Serial Bus (USB)
- Networks like Ethernet, Local Area Network(LAN) etc
- Multi Media Cards (SD Cards, Flash memory, etc)
- Serial Communication Interface (SCI) like RS-232, RS-485, RS-422,
- Synchronous Serial Communication Interface like SPI, SSC and ESSI
- Digital to Analog/ Analog to Digital (DAC/ADC)
- General Purpose Input/Output (GPIO)
- Debugging like In System Programming (ISP)

3.2.2 ARDUINO SOFTWARE IDE

The Arduino Integrated Development Environment - or Arduino Software (IDE) - contains a text editor for writing code, a message area, a text console, a toolbar with buttons for common functions and a series of menus. It connects to the Arduino and Genuino hardware to upload programs and communicate with them.

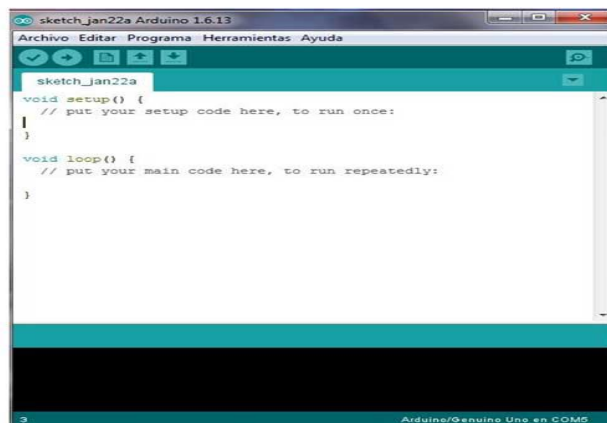


Fig 3.21 writing sketches

3.2.2.1 WRITING SKETCHES:

Programs written using Arduino Software (IDE) are called **sketches**. These sketches are written in the text editor and are saved with the file extension **.ino**. The editor has features for cutting/pasting and for searching/replacing text. The message area gives feedback while saving and exporting and also displays errors. The console displays text output by the Arduino Software (IDE), including complete error messages and other information. The bottom right hand corner of the window displays the configured board and serial port. The toolbar buttons allow you to verify and upload programs, create, open, and save sketches, and open the serial monitor

Table 3.6 writing sketches

	Verify Checks your code for errors compiling it.
	Upload Compiles your code and uploads it to the configured board. See uploading below for details. Note: If you are using an external programmer with your board, you can hold down the "shift" key on your computer when using this icon. The text will change to "Upload using Programmer"
	New Creates a new sketch.
	Open Presents a menu of all the sketches in your sketchbook. Clicking one will open it within the current window overwriting its content. Note: due to a bug in Java, this menu doesn't scroll; if you need to open a sketch late in the list, use the File Sketchbook menu instead.
	Save Saves your sketch.
	Serial Monitor Opens the serial monitor.

Additional commands are found within the five menus: **File**, **Edit**, **Sketch**, **Tools**, and help. The menus are context sensitive, which means only those items relevant to the work currently being carried out are available

CHAPTER: 4

RESULTS AND DISCUSSIONS

4.1 OUTPUT

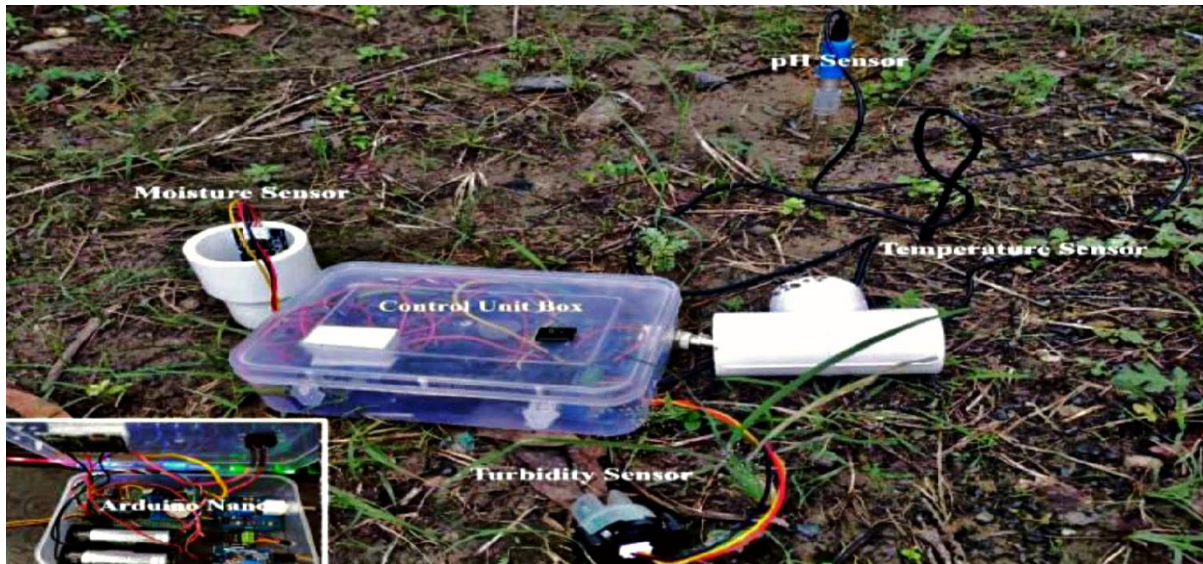


Fig 4.1 Field Setup with FarmFox at the Test Location

It is observed the temperature of the plot, soil moisture and moisture level, which can be beneficial for plant growth. This is observed when the data observed on the website is loaded into the Adafruit database using the Wi-Fi module connected to the NodeMCU. Here, the sensor output is considered as a graphical representation. Benefits Electric shock, less risk of leaving poisonous animals in the field. Watering depends on the level of humidity in the area. All form parameters can be viewed in an online graphic document. Effective and inexpensive design. Effective and affordable design; quick response; ease of use. Experiments are to review IoT networks with Soil Moisture, Temperature, Humidity LDR, UltraSonic, Rain Sensor and integrate them with the cloud. Including two IoT sensors. All sensors were connected to an in crop field in Fig 4.1 . These sensors are interfaced to NODE MCU. Sensors are generating the real-time information for various field parameters to make up the motors on/off. IoT devices and setup are programmed to receive data. Send sensors (current and voltage information) connected to the platform.

4.2.OUTPUT GRAPH

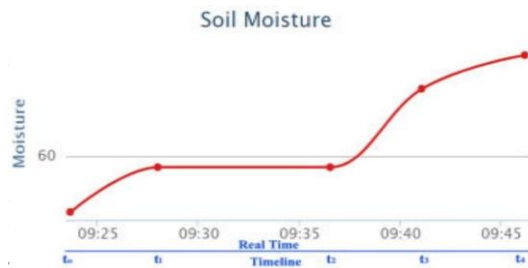


Fig 4.2 Graph for soil moisture



Fig 4.3 Graph of pH

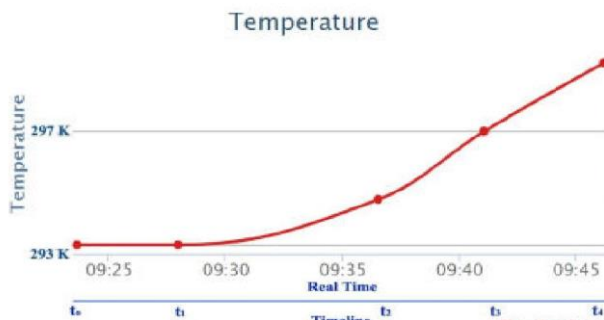


Fig 4.4 Graph of Temperature



Fig 4.5 Graph of Turbidity

More precisely, every 15 seconds, the IoT sensor device can provide 4 parameters such as moisture level, temperature, pH, turbidity values. This information has sent to the website server using the concept of channels in subscribe paradigm. The above 4 parameters related to provide precise irrigation to crop fields. the energy information connected to the IoT device throughout the kitchen Soil Moisture, Temperature sensor. On the farming field, this information can be accessed from any device and from anywhere with an Internet connection.

Figure 4.2 shows graphs show soil moisture readings on a standard line graph with a Y axis showing the soil moisture reading for each sensor depth. Soil moisture is directly proportional to water level of the soil.

So, if water level of soil is high then soil Moisture also will be high and vice versa.

Figure 4.3 shows graphs show soil pH readings on a standard line graph with a Y axis showing the soil pH reading for each sensor depth. Natural soil pH depends on the rock from which the soil was formed (parent material) and the weathering processes that acted on it—for example climate, vegetation, topography and time. These processes tend to cause a lowering of pH (increase in acidity) over time

Figure 4.4 shows graphs show soil Temperature readings on a standard line graph with a Y axis showing the soil Temperature reading for each sensor depth, The temperature of the soil depends on the ratio of the energy absorbed to that lost from the soil. It fluctuates annually and daily, affected mainly by variations in air temperature and solar radiation. Soil temperature is one of the important factors that influence soil properties processes involved in plant growth

Figure 4.5 shows graphs show soil Turbidity readings on a standard line graph with a Y axis showing the soil Turbidity reading for each sensor depth , Stream channel movement can also release sediment. Turbidity is affected by several factors in water: presence of dissolved and suspended solids, size and shape of particles and composition of the particles.

CHAPTER : 5

CONCLUSIONS AND FUTURE ENHANCEMENT

5.1 APPLICATIONS

- ❖ This method is used in agricultural area.
- ❖ Enable management of a greater number of resources through remote sensing.
- ❖ Improved productivity of staff and reduced human labor. ...
- ❖ Efficient operation management. ...

5.2 FUTURE ENHANCEMENT:

In future we would add the camera technology to interface with controller get live stream update through IOT. And we also introduce different machine learning and deep learning technique to predict the crop fields.

5.3.ADVANTAGES:

- ❖ Sensors provide accurate details of field area.
- ❖ The field area is monitored remotely from webpage.
- ❖ Increased agility of the processes.
- ❖ Reduce waste.
- ❖ Improve productivity.
- ❖ Better use of resources and assets.
- ❖ Cost-effective operation.
- ❖ Improved work safety.
- ❖ Thorough marketing and business development.
- ❖ Improved customer service and retention.
- ❖ Better business opportunities.

5.4 CONCLUSIONS:

Here the developed an IoT based automated soil health monitoring system, equipped to deal with agricultural parameters. Farmers will be able to integrate different field parameters to take smart decisions according to the situation. FarmFox can be directly connected to the cloud and capable of remote data storage/retrieval facilities. This work can further be extended to incorporate AI /machine learning algorithms to help the agro-scientists and farmers taking smarter decisions and strategy formations towards Agriculture.

CHAPTER-6

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Cite every reference inside the book

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