GOVERNMENT OF KARATAKA

MAHARANI CLUSTER UNIVERSITY

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PROJECT REPORT

TOPIC: VOICE BASED RAIN DETECTION USING PYTHON AND RAIN SENSOR

A partially project report is submitted in fulfilment of the requirement

BACHELOR OF COMPUTER APPLICATIONS

Submitted By

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"CERTIFICATE"

This is to certify that the project entitled "VOICE BASED RAIN DETECTION USING PYTHON AND RAIN SENSOR" submitted to MAHARANI CLUSTER UNIVERSITY is partial fulfillment for the degree of Bachelor of Computer Applications in Computer Science is a Bonafede Original work carried out by Rabiya Basheera.S (20US1095) and Saleha Begum (20US1108) under my guidance and supervision during the year 2022-2023. The project Report as it satisfies in the academic requirements in respect of project work prescribed for BCA degree.

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EXTERNAL EXAMINER

1………………………

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CONTENTS

Abstract

Internet of things is a technology of the future that has already started to touch our homes. The IOT based Voice based rain detection system using rain sensor and python that automates home appliances and allows user to control them easily through internet from anywhere over the world or within the home. It uses a combination of hardware and software to enable control and management over appliances and devices within a home. Home automation not only refers to reduce human efforts but also energy efficiency and time saving. As home automation apps become more intelligent, their capabilities become almost endless from controlling lights and locks to small appliances. Not only can you control your home, but you can also set commands that help your devices learn and then automatically react to your schedule.

Your devices can even work together to create a more cohesive experience. For example, you can have your thermostat adjust and your lights turn off at a certain time, say when you're leaving the house in the morning. You can also combine hubs to increase connectivity across your home. The benefits of home automation typically fall into a few categories, including savings, safety, convenience, and control. Additionally, some consumers purchase home automation for comfort and peace of mind.

The main objective of this project is to develop a home automation system using an Raspberry Pi/ Node MCU board with Internet being remotely controlled by any Android OS smart phone. As technology is advancing so houses are also getting smarter. Modern houses are gradually shifting from conventional switches to centralized control system, involving remote controlled switches. Presently, conventional wall switches located in different parts of the house makes it difficult for the user to go near them to operate. Even more it becomes more difficult for the elderly or physically handicapped people to do so. Remote controlled home automation system provides a most modern solution with smart phones.

Chapter 1

Introduction

1.1 Introduction to Internet of Things (IoT)

The Internet of Things (IoT) is a new, but at the same time an old term. It was already mentioned by Kevin Ashton in 1999, while holding a presentation at Proctor & Gamble. He used the term to link the idea of radio frequency identification (RFID) to the then new topic Internet [1]. Since then the use of this term has blossomed and major companies have predicted an increase in IoT [2]. One prediction is that the number of connected things in the world will have a thirtyfold increase between 2009 and 2020, thus by 2020 there will be 26 billion things that are connected to the Internet [2]. The reason IoT has become so huge depends partly on two things: Moore's law and Koomey's law. Moore's law states that the number of transistors on a chip doubles approximately every two years. This has enabled people to develop more powerful computers on the same sized chip. Intel, a well-known semiconductor chip maker had during 1971, 2300 transistors on a processor and by 2012 their current processors contained 1.4 billion transistors. This is an increase of approximately 610 000 % and it is expect that this trend will continue. Koomey's law explains that the number of computations per kilowatt-hour roughly doubles every one and a half years [4]. Kevin Ashton states that these two laws have together enabled us to create powerful and energy efficient computers. By turning the graph for Moore's law upside down it can be interpreted as the size of a computer (of a fixed capacity) is halved every two years.

Doing the same thing to Koomey's law can be interpreted as the amount of energy needed to perform a computation is dropping at a rapid rate. Combining these interpretations tells us that we can perform the same amount of computations on increasingly a smaller chip, while consuming decreasing amounts of energy - hence computations are becoming more energy efficient. The potential result is a small, powerful, and energy efficient computer which enables us to provide more advanced services using less chip area and at a lower energy that what has been possible before. Defining the term IoT can be somewhat difficult because it has many definitions depending on who is defining the term. The basic concept of IoT is to connect things together, thus enabling these "things" to communicate with each other and enabling people to communicate with them [5]. What these things are varies depending on which context the term is used and the aim of using the thing. In this thesis we have chosen to follow the definition of IoT proposed by ITU's Telecommunication Standardization Sector (a United Nations agency which specializes in ICT): "… a global infrastructure for the information society, enabling advanced services by interconnecting (physical and virtual) things based on existing and evolving interoperable information and communication technologies”.

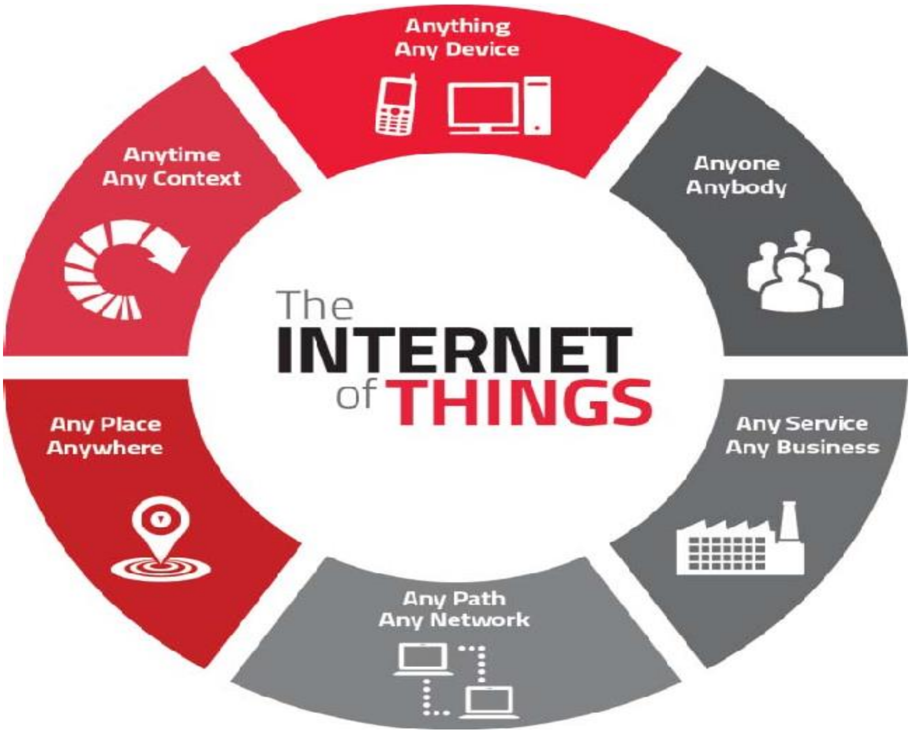


Figure 1.1: Internet of Things

Interconnecting the physical world with the virtual world and applying this concept to all things opens up new possibilities in the sense of being able to at any time access anything from any place. Providing new possibilities will also generate new threats, security risks, and expose vulnerabilities in the unexplored world of interconnected everything. “Things” in the physical world are objects that physically exist and from the perspective of IoT we are able to sense, operate, and connect to these things, while in the virtual world “things” are objects that can be stored, accessed, and processed. IoT involves sensors in order to collect information. Sensors are already being used in daily life, however most people may not realise it. Smartphones contain different kind of sensors, such as accelerometers, cameras, and GPS receivers. Built-in sensors are nothing new in today’s society. Kevin Ashton said that IoT is already happening, but we might not see it compared to Smartphones which can both be seen and touched. RFID is such an IoT-technology that exists but is not necessarily seen; so the development of IoT might progress a long way before it is visible for everyone.

1.2 Characteristics of IoT

1. Intelligence

IoT comes with the combination of algorithms and computation, software & hardware that makes it smart. Ambient intelligence in IoT enhances its capabilities which facilitate the things to respond in an intelligent way to a particular situation and supports them in carrying out specific tasks. In spite of all the popularity of smart technologies, intelligence in IoT is only concerned as means of interaction between devices, while user and device interaction is achieved by standard input methods and graphical user interface.

2. Connectivity

Connectivity empowers Internet of Things by bringing together everyday objects. Connectivity of these objects is pivotal because simple object level interactions contribute towards collective intelligence in IoT network. It enables network accessibility and compatibility in the things. With this connectivity, new market opportunities for Internet of things can be created by the networking of smart things and applications.

3. Dynamic Nature

The primary activity of Internet of Things is to collect data from its environment, this is achieved with the dynamic changes that take place around the devices. The state of these devices changes dynamically, example sleeping and waking up, connected and/or disconnected as well as the context of devices including temperature, location and speed. In addition to the state of the device, the number of devices also changes dynamically with a person, place and time.

4. Enormous scale

The number of devices that need to be managed and that communicate with each other will be much larger than the devices connected to the current Internet. The management of data generated from these devices and their interpretation for application purposes becomes more critical. Gartner (2015) confirms the enormous scale of IoT in the estimated report where it stated that 5.5 million new things will get connected every day and 6.4 billion connected things will be in use worldwide in 2016, which is up by 30 percent from 2015. The report also forecasts that the number of connected devices will reach 20.8 billion by 2020.

5. Sensing

IoT wouldn't be possible without sensors which will detect or measure any changes in the environment to generate data that can report on their status or even interact with the environment. Sensing technologies provide the means to create capabilities that reflect a true awareness of the physical world and the people in it. The sensing information is simply the analogue input from the physical world, but it can provide the rich understanding of our complex world.

6. Heterogeneity

Heterogeneity in Internet of Things as one of the key characteristics. Devices in IoT are based on different hardware platforms and networks and can interact with other devices or service platforms through different networks. IoT architecture should support direct network connectivity between heterogeneous networks. The key design requirements for heterogeneous things and their environments in IoT are scalabilities, modularity, extensibility and interoperability.

7. Security

IoT devices are naturally vulnerable to security threats. As we gain efficiencies, novel experiences, and other benefits from the IoT, it would be a mistake to forget about security concerns associated with it. There is a high level of transparency and privacy issues with IoT. It is important to secure the endpoints, the networks, and the data that is transferred across all of it means creating a security paradigm.

There are a wide variety of technologies that are associated with Internet of Things that facilitate in its successful functioning. IoT technologies possess the above-mentioned characteristics which create value and support human activities; they further enhance the capabilities of the IoT network by mutual cooperation and becoming the part of the total system.

1. 3 Applications of IoT

1. Smart Home

Smart Home clearly stands out, ranking as highest Internet of Things application on all measured channels. More than 60,000 people currently search for the term "Smart Home" each month. This is not a surprise. The IoT Analytics company database for Smart Home includes 256 companies and startups. More companies are active in smart home than any other application in the field of IoT. The total amount of funding for Smart Home startups currently exceeds $2.5bn. This list includes prominent startup names such as Nest or AlertMe as well as a number of multinational corporations like Philips, Haier, or Belkin.

2. Wearables

Wearables remains a hot topic too. As consumers await the release of Apple's new smart watch in April 2015, there are plenty of other wearable innovations to be excited about: like the Sony Smart B Trainer, the Myo gesture control, or LookSee bracelet. Of all the IoT startups, wearables maker Jawbone is probably the one with the biggest funding to date. It stands at more than half a billion dollars!

3. Smart City

Smart city spans a wide variety of use cases, from traffic management to water distribution, to waste management, urban security and environmental monitoring. Its popularity is fueled by the fact that many Smart City solutions promise to alleviate real pains of people living in cities these days. IoT solutions in the area of Smart City solve traffic congestion problems, reduce noise and pollution and help make cities safer.

4. Smart grids

Smart grids is a special one. A future smart grid promises to use information about the behaviors of electricity suppliers and consumers in an automated fashion to improve the efficiency, reliability, and economics of electricity. 41,000 monthly Google searches highlights the concept's popularity. However, the lack of tweets (Just 100 per month) shows that people don't have much to say about it.

5. Industrial internet

The industrial internet is also one of the special Internet of Things applications. While many market researches such as Gartner or Cisco see the industrial internet as the IoT concept with the highest overall potential, its popularity currently doesn't reach the masses like smart home or wearables do. The industrial internet however has a lot going for it. The industrial internet gets the biggest push of people on Twitter (~1,700 tweets per month) compared to other non-consumer-oriented IoT concepts.

6. Connected car

The connected car is coming up slowly. Owing to the fact that the development cycles in the automotive industry typically take 2-4 years, we haven't seen much buzz around the connected car yet. But it seems we are getting there. Most large auto makers as well as some brave startups are working on connected car solutions. And if the BMWs and Fords of this world don't present the next generation internet connected car soon, other well-known giants will: Google, Microsoft, and Apple have all announced connected car platforms.

7. Connected Health (Digital health/Telehealth/Telemedicine)

Connected health remains the sleeping giant of the Internet of Things applications. The concept of a connected health care system and smart medical devices bears enormous potential (see our analysis of market segments), not just for companies also for the well-being of people in general. Yet, Connected Health has not reached the masses yet. Prominent use cases and large-scale startup successes are still to be seen. Might 2015 bring the breakthrough?

8. Smart Retail

Proximity-based advertising as a subset of smart retail is starting to take off. But the popularity ranking shows that it is still a niche segment. One LinkedIn post per month is nothing compared to 430 for smart home.

9. Smart Supply Chain

Supply chains have been getting smarter for some years already. Solutions for tracking goods while they are on the road, or getting suppliers to exchange inventory information have been on the market for years. So while it is perfectly logic that the topic will get a new push with the Internet of Things, it seems that so far its popularity remains limited.

10. Smart Farming

Smart farming is an often overlooked business-case for the internet of Things because it does not really fit into the well-known categories such as health, mobility, or industrial. However, due to the remoteness of farming operations and the large number of livestock that could be monitored the Internet of Things could revolutionize the way farmers work. But this idea has not yet reached large-scale attention. Nevertheless, one of the Internet of Things applications that should not be underestimated. Smart farming will become the important application field in the predominantly agricultural-product exporting countries.

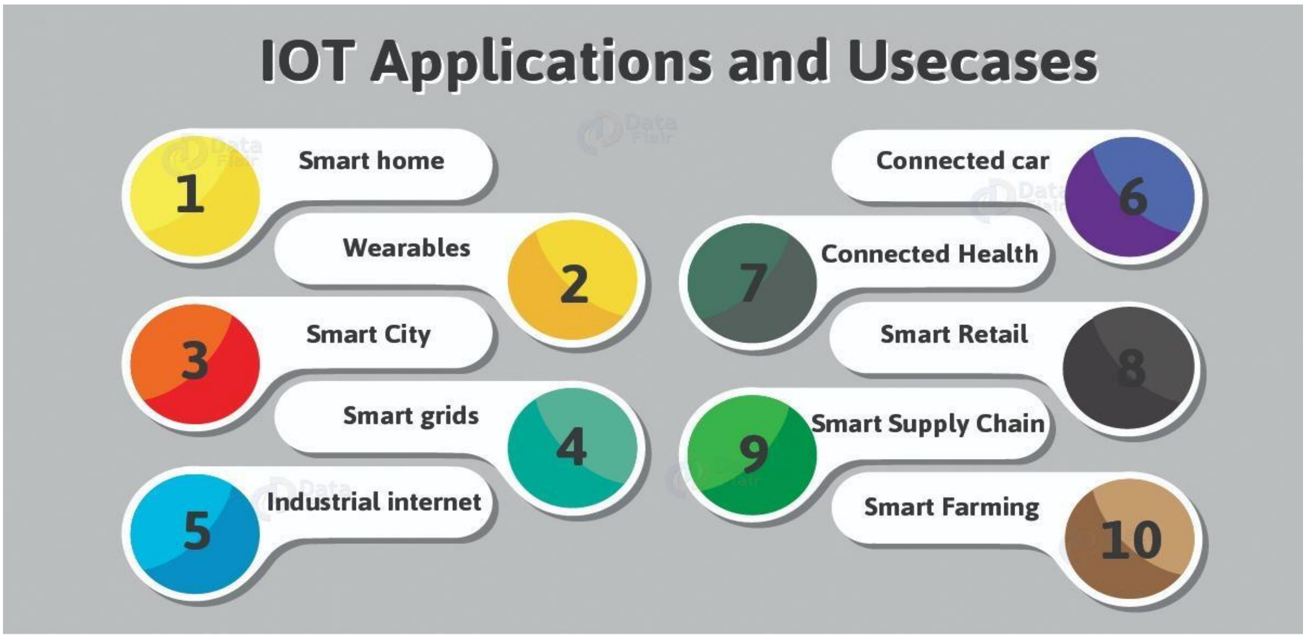


Figure 1.2: Applications of IoT

1.4 Technical Features

Arduino IDE:

Arduino is a physical computing platform based on a simple I/O board and a development environment that implements the Processing/Wiring language. Arduino can be used to develop stand-alone interactive objects or can be connected to software running on a computer (e.g., Macromedia Flash, Processing, Max/MSP, Pure Data, SuperCollider). 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.

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 righthand 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.

1.5 Preamble

The process of detecting the rain fall in the measures of centimeters. And it gives the output in the form of voice message. It is used for rain detection, weather monitoring and weather castings.it is also used to provide voice notification when it detects rain.

1.6 Problem Statement and Scope of the Project

Problem Statement:

The problem statement for a voice-based rain detection system using Python and a rain sensor to develop a system that can accurately detect rainfall and provide real-time information and control capabilities through voice commands. The primary challenges and goals include:

1. * Rain Detection Accuracy*: Create a rain detection mechanism that accurately senses the onset of rainfall and quantifies its intensity .
2. *Voice Recognition*: Implement voice recognition capabilities to accept and process user voice commands for rain-related actions.
3. *Real-time Updates*: Ensure the system provides real-time updates on rainfall status and can promptly respond to changes in weather conditions.
4. *Automation*: Develop automation logic to control various devices or systems based on rain detection, such as closing windows, managing irrigation, or sending alerts.
5. *User-Friendly Interface*: Design a user-friendly voice interface that allows users to interact with the system easily.

Scope of the Project:

The scope of the project encompasses various aspects related to rain detection and voice interaction:

1. *Hardware Integration*: Select and integrate rain sensors with a microcontroll capture rainfall data.

2. *Sensor Calibration*: Calibrate the rain sensor to ensure accurate measurement of rainfall intensity.

3. *Voice Recognition*: Implement voice recognition using Python libraries (e.g., SpeechRecognition) to understand and interpret user voice commands.

4. *Voice Response*: Create a voice feedback system to provide users with real-time updates on rainfall and system actions.
5. *Automation Logic*: Design logic to automate actions based on rain detection, such as closing windows, adjusting irrigation, or sending notifications.

6. *User Interface*: Develop a user interface for voice interaction, including a set of recognized voice commands and appropriate response

7. *Alerts and Notifications*: Incorporate an alerting system to inform users of rain-related events, such as starting or stopping rainfall.

8. *Testing and Validation*: Thoroughly test the system under various weather conditions to ensure its accuracy and reliability.

9. *Documentation*: Prepare comprehensive documentation that includes setup instructions, usage guidelines, and troubleshooting tips.

10. *Scaling and Customization*: Consider the potential for scalability and customization, allowing user to adapt the system to their specific needs and devices.

11. *Future Expansion*: Explore options for future expansion, such as integrating weather forecasting data or connecting to smart home ecosystems.

The project aims to provide users with a convenient and efficient way to monitor and respond to

rain conditions using voice commands, ultimately enhancing convenience and automation in

applications, from home automation to agriculture and event planning.

1.7 Methodology

The heart of rain detection is consisting of Node MCU hardware, sensors. Node MCU has been chosen as the processing unit for the system because of its user-friendly features and economic benefits.

Further, python coded algorithm has been fed into the Node MCU and is connected to the control board through usb cable. The Devices to be controlled have been interfaced with Node MCU using rain sensor to measure rain. The sensor data are fed into Aurdino IDE on NodeMCU.

Chapter 2

Hardware and Software Requirement Specification

2.1 Introduction

The design consists more on actual planning of software and hardware part than the code to be created. A number of software and hardware implementation techniques were used to design and develop the system.

2.2 Hardware Requirements

2.2.1 Node Mcu ESP8266

The NodeMCU (*N*ode *M*icro*C*ontroller *U*nit) is an open-source software and hardware development environment built around an inexpensive System-on-a-Chip (SoC) called the ESP8266.

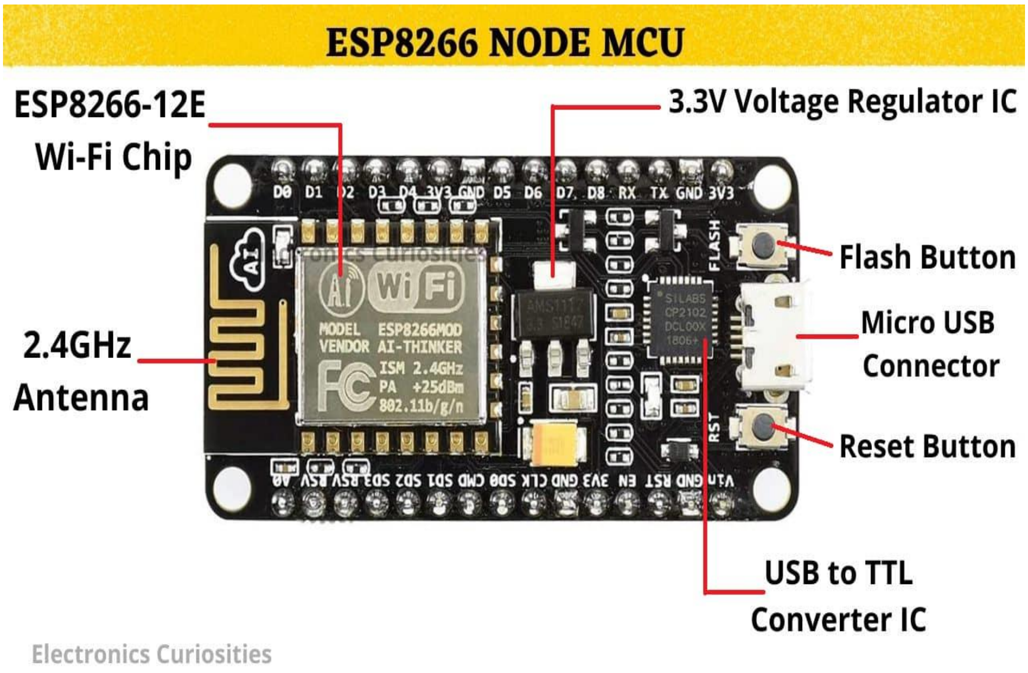


Figure 2.1 Nodemcu Esp8266 model

Components of Nodemcu Esp8266
Microcontroller: Tensilica 32-bit RISC CPU Xtensa LX10

Operating Voltage: 3.3V

Input Voltage: 7-12V

Digital I/O Pins (DIO): 16

Analog Input Pins (ADC): 1

UARTs: 1

SPIs: 1

I2Cs: 1

Flash Memory: 4 MB

SRAM: 64 KB

Clock Speed: 80 MHz

USB-TTL based on CP2102 is included onboard, Enabling Plug n Play

PCB Antenna

Small Sized module to fit smartly inside your IoT projects

A brief description of the components on the NodemcuEsp8266.

NodeMCU ESP8266 is an open source lua based firmware and development board specially targeted for IOT based application .It includes firmware that runs on the ESP8266 Wi-Fi SoC Espressif system and hardware which is based on ESP-12 module.

However, as a chip, the ESP8266 is also hard to access and use. You must solder wires, with the appropriate analog voltage, to its pins for the simplest tasks such as powering it on or sending a keystroke to the "computer" on the chip. You also have to program it in low-level machine instructions that can be interpreted by the chip hardware. This level of integration is not a problem using the ESP8266 as an embedded controller chip in mass-produced electronics. It is a huge burden for hobbyists, hackers, or students who want to experiment with it in their own IoT projects.

But, what about Arduino? The Arduino project created an open-source hardware design and software SDK for their versatile IoT controller. Similar to NodeMCU, the Arduino hardware is a microcontroller board with a USB connector, LED lights, and standard data pins. It also defines standard interfaces to interact with sensors or other boards. But unlike NodeMCU, the Arduino board can have different types of CPU chips (typically an ARM or Intel x86 chip) with memory chips, and a variety of programming environments. There is an Arduino reference design for the ESP8266 chip as well. However, the flexibility of Arduino also means significant variations across different vendors. For example, most Arduino boards do not have WiFi capabilities, and some even have a serial data port instead of a USB port.

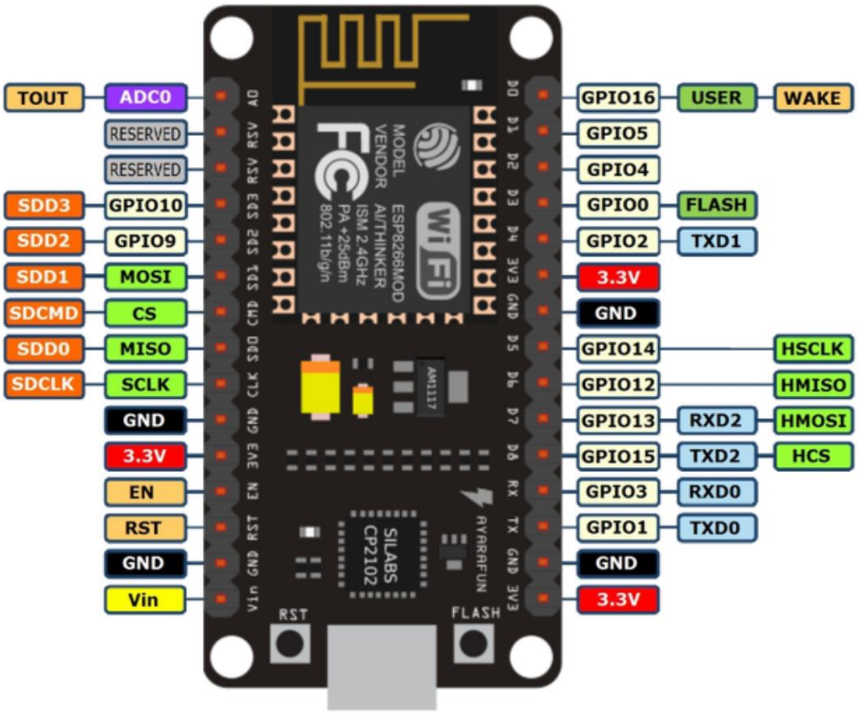


Figure 2.3 GPIO connector on RPi

For practical purposes ESP8266 NodeMCU V2 and V3 boards present identical pinouts. While working on the NodeMCU based projects we are interested in the following pins.

Power pins (3.3 V).

Ground pins (GND).

Analog pins (A0).

Digital pins (D0 – D8, SD2, SD3, RX, and TX – GPIO XX)

Most ESP8266 NodeMCU boards have one input voltage pin (Vin), three power pins (3.3v), four ground pins (GND), one analog pin (A0), and several digital pins (GPIO XX).

Step 1: NodeMCU ESP8266

The term NodeMCU usually refers to the firmware, while the board is called Devkit. NodeMCU ESP8266 consists of an ESP-12E on a board, which facilitates its use .It also has a voltage regulator, a USB interface.

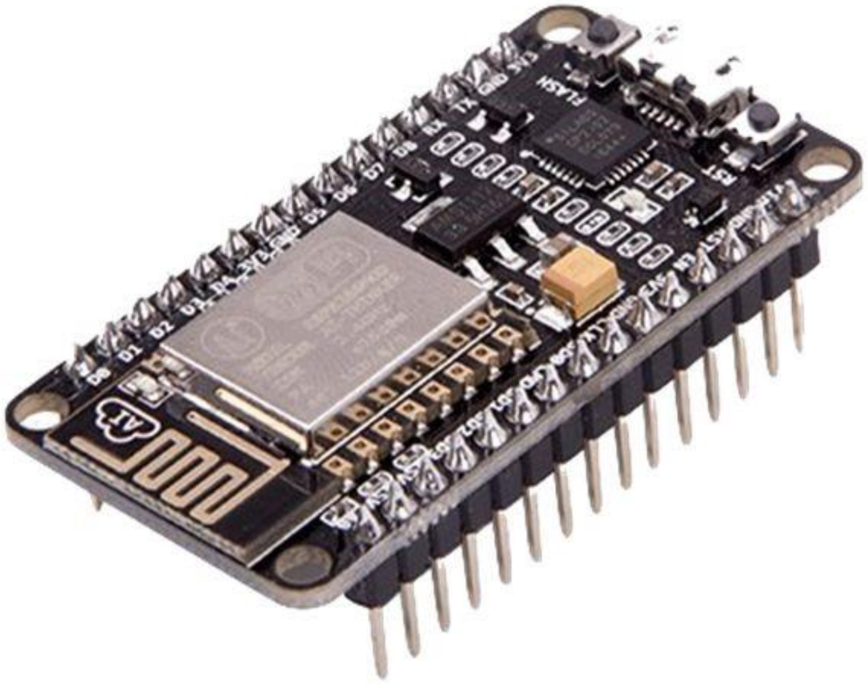


Figure 2.4 Nodemcu

Step 2: ESP-12E

The ESP-12E is a board created by AI-THINKER, which consists of an ESP8266EX inside the metal cover.

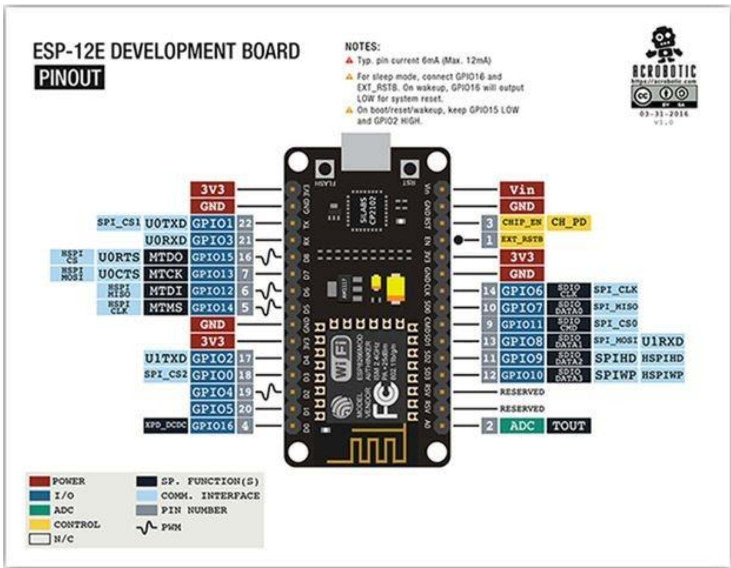
Fig 2.5 Wi-Fi ESP8266

Step 3: ESP8266EX

Made by Espressif, this microchip has integrated WiFi and low-power consumption.

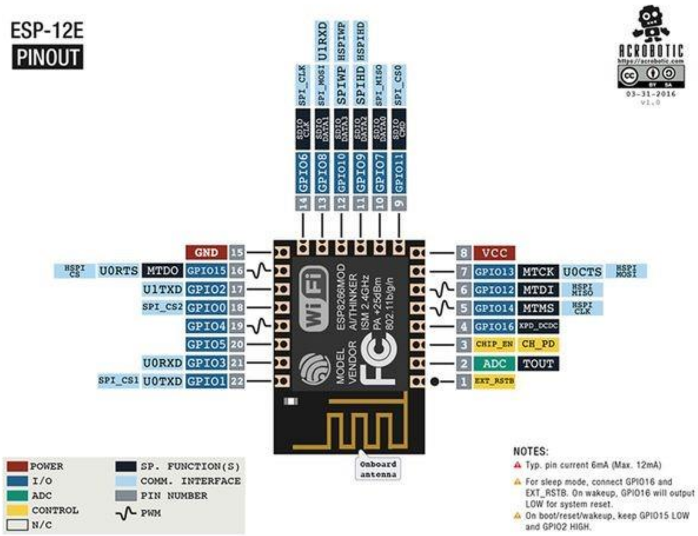
Processor RISC Tensilica L 106 32bit with a maximum clock of 160 MHz

Step 4: NodeMCU 1.0 ESP-12E Pinout



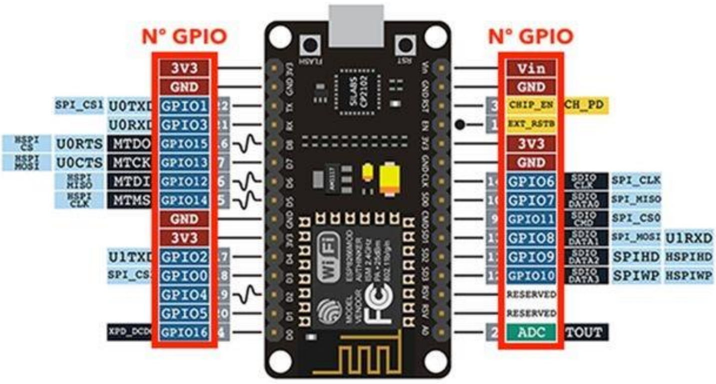
Step 5: ESP-12E Pinout

I want to emphasize that NodeMCU and ESP-12E are not the same things. In the case of the ESP-12E, the recording uses the serial, the UART. In NodeMCU, this is performed by the USB.



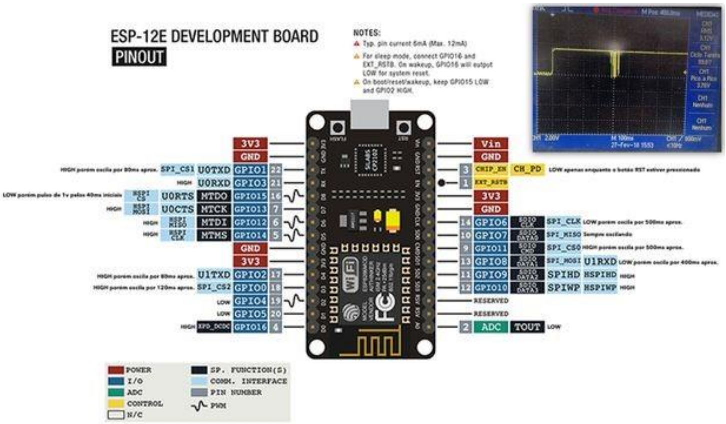
Step 6: And After All This, What's the Number to Put When Programming?

Use the number that is in front of the GPIO or the constants A0, D0, D1, D2, D3, D4, D5, D6, D7, and D8.



Step 7: Boot

We put the oscilloscope at the tip of each pin. This allows us to find, for example, that when we turn on the NodeMCU, its pins are not all the same. Some are up and others down, by default. See the comments on the behavior of each post after the boot in the image below.



Step 8: Constants That Are Already Predefined

Constante	Valor
D0	16
D1	5
D2	4
D3	0
D4	2
D5	14
D6	12
D7	13
D8	15
A0	17

Step 9: INPUT / OUTPUT

When performing INPUT and OUTPUT tests on the pins, we obtained the following results:

- digitalWrite did NOT work with GPIOs 6, 7, 8, 11, and ADC (A0)
- digitalRead did NOT work with GPIOs 1, 3, 6, 7, 8, 11, and the ADC (A0)
- analogWrite did NOT work with GPIOs 6, 7, 8, 11, and ADC (A0) (GPIOs 4, 12, 14, 15 have hardware PWM, and the others are by software)
- analogRead worked only with the ADC (A0)
- 6, 7, 8, 11 do NOT work for the above four commands

2.2.2 Rain Sensor

sensor that is used to notice the water drops or rainfall is known as a rain sensor. This kind of sensor works like a switch. This sensor includes two parts like sensing pad and a sensor module. Whenever rain falls on the surface of a sensing pad then the sensor module reads the data from the sensor pad to process and convert it into an analog or digital output. So the output generated by this sensor is analog (AO) and digital (DO). A

Specifications

The specifications of rain sensors like different parameters with values are mentioned below.

Operating voltage ranges from 3.3 to 5V

The operating current is 15 mA

The sensing pad size is 5cm x 4 cm with a nickel plate on one face.

Comparator chip is LM393

Output types are AO (Analog o/p voltage) & DO (Digital switching voltage)

The length & width of PCB module 3.2cm x 1.4cm

Sensitivity is modifiable through Trimpot

Red/Green LED lights indicators for Power & Output

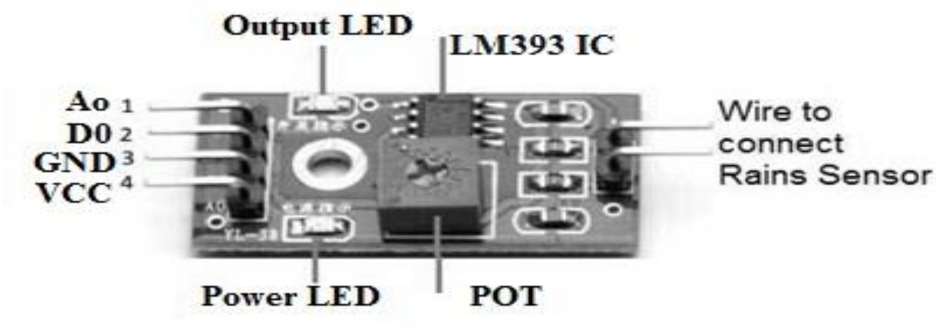
Working Principle

The rain sensor working principle is pretty simple. The sensing pad includes a set of uncovered copper traces which mutually work like a variable resistor or a potentiometer. Here, the sensing pad resistance will be changed based on the amount of water falling on its surface. So, here the resistance is inversely related to the amount of water.

When the water on the sensing pad is more, the conductivity is better & gives less resistance. Similarly, when the water on the surface pad is less, the conductivity is poor & gives high resistance. So the output of this sensor mainly depends on the resistance.

Rain Sensor Pin Configuration

The rain sensor is super easy to use and only has 4 pins to connect.



Pin Configuration

Analog Output (AO) Pin: This pin gives an analog signal between the voltage supply from 5V to 0V.

Digital Output (DO) Pin: This pin gives digital o/p for the internal comparator circuit & it can be connected to an Arduino board otherwise to a 5V relay.

Ground Pin: It is a ground connection.

VCC Pin: This pin provides a voltage supply to the rain sensor that ranges from 3.3V to 5V. Here, the analog output will change based on the voltage provided to the sensor.

Rain Sensor Module

The rain sensor module includes a sensing pad which includes two series copper tracks coated with nickel. This pad includes two header pins which are connected internally to the copper tracks of the pad. The main function of these two header pins is for connecting the Sensing Pad with the rain sensor module with the help of two jumper wires. Here, the rain sensor module's one pin provides a +5v power supply toward the one path of the sensing pad, whereas the other pin gets the return power from another path of the pad.

Rain Sensor Module

Generally in dry situations, this pad gives huge resistance as well as less conductive. So, the voltage supply cannot be supplied from one path to another path. Here resistance mainly depends on the quantity of water on the sensing pad surface.

Once water falls on the surface of the sensor pad, then its resistance will be reduced & conductivity will be enhanced. So, once the amount of water increases on the surface of the pad then it can supply huge power from one path to other.

Sensor Module

The Sensor module includes some essential components like Variable Resistor, LM393 IC, output LED & Power LED.

Variable Resistor

The rain sensor module includes a variable resistor onboard. The main function of this is to fix the rain sensor's sensitivity, turn the preset knob to change the rain detection sensitivity. If the knob is turned in clockwise, then the sensitivity of the rain sensor will be enhanced. If it is rotated anticlockwise, then the sensitivity of this sensor will be reduced.

Power LED

The main function of the power LED in this module is to indicate the power supply of the sensor is ON/OFF. Once we switched ON the power supply for this sensor, then the RED LED will be switched ON.

Output LED

Once the rain sensor notices the water drop or rainfall, then RED LED will be activated. Similarly, the rain is not detected by the module then RED LED will be deactivated

Working

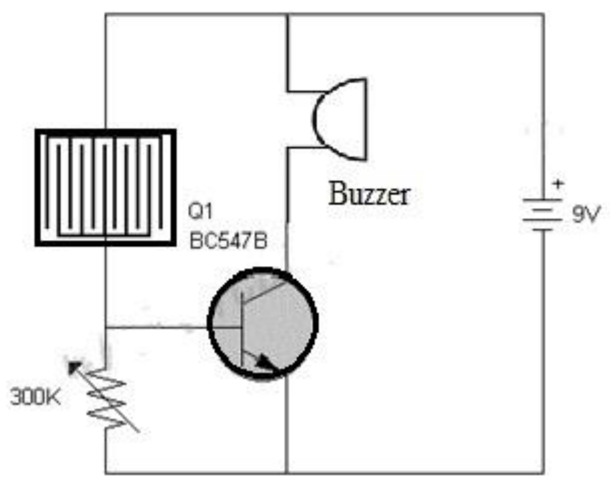
At first, the sensing pad has to connect to the sensor module using a jumper wire. Now, both the pins of rain sensor modules like GND & VCC are connected to a 5V power supply pin. After that, fix the threshold voltage at the Non-Inverting terminal of the LM393 IC in the dry state of the pad by turning the knob of the potentiometer to fix the sensitivity of the rain sensor.

the volume of raindrops on the surface of the pad increases then its conductivity increases & resistance decreases. After that from the pad, a less amount of voltage can be provided to the Inverting input terminal of the LM393 IC. Then this IC evaluates this voltage through the threshold voltage. In this state, the input voltage is low as compared to the threshold voltage, as a result, the output of the rain sensor goes LOW.

When no rain falls on the surface of the pad then it has high resistance & less conductivity. After that, the high voltage will be assigned across the pad. Thus, the high voltage from the pad can be provided to the Inverting input of the IC. Once more the integrated circuit evaluates this voltage by using the threshold voltage. So, in this state, this input voltage is higher as compared to the threshold voltage. As a result, the output of the sensor module goes high.

Rain Sensor Circuit

The rain sensor alarm circuit is shown below. This circuit can be designed with different components like rain sensor module, 9V supply, buzzer, variable resistor -300K, BC547B transistor, etc.



Rain Sensor Circuit Diagram

In the following circuit, the BC547B transistor is an essential component that works like a switch in this circuit. The rain sensor is very responsive to water drops or rainfalls. The circuit sensitivity can be adjusted through a variable resistor. Once the rain falls onto the sensor strips then the circuit will be activated because water is a great electricity conductor.

The voltage is supplied to the transistor to turn ON the transistor then it activates the buzzer which is connected to it. Here, the buzzer in this circuit works like an alarm to alert the user. For better performance, the sensor strip must be connected very close to the circuit. This sensor can be designed through different methods based on your choice & convenience.

Types of Rain Sensor

There are different kinds of rain sensors are available which include the following.

Water Collection Basin

This kind of sensor is one of the initial types. As the name suggests, a basin or a cup is connected to this sensor to work as a rain gauge because the water gathers within it. So this will help the sensor to decide whether it requires triggering the sprinklers.

The main disadvantage of this sensor is that it cannot differentiate among debris & rainwater so this can lead to an incorrect disruption of the watering cycle. Once the sensor includes a shallower basin, then the wind can drive the water away from the container that leads to related problems. These are also called collection cups of rainfall and they work through wireless systems also.

Conductive Sensors

Conductive sensors utilize advanced technology & the working principle of this sensor is conductivity. In this sensor, there are mainly two electrodes present underneath the basin. Once the level of water achieves these electrodes then a circuit finishes & activates a switch.

This system can distinguish between water and wastage, however, if the wastage comes up the level of water after a brief clean-up, the sprinklers may disable prematurely. Therefore, the open container is a problem in both collections of water as well as the conductive type of rain sensors.

Hygroscopic Disk

This kind of sensor has achieved so much popularity over the years & it is considered as most accurate. This sensor includes a cork disk that increases through absorbing rain. This turns ON a switch after a fixed quantity is gathered.

The planned watering won't begin except the disk has dried out and taken back to its regular size; thus the longer it stays wet &expanded, the sprinklers will stay shut down for a long time. This system has been confirmed to be efficient & accurate which has been included in its command.

Freeze Sensors

Freeze sensors are mainly designed to notice rain & frost. They detect the temperature to decide once the water runs throughout the sprinkler pipes risk breaking them. These types of sensors are the most expensive.

Advantages

The advantages of rain sensors include the following.

The rain sensor is used to save money by disabling the irrigation system once it rains. So that electricity consumption can be reduced.

1. Simple operating principle
2. It operates with less power
3. The cost of an individual sensor is less
4. Rain sensor-based systems installation is very simple

The life of different systems based on rain sensors will be extended like irrigation systems, car wipers through running them simply once it is needed.

Disadvantages

- The main disadvantage of the sensor is the same as the Soil Moisture Sensor. That is the quality of the PCB of the sensing Plate or PCB. Which you should consider if you are using this sensor task in which plate is exposed to moisture and water for a long time.
- The second disadvantage is very selective, as the analog value which is provided in the sensor is not used mainly. Analog value is not useful in most of the cases because, as soon as the water falls on the plates, the Digital output will be high, so there is no scope for analog values.

Chapter 3

Project Description

3.1 Introduction

Internet of things is a technology of the future that has already started to touch our homes. The IOT based rain detection system using Node MCU is helpful for detecting rain automatically. The objective of this is how to detect rain drops using Node MCU, external interrupts and rain sensor.

The rain sensor used is composed by two parts. The first one is the effective sensor, which is a plaque that is exposed to the rain. This plaque has two strips of conductive material, very close to each other, but without touching. So, if we apply a voltage between the two strips, it will be an open circuit. Nevertheless, when we expose this surface to the rain, the water that falls closes the circuit between the strips and a different voltage can be measured. Keep in mind that when the rain drops the two strips will not be short circuited because water is not a perfect conductor . So, this sensor will act as a variable resistor [3], which will be lower when more water falls on the surface, connecting the stripes in more points. I've tested the resistance of the sensor with a multi meter after applying some water drops and it was about 65 kΩ. The second part is the electronic circuit board responsible to process the signal from the plaque and expose it as two signals, one digital and another analog. So, we have a digital output pin, which operates as active-low, indicating that rain is being detected or not. Since this pin is active-low, it will have a value of GND when rain is detected, and VCC when rain is not detected. Since, as stated, the rain sensor will act as a variable resistor, its output will be an analog voltage that needs to be converted to this digital one. So, the electronic circuit uses a LM393 comparator [4] to compare this analog voltage to a certain threshold and output GND or VCC accordingly. The PCB of this electronic circuit has a potentiometer that we can change to adjust this threshold, making the sensor more or less sensible to the rain drops.

Additionally, the sensor has an analog output with a variable voltage that depends on the resistance of the sensor and thus, on the amount of water on it.

This module can work with voltage supplies of both 3.3 V and 5 V [5], making it possible to use with both Arduino and the ESP8266.

This is a very cheap and easy to use sensor.which is composed by a plaque and a circuit board. This is a very cheap and easy to use sensor.

3.2 Fritzing

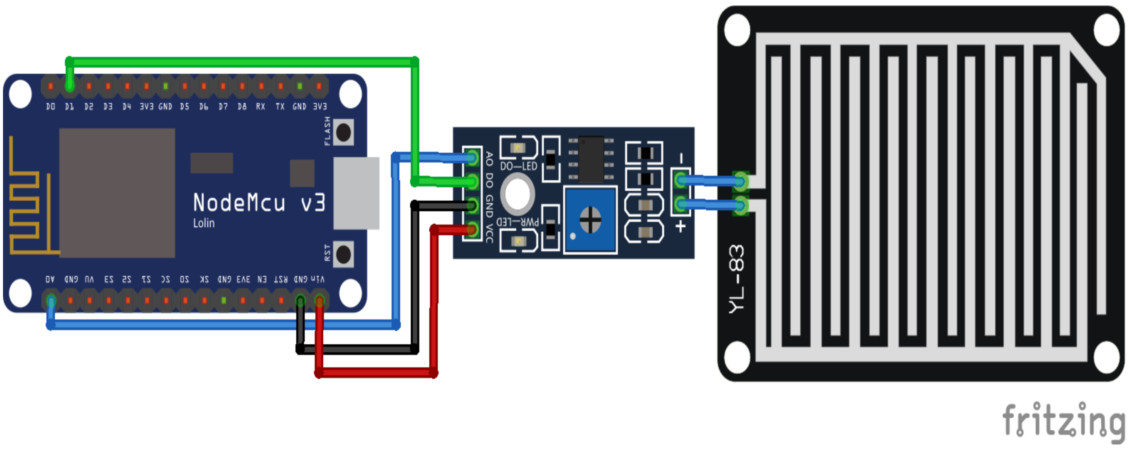


Figure 3.1 Fritzing

The Figure 3.1 describes the connection of NodeMCU and Rain sensor for rain detecting system. In this prosed project, rain sensor checks the rain fall in centimeters and displays in output screen in the from of numbers.

Chapter 4
Requirement Analysis

4.1 Introduction

Internet of things is a technology of the future that has already started to touch our homes. The IOT based home automation system using raspberry pi that automates home appliances and allows user to control them easily through internet from anywhere over the world or within the home. It uses a combination of hardware and software to enable control and management over appliances and devices within a home [1]. Home automation not only refers to reduce human efforts but also energy efficiency and time saving. As home automation apps become more intelligent, their capabilities become almost endless from controlling lights and locks to small appliances [5]. Not only can you control your home, but you can also set commands that help your devices learn and then automatically react to your schedule. Your devices can even work together to create a more cohesive experience [2] [4]. For example, you can have your thermostat adjust and your lights turn off at a certain time, say when you're leaving the house in the morning. You can also combine hubs to increase connectivity across your home. The benefits of home automation typically fall into a few categories, including savings, safety, convenience, and control. Additionally, some consumers purchase home automation for comfort and peace of mind [3].

The main objective of this project is to develop a home automation system using an Raspberry Pi/ Node MCU board with Internet being remotely controlled by any Android OS smart phone. As technology is advancing so houses are also getting smarter. Modern houses are gradually shifting from conventional switches to centralized control system, involving remote controlled switches. Presently, conventional wall switches located in different parts of the house makes it difficult for the user to go near them to operate. Even more it becomes more difficult for the elderly or physically handicapped people to do so. Remote controlled home automation system provides a most modern solution with smart phones. The figure 1 shows the home automation using blynk mobile application

Hardware Requirement

1. Node MCU ESP8266
2. Rain sensor
3. Control broad
4. Jumper wires

- Male to Female

- Male to Male
- Female to Female

Software Requirement

- Programming Language: Python
- Windows Operating System
- Arduino IDE

Objective of the proposed Work

- To Provides best prototype for weather casting.
- To provides the output in the form of voice message.
- It mostly helps to detect rain in measures of centimeters in the weather casting department.

Chapter 5

Analysis and Design Specification

5.1 Architectural Deign

It is the process where the architecture of the complete project is designed and how the data is flowing in complete project. Basically, system design can take two approaches namely – Top down approach and Bottom up approach.

First one is usually for the design which is more applicable for build from scratch applications. And second one is for the design like requirements clearly known. In this project Top down approach is followed. Figure 5.1 shows the Blynk IoT Platform

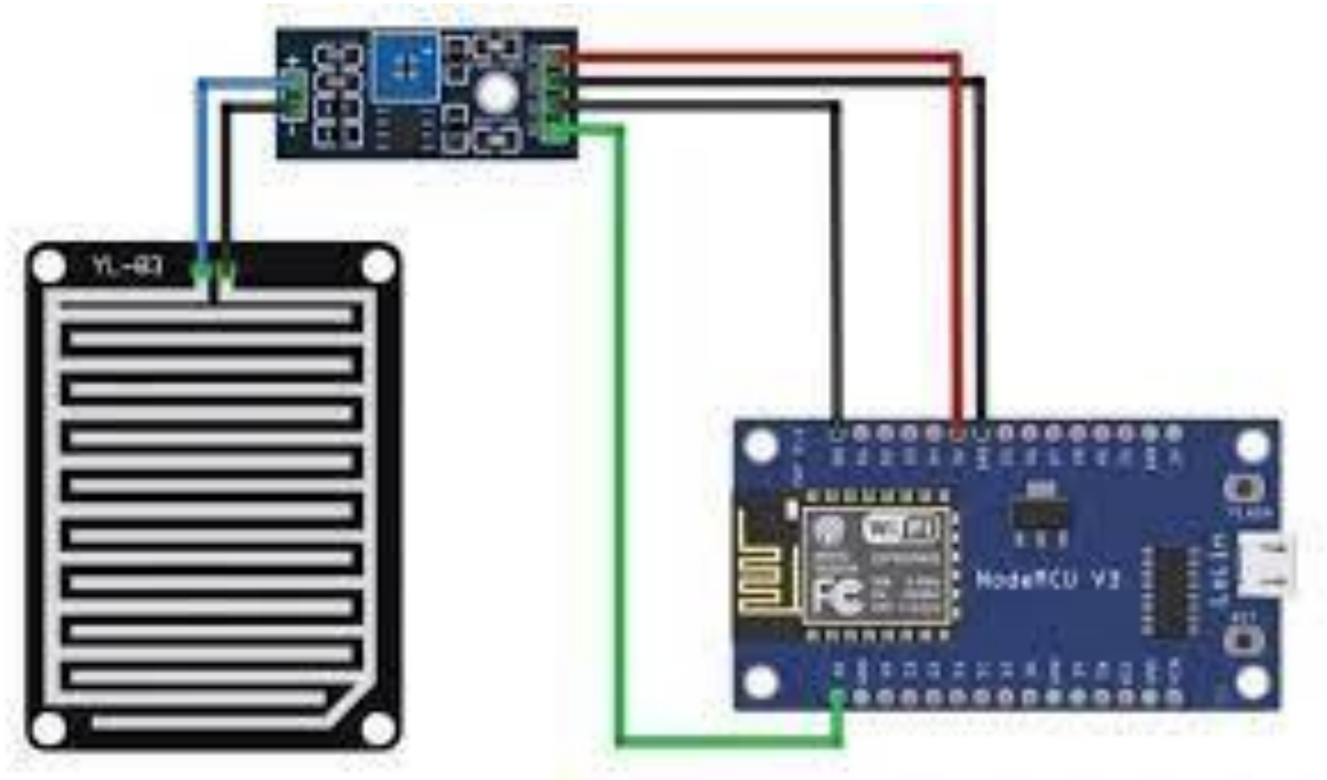


Figure 5.1: design of rain sensor

5.2 Block Diagram

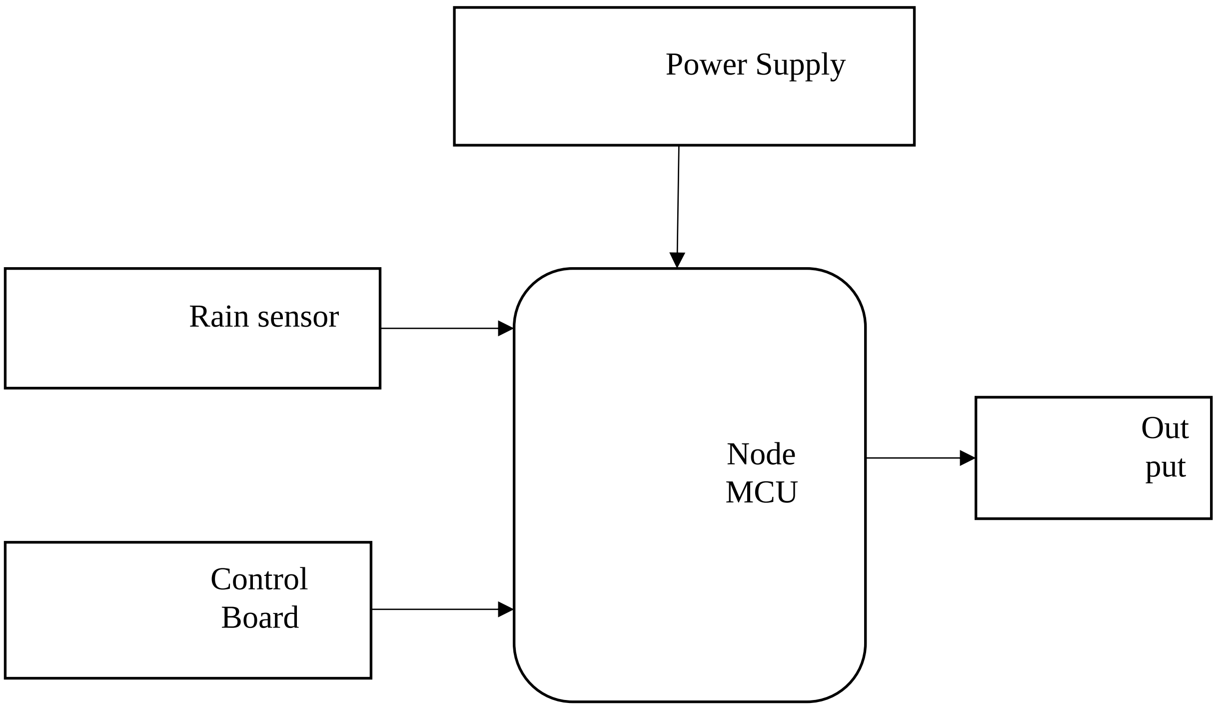


Figure 5.2: Block Diagram of Voiced Based Rain Detecting System

5.3 Module Specification

Arduino IDE:

Arduino is a physical computing platform based on a simple I/O board and a development environment that implements the Processing/Wiring language. Arduino can be used to develop stand-alone interactive objects or can be connected to software running on a computer

Python IDE

The IDE acts as an interface between the user and Node MCU controller. The IDE contains libraries, tools etc to send instructions to the microcontroller. The instruction are then processed by the NodeMCU are sent by the IDE and returns the required values.

Rain sensor

A **rain sensor** or rain switch a switching device activated by rainfall. There are two main applications for rain sensors.

5.4 Data Flow Diagram

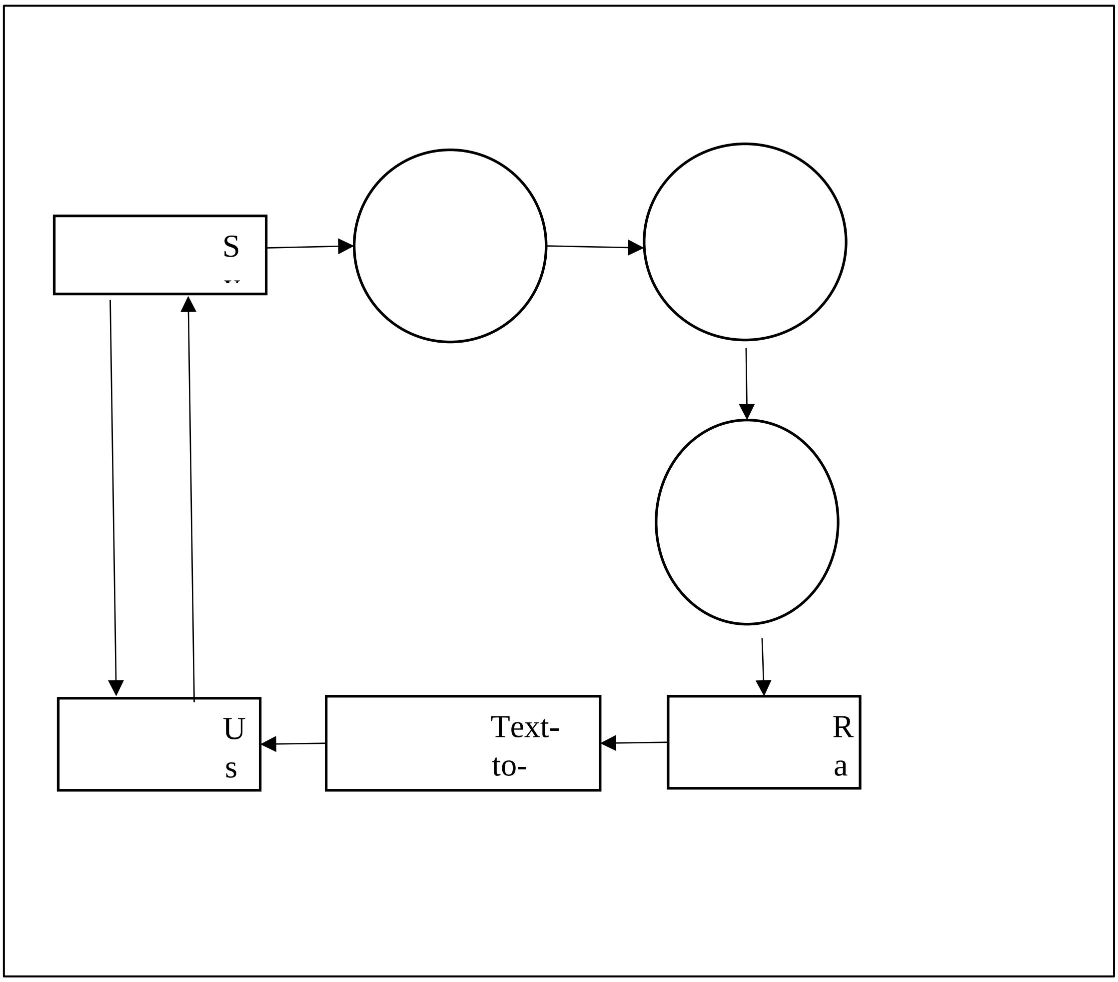


Figure 5.4: Data Flow Diagram

The figure 5.3 depicts show the data flows of Voice based rain detection system. The user is entity who is given the information from the various sensors. The data is taken by Arduino are analysed based on parameters. The instructions are then sent to various modules like Rain sensor.

Chapter 6
Implementation

Arduino is a physical computing platform based on a simple I/O board and a development environment that implements the Processing/Wiring language. Arduino can be used to develop stand-alone interactive objects or can be connected to software running on a computer

Step 1: Download the Arduino IDE and open as shown in figure 6.1

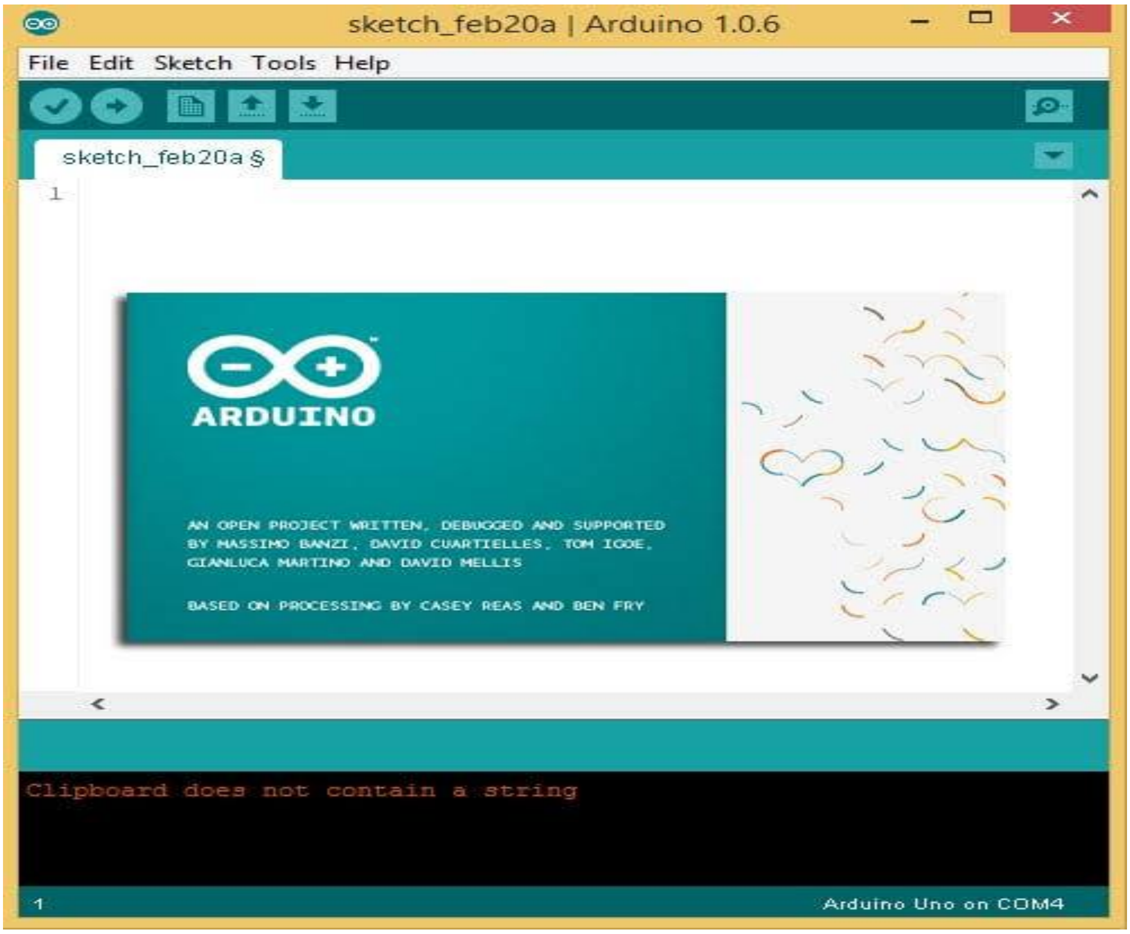


Figure 6.1 Arduino IDE

Step 2: install the libraries as shown in figure 6.2

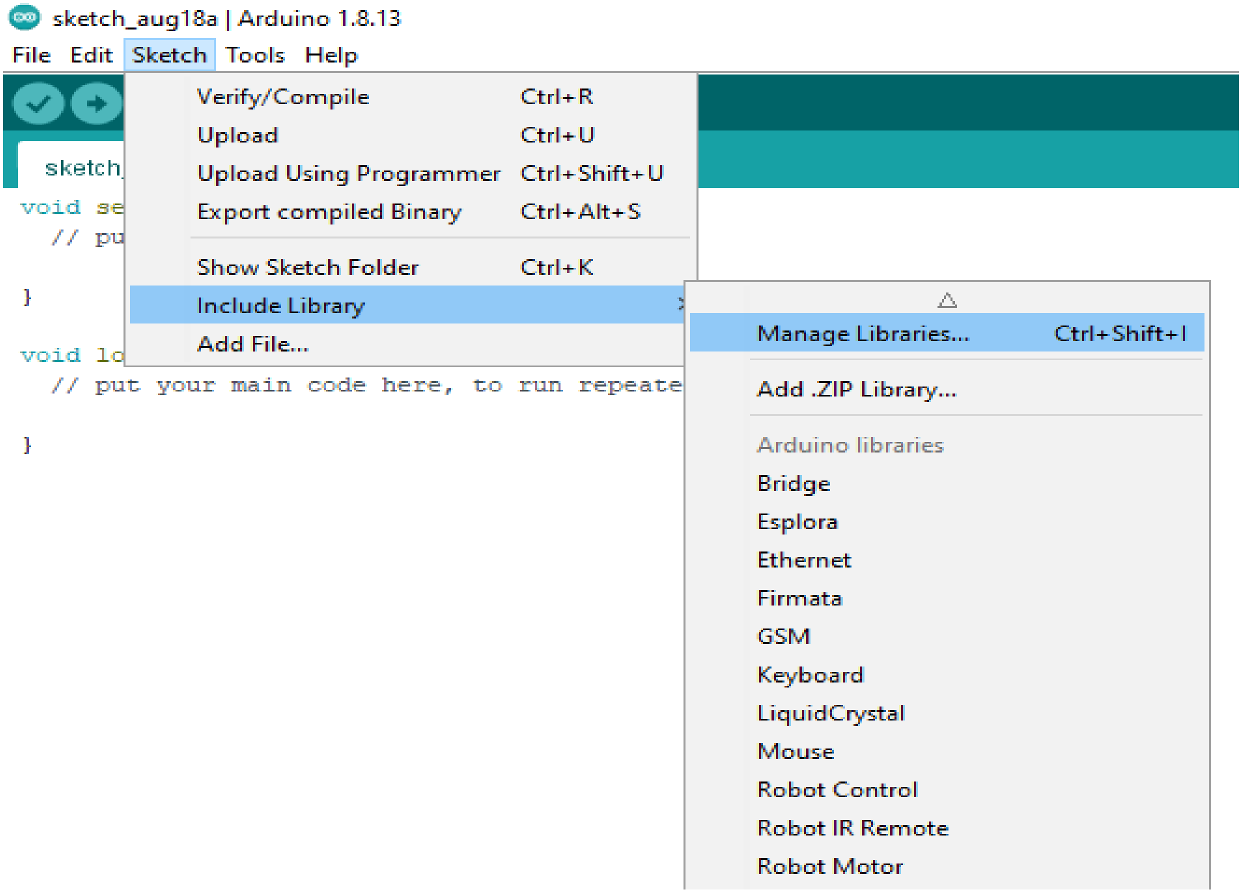


Figure 6.2 Creating Blynk App Account

Step 3: Create new sketch in Arduino IDE as shown in figure 6.3

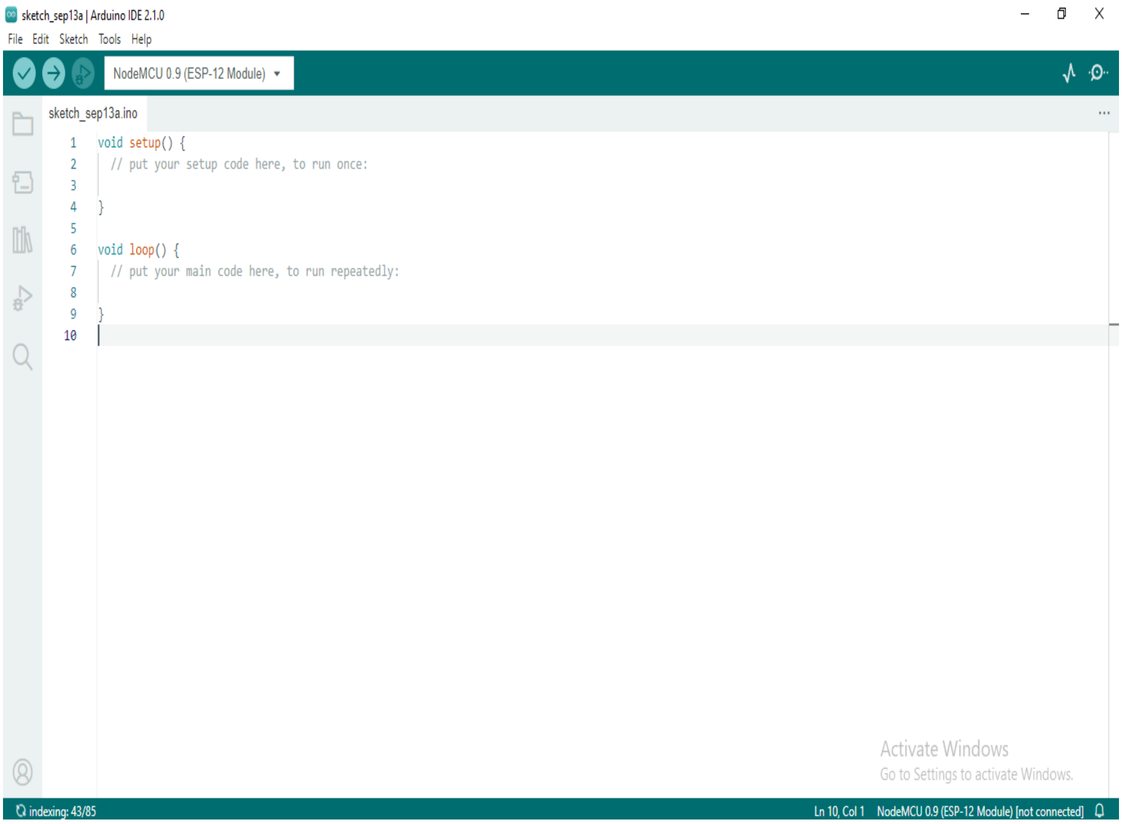


Figure 6.3: Creating New Sketch

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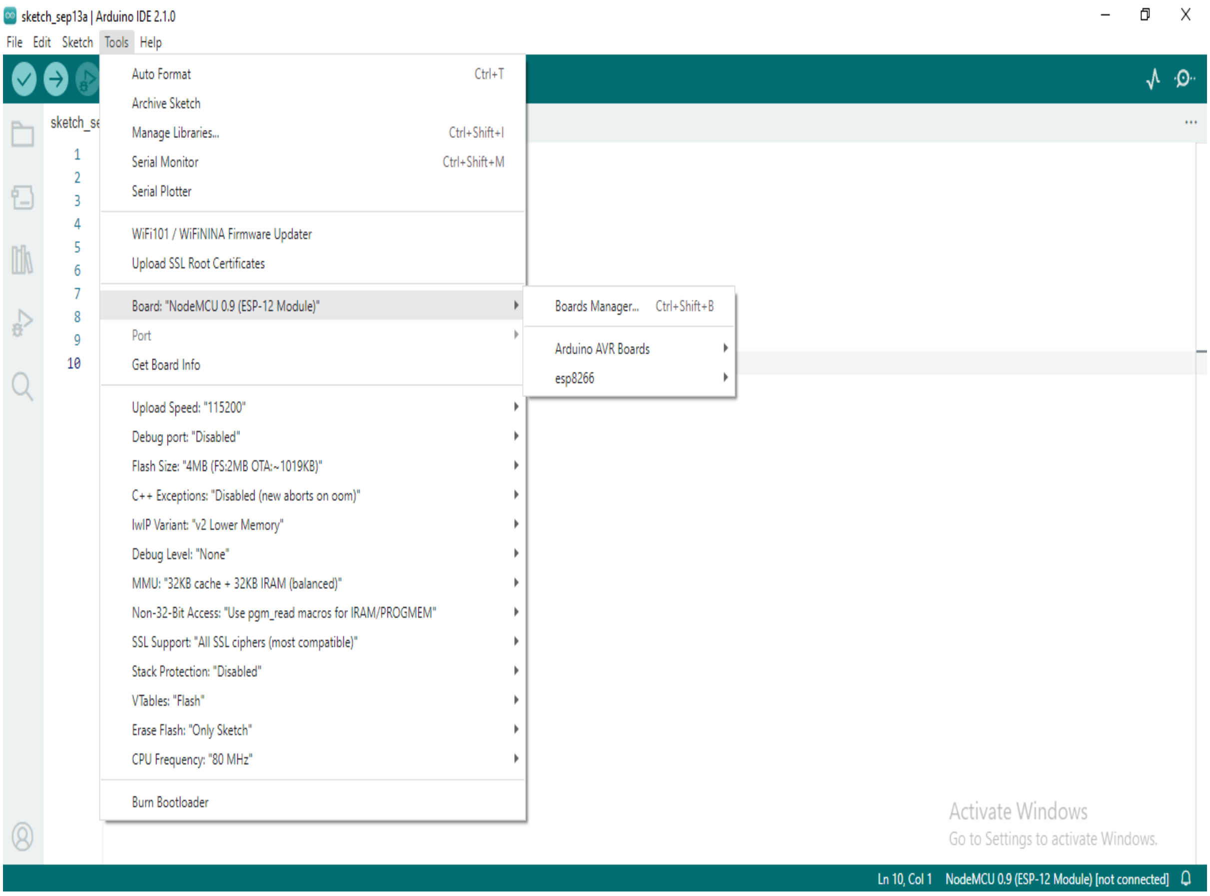
Step 4: select the board as shown in figure 6.4



6.4: Adding board to the sketch

Step 5: Enable the port as COM 3 as shown in figure 6.5

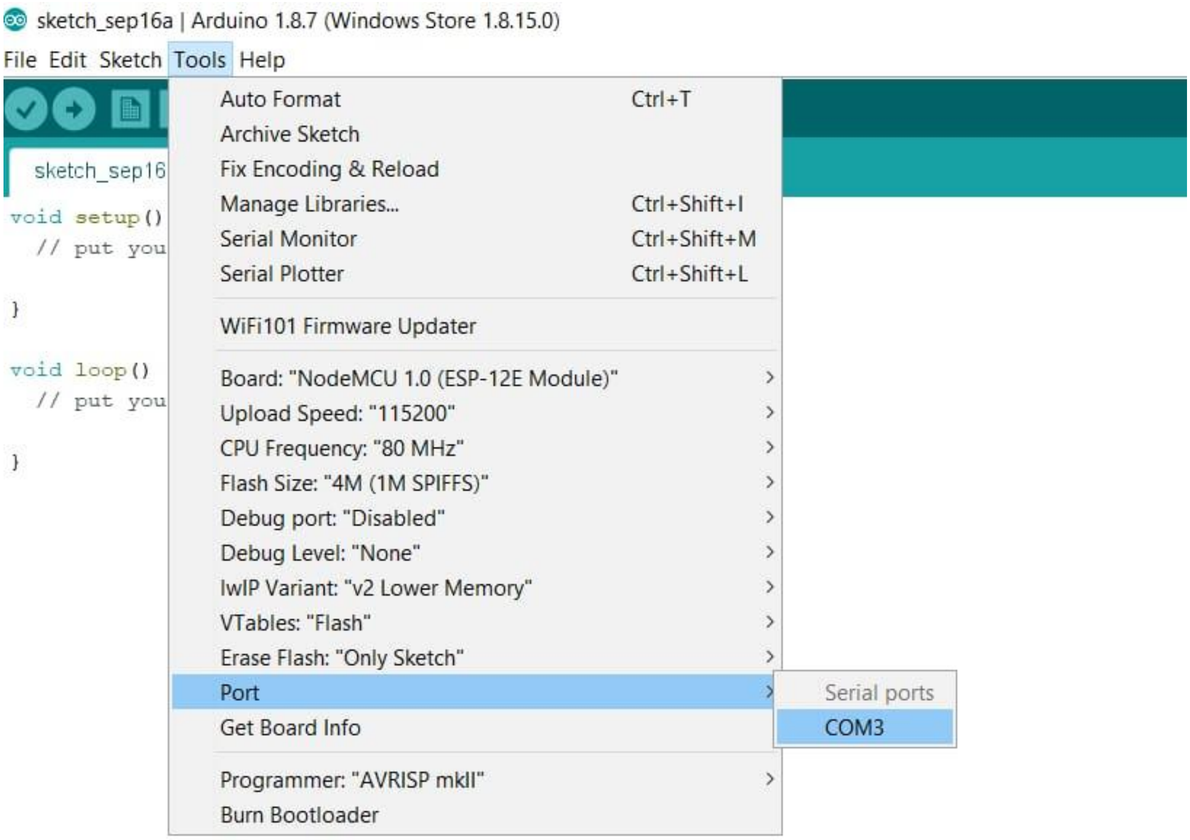


Figure 6.5: Adding port to the sketch

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Step 6: Upload the code to NodeMCU as shown in figure 6.6

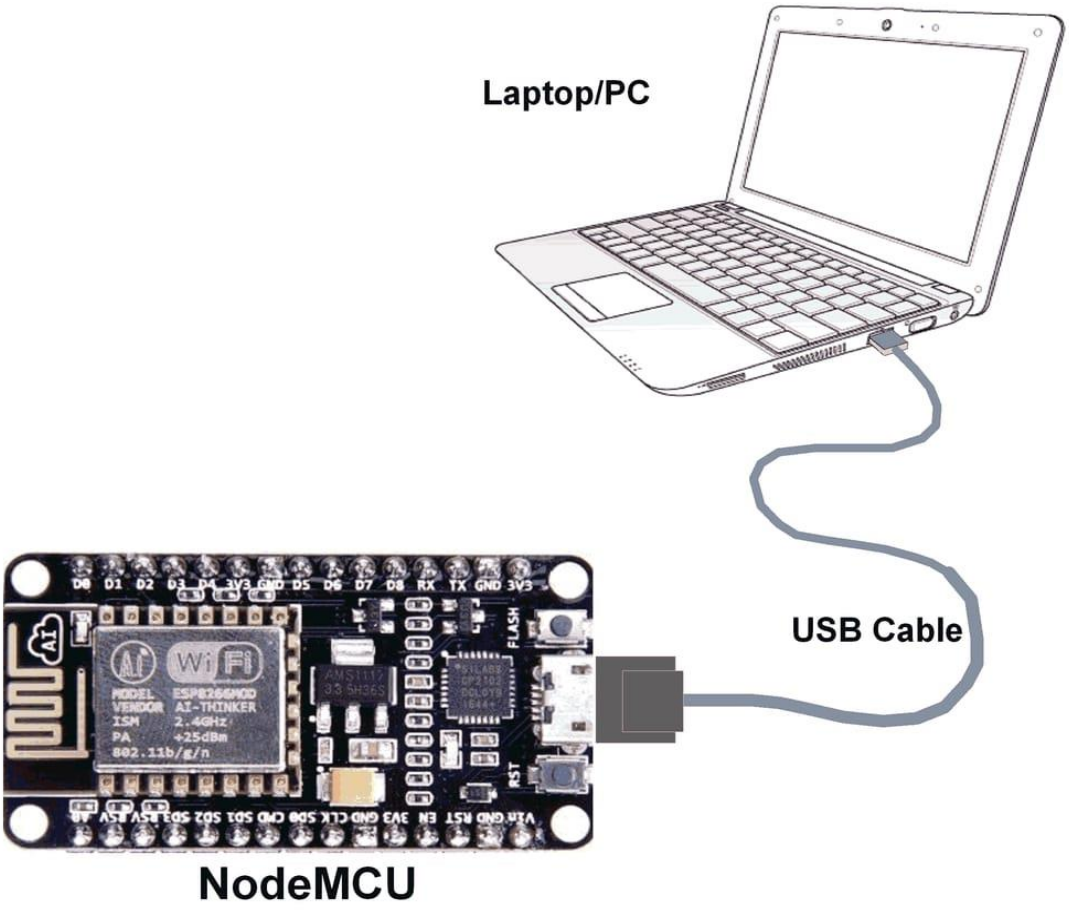

Figure 6.6: Uploading code

Step 7: Connect all the NodeMCU and rain sensor as shown in figure 6.7

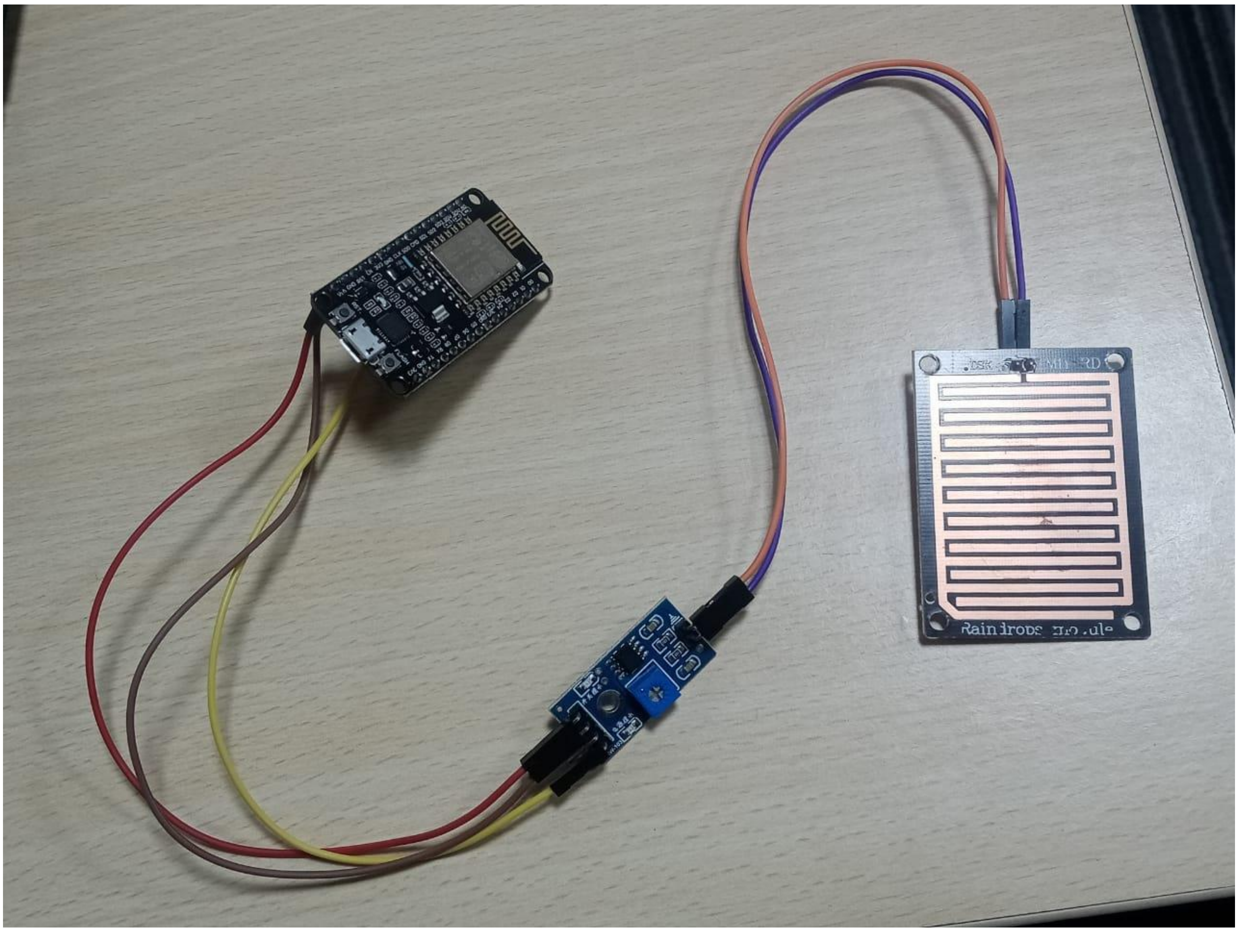

Figure 6.7 :Connection of Devices

Step 8: Run the code and output displays as shown in figure 6.8

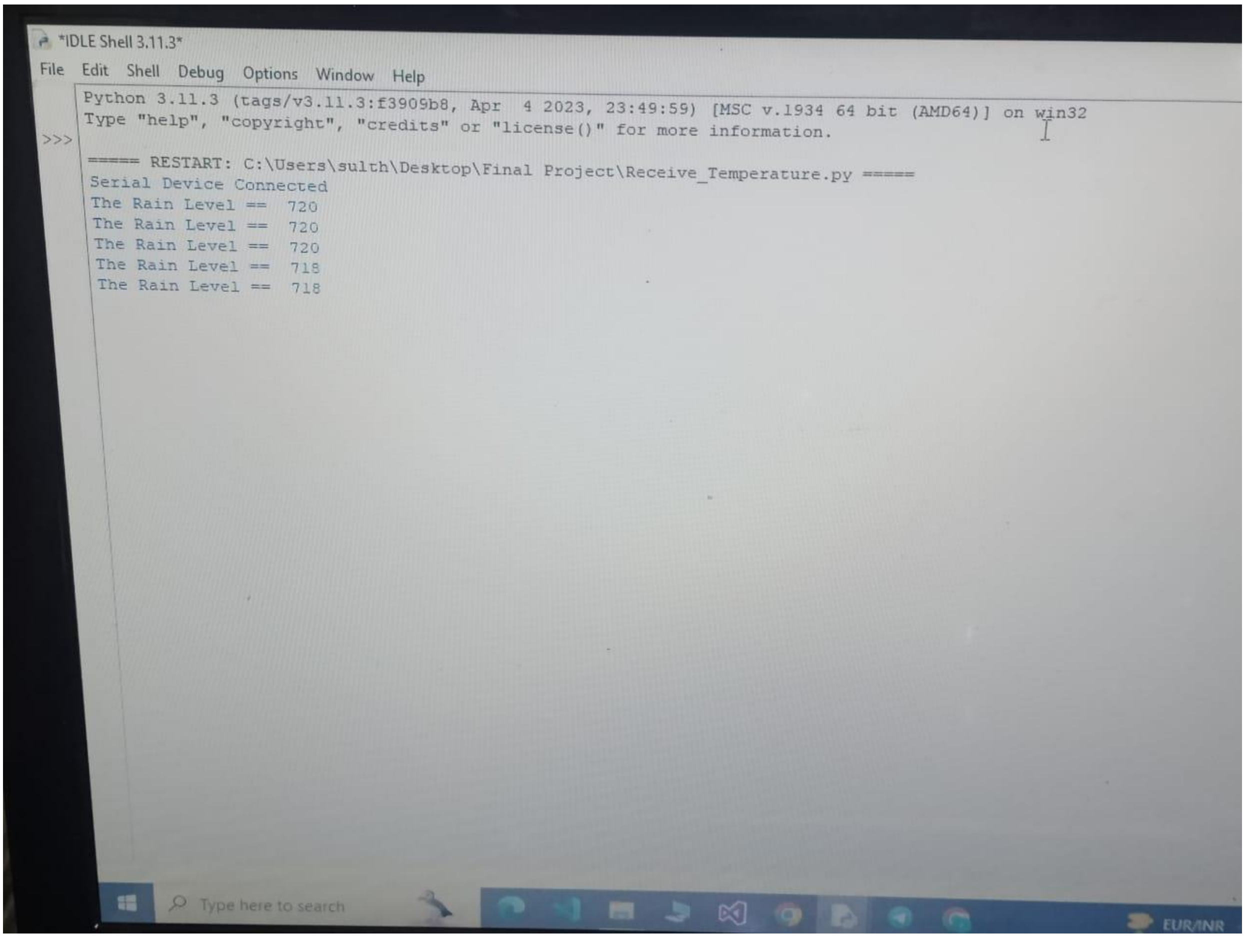

Figure 6.8: Displays output.

Chapter 7

Testing

7.1.1 Unit Testing

Unit Testing is a level of software testing where individual units/ components of a software are tested. The purpose is to validate that each unit of the software performs as designed. A unit is the smallest testable part of any software. It usually has one or a few inputs and usually a single output. In procedural programming, a unit may be an individual program, function, procedure, etc. In object-oriented programming, the smallest unit is a method, which may belong to a base/ super class, abstract class or derived/ child class. (Some treat a module of an application as a unit. This is to be discouraged as there will probably be many individual units within that module.) Unit testing frameworks, drivers, stubs, and mock/ fake objects are used to assist in unit testing.

Benefits of Unit Testing

- **Unit testing increases confidence in changing/ maintaining code:** If good unit tests are written and if they are run every time any code is changed, we will be able to promptly catch any defects introduced due to the change. Also, if codes are already made less interdependent to make unit testing possible, the unintended impact of changes to any code is less.
- **Codes are more reusable:** In order to make unit testing possible, codes need to be modular. This means that codes are easier to reuse.
- **Development is faster:** If you do not have unit testing in place, you write your code and perform that fuzzy ‘developer test’ (You set some breakpoints, fire up the GUI, provide a few inputs that hopefully hit your code and hope that you are all set.) But, if you have unit testing in place, you write the test, write the code and run the test. Writing tests takes time but the time is compensated by the less amount of time it takes to run the tests; You need not fire up the GUI and provide all those inputs. And, of course, unit tests are more reliable than ‘developer tests’. Development is faster in the long run too. How? The effort required to find and fix defects found during unit testing is very less in comparison to the effort required to fix defects found during system testing or acceptance testing.

- The cost of fixing a defect detected during unit testing is lesser in comparison to that of defects detected at higher levels. Compare the cost (time, effort, destruction, humiliation) of a defect detected during acceptance testing or when the software is live.
- **Debugging is easy**: When a test fails, only the latest changes need to be debugged. With testing at higher levels, changes made over the span of several days/weeks/months need to be scanned.

Table 1 and 2 specifies the test cases involves in checking the connection and the reading of data from sensors

Table 1: Unit Testing for sensors

Testcase ID	**Test Case Description**	**Input**	**Expected Output**	**Actual Output**	
1	Reading Sensor Data	Digital Pin	Measures of rain in the form of centimeters based on voice	Measures of rain in the form of centimeters based on voice	

Chapter 8

Future Enhancement

Enhancing a Voice-Based Rain Detection System using Python and a rain sensor can be an exciting project. Here are some future enhancement ideas to consider:

1. Machine Learning Integration: Incorporate machine learning algorithms to improve rain detection accuracy. Train a model to differentiate between different rain intensities or predict rain patterns based on historical data.

2. Voice Recognition: Enhance the voice-based interaction by implementing voice recognition technology. Users can ask specific questions about the weather, receive forecasts, or request rain-related information using natural language.

3. IoT Integration: Connect the rain sensor and the system to the Internet of Things (IoT) platform. This allows for remote monitoring and control of the system, as well as data sharing with other IoT devices.

4. Real-time Alerts: Implement real-time voice alerts to notify users about changing weather conditions, including the onset of rain or weather warnings. This can enhance user safety.

5. User Customization: Provide users with options to customize the voice-based system, such as setting rain intensity thresholds for alerts or choosing specific phrases for interaction.

6. Weather Forecast Integration: Integrate weather forecast APIs to provide users with future rain predictions and more comprehensive weather information.

7. Data Logging and Analysis: Log rain sensor data over time and perform data analysis to identify patterns and trends in local rainfall. Users can access historical rain data through voice commands.

Chapter 9

Conclusion

A voice-based rain detection system using Python and a rain sensor can provide a valuable solution for detecting rainfall and informing users audibly. In conclusion, such a system offers several benefits. The system can continuously monitor rainfall and provide immediate feedback through voice alerts, ensuring users stay informed about changing weather conditions. Voice-based alerts make the system accessible to a wide range of users, including those with visual impairments, enhancing safety and awareness during rainfall. By integrating Python and a rain sensor, the system can operate autonomously, reducing the need for constant human monitoring. Users can customize the voice alerts to suit their preferences and requirements, enhancing the user experience. The system can log rainfall data, enabling users to track historical weather patterns and make informed decisions.

However, it's important to consider certain challenges and limitations, such as the accuracy of the rain sensor, potential false positives/negatives, and the need for a reliable internet connection for voice alerts.

Overall, a voice-based rain detection system using Python and a rain sensor offers a practical and user-friendly approach to staying informed about rainfall, contributing to safety and convenience in varying weather conditions.