DEPARTMENT OF INFORMATION TECHNOLOGY

RAMNIRANJAN JHUNJHUNWALA COLLEGE (AUTONOMOUS) *(Affiliated to University of Mumbai)*
GHATKOPAR (WEST), 400086.

MAHARASHTRA

2022-2023

PLANT MONITORING SYSTEM

A Project Report

Submitted in partial fulfillment of the

Requirements for the award of the Degree of

BACHELOR OF SCIENCE

(INFORMATION TECHNOLOGY)

By

RAJBHAR SUDESH (Roll no: - 3067)

Under the Guidance of

Mrs. Punam Sindhu

RAMNIRANJAN JHUNJHUNWALA COLLEGE (AUTONOMOUS) *(Affiliated to University of Mumbai)*
GHATKOPAR (WEST), 400086.

Certificate

This is to certify that the Project entitled, "PLANT MONITORING SYSTEM" is bonafide work of Mast. Rajbhar Sudesh (3067) submitted in partial fulfillment of the requirements for the award of Degree Bachelor of Science in Information Technology.

Signature of Internal Guide

Sign of Co-ordinator

Examiner

Date: - 24/03/2023

College Seal

ABSTRACT

- The purpose of this project is to provide an embedded system for plant monitoring and nursery to reduce the manual monitoring of the plants and get the information via mobile application.
- The system is proposed to help the nursery manager to monitor the plants. The soil is tested using various sensors such as pH sensor, temperature sensor, and humidity sensor. Based on the result, the gardener or nursery management can plant the appropriate plants that suits the soil.
- The obtained sensor values are sent to the nursery manager through the Wi-Fi router and the plant suggestion is made through the mobile application.
- Automatic system is carried out when the soil temperature is high. Crop image is captured and it is sent to the field manager to suggest pesticides
- Plants play the major role in economics and survival of people in India. The purpose of this project is to provide an embedded based system for soil monitoring and irrigation to reduce the manual monitoring of the field and get the information via mobile application.

ACKNOWLEDGEMENT

Before we get into the thick of things, we would like to add a few heartfelt words for the people who were part of the PLANT MONITORING SYSTEM project in numerous ways, people who gave unending support right from the stage the project idea was conceived.

A project report is such a comprehensive coverage; it would not have been materialized without the help of many. The four things that go on to make a successful endeavor are dedication, hard work, patience and correct guidance.

In particular, I would like to thank our principal Dr. Himanshu Dawda Sir. I would like to give a very special honor and respect to our teacher, Prof. Punam Sindhu who took keen interest in checking the minute details of the project work and guided us throughout the same. A sincere quote of thanks to the non-teaching staff for providing us with their time. I appreciate outstanding cooperation by them, especially for the long Lab timings that we could receive.

Last but not least I wish to avail myself of this opportunity, express a sense of gratitude and love to my friends and my beloved FAMILY for their manual support, strength and help for everything.

DECLARATION

I hereby declare that the Project entitled, “PLANT MONITORING SYSTEM” done at R. J. COLLEGE, Ghatkopar (W), and Mumbai, has not been in any case duplicated to submit to any other university for the award of any degree. To the best of my Knowledge other than me, No one has submitted to any other University.

The Project is done in partial fulfillment of the requirements for the award of degree of BACHELOR OF SCIENCE (INFORMATION TECHNOLOGY) to be submitted as a FOURTH semester project as part of our curriculum.

INDEX

Chapter 1-Introduction

1.1 Objectives

- To serve humanity nowadays technology is playing a wonderful role and a man's basic and primary need is food indeed.
- It can be said that about more than 85% of people of India are directly, indirectly dependent on agriculture.
- Proper irrigation by water pump cannot be maintained due to frequent power outages, unavailability of grid lines in remote areas and scarcity/cost of fuel to run pumps. To make a sustainable irrigation system and monitoring system for getting better crops growth as well as best production, this IOT based Automatic irrigation system is proposed.
- Different kinds of sensors are used. This report presents a fully automated drip irrigation system which is controlled and monitored. Temperature and the humidity content of the soil are frequently monitored.
- The system informs user about any abnormal conditions like less moisture content and temperature rise, even concentration of water by sending notifications through the wireless module

1.2 Background

- It is widely known that the resources of water are decreasing all over the world. On the other hand, rapid urbanization, population growth, industries and agriculture expansion increase the demand for fresh water.

- In the agriculture based countries including India, for irrigation purposes water is used more than any other purpose, and the production rate can be decreased if any kind of hampering happens in water supply. The improvement of water usage efficiency without decreasing yield can be done by maintaining water management strategies & up-to-date technologies. It has become a crying need for the agro-based countries to take more efficient technology in the form of agriculture to create better management of water resources.

- Digital Bangladesh concept that has led to tremendous growth in digital information storage, retrieval and communication. Nowadays the concept of Internet of Things (IOT) has made human life more comfortable. Everyone is referring to this system of inter-related computing devices, objects, things, animals, people, etc.

- Without human involvement the system is able to share information over a network. The idea of IoT has been blooming since decades. For water savings function it has been proved that Wireless sensor network (WSN) systems are very helpful for irrigation management. WSN is the system which is a mesh of a network of sensor nodes which are connected to each other and the nodes directly collect data from the environment and provide real time data to the rim which is very much helpful for the farmers.

- Both as a data collection device and as a decision-making tool for real time monitoring this system can be used. The farmers are aware of water shortage or over watering may damage the yield. They need to understand when and how much water is needed for specific crops. Most farmers have little knowledge of their farm and they are unaware of the methods of improving their productivity of agricultural practices.

- All these convicts make it necessary to think of resolving support systems for agriculture. In order to overcome this problem, IoT based Wireless Sensor Network (WSN) for agriculture monitoring controls are applied.

- The artificial implementation of water in the eld is known as irrigation. Irrigation comes in many forms. Many kinds of ancient water supplying technology are rapidly replacing the old ones and applying it to the soil.

- Depending on how water is distributed throughout the eld there are many different types of irrigation systems, In this report a system has been developed to solve the problem of real time monitoring and stored data monitoring to investigate the soil condition at any time to take decision what types of crops should be grown and what should be done with the soil to get better and best production of the crops and also makes the whole system wirelessly automatic control over mobile phone which can reduce the cost of the labor as well the effort of a farmer.

1.3 Purpose, Scope, and Applicability:

1.3.1 Purpose

Due to rapid population and industrial growth, non-renewable resources are being depleted at an alarming pace. With coal, oil, and gas projected to run out in 35 to 42 years, alternative renewable energies are increasingly researched and implemented in global society. Through the use of piezoelectricity, everyday tasks such as driving and walking could be transformed into energy harvesting actions as the pressure from car wheels and feet could provide energy for the world to use. With billions of people partaking in piezoelectric energy harvesting, the need for other forms of energy, renewable and non-renewable, would decrease with minimal cost to the environment or changes to society or individual daily life. This Project of designing a shoe serves as one of the first steps in researching piezoelectricity as a viable alternative energy source.

1.3.2 Scope

Scope and Limitations:

The scope of this project is

1. Monitoring of soil moisture content

2. Automatic Control system.

3. Real time monitoring of soil

4. Mobile based control system.

5. IOT Based platform

Limitations of this project is:

1. The system can only be used via internet connection.

2. The system can be used with the help of batteries where AC current is not available

1.3.3 Applicability: -

- Soil monitoring systems using IoT (Internet of Things) technology can have a variety of applications in agriculture, environmental monitoring, and construction. Some of the applicability's of soil monitoring systems made by IoT include:
- Precision Agriculture: Soil monitoring systems can help farmers to optimize crop yields and reduce costs by providing real-time data on soil moisture, temperature, and nutrient levels. This data can be used to inform irrigation and fertilization decisions, ensuring that crops receive the appropriate amount of water and nutrients at the right time.
- Environmental Monitoring: Soil monitoring systems can be used to monitor soil health and detect changes in soil conditions caused by climate change, pollution, or other environmental factors. This information can help to inform conservation efforts and land management decisions.
- Landscaping and Gardening: Soil monitoring systems can help homeowners and landscapers to maintain healthy lawns and gardens by providing information on soil moisture, pH levels, and nutrient levels.
- Construction: Soil monitoring systems can be used in construction to monitor the stability of soil and detect changes in soil conditions that could impact building foundations and other structures.

1.4 Organization of Report

- Survey of Technologies

Survey of Technologies includes Comparing different Technologies that can be used and Choosing the best out of them which we are going to use for the Development of our Platform.

- Requirements Specification

We will be defining the problem statement of our project. We will also to be stating the requirement specification. Planning and Scheduling of the project will be defined. Milestones of the project will also be defined.

- Software and Hardware Requirements

We will define details of software and hardware needed for the development and implementation of the project. In hardware requirements we will specify Arduino pin requirements, motor voltage, etc. Needed to run the software. In software requirements we will specify the operating system, the compiler, testing tools, linker, and the libraries etc. which will be necessary to compile, link and install the

software.

- Conceptual Models

We will produce a model of the overall system which will describe operations that can be performed on the system, and the sequences of those operations. These models will be produced using different conceptual models like Block Diagrams, Sequence Diagrams etc.

- System Design

1. Model & Designs:

We will explain different models related to project to show the working more properly

Chapter 2-Survey of Technologies

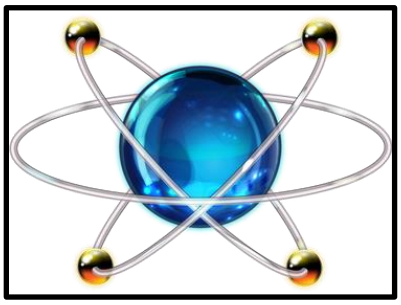
Software Technologies:

1. Software

A) Arduino IDE.

Item	Specification
Arduino Uno	ATmega328P – 8 bit AVR family microcontroller, Operating Voltage 6-20V, DC Current on I/O Pin – 40ma
Development Platform	IA-32, x86-64, ARM
Language Used	Arduino C++
Code development	Arduino IDE

B) Proteus.



The Proteus Design Suite is a proprietary software tool suite used primarily for electronic design automation. The software is used mainly by electronic design engineers and technicians to create schematics and electronic prints for manufacturing printed circuit boards. We used Proteus to develop a live simulation of our working project.

C) Tinker cad.

Tinker cad is a free-of-charge, online 3D modeling program that runs in a web browser. Since it became available in 2011 it has become a popular platform for creating models for 3D printing as well as an entry-level introduction to constructive solid geometry in schools.

Tinker cad is used here in order to develop a live simulation of our soil moisture system.

D) MIT App Inventor:-

- MIT App Inventor is used to create apps that interact with devices and systems.
- To connect an app to an IoT device, users can use a variety of tools and

Technologies, such as Bluetooth, Wi-Fi, and cloud platforms.

MIT App Inventor was used to develop the apt to show the interface required to display the temperature and humidity of our project.

E) Star UML:-

- Strum is a modeling tool used to design software systems using the Unified Modeling Language (UML) notation.
- It is a popular choice for software developers and architects because of its versatility and powerful features
- We used STARUML to develop different types of Software diagrams in order to understand the working of our project better.

F) NetBeans IDE.

NetBeans is an integrated development environment for Java. NetBeans allows applications to be developed from a set of modular software components called modules. NetBeans runs on Windows, macros, Linux and Solaris

We used NetBeans here to develop a Website based on Java Servlets and jip pages ,The website will show information about our project and also contains a downloadable link of our apt that shows temperature and humidity in case if customer needs to see. There is also a section for Customer where they can send their query directly to us which will be saved in our database.

F) MYSQL DATABASE. (THROUGH JDBC)

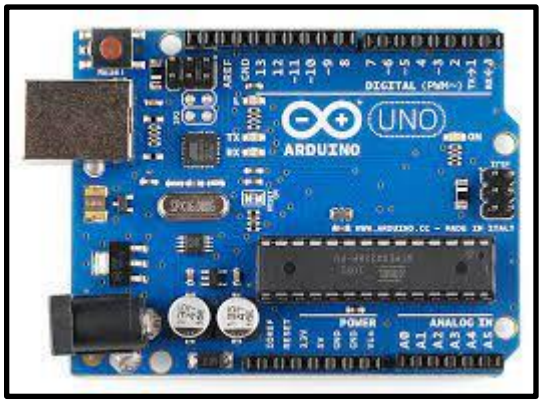
MySQL is an open-source relational database management system. Its name is a combination of "My", the name of co-founder Michael Wideness's daughter my, and "SQL", the acronym for Structured Query Language

We used NetBeans here to develop a Website based on Java Servlets and jip pages ,The website will show information about our project and also contains a downloadable link of our apt that shows temperature and humidity in case if customer needs to see. There is also a section for Customer where they can send their query directly to us which will be saved in our database, and thereby we can solve their queries.

Hardware Components we have used:-

1) Arduino Uno :- (360 Rs)

The Arduino Uno is a microcontroller board based on the ATmega328P microcontroller. It is one of the most popular and widely used boards in the Arduino family due to its ease of use and versatility. Some key features of the Arduino Uno include:

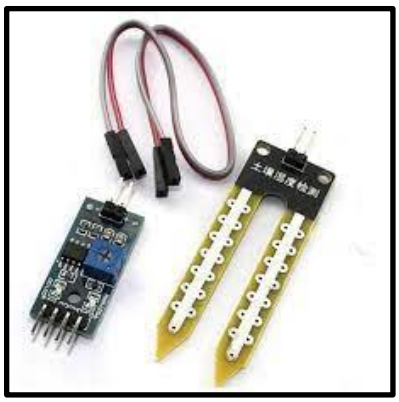


2) HC05 Bluetooth Module :- (200 Rs)

The HC-05 is a popular Bluetooth module that can be used to add Bluetooth connectivity to a wide range of electronic projects. It is based on the CSR BC417 chipset and supports Bluetooth 2.0 and 4.0 protocols.

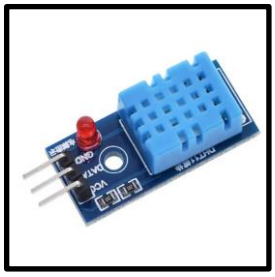
3) Soil Sensor :- (50-100 Rs)

A soil sensor is an electronic device that measures the moisture level, temperature, and other parameters of soil. It is used to monitor the health and growth of plants, and to optimize irrigation and fertilization.



4) Dht11 Sensor :- (50-70 Rs)

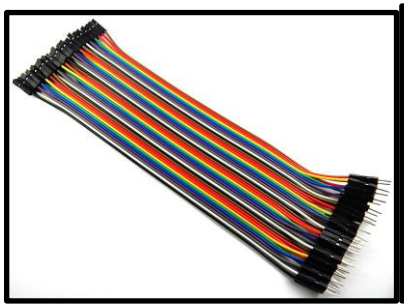
The DHT11 is a digital temperature and humidity sensor that is widely used in electronic projects. It is a low-cost, easy-to-use sensor that provides accurate and reliable measurements of temperature and humidity.



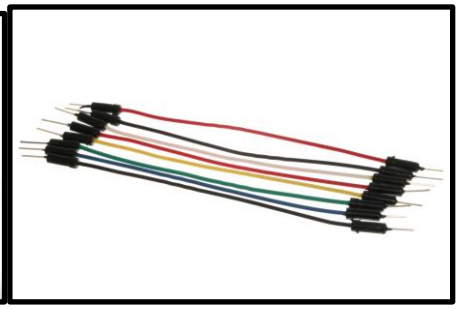
5) Jumper wires (20-30 Rs)

It is used for making connections between components.

Male to female

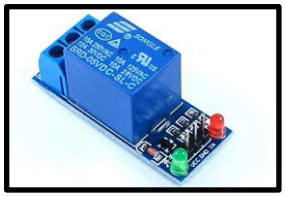


Male to male



6) 1 Cap Relay :- (65 Rs)

A 1-channel relay is an electronic device that can be used to control a single electrical circuit or device. It is commonly used in electronic projects and automation systems to switch on/off devices such as lights, fans, and motors.



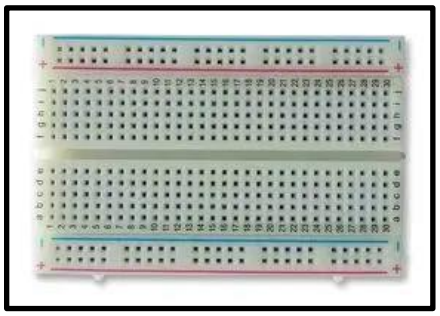
7) Mini Motor Pump :- (100-200 Rs)

It is used to pump the water from the tank to the plant using relay module.

8) Batteries :- (25-30 Rs)

We have used 9V Batteries for power supply.

9) Breadboard (100 Rs)



Operating System:-

- For many embedded applications, it is obvious that an OS is needed. If the application is complex and is running on a high-end processor, it is almost certain that an OS would be beneficial. At the other end of the scale, simple software running on a low-end chip has no need of an OS at all.
- A microcontroller will run just one program repeatedly — not a full operating system. This flexibility combined with the fact that the Arduino software is free,

  The hardware boards are pretty cheap, and both the software and hardware are easy to learn.
- Microcontrollers also don't have the same amount of computing

  Power or resources as most single-board computers.
- Arduino is a micro-controller board which runs a dedicated program, there's no OS, just your code.

Arduino IDE:

- The Arduino integrated development environment (IDE) is a cross-platform application (for Windows, macros, Linux) that is written in the programming language Java. It is used to write and upload programs to Arduino compatible boards.
- Arduino IDE is an open source software that is mainly used for writing and compiling the code into the Arduino Module.
- Each of them contains a microcontroller on the board that is actually programmed and accepts the information in the form of code.
- The main code, also known as a sketch, created on the IDE platform will ultimately generate a Hex File which is then transferred and uploaded in the controller on the board.

Writing sketches:

- Programs written using Arduino IDE are called sketches. These sketches are written in the text editor and are saved with the file extension '.ion'. The editor has features for cutting/pasting and for searching/replacing text.
- The message area gives feedback while saving and exporting and also display errors. The console displays text output by the Arduino IDE., including complete error messages and other information. The bottom right corner of the window displays the configured board and serial port.

Alternative Technologies: -

1. Raspberry Pi: -

The Raspberry Pi is a series of small single-board computers developed in the United Kingdom by the Raspberry Pi Foundation to promote teaching of basic computer science in schools and in developing countries.

The original model became far more popular than anticipated, selling outside its target market for uses such as robotics. It does not include peripherals (such as keyboards and mice) or cases. However, some accessories have been included in several official and unofficial bundles.

Advantages of Arduino over Raspberry Pi:

Simplicity:

It's very easy to interface analog sensors, motors and other electronic components with Arduino, with just a few lines of code. While in Raspberry pi, there is much overhead for simply reading those sensors, we need to install some libraries and software's for interfacing these sensors and components.

Robustness:

Raspberry Pi runs on an OS so it must be properly shut down before turning OFF the power, otherwise OS & applications may get corrupted and Pi can be damaged. Arduino is just a plug and play device which can be turned ON and OFF at any point of time, without any risk of damage. It can start running the code again on resuming the power.

Power consumption: -

Pi is a powerful hardware, it needs continuous 5v power supply and it is difficult to run it on Batteries, while Arduino needs less power and can easily be powered using a battery pack.

Price:-

Obviously, Arduino is cheaper than Raspberry Pi, Arduino costs around $10-20 depending on the version, while the price of Raspberry is around $35-40.

2. Proteus: -

Proteus is a software tool suite used for electronic design automation (EDA). It is widely used by engineers and designers to create schematic captures, PCB layouts, and simulations of electronic circuits.

Proteus is a comprehensive tool that includes several components, such as:

- ISIS schematic capture: This is a module of Proteus that allows users to create and edit schematics for electronic circuits. It supports a wide range of components and has a user-friendly interface.
- ARES PCB layout: This is another module that allows users to create and edit printed circuit board (PCB) layouts. It has a powerful auto router and a library of standard footprints.

- VSM simulation: This is a module of Proteus that allows users to simulate the behavior of electronic circuits. It supports both analog and digital simulations and can be used to verify circuit functionality and test designs before implementation.
- Proteus VSM SDK: This is a development kit that allows users to create their own simulation models and add them to Proteus.

Proteus is commonly used in the electronics industry for design and development of embedded systems and microcontroller-based projects. It is also used in education and research to teach and explore electronics and circuits.

3. Tinker cad :-

Tinker cad is a web-based 3D modeling software tool that allows users to create 3D designs using a simple and intuitive drag-and-drop interface. It is popular among hobbyists, educators, and students who want to create 3D models for 3D printing or other applications.

Tinker cad provides a range of features and tools for 3D design, including:-

- Basic shapes and primitives: Users can choose from a library of basic shapes and primitives such as cubes, spheres, cylinders, and cones to build their designs.
- Import/export functionality: Users can import existing 3D models in STL, OBJ, and other file formats or export their designs in STL or OBJ formats for 3D printing.
- Design tools: Tinker cad provides tools for editing and manipulating 3D objects such as resizing, rotating, mirroring, grouping, and aligning.
- Collaboration and sharing: Users can collaborate on designs with others by sharing design links or working on designs together in real-time.

Tinker cad is free to use and accessible through a web browser, making it easy for users to create 3D designs from anywhere with an internet connection.It is also beginner-friendly, making it an excellent tool for introducing 3D design to new users or for quick prototyping of simple designs

4. **MIT App Inventor: -**

App inventor is a web application integrated development environment originally provided by Google, and now maintained by the Massachusetts Institute of Technology (MIT). It allows newcomers to computer programming to create application software (apps) for two operating systems (OS): Android, and iOS.

It uses a graphical user interface (GUI) very similar to the programming languages Scratch and the Star Logo TNG user interface, which allows users to drag and drop visual objects to create an application that can run on mobile devices.

Chapter 3- Requirements and Analysis

3.1 Problem Definition: -

3.1.1 Problems with existing System: -

Due to rapid population and industrial growth, non-renewable resources are being depleted at an alarming pace. With coal, oil, and gas projected to run out in 35 to 42 years, alternative renewable energies are increasingly researched and implemented in global society. This has become a threat for our Future generations.

The Problem with the existing system can be minimized and we can use it as a smart gadget and bring efficiency and ease to our way of living.

3.1.2 Proposed System: -

- This project can be extended in future studies in order to improve the system in various aspects such as this project can be used vastly in the labs of biotechnology and hybridization of plants, where the temperature and humidity of an herb or a hybridized plant is measured very keenly. Now one can check on the app anytime if we detect any changes
- Our project also waters a plant whenever the moisture of the plant goes low so the farmers who can spend some money can buy our project and use it in their farms.

3.2 Feasibility Study

3.2.1 Operational Feasibility:

- In terms of feasibility, soil monitoring systems are becoming increasingly cost-effective and accessible due to advancements in sensor technology and wireless communication. Wireless sensors can be installed directly in the soil to collect data and transmit it to a central database or application for analysis. This enables real-time monitoring and analysis of soil conditions, which can help inform decision-making processes related to irrigation, fertilization, and soil conservation.
- Moreover, these systems are also becoming more user-friendly, with many systems now offering easy-to-use interfaces for data visualization and analysis. This allows farmers, researchers, and other stakeholders to access and interpret soil data more easily, making it possible to make informed decisions and take appropriate action.
- Overall, soil monitoring systems are a feasible solution for improving soil management practices and addressing environmental challenges. With the increasing availability of affordable sensor technology and wireless communication, soil monitoring systems will continue to become more accessible and useful for a wider range of applications.

3.2.2 Economical Feasibility:

- The cost of a soil monitoring system can vary depending on several factors, such as the number and type of sensors used, the complexity of the system, and the size of the area being monitored.
- Basic soil monitoring systems that measure soil moisture, temperature, and other basic parameters can cost anywhere from a few hundred to a few thousand dollars. More advanced systems that include sensors for multiple parameters and cover larger areas can cost tens of thousands of dollars.
- In addition to the initial cost of purchasing the system, there may be ongoing costs associated with maintenance, calibration, and data management. These costs can vary depending on the system and the level of support provided by the manufacturer.
- However, it's important to consider the potential benefits of a soil monitoring system, such as improved crop yields, reduced water and fertilizer use, and more efficient use of resources. In many cases, the cost of a soil monitoring system can be recouped through these benefits over time.
- Overall, the cost of a soil monitoring system is an important consideration, but it should be balanced against the potential benefits and the long-term value of the system for soil management and sustainability.

3.3 Requirement Specification.

3.3.1 Functional Requirements

Authentication/ User Account	
Req01	Smartphones.

Application	
Req02	Set a temperature limit
Req03	Connect via Bluetooth

Req04	Monitor your plant
Req05	Internet connection

Non-Functional Requirements

1. Performance Requirement:

- Performance is measured in terms of the output provided by the application. Requirement specification plays an important part in the analysis of a system.
- Only when the requirement specifications are properly given, it is possible to design a system, which will fit into required specifications because they are the people who finally use the system.
- This is because the requirements have to be known during the initial stages so that the system can be designed according to those requirements. It is very difficult to change the system once it has been designed and on the other hand designing a system, which does not cater to the requirements to the user, is of no use. The requirement specification for any system can be broadly stated as given below:
- The system should be able to interface with the existing system.
- The system should be accurate.

2. Reliability:

• In this system reliability means the user should get the agile responses.

3. Integrity:

• The temperature and humidity recorded should be correct and the pump should water the plants when required.

4. Availability:

• The Application data i.e. temperature and humidity accessible to the User anytime.

5. Usability:

• The system should handle the complex technical details automatically and provide a simplified interface to the user.

6. Efficiency:

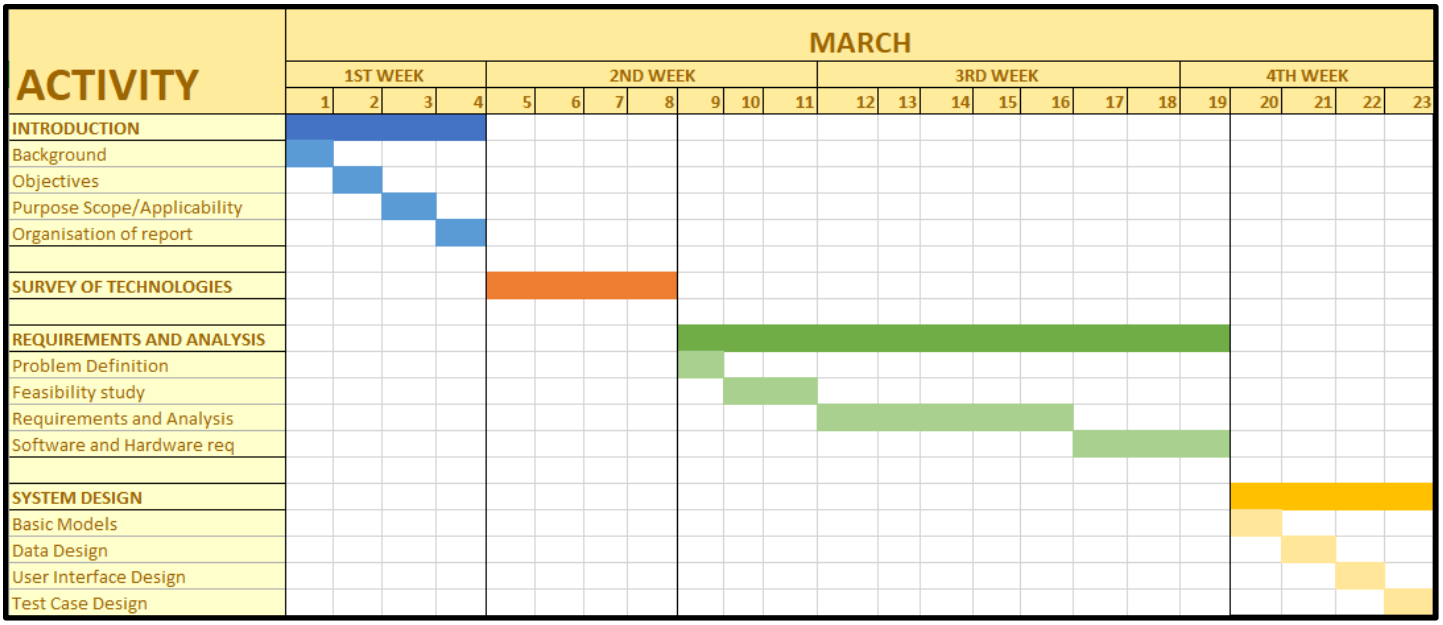
• The Arduino doesn't require much power, the Bluetooth module used in the system hardware will not consume much power so the device used will be longer.

7. Reusability:

• The components and modules are to be selected and designed so as to be reused when the system

3.4 Planning and Scheduling

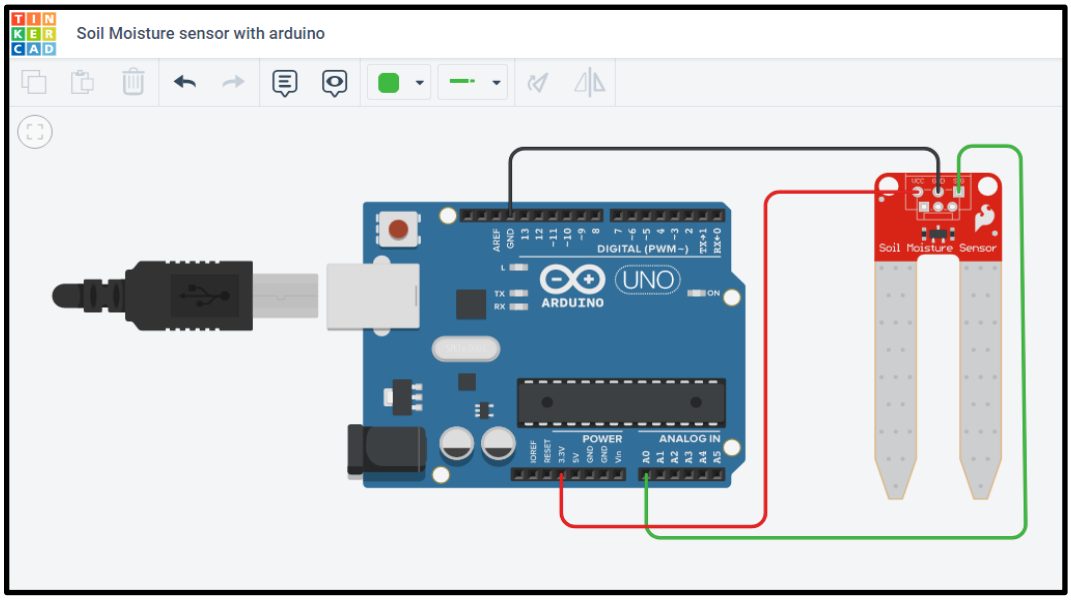
- Planning and scheduling is a convoluted piece of programming advancement.
- Planning: Planning, can be thought as deciding all the little errands that must be completed so as to achieve the objective. Planning additionally considers rules, known as requirements, which control when certain errands can or can't occur.
- Scheduling: Scheduling can be thought as deciding if sufficient assets are accessible to complete the arrangement. Legitimate Gantt graph and Program Evaluation Review Technique of the venture is demonstrated as follows.

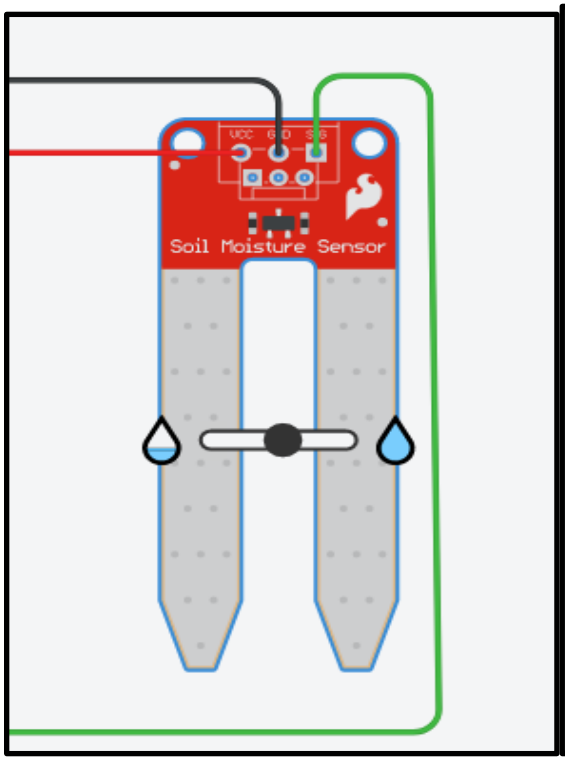


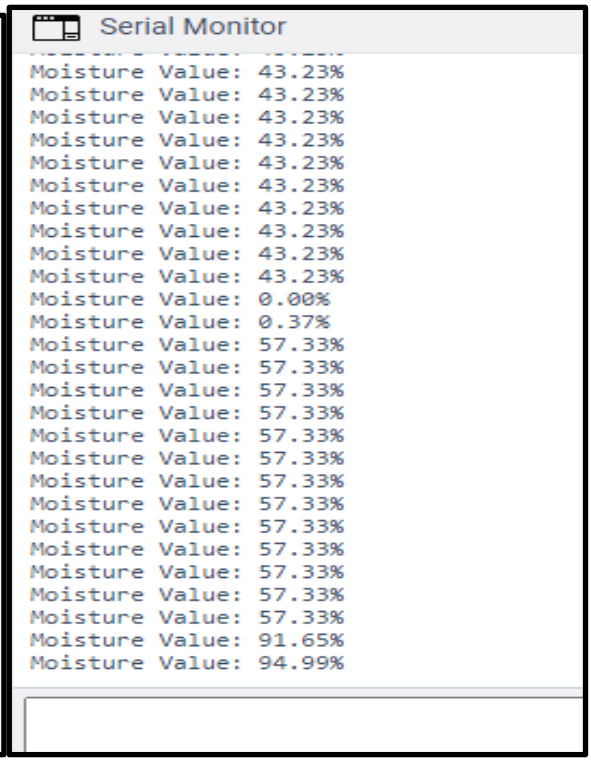
GANTT CHART

CHAPTER 4: SYSTEM DESIGN

4.1 BLOCK DIAGRAMS IN TINKERCAD





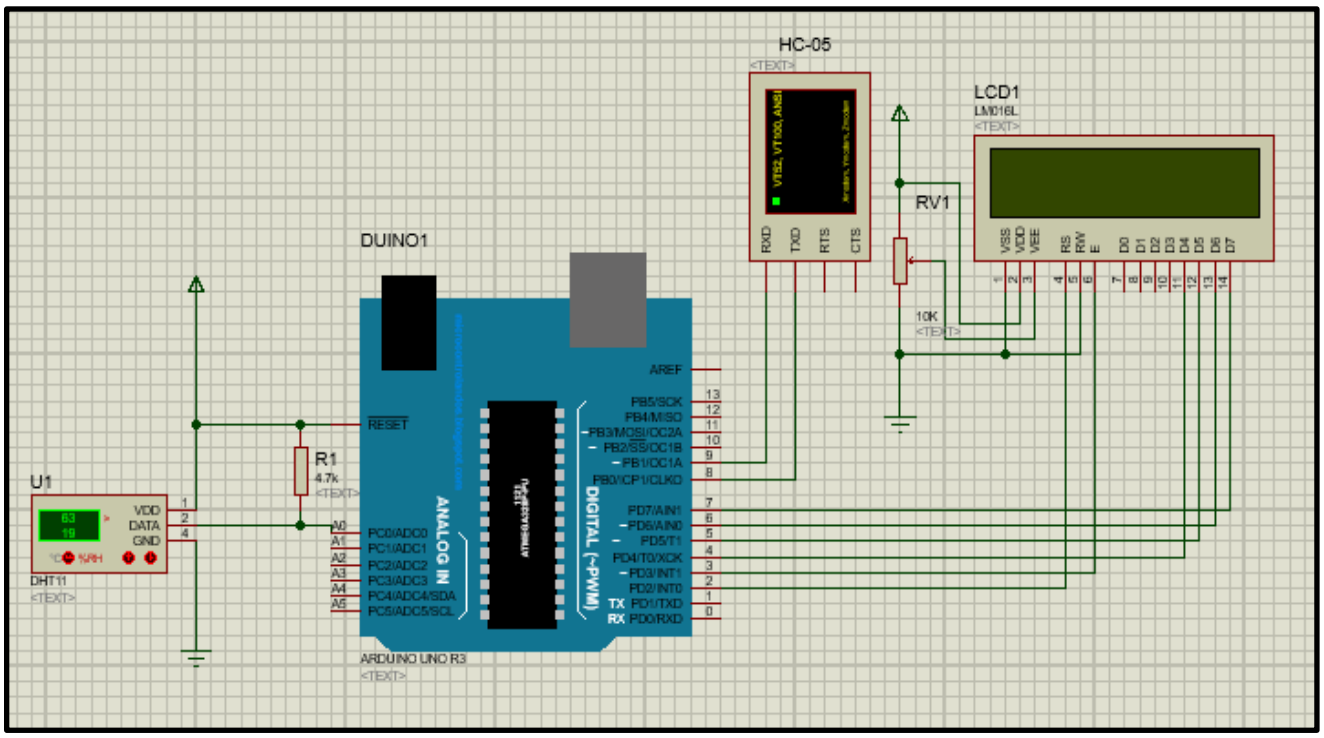


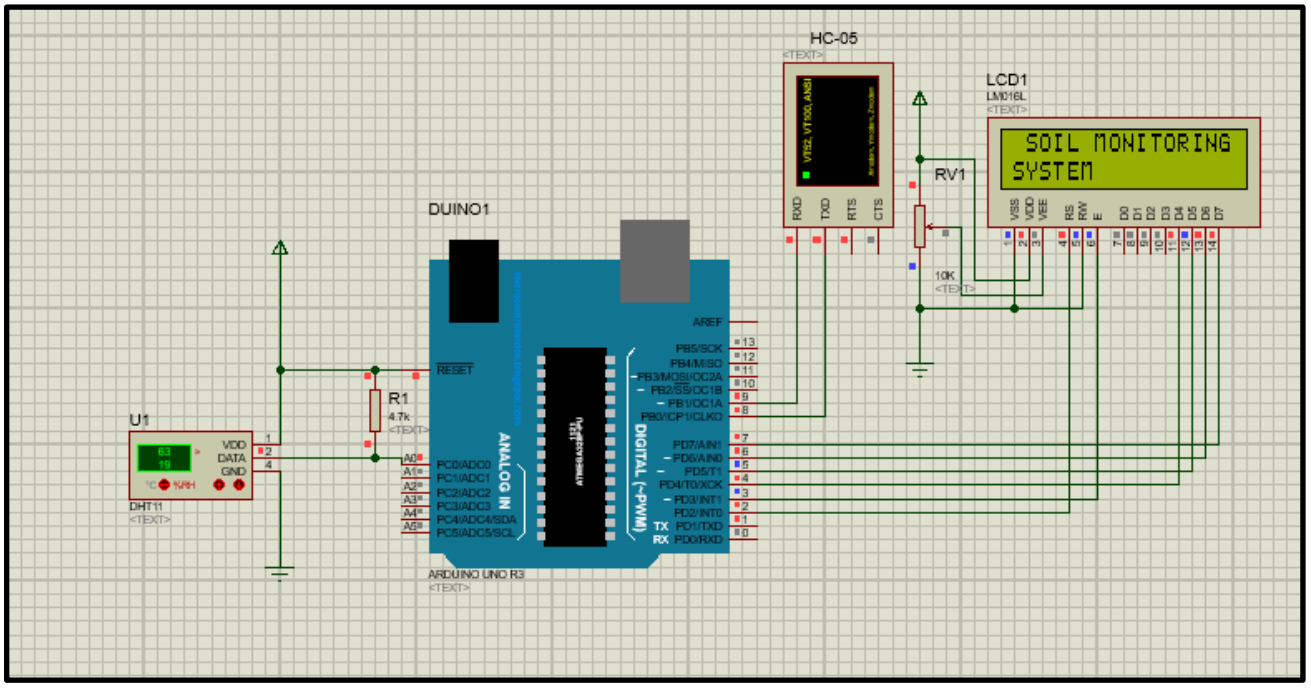
Video Simulation:

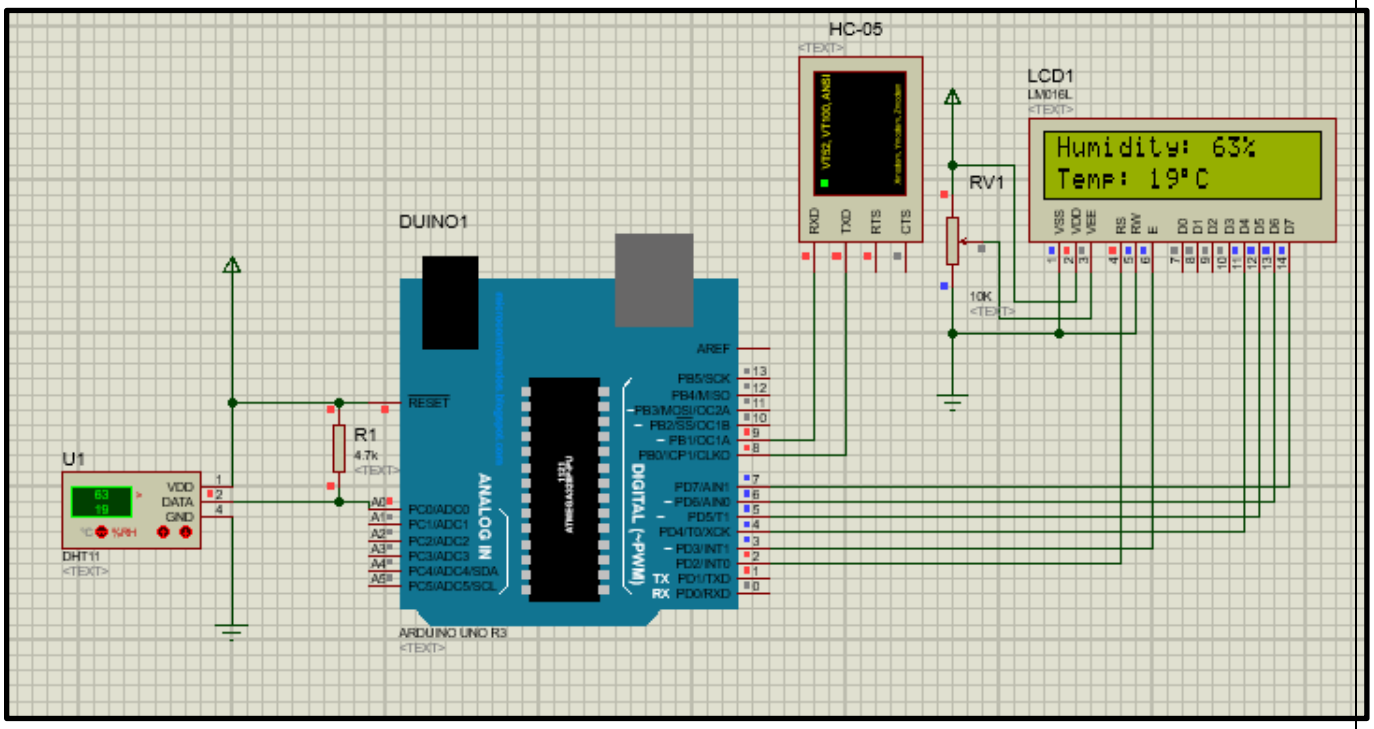
https://drive.google.com/file/d/1TZwoWoAKn7GeWLQ2Ign07D1UiUyGHUUv/view?usp=share_l

ink

4.2 BLOCK DIAGRAMS IN PROTEUS.



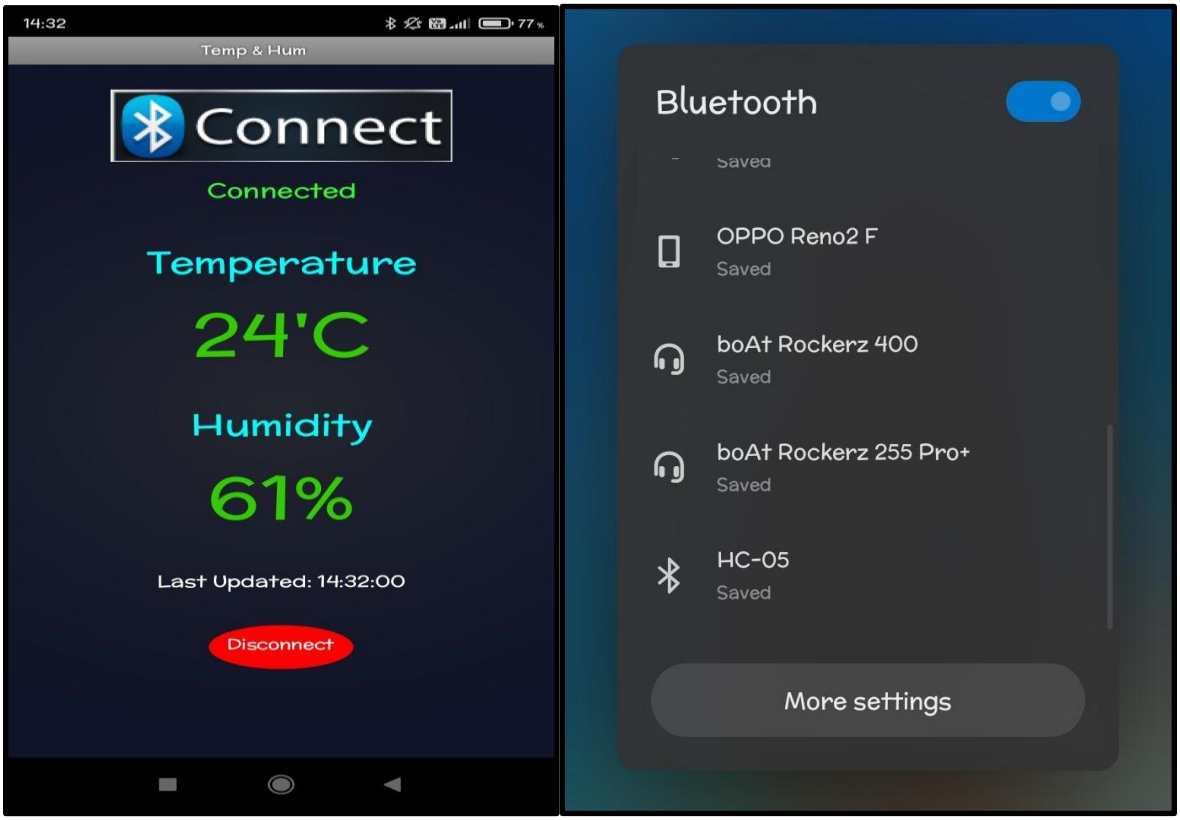




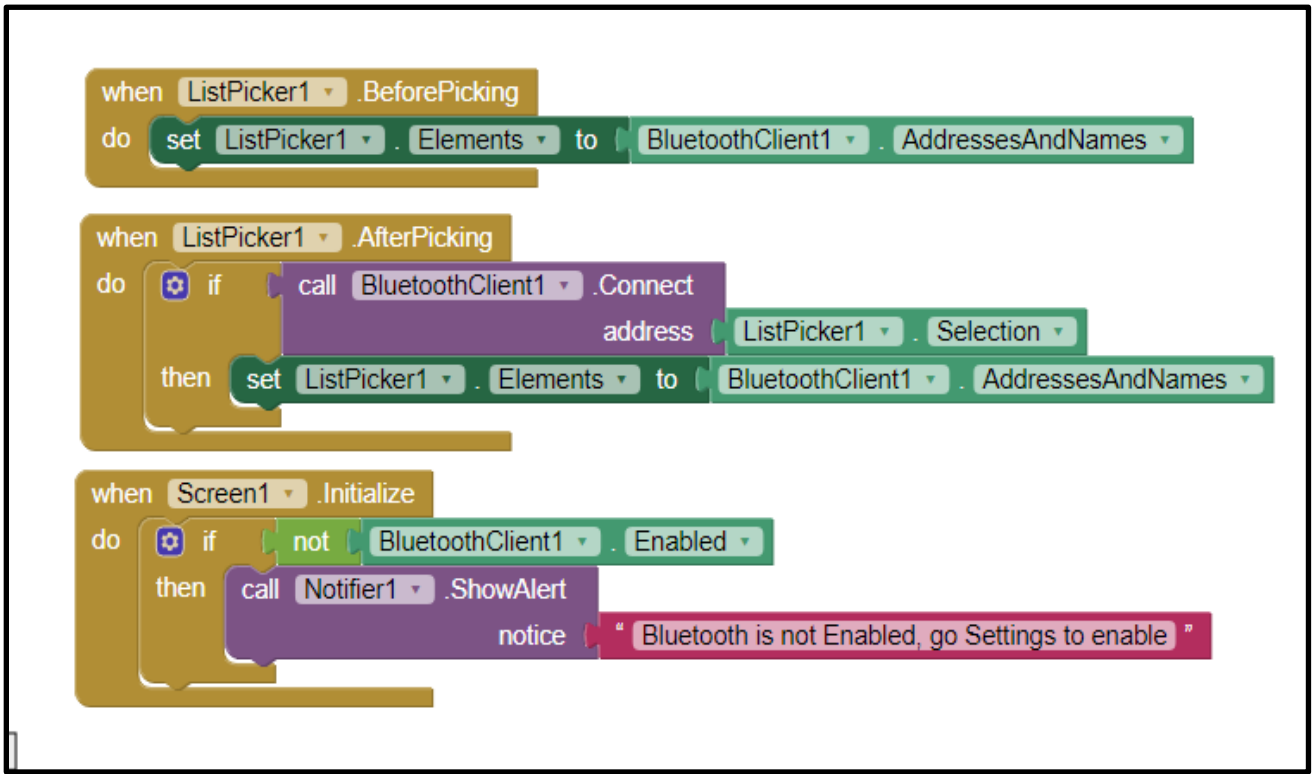
Video Simulation:

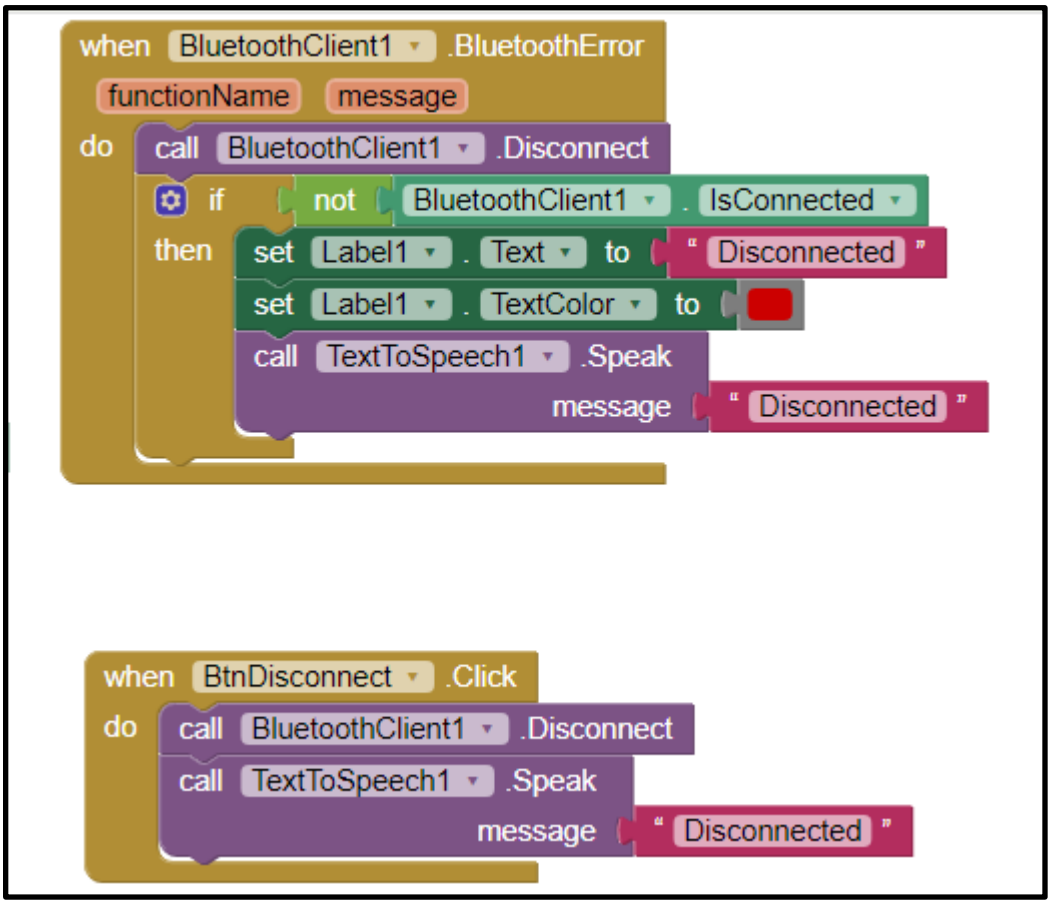
https://drive.google.com/file/d/1LvtlTWgP6ANXyaZbgAJhbuMtl39nrjkI/view?usp=sharing

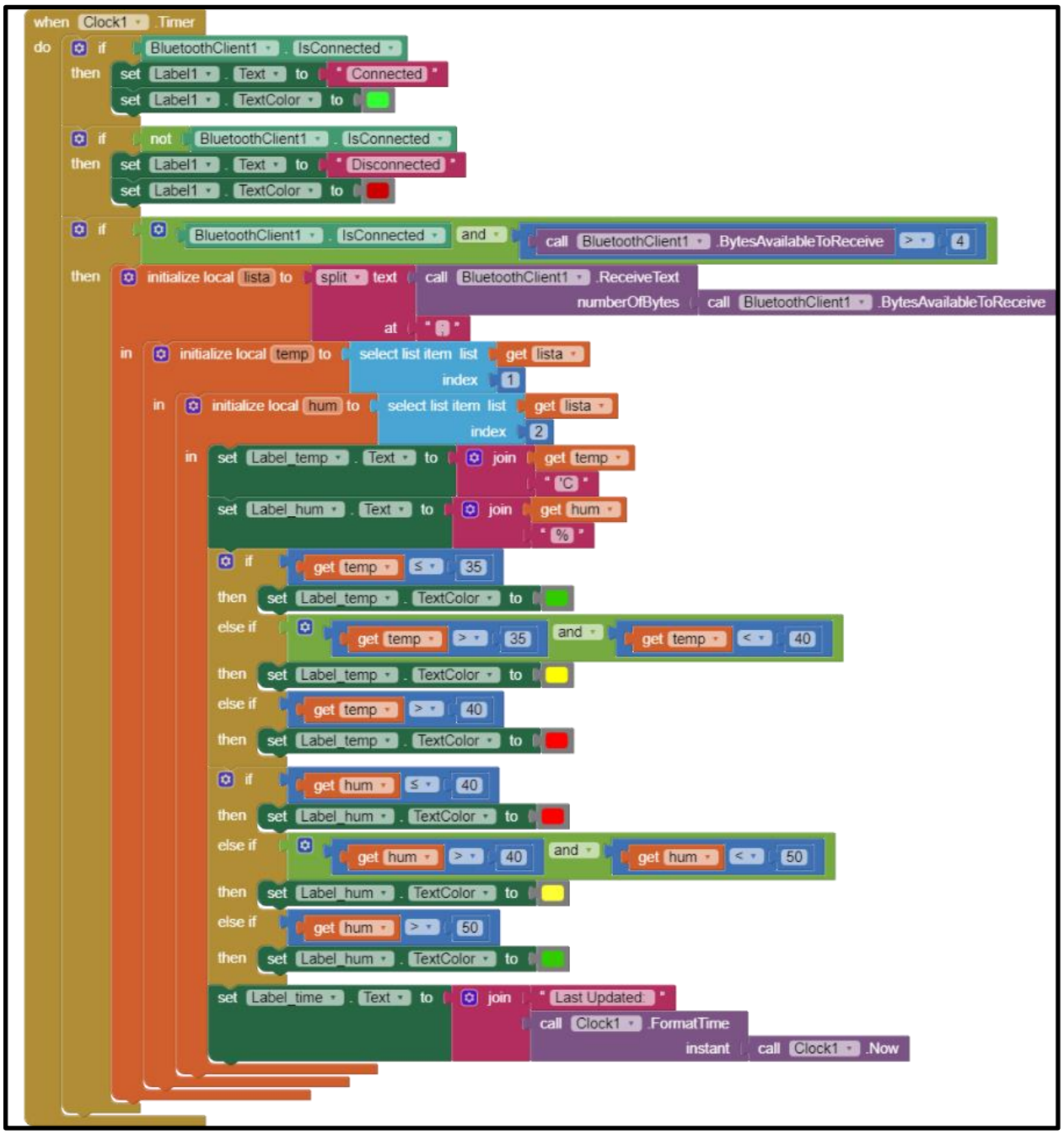
4.3 MIT APP INTERFACE:



BLOCK DIAGRAMS:

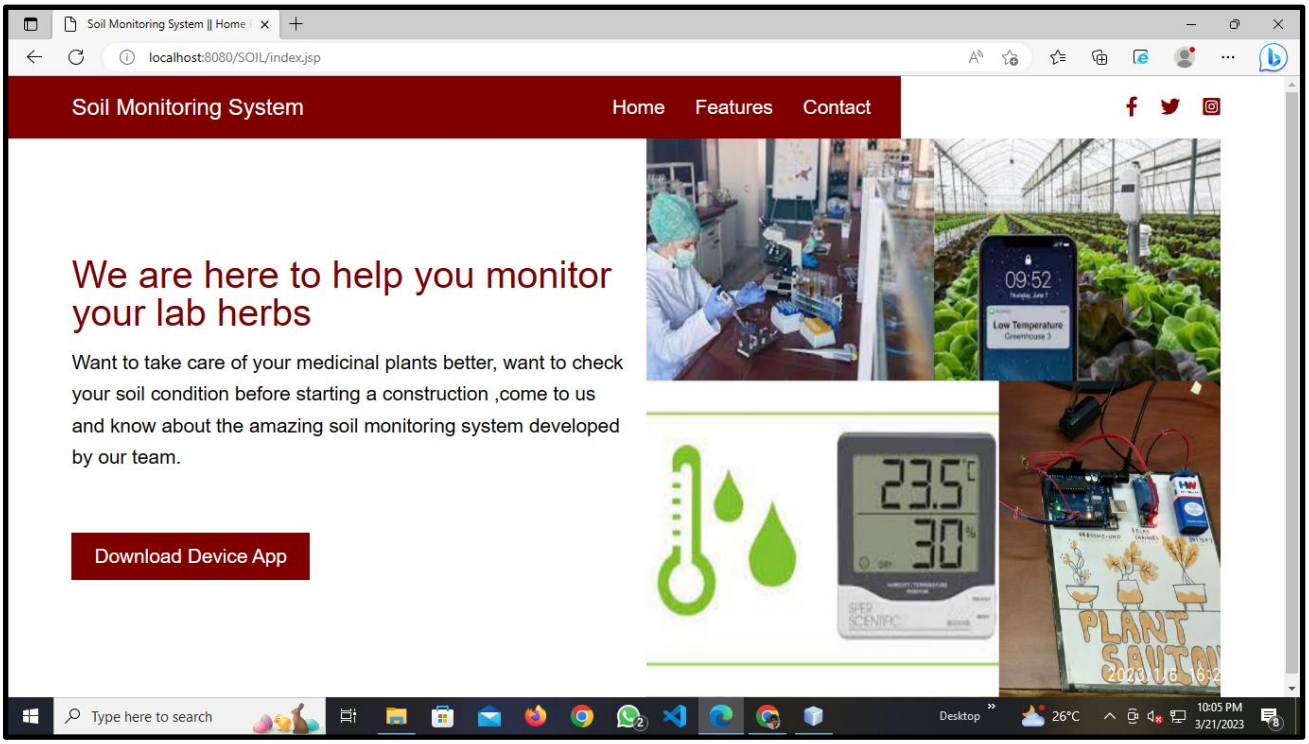



when BluetoothClient1 .BluetoothError
functionName message
do call BluetoothClient1 .Disconnect
if not BluetoothClient1 . IsConnected
then set Label1 . Text to " Disconnected "
set Label1 . TextColor to
call TextToSpeech1 .Speak
message " Disconnected "
when BtnDisconnect .Click
do call BluetoothClient1 .Disconnect
call TextToSpeech1 .Speak
message " Disconnected "

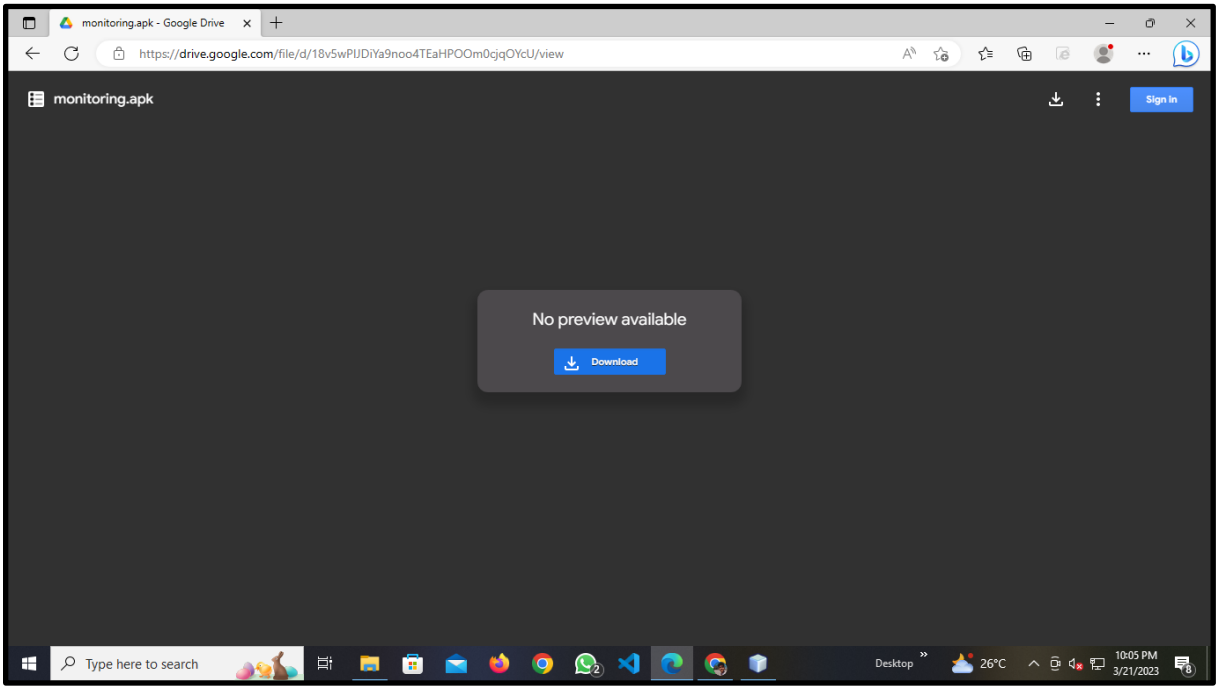

when Clock1 .Timer
do if BluetoothClient1 . IsConnected
then set Label1 . Text to " Connected "
set Label1 . TextColor to
if not BluetoothClient1 . IsConnected
then set Label1 . Text to " Disconnected "
set Label1 . TextColor to
if BluetoothClient1 . IsConnected and call BluetoothClient1 .BytesAvailableToReceive > 4
then initialize local lista to split text call BluetoothClient1 .ReceiveText
numberOfBytes call BluetoothClient1 .BytesAvailableToReceive
at " , "
in initialize local temp to select list item list get lista
index 1
in initialize local hum to select list item list get lista
index 2
in set Label_temp . Text to join get temp
" °C "
set Label_hum . Text to join get hum
" % "
if get temp ≤ 35
then set Label_temp . TextColor to
else if get temp > 35 and get temp < 40
then set Label_temp . TextColor to
else if get temp > 40
then set Label_temp . TextColor to
if get hum ≤ 40
then set Label_hum . TextColor to
else if get hum > 40 and get hum < 50
then set Label_hum . TextColor to
else if get hum > 50
then set Label_hum . TextColor to
set Label_time . Text to join " Last Updated: "
call Clock1 .FormatTime
instant call Clock1 .Now

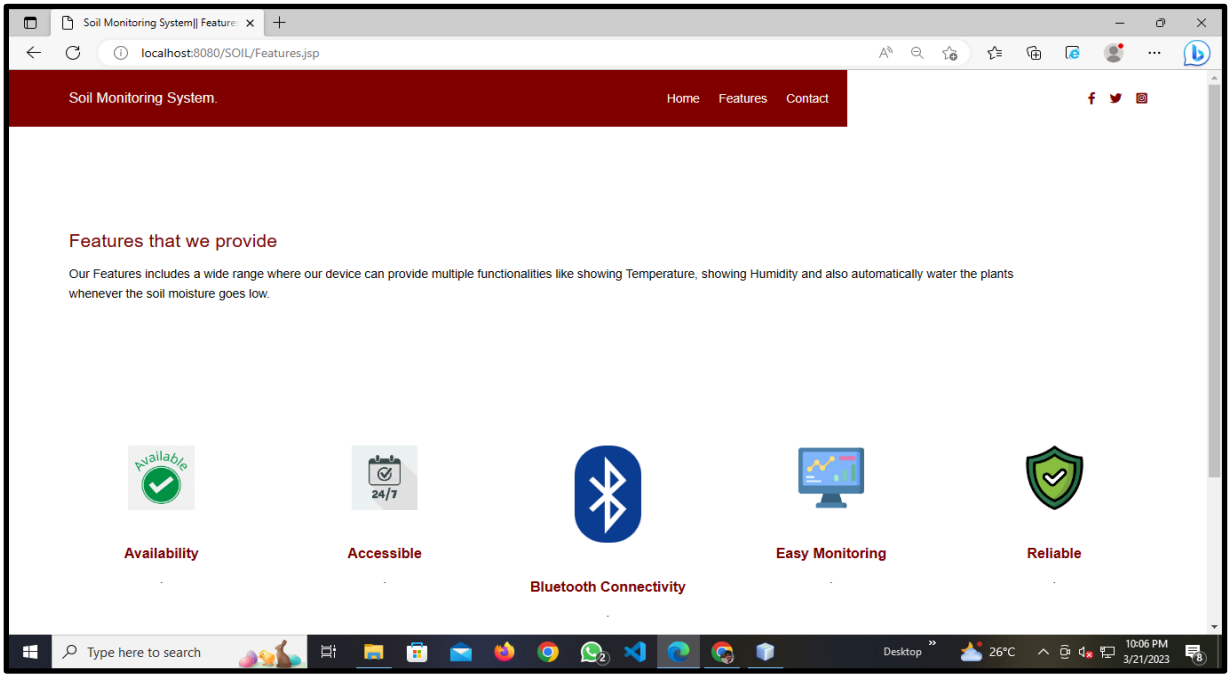
4.4 WEBSITE WITH JDBC CONNECTIVITY FOR CUSTOMER QUERY.

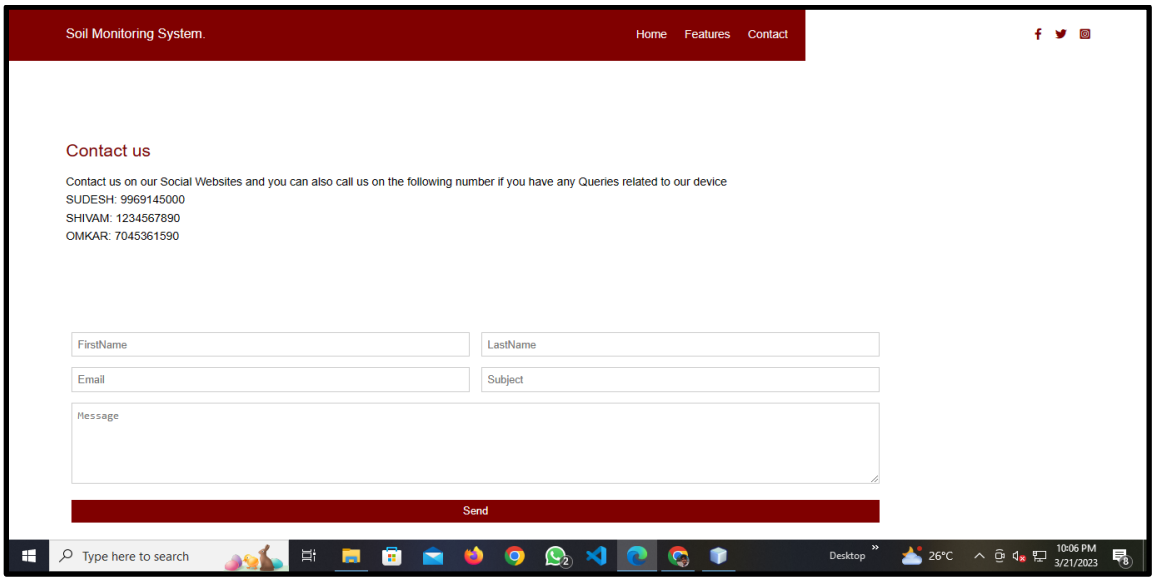
WEBSITE INTERFACE:



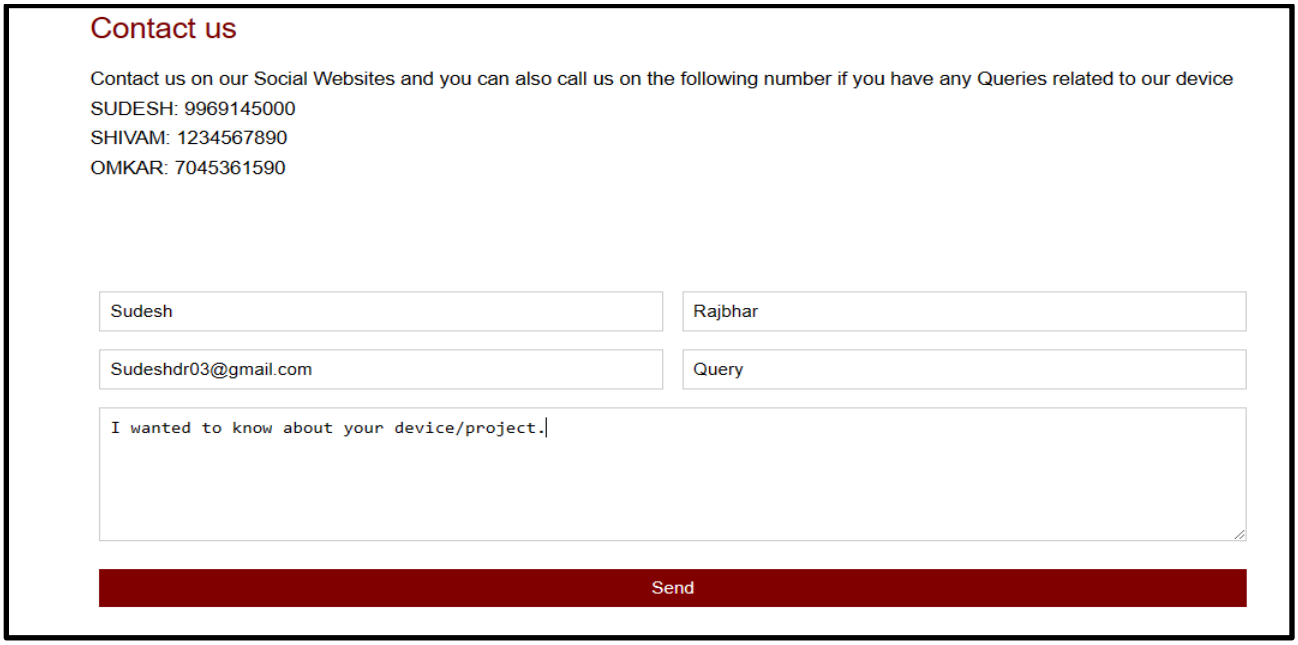
Main Page containing little information about project and link for two other pages Features and Contact, Each of the three pages contains our social links. If you can see the above page also contains a download button that leads to our app of temperature and humidity measuring as shown below,


monitoring.apk - Google Drive
https://drive.google.com/file/d/18v5wPIJDiYa9noo4TEaHPOOm0cjqOYcU/view
monitoring.apk
Sign In
No preview available
Download
Type here to search
Desktop
26°C
10:05 PM
3/21/2023


Soil Monitoring System|| Feature
localhost:8080/SOIL/Features.jsp
Soil Monitoring System.
Home
Features
Contact
Features that we provide
Our Features includes a wide range where our device can provide multiple functionalities like showing Temperature, showing Humidity and also automatically water the plants whenever the soil moisture goes low.
Availability
Accessible
Bluetooth Connectivity
Easy Monitoring
Reliable
Type here to search
Desktop
26°C
10:06 PM
3/21/2023



When a customer will send its data/query to us by clicking the send button his/her data will be stored in our database



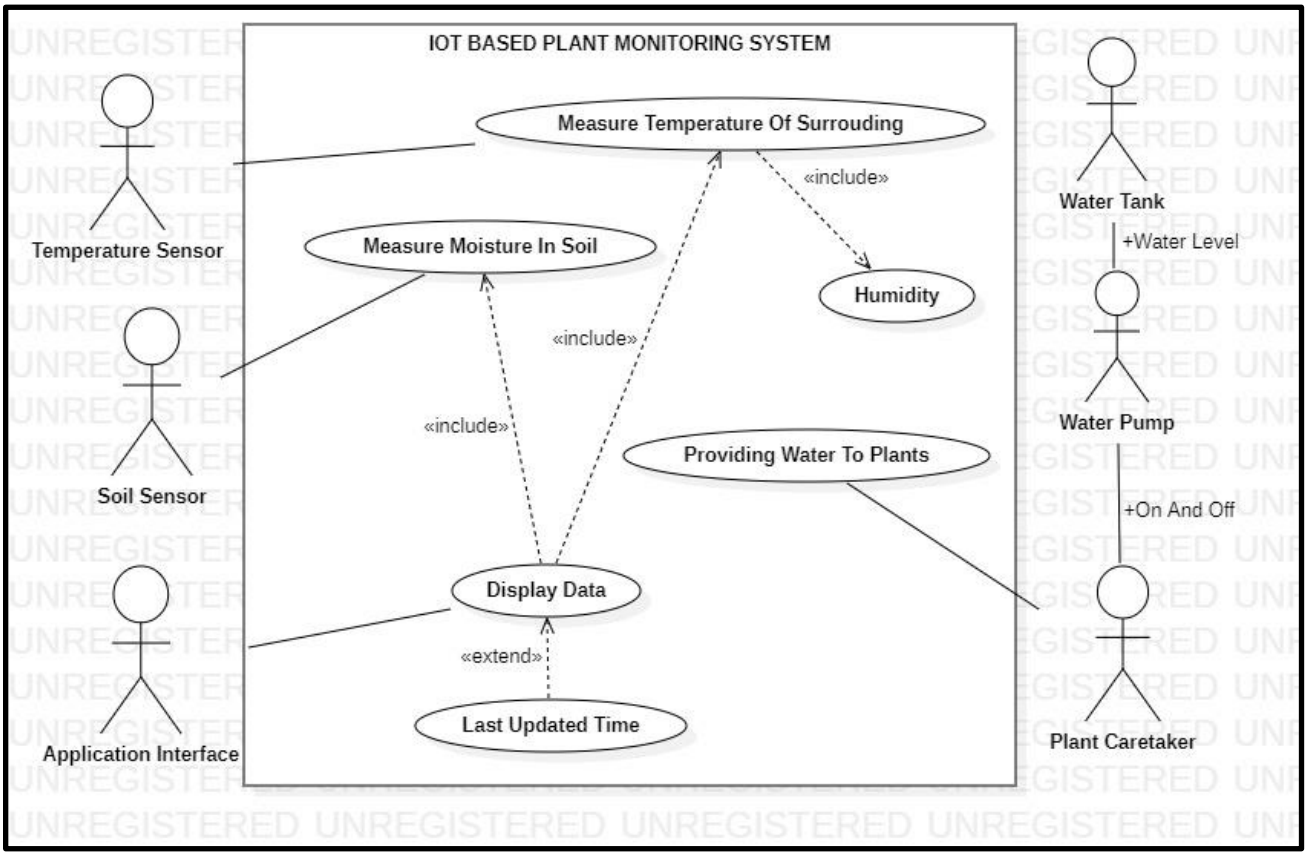
Below is our database;

```
mysql> select *from info;
+-----------+----------+----------------------+---------+-------------------------------------
| FirstName | LastName | Email                | Subject | Message
+-----------+----------+----------------------+---------+-------------------------------------
| Sudesh    | Rajbhar  | Sudeshdr03@gmail.com | Query   | I wanted to know about your project
```

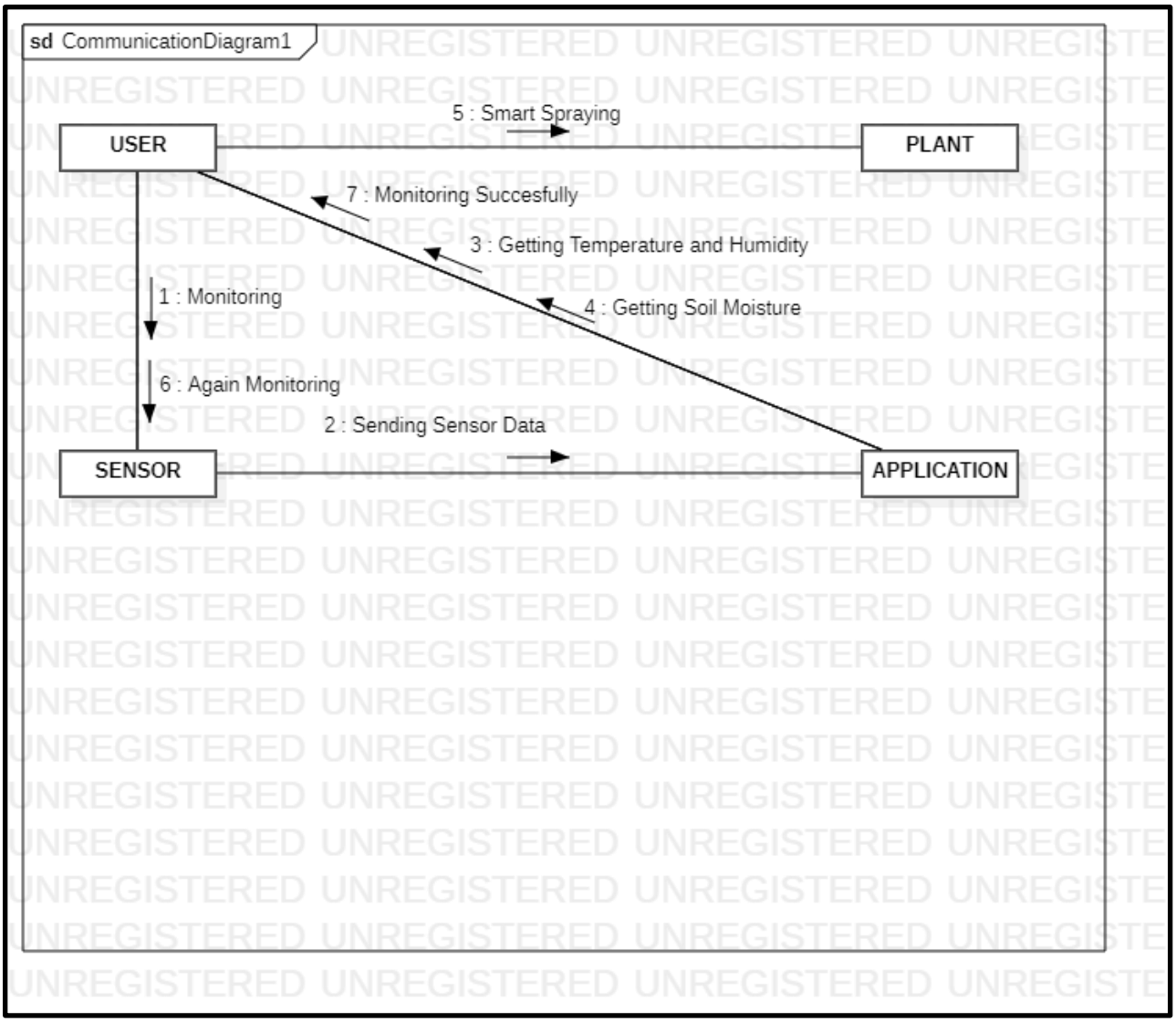
We created a Database named data and a table named info inside our sq. client to get our data stored there.

4.5 UML DIAGRAMS

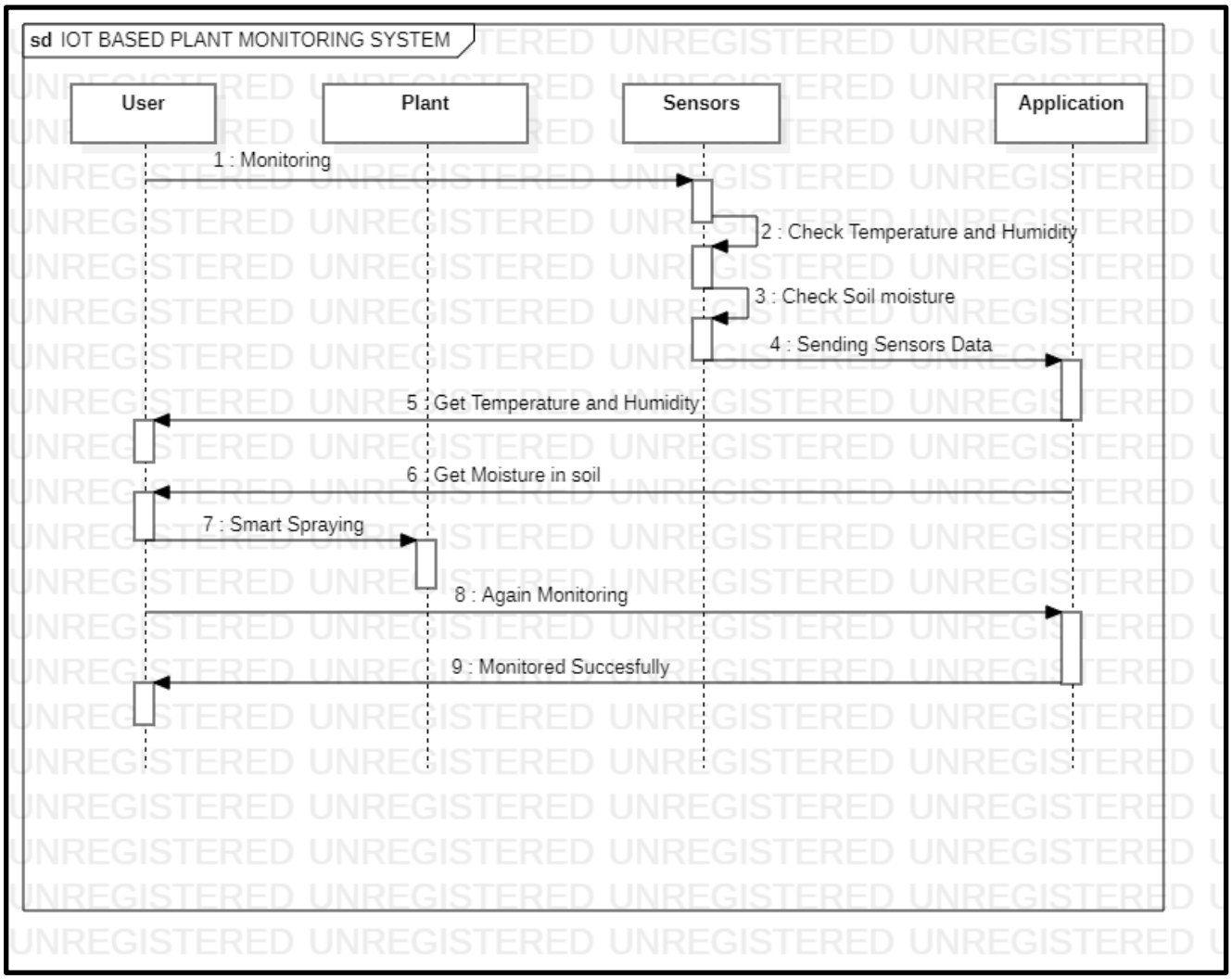
1. USE CASE DIAGRAM/IOT:-



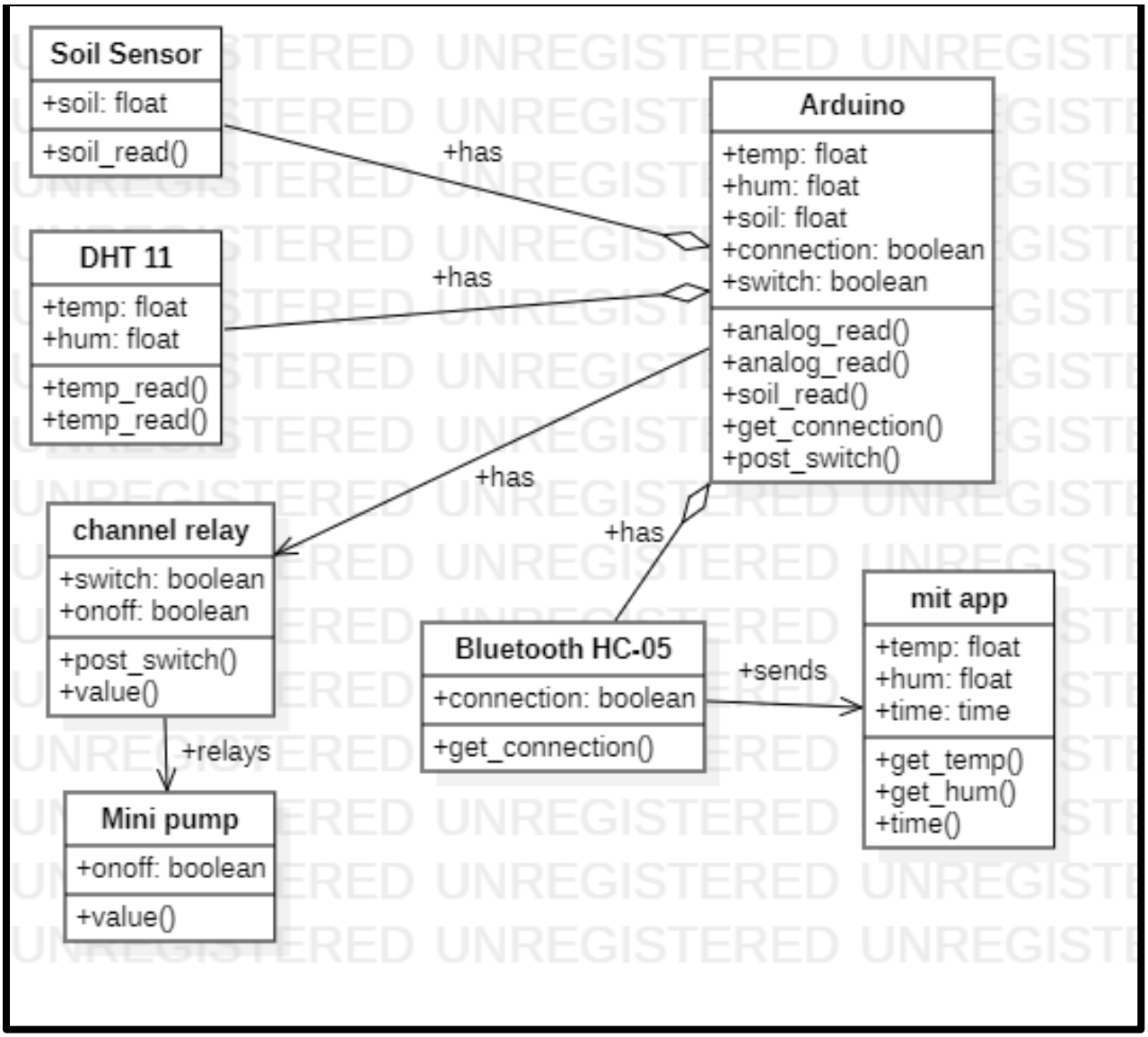
2. COLLABORATION DIAGRAM/IOT:-



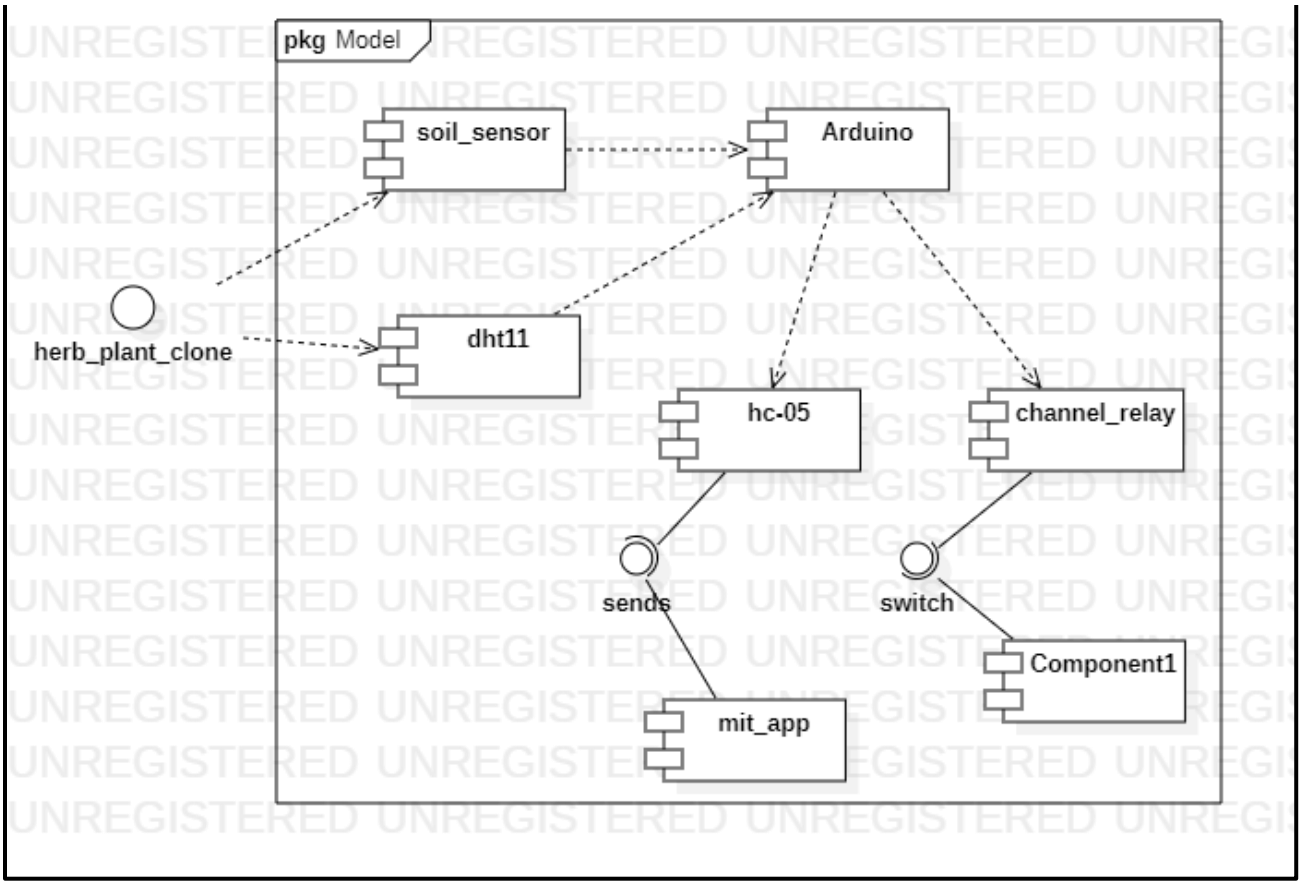
3. SEQUENCE DIAGRAMS/IOT:-



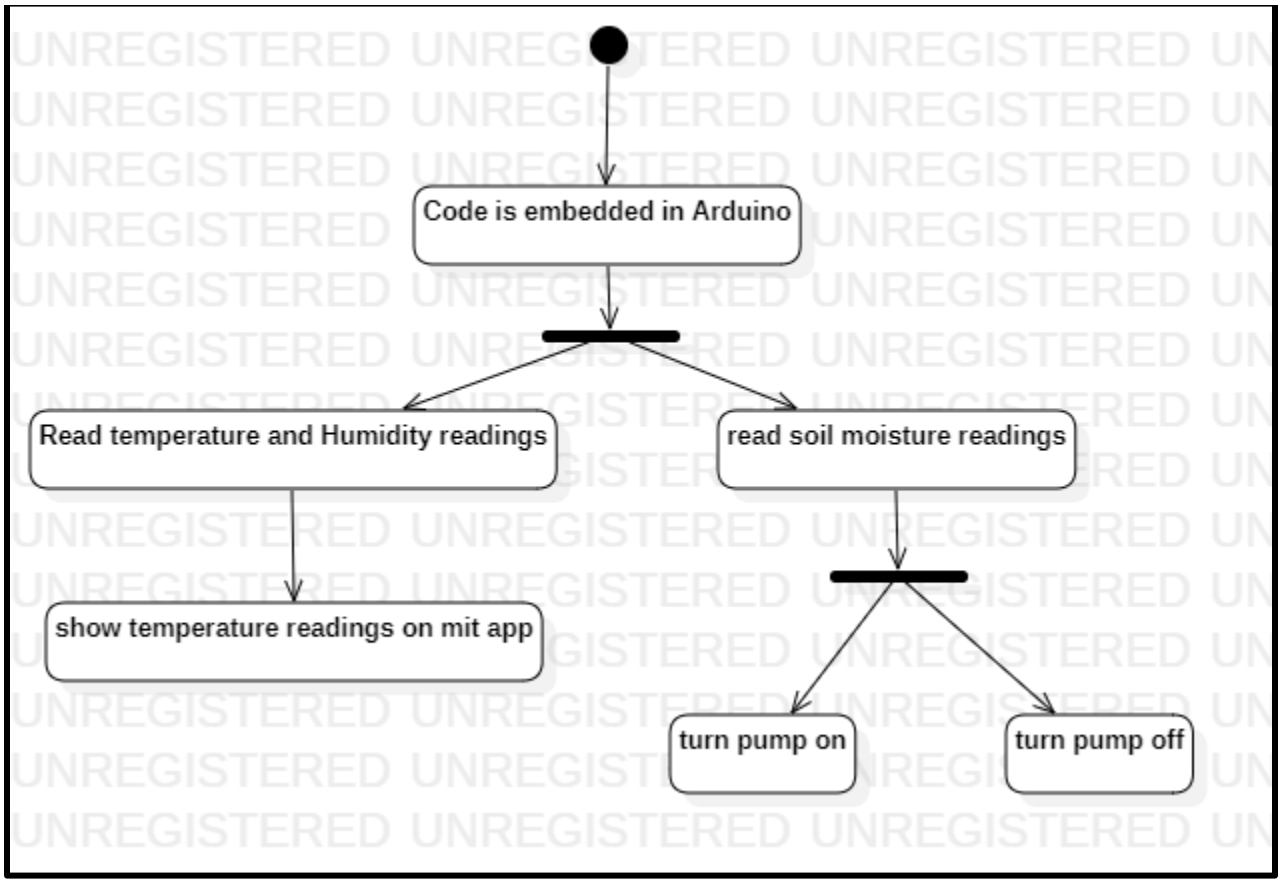
4. CLASS DIAGRAM/IOT:



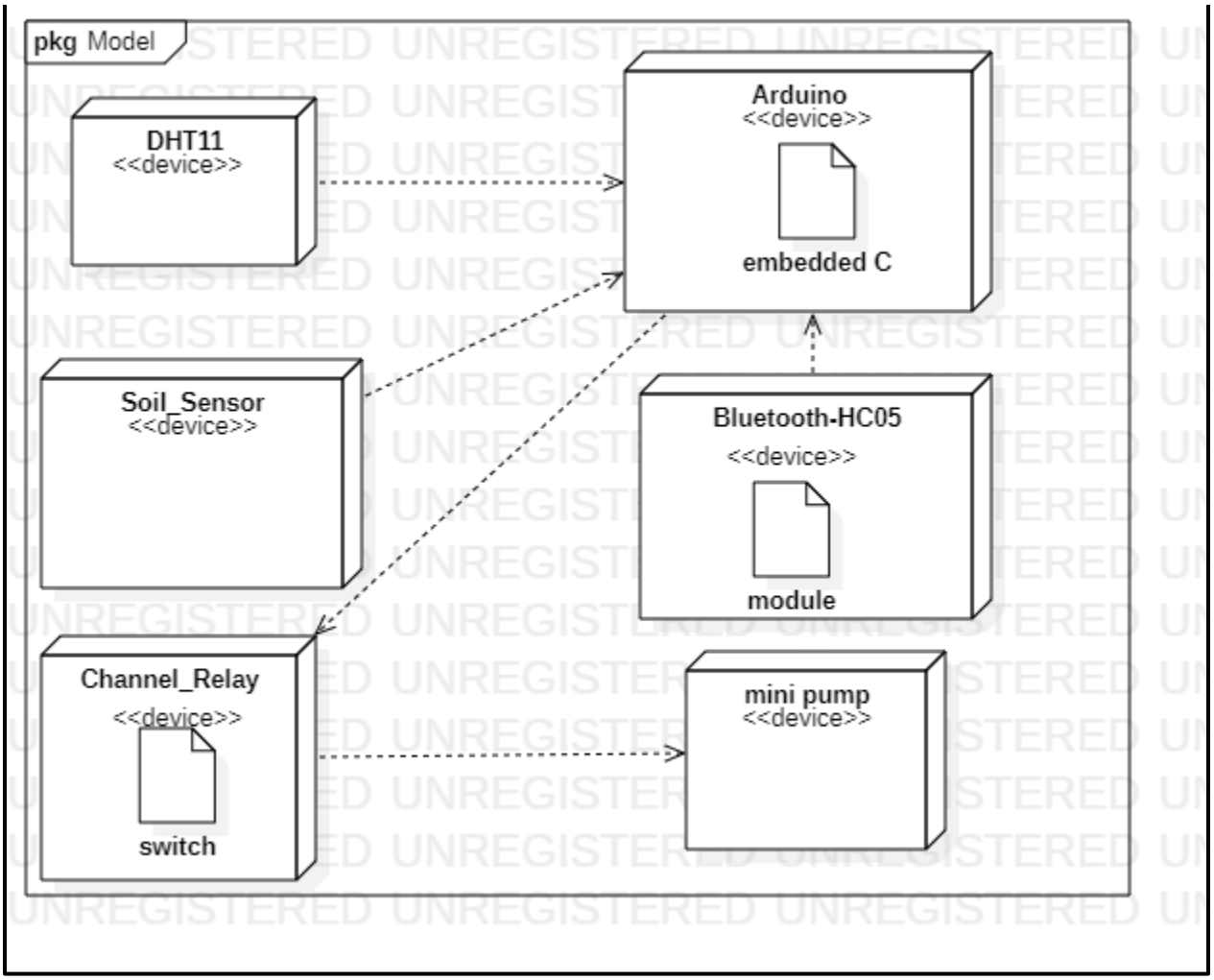
5. COMPONENT DIAGRAM/IOT:



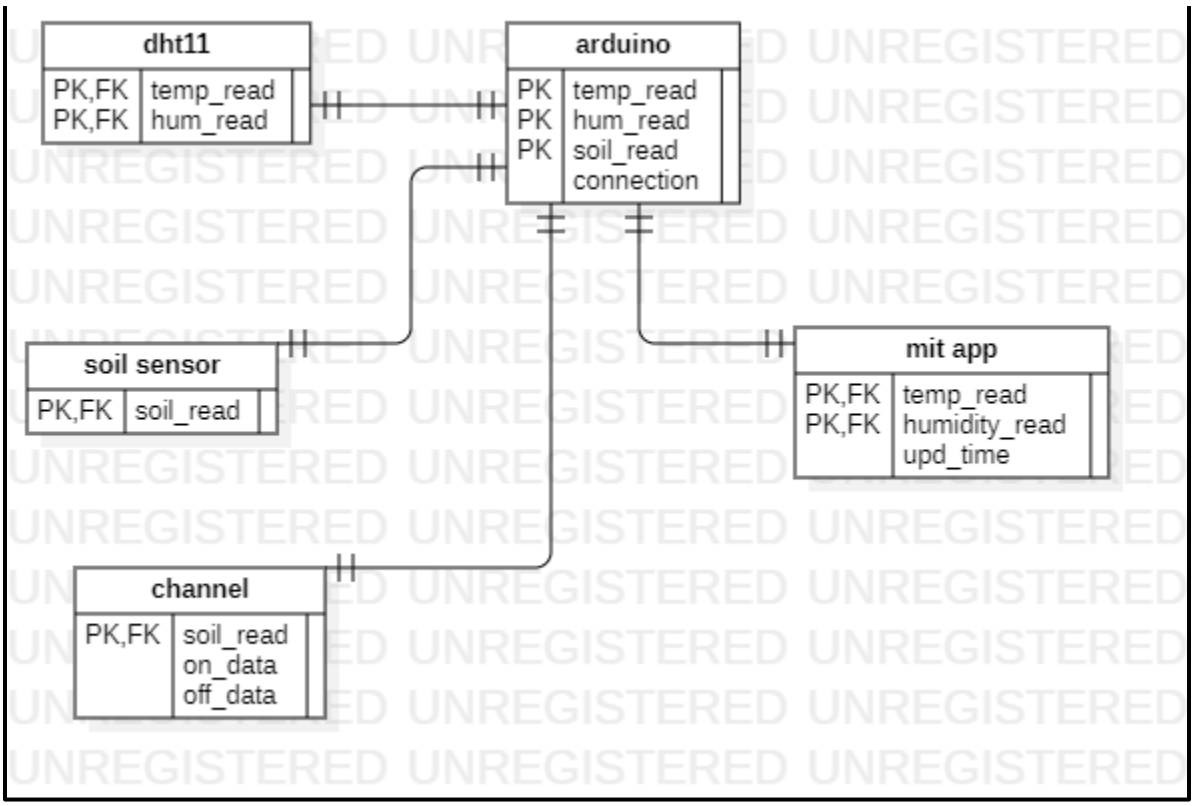
6. STATECHART DIAGRAM/IOT:



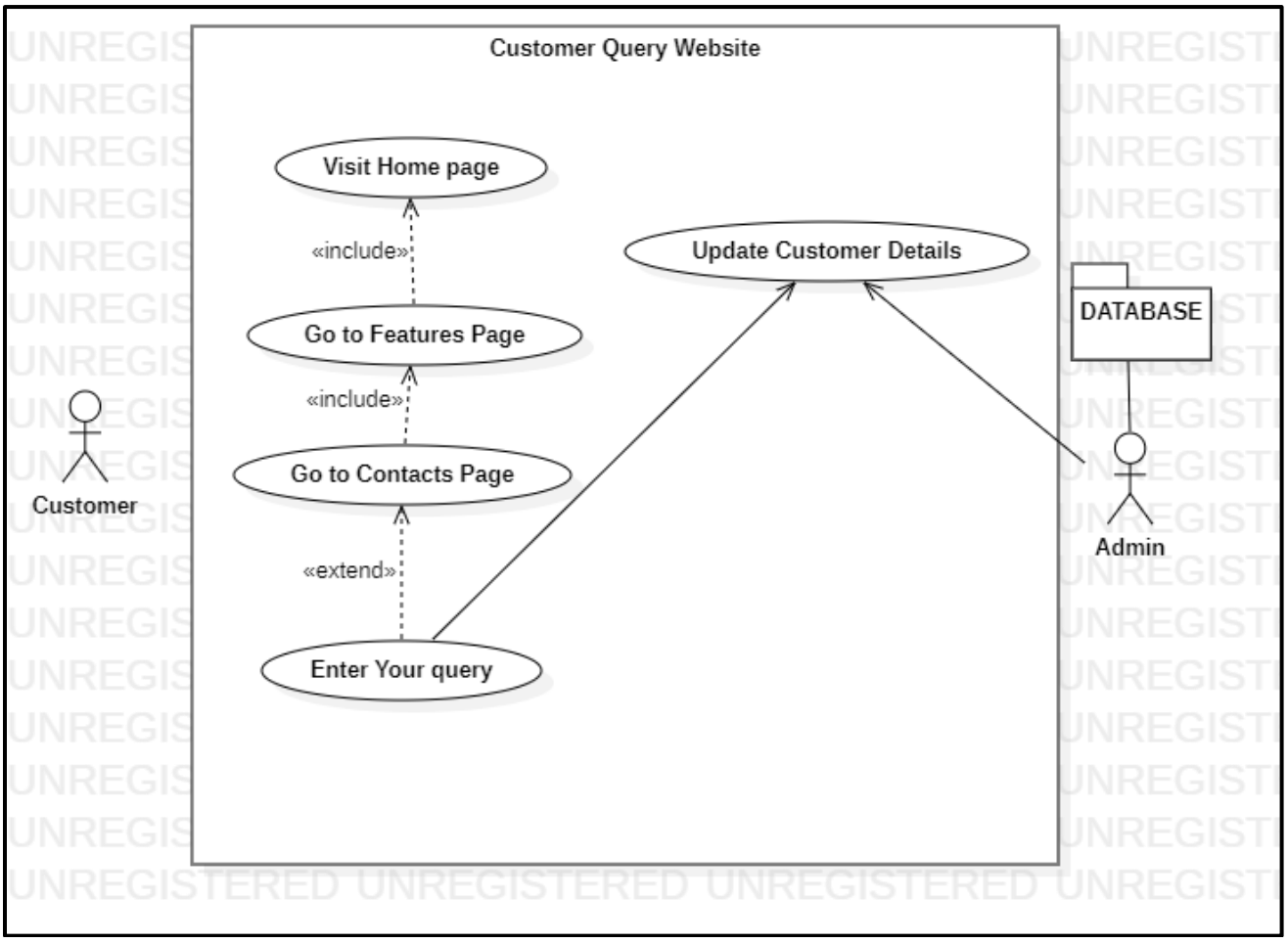
7. DEPLOYMENT DIAGRAM/IOT:



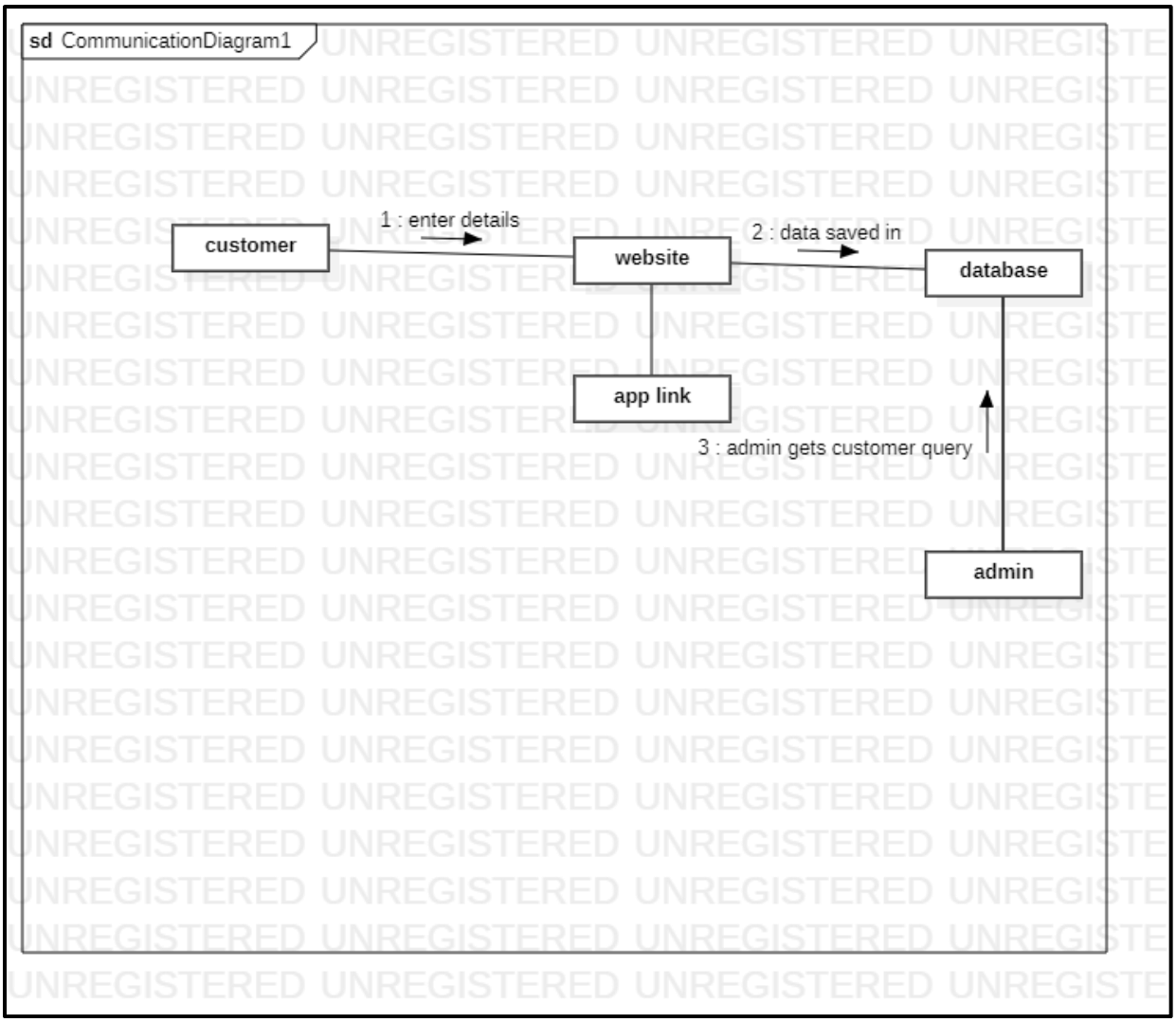
8. ER Diagram/IOT:



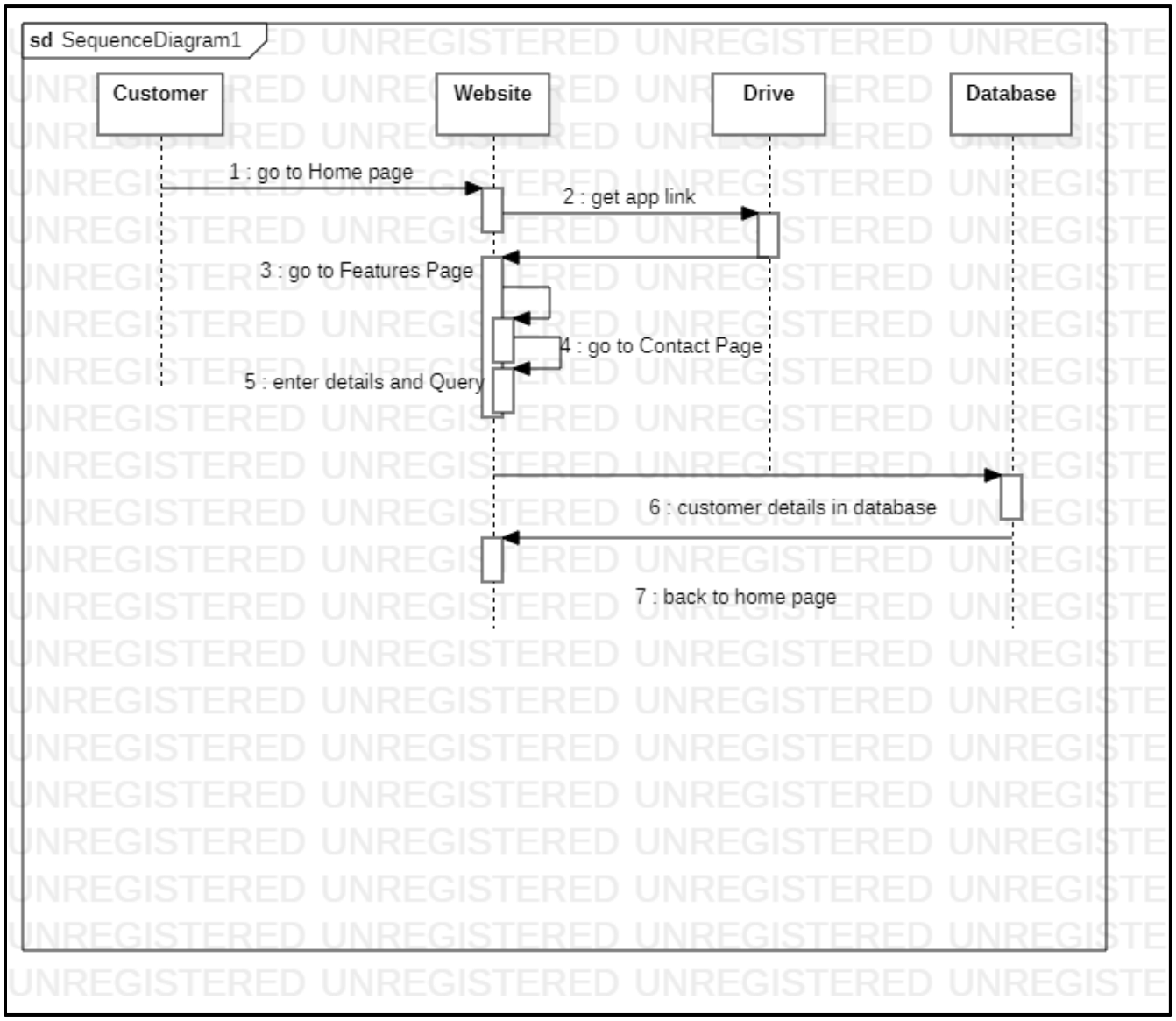
1. USE CASE DIAGRAM/WEBSITE:-



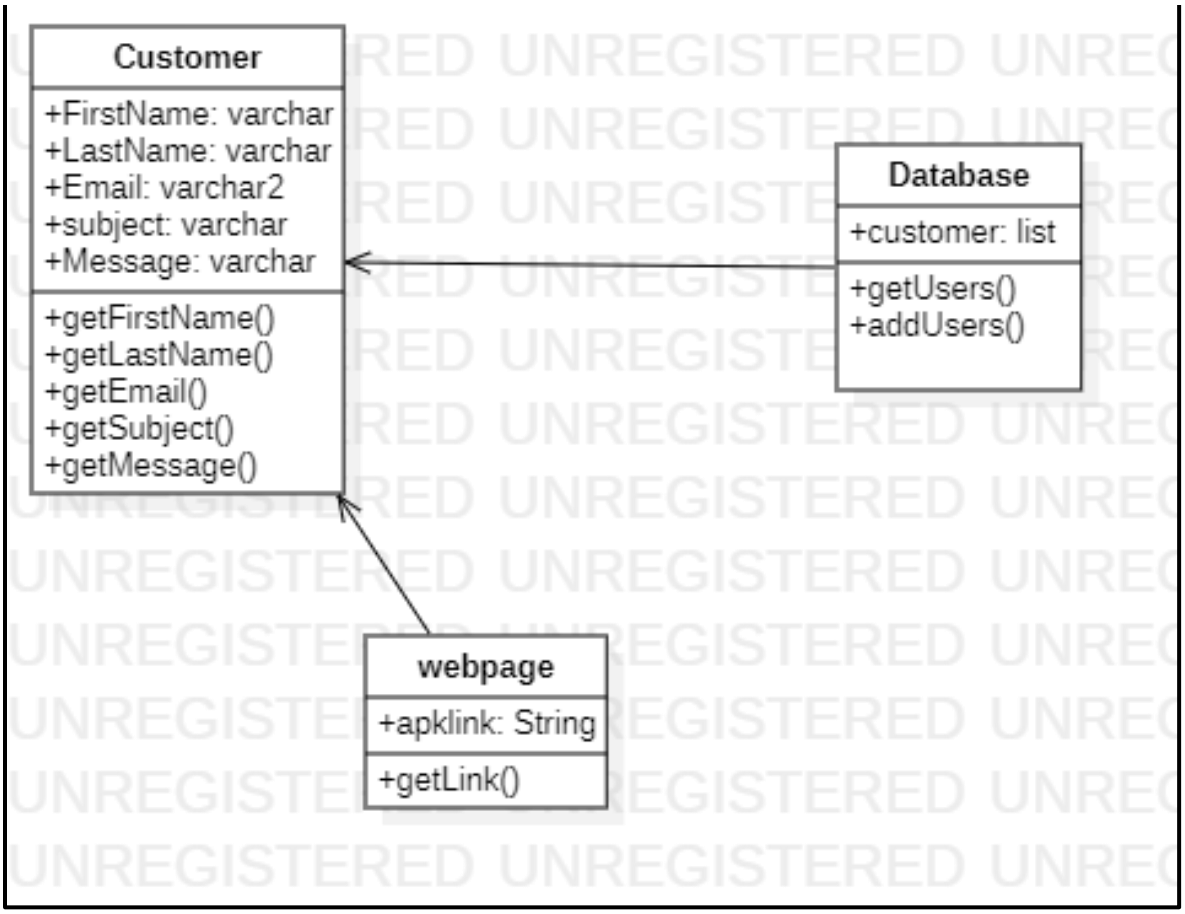
2. COLLABORATION DIAGRAM:-



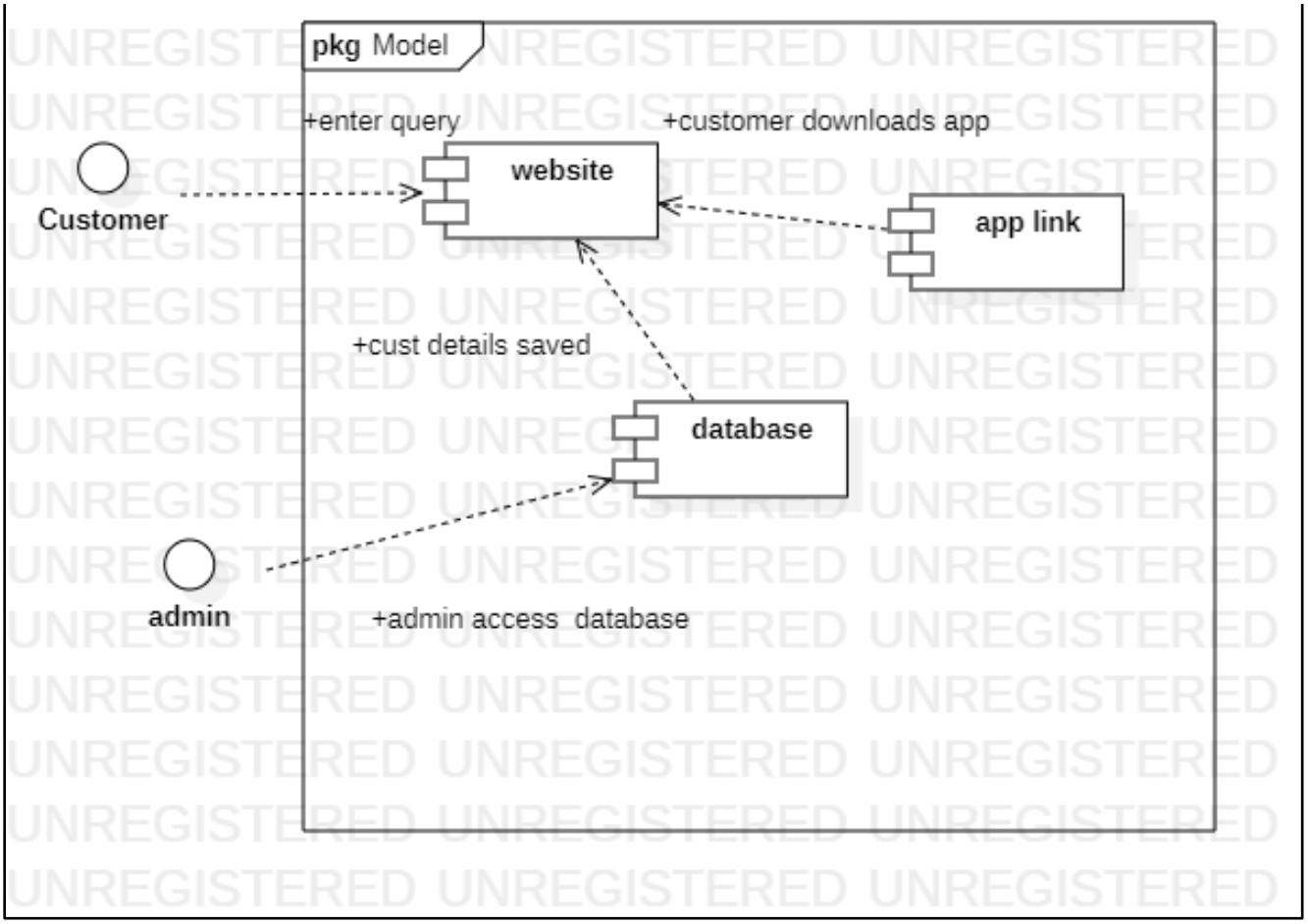
3. SEQUENCE DIAGRAMS:-



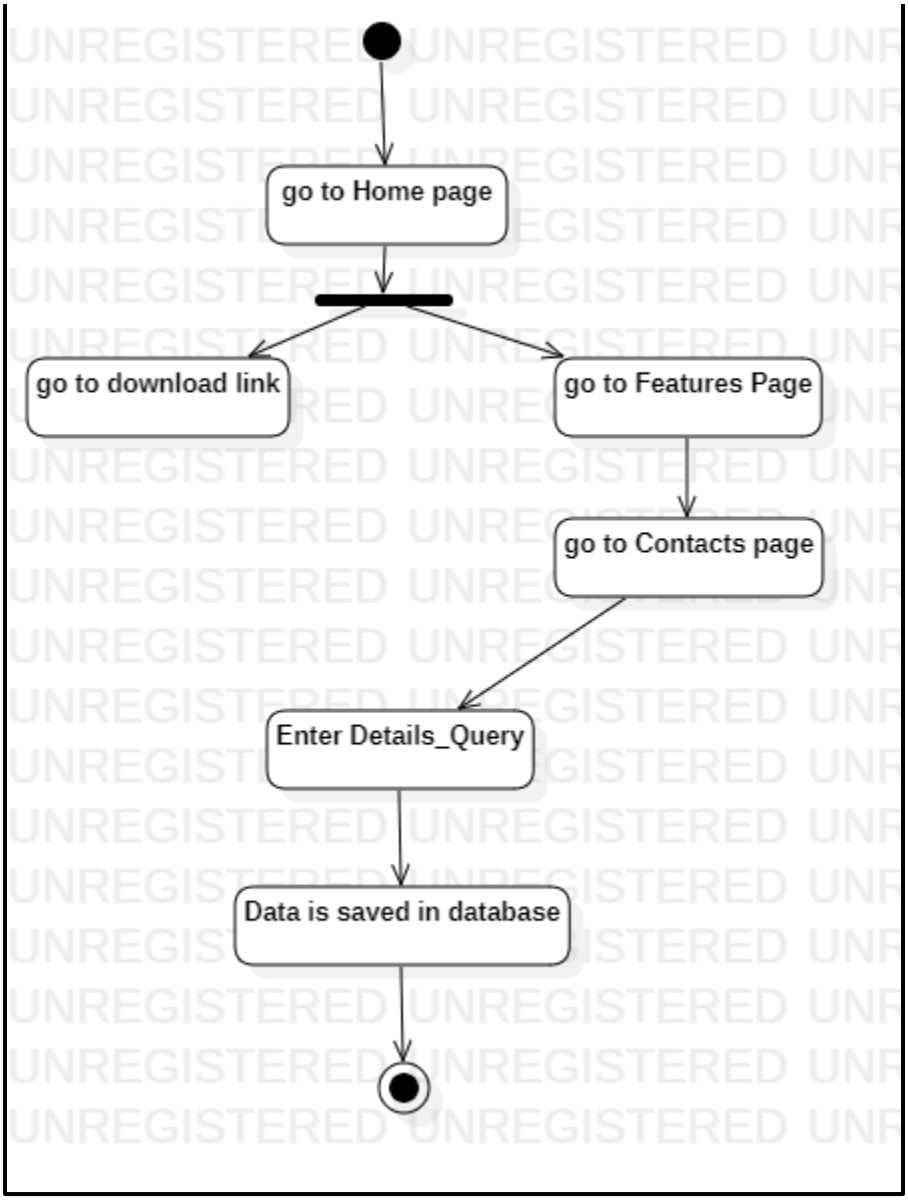
4. CLASS DIAGRAM.



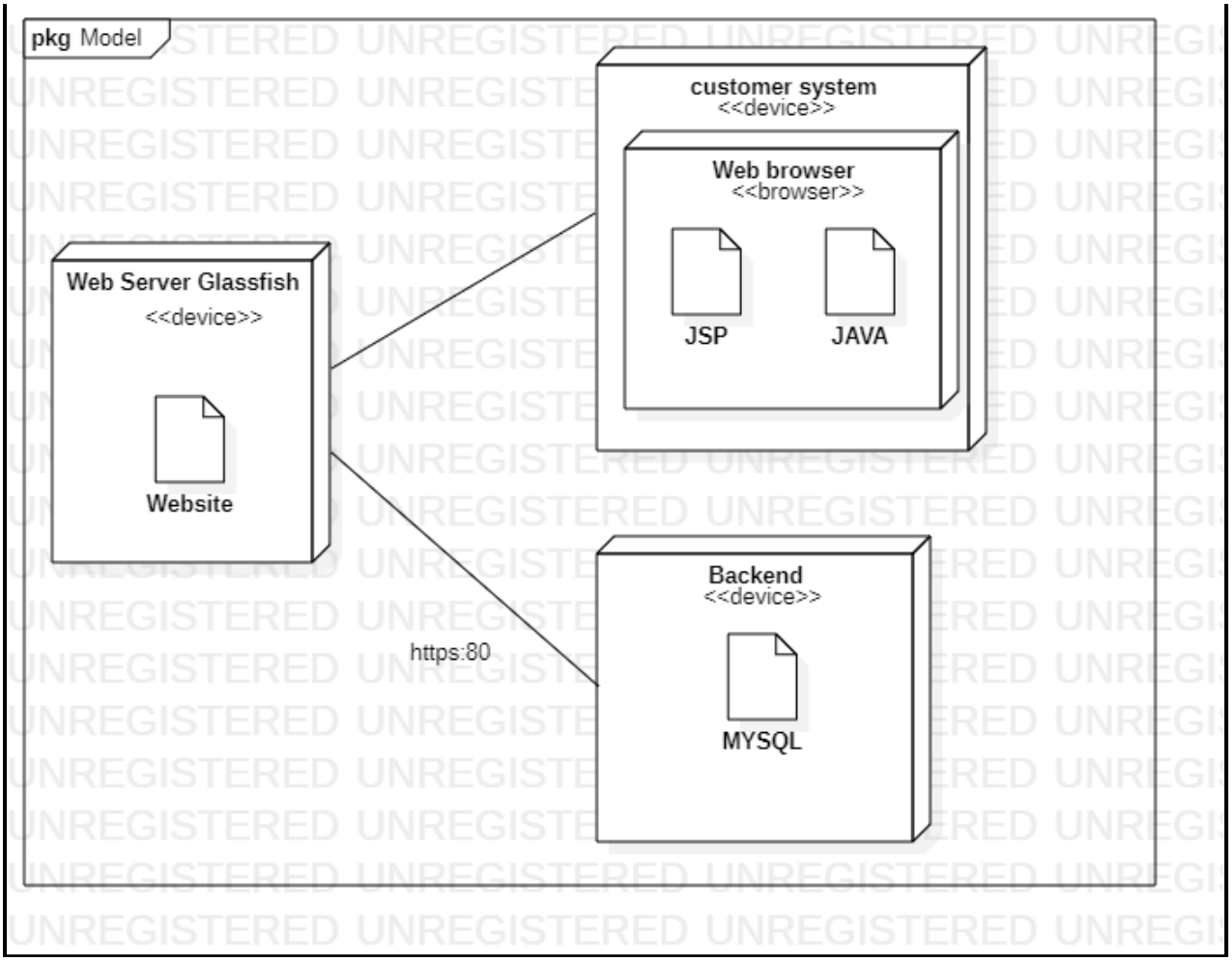
5. COMPONENT DIAGRAM:



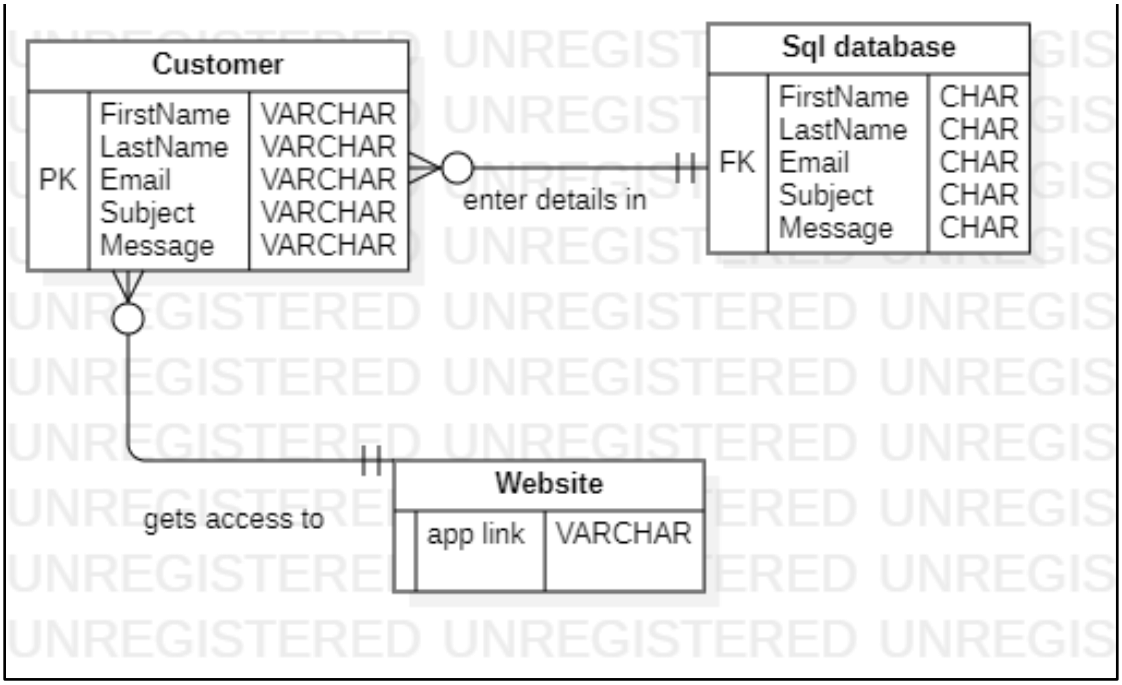
6. STATECHART DIAGRAM.



7. DEPLOYMENT DIAGRAM.



8.ER Diagram:


Customer
PK
FirstName VARCHAR
LastName VARCHAR
Email VARCHAR
Subject VARCHAR
Message VARCHAR
enter details in
Sql database
FK
FirstName CHAR
LastName CHAR
Email CHAR
Subject CHAR
Message CHAR
gets access to
Website
app link VARCHAR

Chapter 5: Implementation and Testing.

5.1 Implementation Approach

We decided to go with an incremental development approach for implementing the project. This approach was suitable for us since our application was built with HW/SW architecture. Each Hardware Component's functionality was developed and tested independently. The User Interface of the application was developed separately and only serves the purpose of displaying the view to the user by requesting data from the Hardware backend. Both the members in the team took responsibility for their respective services and developed it individually with some common coding standards that will be discussed further.

5.2 Coding Details.

Arduino is Coded using embedded c language:

EMBEDDED C:

Embedded C is a programming language used for developing software for embedded systems. It is a variant of the C programming language that has been optimized for use in resource-constrained systems, such as microcontrollers and other embedded devices.

Embedded C has many of the same features as standard C, but it also includes additional features to support the development of embedded systems. For example, it provides access to specific hardware registers and memory locations, which are essential for controlling the behavior of the device.

Embedded C is used to develop software for a wide range of embedded systems, including consumer electronics, automotive systems, medical devices, and industrial control systems. Some of the key benefits of using Embedded C for these applications include its low memory footprint, its efficient use of system resources, and its ability to interface directly with hardware.

To develop software using Embedded C, developers typically use a specialized Integrated Development Environment (IDE) that includes tools for compiling, debugging, and testing code on the target hardware. They may also use specialized libraries and frameworks that provide additional functionality and simplify the development process.

ARDUINO CODE TO FIND SOIL MOISTURE:

```
    #include <SoftwareSerial.h>
SoftwareSerial bt(8, 9); // RX, TX
#include "dht.h"
dht DHT;
const int sensor_pin = A1;  /* Soil moisture sensor O/P pin */
int sensor_analog;
void setup() {
 Serial.begin(9600);
 bt.begin(9600);
 Serial.println("Ready");
}
void loop(){
 sensor_analog = analogRead(sensor_pin);
 Serial.print(sensor_analog);
 bt.print(sensor_analog);
  delay(1000);
}
```

ARDUINO CODE FOR AUTOMATIC WATER PUMP:

```
 int water; //random variable
void setup() {
 pinMode(3,OUTPUT);
pinMode(6,INPUT);}
void loop() {
 water = digitalRead(6);
if(water == HIGH)
{ digitalWrite(3,LOW);
}
else{
digitalWrite(3,HIGH);}
delay(400);
}
```

ARDUINO CODE TO FIND TEMPERATURE AND HUMIDITY:

```
#include <SoftwareSerial.h>
SoftwareSerial bt(8, 9); // RX, TX
#include "dht.h"
#define dataPin A0
dht DHT;
int temp;
int hum;
void setup() {
 Serial.begin(9600);
 bt.begin(9600);
 Serial.println("Ready");
}
void loop(){
  int readData = DHT.read11(dataPin);
 hum = DHT.humidity;
temp = DHT.temperature;
 bt.print(temp); //send distance to MIT App
bt.print(";");
 bt.print(hum); //send distance to MIT App
 bt.println(";");
 bt.printl(moisture_percentage);
 delay(1000);
}
```

ARDUINO CODE TO FIND TEMPERATURE, HUMIDITY AND SOIL MOISTURE:

```
#include <SoftwareSerial.h>
SoftwareSerial bt(8, 9); // RX, TX
#include "dht.h"
#define dataPin A0
dht DHT;
int temp;
int hum;
const int sensor_pin = A1;  /* Soil moisture sensor O/P pin */
int sensor_analog;
void setup() {
Serial.begin(9600);
 bt.begin(9600);
Serial.println("Ready");}
void loop(){
int readData = DHT.read11(dataPin);
hum = DHT.humidity;
 temp = DHT.temperature;
```

```
sensor_analog = analogRead(sensor_pin);
Serial.print(sensor_analog);
 bt.print(temp); //send distance to MIT App
 bt.print(";");
 bt.print(hum); //send distance to MIT App
bt.println(";");
bt.print(sensor_analog);
 delay(1000);}
```

Website is coded using jsp/html language:

JSP stands for JavaServer Pages, and it is a technology used to create dynamic web pages in Java. JSP allows developers to embed Java code directly into HTML pages, which enables the creation of dynamic content that can change based on user input, database queries, or other factors.

JSP files are similar to HTML files, but they include special tags that allow developers to insert Java code into the page. When the JSP page is requested by a web browser, the server processes the Java code and generates an HTML page that is sent back to the browser.

JSP technology is often used in conjunction with other Java web technologies, such as Servlets and JavaBeans, to create web applications that can handle user input, access databases, and interact with other web services. JSP also supports the use of custom tags and libraries, which can simplify the development process and improve code reusability.

CODE FOR WEBSITE MADE USING JAVA:

Index.jsp

```
<!DOCTYPE html>
<html lang="en">
  <head>
    <meta charset="UTF-8" />
    <meta http-equiv="X-UA-Compatible" content="IE=edge" />
    <meta name="viewport" content="width=device-width, initial-scale=1.0" />
    <link
      rel="stylesheet"
      href="https://cdnjs.cloudflare.com/ajax/libs/font-awesome/5.15.3/css/all.min.css"
      integrity="sha512-
iBBXm8fW90+nuLcSKlbmrPcLa0OT92xO1BIsZ+ywDWZCvqsWgccV3gFoRBv0z+8dLJgyAHIhR
35VZc2oM/gI1w=="
      crossorigin="anonymous"
      referrerpolicy="no-referrer"
    />
    <link rel="stylesheet" href="style.css">
    <title>Soil Monitoring System || Home Page</title>
  </head>
  <body>
    <header>
      <div class="main-nav">
        <a href="index.html" class="logo">Soil Monitoring System</a>

        <ul>
          <li><a href="index.jsp">home</a></li>
          <li><a href="services.jsp">services</a></li>
          <li><a href="contact.jsp">contact</a></li>
        </ul>
      </div>
      <div class="sub-nav">
        <ul>
          <li>
            <a href="https://github.com/SudeshDR"><i class="fab fa-facebook-f"></i></a>
          </li>
          <li>
            <a href="https://www.linkedin.com/in/sudesh-rajbhar-a37015261/">
              <i class="fab fa-twitter"></i>
            </a>
          </li>
          <li>
```

```
          <a href="https://in.pinterest.com/sr_artspace/">
            <i class="fab fa-instagram-square"></i>
          </a>
        </li>
      </ul>
    </div>
  </header>

  <div class="container">
    <div class="hero">
      <div class="content">
        <h1 class="heading-primary">
          We are here to help you monitor your plants
        </h1>
        <p>
          Want to take care of your medicinal plants better, want to check your soil condition before
starting a construction
,come to us and know about the amazing soil monitoring system developed by our team
        </p>

        <a href="#" class="btn">Download Device App</a>
      </div>

      <div class="hero-img">
        <img src="img/hero.png" alt="Hero Image">
      </div>
    </div>
  </div>
 </body>
</html>
```

Features.jsp

```
<!DOCTYPE html>
<html lang="en">
 <head>
  <meta charset="UTF-8" />
  <meta http-equiv="X-UA-Compatible" content="IE=edge" />
  <meta name="viewport" content="width=device-width, initial-scale=1.0" />
  <link
   rel="stylesheet"
   href="https://cdnjs.cloudflare.com/ajax/libs/font-awesome/5.15.3/css/all.min.css"
   integrity="sha512-
iBBXm8fW90+nuLcSKlbmrPcLa0OT92xO1BIsZ+ywDWZCvqsWgccV3gFoRBv0z+8dLJgyAHIhR
```

```
35VZc2oM/gI1w=="
      crossorigin="anonymous"
      referrerpolicy="no-referrer"
    />
    <link rel="stylesheet" href="style.css">
    <title>Soil Monitoring System|| Features Page</title>
  </head>
  <body>
    <header>
      <div class="main-nav">
        <a href="index.html" class="logo">Soil Monitoring System.</a>

        <ul>
          <li><a href="index.jsp" >home</a></li>
          <li><a href="Features.jsp">Features</a></li>
          <li><a href="contact.jsp">contact</a></li>
        </ul>
      </div>

      <div class="sub-nav">
        <ul>
          <li>
            <a href="https://github.com/SudeshDR"><i class="fab fa-facebook-f"></i></a>
          </li>
          <li>
            <a href="https://www.linkedin.com/in/sudesh-rajbhar-a37015261/">
              <i class="fab fa-twitter"></i>
            </a>
          </li>
          <li>
            <a href="https://in.pinterest.com/sr_artspace/">
              <i class="fab fa-instagram-square"></i>
            </a>
          </li>
        </ul>
      </div>
    </header>

    <div class="container">
      <div class="description">
        <h2 class="heading-secondary">
          Features that we provide
        </h2>
        <p>
          Our Features includes a wide range where our device can provide multiple functionalities like
```

```
showing Temperature, showing Humidity and also automatically water the plants whenever the soil moisture goes low.
      </p>
    </div>

    <div class="cards">
      <div class="card">
        <div class="icon">
           <img src="img/img-1.png" alt="Image 1" width="200" height="200">
        </div>

        <h3 class="heading-tertiary">Availability</h3>
        <p>
          .
        </p>
      </div>

      <div class="card">
        <div class="icon">
           <img src="img/img-2.png" alt="Image 2" width="100">
        </div>

        <h3 class="heading-tertiary">Accessible</h3>
        <p>
          .
        </p>
      </div>

      <div class="card">
        <div class="icon">
          <img src="img/img-3.png" alt="Image 3" >
        </div>

        <h3 class="heading-tertiary">Bluetooth Connectivity</h3>
        <p>
          .
        </p>
      </div>

      <div class="card">
        <div class="icon">
          <img src="img/img-4.png" alt="Image 4">
        </div>

        <h3 class="heading-tertiary">Easy Monitoring</h3>
```

```
        <p>
        .
        </p>
      </div>

      <div class="card">
        <div class="icon">
          <img src="img/img-5.png" alt="Image 5">
        </div>

        <h3 class="heading-tertiary">Reliable</h3>
        <p>
        .
        </p>
      </div>

      <div class="card">
        <div class="icon">
          <img src="img/img-6.png" alt="Image 6">
        </div>

        <h3 class="heading-tertiary">easy GUI</h3>
        <p>
          .
        </p>
      </div>
    </div>

  </div>
 </body>
</html>
```

Contact.jsp:

```
<%--
   Document   : index
   Created on : 14 Feb, 2023, 12:11:28 PM
   Author     : Admin
--%>

<%@page contentType="text/html" pageEncoding="UTF-8"%>
<!DOCTYPE html>
<html lang="en">
 <head>
   <meta charset="UTF-8" />
```

```
    <meta http-equiv="X-UA-Compatible" content="IE=edge" />
    <meta name="viewport" content="width=device-width, initial-scale=1.0" />
    <link
      rel="stylesheet"
      href="https://cdnjs.cloudflare.com/ajax/libs/font-awesome/5.15.3/css/all.min.css"
      integrity="sha512-
iBBXm8fW90+nuLcSKlbmrPcLa0OT92xO1BIsZ+ywDWZCvqsWgccV3gFoRBv0z+8dLJgyAHIhR
35VZc2oM/gI1w=="
      crossorigin="anonymous"
      referrerpolicy="no-referrer"
    />
    <link rel="stylesheet" href="style.css">
    <title>Soil Monitoring System || Contact Page</title>
  </head>
  <body>
    <header>
      <div class="main-nav">
        <a href="index.html" class="logo">Soil Monitoring System.</a>

        <ul>
          <li><a href="index.jsp">home</a></li>
          <li><a href="Features.jsp">Features</a></li>
          <li><a href="contact.jsp">contact</a></li>
        </ul>
      </div>

      <div class="sub-nav">
        <ul>
          <li>
            <a href="https://github.com/SudeshDR"><i class="fab fa-facebook-f"></i></a>
          </li>
          <li>
            <a href="https://www.linkedin.com/in/sudesh-rajbhar-a37015261/">
              <i class="fab fa-twitter"></i>
            </a>
          </li>
          <li>
            <a href="https://in.pinterest.com/sr_artspace/">
              <i class="fab fa-instagram-square"></i>
            </a>
          </li>
        </ul>
      </div>
    </header>
```

```
<div class="container">
  <div class="description">
    <h2 class="heading-secondary">
      Contact us
    </h2>
    <p>
      Contact us on our Social Websites and you can also call us on the following number if you have any Queries related to our device </p>
    <p>SUDESH: 9969145000</p>
    <p>SHIVAM: 1234567890</p>
    <p>OMKAR: 7045361590</p>
  </div>

  <div class="contact-form mb">
    <form action="servlet" method="post">
      <div class="row">
        <div class="input50">
          <input type="text" placeholder="FirstName" name="FirstName">
        </div>
        <div class="input50">
          <input type="text" placeholder="LastName" name="LastName">
        </div>
      </div>

      <div class="row">
        <div class="input50">
          <input type="email" placeholder="Email" name="Email">
        </div>
        <div class="input50">
          <input type="text" placeholder="Subject" name="Subject">
        </div>
      </div>

      <div class="row">
        <div class="input100">
          <textarea placeholder="Message" name="Message"></textarea>
        </div>
      </div>

      <div class="row">
        <div class="input100">
          <input type="submit" value="Send" ></input>
        </div>
      </div>
    </form>
```

```
    </div>

   </div>
  </body>
</html>
```

style.css

```
:root {
color: maroon;
color: white;
color: black;
}

*,
*::before,
*::after {
  margin: 0;
  padding: 0;
  box-sizing: border-box;
}

body {
  font-family: sans-serif;
  font-size: 1.3rem;
  min-height: 100vh;
  line-height: 1.6;
}

/* utility  */
.container {
  padding: 0 5%;
}

a {
color: white;
text-decoration: none;
}

p {
color: black;
}

.mb {
  margin-bottom: 4rem;
```

```
}

.heading-primary {
  font-size: 2.5rem;
  font-weight: 300;
  line-height: 1;
 color: maroon;
margin-bottom: 1rem;
}

.heading-secondary {
  font-size: 2rem;
  font-weight: 300;
  line-height: 1;
color:maroon;
margin-bottom: 1.5rem;
}

.heading-tertiary {
  font-size: 1.5rem;
color:maroon;
margin-bottom: .5rem;
}

/* header  */
header {
  height: 10vh;
  display: flex;
}

.main-nav {
  width: 70%;
  background-color: maroon;
  padding-left: 5%;
  display: flex;
  align-items: center;
  justify-content: space-between;
}

.main-nav ul,
.sub-nav ul {
  list-style: none;
  display: flex;
}
```

```
.main-nav ul li a {
  text-transform: capitalize;
  padding-right: 2rem;
}

.logo {
  font-size: 1.5rem;
}

.sub-nav {
  width: 30%;
  padding-right: 5%;
  display: flex;
  align-items: center;
  justify-content: flex-end;
}

.sub-nav ul li a {
color:maroon;
    padding-left: 1.5rem;
}

/* hero  */
.hero {
  height: calc(100vh - 10vh);
  display: flex;
  justify-content: space-between;
}

.content {
  flex: 0 0 50%;
  display: flex;
  flex-direction: column;
  align-items: flex-start;
  justify-content: center;
  padding-right: 1rem;
}

.hero-img {
  flex: 0 0 50%;
}

.hero-img img {
  width: 100%;
  height: 100%;
```

```
}

.btn {
  display: inline-block;
  background-color: maroon;
  padding: 0.5rem 1.5rem;
  margin-top: 4rem;
}

/* services  */
.description {
  height: 50vh;
  width: 90%;
  display: flex;
  flex-direction: column;
  justify-content: center;
}

.cards {
  display: grid;
  grid-template-columns: repeat(auto-fit, minmax(300px, 1fr));
  gap: 4rem;
  text-align: center;
  margin-top: 4rem;
}

.card {
  margin-bottom: 2rem;
}

.card .icon img {
  width: 7rem;
  height: auto;
  margin-bottom: 3rem;
}

/* work  */
.work {
  display: grid;
  grid-template-columns: repeat(auto-fit, minmax(300px, 1fr));
  gap: 2rem;
}

.work img {
  width: 100%;
```

```
  height: 100%;
}

/* contact  */
.contact-form form {
  width: 80%;
}

.contact-form .row {
  width: 100%;
  display: flex;
}

.input50 {
  width: 50%;
  margin: 0 10px;
}

.input100 {
  width: 100%;
  margin: 0 10px;
}

.contact-form .row input,
.contact-form .row textarea {
  font-size: 1.2rem;
  font-weight: 300;
  width: 100%;
  border: 1px solid rgba(0, 0, 0, 0.2);
color:black;
padding: 10px;
  outline: none;
  margin: 10px 0;
}

.contact-form .row textarea {
  height: 150px;
}

.contact-form .row input[type="submit"] {
  background-color: maroon;
  color: white;
  border: 0;
  cursor: pointer;
}
```

```
@media(max-width:950px) {
  .hero-img,
  .sub-nav {
    display: none;
  }

  .content {
    flex: 0 0 100%;
  }

  .main-nav {
    width: 100%;
  }

  .contact-form form {
    width: 100%;
  }

  .contact-form .row {
    flex-direction: column;
  }

  .contact-form .input100,
  .contact-form .input50 {
    width: 100%;
  }
}
```

Servlet pages that provide JDBC Connectivity are coded through JAVA (Servlet):

Servlet programming is a technology used for developing dynamic web applications in Java. Servlets are Java classes that are designed to handle HTTP requests and responses, allowing developers to create web applications that can interact with users and respond to user input. Servlets are often used in conjunction with JavaServer Pages (JSP) and other Java web technologies to create complete web applications. Servlets can handle a wide range of tasks, including user authentication, form handling, database access, and more.

To create servlets, developers typically use an Integrated Development Environment (IDE) that includes tools for creating and editing Java code, as well as tools for testing and deploying web applications. Common Java IDEs include Eclipse, IntelliJ IDEA, and NetBeans. Servlet programming involves creating Java classes that implement the Servlet API. These classes typically extend the HttpServlet class and override methods such as doGet () and doPost () to handle HTTP requests and responses. Servlets can also use JavaServer Pages (JSP) to generate dynamic content.

Why not PHP:

Java and PHP are both popular programming languages used for developing web applications. When it comes to database connectivity, Java has some advantages over PHP:

JDBC: Java Database Connectivity (JDBC) is a standard API for connecting to relational databases from Java programs. JDBC provides a high-level abstraction layer over the underlying database, making it easier to work with different databases without changing the code. JDBC provides a consistent interface for connecting to different databases, which makes it easier to manage and maintain database connectivity.

1. Performance: Java is a compiled language, which means that the code is translated into machine code and executed directly by the processor. This can make Java applications faster and more efficient than PHP applications, especially when dealing with large amounts of data.

2. Security: Java has a strong security model that includes features such as sandboxing, code signing, and access control. These features help protect against malicious attacks and ensure that only authorized users can access the database.

3. Scalability: Java applications can be easily scaled to handle large volumes of data and traffic. Java's multithreading capabilities make it easy to handle multiple requests simultaneously, which can help improve performance and reduce response times.

In summary, while Java may have some advantages over PHP in database connectivity, both languages have their own strengths and weaknesses. The choice between Java and PHP depends on the specific requirements of the project and the expertise of the development team.

servlet.java:

```
package pig;

Import java.sql.*;
import com.mysql.jdbc.Connection;
import java.io.IOException;
import java.io.PrintWriter;
import java.sql.DriverManager;
import java.sql.SQLException;
import java.util.logging.Level;
import java.util.logging.Logger;
import javax.servlet.ServletException;
import javax.servlet.http.HttpServlet;
import javax.servlet.http.HttpServletRequest;
import javax.servlet.http.HttpServletResponse;

public class servlet extends HttpServlet {

    protected void processRequest(HttpServletRequest request, HttpServletResponse response)
            throws ServletException, IOException, SQLException, ClassNotFoundException {
        response.setContentType("text/html;charset=UTF-8");
        try (PrintWriter out = response.getWriter()) {
            /* TODO output your page here. You may use following sample code. */
            out.println("<!DOCTYPE html>");
            out.println("<html>");
            out.println("<head>");
            out.println("<title>Customer DataServlet</title>");
            out.println("</head>");
            out.println("<body>");
            out.println("<h1>Your Query has been sent to" + request.getContextPath() + "</h1>");

            out.println("<p>Wait for the Reply...</p>");

            Class.forName("com.mysql.jdbc.Driver");
            Connection con = (Connection)
DriverManager.getConnection("jdbc:mysql://localhost:3306/data","root","mysql");
            out.println("<p>Have a nice day</p>");
            Statement st = (Statement)con.createStatement();


            String WFirstName = request.getParameter("FirstName");
            String WLastName = request.getParameter("LastName");
            String WEmail = request.getParameter("Email");
            String WSubject = request.getParameter("Subject");
```

```
        String WMessage = request.getParameter("Message");


        String sqlQuery = "Insert into info values('" + WFirstName + "', '" + WLastName + "', '" +
WEmail + "','" + WSubject + "','" + WMessage + "');";
        //out.println(sqlQuery);
        st.executeUpdate(sqlQuery);
        //out.println("<h1>CustomerDataServlet at " + request.getContextPath() + "</h1>");


        out.println("<form action ='servlet2' method = 'post'>");
        //out.println("<input type = 'submit' value = 'Fetch Page'/>");


        out.println("</form>");

        out.println("</body>");
        out.println("</html>");

    }
  }

  @Override
  protected void doGet(HttpServletRequest request, HttpServletResponse response)
        throws ServletException, IOException {
    try {
        processRequest(request, response);
    } catch (SQLException ex) {
        Logger.getLogger(servlet.class.getName()).log(Level.SEVERE, null, ex);
    } catch (ClassNotFoundException ex) {
        Logger.getLogger(servlet.class.getName()).log(Level.SEVERE, null, ex);
    }
  }

  @Override
  protected void doPost(HttpServletRequest request, HttpServletResponse response)
        throws ServletException, IOException {
    try {
        processRequest(request, response);
    } catch (SQLException ex) {
        Logger.getLogger(servlet.class.getName()).log(Level.SEVERE, null, ex);
    } catch (ClassNotFoundException ex) {
        Logger.getLogger(servlet.class.getName()).log(Level.SEVERE, null, ex);
    }
  }
```

```
    @Override
    public String getServletInfo() {
        return "Short description";
    }

}
```

servlet2.java:

```
package pkg;

Import java.sql.*;
import java.io.IOException;
import java.io.PrintWriter;
import java.sql.Connection;
import java.sql.DriverManager;
import java.sql.ResultSet;
import java.sql.SQLException;
import java.sql.Statement;
import java.util.logging.Level;
import java.util.logging.Logger;
import javax.servlet.ServletException;
import javax.servlet.http.HttpServlet;
import javax.servlet.http.HttpServletRequest;
import javax.servlet.http.HttpServletResponse;

public class servlet2 extends HttpServlet {

    protected void processRequest(HttpServletRequest request, HttpServletResponse response)
            throws ServletException, IOException, ClassNotFoundException, SQLException {
        response.setContentType("text/html;charset=UTF-8");
        try (PrintWriter out = response.getWriter()) {

            out.println("<!DOCTYPE html>");
            out.println("<html>");
            out.println("<head>");
            out.println("<title>Servlet ShowStudent</title>");
            out.println("</head>");
            out.println("<body>");
            out.println("<h1>Servlet ShowStudent at " + request.getContextPath() + "</h1>");

            Class.forName("com.mysql.jdbc.Driver");
```

```
        Connection con = DriverManager.getConnection("jdbc:mysql://localhost:3306/data", "root",
"mysql");
        Statement st1 = (Statement) con.createStatement();
        String qry = "Select * from info;";
        ResultSet rs1 = st1.executeQuery(qry);
        out.println("<h1>Student Data</h1>");
        out.println("<table border = '1' bgcolor = 'grey'>");
        out.println("<tr>");
        out.println("<td><b>FirstName</b></td>");
        out.println("<td><b>LastName</b></td>");
        out.println("<td><b>Email</b></td>");
        out.println("<td><b>Subject</b></td>");
        out.println("<td><b>Message</b></td>");
        out.println("</tr>");

        while (rs1.next()) {
            out.println("<tr>");
            out.println("<td>" + rs1.getString("FirstName") + "</td>");
            out.println("<td>" + rs1.getString("LastName") + "</td>");
            out.println("<td>" + rs1.getString("Email") + "</td>");
            out.println("<td>" + rs1.getString("Subject") + "</td>");
            out.println("<td>" + rs1.getString("Message") + "</td>");



            out.println("</tr>");
        }
        out.println("</table>");
        out.println("</body>");
        out.println("</html>");

    }
  }

  @Override
  protected void doGet(HttpServletRequest request, HttpServletResponse response)
        throws ServletException, IOException {
    try {
        processRequest(request, response);
    } catch (ClassNotFoundException ex) {
        Logger.getLogger(servlet2.class.getName()).log(Level.SEVERE, null, ex);
    } catch (SQLException ex) {
        Logger.getLogger(servlet2.class.getName()).log(Level.SEVERE, null, ex);
    }
  }
```

```
    @Override
    protected void doPost(HttpServletRequest request, HttpServletResponse response)
            throws ServletException, IOException {
        try {
            processRequest(request, response);
        } catch (ClassNotFoundException ex) {
            Logger.getLogger(servlet2.class.getName()).log(Level.SEVERE, null, ex);
        } catch (SQLException ex) {
            Logger.getLogger(servlet2.class.getName()).log(Level.SEVERE, null, ex);
        }
    }

    @Override
    public String getServletInfo() {
        return "Short description";
    }// </editor-fold>

}
```

Sql database:

```
create database data;

use data;

create table info(
FirstName varchar(20),
LastName varchar(20),
Email varchar(20),
Subject varchar(20),
Message varchar(20));

select * from info;
```

5.3 Testing Approach

• The system was developed in a set of different modules at the same time. Every prototype generated was tested under various test cases which decides whether or not the system has met the requirements.

• Also, the requirements were gathered throughout the development of the project. Thus, the modules generated were developed with versioning so as to synchronize the software interface and the hardware architecture effectively.

• Hence, we implemented the following testing methodologies:

5.3.1 Unit Testing

• Software Interfaces, Application Interfaces and the Hardware connections were individually tested based on the designed test cases.

5.3.2 Integrated Testing

• The hardware and the software modules were integrated and were tested against the specified requirements that were gathered and analyzed till the development. Any flaw generated during test, was noted and then the system went under few changes to cope up with them

5.3.3 Regression Testing

• Changes made in the software after integration testing might have altered the functioning of the system at some point. Hence a check of regression testing was made on the reports generated, delays in switching and privileges granted to the users.

5.3.4 Acceptance Testing

• Based upon the set-goal criteria, the system was tested in the actual environment before it was assured as a product of deployment.

Chapter 6: Case Study related to Plants based on Humidity and Temperature

There are some plants, crops, fruits and vegetables which require specific temperature and humidity for their growth.
We have listed some case studies of such plants, crops, fruits and vegetables below:-

Plants such as:-

- Herbs such as basil, mint, parsley, and cilantro require specific temperature, humidity, and soil moisture conditions to grow and thrive. Here are some guidelines for the optimal environmental conditions for these herbs:

- Temperature: Most herbs prefer a temperature range of 60°F to 75°F (15°C to 24°C), with basil and cilantro preferring slightly warmer temperatures around 70°F to 75°F (21°C to 24°C) and parsley preferring slightly cooler temperatures around 60°F to 65°F (15°C to 18°C).

- Tea: Tea plants require a temperature range of 13-30°C (55-86°F) and a relative humidity of 70-80% during the growing season.

- Turmeric: Turmeric plants require a temperature range of 20-30°C (68-86°F) and a relative humidity of 70-80% during the growing season.

- Pepper: Pepper plants require a temperature range of 24-29°C (75-84°F) and a relative humidity of 75-85% during the growing season.

- Orchids: The temperature range and humidity requirements for orchids vary depending on the species, but generally, they require a temperature range of 16-24°C (60-75°F) and a relative humidity of 40-70%.

Crops such as:-

- Rice: Rice requires a temperature range of 20-35°C (68-95°F) and a relative humidity of 70-90% during the growing season.
- Wheat: Wheat requires a temperature range of 15-25°C (59-77°F) and a relative humidity of 50-60% during the growing season.
- Corn: Corn requires a temperature range of 18-32°C (64-90°F) and a relative humidity of 50-70% during the growing season.
- Soybeans: Soybeans require a temperature range of 18-32°C (64-90°F) and a relative humidity of 60-80% during the growing season.

Vegetables such as:-

- Potatoes: Potatoes require a temperature range of 15-25°C (59-77°F) and a relative humidity of 80-90% during the growing season.
- Tomatoes: Tomatoes require a temperature range of 21-27°C (70-81°F) and a relative humidity of 80-90% during the growing season.
- Okra (Ladyfinger): Okra plants require a temperature range of 20-35°C (68-95°F) and a relative humidity of 50-80% during the growing season.
- Cucumber: Cucumber plants require a temperature range of 21-30°C (70-86°F) and a relative humidity of 70-80% during the growing season.
- Eggplant (Brinda): Eggplants require a temperature range of 18-30°C (64-86°F) and a relative humidity of 50-70% during the growing season.
- Green beans: Green beans require a temperature range of 16-30°C (60-86°F) and a relative humidity of 60-70% during the growing season.
- Cauliflower: Cauliflower plants require a temperature range of 15-20°C (59-68°F) and a relative humidity of 60-75% during the growing season.

Fruits such as:-

- Mango: Mango trees require a temperature range of 24-27°C (75-80°F) and a relative humidity of 60-80% during the growing season.
- Banana: Banana plants require a temperature range of 25-30°C (77-86°F) and a relative humidity of 50-70% during the growing season.
- Papaya: Papaya trees require a temperature range of 21-33°C (70-91°F) and a relative humidity of 60-80% during the growing season.
- Guava: Guava trees require a temperature range of 20-30°C (68-86°F) and a relative humidity of 50-80% during the growing season.
- Grapes: Grapes require a temperature range of 15-25°C (59-77°F) and a relative humidity of 60-80% during the growing season.
- Citrus fruits: Citrus fruits such as oranges and lemons require a temperature range of 15-30°C (59-86°F) and a relative humidity of 50-70% during the growing season's.

Chapter 7: Conclusions, Limitations and Future Scope

Conclusion:

- Soil monitoring systems have proven to be effective in monitoring various soil parameters such as moisture content, temperature, pH levels, nutrient levels, and more.
- These systems offer several benefits, including increased agricultural productivity, reduced water usage, improved crop yields, and reduced labor costs.
- Overall, soil monitoring systems have the potential to revolutionize the agriculture industry and increase sustainability.

Limitations:

- Despite their many benefits, soil monitoring systems also have some limitations. Firstly, they can be expensive to install and maintain, which can make them inaccessible to some farmers.
- Secondly, soil monitoring systems are highly dependent on the accuracy of the sensors used to measure various soil parameters.
- Therefore, calibration and maintenance of sensors are crucial to ensure the accuracy of the data.
- Thirdly, the data generated by soil monitoring systems can be overwhelming and complex, and farmers may need specialized training to make sense of it.

Future Scope:

- The future scope of soil monitoring systems is vast. With the advancements in technology, soil monitoring systems can become more affordable, accurate, and user-friendly.
- Additionally, the integration of AI and machine learning algorithms can help farmers make data-driven decisions and optimize their farming practices.
- Furthermore, soil monitoring systems can be integrated with other technologies such as precision agriculture and IoT, leading to more efficient and sustainable farming practices.
- Overall, the future of soil monitoring systems looks promising and has the potential to revolutionize the agriculture industry.