

# **SMART PLANT MONITORING SYSTEM**

**A Project report**

*Submitted in partial fulfillment of the requirements for the  
degree of*

**BACHELOR OF TECHNOLOGY**

**IN**

**ELECTRONICS AND COMMUNICATION ENGINEERING**

*By*

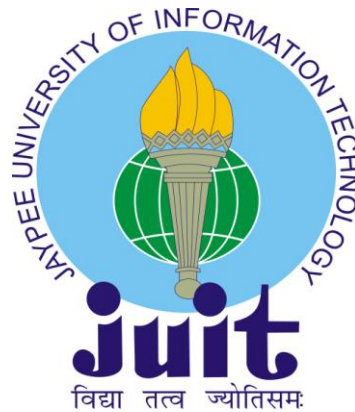
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### CERTIFICATE

This is to certify that the work reported in the B.Tech project report entitled **“SMART PLANT MONITORING SYSTEM”** which is being submitted by Suraj Singh Thakur (141008), Dhritayman Sharma (141016), Pankaj Sharma (141017), in fulfillment for the award of Bachelor of Technology in Electronics and Communication Engineering by the Jaypee University of Information Technology, is the record of candidate’s own work carried out by him/her under my supervision. This work is original and has not been submitted partially or fully anywhere else for any other degree or diploma.

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## **LIST OF ACRONYMS AND ABBREVIATIONS**

### **ABBREVIATIONS**

### **FULL FORM**

AIS	Automatic Irrigation System
T&H	Temperature and Humidity
I/O	Input,Output
Hz	Hertz
V	Volts
IDE	Integrated Development Environment
KHz	Kilo-Hertz
IDC	Insulation Displacement Connector

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## DECLARATION BY THE SCHOLARS

We hereby declare that the work reported in the B-Tech thesis entitled “**SMART PLANT MONITORING SYSTEM**” submitted at **Jaypee University of Information Technology, Wagnaghat India**, is an authentic record of our work carried out under the supervision of **Dr.Rajiv Kumar** .We have not submitted this work elsewhere for any other degree or diploma.

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## **ABSTRACT**

Plant monitoring is seen as one of the most important tasks in any farming or agriculture based environment. With the inception of Ambient Intelligent systems, there have been a rise in ambient intelligent based devices-Smart Homes and other similar technologies involving RFID has evolved over the past few years. Integration of such an ambient intelligent system with plant monitoring makes farming easier. In this paper, we discuss about the implementation of a smart plant monitoring system which makes use of the concept ambient intelligence with the use of .Net Gadgeteer which, proactively handles the plant monitoring system. The given implementation works along with a cloud based server and a mobile based device (ideally Android/iOS device) which helps the user to control and see the status of the plant which is being monitored by the hardware device. The given circuitry detects changes in the moisture, temperature and light conditions in and around the plant, and performs a machine based curation on the plant by providing necessary irrigation and illumination for the plant. Machine curation is also integrated with active weather forecasting systems which are deployed in the cloud based server using which advanced machine curation is performed. For user based curation, the Android device provides user an option to override a machine curated operation.



# CHAPTER 1

## Introduction Of Project

This is an IoT based project that will be capable of analyzing various characteristics of soil such as moisture, temp ,light etc. from anywhere using internet. This device will be installed in soil and data fetched by the device would be managed through an android/web application. This data will be analyzed and information about best gardening options for that particular plant will be provided by the app itself.

For some of us, plants are hard to keep alive and while there are all sorts of tech tricks to keeping plants alive, most of them are rather gaudy.

a **smart plant pot** that can e-mail you or notify you on app once thirsty, hot/cold, sleeping etc. charge it like a cell phone, no prior gardening experience required.

A smart plat pot system tell us about the plants information on android app using microcontroller and sensor.

We always remember that Plants are our life.

Three things we must remember about plants . That Plants always accept the negative energy from the environment , keep the air fresh and clean, which is important and necessary for our health.

Plants are building block of earth, Plants gives us many things like vegetables , fruits etc, But how we are serious about the plants , how and at what time interval we give water, temperature etc.

By using Smart plant pot system we can find out the description of plants i.e water level, moisture and temperature quantity absorbs the plants.

IN this project technology and hardware are simultaneously used to make report of plant condition. Pot used in the project is an open source and we can get it free from internet.

## **1.1: Problem Statement:-**

This is an IOT based system to check the plant soil, temperature, water and cold level of plant using microcontroller and sensor , all these description will be display on the android app , and all these information should be save on cloud .

## **1.2: Objective of project:-**

The main objective of this project is use the hardware and software together . This project is used to implements the technology with nature.

Smart Plant pot project have many features like

It uses simple hardware and software.

It is non toxic.

It is totally free , it is an open source , no any license is required to execute this, It is like a second hand uses in gradient to protect the plants, IT automatically work and send all information on the cloud through android app which notify about plants condition, so doctor team can reach on time and we can save plant , this will be more valuable for earth.

This device uses wifi arduino system i.e called nodemcu.

**This is list of devices we used in system which are as follows**

1 wifi microcontroller - updated to wifi nodemcu

2 battery pack is used

3 breadboard devices

4 RGB led module are also used

5 temperature/humidity module

6 light sensor

7 water sensor

8 jumper wires

### **1.3 Following steps are used to make this project.**

#### **Step 1: Design**

First we have to prepare design of the pot so that we can place the circuit in a different section in the pot to save it from water or any other damage.

Plant pot can be;

- hand made with clay
- cut out of existing plastic pot
- can be 3D printed (last step for updates)

#### **Step 2: Circuit Diagram**

We have to design the circuit diagram based on the connection of sensors i.e Temperature & humidity sensor, Light sensor, Soil moisture sensor and RGB LED module with the microcontroller.

#### **Step 3: Updates**

This system give signals which seems that it is natural process.

If it shows green light means every condition is necessary for plant for which we are making test.

If Yellow appears , it means no light (Sleeping mode).

Read signals means plant is cold or hot all these depends upon the environment condition at that time. If device shows blue signal it means plant is thirsty.

pot is equipped with **nodemcu wifi board**. a much stronger computer with better and easier to program wifi capability.

**Using the app**, we can always be alert on our garden.

## **Step 4: Arduino Code**

in this step program coding is used in arduino , which is used in the project, for this you may have good programming skill.

## **Step 5: android App design**

In this step app is designed in this way that plant description will be show in better design like

temperature, moisture, water level, cold and hot level etc.

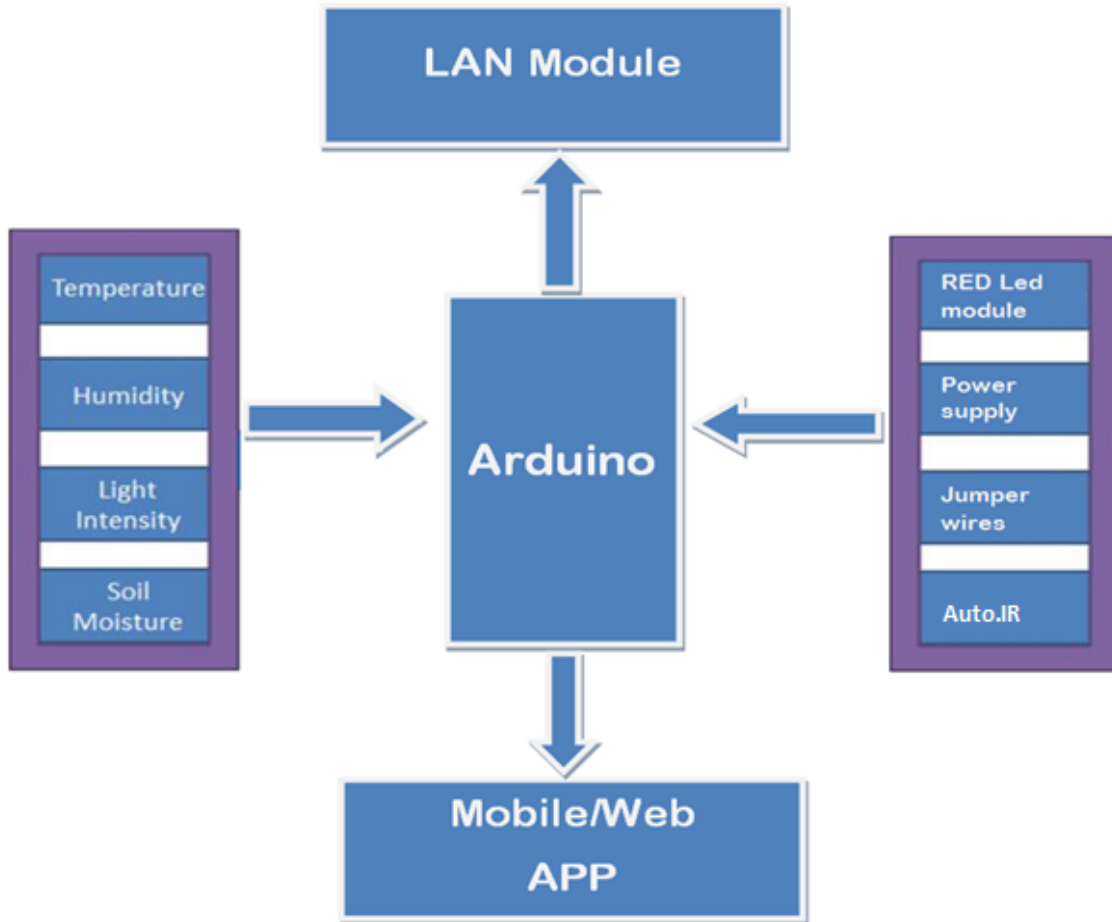
## **Step 7:**

Now in this steps after seen everything about the plant , we must water the plant and seeds the plants for the plants growth.

## **Step 8: Conclusion**

After reading many studies, we concludes that why people fails to grow plants , they can not understand why the plants are not growing, because people are busy, they forgot the nature, this is very bad, so we decide to make smart plant pot which automatically give report about the plant.

## 1.4: Methodology



**Figure 1.1:** Flow Chart

## **CHAPTER 2**

### **Literature Survey for Hardware and Software requirements**

#### **2.1 : Android Introduction:**

Android products are widely used in our daily life such as mobile phones, televisions, tablets etc. Basically, an android is an open source which means it is available for every platform. Also, it is a type of Linux based operating system for smart phones and tablet computers.

The Open Handset Alliance has developed it. Android provides a platform to all the application developer to develop their applications and that can be run on different devices of android.

In 2007, Google has launched the first beta version of Android SDK (Software Development kit). Also, in September 2008, Google has launched the first Android 1.0 commercial version.

#### **2.2 : Benefits of Android:**

The first basic advantage of android is that it is an open source and the code is available for free for Android developers. It provides a very attractive and good user interface for users. For data storage, a lightweight database is available name as SQLite (Structured Query Language), basically used to store and retrieve data in a database. An android supports great features such as messaging, connectivity, real time messaging (as Google Cloud Messaging), Wi-Fi direct etc. There are many android applications are available in the market now a days. Some of are:-News , Sports, music, multimedia, travel, etc.

## 2.3 : Android Versions:

Android versions are related to different code names such as

Version	Code Name
Android 1.6	Donut
Android 2.0	Éclair
Android 2.2	Froyo
Android 2.3	Gingerbread
Android 3.0	Honeycomb
Android 4.0	Ice cream sandwich
Android 4.1	Jelly Bean
Android 4.4	KitKat
Android 5.0	Lollipop
Android 6.0	Marshmallow

### Intent:

Intent is a part of android application which is used to make relations between activities into an app. Generally it is used to link one activity of an app to other activities of the app. A bunch of code is need to write to open other activity of that app. The sample code for MainActivity class is given below:

```
Intent intent = new Intent(MainActivity.this, SecondActivity.class);
```

```
startActivity(intent);
```

As you may see on the above code, First we use an object of intent with their parameters and after that we pass the object in startActivity method. Actually, the startActivity method helps to move the user from MainActivity to SecondActivity.

Also, there are two types of intent:

1. **Implicit Intent:** An implicit intent is used to perform an action instead of defining the exact activity of exact components. It has some predefined methods such as ACTION.VIEW, ACTION.MAIL etc that helps to directly perform the action to another application from your application.
2. **Explicit Intent:** In explicit intent, open an activity of your app from another activity which is already in your app. In it the components which is explicitly define, is called by the Android System. Remember that we do not use the predefined method such as ACTION.VIEW etc.

## 2.4: Bundles:

Generally, if we wish to pass a value or data between two activities, we use bundles. A Bundle passes the value in next activity, without any data type restrictions, with the help of intent.

putExtra Method is used for sending the data between activities such as

```
Intent intent = new Intent(MainActivity.this, SecondActivity.class);
```

```
Intent.putExtra("Key", value);
```

```
startActivity(intent);
```

As you can see above sample code, the data is passed by putExtra method with two parameters, key and value. The key defines the specific name of that value which we wish to pass in activities and the value is depending on the user requirement.

Also, we can find or get the passed data from previous activity to next activity by bundle.

Here is the sample code for it:

```
Intent intent = getIntent();
```

```
Bundle data = intent.getExtras();
```

```
If (data != null)
```



```
{  
  
String fetchData = (String) intent.get("Key");  
  
}
```

As per the above code, first we need to make an intent object to get the intent which has the data by using getIntent method. And after that we use bundle object and add the passed values into it.

## **SharedPreferences:**

Android provides different methods to pass and store the data in activities. Shared preference is also a part of it. By using key and value pair, you can retrieve/save data in shared preference.

The method use for shared preference .

Java is a programming language and environment invented by James Gosling and others in 1994. Java was originally named Oak in 1992. (electronic devices)

## **Features of JAVA**

### **1. Simple**

java inherits syntax from c and oops

concepts from c++.

### **2. Object oriented**

java is trully oops language c++ is not everything in java is defined inside a class.

We can not write programm without using class & objects.

even the main function is also defined inside a class.

trully not fully

primitive data types

int, char, float :- these are not objects

not classes

public:- it is an access spiffier, it means we can use class data inside or out side the class. it class the jvm which provides run environment to execute any java program

static:- it means no need to make object of the class

void:- it does not return any value

main():- it entry point into java program

System:- it is java class which connect java with our system

out:- it is member of system class which show out put on console window

print() it is function which show output

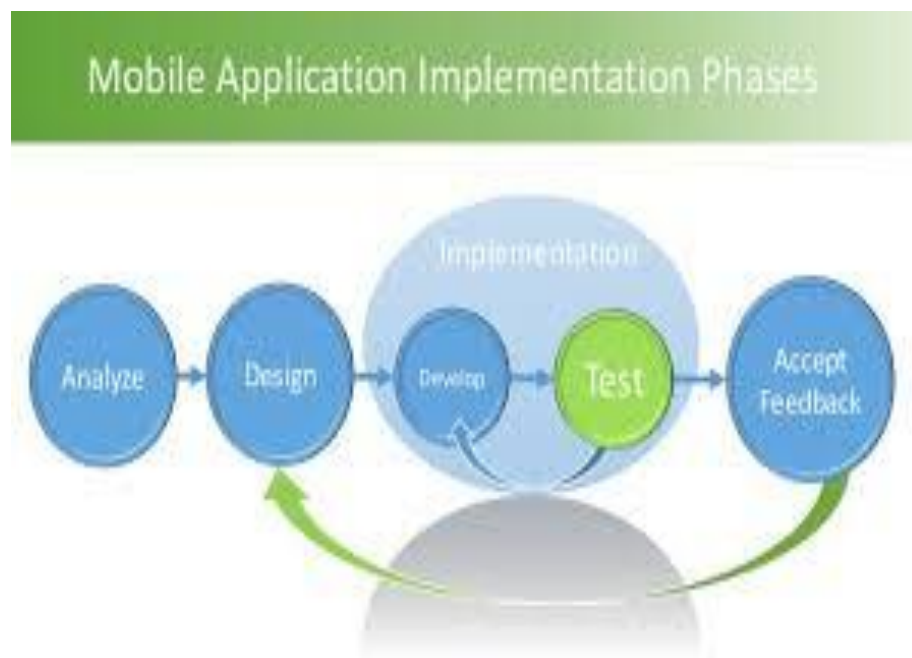
# CHAPTER 3

## SYSTEM DEVELOPMENT

### 3.1: SYSTEM DEVELOPMENT LIFE CYCLE (SDLC)

#### System development lifecycle (SDLC)

The systems development life cycle (SDLC) is a conceptual model used in project management that describes the stages involved in an information system development from an initial feasibility study through maintenance of the completed application. Various SDLC methodologies have developed to guide the process involved including the waterfall model (the original SDLC method). documentation is crucial regardless of the model chosen or devised for any application, and is usually done in parallel with the development process. Some methods work better for specific types of projects , but in the final analysis , the most important factor for the success of a project may be how closely particular plan was followed



### 3.2: Requirement gathering

In this first collect the formation which should be used to make app.

Information may be gathered from the people and other sources, and team requirements must be fulfilled by manager of the team

App information like database, design and other components may be required.

### 3.3: Feasibility study

After requirement gathering the team comes up with a rough plan of software process.

At this step team analyzes if a software can be made fulfill all requirements of the user and if there any possibility of software being no more useful. It is found out, if the project is financially, practically and technologically feasible for the organization to take up. There are many algorithms available, which help the developers to conclude the feasibility of a software project.

- **Technical Feasibility:** This is concerned with specifying equipment and software that will successfully satisfy the use considerably, but might include
  - ❖ The feasibility to produce output in a given time because system is fast enough to handle multiple users.
  - ❖ Response time under certain circumstances and ability to process a certain volume of transaction of a particular speed.
  - ❖ Feasibility to communicate data to distant location.
- **Economical Feasibility:** Economic analysis is the most frequently used technique used for evaluating the effectiveness of a proposed system. More commonly known as cost/benefit analysis the procedure is to determine the benefits and savings that are expected from a proposed system and compared them with cost. Though the cost of installing the system may

appear high, it is one time investment. The resulting benefits is that automation results in turnaround time. The resulting cost/benefit ratio is favorable.

- **Operational Feasibility:** It is mainly related to human organizational as social aspects. The points to be considered are - The system interface is standard, user friendly and provides extensive help. Hence no special training is not required.
- **Social Feasibility:** Social feasibility is determination of whether a proposed project will be acceptable to people or not, So this project is totally Social and Feasible



### 3.4 Software testing

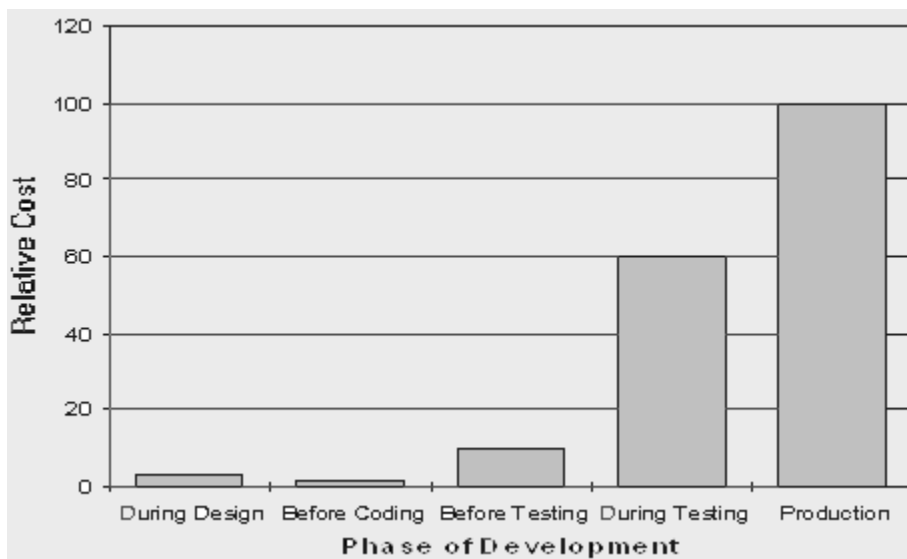
Software testing is a process through which we can analyze and verify a user requirement i.e our software can full fill the customer requirement or not. Does our software is given accurate and complete result, and result is effective.

Testing is process and set of tools to check a software.

There are many types to test software like blackbox, whitebox, graybox, integration testing and acceptance testing. Testing of the software tells us or shows us that ur software upto which extent it is ok and what part of code are not working properly.

Software testing makes the project accurate and show limitation of our project.

It is tools which works on the project and check each module manually by enter details into modules and it shows errors also.



## **BlackBox Testing:-**

BlackBox testing means to check the software without checking the internal functions used in the project.

In the our app .

first we login into app by enter details of admin , teacher and students by entering details like username and password and it land on user home page.

.

## **White box Testing:-**

white box testing means to check the design , internal functions and algorithm of project. Sometimes we click on the login button without register on project i.e so here we make test case to verify our software

Title of Test Case:- App

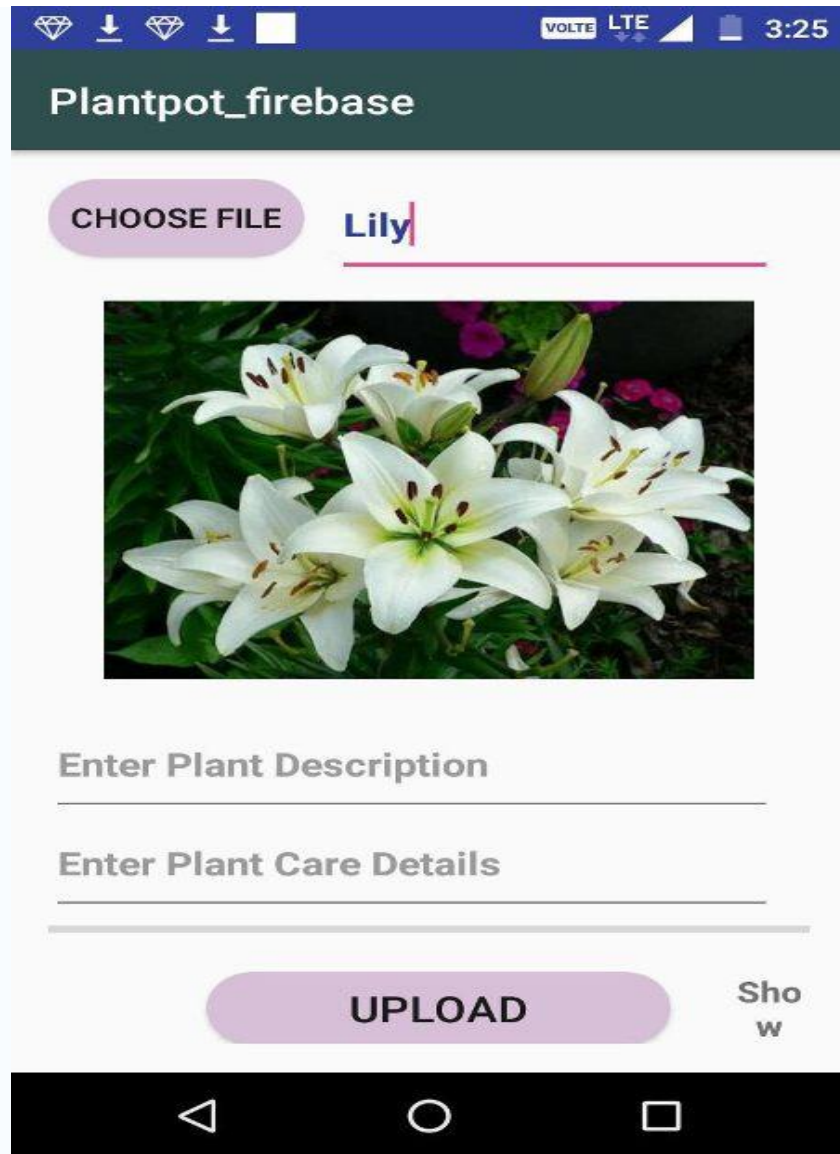
## **Steps to Test the Android app:**

We have created two Apps one to manage the plant database i.e to upload the plant its image , description, plant care details in the firebase database .from this we can manage the add or delete the plant .And the second one is for the users to take care of its plant.

### **App 1 = The App to manage the database(Owners App)**

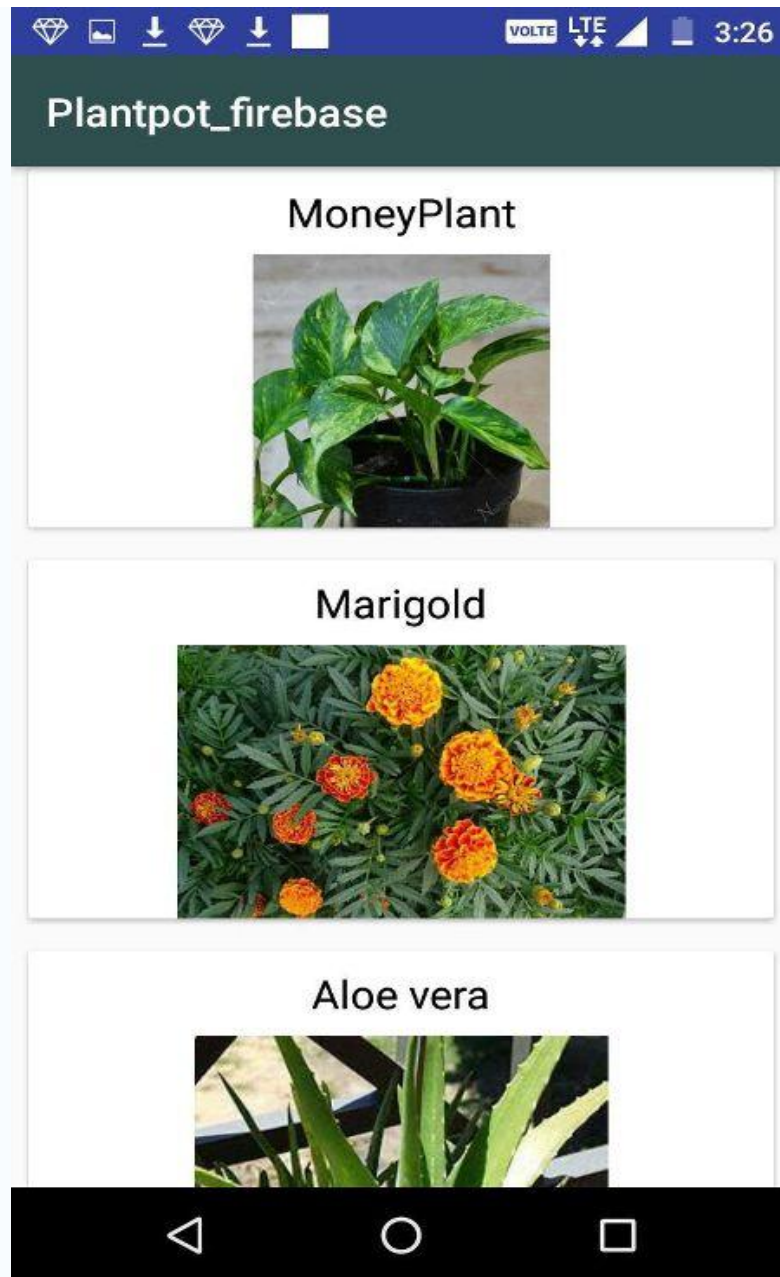
- 1** The manager who manages the data will install this app on his android phone and opens it a after installing.
- 2** It will open the first activity in which we can see the choose file button through which image can be chosen from the phone for the plant
- 3** Then we have Enter plant name text field in which we will enter the name of the plant
- 4** Then there is a description and plant care details TextView fields in which according to the details and needs and care of the plants fields will be fill.
- 5** Then we have upload button at the bottom which on click uploads the plant details on the firebase and if it succeeds it will show a Toast message of 'Upload Successful'.





**Figure 3.1:** Activity 1 of the Owners App

6 On side of it we have show uploads field clicking to which leads to opening the activity which shows the All added plant in database in a listview .

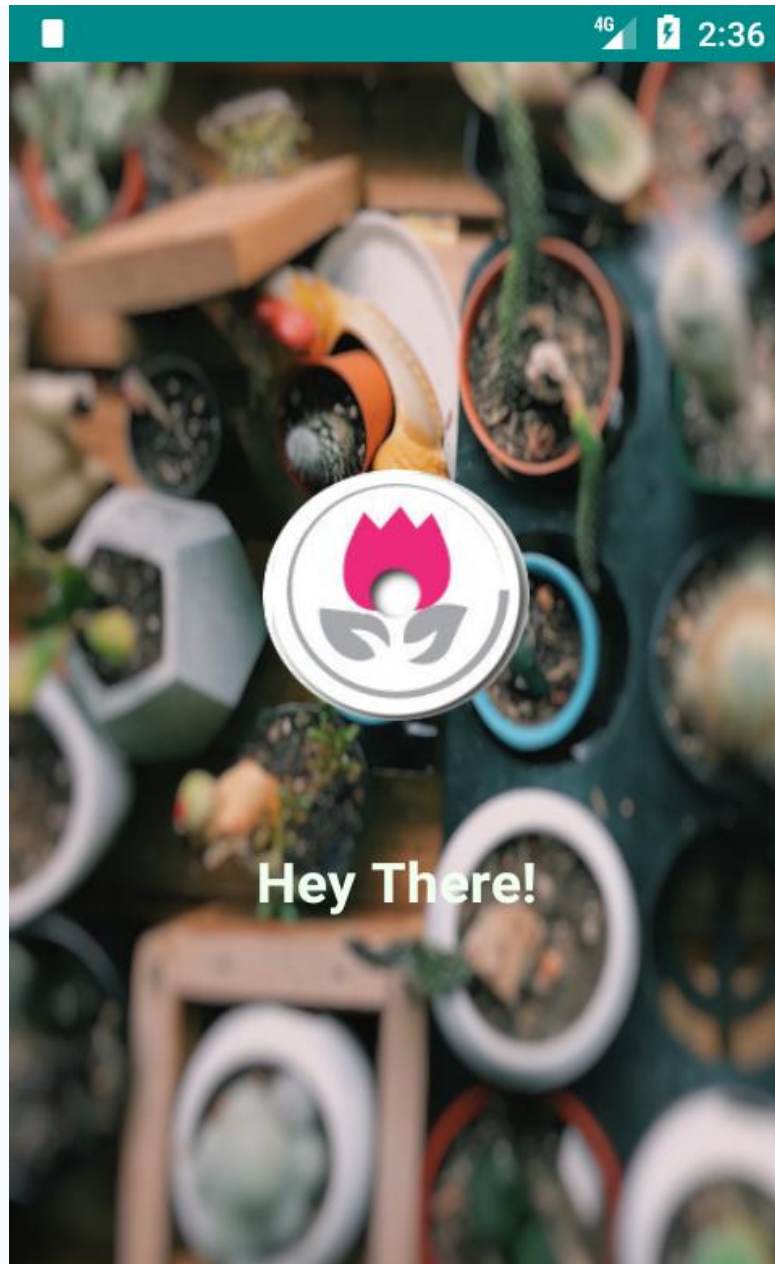


**Figure 3.2:** Activity 2 of the Owners App

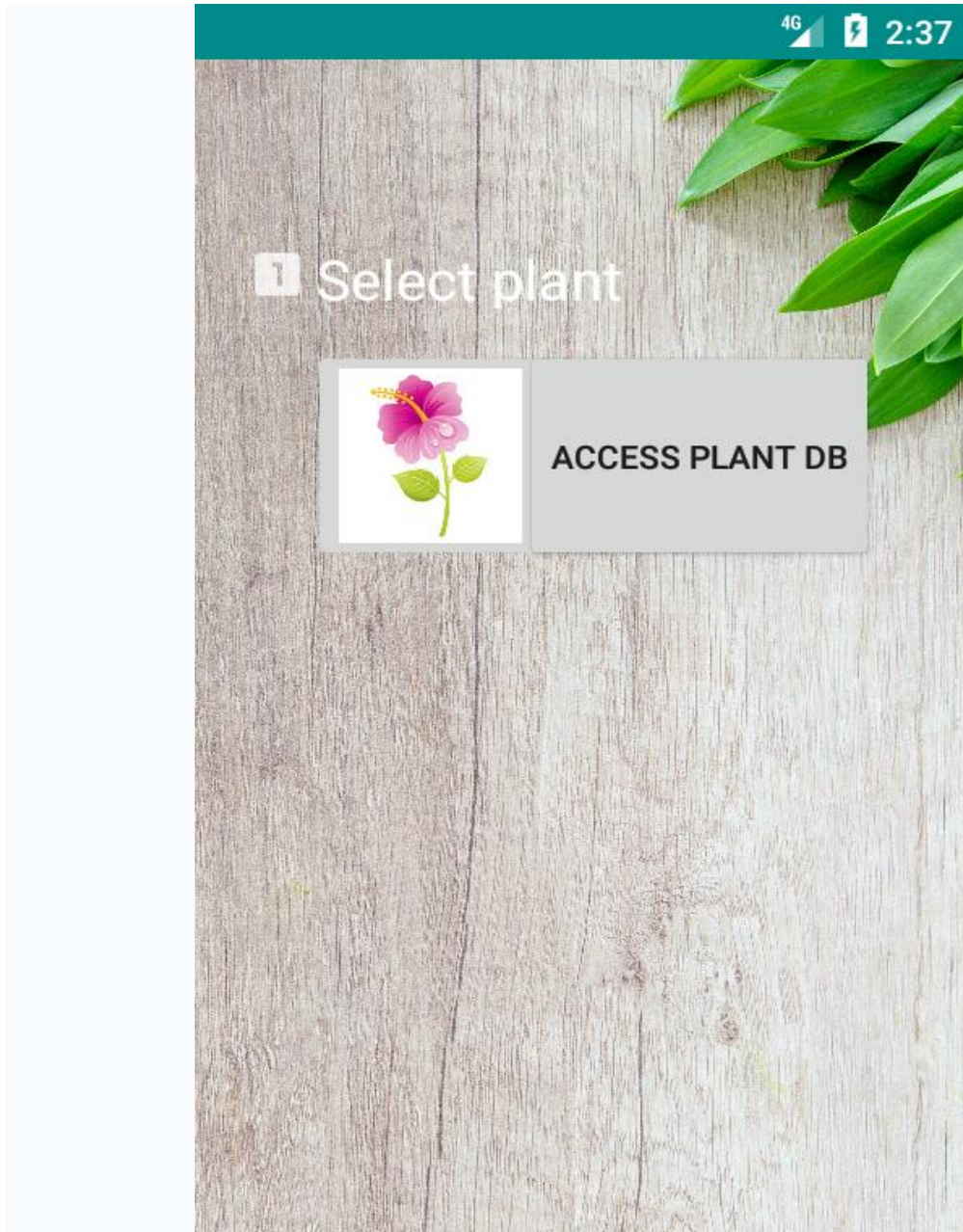
7 we can delete the plant if we want to from the database by long pressing on the plant that we want delete ad select on the delete option from the menu that will pop on long pressing .

## App 2: App for the Users

- 1 First User will install the app on its android phone .Then after installing the app , app will open the and Then it will show the first activity which is the welcome activity it will show for 5 seconds and show the app logo with hey there text below it.



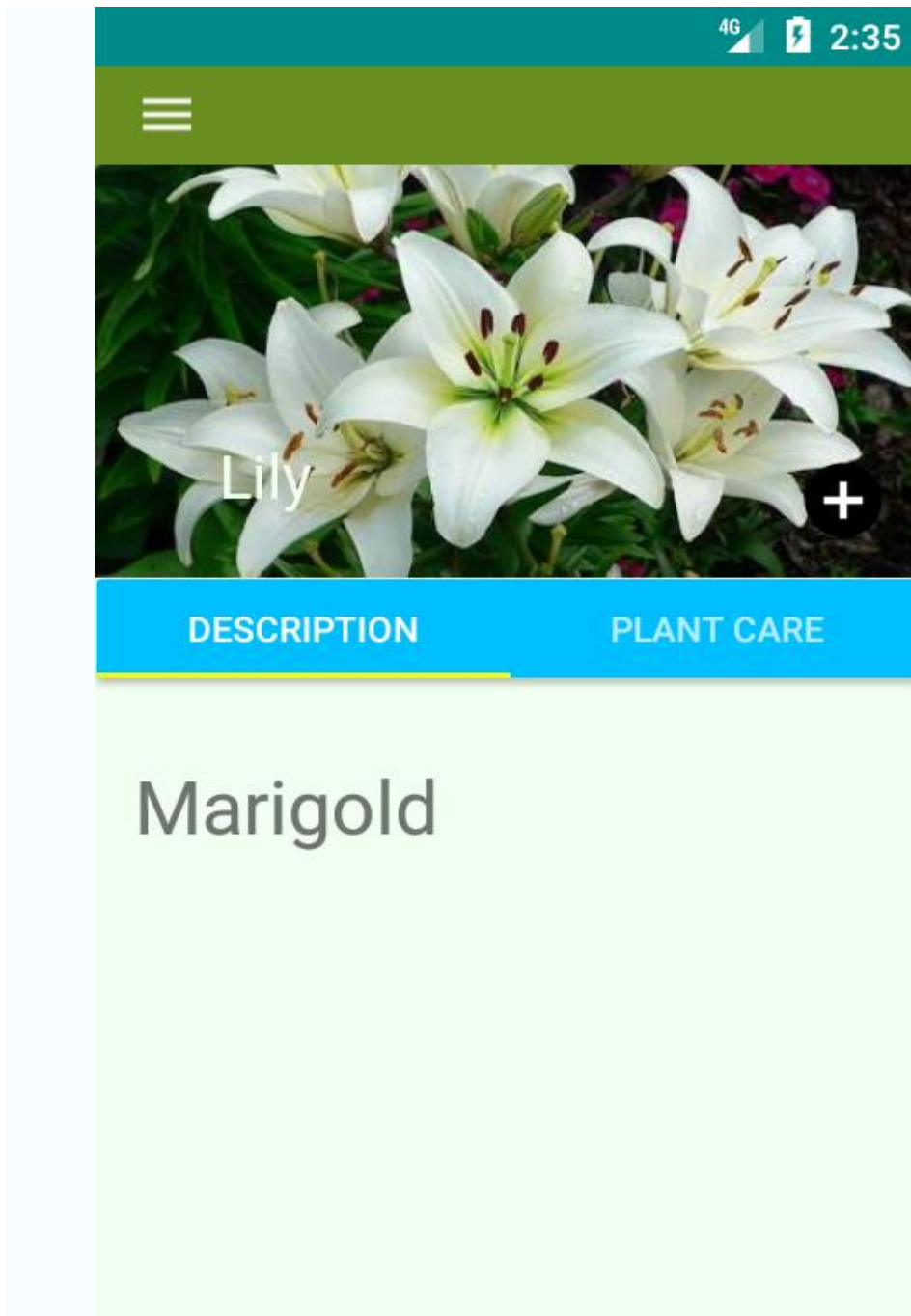
- 2 After 5 seconds the welcome screen will disappear and it will direct to the Activity Based on the first run it will open the activity which will show you to ACCESS PLANT database which is created in firbasedatabse.



- 3 After clicking the ACCESS PLANT DB we will be directed to another activity which will open the plant database that we have created on firebase database. Here we can see different plants list from which we can choose any one by clicking on it. We have used the RecyclerView to retrieve the data from the firebase and to show it in a list view.

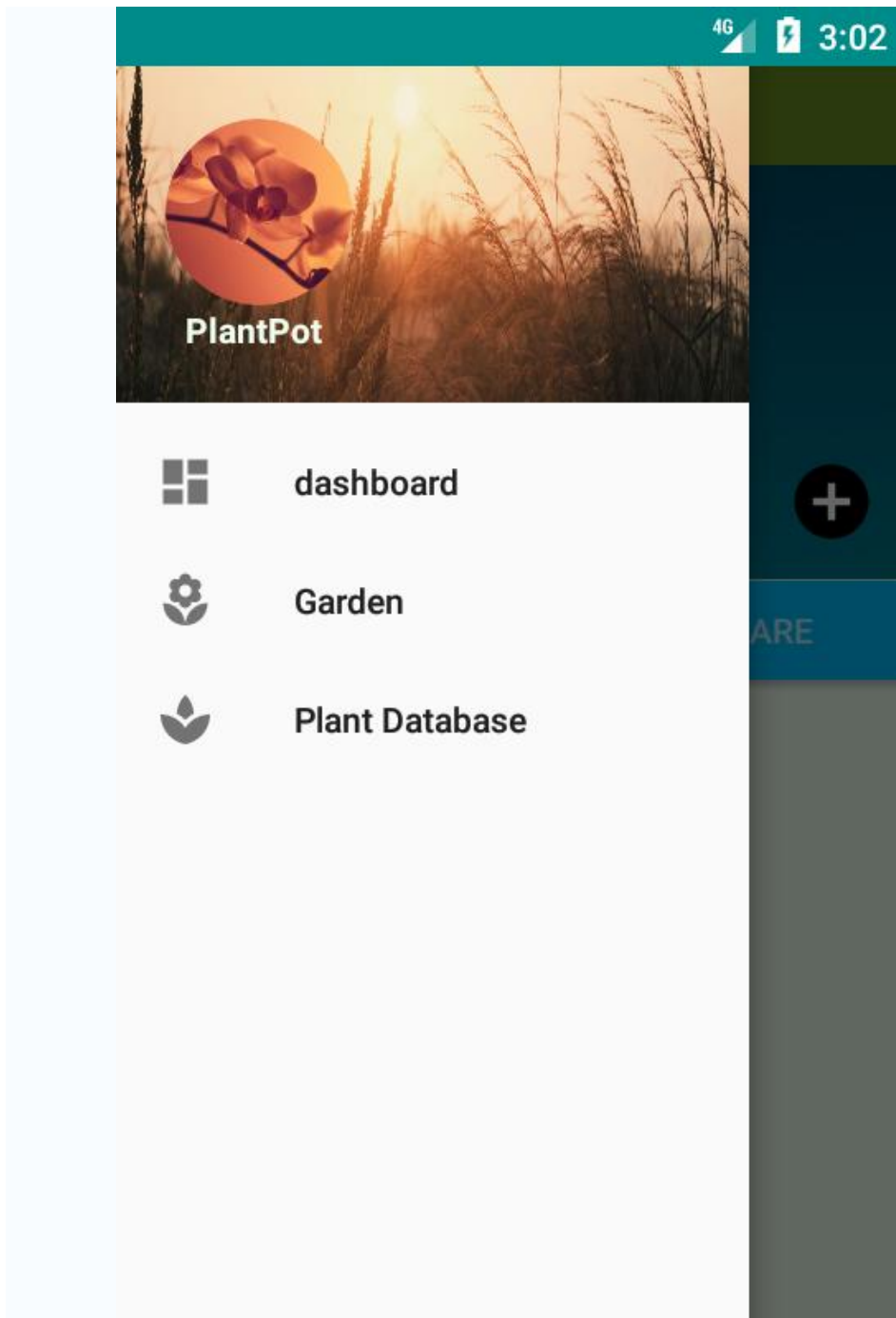


- 4 After clicking the any plant the onclickListener listens the command and get the key of the plant from the firebase and open a new activity which will show the plant image its name (one you clicked) and here we have added Two tabs one for showing the description of the plant and plant care details of the plant that user have clicked.And also here user can see a circle add button which onclick adds the plant on the users Garden Activity.

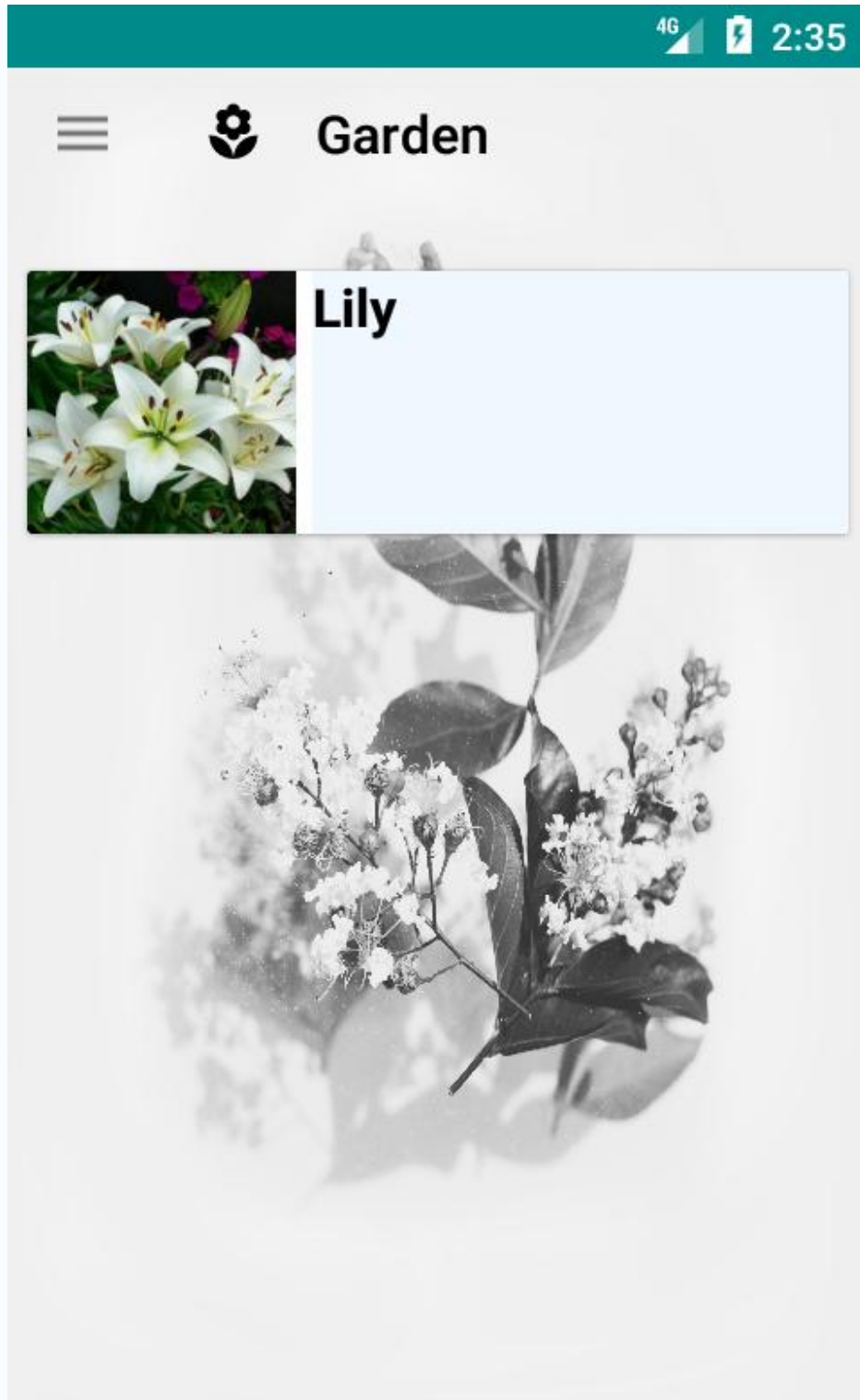


5 In above activity we have added one extra feature of Navigation Drawer.

On clicking on the navigation button (button with icon of 3 stripes) the Navigation Drawer pops out on which we have added menu with option like Garden, Plant Database etc. If user clicks on the option it will redirect directly to that particular Activity just as the option name specifies.

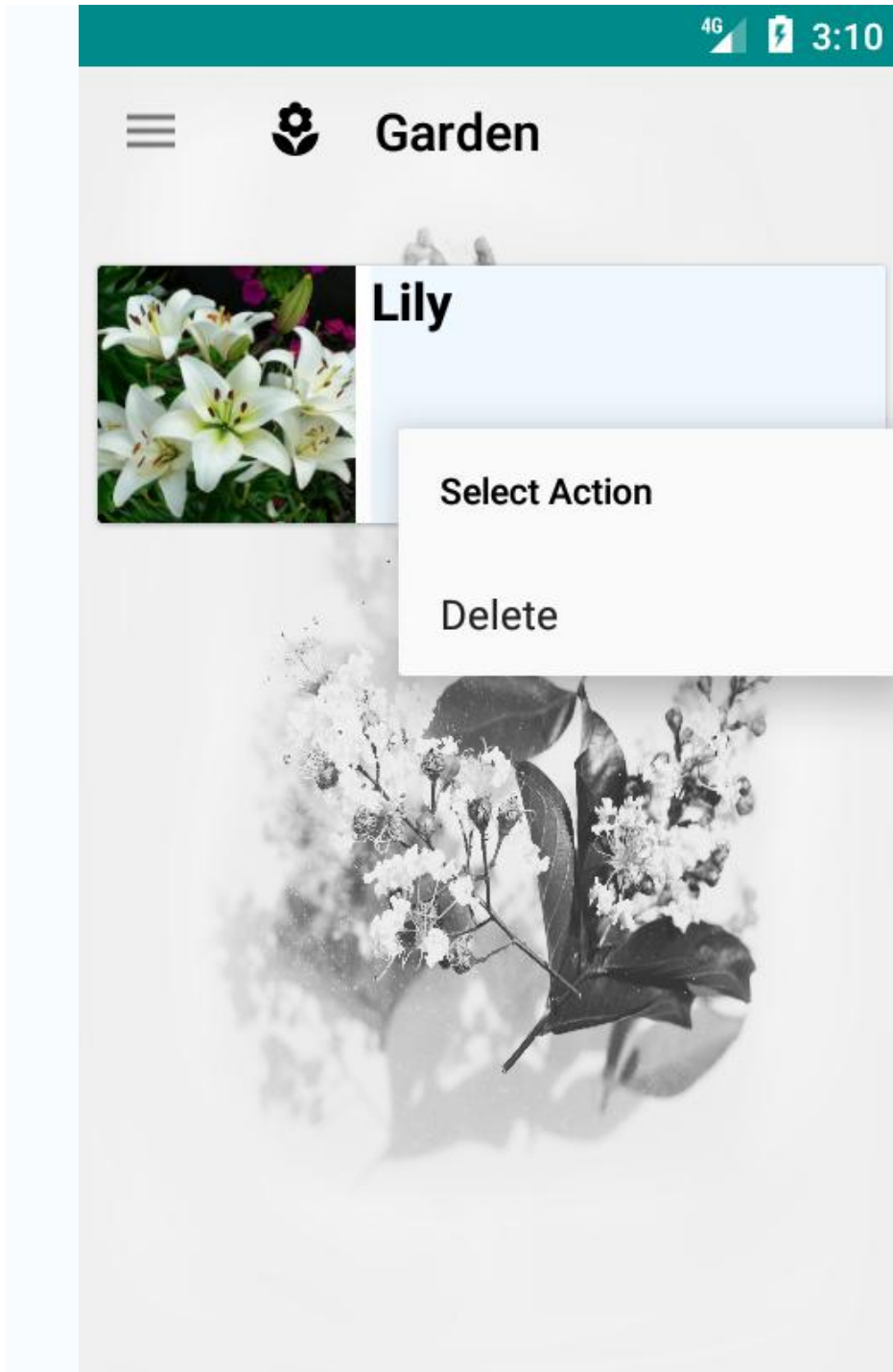


- 6 After Clicking the Circle add button the plant will be added to the garden Activity and user is directed to garden activity. Here user can see the plants that he/she have added to its garden.





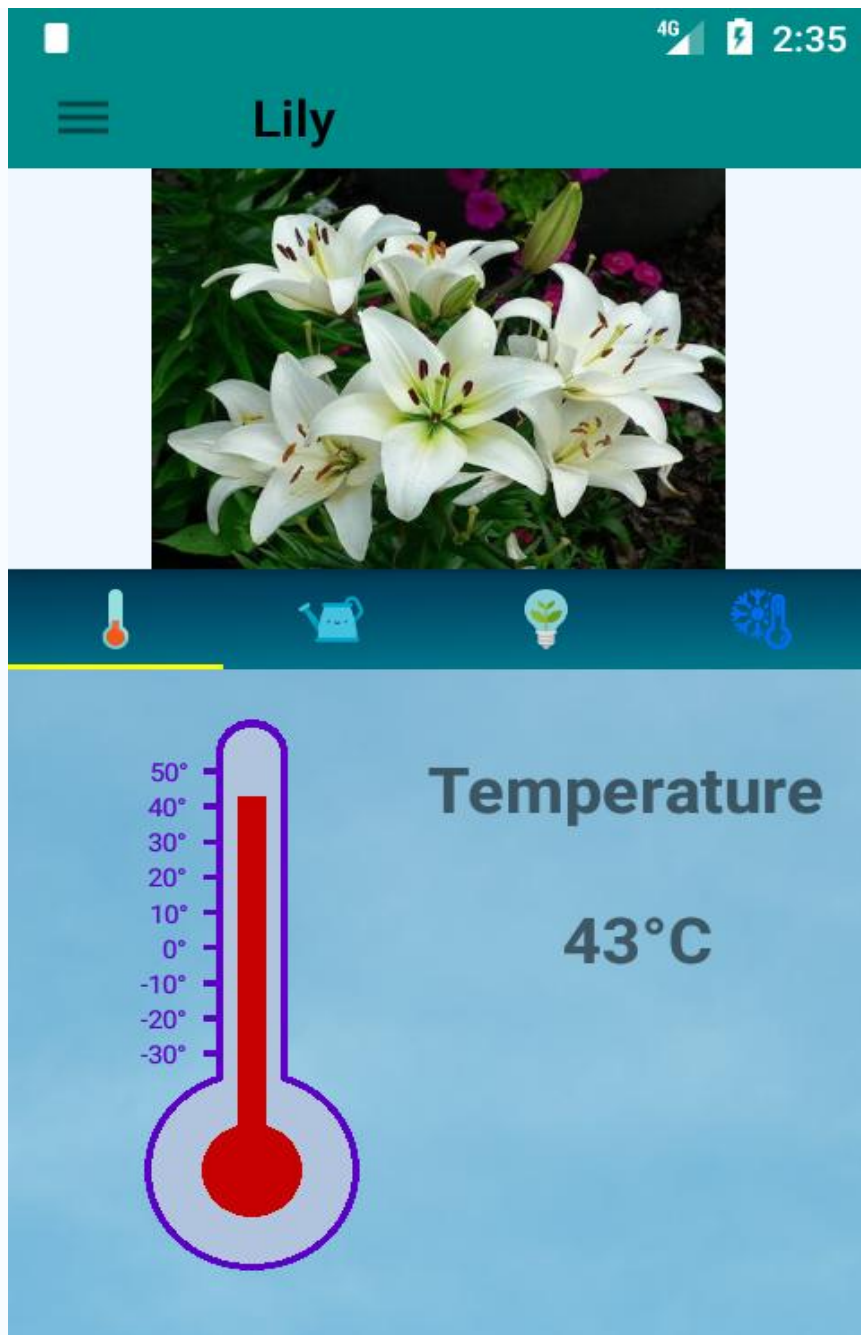
- 7 if the user wants to delete one of its plant from the garden he/she just have long press the plant name that user wishes to delete and then a delete option will pop up and just click on delete the plant will be delete from the garden.



- To view the conditions of plant or the values of sensor i.e Temperature & Humidity sensor, Light sensor and Soil moisture sensor user just have to click on the plant name and the `onClickListener` listens it redirect the user to the next activity which will show the values of sensors in 4 different tab layout

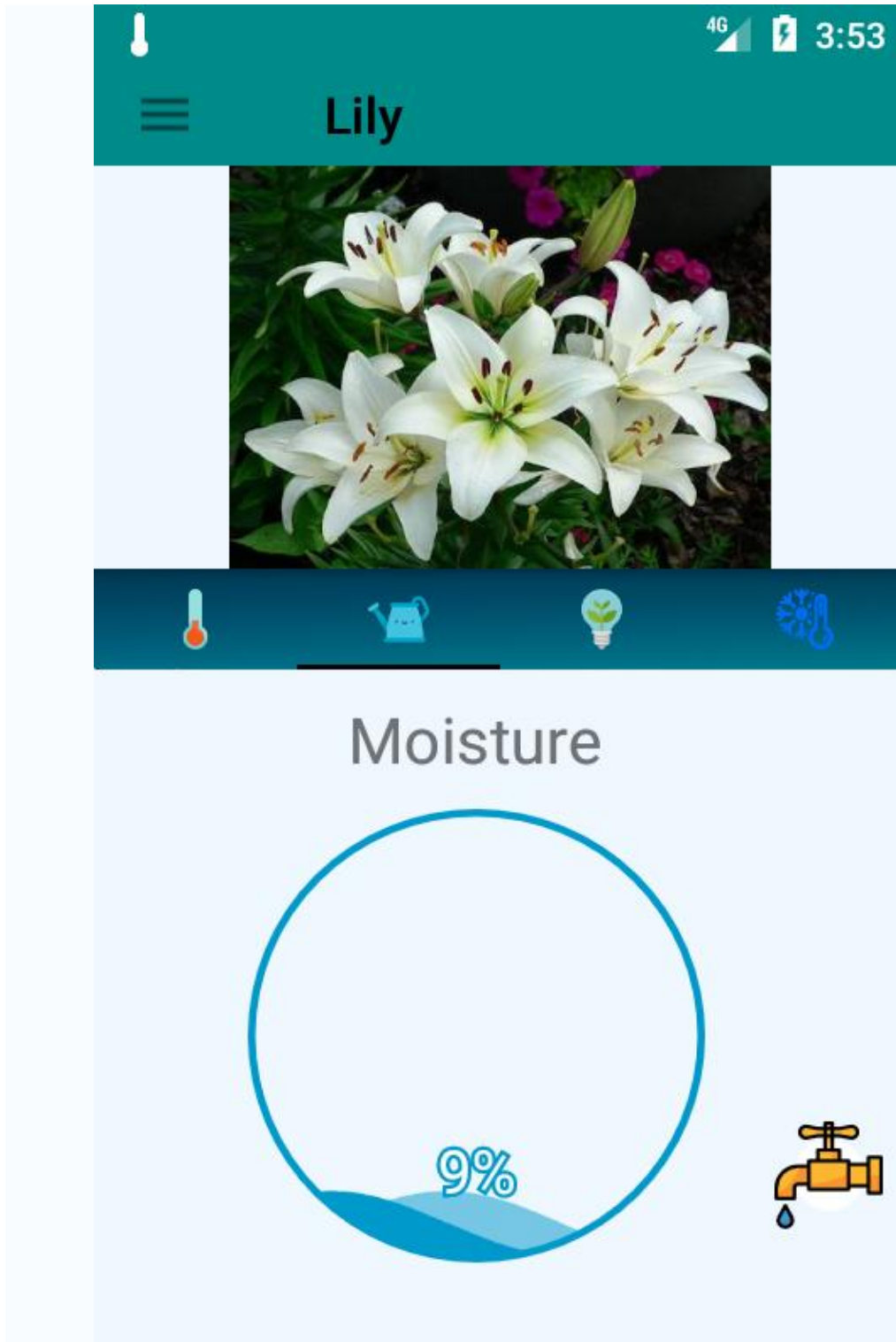
### Tab 1:Temperature

It will show the temperature of the plant in Degree Celcius in a thermometer .



## Tab 2: Water

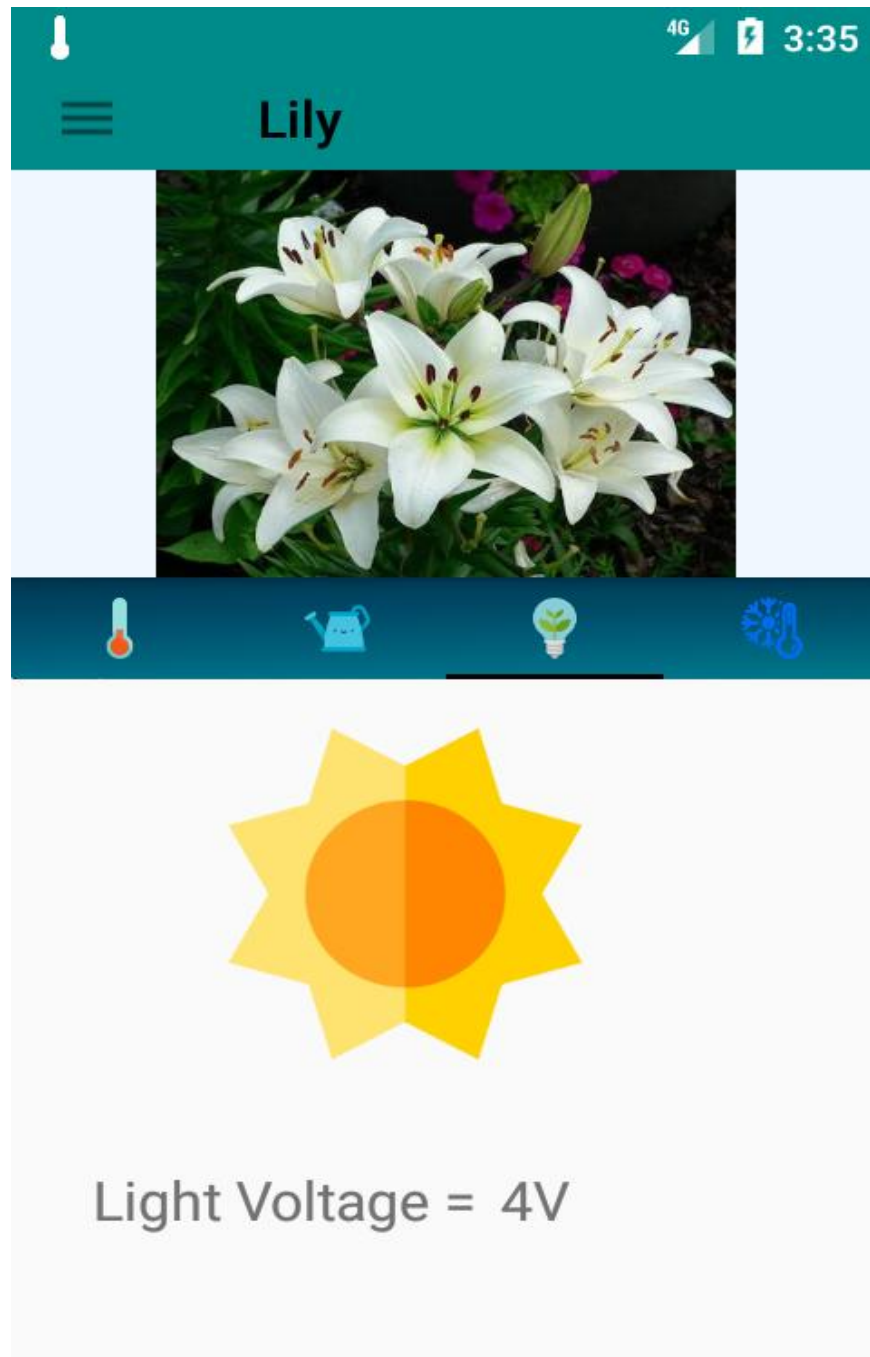
It will show the Soil moisture of the plant in percentage in a wave loading view.



### Tab 3:Light

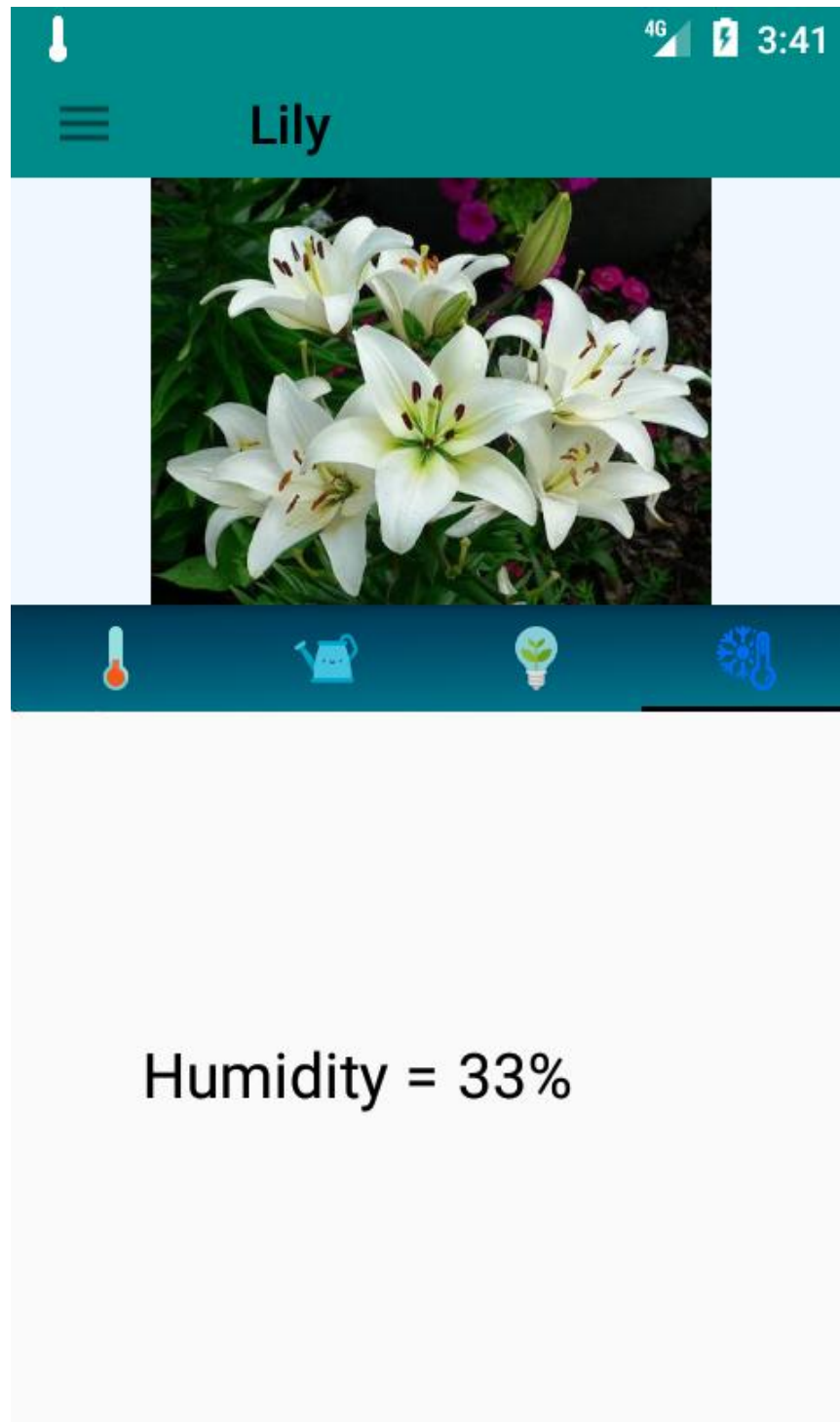
It will show the Light levels in voltage in which 4 to 5 V means there is sunlight for the plant

And 0V means there is no sunlight for the plant .

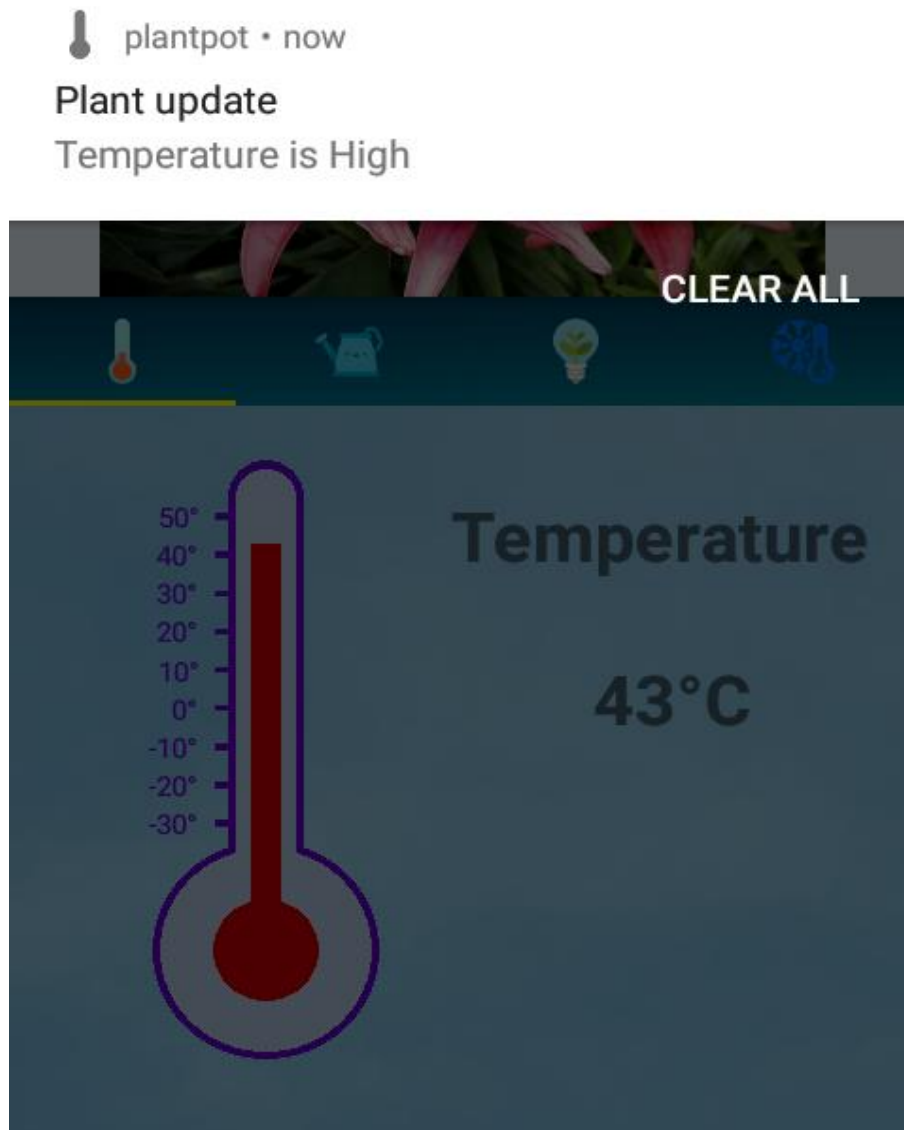
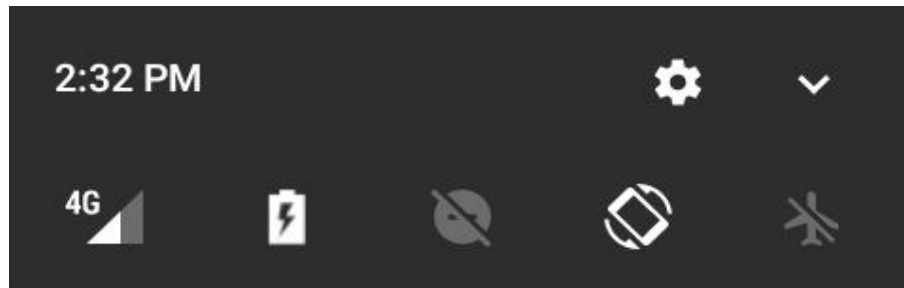


#### Tab 4: Humidity

This Tab will show the percentage of Humidity of plants atmospheres

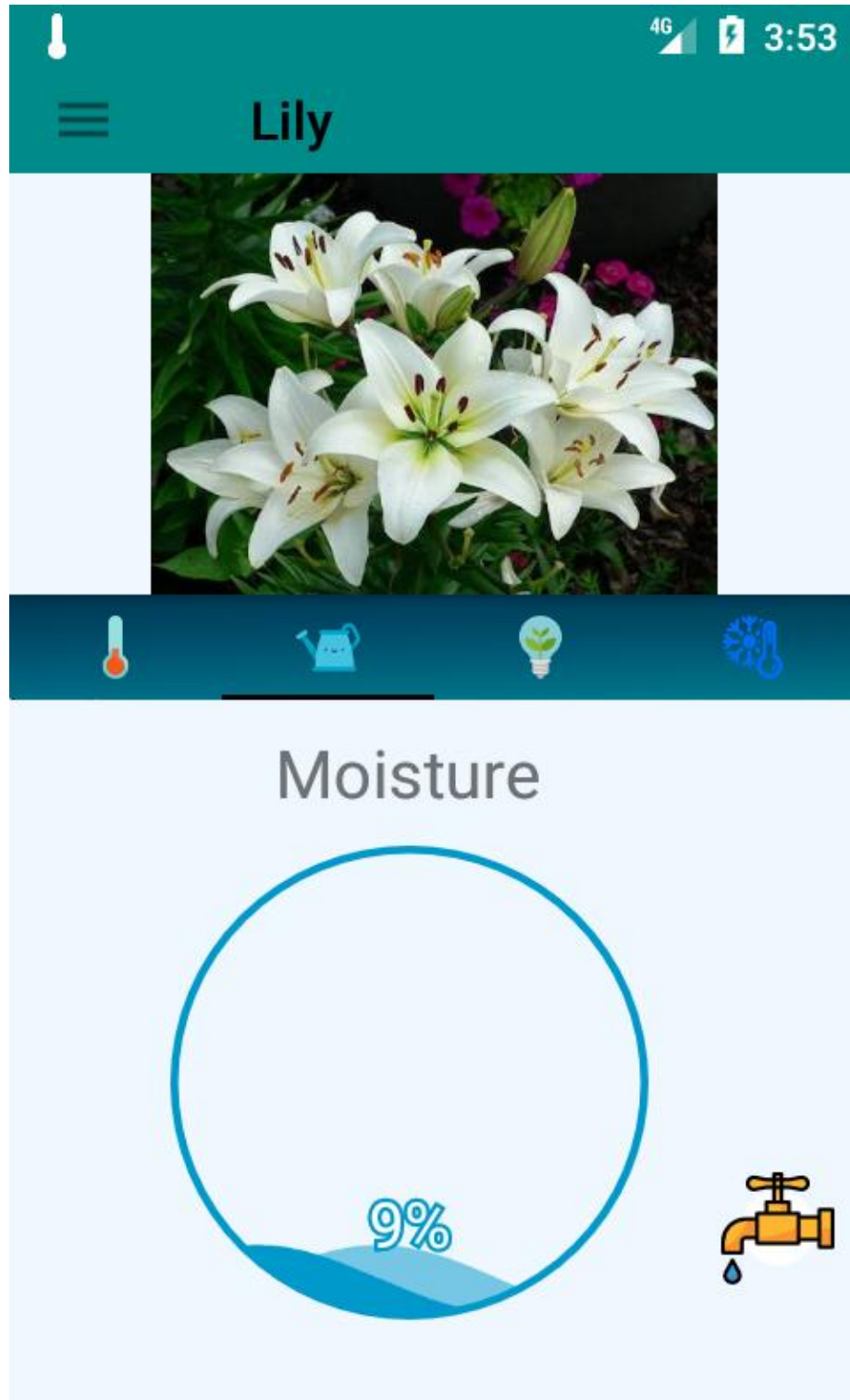


- 9 We have added the Notification feature also . If the Temperature of the plant goes beyond the plants normal temperature range or if the soil moisture level goes down the normal point then a notification will be pops on on user phone alerting him about the critical condition of the plant.



## 10 TAP Button :

On the right most corner of the water tab user can see a TAP Button which onClick activates the Automatic Irrigation System which supplies the water to the plant with just one click.



# CHAPTER 4

## HARDWARE

### 4.1: Arduino

It is software and hardware company which makes the project, software and hardware kit for microcontroller, It is an open source community for microcontroller, This is under GNU. It makes the single board microcontroller

### Software for Arduino

We have used Arduino IDE software to program the microcontroller.

### 4.2: The hardware is consist of following components:

#### NodeMcu:

NodeMcu is an open source IoT platform. It includes firmware which runs on the ESP8266 Wi-Fi SoC from Espressif Systems, and hardware which is based on the ESP-12 module.<sup>[6][7]</sup> The term "NodeMcu" by default refers to the firmware rather than the development kits. The firmware uses the Lua scripting language. It is based on the eLua project, and has built in ESP8266 wifi module.



Figure 4.1: NodeMCU



## Temperature & Humidity Sensor

The Plant pot can have either of Dht11 or Dht22 digital temperature & humidity sensor which is new model for measurement .

In this temp. is displayed in C.

it show humidity in %

We are using Dht11 sensor which shows 20 % to 80% reading which is 2-5% accurate and -40 to 80 degree c temperature which is  $\pm 0.5$  accuracy, it may be increase or decrease

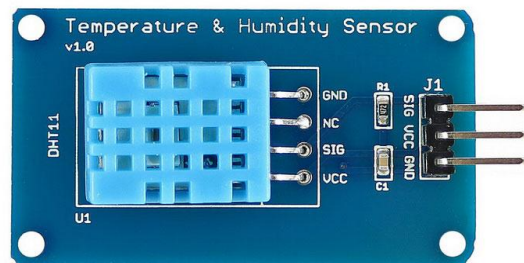


Figure 4.2: DHT11

## Light Sensors

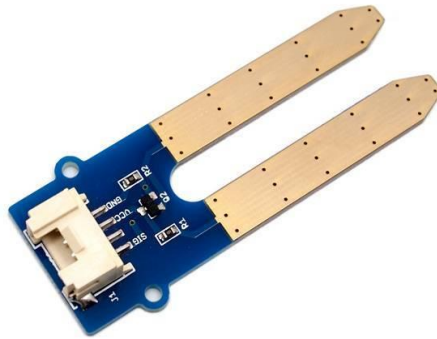
IN the pot lightsensor is used which send 0 or 1 signal . IN the device sensitivity can be adjusted by blue screw to up down the signal , it can be done without arduino.



Figure 4.3: Light Sensor

### **Soil Moisture(water) Sensor:**

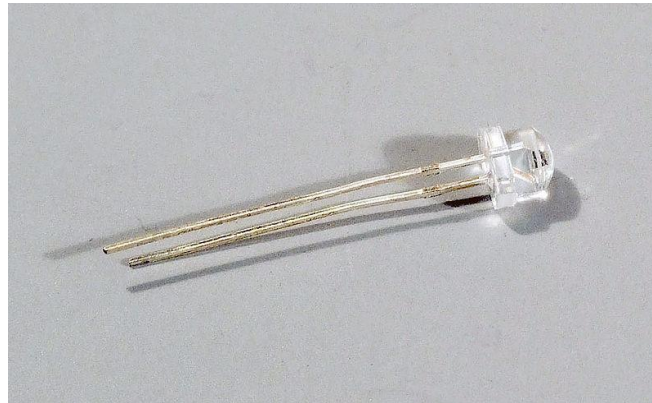
It is analog device , which shows reading from 0-1023 and it alarm us when soil value is between 0-300, and this value can be seen in code, this can be adjusted for each **plant differently**.



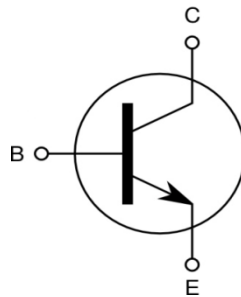
**Figure 4.4:** Soil moisture sensor

### Light Sensor:-

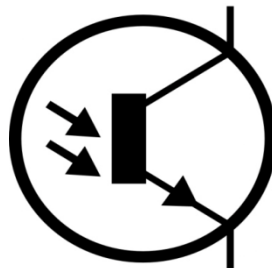
A light sensor is device which show light level ,it may be bright/ dark signal. There are many different types of sensor like Photoresistors ,photodiodes and phototransistor.



**Figure 4.5:** A Phototransistor



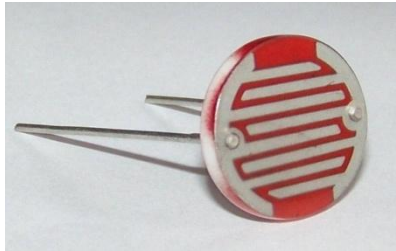
**Figure 4.6 :***Circuit diagram of a transistor*



*Circuit diagram of a phototransistor*

## Photoresistors

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**Figure 4.7:** Aphotoresistor

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## RGB LED Module

RGB LED Module is used in this project as an indicator that will indicate the conditions of the plant. Using PWM dimming we can make different of colors and changing effects. RGB modules are perfect for many projects. Module input voltages vary from 5VDC-12VDC.



**Figure 4.6:** RGB Led Module

## **Plant Pot 3D printed model**

Below figure shows the how our plant pot looks like and it is prepared from laser cutting of acrylic sheet of 4mm thick .



## **Automatic Irrigation System(AIS)**

It is the supplying of water to the plant. Irrigation has been used to assist in the growing of agricultural crops, maintenance of landscapes, and re-vegetation of disturbed soils in dry areas and during periods of inadequate rainfall. In crop production, irrigation helps in protecting plants against frost, suppressing weed growth in grain fields and preventing soil consolidation. Irrigation systems are also used for dust suppression, disposal of sewage, and in mining. The old method used for irrigation was the use of methods such as watering cans, water channels that have to be opened and closed manually or backpack sprinklers. In this case, a lot of water is

wasted in the process . There is need for improvement on the existing or old forms of irrigation

The AIS should perform the following functions:

- continuously monitor the amount of soil water available to plants (this is usually achieved using a sensing system).
- determine if water is required for the plants based on the information obtained from soil moisture sensor.
- supply exact (or approx) amount of water required for the plants. This will be enhanced by how well it achieves requirement 1.
- discontinue the water supply when the required amount has been delivered to the plants. This feature is important as the amount of water available for the irrigation system is not infinite, therefore water management is paramount.

### **AIS System Consists of**

#### **The Pump**

The pump used was constructed using a miniature dc motor powered by the output of the power supply unit. The mechanical output point of the motor was loaded with miniature bidirectional fan blades and secured firmly using glue. The pumping was achieved by placing the fan blades in an enclosure made from two cylindrical plastic stoppers. The motor was also inserted into a stopper to protect it from contact with water. The electrical connections to the motor were passed through a tight hole in the side of the stopper. The stopper containing the motor was then taped with a water-tight cellophane tape to the pumping enclosure to make the pumping system one single unit. When it is put in water and connect it with the power supply, water is pass through the hole at the top of the pump, the

blades attached to the rotor spin the water around in the pumping enclosure and the water exits through the pipe attached to the hole at the side of the enclosure.

### **Circuit implementation**

The implementation of the electronic circuitry involved the computerized simulation (using NDeMCU) of the system design, physical implementation of the circuit using a breadboard to ensure proper operation and the final implementation of the circuit on a bread board.

### **System testing and result**

The system will be testing using different soil samples.

**CHAPTER 5**  
**CONCLUSION AND FUTURE OUTLOOK:**



## **CONCLUSION**

Our conclusion about the case study of planets is that people have no time to know the plants growth, which is necessary for plants, If there are no plants on the earth ,we face many problems like we can not breath, air will be not clear, we can not get fruits, vegetables etc.

Peoples are busy, they are fail to spend time on them i.e what a plant need like how much water is need for growth, cold and hot condition, what seeds are needed for growth,

So we develop a smart plant pot which automatically send signals through android app i.e report of temperature, humidity, cold and water level of any plant we added in the database of the app. Which has unique id.Smart plant pot system is better combination of hardware and software combination , It gives beter results about the plant via email or notification.

## **FUTURE OUTLOOK:**

For future outlook, we could add certain functionality for making the system more smart by uploading the configuration of the plant at the time of set upset, through the hardware device interface. Functionalities like scheduled manual override can be added. Camera monitoring , live streaming of the plant etc.

## **RESULTS**

The hardware is connected with all the sensors in the board. The hardware components include the microcontroller(NodeMCu),RGB Led module, and all the sensors interfaced. The output denotes the temperature, soil moisture condition and the intruder detection. The second result is the output from the Android Application that is developed in the mobile phone. It determines the temperature, humidity, moisture and the intruder detection.

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