Department of Electrical and Computer Engineering
North South University

CSE 499: Senior Project Design
Course Instructor: Dr. Dihan Md. Nurudddin Hasan

"Farmware"

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Dedicated to
Our Beloved Dihan Sir

Fall, 2019

DECLARATION

This is to certify that the work reported in this thesis was done by the author, unless specified otherwise. No part of this work has been submitted elsewhere partially or fully for the award of any other degree or diploma. Any material reproduced in this project has been properly acknowledged.

Student's name and signature

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APPROVAL

We, **Tahmim Ali (ID-1510444042), Md. Fahad Hasan Chowdhury (ID-1610331042) Md. Shohaib Islam (ID-1611237042) and Jubayer Uddin Shamim (ID- 1511989642)**, members of **CSE 499 (Senior Design Project)** from the Electrical and Computer Engineering department of North South University; have worked on the project titled **"Farmware" a smart farming system** under the supervision of
Dr. Dihan Md. Nuruddin Hasan as a partial fulfillment of the requirement for the degree of Bachelors of Science in Engineering and has been accepted as satisfactory.

Supervisor's Signature

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Abstract

Bangladesh is an agricultural country and most of the farmers in our country is uneducated also they don't know how to access the facility of digital system. The farmers of our country are really hard worker, be it sunny or rainy they had to work in their fields. We developed our project "Farm-ware" to make their life easy and also we kept our app simple so that they can access it easily. Our project is mainly a smart farming based app, we can implement this in a particular area to get the information of the atmosphere as well as the growth rate of the plants of that area.

Acknowledgement

We would like to Thanks our faculty, **Dihan Md. Nuruddin Hasan** sir to give us this opportunity to do this project on **"Farm-Ware"**. It was really a good opportunity for us because we got to learn so many new things which will be very useful for us. Also we would like to thank our friends who helped us to know more about this project and our group members, who were very dedicated and active.

Contents

Introduction

We have done the project farm-ware to make it easy for the people to get enough information about the temperature, humidity, soil moisture etc. of a particular area. Bangladesh is an agricultural country. But maximum number of our farmers are uneducated. So they can't access the facility of the digital services related to agriculture using smart devices. Project Farm-Ware is based on this context to provide information collected by Hardware tools and served by easy interface presenting the information only. Farm ware is also included with website and smartphone application to spread the collected information.
The hardware part is going to build by using micro controller and sensors. The information will be about the temperature, soil moisture, humidity, water flow and water level, pesticides, plant growth etc. The information will be presented on spot by the device. Information will also be stored in the cloud. The information can be accessed through our app easily and simply. We have also implemented machine learning using our sensors data. Which will determine the growth rate of the plants. Most of the people in this country is depended on agriculture and that is why keeping this in mind we developed this project to make farming easier for the people. With the growing adoption of the Internet of Things (IoT), connected devices have penetrated every aspect of our life, from health and fitness, home automation, automotive and logistics, to smart cities and industrial IoT. Thus, it is only logical that IoT, connected devices, and automation would find its application in agriculture and, as such, tremendously improve many facets of the farming practice. The agriculture industry could be further developed by employing new technologies, in particular, the Internet of Things (IoT). Farming has seen a number of technological transformations in the last decades, becoming more industrialized and technology-driven. By using various smart agriculture gadgets, farmers have gained better control over the process of raising livestock and growing crops, making it more predictable and efficient.

Problem Statement

Farming is not an easy job there is a lot to handle and also farmers need to know so many information like what is good for their plant and what is not also they should know about the atmosphere. To provide efficient decision support system using wireless sensor network which handle different activities of farm and gives useful information related to farm field to farmer. As our country is developing, our farming system should also develop. Many farmers lack the knowledge of smart farming and also how to apply technology for their benefit.
The hardware part is going to build by using micro controller and sensors. The information will be about the temperature, soil moisture, humidity, water flow and water level, pesticides, plant growth etc.
The information will be presented on spot by the device. Information will also be stored in our database. To show the information we will use smartphone applications

Proposed Solution

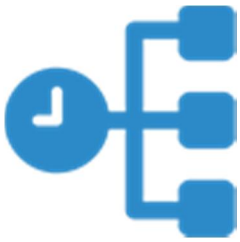
Our solution in this situation is creating Farm-Ware. It will save time and toil both. Also it is a low cost project so that the farmers can implement it on their land and can get the information easily and quickly. Our solution has some attractive features like:

1. Low cost to implement the whole system.
2. Simple design.
3. Easy to implement.
4. Easy to install the app.
5. Easy to use.
6. Data is stored directly.
7. Stored data can be access easily.

In its simple form, our system is consists of some sensors to get the data's from the atmosphere. The whole system will look like this:

Fig. Picture of the whole project.

The sensors will be placed in the particular area like this and also we will implement a camera which will take pictures of the plants to show the growth rate of the plants. The whole thing will be connected with the app, so that all the data's will be visible on the app.
This system will create a great impact on uses of daily life of the farmers as it will reduce their toil and time. Also it will be very useful for a large farming area.



Higher productivity

Improved quality data capture

Lower cost

Our system will work like the following work flow:

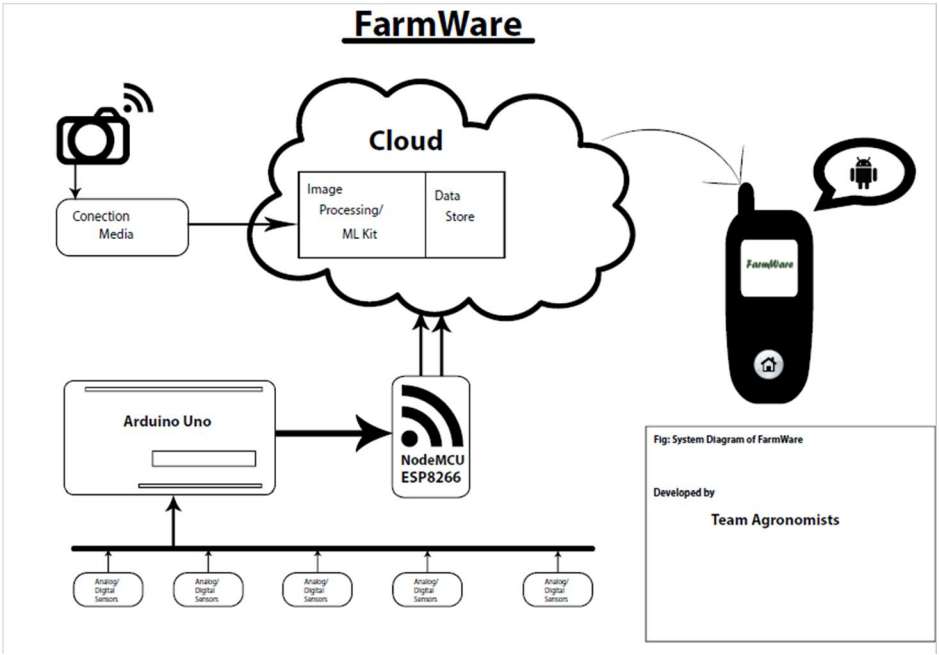


Fig. : System diagram

The farm-ware app is also designed to keep it as simple as possible. This will help the farmers to look after their crops from their home. They can see the crop growth and also get the respected data's through the app.
The approach of the app is given below:

Front-end plan

A total of 8 page-templates in plan
1. Main page
2. Search result page
3. Location page
4. Agricultural data page
5. Advice page
6. Register/login page
7. Farmer profile creation page (all steps 1,2,3 as one)
8. Agricultural officer's details page

Map layout on search results will be visible and this will use Google API.

Back end development

1. Account Creating, Password Recover:
    a. Sign up form, verification by mobile or email.
    b. Login
    c. Forgot Password
    d. MySQL Database
    e. Google sign in

2. Profile Management:
    a. DB plan design
    b. User Profile
    c. Profile of agricultural officer
    d. Others

3. Searching facility:
    a. Location based
    b. Data search

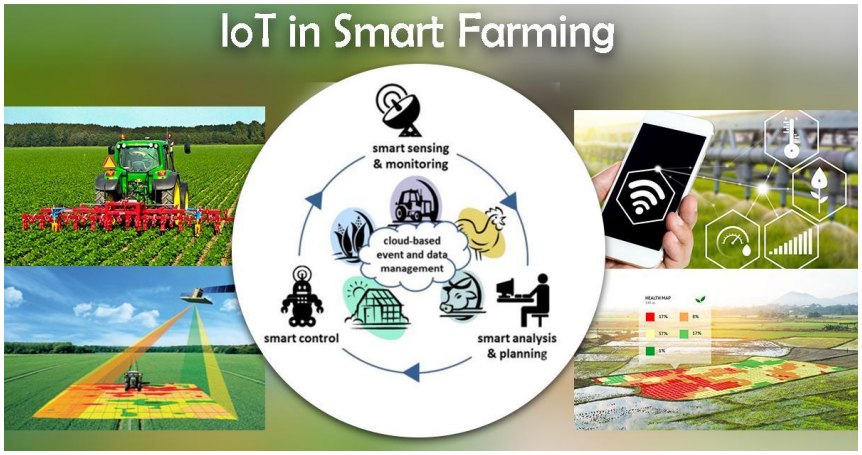
Related work

Smart farming is now a days most popular among the farmers of the developed country. Some of the related works of smart farming based on IoT are as follows:

a. Precision Farming

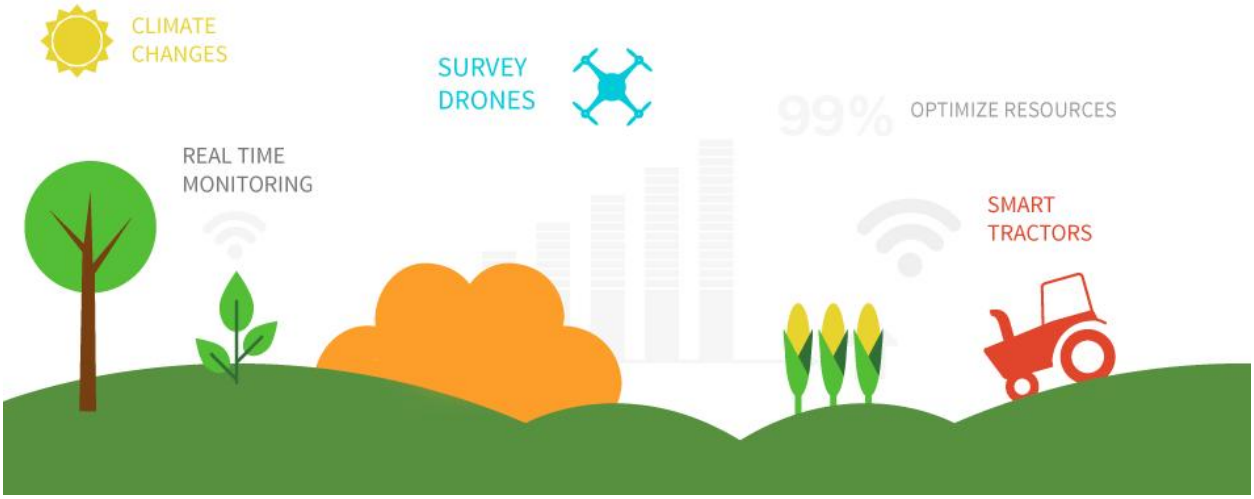
Precision farming is a process or a practice that makes the farming procedure more accurate and controlled for raising livestock and growing of crops. The use of IT and items like sensors, autonomous vehicles, automated hardware, control systems, robotics, etc in this approach are key components.

Precision agriculture in the recent years has become one of the most famous applications of IoT in agricultural sector and a vast number of organizations have started using this technique around the world. The products and services offered by IoT systems include soil moisture probes, VRI optimization, and virtual optimizer PRO, and so on. VRI (Variable Rate Irrigation) optimization is a process that maximizes the profitability on irrigated crop fields with soil variability, thereby improving yields and increasing water use efficiency.



b. Agriculture Drones

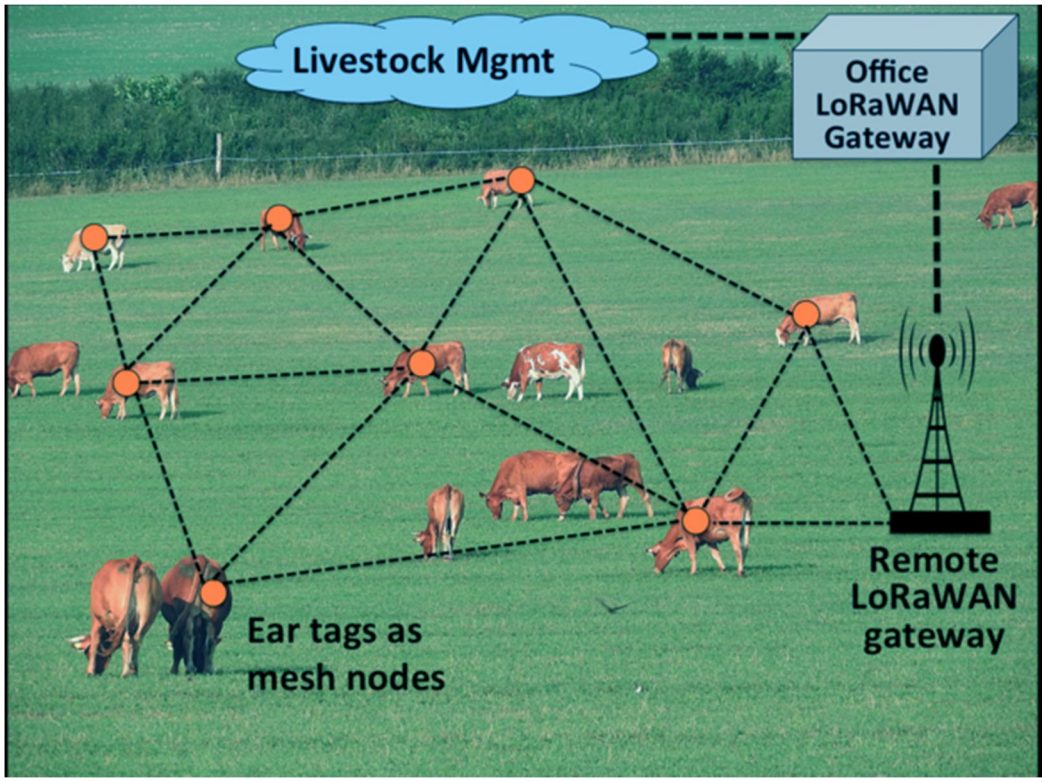
Agricultural drones are a very good example of IoT applications in Agriculture. Agriculture industries today, have become one of the major industries where drones can incorporate. Two types of drones, that is, *ground-based* and aerial-based drones are being incorporated in agriculture in many ways such as, for crop health assessment, irrigation, planting, and soil & field analysis. The benefits that the usage of drones brings to the table include, ease of use, time-saving, crop health imaging, integrated GIS mapping, and the ability to increase yields. The drone technology will give a high-tech makeover to the agriculture industry by making use of strategy and planning based on real-time data collection and processing. The farmers through drones can enter the details of what field they want to survey. Select an altitude or ground resolution from which they what data of the fields. From the data collected by the drone, useful insights can be drawn on various factors such as plant counting and yield prediction, plant health indices, plant height measurement, canopy cover mapping, nitrogen content in wheat, drainage mapping, and so on. The drone collects data and images that are thermal, multispectral and visual during the flight and then lands at the same location it took off initially.



c. Livestock Monitoring

IoT applications help farmers to collect data regarding the location, well-being, and health of their cattle. This information helps them in identifying the condition of their livestock. Such as, finding animals that are sick so, that they can separate from the herd, preventing the spread of the disease to the entire cattle. The feasibility of ranchers to locate their cattle with the help of IoT

based sensors helps in bringing down labor costs by a substantial amount. One example of an IoT system in use by a company is JMB North America. Which is an organization that provides cow monitoring solutions to cattle producers? Out of the many solutions provided, one of the solutions is to help the cattle owners observe their cows that are pregnant and about to give birth. From them, a battery that is sensor powered is expelled when its water breaks. An information is then sent to the herd manager or the rancher. The sensor thus enables farmers will more focus.



Technical approach

The equipment's that we used to develop our whole system are given below:

1. Arduino Uno board
2. Temperature sensor
3. Humidity sensor
4. Water level sensor
5. Water flow sensor
6. Raindrop sensor
7. Soil moisture
8. Bread-Board
9. NodeMCU ESP8266 Module
10. Wires
11. Android app studio for the app
12. Firebase for storing data
13. Arduino IDE
14. Codelab
15. Python

Hardware Part:

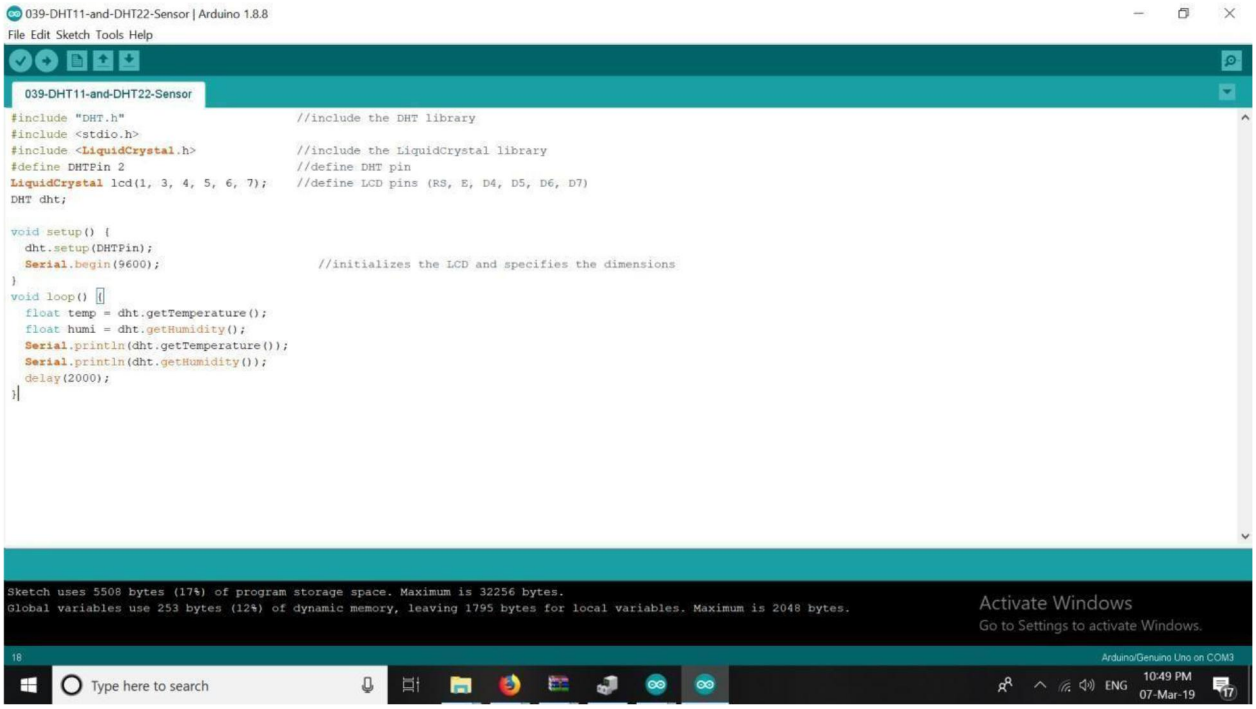
Temperature and Humidity sensors:

We have used Arduino for our project and also done the coding that will detect the temperature and humidity of the atmosphere using DHT22 temperature and humidity sensor.

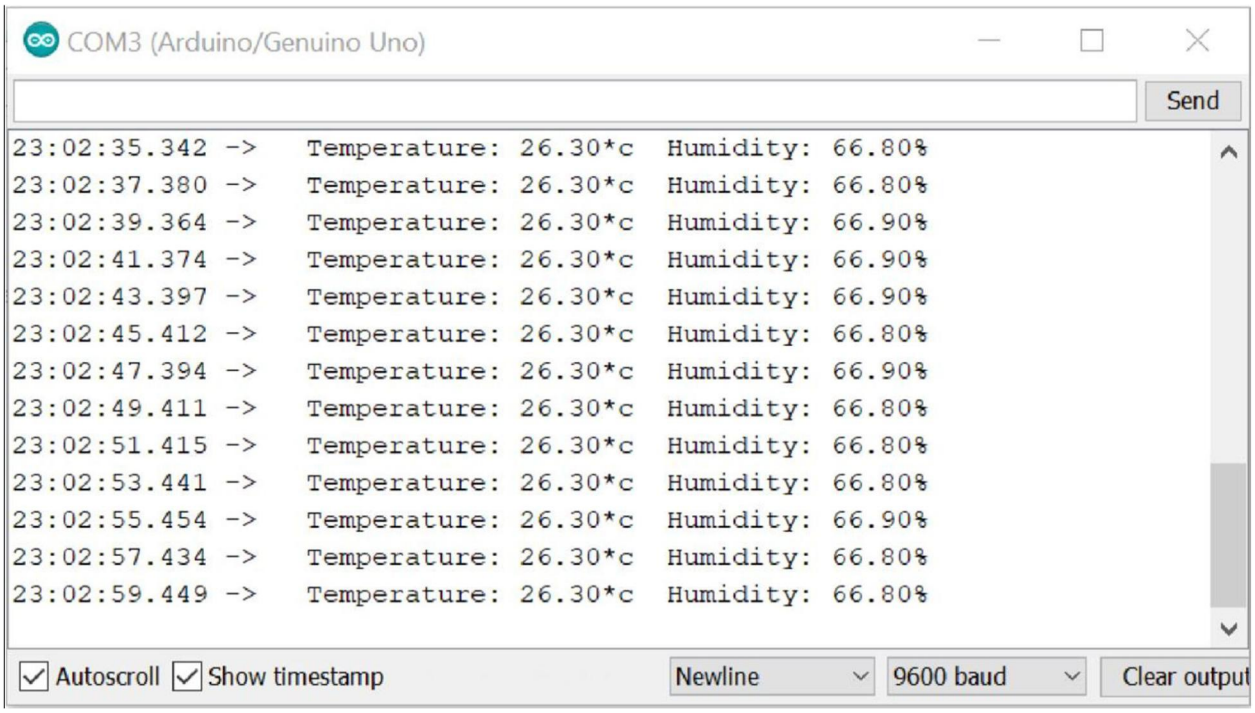
Code:

```
#include "DHT.h" //include the DHT library
#include <stdio.h>
#include <LiquidCrystal.h> //include the LiquidCrystal library
#define DHTPin 2 //define DHT pin
LiquidCrystal lcd(1, 3, 4, 5, 6, 7); //define LCD pins (RS, E, D4, D5, D6, D7)
DHT dht; void
setup() {
dht.setup(DHTPin);
Serial.begin(9600); //initializes the LCD and specifies the dimensions
}
void loop() {
float temp = dht.getTemperature(); float
humi = dht.getHumidity();
Serial.println(dht.getTemperature());
Serial.println(dht.getHumidity());
delay(2000);
}
```

Arduino IDE snap:



Serial Monitor snap:



Circuit:

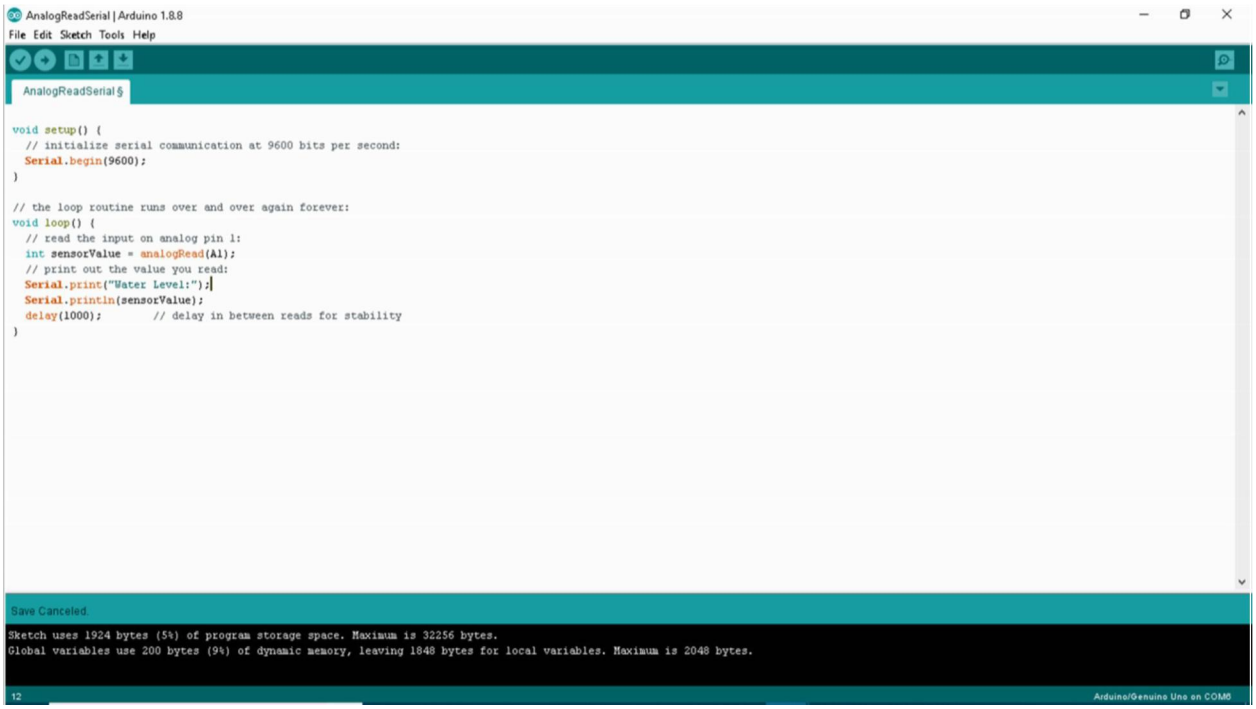
Water Level Sensor:

Water level sensor is used to measure the level of water of a particular area.

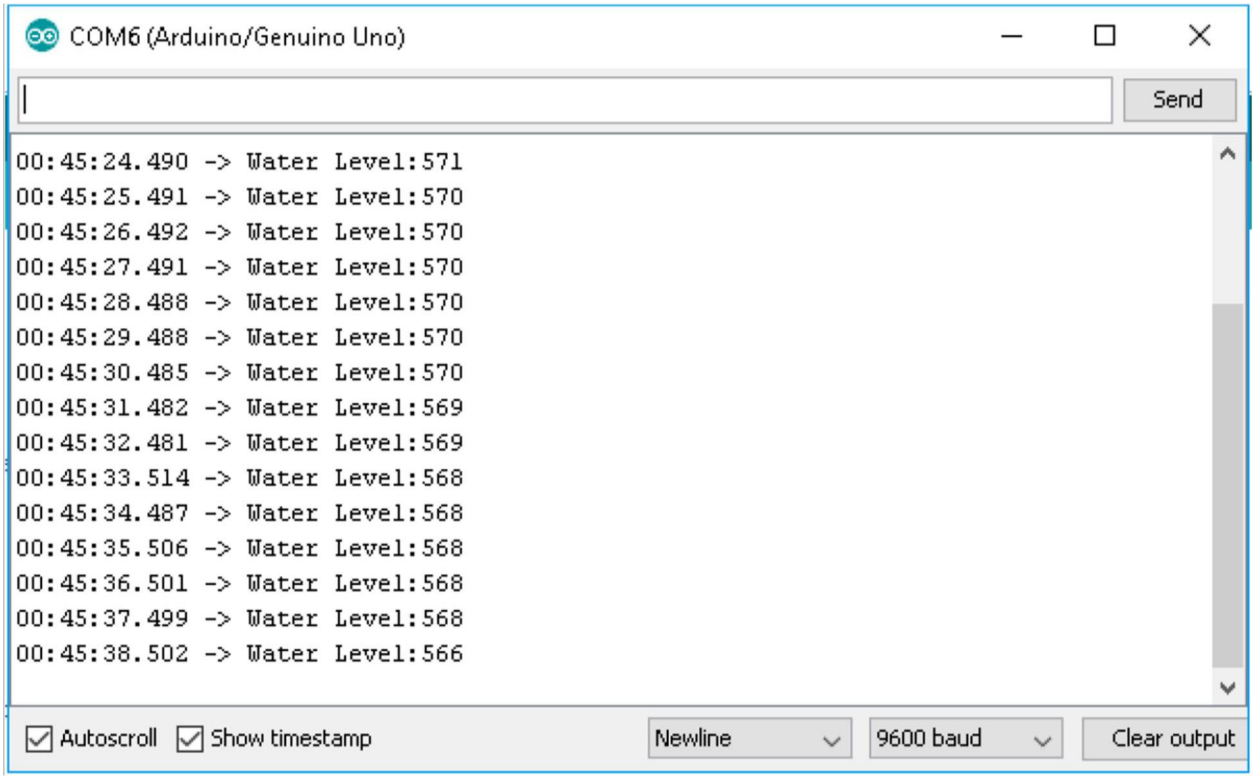
Code:

```
void setup() {
// initialize serial communication at 9600 bits per second:
Serial.begin(9600);
}
// the loop routine runs over and over again forever:
void loop() {
// read the input on analog pin 1: int sensorValue
= analogRead(A1);
// print out the value you read:
Serial.print("Water Level:"); Serial.println(sensorValue); delay(1000);
// delay in between reads for stability
}
```

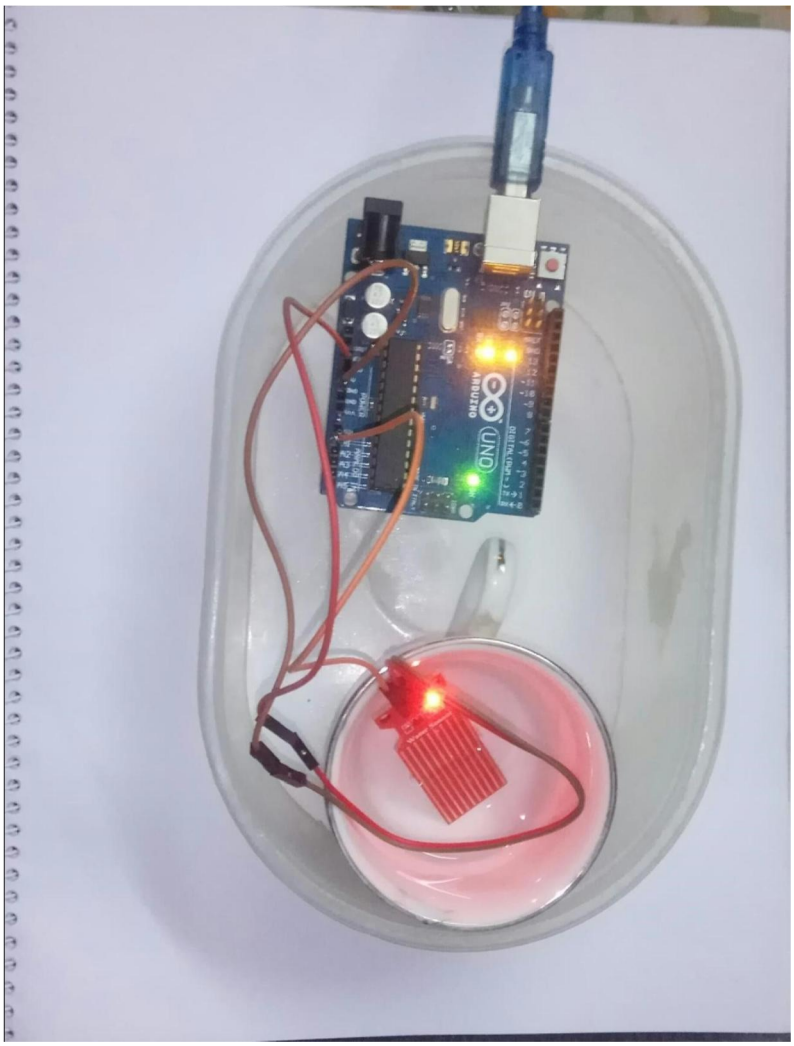
Arduino IDE snap:



Serial Monitor Snap:



Circuit:



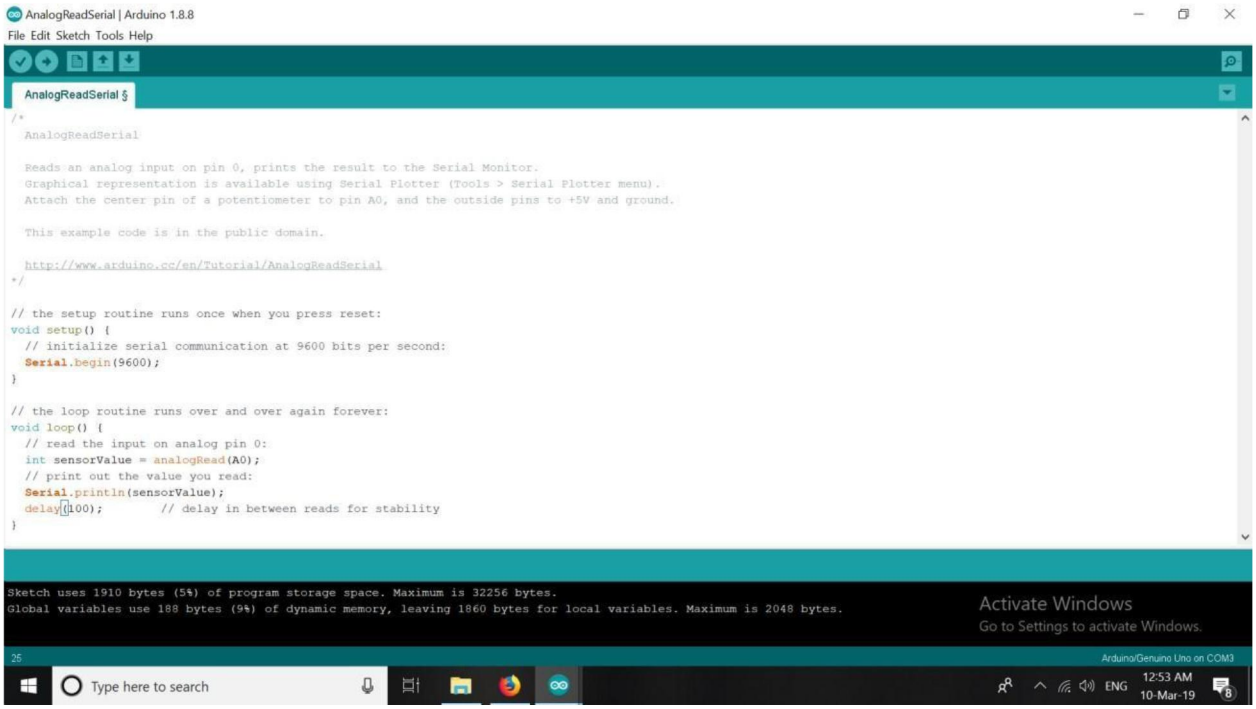
Water flow sensor:

We have used Arduino for our project and also done the coding that will detect the irrigation using Water Flow Sensor.

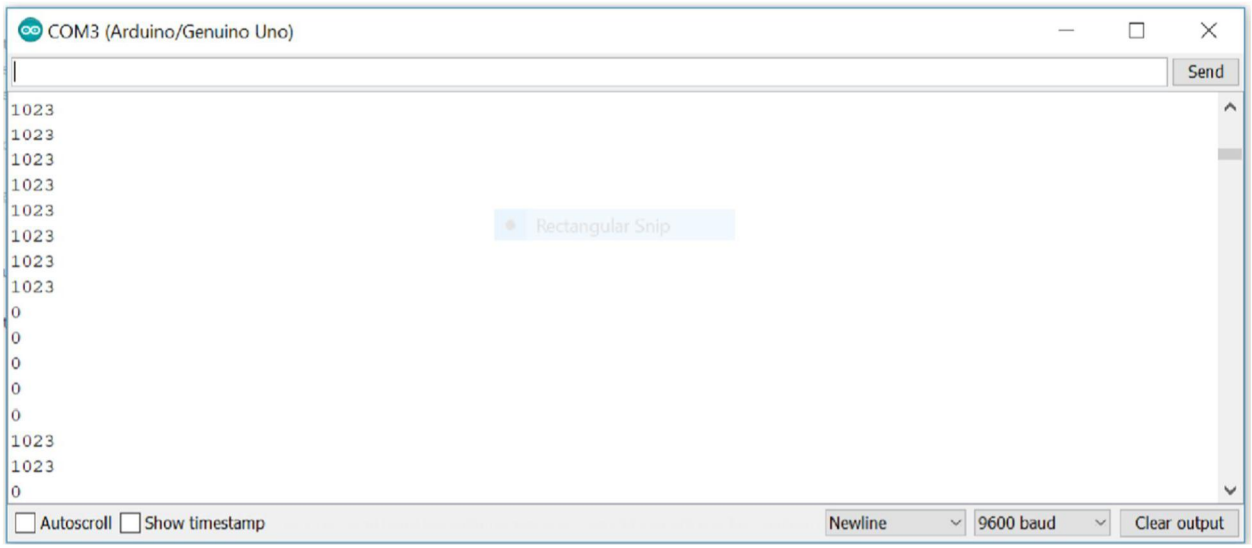
Code:

```
void setup() {
// initialize serial communication at 9600 bits per second:
Serial.begin(9600);
}
// the loop routine runs over and over again forever:
void loop() {
// read the input on analog pin 0: int sensorValue =
analogRead(A0); // print out the value you read:
Serial.println(sensorValue); delay(100); // delay
in between reads for stability
}
```

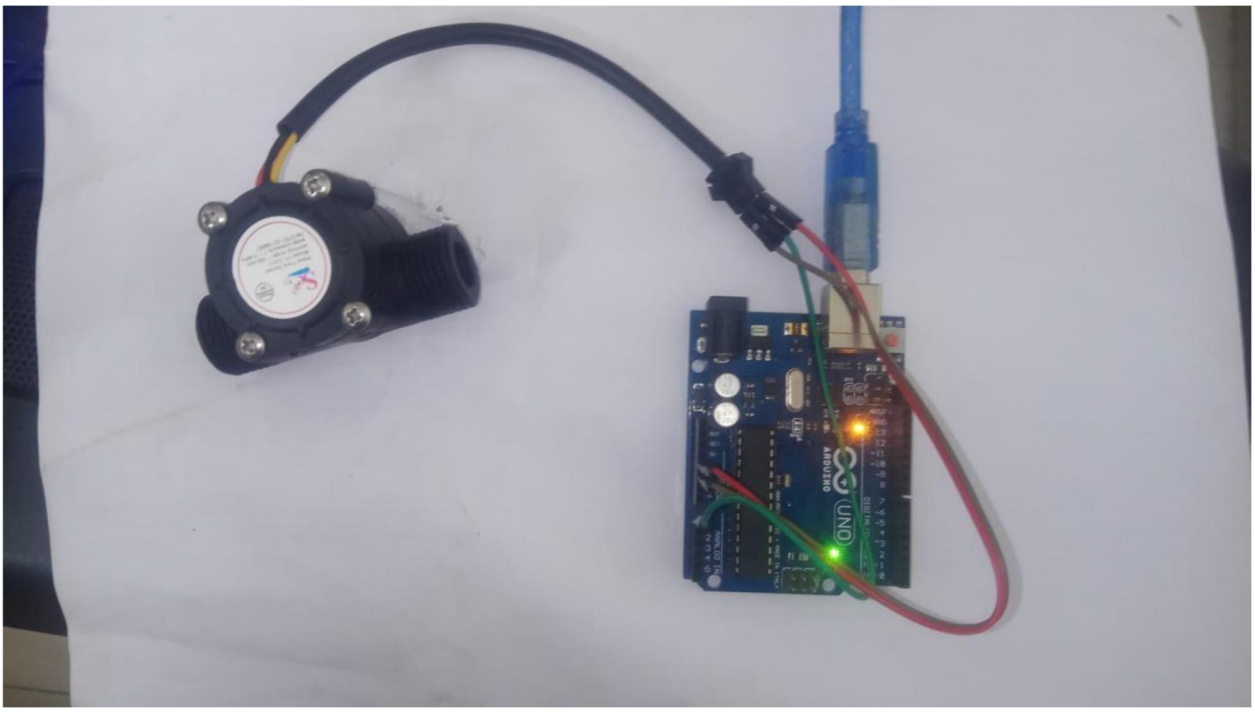
Arduino IDE snap:



Serial Monitor snap:



Circuit:



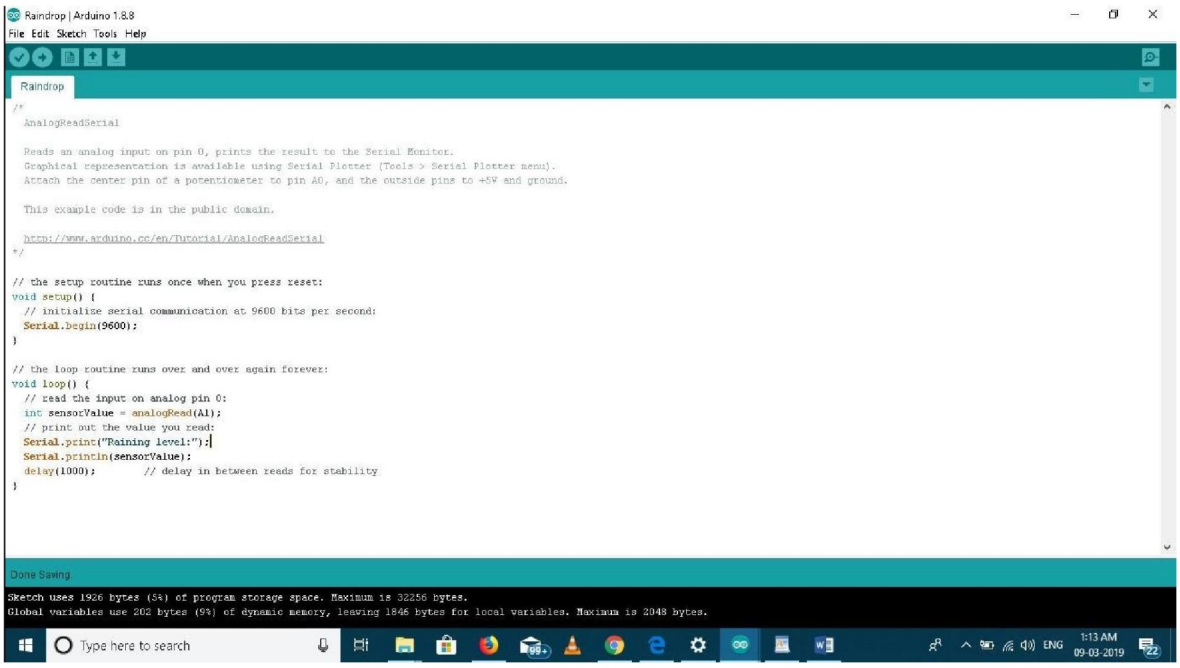
Raindrop sensor:

It will detect the rain drop using the sensor DHK MH-RD Raindrop Sensor.

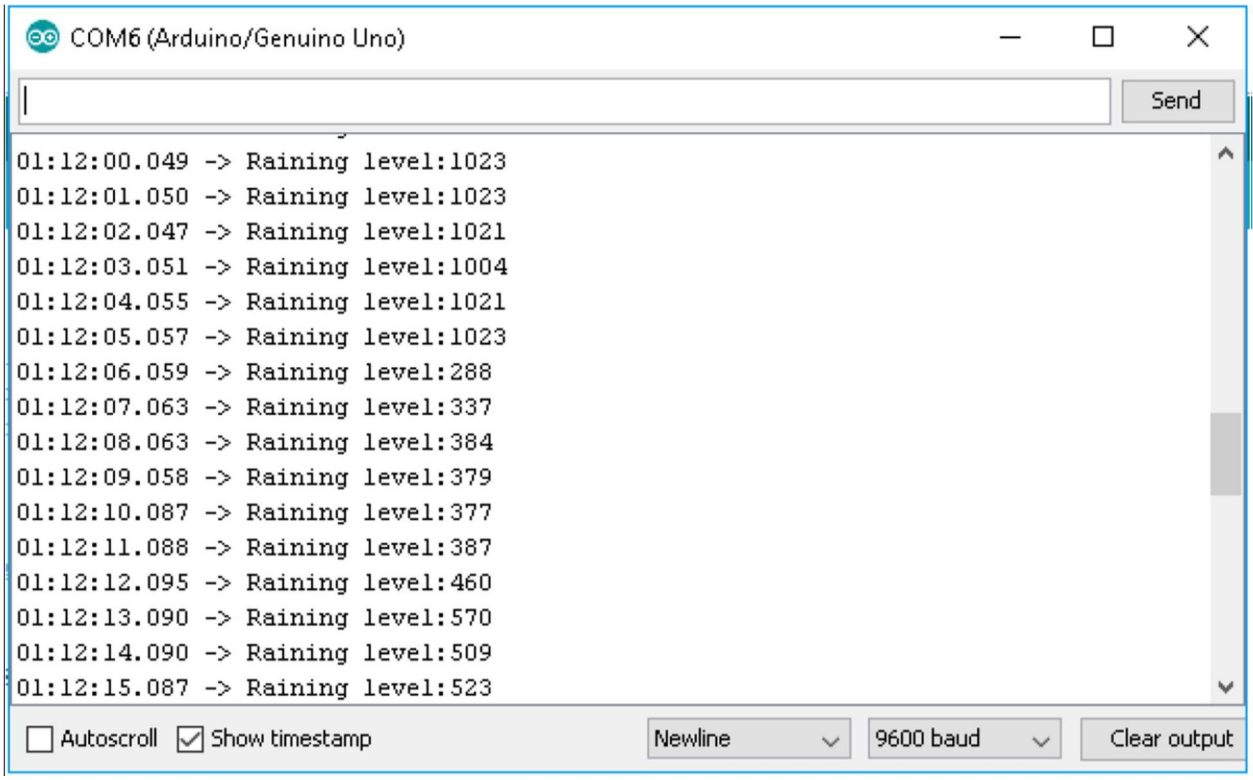
Code:

```
void setup() {
// initialize serial communication at 9600 bits per second:
Serial.begin(9600);
}
// the loop routine runs over and over again forever:
void loop() {
// read the input on analog pin 0:
int sensorValue = analogRead(A0); //
print out the value you read:
Serial.print("Raining Level:");
Serial.println(sensorValue); delay(1000); // delay
in between reads for stability
}
```

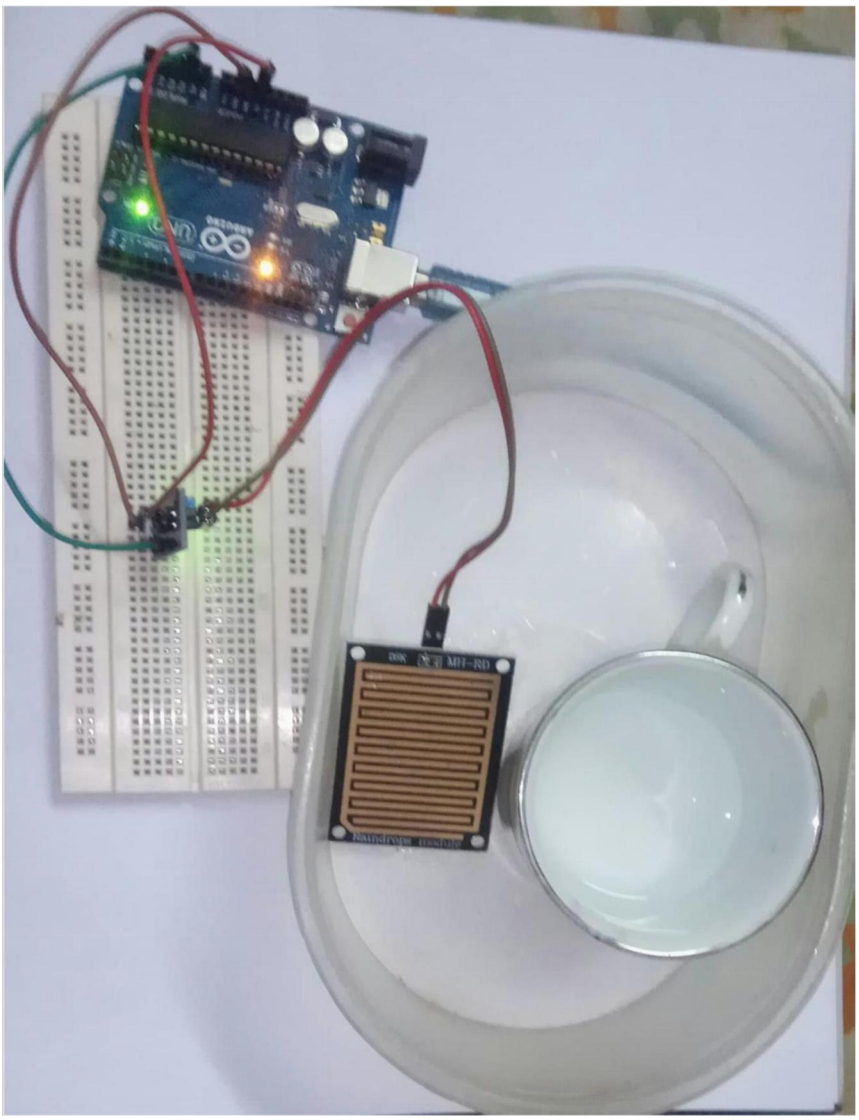
Arduino IDE snap:



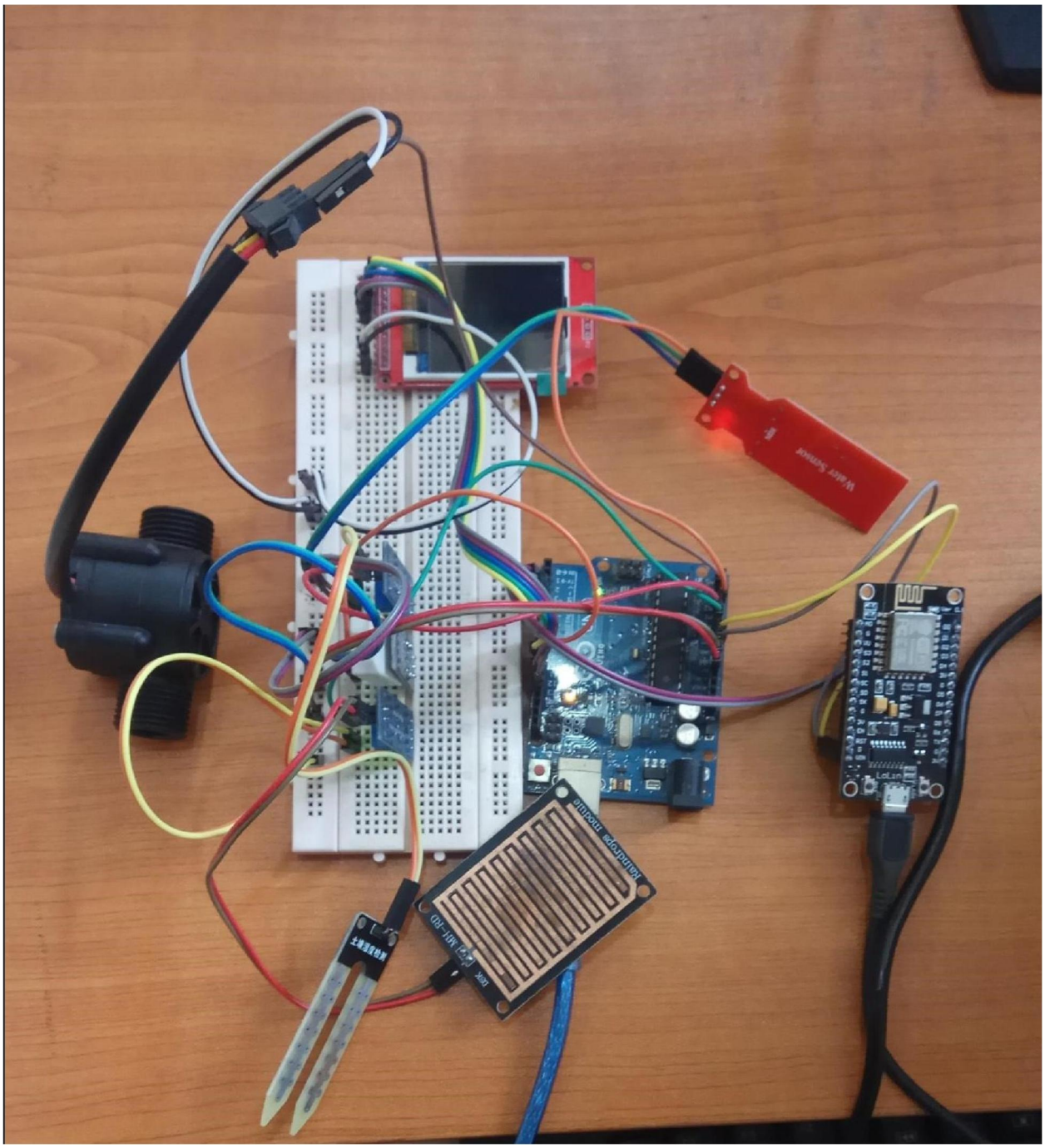
Serial monitor snap:



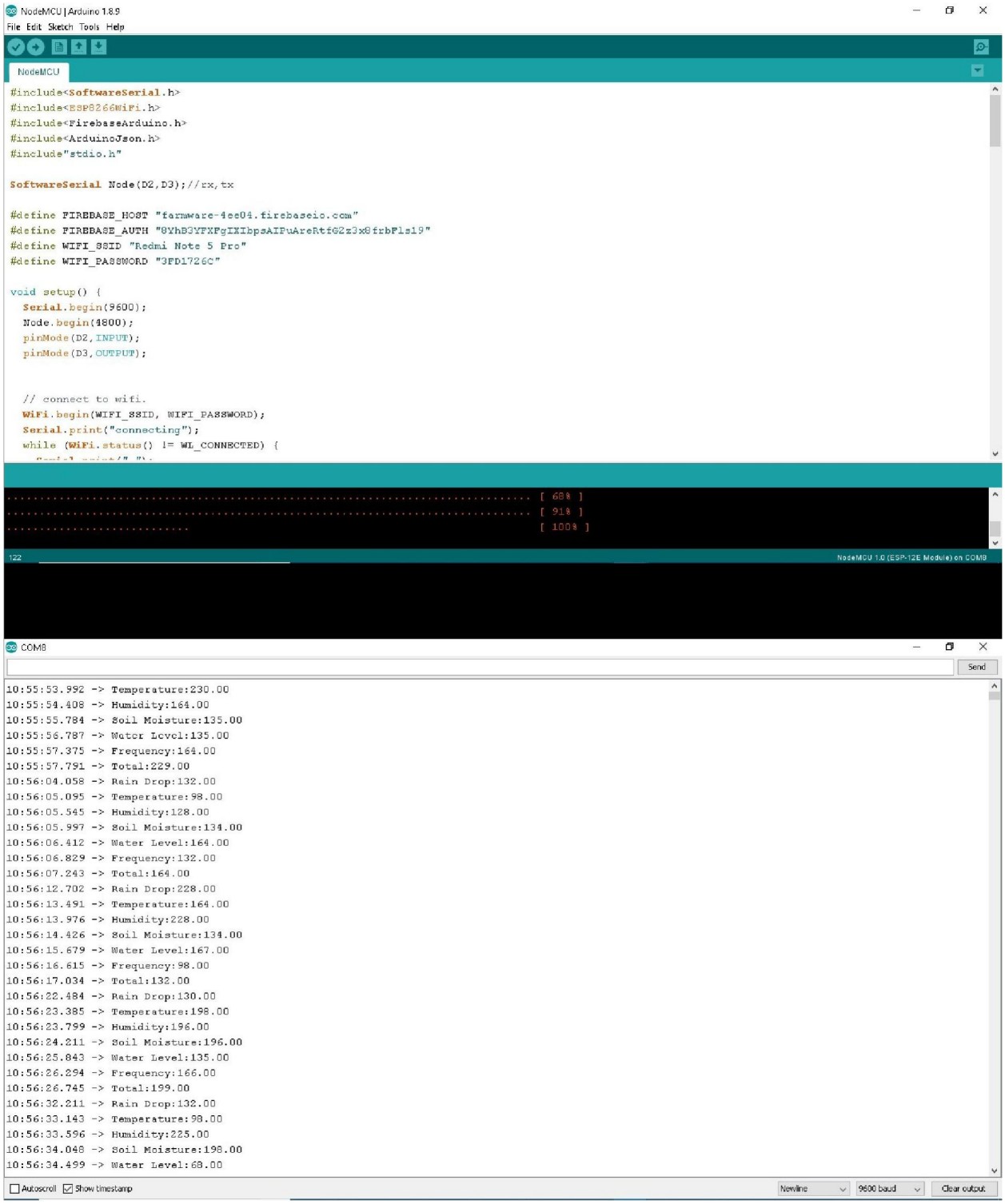
Circuit:



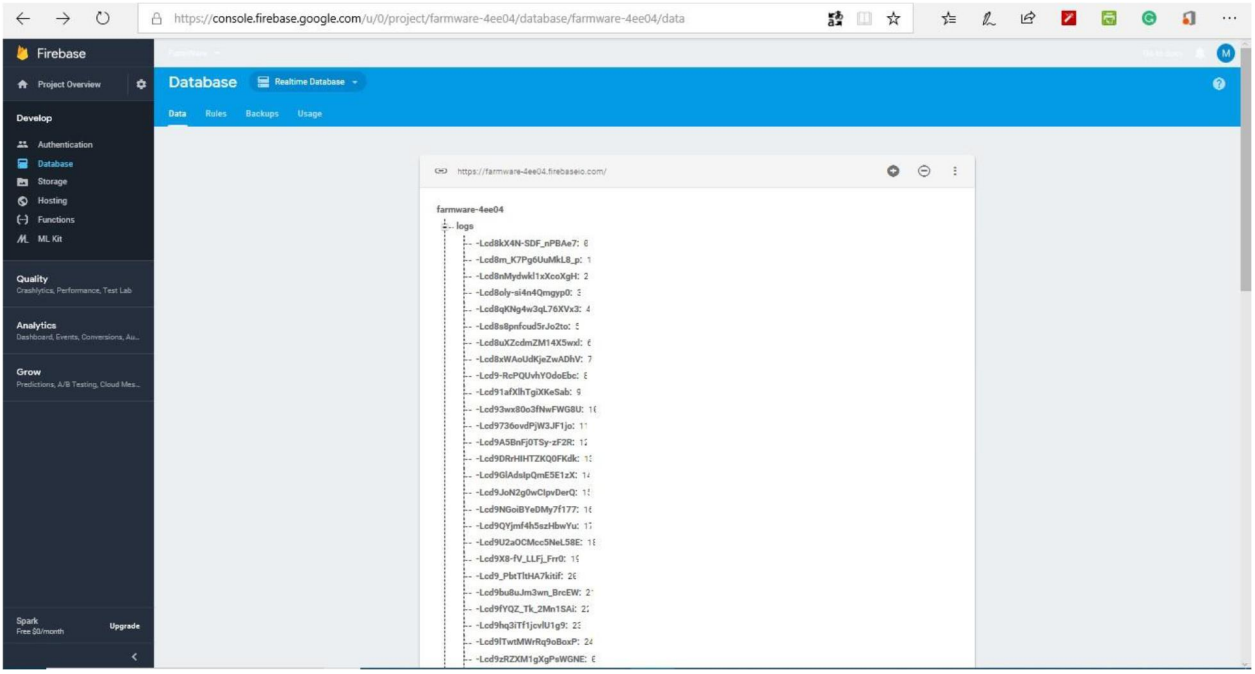
Below is the picture of the whole hardware part:



NodeMCU ESP8266 Code:



Data Stored in firebase:



Software Part:

Our software part is done using android studio, firebase and google colab. The Machine learning part is done using Python. The codes are:

```
from os import listdir
from pickle import dump
from keras.applications.resnet import ResNet50
from keras.preprocessing.image import load_img
from keras.preprocessing.image import img_to_array
from keras.applications.resnet import preprocess_input
from keras.models import Model

# extract features from each photo in the directory
def extract_features(directory):
  # load the model
  model = ResNet50()
  # re-structure the model
  model.layers.pop()
```

```
  model = Model(inputs=model.inputs, outputs=model.layers[-
1].output)
  features = dict()
  filename = directory
  image = load_img(filename, target_size=(224, 224))
  # convert the image pixels to a numpy array
  image = img_to_array(image)
  # reshape data for the model
  image = image.reshape((1, image.shape[0], image.shape[1], image.s
hape[2]))
  # prepare the image for the VGG model
  image = preprocess_input(image)
  # get features
  feature = model.predict(image, verbose=0)
  return feature

# extract features from all images
directory = '/content/Untitled Folder/download.jpg'
features = extract_features(directory)


import pickle

s = open("Marie_Gold.pkl","rb")
clf2 = pickle.load(s)
clf2.predict(features)
```

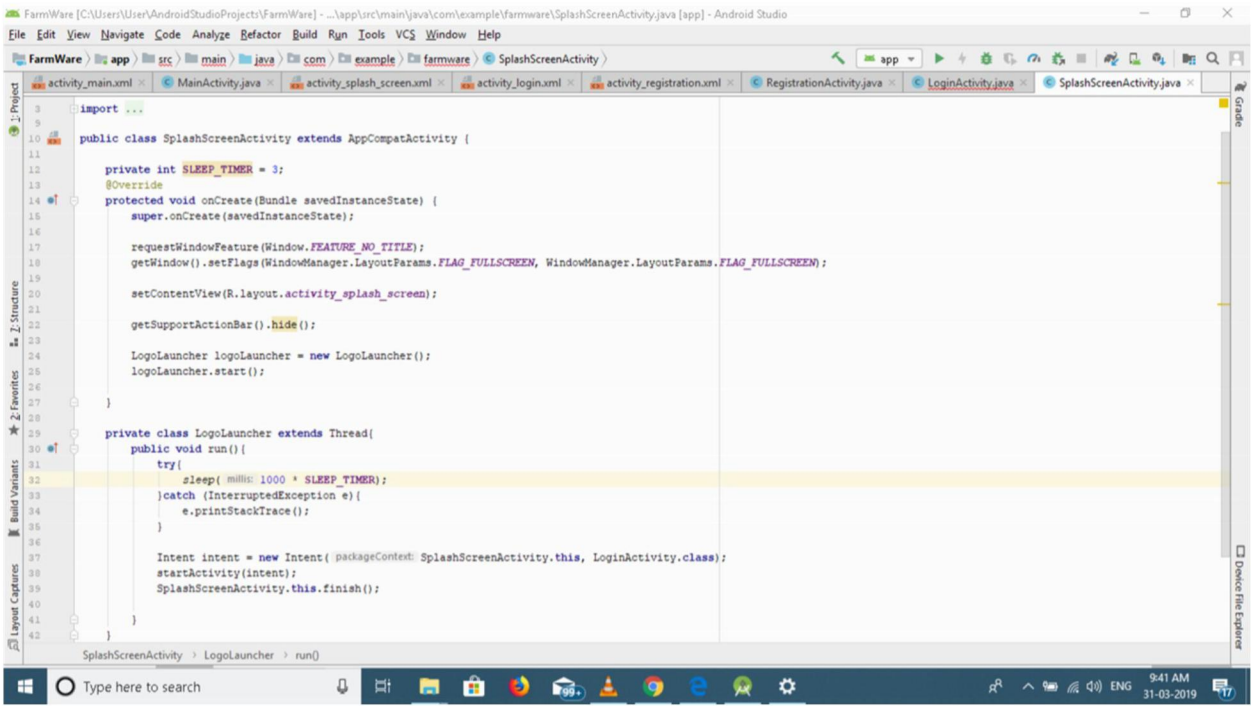
```
#svm classifier

from sklearn.model_selection import cross_val_score
from sklearn import svm
clf = svm.SVC(kernel='linear')
scoresvm = cross_val_score(clf, x, y, cv=4)
scoresvm
print("Accuracy: %0.2f (+/- %0.2f)" % (scoresvm.mean(), scoresvm.st
d() * 2))
```

Android Application Part:

Through this app data's can be viewed from anywhere. Our software part is done using android studio and firebase. The android app layout and codes are given below:

Splash page:

Code:

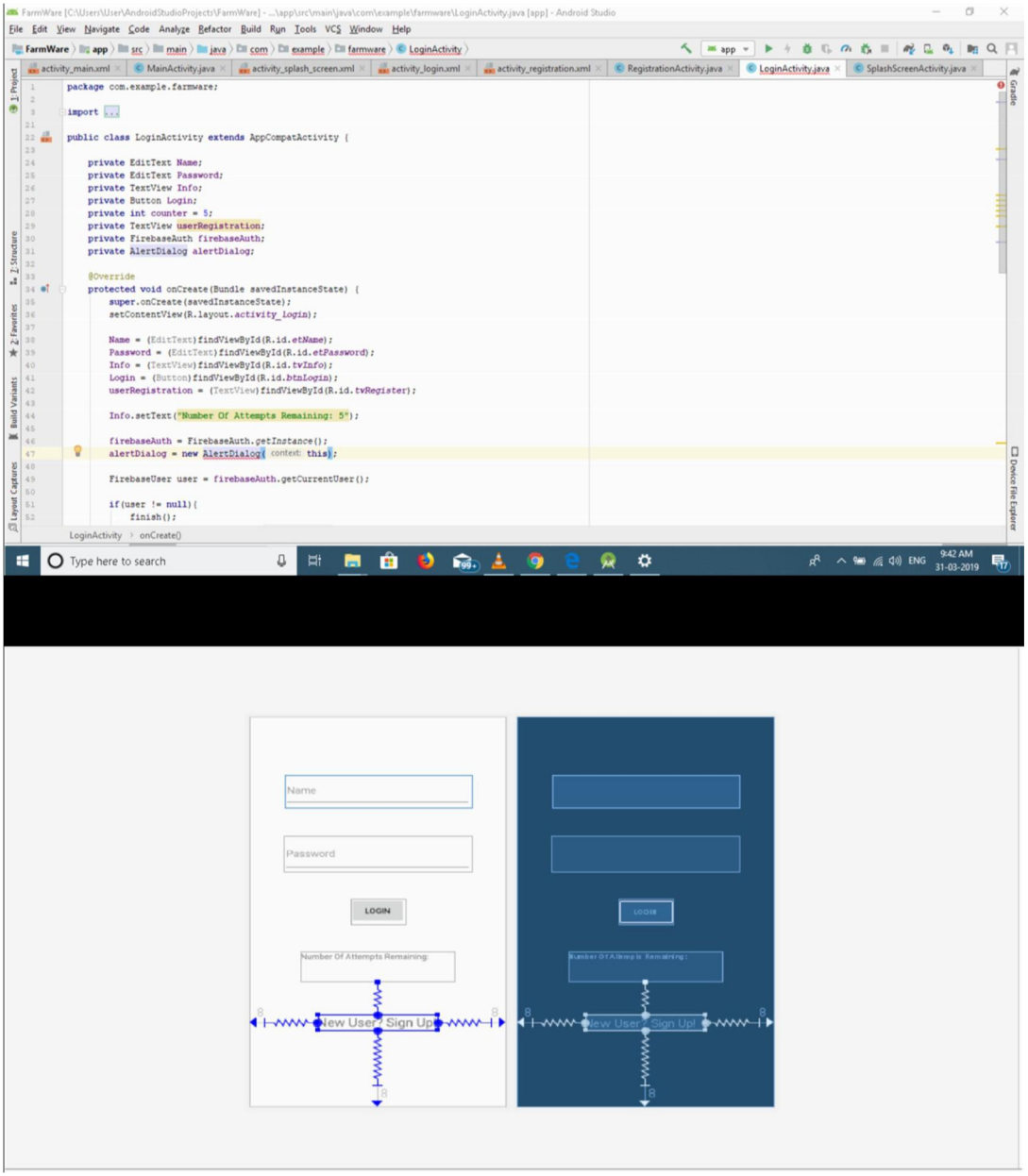


Console design:

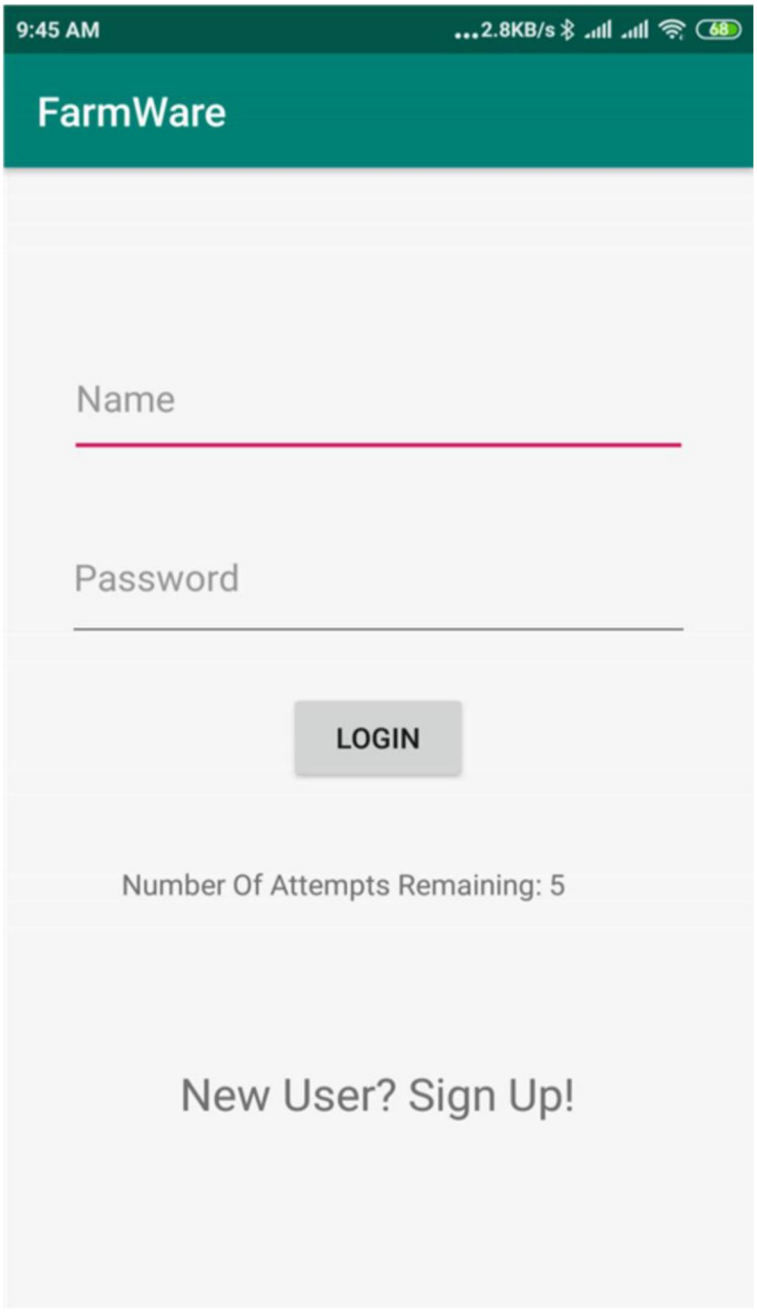
Page view:

Login layout:

Code & Console design:

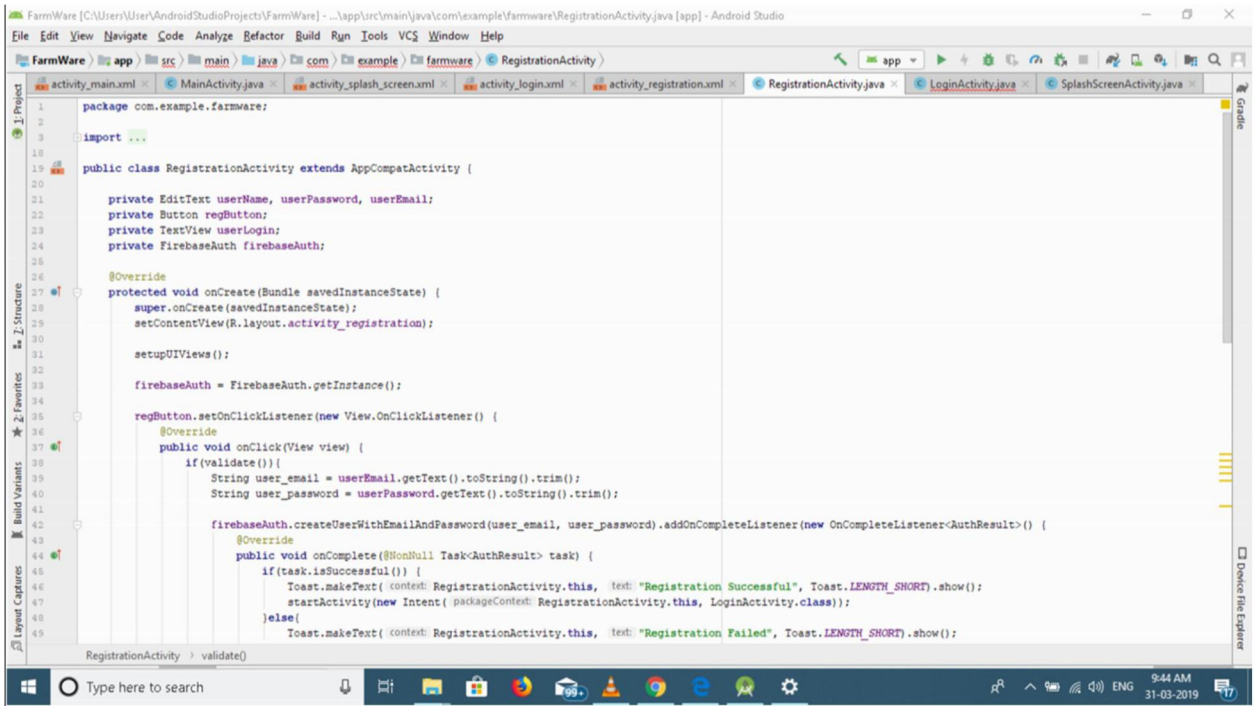


Login page:

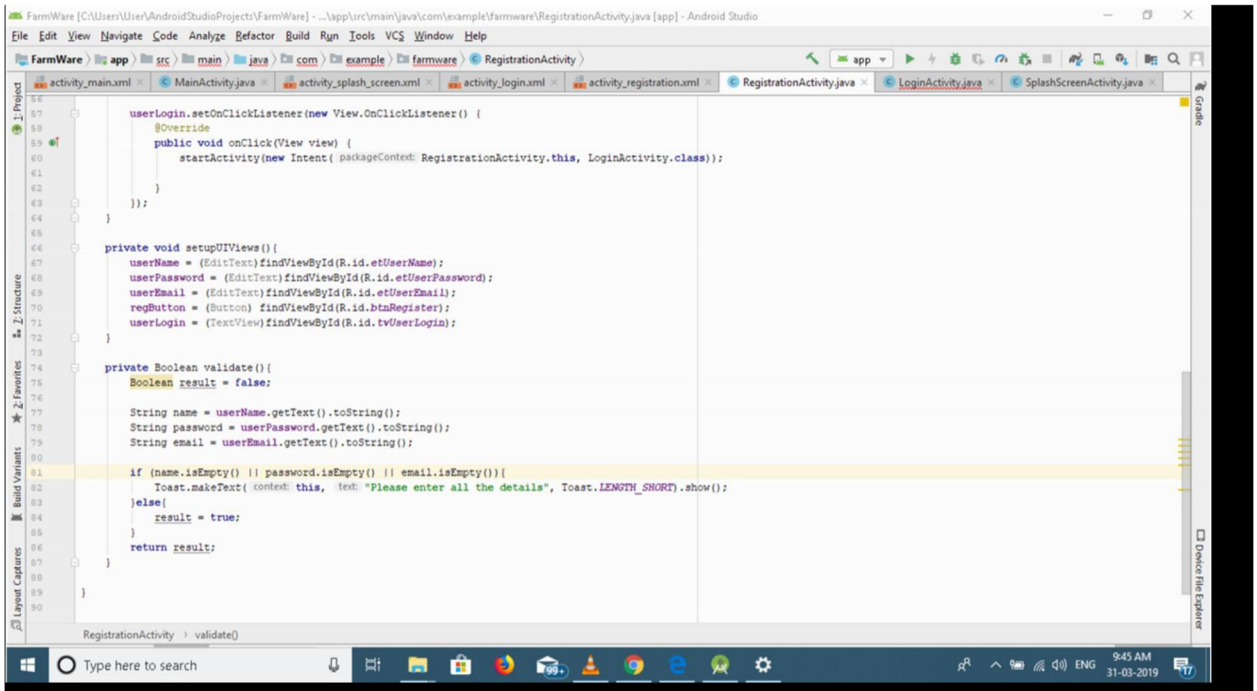

9:45 AM
...2.8KB/s
FarmWare
Name
Password
LOGIN
Number Of Attempts Remaining: 5
New User? Sign Up!

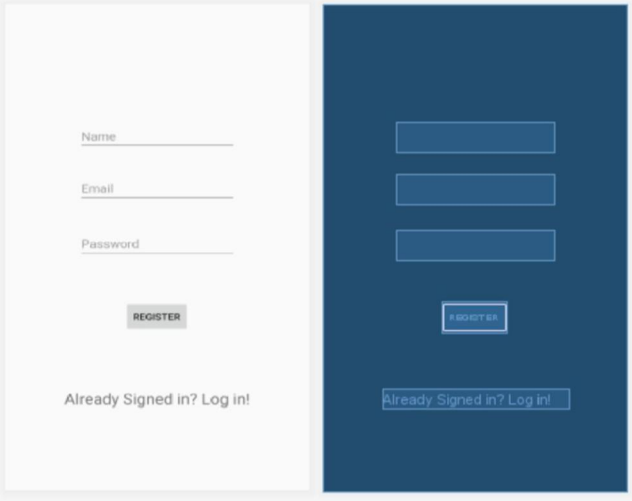
Registration page:

Code & Console Design:

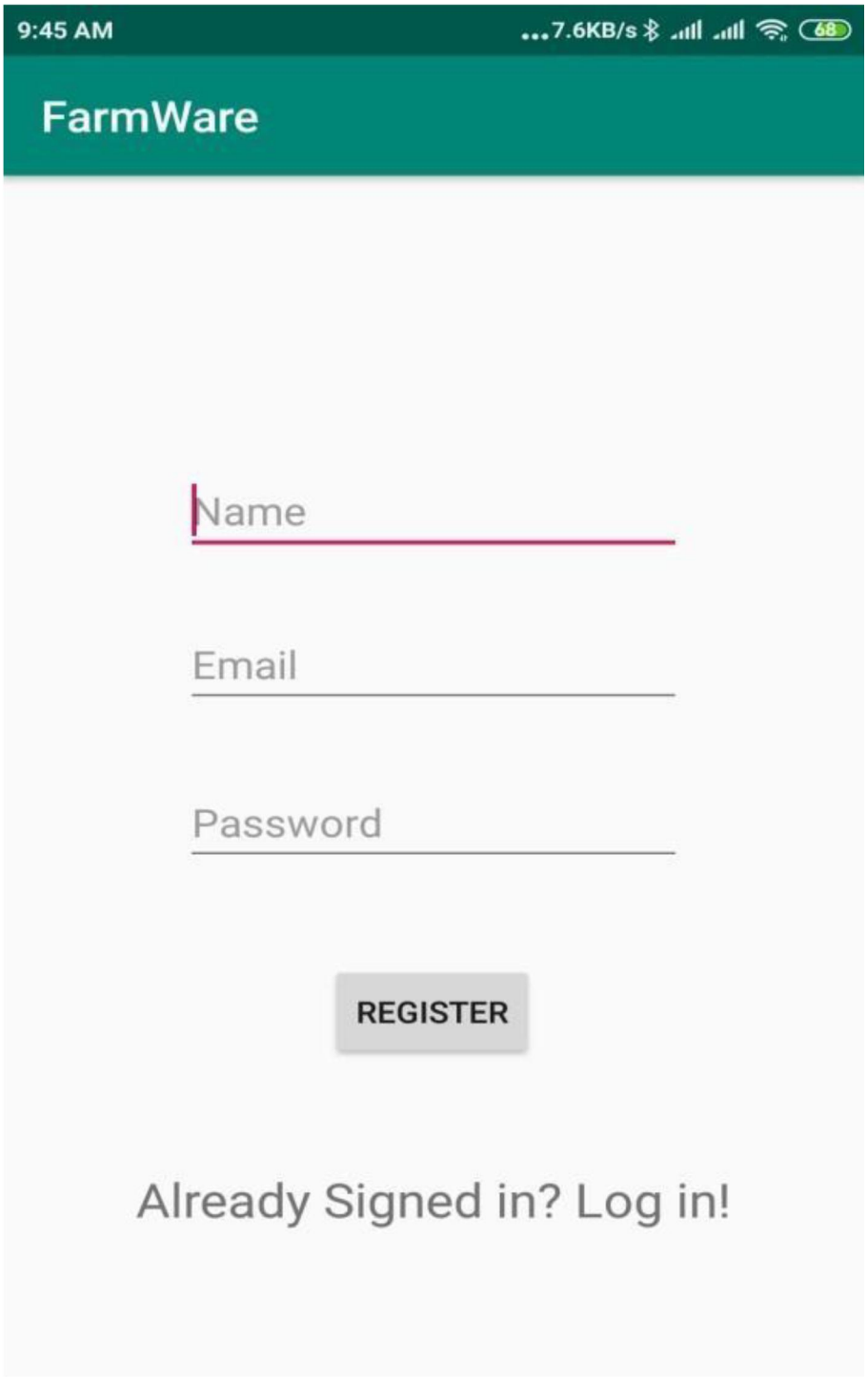


```
package com.example.farmware;

import ...

public class RegistrationActivity extends AppCompatActivity {

    private EditText userName, userPassword, userEmail;
    private Button regButton;
    private TextView userLogin;
    private FirebaseAuth firebaseAuth;

    @Override
    protected void onCreate(Bundle savedInstanceState) {
        super.onCreate(savedInstanceState);
        setContentView(R.layout.activity_registration);

        setupUIViews();

        firebaseAuth = FirebaseAuth.getInstance();

        regButton.setOnClickListener(new View.OnClickListener() {
            @Override
            public void onClick(View view) {
                if(validate()){
                    String user_email = userEmail.getText().toString().trim();
                    String user_password = userPassword.getText().toString().trim();

                    firebaseAuth.createUserWithEmailAndPassword(user_email, user_password).addOnCompleteListener(new OnCompleteListener<AuthResult>() {
                        @Override
                        public void onComplete(@NonNull Task<AuthResult> task) {
                            if(task.isSuccessful()) {
                                Toast.makeText( context: RegistrationActivity.this, text: "Registration Successful", Toast.LENGTH_SHORT).show();
                                startActivity(new Intent( packageContext: RegistrationActivity.this, LoginActivity.class));
                            }else{
                                Toast.makeText( context: RegistrationActivity.this, text: "Registration Failed", Toast.LENGTH_SHORT).show();
```


FarmWare [C:\Users\User\AndroidStudioProjects\FarmWare] - ...\app\src\main\java\com\example\farmware\RegistrationActivity.java [app] - Android Studio
File Edit View Navigate Code Analyze Refactor Build Run Tools VCS Window Help
activity_main.xml
MainActivity.java
activity_splash_screen.xml
activity_login.xml
activity_registration.xml
RegistrationActivity.java
LoginActivity.java
SplashScreenActivity.java
userLogin.setOnClickListener(new View.OnClickListener() {
@Override
public void onClick(View view) {
startActivity(new Intent(packageContext: RegistrationActivity.this, LoginActivity.class));
}
});
}
private void setupUIViews(){
userName = (EditText)findViewById(R.id.etUserName);
userPassword = (EditText)findViewById(R.id.etUserPassword);
userEmail = (EditText)findViewById(R.id.etUserEmail);
regButton = (Button) findViewById(R.id.btnRegister);
userLogin = (TextView)findViewById(R.id.tvUserLogin);
}
private Boolean validate(){
Boolean result = false;
String name = userName.getText().toString();
String password = userPassword.getText().toString();
String email = userEmail.getText().toString();
if (name.isEmpty() || password.isEmpty() || email.isEmpty()){
Toast.makeText(context: this, text: "Please enter all the details", Toast.LENGTH_SHORT).show();
}else{
result = true;
}
return result;
}
}
RegistrationActivity › validate()
Type here to search
ENG
9:45 AM
31-03-2019

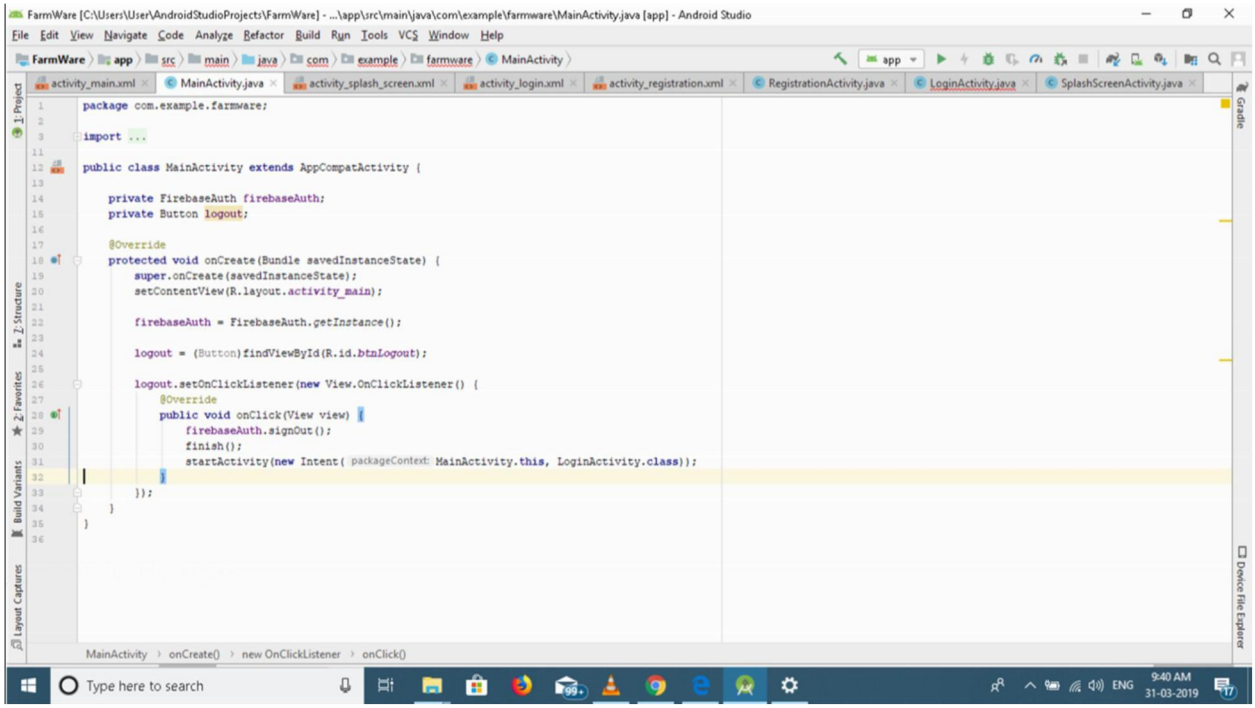

Name
Email
Password
REGISTER
Already Signed in? Log in!
REGISTER
Already Signed in? Log in!

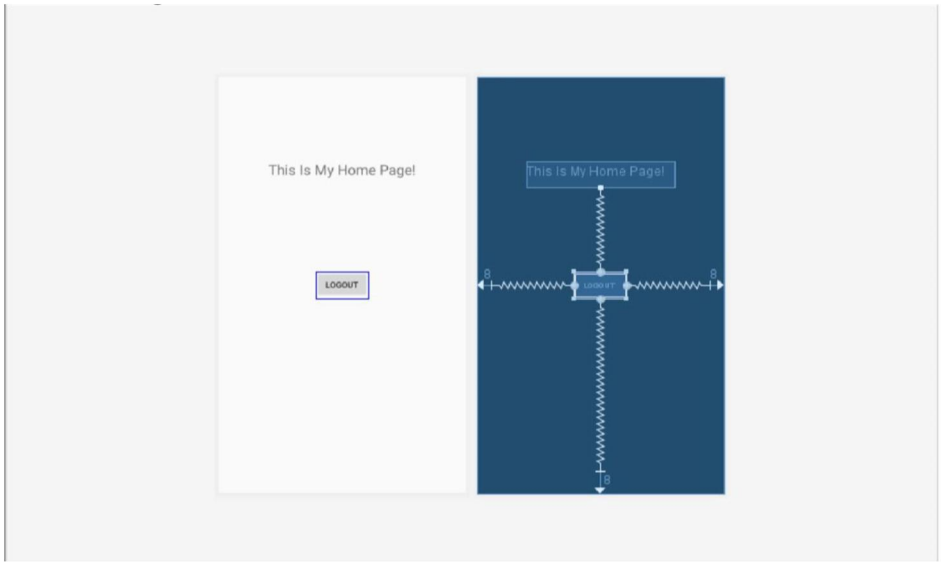
Registration page view:



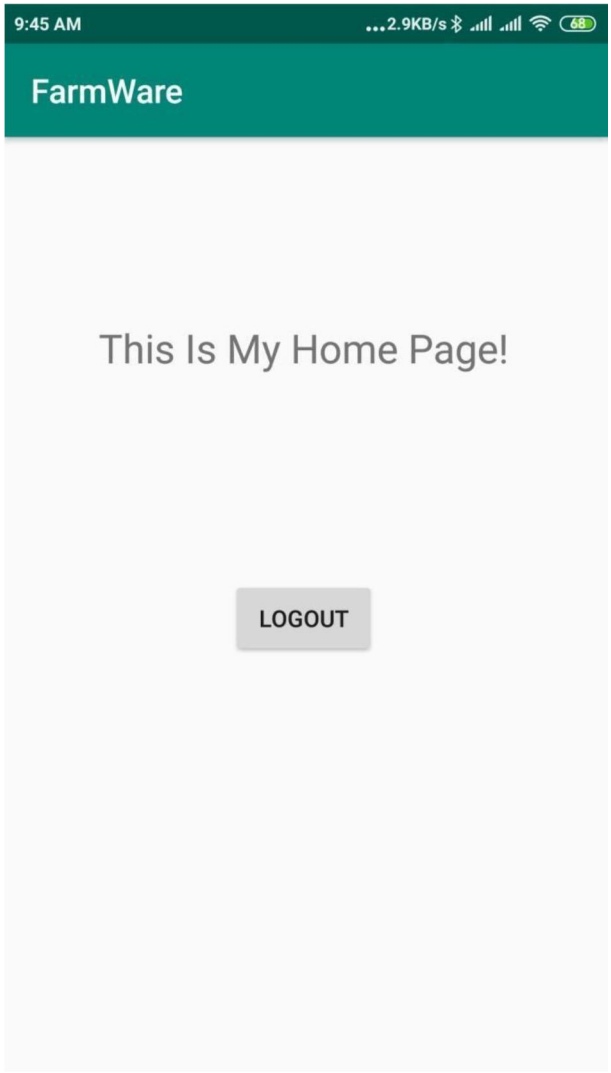
Logout page:

Code & Console Design:

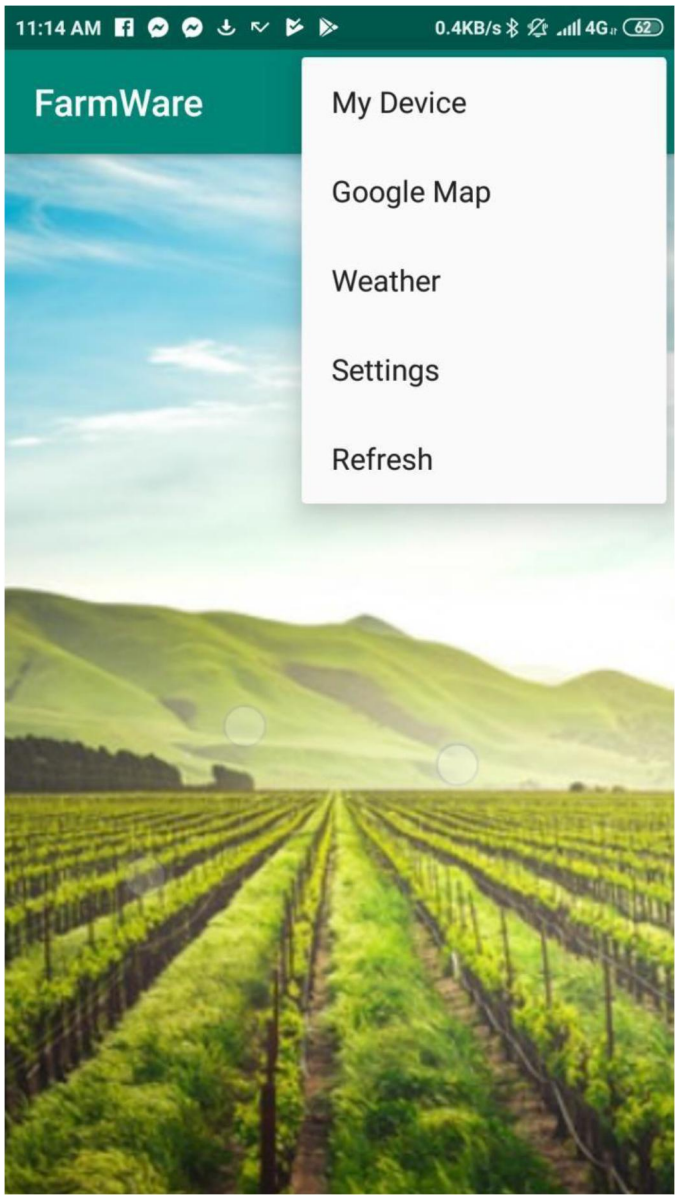




Logout layout:

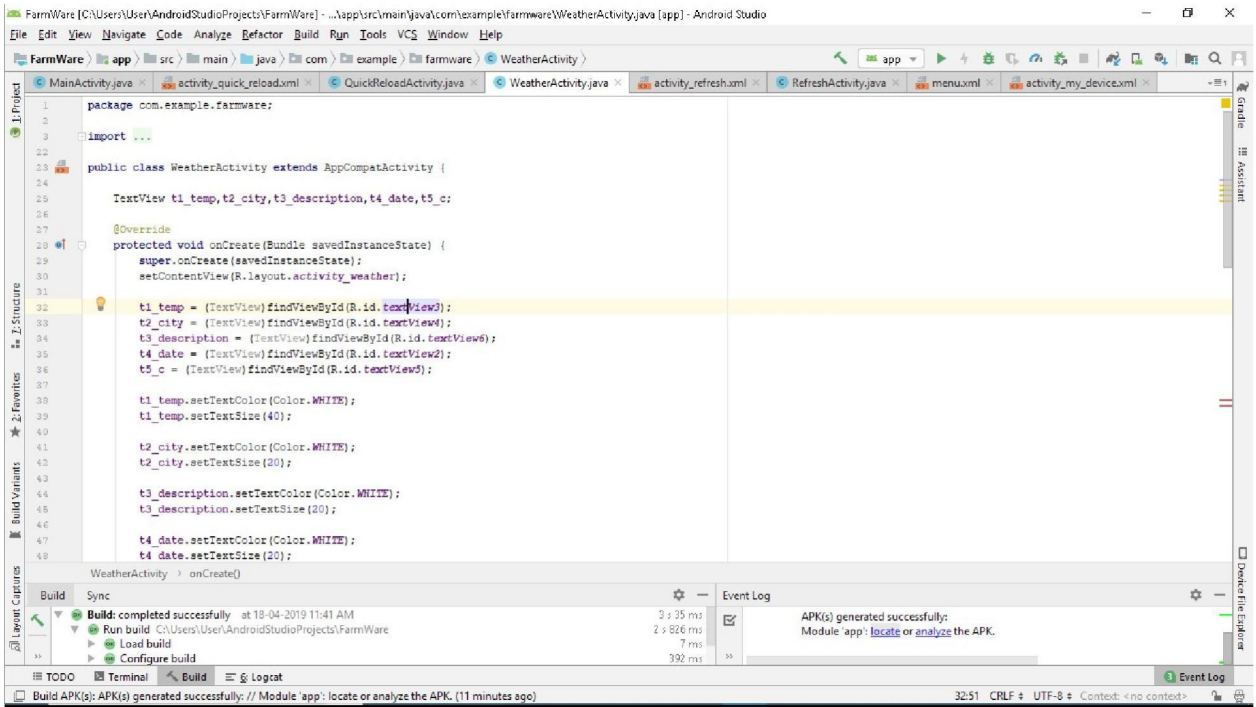


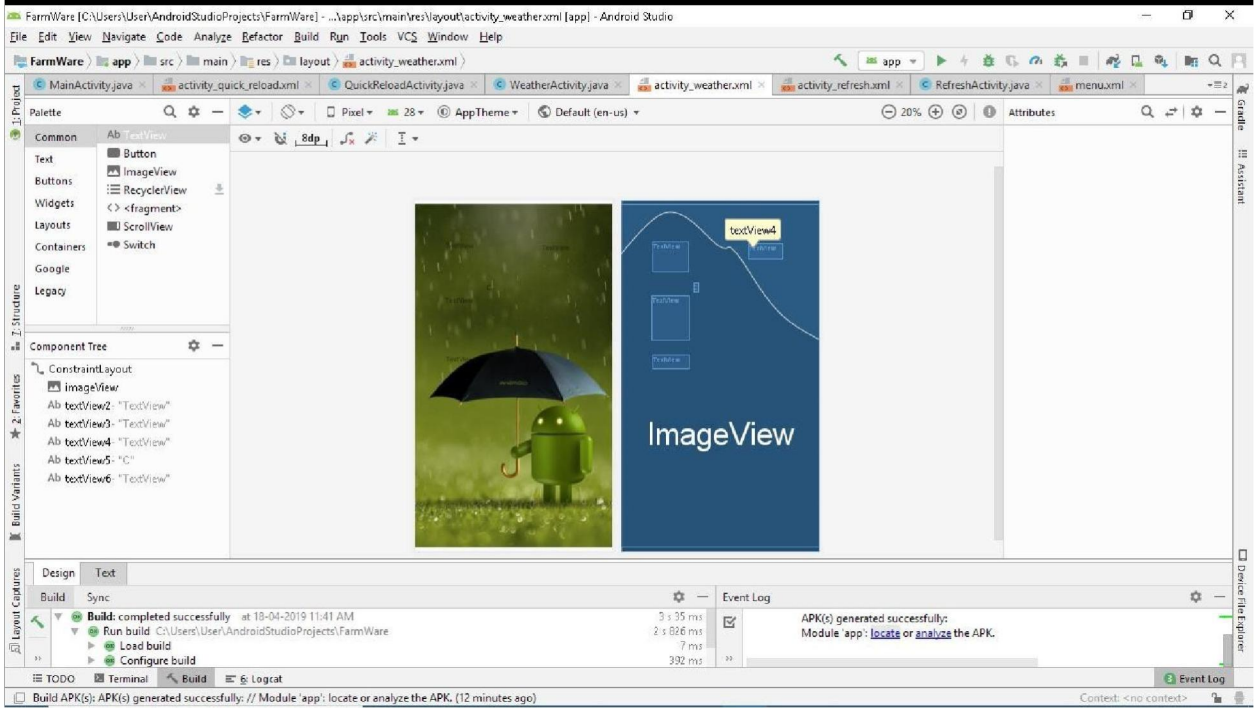
Main Page:


11:14 AM
0.4KB/s
4G
62
FarmWare
My Device
Google Map
Weather
Settings
Refresh

Google weather:

Weather Coding & Console Design:





Project Description and Discussion

Our project has the following features and the objectives of our project is given below:

Features:

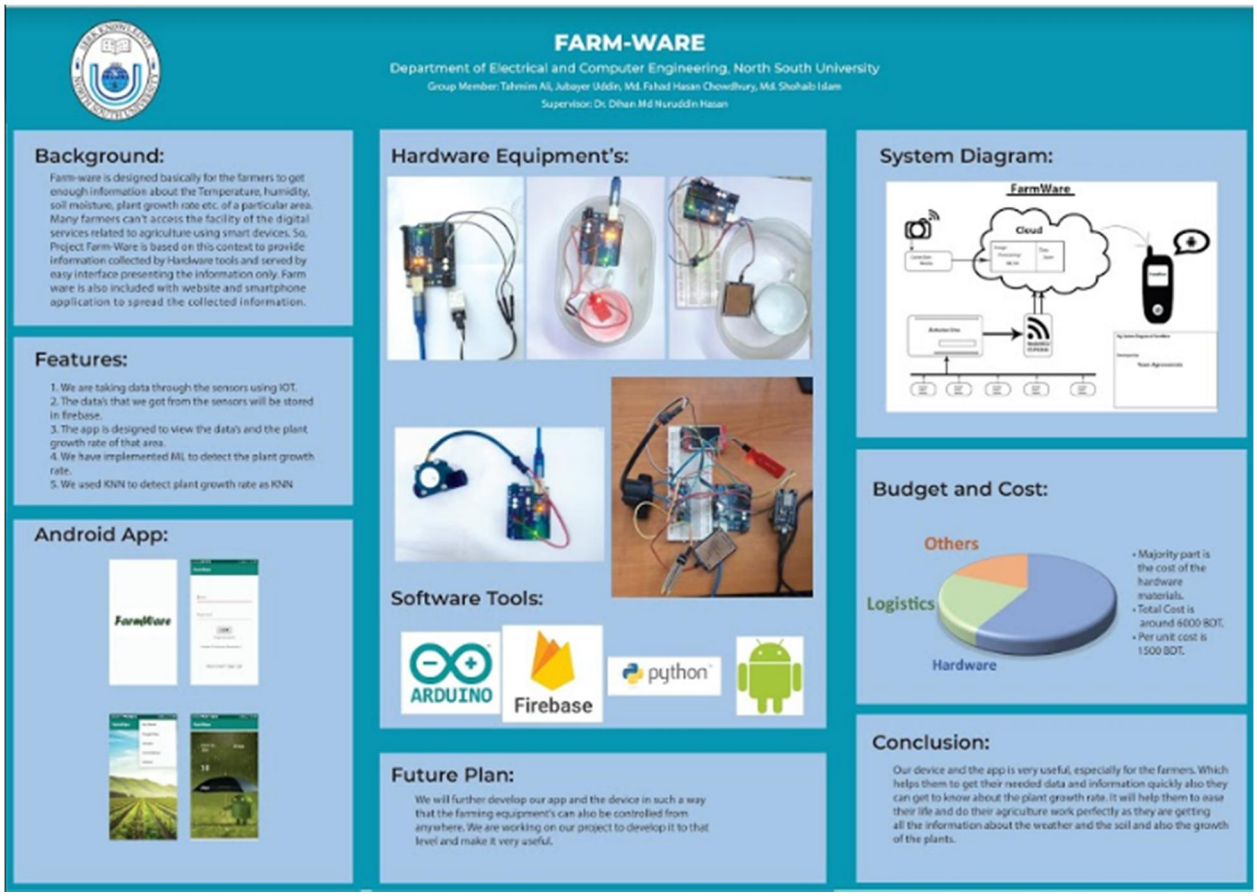
1. The sensors are designed to get the data readings of a particular area.
2. This data will be available on the app easily and quickly.
3. The data can be accessed from anywhere.
4. The data's will be saved on the database so, it will be easy to get the data.

Objectives:

1. As the project is based on greenhouse it will be easy to maintain the weather.
2. The farmers will easily be notified about the conditions of that region.
3. It will make life easy.

We have collected dataset using marigold flower plant. And using these dataset we implemented our machine learning part. That is how to detect the growth of the plants.

Poster:


FARM-WARE
Department of Electrical and Computer Engineering, North South University
Group Member: Tahmim Ali, Jubayer Uddin, Md. Fahad Hasan Chowdhury, Md. Shohaib Islam
Supervisor: Dr. Dihan Md Nuruddin Hasan
Background:
Farm-ware is designed basically for the farmers to get enough information about the Temperature, humidity, soil moisture, plant growth rate etc. of a particular area. Many farmers can't accoss the facility of the digital services related to agriculture using smart devices. So, Project Farm-Ware is based on this context to provide information collected by Hardware tools and served by easy interface presenting the information only. Farm ware is also included with website and smartphone application to spread the collected information.
Features:
1. We are taking data through the sensors using IOT.
2. The data's that we got from the sensors will be stored in firebase.
3. The app is designed to view the data's and the plant growth rate of that area.
4. We have implemented ML to detect the plant growth rate.
5. We used KNN to detect plant growth rate as KNN
Android App:
FarmWare
Hardware Equipment's:
Software Tools:
ARDUINO
Firebase
python
Future Plan:
We will further develop our app and the device in such a way that the farming equipment's can also be controlled from anywhere. We are working on our project to develop it to that level and make it very useful.
System Diagram:
FarmWare
Cloud
Budget and Cost:
Others
Logistics
Hardware
• Majority part is the cost of the hardware materials.
• Total Cost is around 6000 BDT.
• Per unit cost is 1500 BDT.
Conclusion:
Our device and the app is very useful, especially for the farmers. Which helps them to get their needed data and information quickly also they can get to know about the plant growth rate. It will help them to ease their life and do their agriculture work perfectly as they are getting all the information about the weather and the soil and also the growth of the plants.

Lesson Learnt

While starting this project we thought that it would be easy to complete this project but then we realized it is really tough. So, we have learnt a lot of lessons while solving this problem.

- We learnt python to code for ML.
- We knew the basics of android development but for this problem we learnt many more things about android development.
- We learnt how to implement machine learning.

Timeline

		WEEK					
SL	Deliverable	4	8	12	16	20	Man-Week
1	Front end development						10
2	Hardware implementation						10
3	Database management						6
4	Testing & debugging						4
5	Machine learning						4
6	Deployment and final release						4
Total duration							18

Team Dynamics

	Hardware Part (Aurdino)			
1	Temperature sensor	will determine the temp. of an area	week-1	Shohaib Islam
3	Humidity sensor	will determine the humidity of the air	week-2	Shohaib Islam
4	Water level	it will determine the water level	week-3	Tahmim
5	Water flow	determine how much water will flow	week-4	Tahmim
6	Soil moisture	determine the moisture of the soil	week-5	Fahad Hassan
7	Rain Drop	determine the amount of rain	week-6	Jubayer
	Software Part			
8	Starting page (Android app)	the opening page of the app	week-7	Jubayer
9	Login page	login will be required for a user profile	week-7	Fahad Hasan
10	Registration page	to register a new profile	week-7	Tahmim
11	Main page	it will contain the info's	week-8	Jubayer
12	Google Location	it will take the location	week-9	Jubayer
13	Google API	to access the google map	week-9	Tahmim
14	Database	will store the values from sensors	week10-11	Shohaib Islam
15	Dataset		week-12	Jubayer, Shohaib
16	ML Implementation	Will determine plant growth rate	week 13-17	Tahmim, Fahad Hasan
	Final Demo		week 18	

Conclusion

Our device and the app is very useful, especially for the farmers. Which helps them to get their needed data and information quickly. It will help them to ease their life and do their agriculture work perfectly as they are getting all the information about the weather and the soil. We will further develop our app and the device in such a way that the farming equipment's can also be controlled from anywhere also we are planning to implement a camera on the spot which will take few snaps automatically and will detect the growth rate of the plants on a weekly basis. We are working on our project to develop it to that level and make it very useful.

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