

# **SMART CROP MANAGEMENT SYSTEM**

## **REPORT**

*Submitted by*

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*of*

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**IN**

**INFORMATION TECHNOLOGY**



**THIAGARAJAR COLLEGE OF ENGINEERING, MADURAI-15**

**(A Govt. Aided, Autonomous Institution, Affiliated to Anna University)**

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# **THIAGARAJAR COLLEGE OF ENGINEERING, MADURAI-15**

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## **BONAFIDE CERTIFICATE**

**Certified that this project report “SMART CROP MANAGEMENT SYSTEM” is the bonafide work of “V. AAKASH (18IT001), G.L. SANKARA SUBRAMANIYAN (18IT079), S. YAJITH VISHWA (18IT116), K. SURIYAN (18IT128)” who carried out the project work under my supervision during the Academic Year 2020 -2021.**

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## TABLE OF CONTENTS

SL. NO.	DETAILS	PAGE NO.
1	ABSTRACT	5
2	PROBLEM DESCRIPTION	6
3	BACKGROUND	9
4	DESIGN REQUIREMENTS	9
5	PROPOSED METHODOLOGY	10
6	UML DIAGRAMS	14
7	FINAL IMPLEMENTATION	23
8	TESTING AND VALIDATION	24
9	PERFORMANCE TEST RESULTS	28

10	DEPLOYMENT	22
11	CONCLUSION	27
12	REFERENCE	29

# **1. ABSTRACT**

Smart agriculture is an emerging concept, because IOT sensors are capable of providing information about agriculture fields and then act upon based on the user input. Managing huge hectares of agricultural land is tedious also it needs huge manpower. Along with-it farmers are finding difficulty in choosing the right pesticides and fertilizers to the crops at right intervals which is highly necessary to increase the production rate of the field. In this project, it is proposed to develop a Smart agriculture System that uses the advantages of cutting edge technologies such as Arduino, IOT and Wireless Sensor Network. The paper aims at making use of evolving technology i.e. IOT and smart agriculture using automation. Monitoring environmental conditions is the major factor to improve yield of efficient crops. Early failure of crops plays a major impact in the agriculture domain and decides the GDP which is due to pests and shortage of water. To overcome the above problems, we are creating a smart agriculture management system which helps the farmers to manage and monitor crops online and to monitor the health of the field continuously to detect and prevent crop failures.

Also, they perform basic actions like watering, fertilizing the field by an AI powered automated system which uses sensors to detect the humidity and water level and continuously monitors the crops.

## **2. PROBLEM DESCRIPTION**

### **2.1 Problem Statement**

Agriculture is one of the major industries to incorporate drones. Drones equipped with sensors and cameras are used for imaging, mapping and surveying the farms. There are ground based drones and aerial drones. Ground drones are bots that survey the fields on wheels. Aerial drones- formally known as unmanned aerial vehicles (UAVs) or unmanned aircraft systems (UASes) are flying robots. Drones can be remotely controlled remotely or they can fly automatically through software-controlled flight plans in their embedded systems, working in coordination with sensors and GPS. From the drone data, insights can be drawn regarding crop health, irrigation, spraying, planting, soil and field, plant counting and yield prediction and much more. Drones can either be scheduled for farm surveys (drone as a service) or can be bought and stored near farms where they can be recharged and maintained. After the surveys the drones need to be taken to nearby labs to analyze the data that has been collected.

### **2.2 Scope and Importance**

Smart Agriculture allows farmers to maximize yields using minimum resources such as water, fertilizers, seeds etc. Solar powered and mobile operated pumps save the cost of electricity. Smart agriculture uses drones and robots which helps in many ways. This improves the data collection process and helps in wireless monitoring and control. It is a cost effective method. It delivers high quality crop production.

### **2.3 Subject Domain**

The key areas are Internet of Things, Deep Learning, Mobile App Development.

## 2.4 Society Relevancy

Smart agriculture is a new emerging field towards development and food security on increasing productivity, enhancing livelihoods and reducing and removing greenhouse gas emissions from the atmosphere. Through an understanding in ecosystems, water, soil, weather, chemistry and plant & animal biology, they provide us with the things we need to survive.

## 3. BACKGROUND

### 3.1 Literature Survey

S.No	Title of the Paper	Author	Dataset Used and Methodology	Observations
1	Crop Yield Prediction and Efficient use of Fertilizers	Chaithra M Rao, Sanjay Kumar C	KNN Algorithm, crop Dataset (private dataset)	we get nearest matches of crop, rainfall, location and ph to test data from train data set in turn we predict the crops from it.
2	Impact of Deep Neural Network on Predicting Application Rate of Fertilizers	M.S. Suchithra and Maya L. Pai	Clustering Technique, Neural Network and Deep neural network	The recommendation model based on the Deep Neural Network (DNN) outperforms the Standard

				Neural Network classifier with an accuracy equal to 95.1 % (Urea), 95.05 % (MOP) and 96.7 % (Lime). Our model highlights the real possibility for forecasting the application rate of fertilizers.
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### 3.2 Scope of the Problem

Smart Agriculture allows farmers to maximize yields using minimum resources such as water, fertilizers, seeds etc. Solar powered and mobile operated pumps save the cost of electricity. Smart agriculture uses drones and robots which helps in many ways. This improves the data collection process and helps in wireless monitoring and control. It is a cost effective method. It delivers high quality crop production.

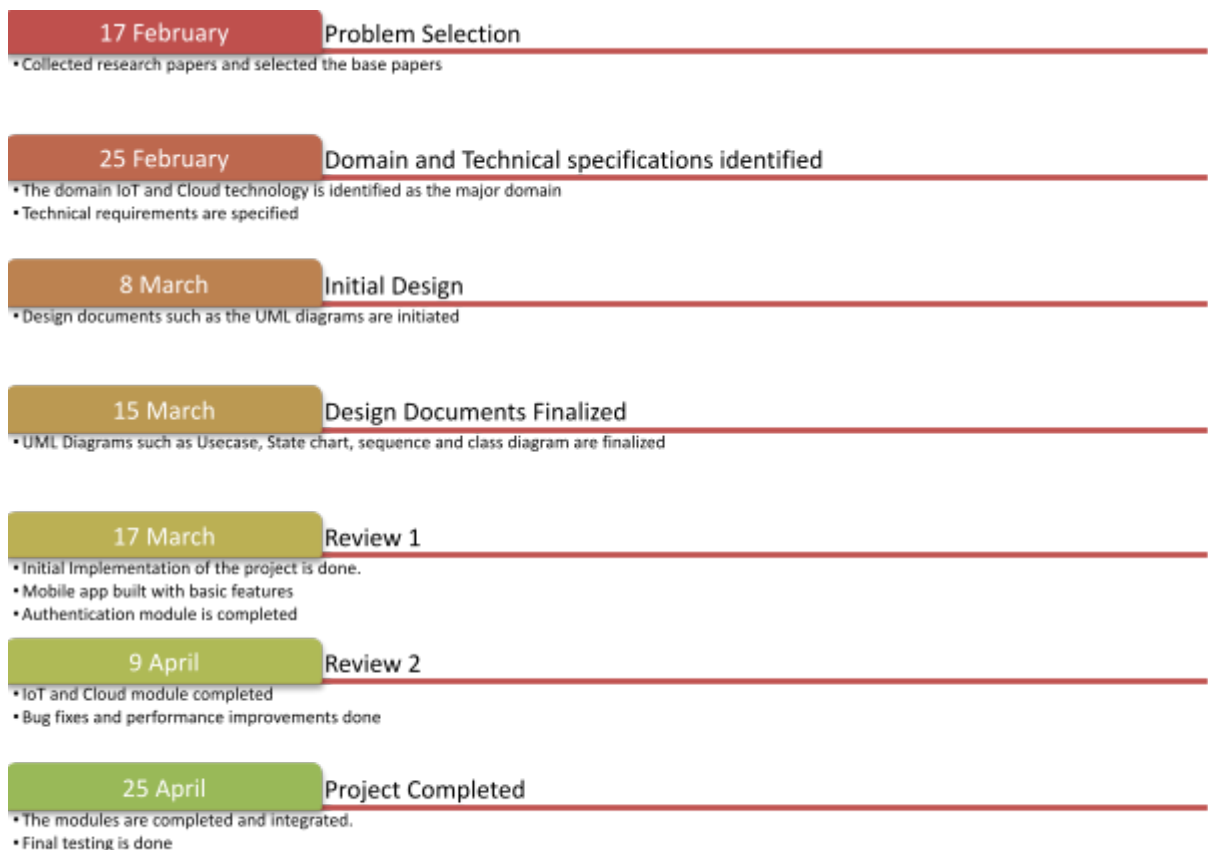


### 3.3 Constraints and Limitations

- Availability of internet continuously. Villages don't have internet and the bandwidth of the connection is slower.
- Iot equipment and mobile apps need farmers to understand and learn to use the technology. This is a major challenge in adopting smart agriculture farming at large scale across the countries.
- Users are not familiar with these technologies. They do not understand artificial intelligence or mobile apps.
- Initial cost is quite high for farmers
- The cost of maintenance is high.

## 4. DESIGN REQUIREMENTS

### 4.1 Schedule



## 4.2 Budget

The budget for the project is **15,000 INR** and the cost includes

- ✓ Google Cloud Platform's Compute Engine
- ✓ IoT devices like sensors and Arduino boards
- ✓ Firebase subscription

## 4.3 Risk Factors

- High technology dependencies.
- Integration with vendors and suppliers is difficult.
- Regulations and other checks done are not verified.
- More chances of failures of minute devices like sensors.
- Since the data is not encrypted, there is a possibility of data breach at the field level. However, the data is encrypted in the http packet and in the database.

## 4.4 Team Members Roles and Responsibilities

G.L. Sankara Subramaniyan	App Development Process, IoT Stimulations
V. Aakash	Deep Learning Model development
S. Yajith Vishwa	App Development Process
K. Suriyan	Data collections and IoT circuit building

## 5. PROPOSED METHODOLOGY

## 5.1 Modules Description

### Login

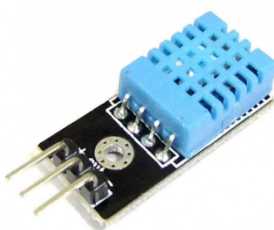
The login page should be the first page that users see in the Crop application. It should provide two text fields - one for entering an email and one for entering a password. If either of the text fields is left blank it is an error that must be reported to the user. If both fields are filled in but there is no record of the user name or the password is incorrect that must also be reported to the user. There would be google sign in button when you click that button the google account used as login account for the application.

### Soil Type

After Login, the user has to choose a Soil and capture the soil in application. Then it redirects to the Crop page where there would be a list of crops which can be grown in that soil.

### Field Monitoring

The field is continuously monitored for humidity, temperature, water level, land acidity and equipment status. The temperature and humidity is measured using a DHT11 sensor which is low-cost and less power consuming. Soil moisture is measured using soil moisture sensors. Land acidity is measured using a ph sensor.



**Dht11**



**soil moisture sensor**

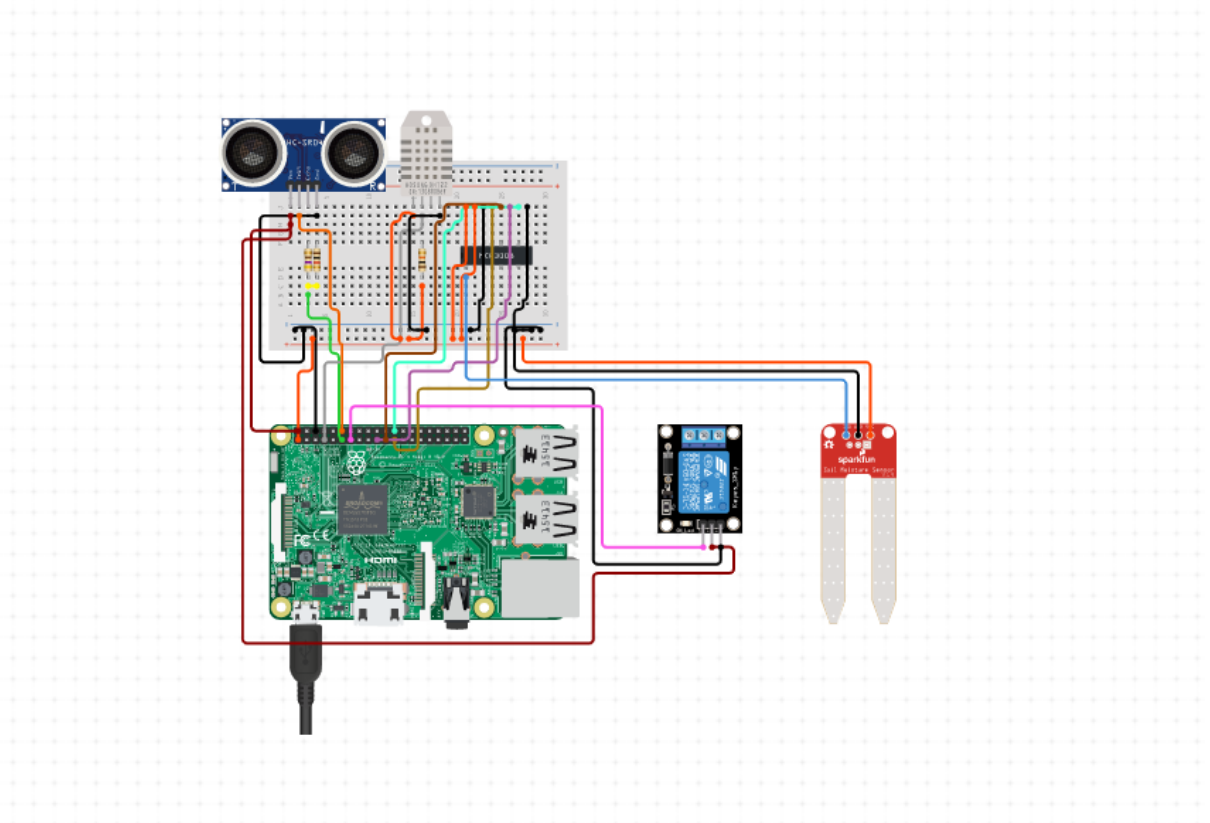


**ph sensor**

### Location Detection

After login, location will be added to the user details using Global Positioning System which is a satellite navigation system used to determine the farm Latitude and Longitude position. Location involves country, State, District, Pin and suggest nearby pest shops.

## Field IoT Layout



## Layout

Linear Layout is a view group that aligns all children in a single direction, vertically or horizontally. Relative Layout is a view group that displays child views in relative positions. Grid View is a View Group that displays items in a two-dimensional, scrollable grid.

## Intent

Android Intent is the message that is passed between components such

as activities, content providers, broadcast receivers, services etc. It is generally used with `startActivity()` method to invoke activity, broadcast receivers etc

## **Menu**

Menus are a common user interface component in many types of applications. A context menu is a floating menu that appears when the user performs a long-click on an element. It provides actions that affect the selected content or context frame.

## **Notification**

A notification is a message you can display to the user outside of your application's normal UI. Android Toast class provides a handy way to show users alerts

## **Widgets**

A widget is a small gadget or control of your android application placed on the home screen. Widgets can be very handy as they allow you to put your favorite applications on your home screen in order to quickly access them.

## **Database**

The Firebase Realtime Database is a cloud-hosted database in which data is stored as JSON. The data is synchronized in real-time to every connected client. ... The Firebase Realtime Database is a NoSQL database from which we can store and sync the data between our users in real-time.

## **Location**

A location can consist of a latitude, longitude, timestamp, and other

information such as bearing, altitude and velocity.

## **Multimedia**

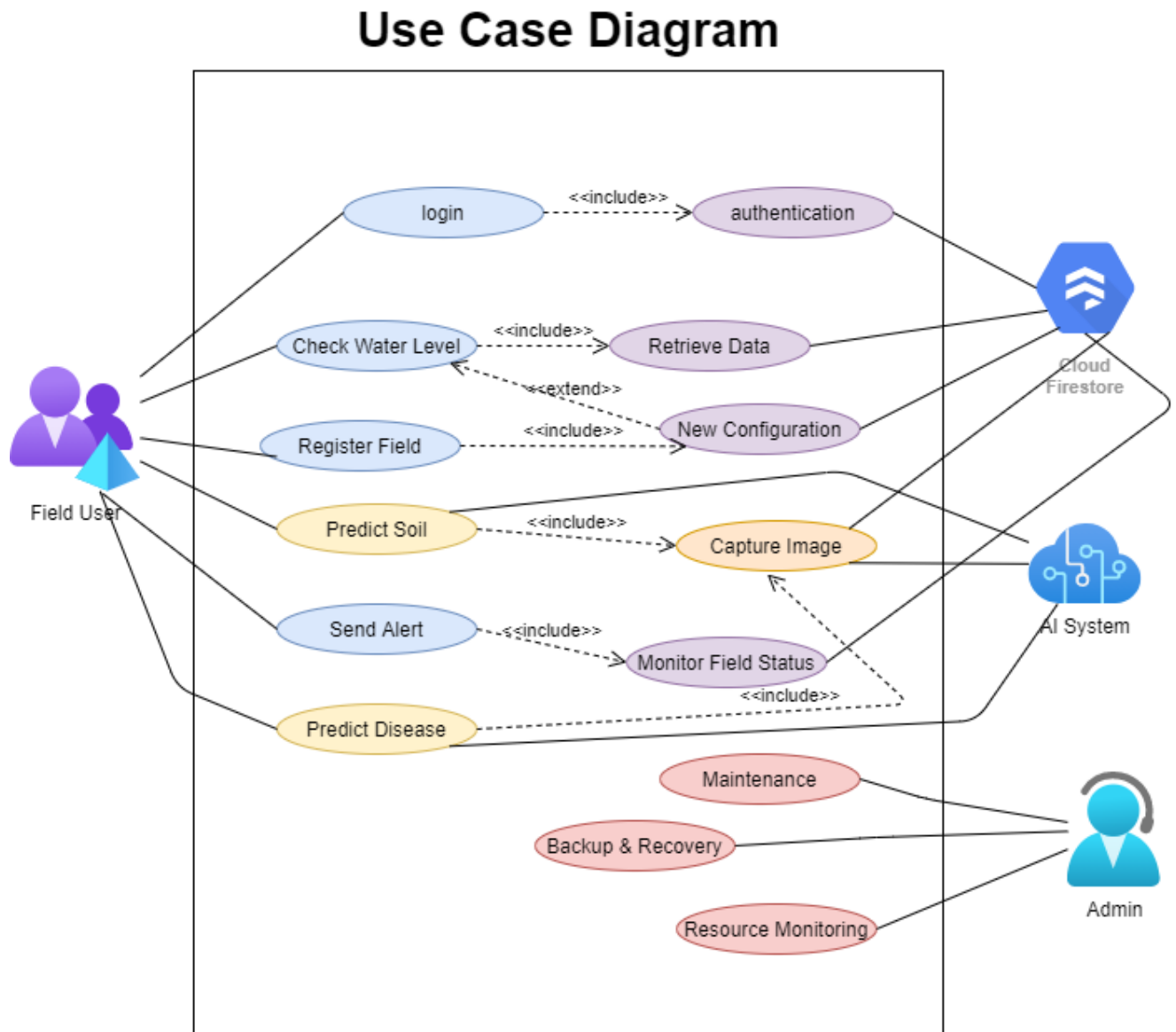
Android multimedia framework includes support for playing variety of common media types, so that you can easily integrate audio, video and images into your applications

### **5.2 Benefits**

- No need of watchman in Field
- Low-cost Build Setup
- Online Monitoring
- Application alert.
- Online Portal for farmers

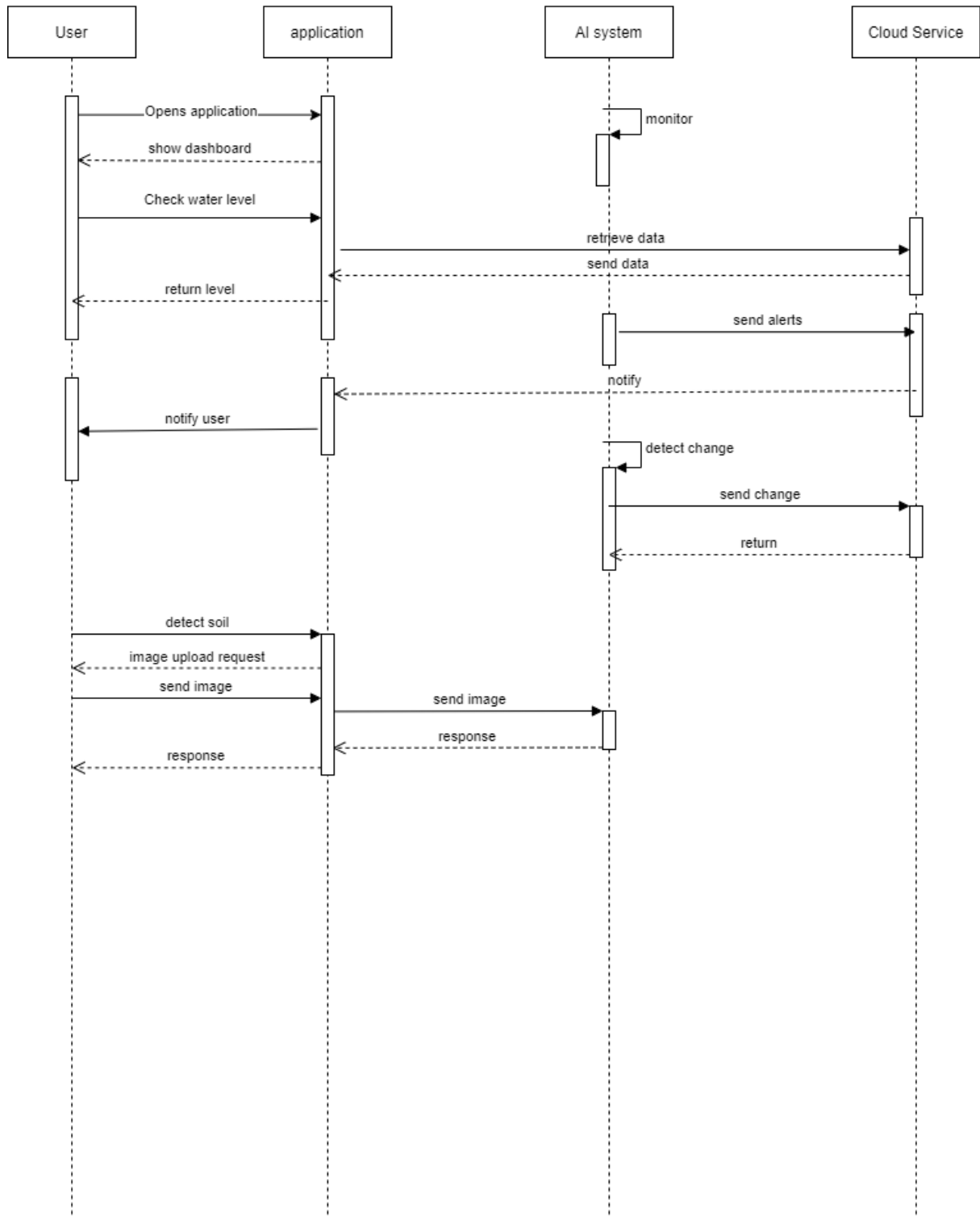
## **6. UML DIAGRAMS**

## 6.1 Use Case Diagram



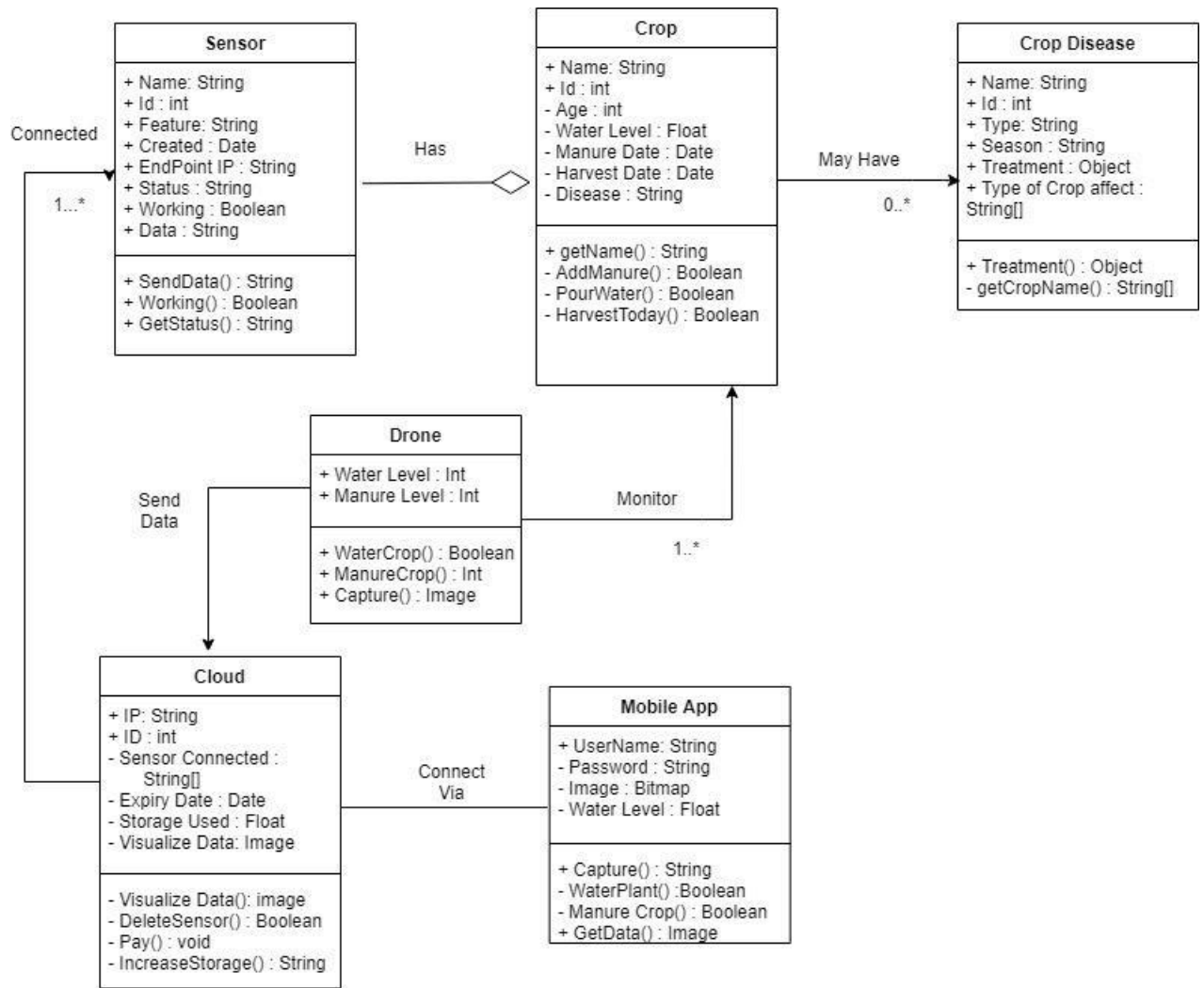
## 6.2 Sequence Diagram

## Sequence Diagram



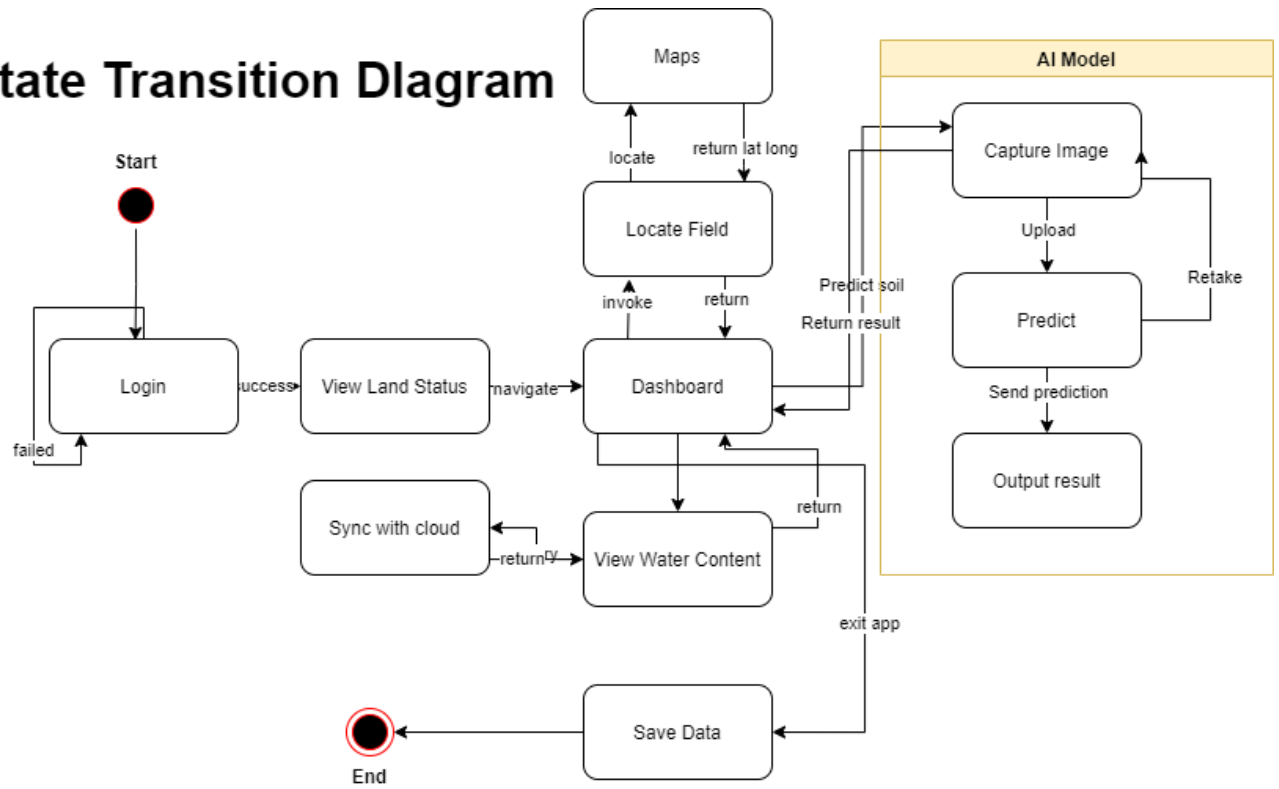
## 6.3 Class Diagram





## 6.4 State Transition Diagram

# State Transition Diagram



## **7. FINAL IMPLEMENTATION**

### **TECHNOLOGY STACK:**

#### **I. FRONT END:**

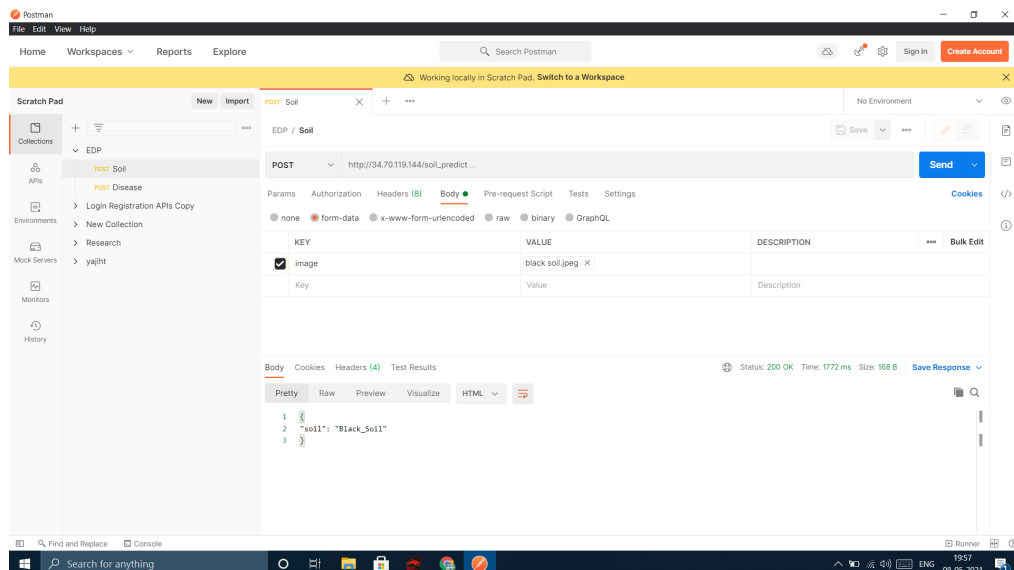
A mobile application has been developed with a user-interactive UI through which users can access the developed modules and functionalities.

#### **II. DATABASE:**

Firebase real-time database has been used to store and retrieve the data. The data from sensors is connected at a specified interval with an edge device and is stored in firebase which is then delivered to the user via mobile app. Also, authentication/login is provided in the mobile app which collectively uses firebase authentication service.

#### **III. BACKEND:**

Python flask is majorly used as a backend service. The trained deep learning models have been deployed as a REST API with flask. Based on the user's input image a JSON response is delivered. The flask server has been containerized and deployed as microservices with Kubernetes on google cloud platform which comes with load balancing services.

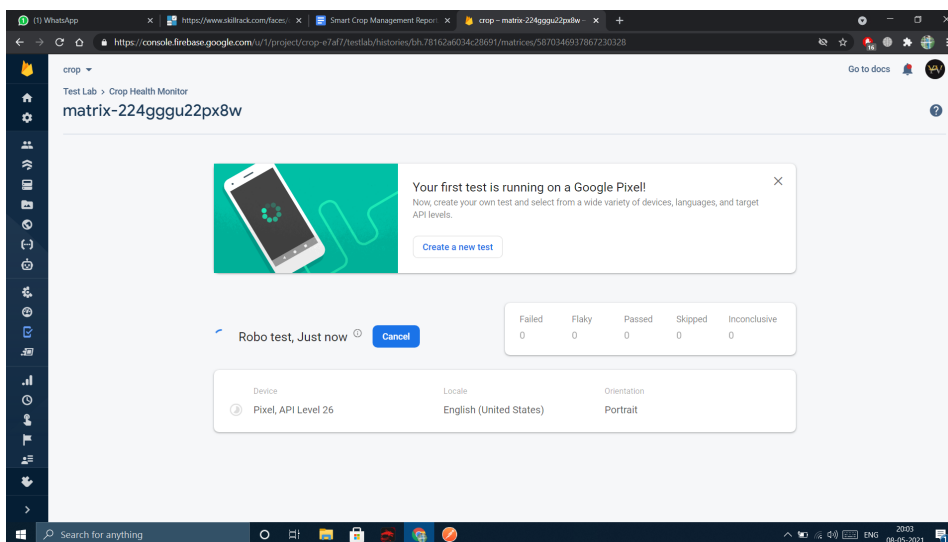


### 3. DATABASE TESTING

We Have used Firebase Database to store details and sensor data. So for unit testing we have enabled analytics and crashlytics to test them on production itself. The log has also been verified at the final stage.

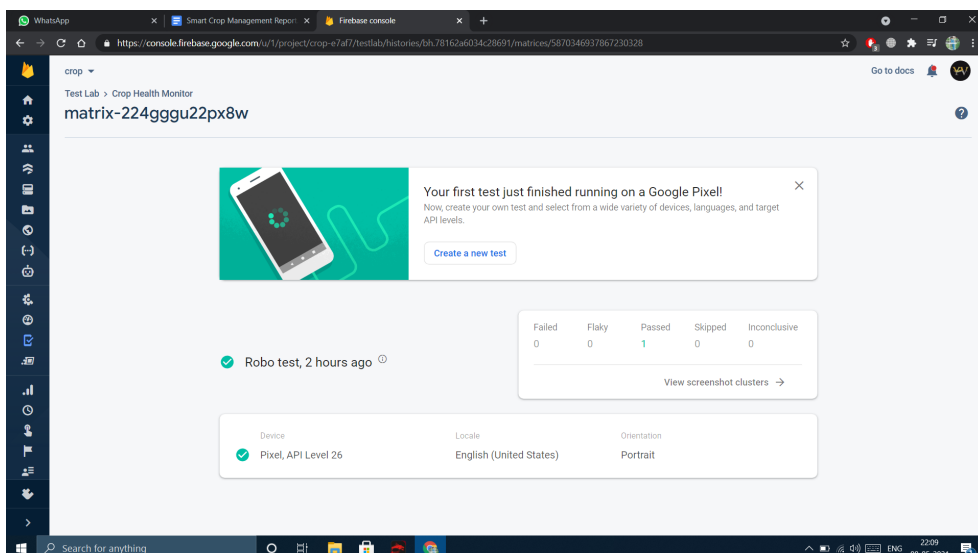
### 2.INTEGRATION TESTING

The Flask app is hosted in GCP with help of container technology and verified using postman. The Android application is installed in various devices and verified.



### 3. USABILITY TESTING

The Android application is given to low educated people to use our application



## **9. PERFORMANCE TEST RESULT**

### **1. PERFORMANCE OF DEEP LEARNING MODELS:**

- I. Disease Predictor - 83% validation accuracy
- II. Soil Predictor - 95.5% validation accuracy

### **2. PERFORMANCE OF MOBILE APP AND API:**

Our cloud REST API comes with load balancing and auto-scaling capabilities so far we haven't seen any deviation/slow in the performance of the mobile app even when multiple requests have been made.

As of future work, we need to gather more images, apply data augmentations, hyperparameter tuning and re-train the model to get more accurate predictions thereby suggesting the best crop/pesticides to the user.

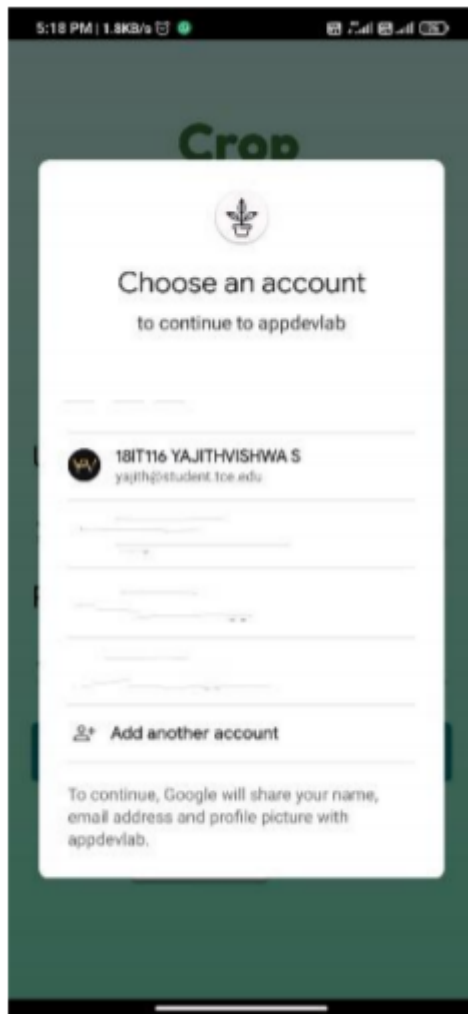
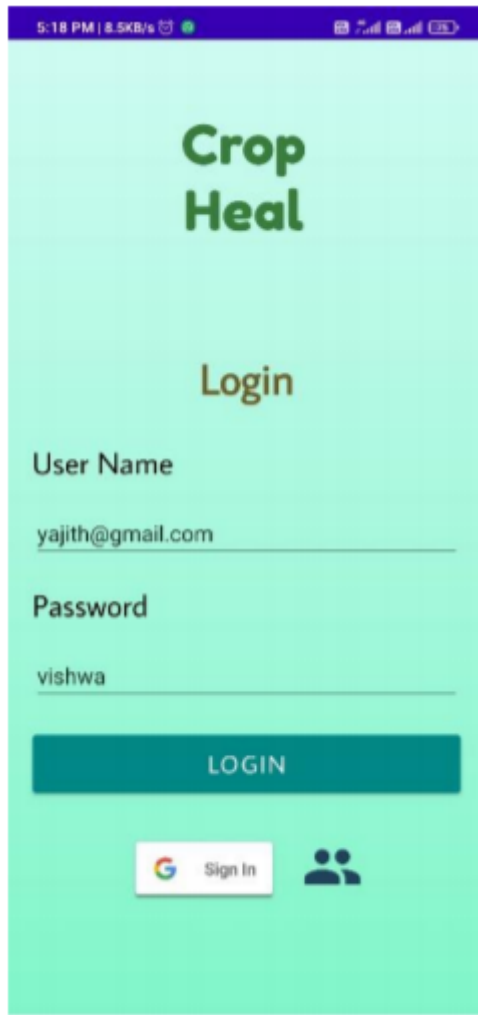
## **10. DEPLOYMENT**

### **Features Used in Application**

- 1. Camera Intent API
- 2. Firebase Database(Backend as Service)
- 3. Containerization Technology (Kubernetes)
- 4. Notification Service
- 5. Google Maps
- 6. Google SignIn(SSO)

### **Design Pictures**

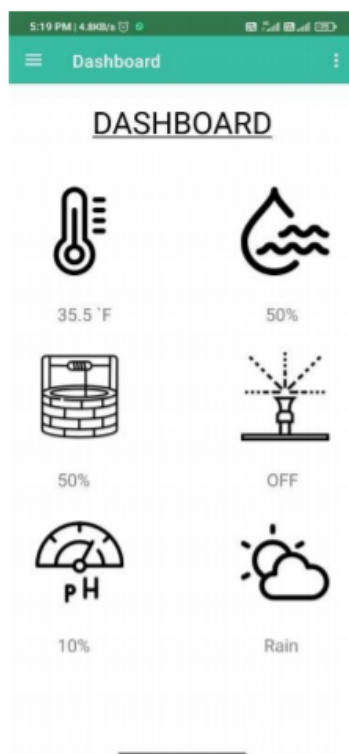
### **Login**



## Soil Capture

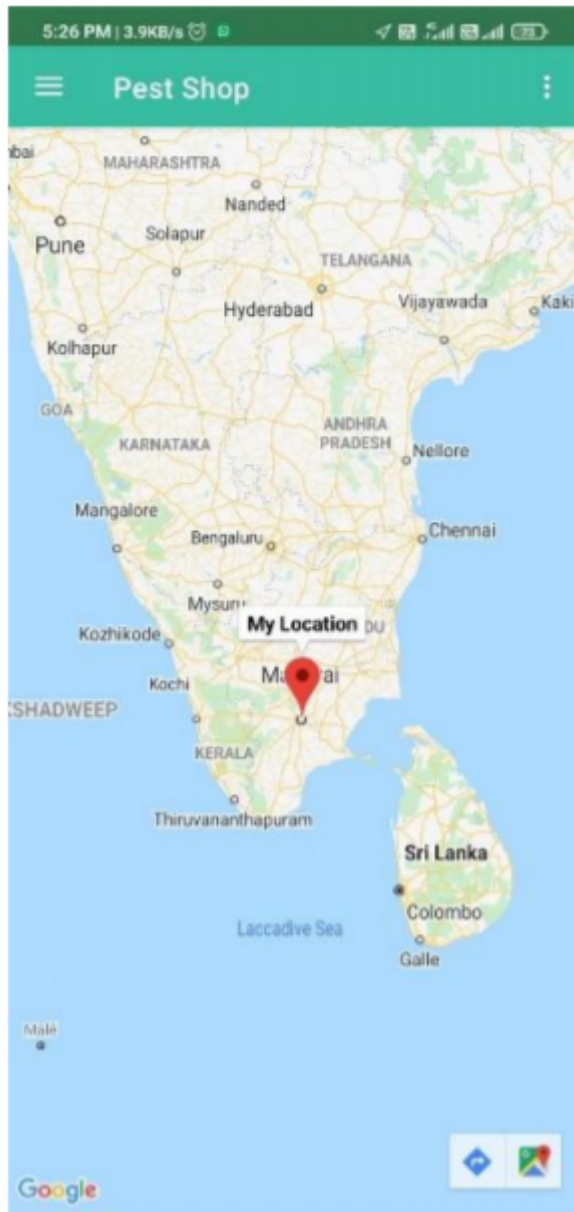


## Dashboard





## Location Detection



## Disease Finder



## Code Report

**Github :** <https://github.com/YajithVishwa/CropHealth-EDP>

## 11. CONCLUSION

The proposed system can be used for any type of land in any location where a network is available. If the model is further trained with many sample images for each type of soil disease, then almost all known diseases can be classified and reported. Combined with Data Analytics, fields can be best used for the current season or environment and can prevent underutilization. As part of the future , a new section will be implemented in a mobile app which gathers local news that is related to agriculture, rainfall and other necessary things for the farmers based on web scraping and other techniques. Further crop recommendation systems can be improved by using the information such as the crops that will be at peak price after n months, rainfall forecast data nearby field data and other things which give the robust option. Further a E-Agri module can be added to mobile app for ordering and delivering of necessary seeds, pesticides and fertilizers which saves the time and effort of farmers

## 12. REFERENCES

1. Annamaria Castrignano: Agricultural Internet of Things and Decision Support for Precision Smart Farming (2020)
2. [https://play.google.com/store/apps/details?id=com.criyagen&hl=en\\_IN&gl=US](https://play.google.com/store/apps/details?id=com.criyagen&hl=en_IN&gl=US)
3. <https://www.smartfarmingtech.com/>
4. <https://www.iotforall.com/iot-applications-in-agriculture>
5. <https://www.sciencedirect.com/science/article/pii/S1877050916315216>
6. <https://ieeexplore.ieee.org/abstract/document/8442535>
7. <https://www.sciencedirect.com/science/article/pii/S2590005620300333>