Integrated Agricultural Software Using Machine Learning and Web Scraping

A project report submitted in partial fulfillment of the requirements for B.Tech. Project

B.Tech.

by

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CANDIDATES DECLARATION

We hereby certify that the work, which is being presented in the report, entitled **Integrated Agricultural App Using Machine Learning and Web Scraping** , in partial fulfillment of the requirement for the award of the Degree of **Bachelor of Technology** and submitted to the institution is an authentic record of our own work carried out during the period *May 2019* to *September 2019* under the supervision of **Prof. Joydip Dhar** and **Dr. Prasenjit Chanak**. We also cited the reference about the text(s)/figure(s)/table(s) from where they have been taken.

Date: Signatures of the Candidates

This is to certify that the above statement made by the candidates is correct to the best of my knowledge.

Date: Signatures of the Research Supervisors

ABSTRACT

The purpose of this project is to analyze the problems being faced by farmers in the agricultural sector. Farmers do not have adequate knowledge about proper management of crops, they do not know whether their crops are affected by some disease or not and they do not have proper weather information in order to make decisions about protecting their crops. All this has lead to poor yield and loss. There is a need to introduce a way to help farmers with the means of Information Technology. This project aims to introduce an Integrated Agricultural Software which can be used by farmers to gain any type of information about growing healthy and disease-free crops. They can use this software to take a snapshot of their crops and check if their crops are affected by some disease. This disease detection scheme will work for Rice, Potato and Tomato crop. Farmers can also use it to get the weather forecast, crop growing information, mandi prices, and many more informative things. All these features are available in a single application which can be used by farmers anywhere anytime.

Keywords: Agriculture, crop information, disease detection, mandi price, agri stores, news, weather forecasting.

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Finally, we are appreciative to our Institution and partners who encouraged us to recharge our soul, refocused and helped us in carrying out this work.

(Sahil) (Sanjit Prasad) (Shashank Swarup Sharma)

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CHAPTER 1

INTRODUCTION AND LITERATURE SURVEY

This chapter includes the details of the background, problem statement, our objective, motivation and literature review. In this section, we briefly describe our project which is intended to bring a glow to people who depend on agriculture.

1.1 Background

Agriculture is currently suffering from a lot of problems due to lack of mechanization, a rise in cereal needs, depletion of natural resources, scarcity of capital and change in weather. It is expected that by 2050, the Indian population will be 1.6 billion for that we need 350 tons of cereal. Also with the time, agriculture lands are also reducing due to various reasons like soil erosion (which is when soil components move from one location to another by wind or water), development of highways, houses and companies. As we can not increase the agricultural land. So somehow we have to increase the productivity of crops to fulfill the requirement. The only way we can help farmers is by enhancing productivity using modernized technology. Farmers are not in touch with IT and this seems the cause for their backwardness. This project is intended to bring a glow to the peoples who depend on agriculture.

1.2 Motivation

In today′s era, farmers have to grow more amount of crop. Therefore, Intelligent farming technologies must be introduced to diminish the costs of growing crops, maximize yields and earnings, and still be productive in the process. However, they face many challenges due to the lack of required information for growing crops. Even though some Apps have been developed for this purpose, they provide limited functionality and do not provide a one-step solution to all the agricultural problems. Hence, there is a need to come up with an Integrated App that could provide more features to the farmers. Therefore we focus on the development of an Integrated Agricultural App, which is dynamic and has an easy to use interface. Our App will have all the necessary functionalities needed by a farmer in their daily routine.

1.3 Literature Review

The development of an Integrated Mobile Application for agricultural purposes has been suggested by this research paper [2]. The Integrated App proposed by them contains information like Crop Information, Mandi Bhav, Forums and Weather Forecasting. The existing Apps only have limited functionality and do not provide a one-step solution to all the agricultural problems. The data on the current Apps remains static and does not get updated with time, which means that they lack automated scripting. If all such scattered functionalities could be integrated into one App, then it would be easy for farmers to get all information in one place. Therefore, the focus should be laid on the creation of an Integrated Agricultural App.

An overview of different mobile-apps currently available in the Google Play Store, targeting the agricultural sector has been presented in this research paper [6]. Also, a solution to overcome the agricultural problems has been suggested by them in the form of an Android application namely Kissan Sevak. Their App includes Market Price, News and weather forecast. They have observed that only a few Apps were able to catch all the essential requirements of a farmer. Finally, they concluded that the functionalities of various existing applications should be available in one single App.

The challenges faced by the farmers in the management of farming have been studied in this research paper [1, 8]. They suggested that mobile Apps can bring a revolutionary change in the field of agriculture and can help in the production of more crops and grains for the country. They have also studied the functionalities in the current Apps and come to the conclusion that there is a need for a more Advanced App which could help farmers in their farming activities.

This research paper focuses on the detection of crop diseases with the help of neural networks and proposes different methodologies for disease detection [4, 13]. They have used the features available on the leaf of the crop for the detection of diseases since most of the crop diseases in India can be classified based on those features. They used texture and morphological features to train a neural network model. They have focused on the classification of 9 plant diseases for coffee, barley, oats and papaya. They have used a deep convolutional network and they achieved an accuracy of 85.98%. More work needs to be done to improve the accuracy and more data of diseases crops must be available for better performance.

This research paper suggests that there is a huge scope for mobile applications for the development of the agricultural process [7, 14]. They proposed that an application based support system can be a boon for Indian Farmers. Mobile technology must be combined with a Geographical Information System(GIS) and wireless sensor networks. It can help in Financial Services, Quality control, Market information, trade relationship management, business management and other support services. Farmers are in a need of an Android Application which can provide them with farming information on a regular period.

This research paper focuses on the development of an Integrated Agricultural App, Kisan Vikas [10]. This App provides information such as Weather forecast, crop prices and news related to agriculture. They have also connected the mobile application to an Arduino based wireless sensor(WSN) which helps in providing information about temperature, pH level and soil moisture. They have laid a huge emphasis on the development of such an App because the agriculture sector employs more than 50% of the working population.

All the research papers discussed above focus on the development of an Integrated Software that can increase farming efficiency. However, Apps suggested by some of these research papers only have few features, that would be helpful for the farmers, but are not sufficient. Hence, we focus on bringing more features that would be beneficial in increasing the productivity of the crops grown by the farmer.

1.4 Area of Improvement

Below we have compared various Apps on Google Play, regarding which modules they have and which are missing. Table 4.2 shows that we need an Integrated Agricultural App that provides most of the information regarding agriculture at one place.

App Name	RSS Feed	Mandi Price	Crop Info.	Weather Info.	Disease Detection	Nearby Agri-Store	Portal
Plantics	✗	✗	✗	✗	✓	✗	✓
Krishi hub	✗	✓	✓	✗	✗	✗	✓
Kishan network	✗	✗	✓	✓	✗	✗	✗
IFFCO Kisan	✗	✓	✓	✓	✗	✗	✓
Apni kheti	✗	✓	✗	✓	✗	✗	✗
Farm bee	✗	✓	✗	✓	✗	✗	✓
Agro base	✗	✗	✓	✗	✗	✗	✗
Agrio	✗	✗	✗	✗	✓	✗	✗
Kisan Yojna	✓	✗	✗	✗	✗	✗	✗
Agri guru	✗	✓	✓	✓	✗	✗	✓
Our App	✓	✓	✓	✓	✓	✓	✓

Table 1.1: Comparison of various existing android app

1.5 Problem Statement

The problem is to provide an android application consisting of all functionalities that a farmer requires in their daily life.

1.6 Objective

Our objective is to deliver an Android Software which will have the following important modules for the benefit of farmer :

- Crop Disease Detection
- Nearby Agricultural Stores
- Weather Information And Forecast
- Mandi prices
- Portal
- RSS Feeds
- Crop Information

CHAPTER 2

DESIGN AND IMPLEMENTATION DETAILS OF DEEP LEARNING MODEL

This chapter includes description of the dataset and details of deep learning models used for disease identification.

2.1 Dataset

We have used a public dataset provided by PlantVillage. This dataset consists of images of diseased and healthy crops. We have used a subset of this dataset containing the images of Rice, Potato and Tomato Crops. Total number of images for Rice, Potato and Tomato were 1139, 2152 and 4329 images respectively. The original dataset consists of 14 types of different crops, however we have taken only 3 crops due to their huge amount of productivity in India.

We have used 80% of total images for training our Deep Learning model and 20% for testing the accuracy of this trained model.

2.2 Details of Deep Learning Model Used for Plant Disease Classification

2.2.1 Transfer Learning

Transfer learning is a machine learning concept in which we use the knowledge gained from solving one problem in solving some other problem. For Example, we can use the knowledge gained from the learning process of classification of different bicycles, in the classification of bikes. In a real-world scenario, we do not have much data for the training of the Convolutional Neural Network [15]. Most computer vision problems have small datasets ranging from 4,000 to 50,000 images. Hence, it is difficult to achieve high accuracy. Here, we can use the concept of transfer learning [11]. We use pre-trained network weights from already trained models which helps in solving the problems with small image datasets [12]. The pre-trained model is used to extract features, detect edges and shapes and some high-level features. This helps in improving the performance and speed up the training progress.

We would be using VGG16, which is a convolutional network for extracting features from input images. These extracted features would then be used to train an Artificial Neural Network which would predict the type of disease with which the crop is suffering.

2.2.2 VGG16 - Convolutional Network

VGG16 is a network model that has been trained on a huge dataset of 14 million images which belong to 1000 classes. Figure 2.1 represents an example of using VGG16 for feature extraction. The input to the conv1 layer is of 224 x 224 RGB image size. After this layer, the image is passed through many convolutional layers. There are also 3 FC(fully connected) layers after the convolutional layers. Initial 2 layers have a total of 4096 channels and the third layer has 1000 channels. Last layer has 1 channel for 1 type of prediction to be done. All the hidden layers are equipped with the rectification(ReLU) non-linearity. This model gives the prediction for 1000 classes.

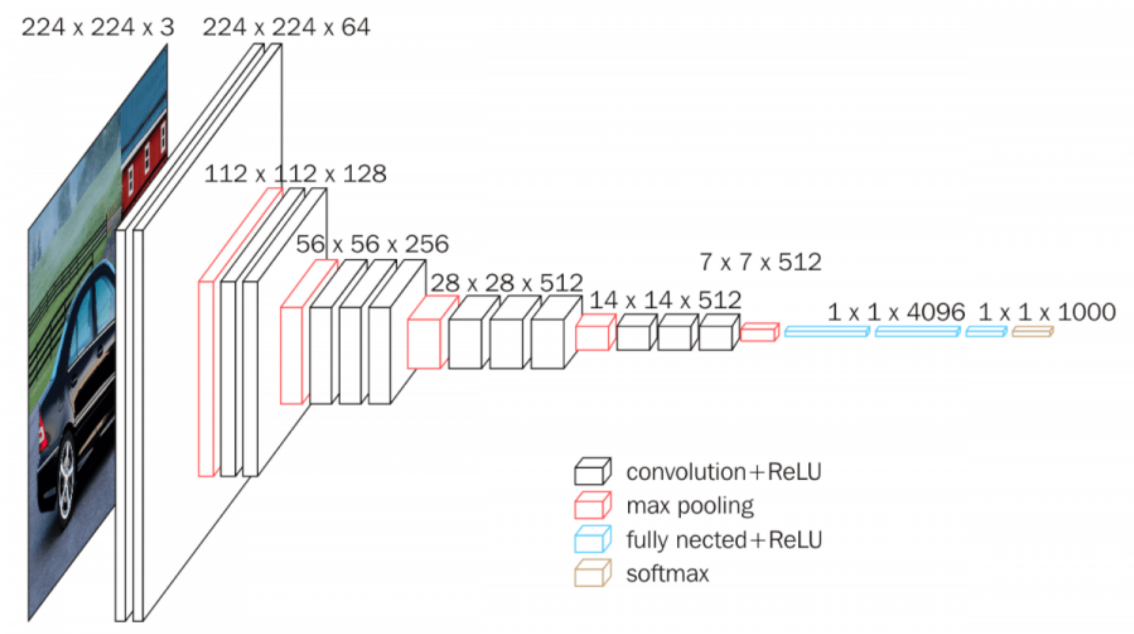

Figure 2.1: VGG 16 model image [16]

2.2.3 Model Implementation For Disease Detection

We use the dataset of 7620 images for the identification of crop diseases. Since we have less number of images, we have done image augmentation to increase the number of images for training in order achieve higher accuracy on our dataset. We have used image reflection and image rotation techniques for data augmentation. We have generated a total of 37251 images for training. We have used the image generator functionality of keras library to generate more images.

All the images are of (256 x 256 x 3) size. We resize them into images of (128 x 128 x 3) size due to computational limitation [3]. These images are then divided into training and testing data. We have taken 80% of total images for training our deep learning model and 20% for test data. We would be using K-fold cross validation in order to make sure that every piece of our data goes into training. We then fed the VGG16 model with training images, which gives an output of 4 Dimensional Array of size (44016, 4, 4, 512). VGG16 is able to extract only the important features from the images and helps in reducing the overall complexity of the algorithm. The total number of pixels for each image has drastically decreased from 196608 to 8192. This decrease saves many hours of training.

The output from the VGG16 is then reshaped into a 2 Dimensional Array of size (44016, 4*4*512). This array is fed into an Artificial Neural Network(Classifier Network) which predicts the crop disease. We have used 2 types of optimizers namely, Adam and Adagrad. Adagrad was able to predict diseases on unseen crops with higher accuracy. The output of the model is then send to the Mobile Application with the help of flask server, so that farmer can see what type of disease is affecting his/her crops.

Figure 2.2 represents the neural network(Classifier Network) [9] used for predicting the disease type. The Classifier Network in our model has 2 relu activation function in the first two layers and we have used softmax activation function in the last layer. We have also used a dropout of 20%. We have used 2 optimizers, out of which best performance is given by Adagrad optimizer.

$$\text{Loss function} = -\frac{1}{N}\sum y_{\mathrm{j}} \times \log y'_{\mathrm{j}} + (1 - y_{\mathrm{j}}) \times \log(1 - y'_{\mathrm{j}}) \tag{2.1}$$

We have used categorical loss entropy as the loss function.This function predicts the probability with which an input may below to a particular class. The overall loss will begin to increase if the probability with which it may belong to it's actual class is quite low. As the model trains on the dataset, loss will begin to decrease. The function is given by equation 2.1 [16]: Here, N represents the total size of the dataset, y_j represents the actual class of an image and y'_j represents the predicted class of the provided image.

Figure 2.2 shows the Artifical Neural Network of our model. This network receives the input from the VGG16 network. This input is then passed through two dense layers. The neurons in these two layers are fully connected with their previous layers.

We have used a dropout of 20%. Dropout is necessary so that overfitting can be avoided. 20% dropout means that, 20% neurons of the dense layer would be selected and switched off randomly. This means, selected neurons won't be used for training during an iteration. This process happens at each iteration of training, which avoids each neuron from learning too much about a characteristic of input data.

After applying the dropout, the data is fed again to a dense layer which is the final layer. This layer has total of 15 outputs, each belonging to every type of disease to be predicted.

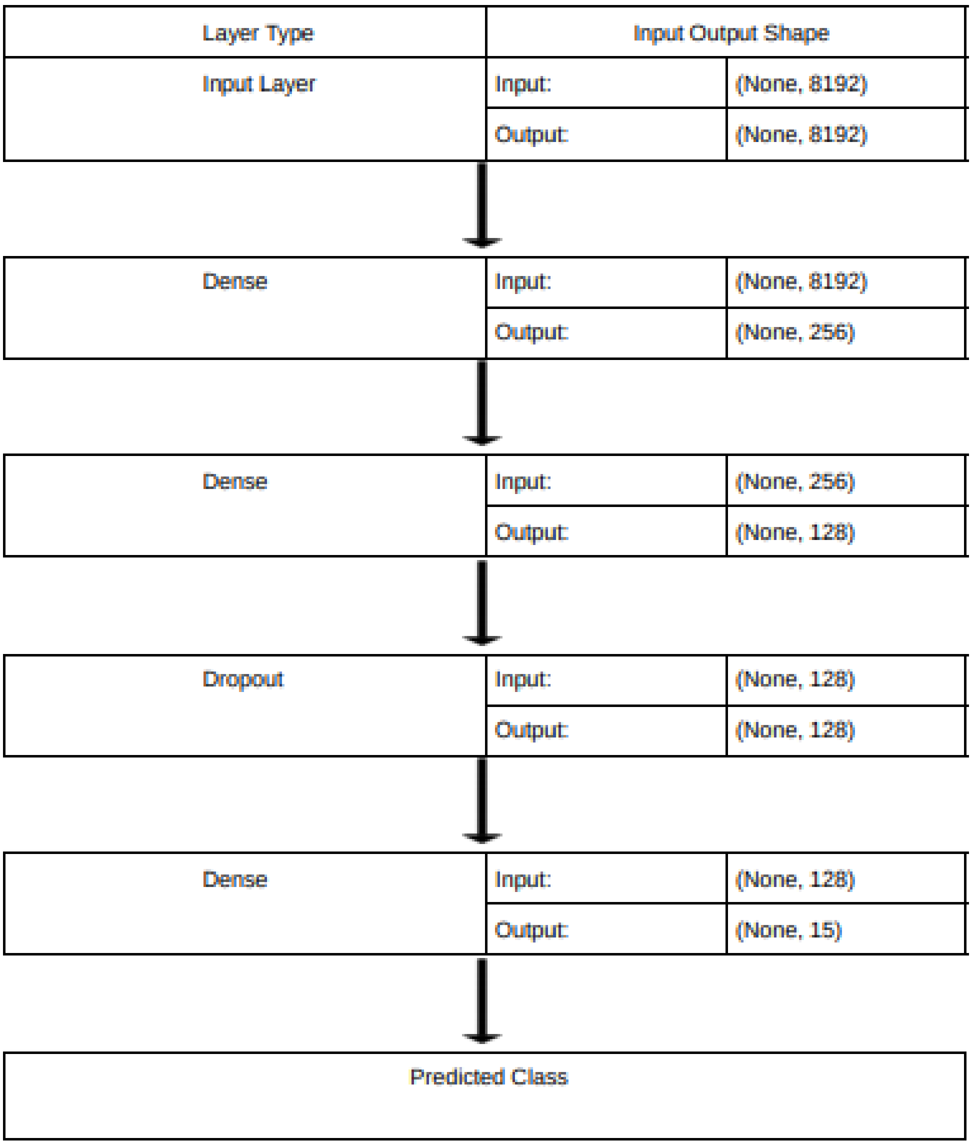

Figure 2.2: Artificial Neural Network

2.2.4 Complete Architecture of Deep Learning Model

Figure 2.3 shows the Deep Learning model which is used for training our model on images of 3 different types of diseased and healthy crops. An image would be captured by user with his mobile phone. He would then upload the photo to our Application.

Our Application would then send this picture to our server where it will pass through our Deep learning model. First of all, the image would be reshaped to 128x128x3 dimension. After this, it would be passed through an Convolutional Neural Network, VGG16 Network, for extracting the important features.

These features are then passed through an Artifical Neural Network. This network predicts the probability with which it may belong to 15 classes of diseases. We take the class which has the highest probability and passes a certain confidence level.

The predicted class is returned to the mobile application through the server. Farmer can then know the disease with which his/her crop is suffering. If the highest probability of a class is below the confidence level, then it may not be possible to predict the disease with which crop is suffering.

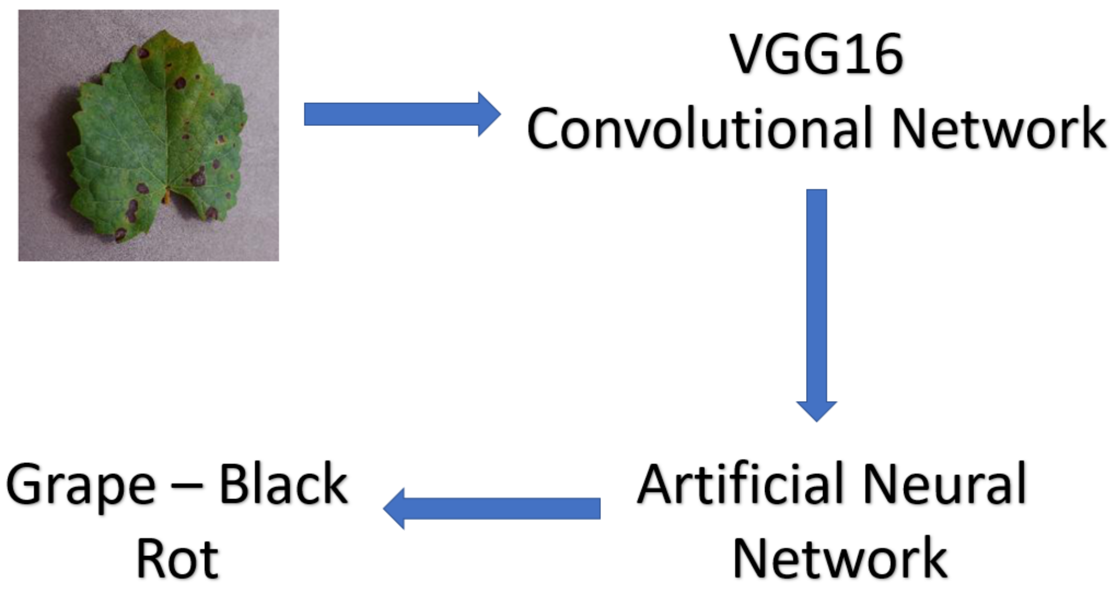

Figure 2.3: Complete Architecture of Model Used

CHAPTER 3

MODULES WISE ACTIVITIES COMPLETED

This chapter includes a short description of activities that have been completed till now.

3.1 Crop Disease, Pest and Insect Information

We have made python web scraper to get Crop information from https://pnwhandbooks.org. We have collected information about various diseases, pests,insects and their cultural, biological and chemical control methods. In total we have 1700 diseases information covering various crops. We put all these data to our database and built the RESTful API for the same, so that it can be served as a POST request to our android application when user makes the request.

3.2 Plant Disease Detection Module

We have collected images from a public dataset by PlantVillage containing 55,020 images. We have used a subset of this dataset consisting of 7620 images. covering 3 crops and 15 diseases. These images were used to train a deep Convolutional Neural Network for prediction of diseases on new crop images.

3.3 Weather Information and Prediction Module

A farmer can not fight the weather. But if they get the information earlier, they can follow precautional activities to reduce the crop losses.for example, If there is raining at the time of harvesting the crop then this will leads to huge loss, But if the farmers knows this earlier then he can delay harvesting by 3-4 days.
We have used the Open Weather API to get weather information of next 5 days at every

3-hour interval including temperature, wind speed, atmospheric pressure, humidity and rainfall prediction. So, for each query user will get 40 entries of weather forecast.

3.4 Nearby Agricultural Stores and Mandi Module

We have used Google Nearby Places API to find agricultural store(Fertilizer, Seeds, Pesticides Store) within five kilometers radius of user′s current location. User can also get the direction to reach that particular store. This modules also includes the location of nearby Mandi markets on google map.

3.5 Mandi Price Module

We are collecting the prices of all the crops and vegetables in all mandis across India from official government website https://agmarknet.gov.in/ and store them in our database. The python script is running as a cronjob and updating the database periodically. This database is hosted on Google cloud engine server and we built the RESTful API for the same so that this could be served to android application also. Here user have to submit the district, commodity followed by market name to get the price of that particular commodity.

3.6 RSS Feed

We are collecting daily news from various agricultural websites like vikaspedia.in, nature.com etc using the python web scraper and then store the news, source of news, date of publish and original link fo news in our database on daily basis. And then built the RESTful API to serves this as a POST request to our andriod application. Farmers can see the latest news from different websites in one place.

3.7 Portal For Farmer Queries

It is very important for the farmers to have a platform where they can discuss about their issues. So we developed a simple portal that would help solve the queries of farmers. Here, different farmers can communicate with each other and solve each other doubts and they can also share the benefits or scheme (like crop bima yojana) given by the government to farmers. so, this will also help in creating the awareness among the farmers.

This module have three main functionalities ask a quetion, reply to any question, see the feed of asked questions.

CHAPTER 4

RESULTS

This chapter includes the description of results of the activities that have been completed.

4.1 Crop Disease, Pest and Insect Information

We have collected information about various diseases, pests, insects and their cultural, biological and chemical control methods. We have made a python web scraper to get Crop information from https://pnwhandbooks.org website and display the same in the application as shown in Figure 4.1 and Figure 4.2 .

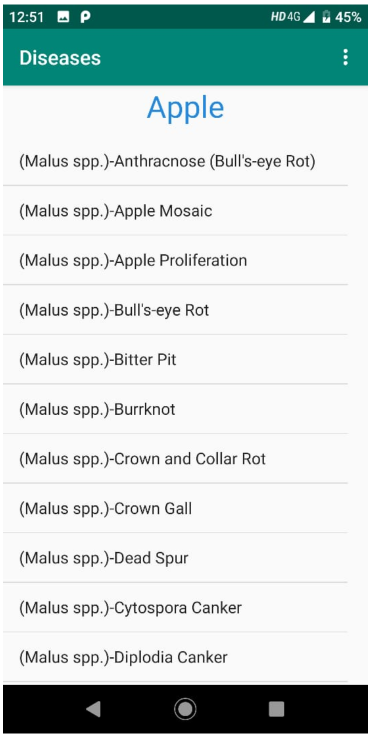

Figure 4.1: Crop Diseases

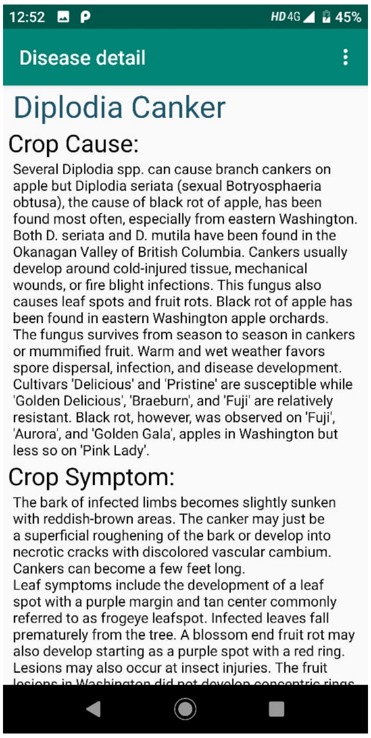

Figure 4.2: Disease Information

4.2 Deep Learning Model for Crop Disease Detection

In order to predict the disease in a crop image, we have to train our deep learning model using the PlantVillage dataset. We have used different optimization techniques inorder to find the best optimization algorithm for our model. Below is the training accuracy and loss related to each optimizer we used.

4.2.1 Accuracy

We have trained our model with the following 2 optimization techniques:

- Adam
- Adagrad

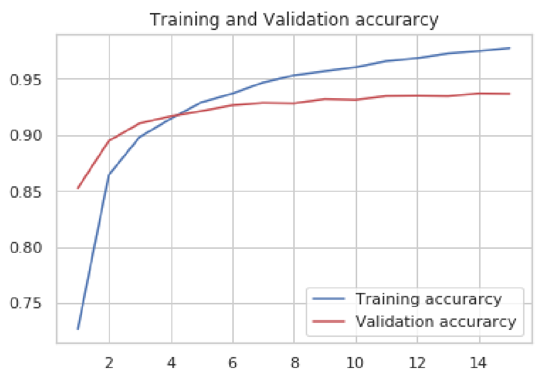

Figure 4.3: Adagrad Accuracy Curve

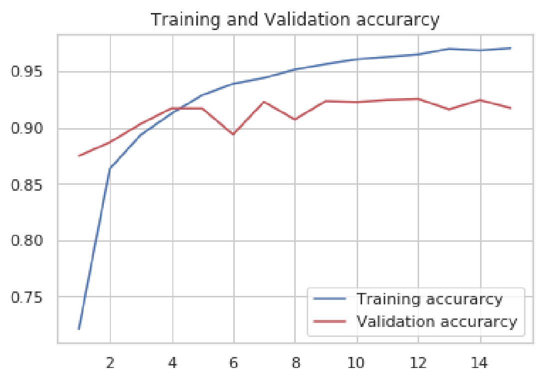

Figure 4.4: Adam Accuracy Curve

Figure 4.3 and 4.4 represents the accuracy curves for Adagrad and Adam respectively. In Figure 4.3, though the training accuracy increases with increase in the epochs. however, validation accuracy begins to decrease with increase in epochs. Hence, this optimizer is actually overfitting the model. But in Figure 4.4, validation accuracy keeps on increasing and there are no fluctuations in the curve, which shows that the model is not overfitting.

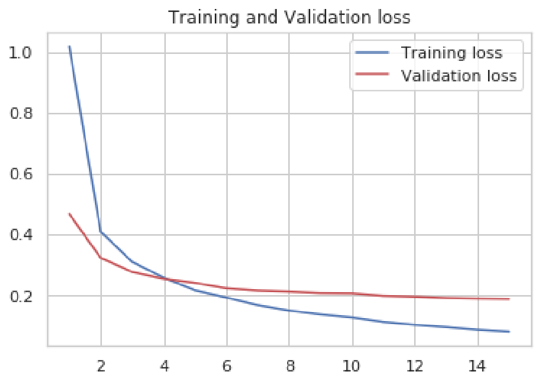

Figure 4.5: Adagrad Loss Curve

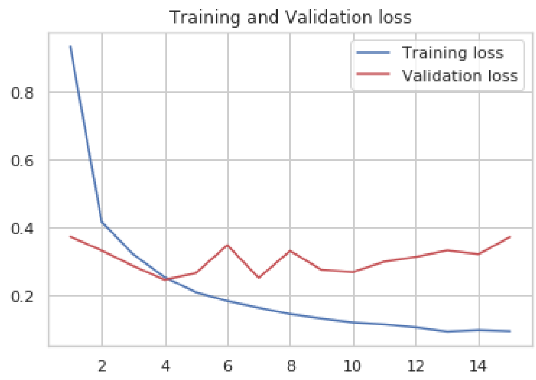

Figure 4.6: Adam Loss Curve

Figure 4.5 and 4.6 represents the loss curves for Adagrad and Adam respectively. In Figure 4.6, it can be clearly observed that the validation losses begin to increase as we increase the number of iterations which again proves that Adam optimizer is overfitting the model. However, in Figure 4.5, validation loss keeps on decreasing. Hence, it can be concluded that Adagrad optimizer works best. After observing these results, we have trained our model based on Adagrad optimizer. We have obtained an accuracy of 98.00% on training data and an accuracy of 93.61% on testing data. The formulae for Adam optimizer are given

$$v_t = \beta_1 \times v_{t\text{-}1} - (1 - \beta_1) \times g_t \,, \tag{4.1}$$

$$s_t = \beta_2 \times s_{t\text{-}1} - (1 - \beta_2) \times {g_t}^2 \,, \tag{4.2}$$

$$\Delta\omega_t = -\eta \frac{v_t}{\sqrt{s_t + \epsilon}} \times g_t \,, \tag{4.3}$$

$$\omega_{t+1} = \omega_t + \Delta\omega_t \,, \tag{4.4}$$

where the parameters are described in Table 4.2.

Parameters	Description
η	Initial Learning Rate
v_t	Exponential Average of gradients along w_t
g_t	Gradient at time along w_t
s_t	Exponential Average of squares of gradients along w_t
β_1, β_2	Hyperparameters

Table 4.1: Description of Parameters in Adam Equation

4.2.2 Confusion Matrix

Rice (Brown Spot)	299	39	0	0	2
Rice (Leaf Smut)	52	300	0	0	2
Tomato (Bacterial Spot)	0	0	1665	2	14
Tomato (Early Blight)	0	0	14	674	12
Tomato (Late Blight)	0	0	25	54	1353
-	Rice(Brown Spot)	Rice (Leaf Smut)	Tomato (Bacterial Spot)	Tomato (Early Blight)	Tomato (Late Blight)

Table 4.2: Confusion Matrix

We have plotted the confusion matrix for our model. Its shape was of 15x15. Since it was not possible to show such a large image clearly, we have shown a 5x5 matrix. Table 4.2 represents a 5x5 confusion matrix for 5 classes. However, the actual matrix would contain all the 15 classes. The original number of images in each category represented by Table 4.2 are as follows:
Rice (Brown Spot) = 334
Rice (Leaf Smut) = 334
Tomato (Bacterial Spot) = 1859
Tomato (Early Blight) = 720
Tomato (Late Blight) = 1509
It can be observed the model predicted most of the test images correctly for these 5 classes.

4.2.3 ROC Curves

We have shown the ROC curve for 15 classes. Also, AUC is also calculated for each class. Figure 4.7 represents the ROC curves for 15 classes to be predicted.

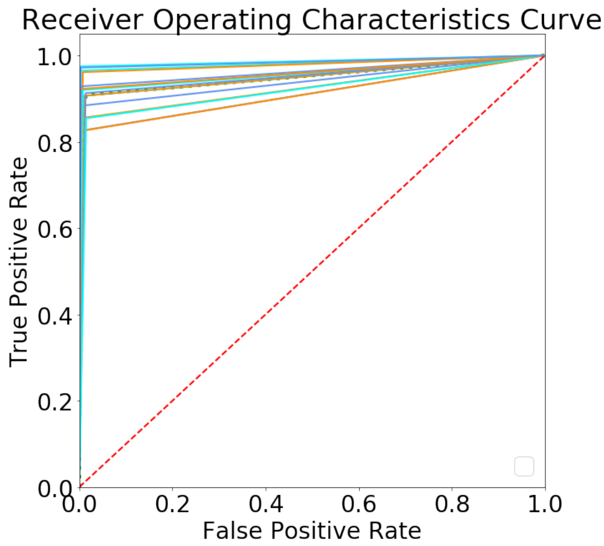

Figure 4.7: ROC Curve

Figure 4.8 represents the Area Under Curve (AUC) for each and every class curve. It can be clearly observed that the AUC for all the classes is close to 1. More the value of AUC is close to 1, better is the model. Hence, our model has performed really well on all the classes.

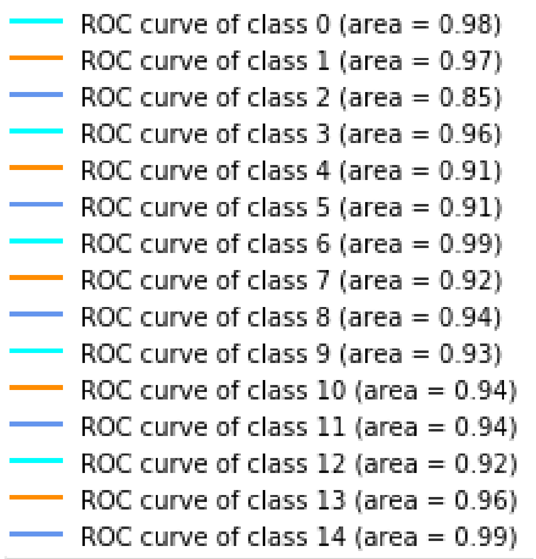

Figure 4.8: Area Under Curve

4.2.4 Precision, Recall and F1 Measure

Figure 4.9 represents the precision, recall and F1 score for all the classes. More the value of F1 score close to 1, better is the prediction of that class. It can be seen that F1 score for all the classes is more the 0.80, which means that model is predicting very well on unseen crop leaf images.

	precision	recall	f1-score
0	0.94	0.97	0.95
1	0.86	0.95	0.90
2	0.94	0.69	0.80
3	0.96	0.91	0.94
4	0.81	0.83	0.82
5	0.85	0.83	0.84
6	0.96	0.98	0.97
7	0.89	0.84	0.87
8	0.95	0.89	0.92
9	0.93	0.87	0.90
10	0.90	0.88	0.89
11	0.86	0.91	0.88
12	0.82	0.87	0.85
13	0.89	0.92	0.90
14	0.98	0.97	0.98

Figure 4.9: Precision, Recall, F1 score

4.3 Weather Information and Prediction

Figure 4.10 shows the integration of the Open Weather API with our Android application. The users can query weather information for any location to get the current weather information and also for up to the next 5 days. The weather information is shown at every 3-hour interval including temperature, wind speed, atmospheric pressure, humidity, and rainfall prediction.

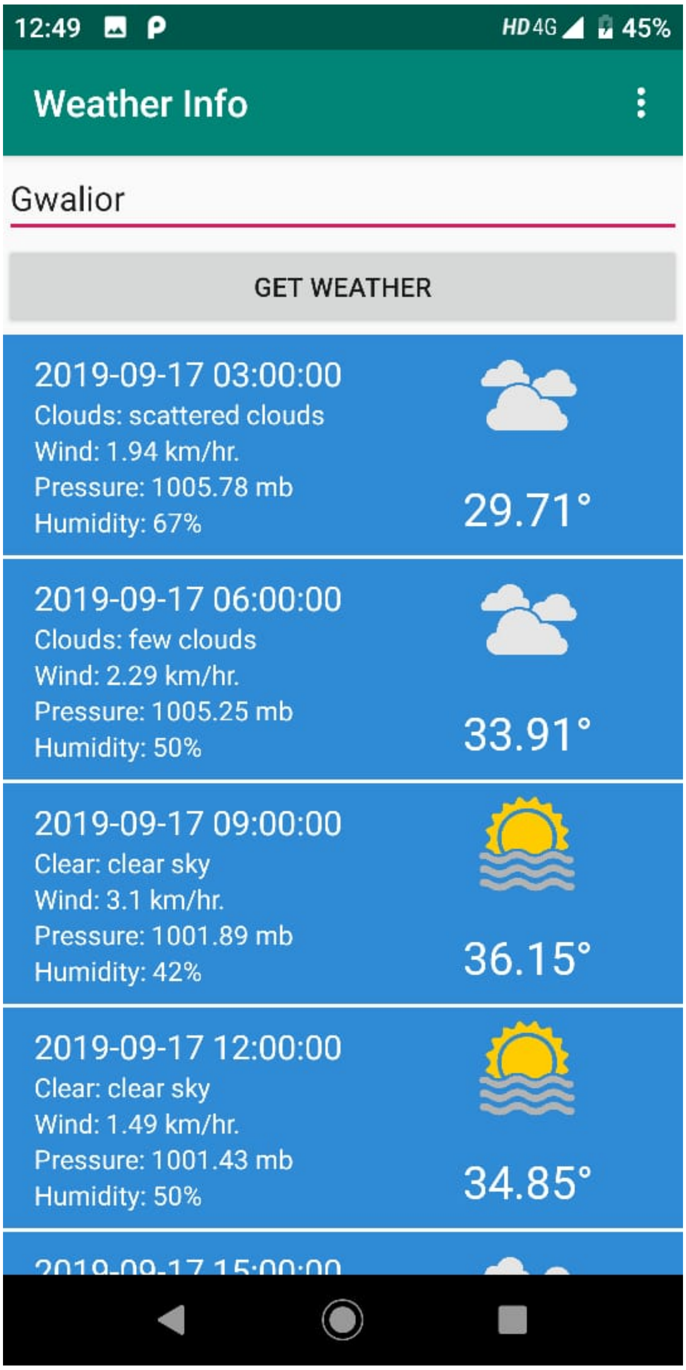

Figure 4.10: Weather module

4.4 Nearby Agricultural Stores and Mandi

In this module, we have made the integration of Google Nearby Places API with Global Positioning System (GPS) [5] which would help the farmers in finding the agricultural store that consists of Seed Store, Fertilizers Store, Pesticide Store within 5 kilometers of user's current location as shown in Figure 4.11. The stores are shown as a green marker with their respective name and the user can also be able to locate a path to that store.

Figure 4.11: Nearby Agri Store module

4.5 Mandi Price

We are collecting the prices of all the crops and vegetables in all mandis across India from the official government website https://agmarknet.gov.in/and store them in our database. The python script would run as a cronjob and update the database periodically and a user can make a request to get the mandi price of a particular crop as shown in Figure 4.12 and Figure 4.13. The user has to first select the crop followed by state and district to know the price of the crop in the Mandi.

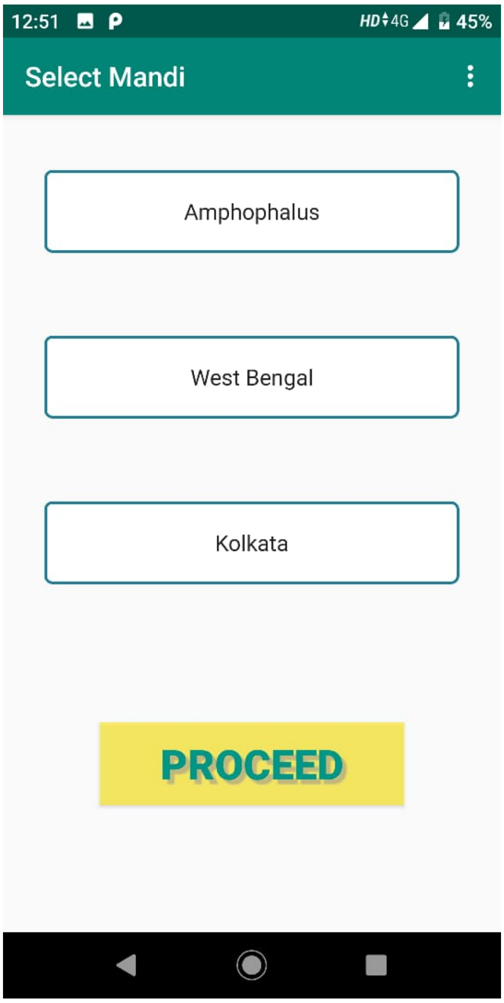

Figure 4.12: Select Mandi

Figure 4.13: Mandi Price

4.6 RSS Feed

We are collecting daily news from various agricultural websites like vikaspedia.in, nature.com, etc. to provide relevant information and knowledge-based content related to agriculture. This would be helpful for farmers to update their knowledge from the available resources and disseminate the knowledge to others. The news would be stored in our database and will be updated regularly and served through the RESTful API to our application. The farmer can see the latest news from different websites in one place as shown in Figure 4.14. The user would be able to see the source of news, date of publication and website from where the news has been taken.

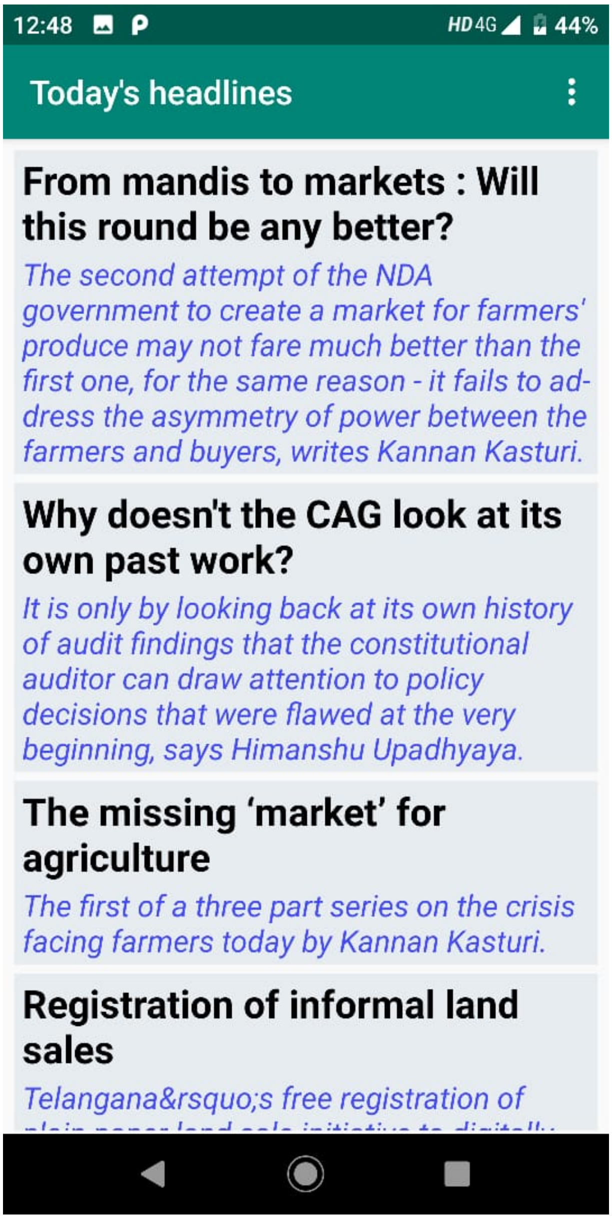

Figure 4.14: Daily News

4.7 Comprehensive Portal For Farmer Queries

A simple portal has been designed which would help farmers in finding answers to various questions from different categories of the crop. Farmers will be able to ask questions on specific queries regarding their crop disease or yield by mentioning the crop name and then asking the question in their respective fields as shown in Figure 4.15, 4.16.

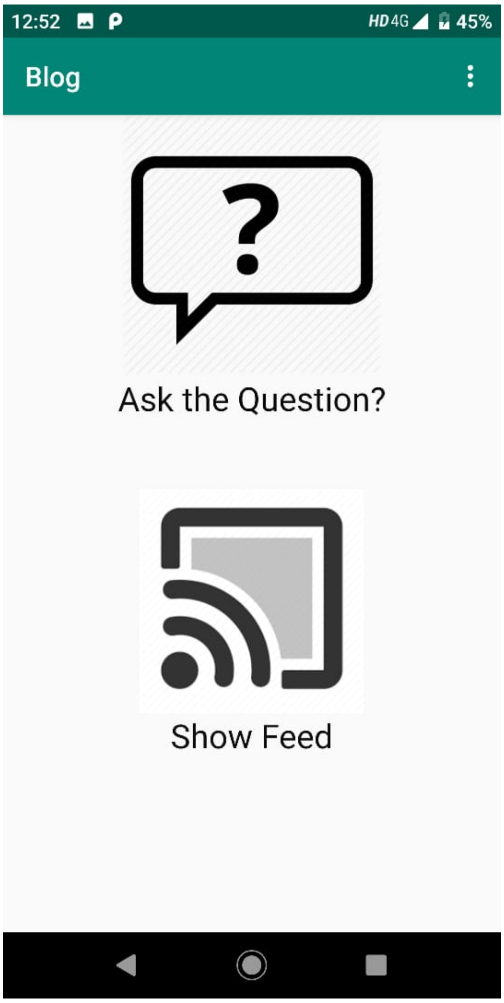

Figure 4.15: Blog For Farmers

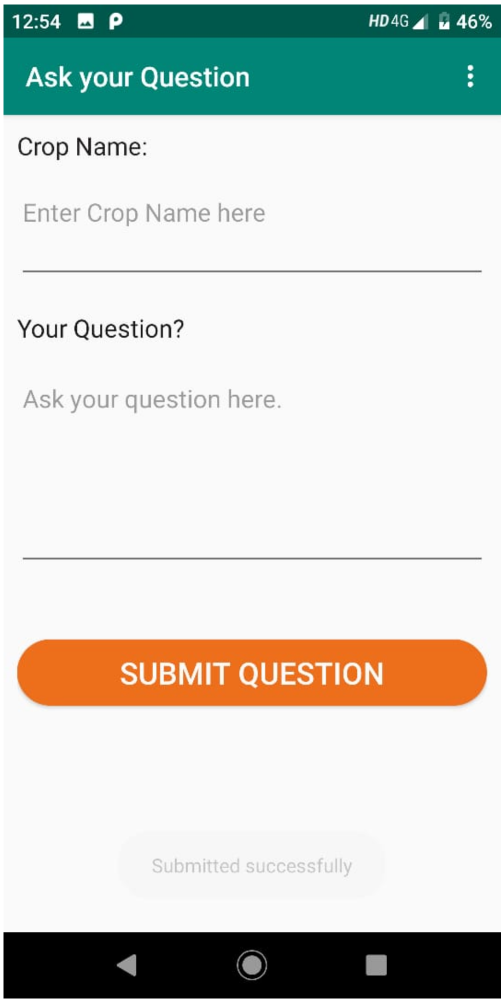

Figure 4.16: Ask Question

The portal also maintains a database of previously asked questions of all crops at one place listed by order of date so that anyone can view the recent answers to a particular question and can also reply with a new answer to that question as shown in the figure Figure 4.17 and Figure 4.18.

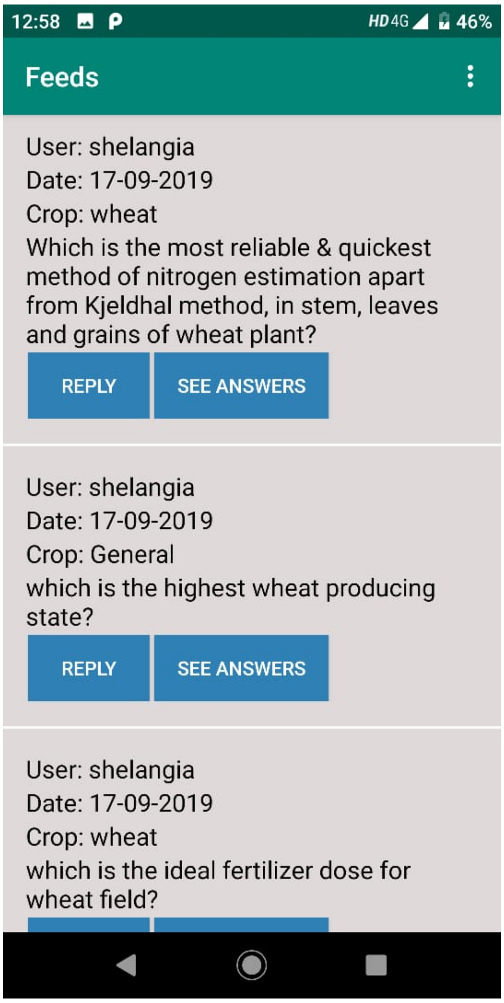

Figure 4.17: Previous Asked Questions

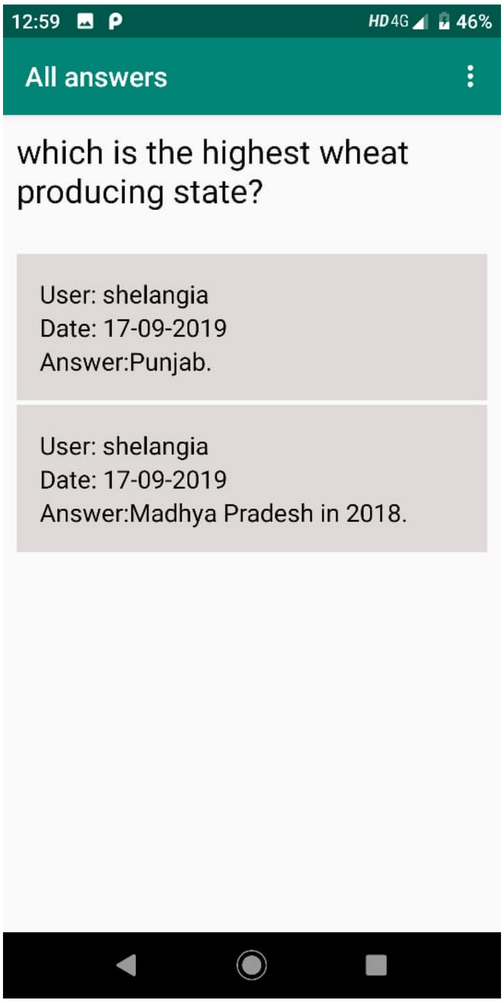

Figure 4.18: Answers replied

CHAPTER 5

CONCLUSION AND FUTURE SCOPE

The preliminary models collectively complete the first stage of this project. Following are the remaining tasks that need to be done:

5.1 Conclusion

We have brought an Integrated Agricultural Software for the benefit of the farmer. With the help of this software, farmers can detect if their crops are affected by some disease or not. They can also see weather forecasts, crop growing methods, latest mandi prices and they can access many more features. We have used Artifical Neural Network and VGG-16 for the training and prediction of disease in crops. We have made our Deep Learning model has been created for Rice, Potato and Tomato crops. We have used the Google cloud services to host our servers. Other additional features are provided using Python Web Scraping and Django Restful-API. We were able to achieve an accuracy of 91% for our prediction of diseases in the mentioned 3 crops. The farmer can easily access the features of the Applications anytime anywhere. This would of great help to farmers to grow healthy and disease-free crops.

5.2 Future Scope

- Regional language support can also be integrated depending upon the native language of the user.
- There is a need to extend the functionality of existing disease detection module to detect various other disease in crops.
- Projects must be scalable to serve large number of users without causing any delay in queries made to the software.

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