AN INTELLIGENT SYSTEM FOR FORECASTING FARMER'S REQUIREMENTS IN MAHAWELI PROJECT: A CASE STUDY

Project ID - 20_21-J11

Final (Draft) Report

Kavindi H.G.A (IT17178150)

BSc (Hons) in Information Technology Specializing in Software Engineering

Department of Computer Science and Software Engineering

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Kavindi H.G.A (IT17178150)

Dr. Pradeep Abeygunawardhana, Ms. Narmada Gamage

(The dissertation was submitted in partial fulfilment of the requirements for the B.Sc. Special Honors degree in Information Technology)

BSc (Hons) in Information Technology Specializing in Software Engineering

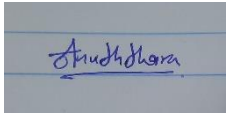Department of Computer Science and Software Engineering

Sri Lanka Institute of Information Technology

Sri Lanka

May 2021

DECLARATION

We declare that this is our own work and this proposal does not incorporate without acknowledgement any material previously submitted for a degree or diploma in any other university or Institute of higher learning and to the best of our knowledge and belief it does not contain any material previously published or written by another person except where the acknowledgement is made in the text.

Name	Student ID	Signature
Kavindi H.G.A	IT17178150	

The supervisor/s should certify the proposal report with the following declaration. The above candidates are carrying out research for the undergraduate Dissertation under my supervision.

Signature of the supervisor: Date:

Signature of the co-supervisor:

ACKNOWLEDGEMENT

ABSTRACT

Agriculture is the major sector in Sri Lanka economy. Approximately 38% labor force was engaged in agriculture since 1999.There is few Organization which has involved with sri Lankan agriculture and its development. The Mahaweli Authority is the one of the major organizations in Sri Lanka. There is a developed mobile application named Mahaweli Market we are decided to develop it furthermore to a Web application using machine learning and Artificial Intelligence. Developing an online trade platform Mahaweli market to support buyers and sellers is one of the main functions of proposed system. Trade plays a determining role of trading food to customers all over the world. It helps to provide high opportunity in customer goods and has played a role in reducing food insecurity all over the world. This proposed model able to develop an online trading system that can used by even a farmer and easily sell their goods and making dealing with buyers with many functionalities.

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1. INTRODUCTION

Agriculture is a momentous part of Sri Lanka's economy. Rice is the main crop, and rice farming is the core foundation of income for people in rural Sri Lanka. In addition to rice, several other food crops are produced for local depletion such as vegetables, fruits and oilseeds. Sri Lanka has two major cultivation seasons called Maha and Yala and Sri Lanka can be divided into a Dry Zone and a Wet Zone. The wet zone covers about 30% of Sri Lanka which is three quarter of the total population of Sri Lanka.

However, since 1945, the population density in Sri Lanka's wet zone areas has increased dramatically, reaching about 1200 people per square foot. This situation has brought the importance of developing agricultural production in Sri Lanka's Dry Zone into sharp focus. As a Solution, Sri Lanka has decided to inauguration a programmed called Mahaweli Development Program to develop the agriculture in Dry Zone in Sri Lanka. This Master plan of Mahaweli Development Program has designated 365,000 ha of land with 13 identified systems.

There is few main purposes of this master plan which are to provide information on the land and water resources of the Mahaweli gaga, to provide an overall water management plan for Dry Zone area and also to provide technical plans to develop the agricultural system in Sri Lanka.

As a fourth year students of Sri Lanka Institute of Information Technology with group of 4 members, we are decided to develop a new intelligence system to manage, predict and analyze including 4 main aspects which are based on harvest,

Healthiness and Disorders of the yield, Market Requirements and also develop a trade platform with buyer seller relationship for Mahaweli development. This research project will be developing cooperation with Mahaweli farmers.
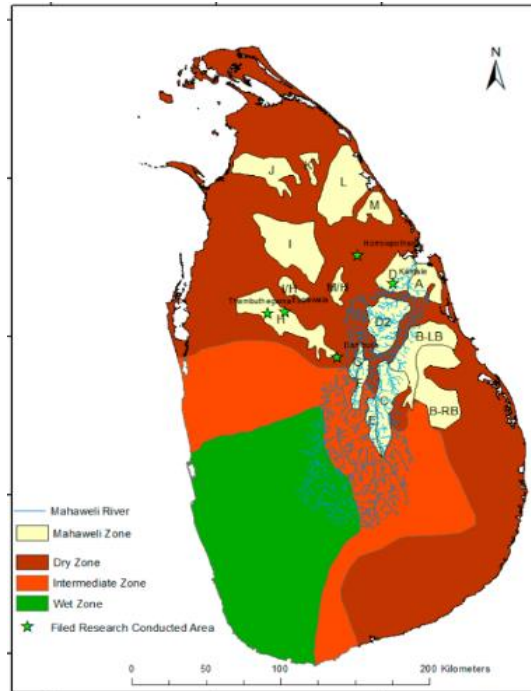

Figure 1.1

1.1 BACKGROUND STUDY

Mahaweli Development is the best organization in Sri Lanka, in making high-quality use of land and water for the advanced agriculture, geothermal power and raising the living standards of citizens mostly in Dry zone areas. One of the main purposes of this master plan of Mahaweli Authority is developing Sri Lanka agriculture using modern technology. There is already have a mobile application called Mahaweli Market with various features included. The features of this mobile application are:

Farmers can inform their harvesting details to Mahaweli authority, Farmers can input their predicated details about harvest and the seasonal time period and buyers can search for details about the product.

We decided to develop this mobile application along with the web-based application with more important features to help Mahaweli authority to develop their project and help to develop Sri Lanka's Agriculture furthermore. The main aspects of our designed web application are giving Harvest Future Predictions, Identify the Healthiness and Disorders of the yield, analyze the Market Requirements and develop a Trade Platform for buyers and sellers. Discussing one of the main aspects of our web application which is to develop the Trade platform concerning buyer and seller relationship is the main purpose of this research proposal paper.

In these days, Mobile applications and Web applications are widely considered a first- world tool that only beneficial to a certain group of people. In that case, it is very rare to find an application for people with less knowledge of using technology

these days. Especially in a scenario like agricultural development, we must mainly focus on people who are doing farming in rural areas.

So, the biggest challenge of this project is how we can develop this application that can use by people who are having any level of experience in the technology platform which is coming under the feature of User Experience. In this case, I have decided to develop the trading platform for the Mahaweli market which can allow buyers and sellers to do their trading very easily thorough this intelligence system. When it comes to trading platform for Sri Lankan agricultural products, buyers and sellers must meet face to face to make a deal between them. Considering other countries, they have a huge market for online trading systems at the international level and local trading systems as well.

In Sri Lanka has export development board which is more considering international exports and trading ways. But we should develop the online trading systems especially in food products which can be more valuable than physical meets. The most suitable example is to prove that 'online trading platform for agricultural products is better than physical deals' is COVID19 outbreak. The entire world is suffering from covid19 outbreak since 2019. It was affected by many countries in deep in their economy of the country and literally the entire world was lock downed. The food is a more important factor that the world could consider in that situation. Sri Lanka is a still a developing country comparing other countries, so this situation was highly affected to the farmers who are doing farming in rural areas and they weren't able to sell their products to the buyers and lot of vegetable products was throwaway. But, if we had an online trading system in this situation which is can use easily even though by farmers in rural areas, there won't be a huge challenge to sell their products.

Other than the outbreak, especially in Sri Lanka, the problem is that farmers are unable to sell their products to fair products and market their products. Most of the time the middleman (broker) takes the products to high price from the farmers sell it. So, the trading platform which is proposed by me has not included any middlemen in the between of buyers and sellers and it has more unique features which are not having in above existing systems. After this proposed design developed, this will affect farmers in rural areas and for the economy of Sri Lanka Agriculture. So, this proposed online trading platform will help to gain a healthy and trustworthy relationship among the buyers and sellers, mostly for the farmers in Sri Lanka.
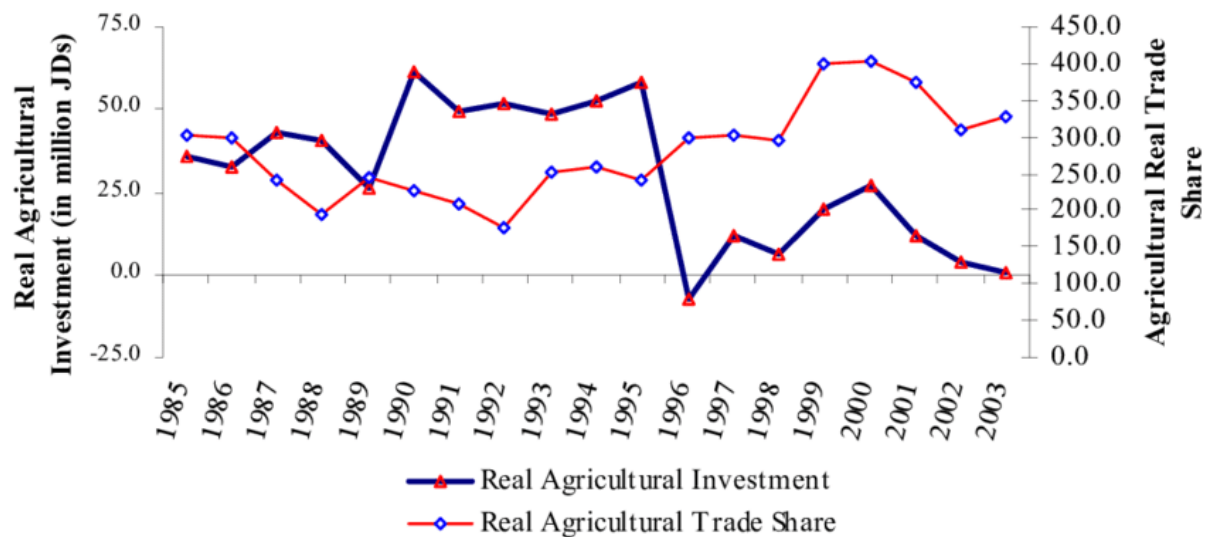

Figure 1.1.1

1.2 LITERATURE SURVEY

There were many researches have done to gather requirements for design the solutions for the online trading platforms based on the product details and user experience. Most of them are done by Indians for their agricultural industry. Therefore I have found several research papers and blogs related to online trading systems while comparing with this proposed system.

[1] This research paper(2020) were explained about the new way to improve the Indian agriculture with considering of several sectors such as, crop health monitoring, Soilsens, Weather forecasting and supply chain efficiency. Farmers will be able to clearly understand consumer demand and customer willingness according to the seasons by using AI, according to the Dilksha Manaware. In reality, as I suggested in my scheme, farmers can boost their bottom line by reducing the costs of handling the logistics and assembly of a middleman.

[2] This research paper looked at how to encourage the transformation and upgrading of traditional agriculture, as well as the development of intelligent agriculture. In addition, this research paper describes that, in light of current major development needs, agricultural artificial intelligence fusion should be promoted in the modern world.

[4] This research paper was also related about Indian farmers and their agriculture. The main research problem was stated as "Can the vegetables marketing be efficient by integrating the consumer". This research paper was explained about how to explore the major factor of satisfaction of farmers and selling products with satisfaction towards vegetable shopping in normal market. In the other hand this paper is also explained about the how to analyze the relationship of farmers' fulfillment with respect to farming and marketing and analyze the relationship

between consumers' positive coordination towards shopping of vegetable in normal market.

1.3 RESEARCH GAP

Currently in Sri Lanka the main way of doing trading is farmers have to go the market physically and sell their products to wholesale buyers or retail buyers. The existing applications:

Colombo Manning Market has an online trading platform for buyers and sellers. The features of this system are users can purchase well after creating an account, sell products and request products.

Govipala is a mobile application which allows users to only can selling and buying products with user details, product details and contact details.
In above both systems simply do the buy and send products according to the users' choice. When the user comes to their websites the user has to register his/herself and after that user can request for the products, sell products and purchase products with various categorizations of the products.

Features	Existing Platforms for Online Trading				
	OpenFood Network (US)	Govipola (SL)	Colombo Manning Market (SL)	AgriBuzz (India)	Mahaweli Market
Buyer And Seller Recommendation System	✖	✖	✖	✖	✔
Search nearby buyers based on location based data	✖	✖	✖	✖	✔
Showing the product quality with the product	✔	✖	✖	✖	✔
No middlemen	✔	✔	It depends	✔	✔
Mobile Responsiveness	✔	✔	✔	✔	✔
Native language and English language	✔	✔	✔	✔	✔

Figure 1.3.1

As the research gap between the existing ones and my proposed system, I have designed this system to farmers can put their products on the page and wholesale, retailer buyers or customers can purchase them and also users will able to see the recommendations about products based on reviews and ratings. After completing a transaction user can give their idea of this as a comment and give the rating to the product.

The most important feature is in our proposed system is the system will able to show farmers who are retailers' buyer, wholesale buyers and who are nearby buyers. Our proposed system will automatically match buyers' and seller's requirement and make them appear to each other. And, user will be able to search by various parameters about product and search items very easily.

1.4 RESEARCH PROBLEM

There have few applications to do online trading in Sri Lanka, but many farmers are not able to use those applications in a proper way because of lack of knowledge of using technology. For make online trading system popular among the farmers, the application should have very user-friendly and understandable user interfaces. The operations should be very easy and understandable to handle even by the farmer. Since this platform has ratings and review according to the buyers, sellers and products system should be more reliable because people will tend to do create fake accounts and add false comments and ratings. The main research problem is how to match buyer and seller, for that we should have to track all the purchase requests which will be coming for products and view our suggestions to the user. Sellers should contact the buyer very easily and buyer should able to contact seller easily. And showing recommendations considering ratings and reviews about products, users' sellers can easily sell their products buyers can easily find their needs. Since this platform using transactions security is a major concern of this system.

2. OBJECTIVES

2.1 MAIN OBJECTIVES

The overall objective of this research is to provide full functionality system which is provide to prediction based information of harvesting ,check healthiness of the crops and marketing analysis along with the trading platform for farmers to sell their products. Online trade system for Mahaweli farmers is facilitated by make communication between buyers and sellers of products. The main objective of this online trade system is developing the online trade system which is can understand and use by any farmers and make visibility among buyers and sellers in dealing without middlemen.

2.2 SPECIFIC OBJECTIVES

In order to achieve that main goal of this proposed project, there have some specific objectives which are,

1. Collecting the actual and accurate data of products, sellers and buyers.

2. Gathering data from Mahaweli authority and get information about trading laws in Sri Lanka.

3. Making the platform more securable since user can register to this system.

4. Analyze the data and make more suitable and user-friendly web application.

5. Implement the algorithm for how to match the buyers and sellers.

6. Create a way to gather rating and reviews comments' data and make recommendations.

7. Add the location-based algorithm for farmers to identify the nearby buyers.

8. Make category for products, sellers and buyers also (Ex: - Wholesale and retail buyers.)

9. Identify the buyer seller relationship in properly.

3. METHODOLOGY

This part will discuss about methodology for approach the one of the system's function which is online trading platform for Mahaweli farmers. I decided to follow the Software Life Cycle to implement this project. Outcome of this system is a Reliable online trading system which is allows farmers can easily their products and all type of buyers can easily buy their products through this platform and match making between buyers and sellers and make recommendation between them.

3.1 Procedures

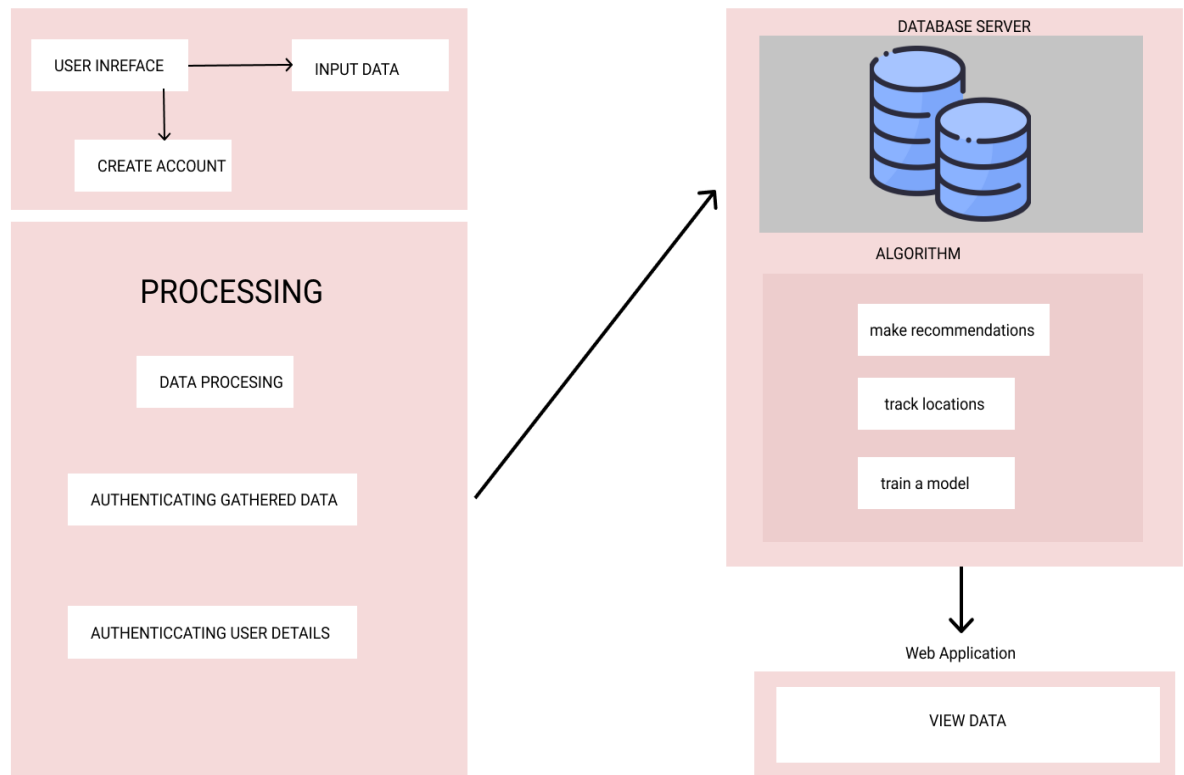## 3.1.1 Component Overview

Figure 3.1.1.1

According to the background review, online trading system is one of the main functions of our proposed system. The overview of this function as below.

All farmers or sellers and buyers must have an account to log into the trade platform. Farmers can add their products to sell in selling page with specific details such as Product name, quantity, unit price, total price, location, sellers' name and contact number etc. There can be various categories of the products in detail page. Buyers can have categories as well such as wholesale buyers or retail buyers. Buyers can rate and add comments or reviews for product as their wishes and buyers can add rating and reviews to the sellers also.

Sellers can add their product selling advertisements based on the location. There is option for matching related sellers and buyers according to the location, product and quantity details. And, when an existing buyer comes to the website again, he/she will see the recommendations and can see the historical data from past transactions. If a farmer wants to do quick sale around the current location, farmer can show his advertisement to people who are already nearby his location.

3.1.2 Development Process

The software development life cycle is depicted in the diagram above. To create this method, I chose to use the software development life cycle process.

Feasibility Study: -

This is the first stage of the software development life cycle. During this process, we should collect information that is critical to the creation of our systems. We should interview farmers, Mahaweli laborers, and people who engage in online trading to gather information.

Requirement Gathering: -

In this phase, all the required information is collected from the users to implement the product as per their needs. Before implementing the whole system, a basic understand is very important.

Design: -During this stage, we will design the overall system architecture which is used for developed and make the SRC document based on the gathered requirement earlier.

Implementation: -

In this phase we will convert the overall system architecture into the source code.

Testing: -

During this phase, application becomes more quality and the best deliverable product. Software testing is must to do in every phase of software development life cycle. This is very critical stage because we should fix all the bug and defects before product deployments. Make sure there is working all the function as request from customer.

Maintenance: -

This is the last phase of the development life cycle, in this phase we need to update the product, maintain and do fixes.

3.2 Technology Selection

3.2.1 Software Component

Version Controlling: - GIT

Machine Learning: - Python, Tensor Flow

Web application Development: - Spring boot, Angular
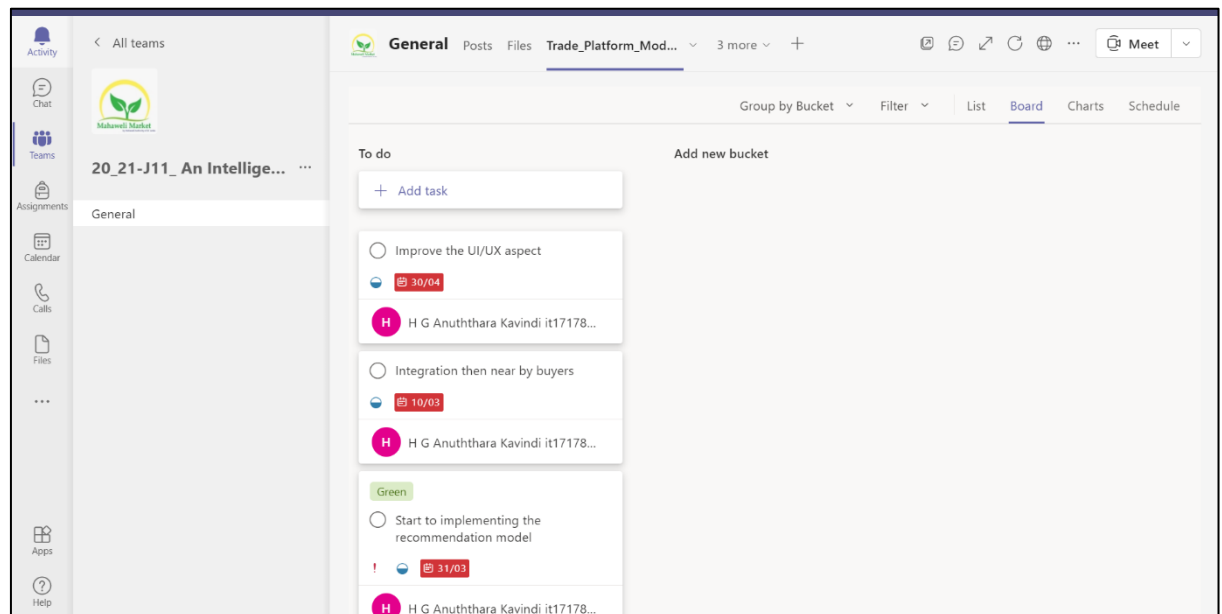
3.2.2 Project Management

Trello

MS Team

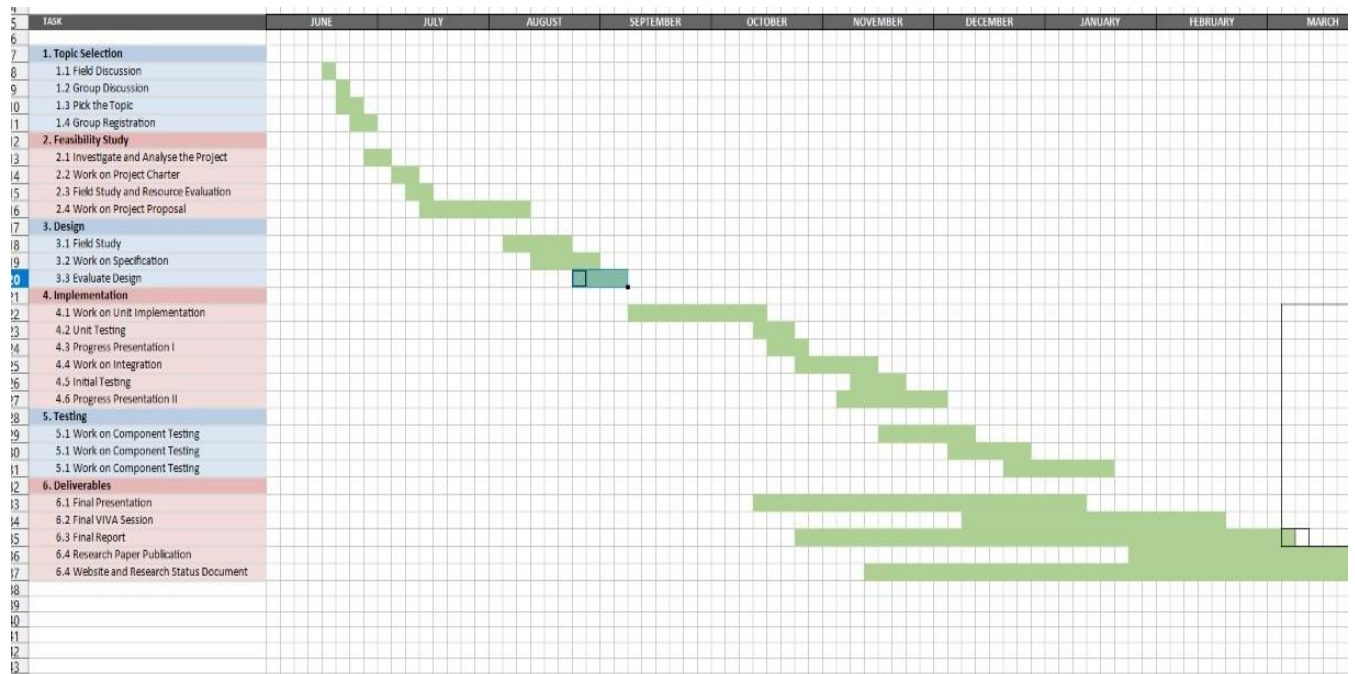Figure 3.2.2.1

3.2.3 Gannt Chart
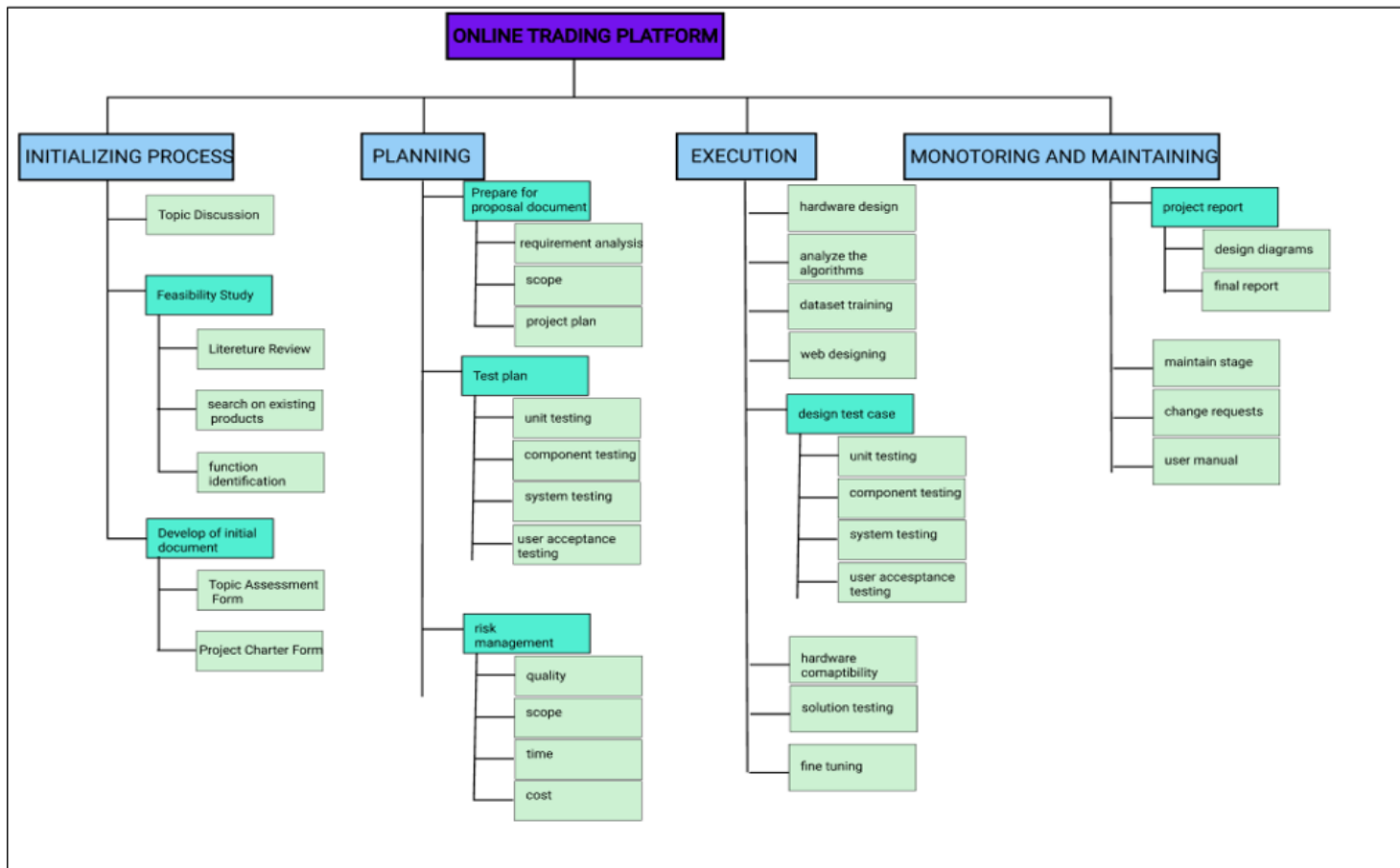

Figure 3.2.3.1

3.2.4 Breakdown Chart

Figure 3.2.4.1

3.3 Implementation Methodology

a) Recommending the best farmers based on the rates, nearby locations and gross net of the products.

The most popular forms of recommending systems are collaborative filtering, content based, utility based, demographic based, knowledge based, and hybrid based. Nowadays, the most commonly used filtering approaches are content based and collaborative based filtering.

The collaborative based filtering identifies products based on user reviews and historical data, and it works by building a database of user preferences for each object.
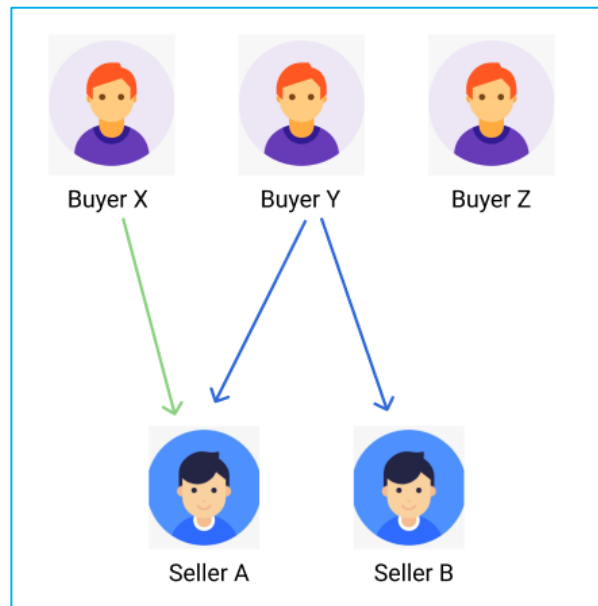
Figure 3.3.1

The sample scenario I have applied in this is that if we assume that buyer x buy only from seller A and Buyer B but both from seller A and B. So eventually system will recommend the seller B to Buyer X. Main attributes are the user specific buying history details of products and seller details.

Recommending method based on content that requires manual entry of function values. For small datasets, this is manageable, but when thousands of new crops are introduced daily, this challenge becomes unmanageable. Other users' data is not needed for content-based filtering. These techniques assess the system's ability to accommodate a large number of users. Content-based filtering is self-contained since it only allows a mechanism to evaluate the objects and user profile in order to make recommendations.
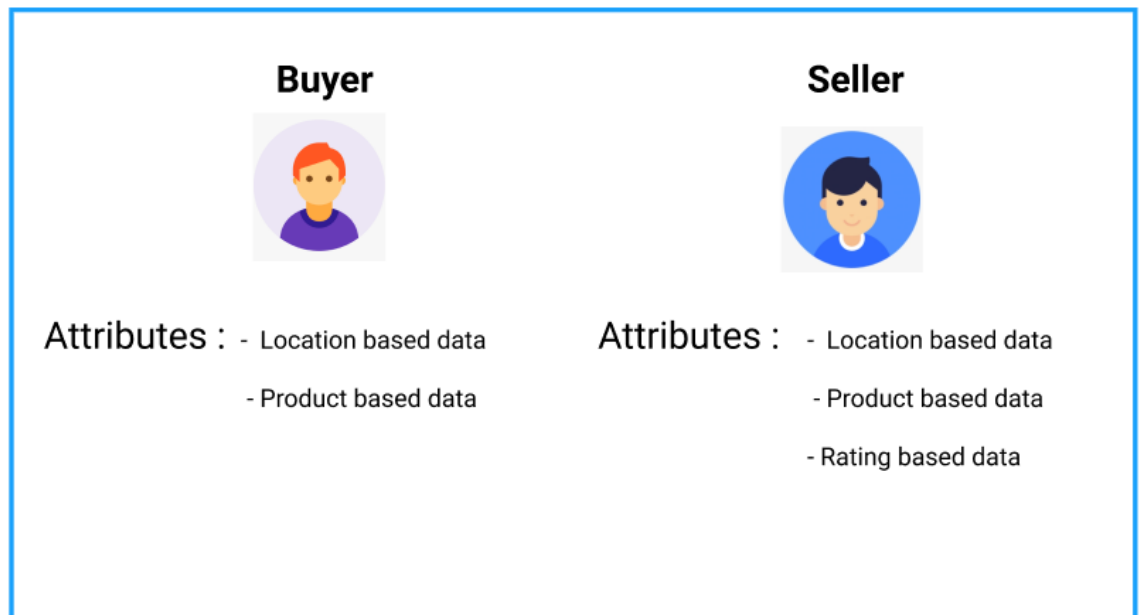

Figure 3.3.2

In the figure 3.3.2 shown when I consider the content based recommendation algorithm I have considered the location based data and product based data as attributes from buyer aspect and location based data, product based data and rating based data from the farmer's aspect.

The main and important point of this research was to implement the recommendation system for buyers to select the best farmers in the Mahaweli. As a first task to implement this recommending system I have found the dataset from mahaweli authority and trained the dataset using machine learning algorithm. I have considered main 4 factors to implement this recommending system which are farmer's selling product, farmer's rate, location details and farmer's gross net.

As a first step, I built a dataset containing all relevant information, such as the farmer's goods, name, gross selling rates, ratings, invoice id, buyer, seller id, product line, unit price, quantity, tax, total, date, time, payment, gross income, and gender. There are over 1000 documents in this dataset.

```
1   Invoice ID,Buyer ID,Buyer,Seller ID,Seller,Gender,Product line,Unit price,Quantity,Tax,Total,Date,Time,Payment,gross income,  Syncing...
2   750-67-8428,1,Thissa Jananayake,1,Saman Kumara,Female,Cruciferous,74.69,7,26.1415,548.9715,1-5-2019,13:08,Ewallet,26.1415,9.1
3   226-31-3081,2,Dammika Perera,2,NImal Liyanage,Female,Root,15.28,5,3.82,80.22,3-8-2019,10:29,Cash,3.82,9.6
4   631-41-3108,3,Sumathipala Wijekoon,1,Saman Kumara,Male,Marrow,46.33,7,16.2155,340.5255,3-3-2019,13:23,Credit card,16.2155,7.4
5   123-19-1176,1,Thissa Jananayake,1,Saman Kumara,Male,Cruciferous,58.22,8,23.288,489.048,1-27-2019,20:33,Ewallet,23.288,8.4
6   373-73-7910,4,Srimewan Gonakawatta,1,Saman Kumara,Male,Allium,86.31,7,30.2085,634.3785,2-8-2019,10:37,Ewallet,30.2085,5.3
7   699-14-3026,2,Dammika Perera,2,NImal Liyanage,Male,Root,85.39,7,29.8865,627.6165,3-25-2019,18:30,Ewallet,29.8865,4.1
8   355-53-5943,2,Dammika Perera,1,Saman Kumara,Female,Root,68.84,6,20.652,433.692,2-25-2019,14:36,Ewallet,20.652,5.8
9   315-22-5665,3,Sumathipala Wijekoon,2,NImal Liyanage,Female,Marrow,73.56,10,36.78,772.38,2-24-2019,11:38,Ewallet,36.78,8
10  665-32-9167,1,Thissa Jananayake,1,Saman Kumara,Female,Cruciferous,36.26,2,3.626,76.146,1-10-2019,17:15,Credit card,3.626,7.2
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21  319-50-3348,3,Sumathipala Wijekoon,3,Arun Withanage,Female,Marrow,40.3,2,4.03,84.63,3-11-2019,15:30,Ewallet,4.03,4.4
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23  371-85-5789,1,Thissa Jananayake,3,Arun Withanage,Male,Cruciferous,87.98,3,13.197,277.137,3-5-2019,10:40,Ewallet,13.197,5.1
24  273-16-6619,3,Sumathipala Wijekoon,3,Arun Withanage,Male,Marrow,33.2,2,3.32,69.72,3-15-2019,12:20,Credit card,3.32,4.4
25  636-48-8204,2,Dammika Perera,1,Saman Kumara,Male,Root,34.56,5,8.64,181.44,2-17-2019,11:15,Ewallet,8.64,9.9
26  549-59-1358,4,Srimewan Gonakawatta,1,Saman Kumara,Male,Allium,88.63,3,13.2945,279.1845,3-2-2019,17:36,Ewallet,13.2945,6
27  227-03-5010,3,Sumathipala Wijekoon,1,Saman Kumara,Female,Marrow,52.59,8,21.036,441.756,3-22-2019,19:20,Credit card,21.036,8.5
```

Figure 3.3.3

Since I have more than 1000 records in my dataset, I have divided my dataset into 6 main categories;

- Allium.csv
- Citrus.csv
- Cruciferous.csv
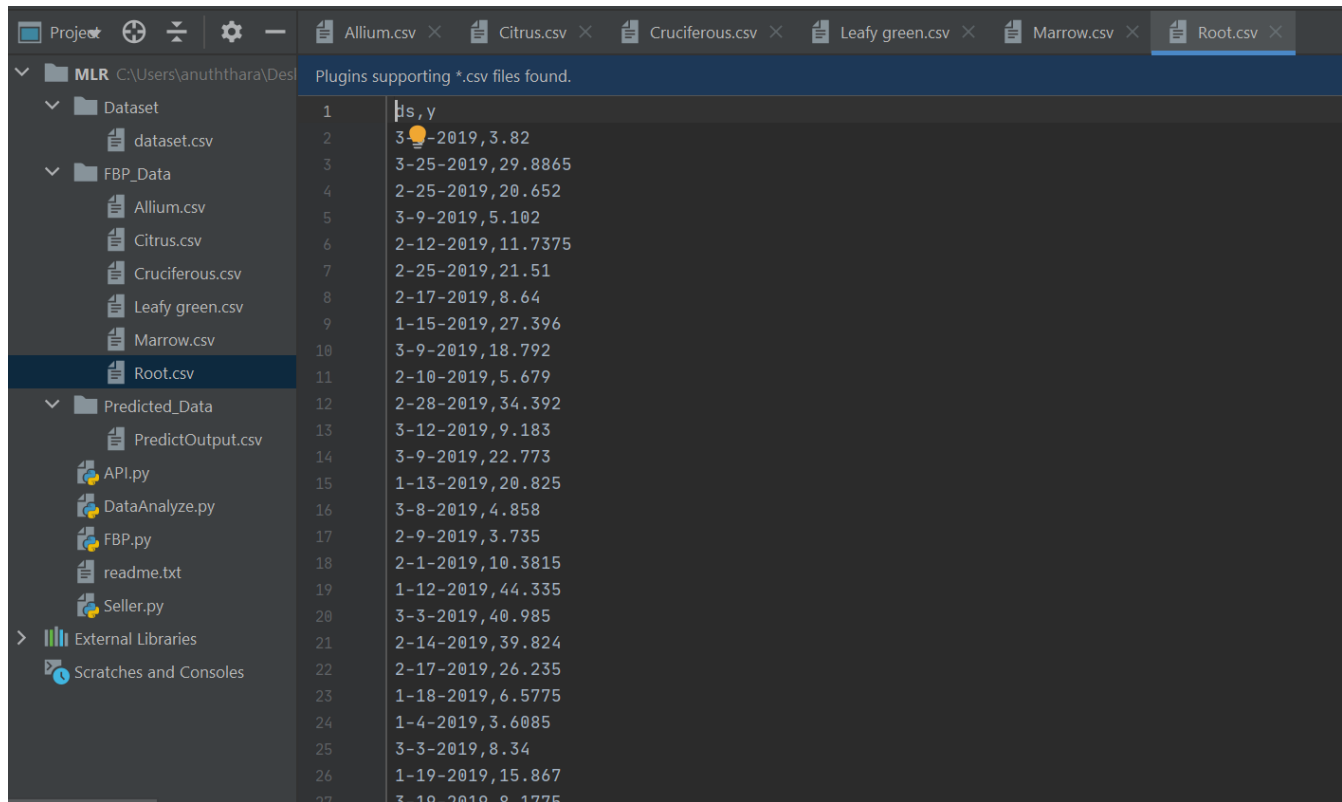- Leafy green.csv

- Marrow.csv
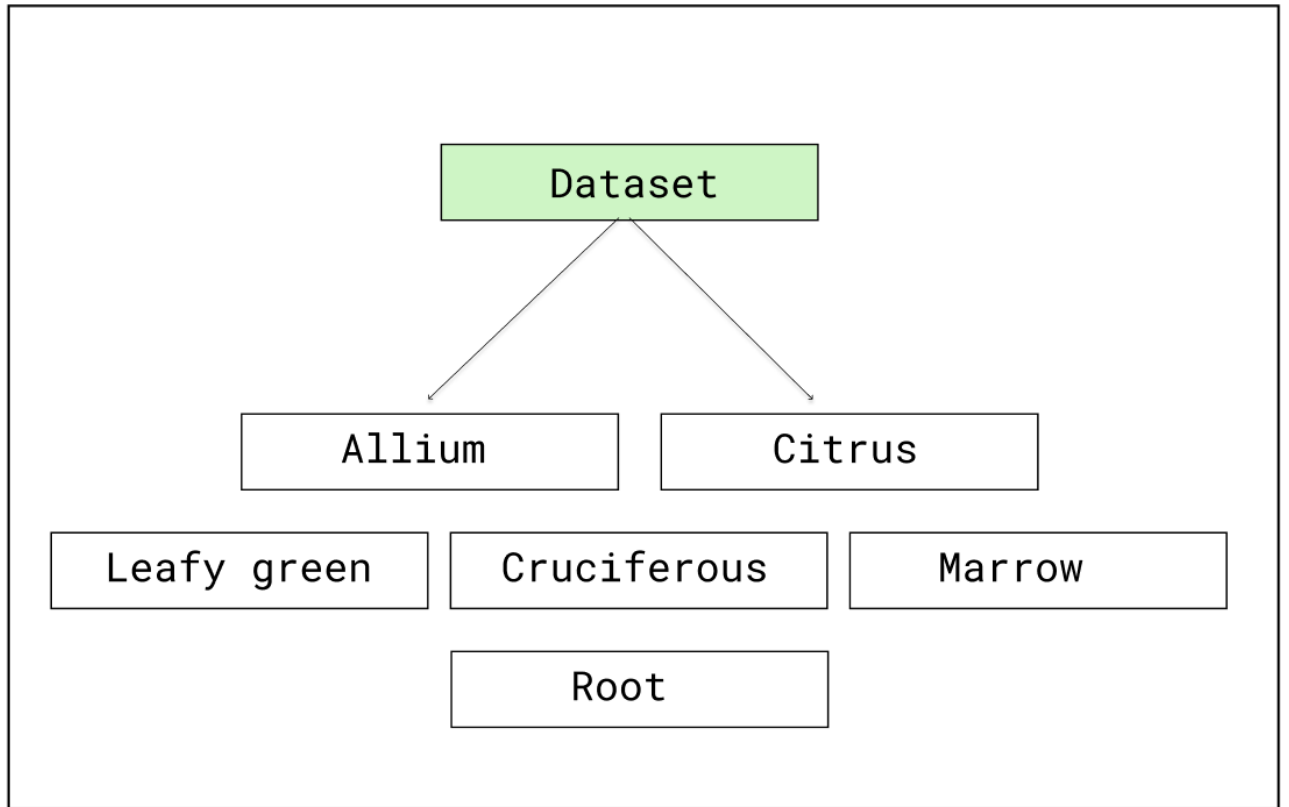
- Root.csv

Figure 3.3.4

Figure 3.3.5

```python
@app.route('/best_seller', methods=['POST'])
def best_seller():
    product = request.form['product']
    sale = Seller.Sale('Dataset/dataset.csv', product)
    # sale = Seller.Sale('Dataset/dataset.csv', 'Citrus')
    data = sale.analyze()
    return_json = []

    for p in data:
        print(p)
        return_json.append('{ "seller_name" : "' + str(p[1]) + '", "rating" :' + str(round(p[0], 2)) + '}')

    temp_start = '{ "data" :['
    temp_end = ']}'

    return_j = temp_start

    for x in return_json:
        if x == return_json[-1]:
            return_j += x
        else:
            return_j += x + ','
    return_j += temp_end

    return json.loads(return_j)
```

Figure 3.3.6

For recommending the best farmers, I have used the Prophet algorithm engineered by
Facebook.

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b) Predict the best crops to harvest for next week or next month.

My other core objective is to predict the best crops to harvest for next month or year. This function will be more important in farmer's aspect because by using this function farmers can get idea of crops which are best to harvest in the future to get the better market sale.

For this I needed the sale prediction data set which is like historical data along with the farmer's details. Data from past years can help the predict the budget sales in future days.

So for this implementation I have created the dataset called predictedOutput.csv which is consist of the data of the parameters I have considered to predict the best crop for harvest in the next month. The parameters are ds, trend, ,ds,trend,yhat_lower,yhat_upper,trend_lower,trend_upper,additive_terms,additive_terms_lower,additive_terms_upper,weekly,weekly_lower,weekly_upper,multiplicative_terms,multiplicative_terms_lower,multiplicative_terms_upper,yhat.

Figure 3.3.7

For prediction, I'm using time series algorithms, and the data is ordered by reasonably deterministic timestamps, which, when compared to random sample data, contain the extra information we can obtain. Time series analysis may aid in predicting data analytics findings. At first, I was thinking about the Arima (Autoregressive Integrated Moving Average) and Prophet Algorithm, which are two time series algorithms.

The prophet algorithm is a method for forecasting time series data that is based on an addictive model that suits non-linear patterns in annually, weekly, and regular seasonality. It fits best with time series with heavy seasonal effects and historical data from several seasons. Prophet is sensitive to missing data and pattern changes.

```python
@app.route('/predict_product', methods=['POST'])
def predict_product():
    days = request.form['days']
    days = int(days)
    predicted_v = []
    return_json = []
    dirs = os.listdir('FBP_Data')

    for d in dirs:
        fb = FBP.FB(d)
        if days == 7:
            predicted_v.append((fb.get_week(), d.replace('.csv', '')))
        else:
            predicted_v.append((fb.get_month(), d.replace('.csv', '')))
    print('Predicted Data---')
    for p in predicted_v:
        print(p)
    predicted_v.sort()
    predicted_v.reverse()
    print('Sorted Data---')
    for p in predicted_v:
        print(p)
        return_json.append('{ "product_name" : "' + str(p[1]) + '", "count" :' + str(round(p[0], 2)) + '}')

    temp_start = '{ "data" :['
    temp_end = ']}'
```

Figure 3.3.8

26

c) Implementation of Android Application with UI/UX aspects.

Since this system will be mainly used by the farmers we had to consider the simplest UI/UX aspects and we have implemented the 3 languages which are 3 major languages in the Sri Lanka. We have implemented the android application with Sinhala, Tamil and English. Our system has 4 main component which are Harvest prediction, measure the Crop Healthiness, Market analysis and online trade platform. There will be 2 main users' category in our system; one category is Farmers or Sellers and other category is the Buyers. This is the user flow of our developed system; Online trade platform flow.

As a summary of my component which is online trade platform there is a user flow;
First user needs to select the one option from 3 languages and user has to log in to the system. Then user has to choose the option which is the user will be logged in as farmer or buyer. If the user selected the farmer option user can logged in as the farmer and select the trade platform and see the crop will be best to harvest in next month or next year according to the prediction which is given by the backend algorithm.

If the user selected the user type as buyer user logged in as buyer and he or she can select one of the crop categories shown in the page and when he or she clicks the find best seller buttons system shoes the farmers who has the highest ratings on that product.

```
1. Home page of
   the mobile
   application

                        2. Select the
                           Lanaguage

3. Login or Register
         /
  Forgot password

                        4. Choose the
                         User Type (Buyer
                            or seller)

5. Select the option
     user's need

  Harvest
                        6. User can choose the
  Market                     product from
  Trade ———————→            categories
  Health

7. user can see
the best farmers
who are selling
selected crop

                        8. User can go back
                           and select the
                         number of days from
                            the spinner

9. User will see the
    best crops for
 harvesting for the
   selcted month
```
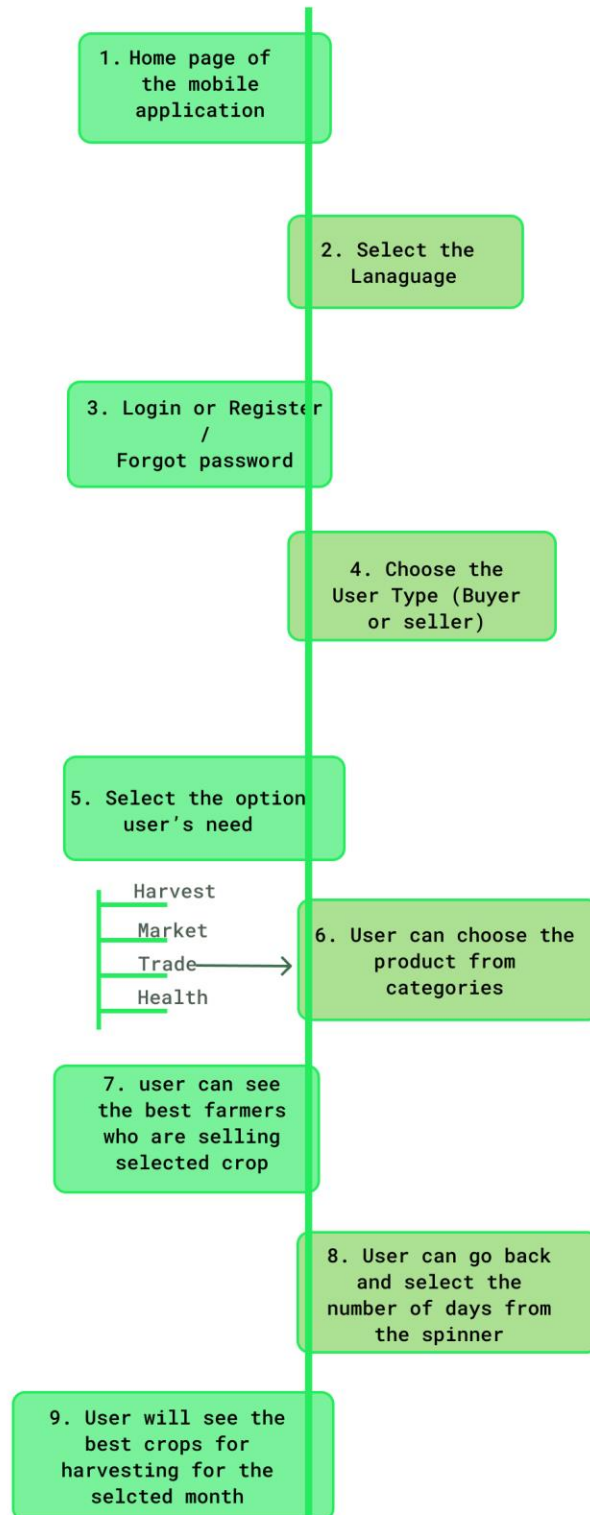
Figure 3.3.9

As I explained earlier our mobile application developed mainly focus on farmers and buyers. We have considered the implementing this frontend application as simplest as we can.
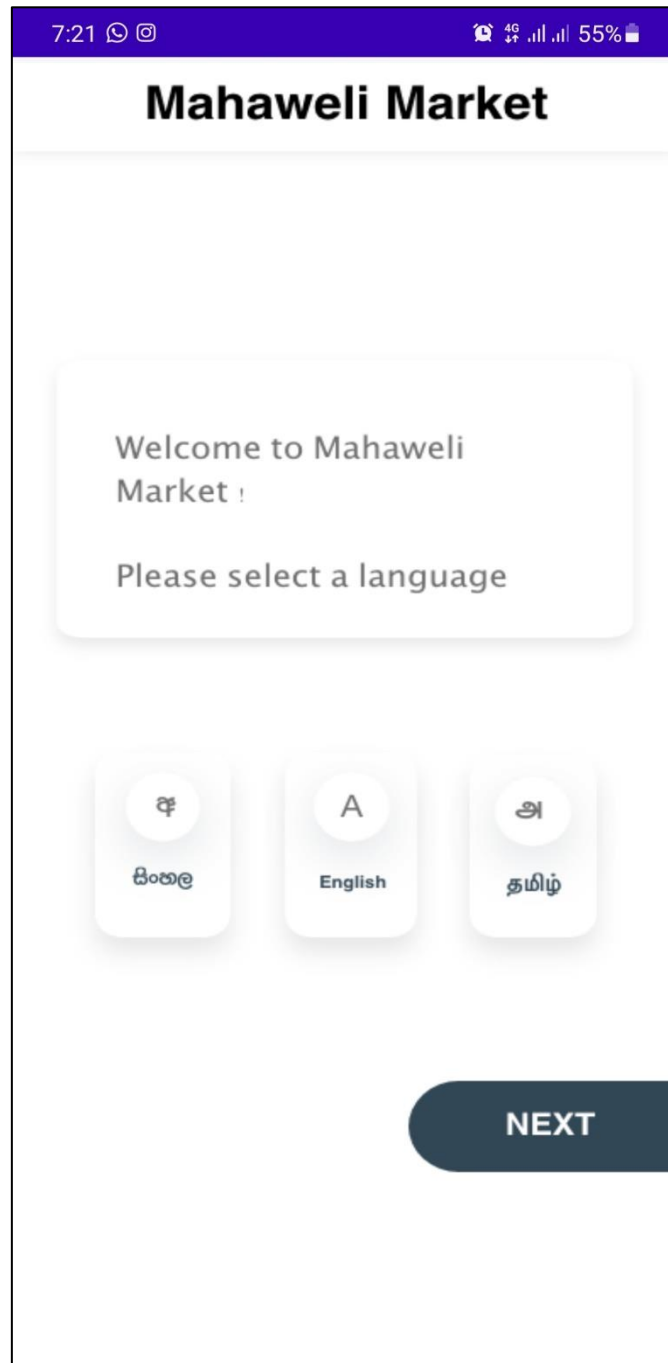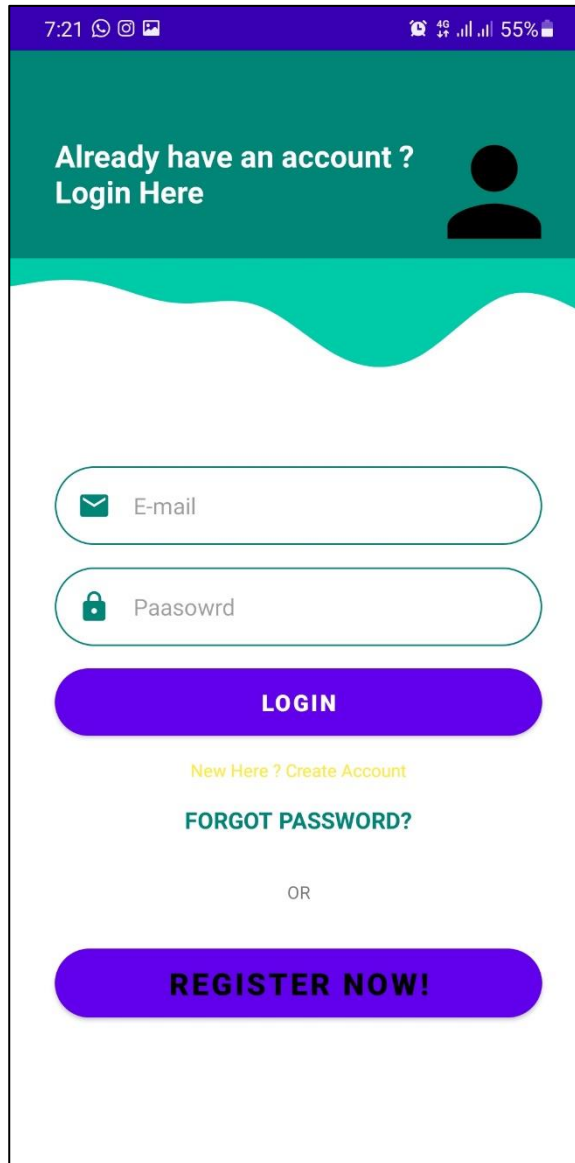

Figure 3.3.10

In the Figure 3.3.8 we can see there are 3 options available for users; Sinhala, Tamil and English languages. User can select any language they prefer. The main purpose of this adding this 3 languages in Sri Lanka these are the 3 main languages in our nation and also we have many Sinhala and Tamil speaking farmers in Mahaweli authority.

Figure 3.3.11

In the Figure 3.3.9 shows the user registration and login User Interface. User can login with their credentials if they already have account in our application or if user doesn't have the account user can register by creating new account. And also we have integrated the forgot password function as well.
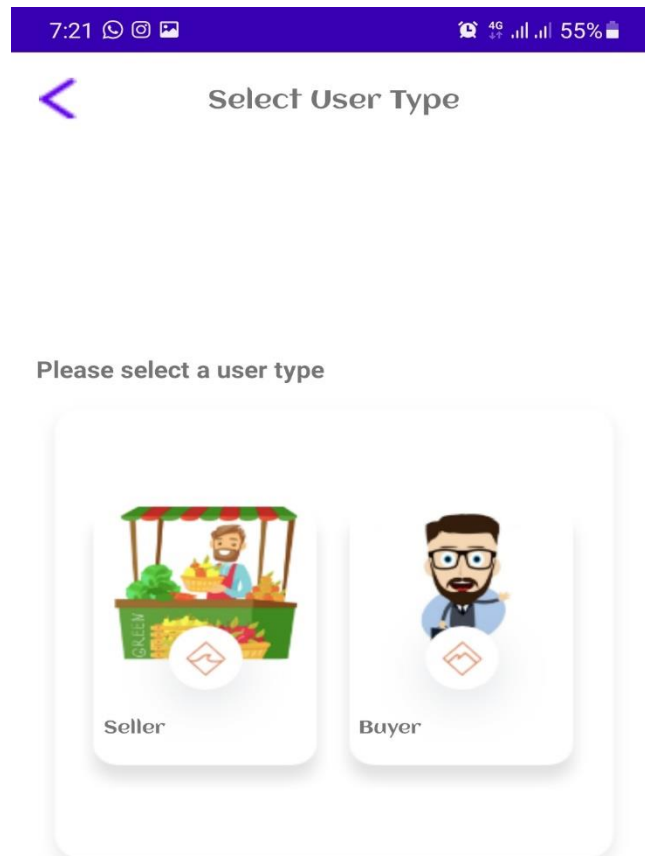
Figure 3.3.12

As shown in the Figure 3.3.10 user can select one user type from Seller user type and Buyer user type. As I mentioned earlier in my component user can log in both ways because when he user wants to buy products from sellers user have to logged in as Buyer and if the user wants to check the best to product to harvest in the next month user has to logged in as farmer.

I have shown my User interfaces when listing the best farmers and best crops to harvest in the below.
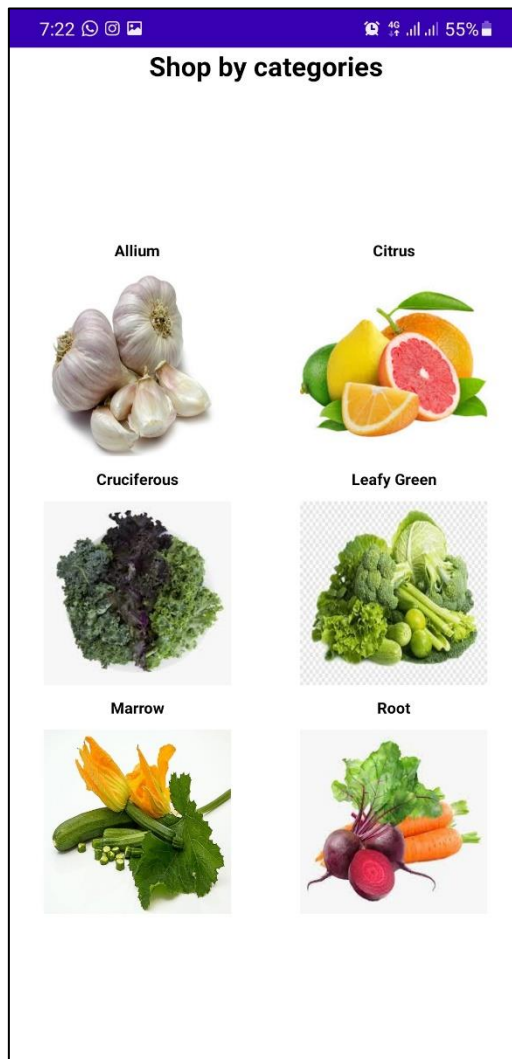
Figure 3.3.13
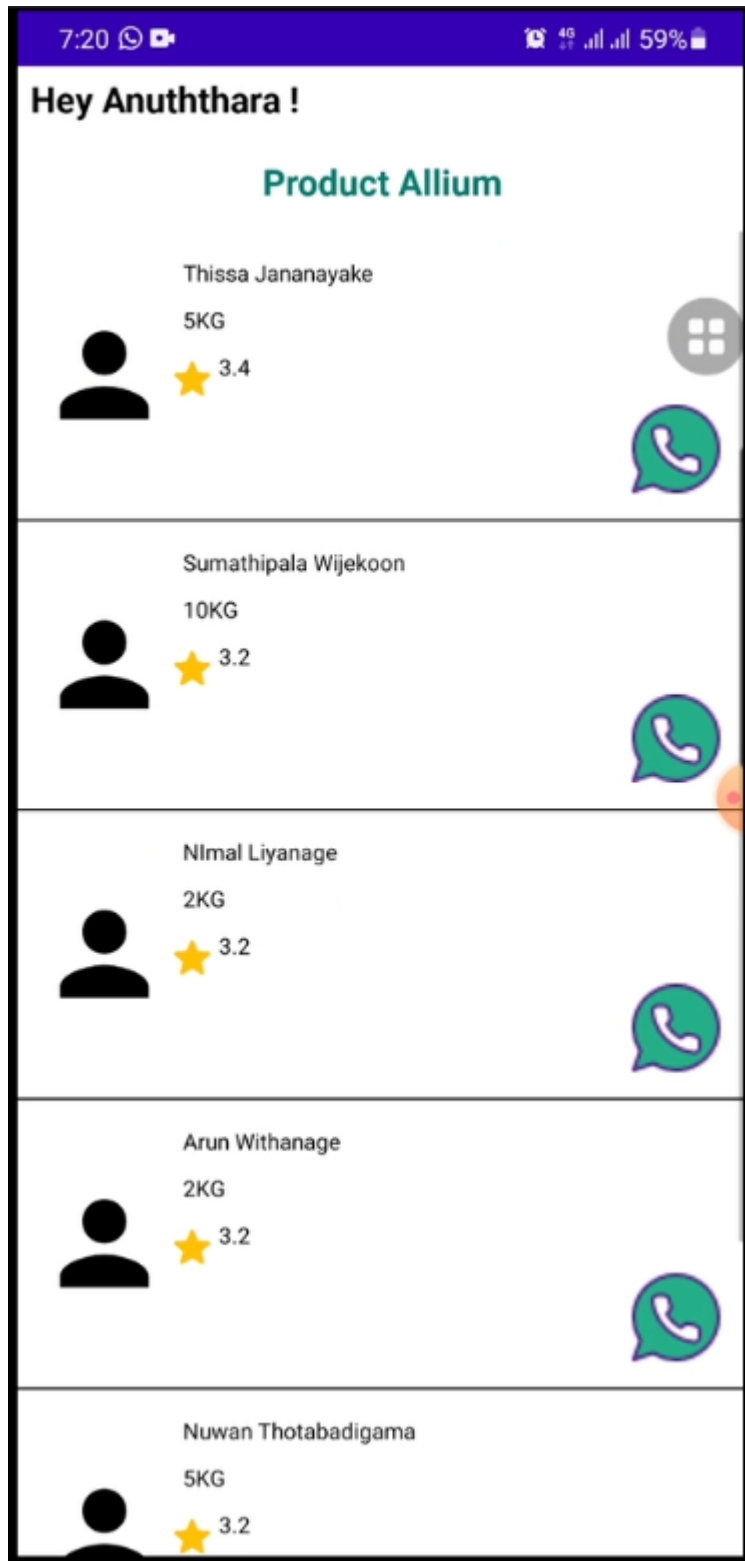
Figure 3.3.14

Figure 3.3.15

3.4 Commercialization

Agriculture's commercialization is now an unavoidable fact all over the planet. The commercialization of agriculture is influenced by a variety of factors. This app gives a direct link of farmers to customers, such that a customer is able to talk directly to a farmer and have the bargaining power with the farmer. Customer needs and changes are then shared with farmers to ensure a better service of the product or service.

By using this proposed system farmers no need to go the physical meeting with buyers, it will reduce the transportation cost.

In this system we have a recommendation engine for farmers to find a perfect buyer, this will cause to quick selling the products and save the cost for hiring middlemen.

Buyers can also search the nearby farmers who are selling products, so buyers can quickly buy the product freshly. Because of the quickness and freshly products buyers will satisfy with products and gain the trustworthy with farmers.
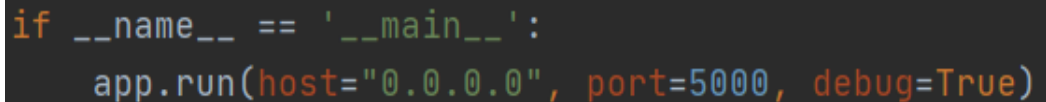
This system will help to gain good communication between buyers and seller.

Since this system will developing considering mobile responsiveness, it will much easier for the buyers to make deals. This helps farmers to have more confidence in their sales and will make farming in Sri Lanka have more value than as it is at the moment where middle men kill the farming value chain.

4. IMPLEMENTATION AND TESTING

4.1 Implementation

Implementation of this application was done through stories. Each story delivered a value instead of a single task. I have used the pystan==2.19.1.1, Prophet, Flask, Flask-Cors for the backend implementation and for the algorithm I have used the prophet algorithm. I have developed my backend implementation separately and it hosted in remote server.

```python
if __name__ == '__main__':
    app.run(host="0.0.0.0", port=5000, debug=True)
```

Figure 4.1.1

File structure wise my backed application has 3 main packages.

- Dataset
- FBP_Data
    - In here I have divided my dataset into categories;

- Allium.csv

- Citrus.csv

- Cruciferous.csv

- Leafy green.csv

- Marrow.csv

- Root.csv

- Predicted_Data

And in the root directory I have created the 4 main files;

- API.py
- DataAnalyze.py
- FBP.py
- Seller.py
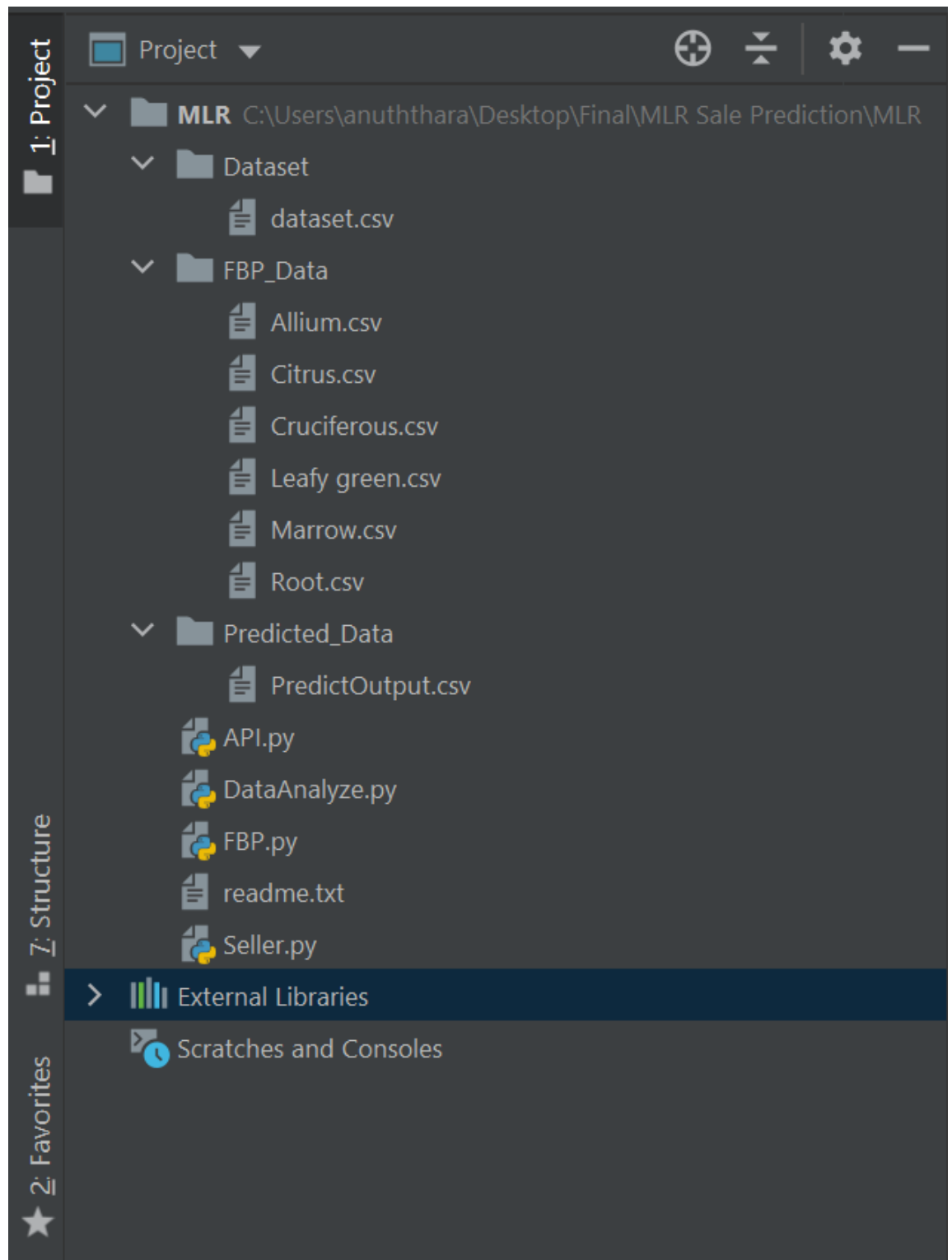
Figure 4.1.2 – Backend Application Directory Structure

Backend of the system:

Used technologies:

- Python 3.8
- Rest API
- Flask
- Prophet

Environment:

- Anaconda

External libraries:
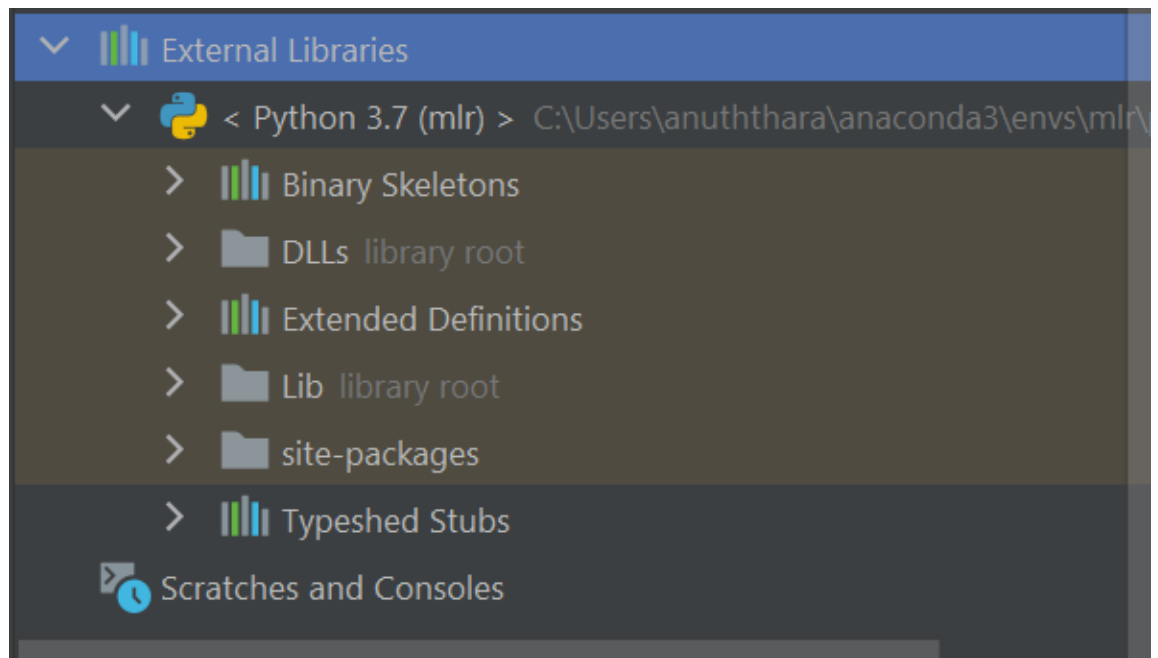
Figure 4.1.3

For the frontend of the application I have used the java android studio.

Frontend of the system:

Used technologies:

- Java

File structure wise our frontend application has 5 main packages.

- Adapters

- Harvest
    - To predict the future harvest

- Healthiness
    - To measure the healthiness of the crop

- Trade Platform
    - Online platform for farmers and buyers

- Market
    - To predict the market analysis of the crops
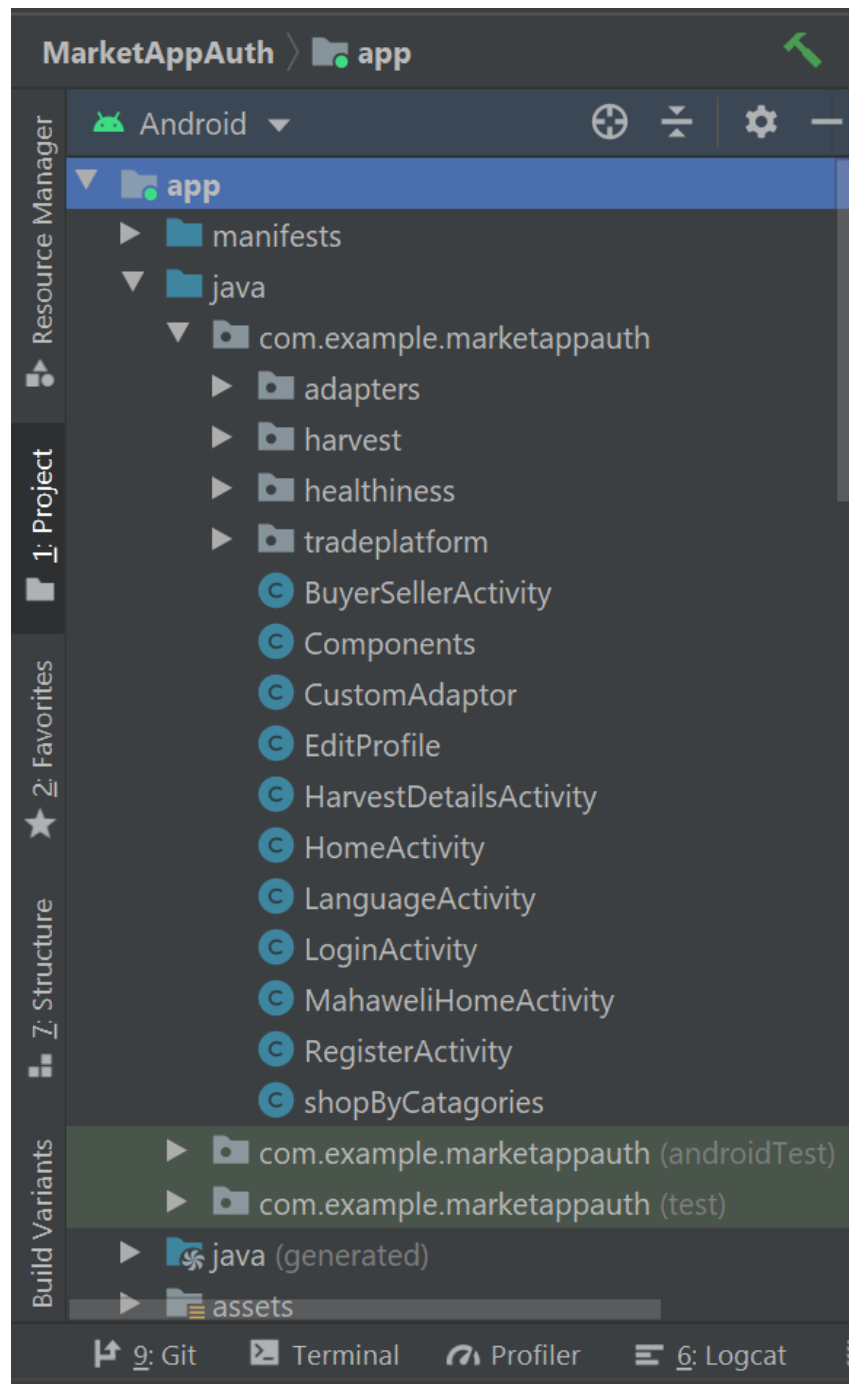
Figure 4.1.4 – File structure of the android application

```
35
36  ▶  ⊟dependencies {
37
38       implementation 'androidx.appcompat:appcompat:1.2.0'
39       implementation 'com.google.android.material:material:1.2.1'
40       implementation 'androidx.constraintlayout:constraintlayout:2.0.4'
41       implementation 'com.google.firebase:firebase-auth:20.0.1'
42       implementation 'com.google.firebase:firebase-firestore:22.0.0'
43       implementation 'com.google.firebase:firebase-storage:19.2.0'
44
45       // Import the BoM for the Firebase platform
46       implementation platform('com.google.firebase:firebase-bom:26.8.0')
47
48       // Declare the dependency for the Realtime Database library
49       implementation 'com.google.firebase:firebase-database'
50
51       implementation 'com.squareup.picasso:picasso:2.71828'
52       implementation "androidx.cardview:cardview:1.0.0"
53       implementation 'androidx.recyclerview:recyclerview:1.1.0'
54       implementation 'androidx.legacy:legacy-support-v4:1.0.0'
```

Figure 4.1.5 – Dependencies structure of the android application

4.2 Testing

Since this application is a lot more focusing on real time data, most of the testing we conducted was manual testing. We used automated tests as well.

Our application uses testing libraries like, jest, mocha and chai.

1. Unit tests - Done using "jest", "super test". For assertions we have used "mocha" also.

2. Integration Tests - All the Rest Endpoints were tested using supertest unit tests and for the assertions we have used "assert" and "chai".

3. UI / End to end testing - These tests are conducted manually. We have done the user acceptance testing as well.

```
dependencies {
    // Required -- JUnit 4 framework
    testImplementation 'junit:junit:4.12'
    // Optional -- Robolectric environment
    testImplementation 'androidx.test:core:1.0.0'
    // Optional -- Mockito framework
    testImplementation 'org.mockito:mockito-core:1.10.19'
}
```

Figure 4.1.6

5. RESULTS AND DISSCUSSION

5.1 Results and Research Findings

According to the first phase of the implementation I have been able to achieve successful results.

In the component of the online trade platform I have achieved to complete the android application with the main function to gaining the farmer and buyer relationship.

My goal was here is to create a beneficial environment for farmers and buyers, allowing them to maximize on their profits, without compromising on quality using the best, efficient and easiest way using a machine learning models that is able to predict the changing patterns of farmers. Being able to notify customers whenever the harvest of a particular crop reduces and being able to alert farmers of the current needs of customers in terms of variety and preferences.

He/she then can decide to order whatever they prefer, the app studies this specific users action and saves on a machine model which then comes us with a predictive analysis of what specific customers and genders like and at what period and under what conditions.

This gives more insights on the farmer's aspect, they are able to do farming geared towards users predilections based on rates. This gives a further analysis of what the farmer should essence on more in order to maximize the production value chain. Profits are maximized as customers cooperate directly with

farmers and they can negotiate basing on users favorites. This helps farmers to have more self-confidence in their sales and will make farming in Sri Lanka have more value than as it is at the moment where middle men destroy the farming value chain.

5.2 Discussion

Most of the research papers I have reviewed were based on simple scenario such as only buying goods from farmers and selling goods for buyers. But the research finding in my component is I have implement the recommendation system for buyers and farmers according to their preferences based on multiple factors such as ratings, tracking locations and product types. And also other than the online trading platform our system has healthy prediction, harvest and weather prediction and also sales predictions. So that users can get maximum outcomes from one place.

Based on the research I have one through all over the internet I have found that there have not many systems for online trading for farmer and buyers. Currently in Sri Lanka there have only 2 main mobile application for such scenario which are called Govipala, Colombo manning market.

But in both applications I have found that there were no system for recommending farmers or products to the buyers and not having the language preferences also. But in our application we have integrated that our own recommendation engine which is recommend the best farmers based on the ratings and locations and also by using our system farmers can get high prediction about the next harvesting crop.

6. DESCRIPTION OF PERSONAL AND FACILITIES

Member	Component	Tasks
Kavindi H.G.A	Develop the trade platform for Mahaweli farmers.	1. Gathering data from Mahaweli authority and get information about trading laws in Sri Lanka 2. Making the platform more securable since user can register to this system 3. Analyze the data and make more suitable and user-friendly web application 4. Implement the algorithm for how to match the buyers and sellers

		5. Create a way to gather rating and reviews comments' data and make recommendations.
		6. Add the location-based algorithm for farmers to identify the nearby buyers
		7. Make category for products, sellers and buyers also (Ex: - Wholesale and retail buyers.)

7. CONCLUSION

With the prevailing challenges in the country like pandemics, economy, digitalization Mahaweli Market App suggests extraordinary solution to the government. It has become the most prominent platform to connect buyers, sellers and government officials together under one roof. All the most important features integrated to the application which were tabled on feasibly study discussions and meetings. Specifically in harvest prediction analysis, it shows the relationship between weather and harvest is linear.

Also, Market prices increases linearly. These conclusions help the solution to predict values with least error. Also considering the theory of matching applied in trade platform using K-Nearest Neighbors.

Finally, the crops images are processed to identify the healthiness of the crop. Nature of such dataset reveals the use of Keras Sequential Model for predictions. Basically, the app provides different aspects of cultivation process ease with decision making. Hence larger portion of the future of cultivation in Sri Lanka will be handled by Mahaweli Market App.

8. REFERENCES

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9. APPENDICES

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