A

Major Project

On

FARMER ECO FRIENDLY RECOMMENDATION SYSTEM

(Submitted in partial fulfillment of the requirements for the award of Degree)

BACHELOR OF TECHNOLOGY

in

COMPUTER SCIENCE AND ENGINEERING

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

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2017-21

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

CERTIFICATE

This is to certify that the project entitled "**FARMER ECO FRIENDLY RECOMMANDATION SYSTEM**" being submitted by **A.ROHITH REDDY(177R1A0562),K.VISHNUVARDHAN(177R1A0580)&D.SREEVALLI(177R1A0576)** in partial fulfillment of the requirements for the award of the degree of B.Tech in Computer Science and engineering of the Jawaharlal Nehru Technological University Hyderabad, is a record of bonafide work carried out by him/her under our guidance and supervision during the year 2020-21.

The results embodied in this thesis have not been submitted to any other University or Institute for the award of any degree or diploma.

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Submitted for viva voice Examination held on _____

ACKNOWLEGDEMENT

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ABSTRACT

Agriculture is the largest source of livelihood in India. Climate plays a crucial role in agricultural production. It has a profound influence on crop growth, development and yield. Choosing the best crop to the given climatic conditions can increase the yield of a farmer. Farmers need a guide to help them in terms of crop suggestions and recommendations based on the amount of rainfall, soil pH, humidity and temperature. We want to aid the farmers in this aspect by suggesting them the type of crop to cultivate and also recommend fertilizers for that crop. Our project aims to build a web application that uses machine learning model to predict the suitable crop to the given weather conditions. We would also recommend use of organic fertilizers to improve fertility of the soil and produce eco-friendly crops

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1. **INTRODUCTION**

1.INTRODUCTION

1.1 PROJECT SCOPE

Agriculture, with its allied sectors, is the largest source of livelihood in India. 70 percent of its rural households depend primarily on agriculture for their livelihood, with 82 percent of farmers being small and marginal [1]. Understanding climatic conditions and growing suitable crops play an important role in increasing farmers' income. Lack of knowledge on best suited crops to the given weather conditions will lead to low yield for the farmers. This will result in increase in the use of chemical fertilizers to get higher yield. Chemical fertilizers decrease the fertility of the soil by destroying the Organic Carbon of the soil. Organic fertilizers can be used instead, which enrich soil health. Cost of chemical fertilizers is much more than that of organic fertilizers.

1.2 PROJECT PURPOSE

The process of learning begins with observations or data, such as examples, direct experience, or instruction, in order to look for patterns in data and make better decisions in the future based on the examples that we provide. The primary aim is to allow the computers to learn automatically without human intervention or assistance and adjust actions accordingly. Using Machine Learning we can make our system to learn better crops for the attributes temperature, humidity, rainfall and soil pH.

1.3 PROJECT FEATURES

The application is developed in a such a way that crop is recommended to the farmers using machine learning algorithm using MLP algorithm. We recommend chemical and organic fertilizers and cost of the fertilizers and recommend which fertilizers are best for the crop. The data set is taken from crop recommendation system

2. SYSTEM ANALYSIS

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SYSTEM ANALYSIS

System Analysis is the important phase in the system development process. The System is studied to the minute details and analyzed. The system analyst plays an important role of an interrogator and dwells deep into the working of the present system. In analysis, a detailed study of these operations performed by the system and their relationships within and outside the system is done. A key question considered here is, “what must be done to solve the problem?” The system is viewed as a whole and the inputs to the system are identified. Once analysis is completed the analyst has a firm understanding of what is to be done.

2.1 PROBLEM DEFINITION

Choosing the best crop to the given climatic conditions can increase the yield of a farmer. Farmers need a guide to help them in terms of crop suggestions and recommendations based on the amount of rainfall, soil pH, humidity and temperature. We want to aid the farmers in this aspect by suggesting them the type of crop to cultivate and also recommend fertilizers for that crop. Our project aims to build a web application that uses machine learning model to predict the suitable crop to the given weather conditions. We would also recommend use of organic fertilizers to improve fertility of the soil and produce eco-friendly crops .

2.2 EXISTING SYSTEM

Though there are various ways to predict the type of crop to grow, each of them has their advantages, they also have their demerits. There hasn’t been a proper system to classify crops based on the environment conditions and soil properties.

Weather forecast based prediction

Using weather forecasting for predicting the rainfall in upcoming months and suggesting various crops based on the amount of rainfall to occur.

Market demand based prediction

Using the trends of the market the demand for the crops is predicted in the market. The crop with higher demand in coming months will be suggested to grow

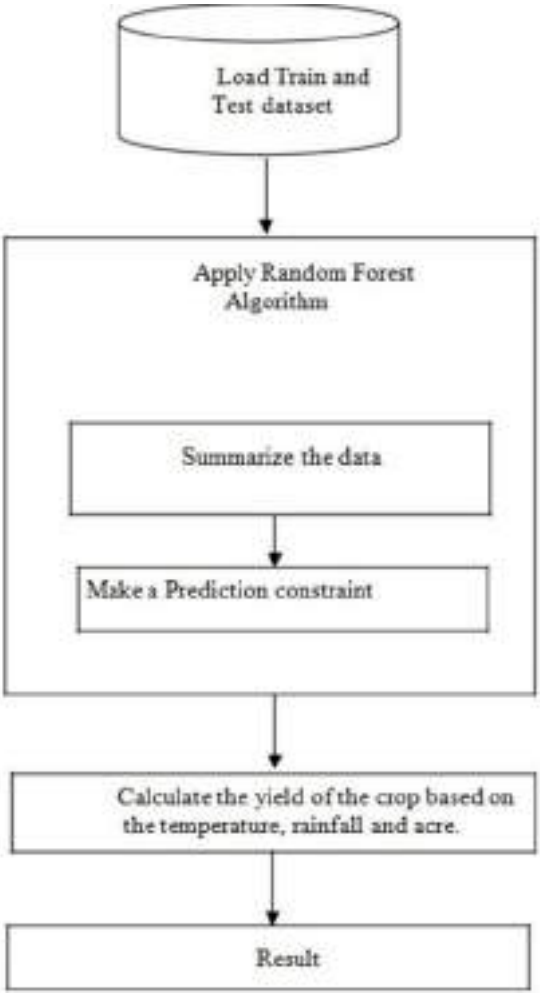

Figure 2.2 Existing system for crop prediction

2.2.1 LIMITATIONS OF EXSISTING SYSTEM

Drawbacks in weather forecast based prediction

Weather forecasts can work up to some extent but yield of the crop grown not only depends upon weather but also soil properties and fertilizers used.

Drawbacks in market demand based prediction

Analyzing the state market, national market and international market gives the crops which are in demand. Sometimes these demands change rapidly.

2.3 PROPOSED SYSTEM

The proposed system for predicting suitable crops for environmental conditions is discussed in this section.

- Inputs to the system are temperature, soil pH, rainfall and humidity in the area.

● Outputs from the system are suitable crops to the given conditions and fertilizers that should be used along with their quantity.

2.3.1 ADVANTAGES OF EXISTING SYSTEM

- Limits the concentration of pests and diseases
- Reduces soil erosion
- Increases crop yield

2.4 FEASIBILITY STUDY

The feasibility of the project is analyzed in this phase and business proposal is put forth with a very general plan for the project and some cost estimates. During system analysis the feasibility study of the proposed system is to be carried out. This is to ensure that the proposed system is not a burden to the company. Three key considerations involved in the feasibility analysis are

• Economic Feasibility

•Technical Feasibility

•Social Feasibility

2.4.1 ECONOMIC FEASIBILITY

The developing system must be justified by cost and benefit. Criteria to ensure that effort is concentrated on project, which will give best, return at the earliest. One of the factors, which affect the development of a new system, is the cost it would require.

The following are some of the important financial questions asked during preliminary investigation:

•The costs conduct a full system investigation.

•The cost of the hardware and software.

•The benefits in the form of reduced costs or fewer costly errors.

Since the system is developed as part of project work, there is no manual cost to spend for the proposed system. Also, all the resources are already available, it give an indication of the system is economically possible for development.

2.4.2 TECHNICAL FEASIBILITY

This study is carried out to check the technical feasibility, that is, the technical requirements of the system. Any system developed must not have a high demand on the available technical resources. The developed system must have a modest requirement, as only minimal or null changes are required for implementing this system.

2.4.2 BEHAVIORAL FEASIBILITY

This includes the following questions:

•Is there sufficient support for the users?

•Will the proposed system cause harm?

The project would be beneficial because it satisfies the objectives when developed and installed. All behavioral aspects are considered carefully and conclude that the project is behaviorally feasible.

2.5 HARDWARE AND SOFTWARE REQUIREMENTS

2.5.1 HARDWARE REQUIREMENTS:

Hardware interfaces specifies the logical characteristics of each interface between the software product and the hardware components of the system. The following are some hardware requirements.

- Processor : i3 or above
- Ram : 4GB or above
- Hard Disk : 50GB or above

2.5.2 SOFTWARE REQUIREMENTS:

Software Requirements specifies the logical characteristics of each interface and software components of the system. The following are some software requirement

- Operating System : Windows 7 and above
- Programming languages : Python and their libraries
- Backend : Machine Learning

3.ARCHITECTURE

3.ARCHITECTURE

3.1 PROJECT ARCHITECTURE

This project architecture shows the procedure followed for breed detection using machine learning, starting from input to final prediction.

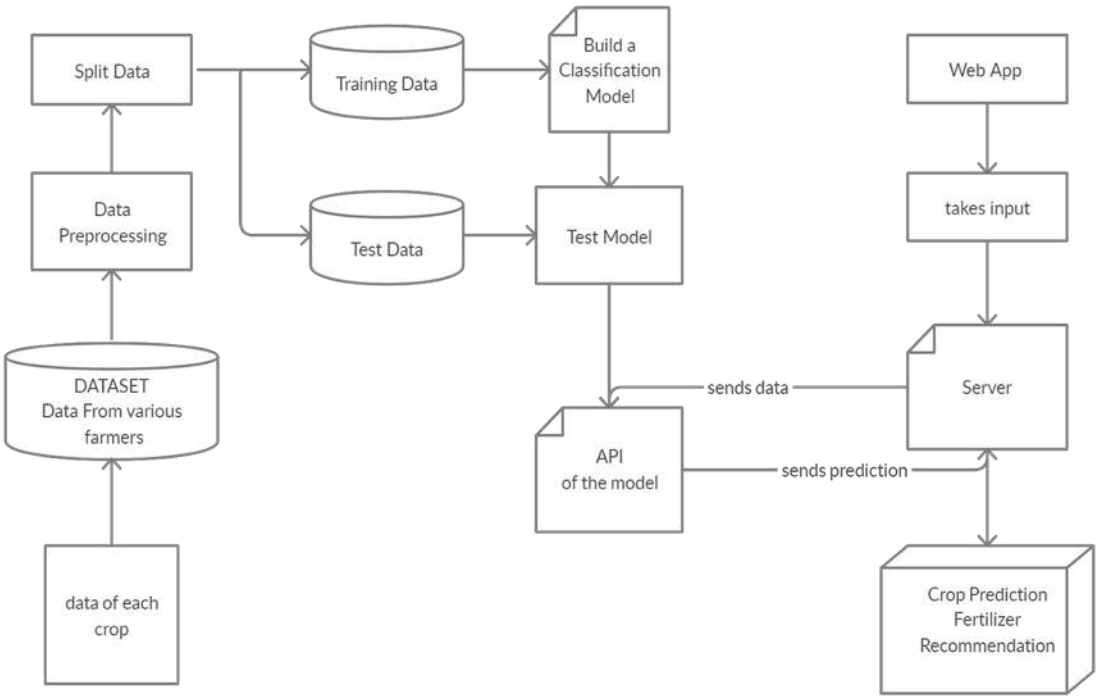

Figure 3.1 Project Architecture of Farmer eco-friendly recommendation system.

3.2 DESCRIPTION

We have collected the dataset for the document with following details from crop recommendation system and we have applied machine learning algorithm such as multi-layer perceptron for crop prediction.

Special Features: In this following step we are going to separate the features which we take to train the model by giving the dataset to the machine learning algorithm.

Training and test data: Training data is passed to the MLP classifier to train the model. Test data is used to test the trained model whether it is making correct predictions or not.

Dataset: Crop recommendation dataset is related about the informed decisions about the farming strategy. It helps the user to build a predictive mode; to recommend the most suitable crop to grow in a particular farm based on various parameters.

3.3 USE CASE DIAGRAM

The use cases of the proposed system are when the farmer enters the data ,the backend model predicts the type of crop and recommends the organic fertilizer over artificial fertilizer. Use case diagram includes farmer, database, MLP classifier as actors. Use cases of the system includes entering data for the actor farmer. Data base helps storing and sharing the data. Finally the actor MLP classifier has the use case crop prediction.

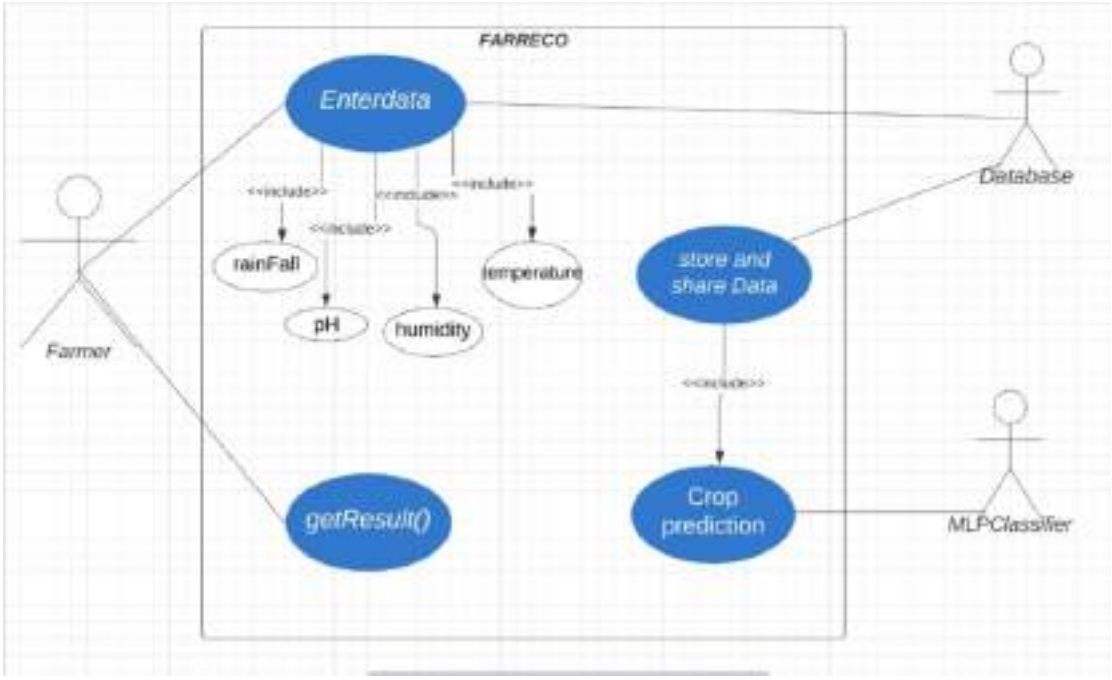

Figure 3.3 Use case diagram for Farmer eco-friendly recommendation system

3.4 CLASS DIAGRAM

Class diagram shows the static representation of the application. It includes classes Farmer, Farreco, Database and MLP classifier. The class Farmer has the attributes name, address. It has method enterData (), requestResult (). The Farreco class has the attributes temperature, humidity, pHvalue , Rainfall.

The methods include getInput(), sendInput(), getCropPrediction(). Database has the functionalities like storedata and sharedata. It has attributes like train data , test data and farmer data. MLP classifier includes hidden layers, learning rate, activation, alpha and number of iterations. It has methods like train() ,test() and predict().

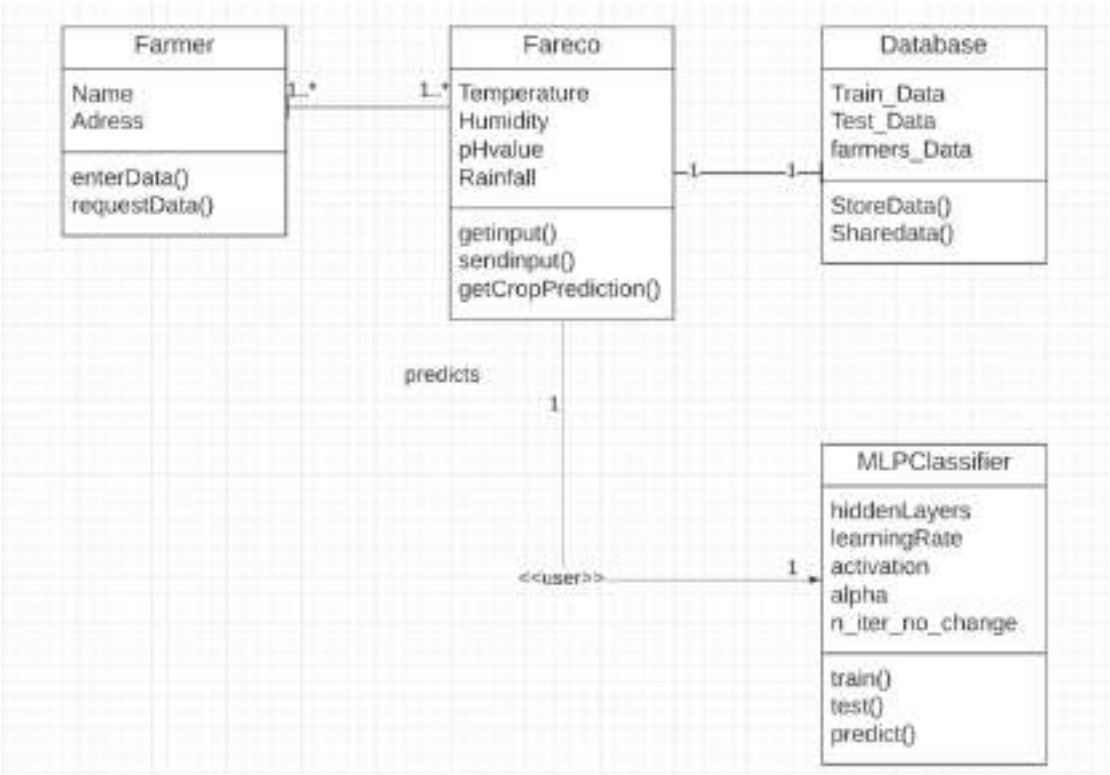

Figure 3.4 Class diagram for Farmer eco-friendly recommendation system

3.5 SEQUENCE DIAGRAM

Sequence diagram shows the time sequence of interaction between objects of a model. The sequence diagram has objects Fareco, database and MLP classifier. The sequence can be described as below.

Farmer acts as an actor in the model. Fareco requests the user to enter the data requestData () in turn the data is entered by the actor enterData (). and finally requests the results requestResults (). The data is sent to database sendData (),and it is stored in the database - storeData(). Further the data is passed to MLP Classifier object for prediction - predict().The system Farreco requests for predicted output, the predicted crop string is passed to getPrediction().Thus, the predicted crop gets displayed on the result page, the objects whose lifespan is expired get killed during the sequence of actions.

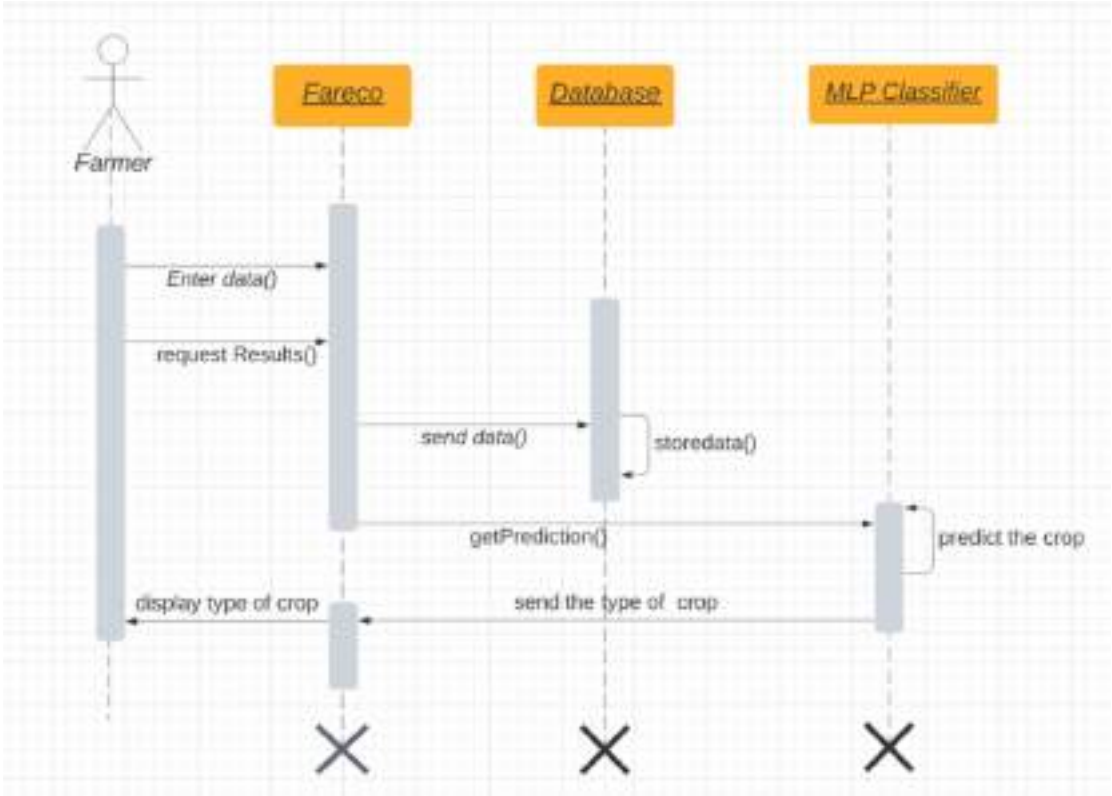

Figure 3.5: Sequence diagram for Farmers eco friendly recommendation system

3.6 ACTIVITY DIAGRAM

Activity diagram shows the dynamic aspects of all the objects within the system. In our system the objects include Farmer, the system Farreco (the user interface), the database of the system and the backend model, MLP classifier.

The initial state of the process flow starts with Farmer. In case of validation, the user is requested to enter the details of the crop. The system Fareco sends the data in appropriate format to the database for further storage. The data is further passed to the MLP classifier model for prediction of the crop. The crop gets predicted and the MLP classifier object passes the object to the Fareco object, which get displayed to the farmer. Therefore , final state of the flow ends at farmer object.

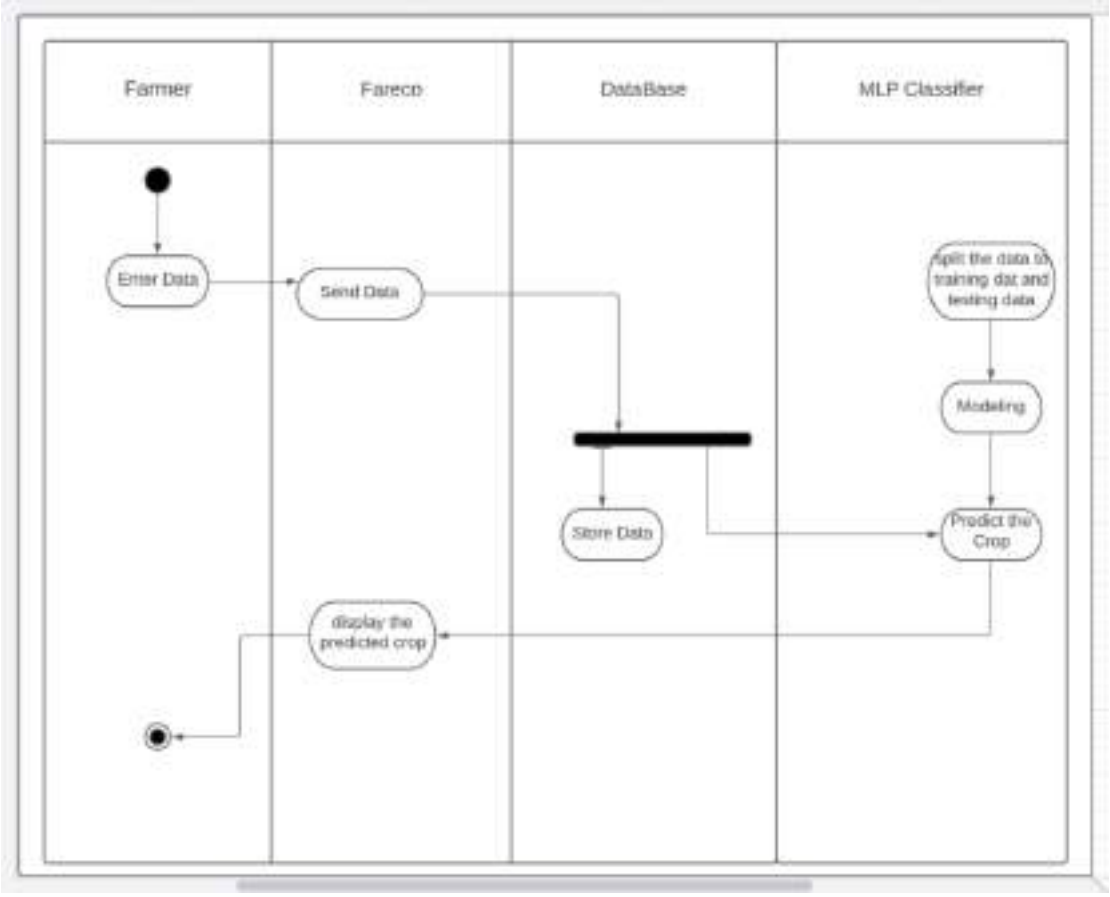

Figure 3.6 Activity diagram for Farmer eco friendly recommendation system

4.IMPLEMENTATION

4.IMPLEMENTATION

4.1 SAMPLE CODE

farmers friend-api

```
#importing pandas and numpy

import pandas as pd
import numpy as np

#read data

data=pd.read_csv('./cpdata.csv') # print(data.head(1))

#preprocessing data

from sklearn import preprocessing
#labelEncoder=preprocessing.LabelEncoder()
# data['label']=labelEncoder.fit_transform(data['label'])

target=data['label']

# print(data.iloc[:,4].value_counts())
# print(target)

# Scaled feature

# min_max_scaler = preprocessing.MinMaxScaler(feature_range =(0, 1))
# data = min_max_scaler.fit_transform(data.iloc[:,0:4])

standardisation=preprocessing.StandardScaler()
standardisation.fit(data.iloc[:,0:4])
# print(standardisation)
```

```
data=standardisation.transform(data.iloc[:,0:4])
#print("mean is ",standardisation.mean_)
# print("scale is ",standardisation.scale_)
# print(data)
#creating dataframe from the array returned by min_max_scaler

data=pd.DataFrame(data,columns=['temperature','humidity','ph','rainfall'])
x=data.iloc[:,:].values
y=target[:].values

#splitting data into train and test data

from sklearn.model_selection import train_test_split
#from sklearn import utils
x_train,x_test,y_train,y_test=train_test_split(x,y,test_size=0.2,shuffle=True)

#importing neural_network from sklearn

From sklearn.neural_network import MLPClassifier
m_clf=MLPClassifier(solver='lbfgs')
m_clf.fit(x_train,y_train)

# print(x_test)
y_predict=m_clf.predict(x_test)
# print(y_predict)

from sklearn.metrics import accuracy_score
# Finding the accuracy of the model
a=accuracy_score(y_test,y_predict)
print("The accuracy of this model is: ", a*100)

#importing pickle
import pickle
pickle.dump(m_clf,open('models/final_prediction.pickle','wb'))
```

farmersfriend/src/app/app.component.html

```
<nav class="navbar fixed-top navbar-expand-sm navbar-dark bg-dark">
 <div >
  <a class="navbar-brand" href="#">
    Farmers Friend
  </a>
</div>
<button class="navbar-toggler" type="button" data-toggle="collapse"
data-target="#navbarSupportedContent"aria-controls="navbarSupportedContent"
aria-expanded="false" aria-label="Toggle navigation">

  <span class="navbar-toggler-icon"></span>
</button>
<div class="collapse navbar-collapse" id="navbarSupportedContent">
  <ul class="navbar-nav mr-auto">
    <li class="nav-item ">
      <a class="nav-link" routerLink="home">Home <span class="sr
only">(current)</span></a>
    </li>
    <li class="nav-item">
    <a class="nav-link" routerLink="explore">Explore</a>
    </li>
    <li class="nav-item ">
      <a class="nav-link" routerLink="contactus">Contact Us</a>
    </li>

  </ul>
  <ul class="nav navbar-nav navbar-right">
    <li ><a class="nav-link" routerLink="login" style="color: whitesmoke;"><i
class="fas fa-sign-in-alt" style="color:bisque; margin-right: 5px;"></i>login</a></li>
<!-- <li><a class="nav-link" routerLink="login" style="color: whitesmoke;"><i
class="fas fa-sign-in-alt" style="color:bisque; margin-right: 5px;"
```

```
</i>logout</a></li> -->
<li><a class="nav-link" routerLink="signup" style="color: whitesmoke; margin-right:
10px;"><i class="fas fa-user" style="color:bisque; margin-right: 5px;"></i>Sign
Up </a></li>
  </ul>
 </div>
</nav>
 <br>
 <br>

<div>
  <router-outlet>
    </router-outlet>
 </div>
```

farmersfriend/src/app/app.component.ts

```
import { Comp1onent } from '@angular/core';

@Component({
  selector: 'app-root',
  templateUrl: './app.component.html',
  styleUrls: ['./app.component.css']
})
export class AppComponent {
  title = 'farmersfriend';
}
```

farmersfriend/src/app/home/home.component.html

```
<div class="row" >
  <div class="col-sm-4 "></div>
  <div class="col-sm-4 jumbotron bg-dark " style="margin-top: 10px;">
      <for1urwm #query="ngForm" (ngSubmit)="onSubmit(query)" style="">
```

```
        <div class="form-group text-center">
          <h2 style="color: cornsilk;">welcome farmer</h2>
      </div>
      <!-- <div class="form-group text-center">
       <label for="temp" ><h5 style="color: aliceblue; margin-right 5px;">temperature
</h5>
<input type="text" name="temperature" id="temp" placeholder="enter temperature "
ngModel class="form-control" required>
</label>
</div> -->
<div class="form-group text-center">
<label for="temp">
<h5 style="color: aliceblue; margin-right: 5px;">temperature </h5>
<select ngModel name="temperature" id="temp" class="browser-default custom
select" style="width:auto" >
<option value="25" selected >choose temperature &#8451; </option>
<option value="25" >25&#8451; - 30&#8451; </option>
<option value="30" >30&#8451; - 35&#8451;</option>
<option value="35" >35&#8451; - 40&#8451;</option>
<option value="40" >40&#8451; - 45&#8451;</option>
<option value="45" > greater than ( > 45&#8451; )</option>
</select>
</label>
</div>
<div class=" form-group text-center">
<label for="ph" ><h5 style="color: aliceblue;margin-right: 5px">soil ph</h5>
<select ngModel name="ph" id="ph" class="browser-default custom-select"
style="width: auto;" >
<option value="7" selected >choose soil ph</option>
<option value="6" >acidic (ph < 6)</option>
<option value="6.5" >mild acidic (6 < ph < 7)</option>
<option value="7" >neutral (ph ~ 7)</option>
<option value="7.5" >mild basic(7<ph<7.5)</option>
<option value="8" >basic (ph > 7.5)</option>
```

```
    </select>
   </label>
 <div class=" form-group text-center">
        <label for="rainfall" ><h5 style="color: aliceblue;margin-right: 5px">rain
fall</h5>
            <!-- <input type="text" name="rainfall" id="rainfall" placeholder="enter
rainfall in mm" ngModel class="form-control" required> -->
              <select ngModel name="rainfall" id="rainfall" class="browser-default
custom-select" style="width: auto;" >
    <option value="130" selected >choose rainfall</option>
    <option value="100" >very low ( < 100 cm )</option>
    <option value="120" > low ( 100 - 130 cm )</option>
    <option value="150" > average ( 140 -160 cm )</option>
    <option value="180" > high (160 - 190 cm)</option>
    <option value="230" >very high ( > 200 cm )</option>
</select>
</label>
</div>
      <div class=" form-group text-center">
        <label for="humidity" ><h5 style="color: aliceblue;margin-right:
5px">humidity</h5>
            <!-- <input type="text" name="humidity" id="humidity"
placeholder="enter humidity" ngModel class="form-control" required> -->
              <select ngModel name="humidity" id="humidity" class="browser-
default custom-select" style="width: auto;" >
       <option value="56" selected >choose humidity</option>
       <option value="30" >very low ( < 35)</option>
       <option value="40" >slightly lower ( 40 - 50 )</option>
       <option value="55" >average ( ~ 55)</option>
       <option value="70" >slightly higher ( 60 - 75 )</option>
       <option value="80" >very high ( > 80)</option>
</select>
</label>
</div>
```

```
<div class="text-center">
      <button type="submit" class="btn btn-light"><h4 style="text-decoration-color:
black;">submit</h4></button>
     </form>
   </div>
</div>
```

farmersfriend/src/app/home/home.component.ts

```
import { Component, OnInit } from '@angular/core';
import { NgForm } from '@angular/forms';
import { DataService } from '../data.service';
import { Router } from '@angular/router';

@Component({
selector: 'app-home',
templateUrl: './home.component.html',
styleUrls: ['./home.component.css']
})
export class HomeComponent implements OnInit {

constructor(private ds:DataService,private router:Router) { }

ngOnInit(): void {
}
userObj
onSubmit(query:NgForm){
this.userObj=query.value;
this.ds.setFormData(this.userObj);

this.router.navigate(['/result']) query.reset()
}
}
```

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import { Component, OnInit } from '@angular/core';
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this.ds.setFormData(this.userObj);

this.router.navigate(['/result'])
query.reset()
}
}
```

farmersfriend/src/app/data.service.ts

```
import { Injectable } from '@angular/core';
import { Observable } from 'rxjs';
import { HttpClient } from '@angular/common/http';
import { API_URL } from './env';
```

```
@Injectable({
 providedIn: 'root'
})
export class DataService {

private userObj
setFormData(f){
this.userObj=f;
console.log(f.temperature)
}
constructor(private hc:HttpClient) { }
getPrediction():Observable<any>{
return this.hc.post(`${API_URL}/api/predict`,this.userObj);
}
}
```

farmersfriend/src/app/result/result.component.html

```
<div class="body">
   <!-- waiting for data -->

<div *ngIf="predicted_data==undefined" class="loader"></div>

<!-- when data is available -->

<div *ngIf="predicted_data!=undefined">
  <div >

<h1 style="margin-top: 0px; background-color: black; background-size:cover; color:
white;" class="text-center">
      <span style="color:lawngreen;">{{predicted_data}}</span> will be suitable to
your environmental conditions.
 </h1>
  </div>
```

```
<br>

<!-- chemical fertilizers table -->
<div>
  <h3 style="margin-top: 20px; ;" class="text-center">
    Quantities of chemical fertilizers used to cultivate {{predicted_data}} are given below along with the cost.

  </h3>
</div>
<div class="row">
<div class="col-sm-3"></div>
<div class="col-sm-6 " >
  <table class="table table-striped table-dark table-hover" style="margin-top:10px;">
    <thead>
      <tr>
  <th colspan="3" style="text-align: center;"><h3 class="textcenter">Chemical fertilizers </h3></th>
 </tr>
<tr>
<th>name</th>
<th>quantity per acre</th>
<th>cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urea(46%)</td>
<td>110kg/acre</td>
<td>Rs.600/-</td>
</tr>
<tr>
 <td>DAP(18%)</td>
<td>27kg/acre</td>
```

```
<td>Rs.650/-</td>
</tr>
<tr>
<td>Super Phosphate</td>
<td>75kg/acre</td>
<td>Rs.700/-</td>
</tr>
<tr>
<td>Potash</td>
<td>20kg/acre</td>
<td>Rs.400/-</td>
</tr>
<tr >
<th colspan="3">total cost of chemical fertilizers is RS.2350/- per acre</th>
</tr>
</tbody>
</table>
</div>
</div>

<!-- organic fertilizers table -->
<div>
<h3 style="margin-top: 20px;" class="text-center">
Organic fertilizers used to cultivate {{predicted_data}} are given below along with
the cost.
</h3>
</div>
<div class="row">
<div class="col-sm-3"></div>
<div class="col-sm-6 " >
<table class="table table-striped table-dark table-hover" style="margin-top: 10px;" >
 </h3></th>
 <thead>
<tr>
```

```
<th colspan="3" style="text-align: center;"><h3 class="text-center">Organic
fertilizers
</tr>
<tr>
<th>name</th>
<th>function</th>
<th>cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Green Manure ( eg: azolla )</td>
<td>fixes nitrogen into soil</td>
<td>Rs.100/-</td>
</tr>
<tr>
<td>farmyard manure</td>
<td>improves organic carbon in soil</td>
<td>Rs.100/-</td>
</tr>
<tr>
<td>compost</td>
<td>improves microbial activity of soil</td>
<td>Rs.200/-</td>
</tr>
<tr >
<th colspan="3">total cost of organic fertilizers is RS.400/- per acre</th>
</tr>
</tbody>
</table>
</div>
</div>
<br>
```

```
<!-- recommendation -->
<div class="row">
<div class="col-sm-1"></div>
<div class="col-sm-9">
<ul class="list-group list-group-flush" style="margin-bottom: 20px;">
<li class="list-group-item list-group-item-info">
<h5 style="margin-top: 20px;" class="text-center">
Cost of organic fertilizers is much less than artificial fertilizers.
</h5>
</li>
<li class="list-group-item list-group-item-info">
<h5 style="margin-top: 20px;" class="text-center"> Organic fertilizers also helps in
improving soil fertility.
</h5>
</li>
<li class="list-group-item list-group-item-info">
<h5 style="margin-top: 20px;" class="text-center">
Crops produced using organic fertilizers has no adverse effects on human health
whereas artificial fertilizers can have negative impact on human health
if used excessively.
</h5>
</li>
<li class="list-group-item list-group-item-success">
<h2 style="margin-top: 20px; ;" class="text-center">
We recommend organic fertilizers to cultivate {{predicted_data}} as they cost less
and gives more yield without any negative impacts on human health
</h2>
</li>
</ul>
 </div>
</div>
</div>
</div>
```

farmersfriend/server.js

```
const exp=require('express')
const path=require('path')

const app=exp()

app.use(exp.json())

app.use(exp.static(path.join( dirname,'./dist/farmersfriend')));

app.get('/*',(req,res)=>{
res.sendFile(path.join( dirname + '/dist/farmersfriend/index.html'));
})

//importing dotenv module
const env=require('dotenv').config()

const host = '0.0.0.0'
const port = process.env.PORT || 5700



app.listen(port || 5700 , host,()=>
{ console.log(`server running on ${port}`)
});
```

5. SCREENSHORTS

5.SCREENSHORTS

5.1 HOME PAGE

5.1.1 Screenshot: Web application home page

5.1.2 ENTERING THE DATA

5.1.2 Screenshot: Data entry and submitting the data

5.2 CROP AND FERTILIZERS RECOMMENDATION

5.2.1 Screenshot: Crop recommended for farmers with suitable environmental conditions and chemical fertilizers used

5.2.2 Screenshot : Organic fertilizers used for recommended crop

5.3 FERTILIZER RECOMMENDATION PAGE

5.3.1 Screenshot : Fertilizers recommendation page

6.TESTING

6.TESTING

6.1 INTRODUCTION TO TESTING

The purpose of testing is to discover errors. Testing is the process of trying to discover every conceivable fault or weakness in a work product. It provides a way to check the functionality of components, subassemblies, assemblies and/or a finished product. It is the process of exercising software with the intent of ensuring that the Software system meets its requirements and user expectations and does not fail in an unacceptable manner. There are various types of test. Each test type addresses a specific testing requirement.

6.2 TYPES OF TESTING

6.2.1 UNIT TESTING

Unit testing involves the design of test cases that validate that the internal program logic is functioning properly, and that program inputs produce valid outputs. All decision branches and internal code flow should be validated. It is the testing of individual software units of the application .it is done after the completion of an individual unit before integration. This is a structural testing, that relies on knowledge of its construction and is invasive. Unit tests perform basic tests at component level and test a specific business process, application, and/or system configuration. Unit tests ensure that each unique path of a business process performs accurately to the documented specifications and contains clearly defined inputs and expected results.

6.2.2 INTEGRATION TESTING

Integration tests are designed to test integrated software components to determine if they actually run as one program. Testing is event driven and is more concerned with the basic outcome of screens or fields. Integration tests demonstrate that although the components were individually satisfaction, as shown by successfully unit testing, the combination of components is correct and consistent. Integration testing is specifically aimed at exposing the problems that arise from the combination of components.

6.2.3 FUNCTIONAL TESTING

Functional tests provide systematic demonstrations that functions tested are available as specified by the business and technical requirements, system documentation, and user manuals.

Functional testing is centered on the following items:

Valid Input : identified classes of valid input must be accepted.

Invalid Input : identified classes of invalid input must be rejected.

Functions : identified functions must be exercised.

Output : identified classes of application outputs must be exercised.

Systems/Procedures : interfacing systems or procedures must be invoked.

Organization and preparation of functional tests is focused on requirements, key functions, or special test cases. In addition, systematic coverage pertaining to identify Business process flows; data fields, predefined processes.

6.4 TEST CASES

6.3.1 Test Data

We have used 20 percent of the collected data for testing. We have shuffled the data before splitting it into test data and train data, then user train_test_split(x,y,test_size=0.2,shuffle=True) method from the sklearn learn module in python.

6.3.2 Test Report

The module is working appropriately given the farmer entered valid input into the web application. Every component of the system is working fine as per the flow mentioned above. We have used the accuracy_score(y_test,y_predict) method from the sklearn.metrics module in python as a metric to measure the accuracy of the model. The accuracy obtained for the model is 91.12 percent.

6.3.3 Error Report

On the off chance that the client does not enter information in determined request, at that point the client will be incited with error messages. Error reduction is done to deal with the normal and sudden mistakes. The error obtained for the model is 8.88 percent that means only 9 out of 100 predictions gave undesirable results.

7. CONCLUSION AND FUTURE ENHANCEMENTS

7. CONCLUSION AND FUTURE ENHANCEMENTS

7.1 PROJECT CONCLUSION

This project aims to predict the type of crop to be sown for given climatic conditions using Back-Propagation classification algorithm. Dataset collected is preprocessed like label-encoded, feature extraction is done and missing values were handled for better accuracy. It also recommends the type of fertilizers to be used for the crop predicted. We promote the usage of organic fertilizers by comparing the cost of fertilizers per acre, for artificial fertilizers and organic fertilizers.

7.2 FUTURE ENHANCEMENT

We would like to get input to the web app directly using IOT sensors in the field so that accurate data is taken and we can predict the best crop for given weather conditions. We are planning to develop an android application so that users can use the app easily. We would like to display content of the application in native languages so that farmers can use the application with great ease. We are also planning to add a voice assistant which can read out the predictions of models and answer queries of farmers.

8.BIBILOGRAPHY

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Farmer Eco Friendly Recommendation System

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[3]*Student, CSE, CMR Technical Campus, Hyderabad, India*
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***Abstract*: In this paper, a real-time ML-based system was built for farmers' eco-friendly recommendation system, Agriculture is the largest source of livelihood in India. Climate plays a crucial role in agriculture production. It has a profound influence on crop growth, development, and yield. Choosing the best crop to the given climatic conditions can increase the yield of a farmer. Farmers need a guide to help them in terms of crop suggestions and recommendations based on the amount of rainfall, soil pH, humidity, and temperature. We want to aid the farmers in this aspect by suggesting to them the type of crop to cultivate and also recommend fertilizers for that crop. Our project aims to build a web application that uses a machine learning model to predict the suitable crop to the given weather conditions. We would also recommend the use of organic fertilizers to improve the fertility of the soil and produce ec0-friendly crops. Our model is trained using the MLP algorithm, this algorithm uses 100 hidden layers to give the result. We chose this algorithm because it provides greater accuracy than other algorithms. Our model is trained with 3000 records consisting of data of various crops. The accuracy of our model is 94.71%.**

***Keywords:* MLP Classifier, Crop Recommendation Dataset, Gradient descent, SoftMax**

1. Introduction

Agriculture, along with its related industries, is India's most important source of income. Agriculture is the primary source of income for 70% of rural households, with 82 percent of farmers being small and marginal. Understanding climatic conditions and cultivating appropriate crops are crucial for farmers to increase their income. Farmers will have a low yield due to a lack of understanding about which crops are best suited to the current weather conditions. To get a higher yield, this will increase the use of chemical fertilizers. Chemical fertilizers reduce soil fertility by depleting the organic carbon in the soil. Instead, organic fertilizers can be employed, which improves soil health. The cost of chemical fertilizers is much more than that of organic fertilizers.

Machine learning is an application of artificial intelligence (AI) that provides systems the ability to automatically learn and improve from experience without being explicitly programmed. Machine learning focuses on the development of computer programs that can access data and use it to learn for themselves. The analysis starts with observations or data, such as examples, direct experience, or instruction, in order to look for patterns in data and make better decisions in the future based on the examples we offer. The main goal is for computers to learn on their own, without the need for human involvement, and to change their behavior accordingly. We can train our system to learn better crops based on temperature, humidity, rainfall, and soil pH by using Machine Learning.

2. Literature Survey

There is much research works in the area of crop prediction based on given weather conditions. Even though there are many research papers, there are no particular ground-level implementations available. Our project is apparently based on and similar to one such research paper namely “Crop Prediction System using Machine Learning” published as a Special Issue on Recent Trends in Data Engineering (Volume 4, Special Issue 5, Dec.-2017) [3]. This study proposes a strategy to lower transportation costs by reducing the number of middle hops and agents between farmers and end-users using an IOT-based method, which will benefit the farmer. Our project's motivation turns out to be this paper. We incorporate the processes described in the paper, as well as a prediction-based approach for recommending crops with the highest profit potential. A presentation titled “Agriculture yield prediction using predictive analytic techniques” was presented at the 2nd International Conference on Contemporary Computing and Informatics (ic3i) in 2016. This study addresses the building of several predictive models and theorises an exploratory data analysis. To identify and analyze the properties of each, a sample data set is gathered and several regression techniques are used. Linear, Multiple Linear, non-Linear, Logistic, Polynomial, and Ridge regression are some of the regression techniques described in this work. This paper provides a comparative analysis of various data analytics algorithms. This aids us in determining which algorithm is most suited to our proposed system. Finally, a review of many articles assisted us in selecting Multi-Layer Perceptron Classifier as the classifier in our suggested system. N.Heemageetha, “A survey on Application of Data Mining Techniques to Analyze the soil for agricultural purpose”,2016IEEE.
This paper discusses various data mining techniques like Market-based Analysis, Association Rule Mining, Decision Trees, Classification, and Clustering. It entirely covers the Data Mining concept. Various data mining algorithms such as Naive Bayes classifier, J48, K-Mean are explained in this paper. It also provides the classification of soil based on Naive Bayes, Genetic algorithm, Association Rule Mining. Eventually, it covers Clustering in soil databases. This paper helped us in understanding and analysis of different data mining algorithms and classification mechanisms. This will prove to be extremely beneficial while developing our project and will help in mining the dataset obtained

from sensors employed remotely. Await Kumar, Shiv Kumar "Prediction of production of crops using K-Means and Fuzzy Logic", IJCSMC, 2015.

This paper presents a technique for predicting current-year crop production. It uses the K-Means data mining technology to calculate crop productivity. In addition, this system employs a fuzzy logic-based prediction method. Fuzzy logic is a rule-based prediction logic in which a set of rules is applied to the land for agricultural purposes, such as rainfall and crop production. This study provides a thorough understanding of how K-Means can be applied to data analysis. We will use the set of rules to anticipate which crop would return the most profit based on previous years' crop costs and current soil and weather data, similar to how they have applied the set of rules in the form of fuzzy logic. The "Food and Agriculture Organization of the United Nations" published "Soil pollution: a Hidden Reality." In addition to crop prediction, our study advocates for the use of organic fertilizers over synthetic fertilizers. After a thorough review of numerous agricultural research publications, it became clear that artificial fertilizer use has caused soil fertility to decline rapidly over time.

3. Methodology

A.Dataset Creation

A Dataset was created by collecting a set of 3000 records that were taken using the various crop yielding results. Each record was labeled with crop name, temperature, humidity, rainfall, pH, Nitrogen, Phosphorus, and potassium. These records are saved in a CSV file. This dataset was built by augmenting datasets of rainfall, climate, and fertilizer data available for India. We are going to show you a dataset that will allow you to develop a predictive model that will recommend the best crops to produce on a specific farm based on numerous criteria.

The data fields in our dataset are:

N - the ratio of Nitrogen content in the soil
P - the ratio of Phosphorous content in the soil
K - the ratio of Potassium content in the soil
Temperature - the temperature in degree Celsius
Humidity - relative humidity in %
pH - ph value of the soil
Rainfall - Rainfall in mm

B. System Architecture

With the help of Labels in the dataset, a real-time crop recommendation ML model was developed using the MLP algorithm. The data taken from the various farmers are kept under data preprocessing. Because the deep learning algorithm cannot handle noisy, incompatible, or missing data, the crop suggestion model's dataset must be preprocessed. Outliers and errors are present because the data is noisy: In the sense that it represents the difference in data, incompatible or inconsistent data.
features: Incomplete data refers to a lack of features or attribute values in a dataset. The basic steps involved in any data preprocessing phase include data cleaning, data Integration: data transformation and data reduction are all things that may be done with data.
After the data preprocessing the data is split into test and train data the amount of training data we took is 80%, and the remaining is test data. The trained data is sent into the classification model and test data is sent into the test model. Now both the classification model and test model are sent into the API model.
On the other hand, the web app takes input from the farmer or any user, those inputs are sent to the server, the data is sent to the API model and the predicted results are sent back to the server. From the server, the results are displayed to the farmer.

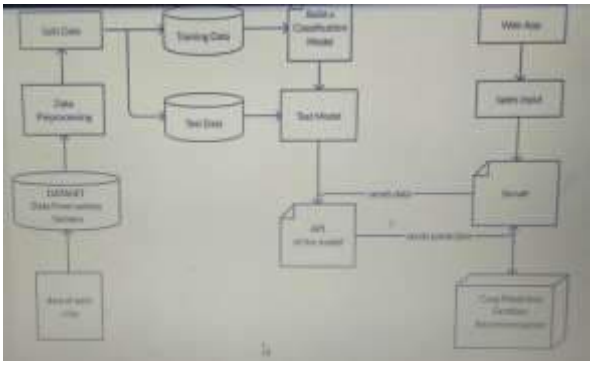

Figure 1: System Architecture

Figure 2: Plotting data: Considering X: Rainfall, Y: Humidity.

Figure 3: Plotting data: Considering X: Humidity, Y: Temperature.

C. Feature Extraction

Feature extraction is a broad phrase that refers to strategies for creating combinations of variables to get around these issues while still accurately representing the data. Many practitioners of machine learning feel that well optimized feature extraction is the key to building good models.

D. Training and Testing

The data collected is divided into two sets i.e. training set and testing set. The data to which the model is fitted is known as training data. The process of training a model requires the help of an algorithm that learns from the training data. We have different algorithms in Machine Learning, Deep Learning, and Neural Networks. In our project, we are using the machine learning algorithm MLP to train the model and then compare the accuracies they provide when test data is provided.

To test the accuracy of the model we use a Testing mechanism. The data collected is divided into training and testing data. Data is tested by using testing data set and new data sets and comparing the result in form of accuracy, precision, and recall. Testing the model in our project involves giving the test data, extracting the features of test data.

E. Classification

The Class MLP classifier uses Back Propagation to train a multi-layer perceptron (MLP) method. MLP uses two arrays to train: array X (3000 samples, 4 features), which contains the training samples as floating-point feature vectors, and array y (samples,) which contains the target values (class labels) for the training samples. By using SoftMax as the output function, the MLP classifier offers multi-class classification. The multi-layer perceptron is a supervised learning algorithm that learns from data. It can learn a non-linear function approximator for classification or regression given a collection of features X=x1,x2,...,xm and a target y. The input layer, on the left, is made up of a group of neurons that represent the input features. Temperature, humidity, soil pH, and rainfall are all inputs for our model. Each neuron in the previous hidden layer transforms the values from the previous layer with a weighted linear summation w1x1 + w2x2 + w3x3 + w4x4 + a non-linear activation function (x1=temperature, x2=humidity, x3=soil pH, x4=rainfall), followed by a non-linear activation function (x1=temperature, x2= The public attributes are contained in the multi-layer perceptron in scikit learn. The terms _coefs_ and _intercepts_ are used interchangeably. The weight matrix at index I represents the weights between layer I and layer i+1, and coefs_ is a collection of weight matrices. intercepts_ is a list of bias vectors, where the vector at index i represents the bias values added to layer i+1. MLPClassifier uses 100 hidden layers by default. We have 30 classes of output in our system.

F. SoftMax

SoftMax is a function that takes a vector z of K real numbers as an input and normalizes it into a probability distribution made up of K probabilities proportional to the input numbers' exponentials.
The formula defines the SoftMax function.

G. Regularization

The MLP Classifier employs the parameter alpha for regularization terms, which helps to minimize overfitting by penalizing excessive weights. The graphic below shows various decision functions as a function of alpha.
In our MLP Classifier, we chose alpha = 0.0001.

H. Gradient Descent

MLP uses Stochastic Gradient Descent, Adam, or L-BFGS to train. Stochastic Gradient Descent (SGD) is a method for updating parameters based on the gradient of the loss function for a parameter that requires adaptation, i.e.

$$w \leftarrow w - \eta(\alpha \partial R(w)/\partial w + \partial Loss/\partial w)$$

where η is the learning rate that governs the parameter space search step size. The network's loss function is called Loss.

I. Activation Formula

The hyperbolic tan is the default activation function. It's written as

$$\sigma(\mathbf{z})_i = \frac{e^{z_i}}{\sum_{j=1}^{K} e^{z_j}} \text{ for } i = 1, \ldots, K \text{ and } \mathbf{z} = (z_1, \ldots, z_K) \in \mathbb{R}^K$$

4. Feasibility Study

A feasibility study involves deciding whether the project we are taking up can be done or not. The decision is taken based on two criteria i.e. cost required and the value of the project. Before starting on with the project, a detailed study of the background of the project is required. The positive and negative outcomes of the project should be analyzed beforehand. If the commencement of the project is done without a proper feasibility study, it might lead to wastage of money invested in the project or might lead to the failure of the project.

A. Technical Feasibility

Technical feasibility involves the evaluation of the hardware and the software requirements of the proposed system. In this project, the technologies involved are Machine learning algorithms for building the model. These are necessary for fulfilling the requirements of the proposed project. The language used is Python. PyCharm is the IDE that will be used in the project. A basic understanding of the inbuilt libraries such as Librosa, NumPy, Scikit-Learn, SciPy, Pandas, Statistics, etc. is required.

B. Economic Feasibility

For the reckoning ability of a new project economic feasibility is the most familiar method. It is also called cost analysis. This assessment commonly comprises a cost/ benefits analysis of the project. The most important factors for the study of the project are Cost and Time.

C. Operational Feasibility

Operational feasibility is used to analyze if we can solve a real-life problem with the proposed system. It assesses the practical nature of the project. It provides us an opportunity for grabbing the advantages of the opportunities and helps to meet all the requirements

$$g(z) = \frac{e^{z} - e^{-z}}{e^{z} + e^{-z}}$$

which are provided by the customer for the development of the project.

5.Testing

A Testing Plan

A test plan is the first step in the testing process. This plan defines all of the testing-related actions that must be completed, as well as the timelines, resources, and testing requirements. The stated test cases are executed during unit testing, and the actual result is compared to the expected output. The test report and the error report are the final outputs of the testing phase.

B Test Data

We have used 20 percent of the collected data for testing. We have shuffled the data before splitting it into test data and train data, then used the

train_test_split (x, y, test size=0.2, shuffle=True) method from the sklearn learn module in python.

C Test Report

The module is working appropriately given the farmer entered valid input into the web application. Every component of the system is working fine as per the flow mentioned above. We have used the accuracy score (y_test, y_predict) method from the sklearn. metrics module in python as a metric to measure the accuracy of the model.

The accuracy obtained for the model is 91.12 percent.

D Error Report

If the client does not provide information in the deciding request, the client will receive error messages. Error reduction is used to deal with both routine and unexpected errors.

The model's error was 8.88 percent, which suggests that just 9 out of 100 predictions were incorrect.

E Back Propagation

For training Multi-layer Perceptron's, backpropagation is a supervised learning approach. Using a concept known as the delta rule or gradient descent, the backpropagation algorithm looks for the least value of the error function in weight space. The weights that minimize the error function are therefore regarded as a learning problem solution.

We initialize weights with some random numbers or any variable for that fact when creating a Neural Network. Now, obviously, we are not superhuman. As a result, it isn't necessary that the weight values we choose be correct or that they are the best fit for our model.

We chose some weight values at the start, but our model output differs significantly from our real output, resulting in a large error value. What we need to do is figure out how to get the model to modify the parameters (weights) so that the mistake is as small as possible.

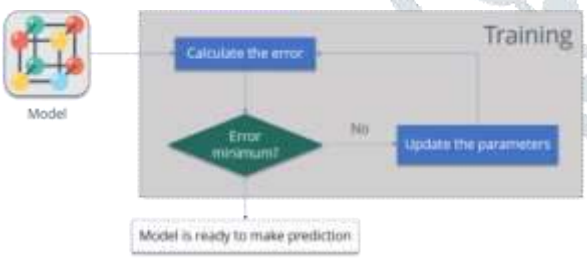

Figure 4: A model for error calculation

6.Results and Discussions

The information gathered is divided into two groups: training and testing. The MLP model's training dataset is used to create the crop suggestion, prediction model. During mode development, the activation function and hidden layers are carefully chosen to deliver the best results. The model is provided test data once it has been developed to calculate the error and accuracy. Gradient descent backpropagation alters the error value by allocating weights to the neurons based on the error value. The model predicts and suggests the crops to be sown with an accuracy of roughly 94.71 percent when the inputs are submitted into the developed model via the user interface.

Figure 5: Home Page

Figure 6: Entering the input data

Figure 7: Predicted crop and quantity of chemical fertilizers is shown.

Figure 8: Quantity of organic fertilizers is shows

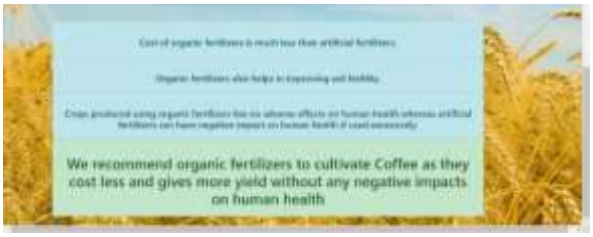

Figure 9: Recommendation of fertilizers

7. Conclusion

Prioritizing the agricultural sector will be crucial in the future. Despite the fact that Deep ANN has been utilized in a number of projects, its performance is still improving. The Deep Neural Network has a good processing capability in general,

and its performance with the small dataset cannot be improved. As a result, when Deep Learning is applied to an ANN, the performance of the ANN is improved by using an additional dataset. Current agricultural methods utilize an excellent forecasting system in an attempt to resolve the issues. The precision crop recommendation model is constructed in such a way that it can address the issues that farmers face. As a result, the crop prediction model efficiently selects the optimal crop for cultivation-independent of seasonal variances. The recommendations provided by the GUI greatly aid farmers in selecting which crop is most suited to their field. The system could be enhanced in the future by incorporating hybrid methods for proposing fertilizers to be applied on a timely basis in order to maximize profit and yield.

This project aims to predict the type of crop to be sown for given climatic conditions using the Back-Propagation classification algorithm.

Dataset collected is preprocessed like label-encoded, feature extraction is done, and missing values were handled for better accuracy.

It also recommends the type of fertilizers to be used for the crop predicted. We promote the usage of organic fertilizers by comparing the cost of fertilizers per acre, for artificial fertilizers and organic fertilizers.

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