A Course Based Project Report on

CROP RECCOMENDATION SYSTEM USING MACHINE LEARNING

Submitted to the

Department of CSE-(CyS, DS) and AI&DS

in partial fulfilment of the requirements for the completion of course

PYTHON PROGRAMMING LABORATORY (22ES2DS101)

BACHELOR OF TECHNOLOGY

IN

CSE-Data Science

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VALLURUPALLI NAGESWARA RAO VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

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CERTIFICATE

This is to certify that the project report entitled "**Crop Recommendation System using machine learning** " is a bonafide work done under our supervision and is being submitted by **Mr. A.Hansikh(23071A6701) , Miss.A.Lohitha Abhijna (23071A6702), Miss.Manvitha.Ch (23071A6714), Mr.J.Mani (23071A6724)** in partial fulfilment for the award of the degree of **Bachelor of Technology** in **CSE-Data Science**, of the VNRVJIET, Hyderabad during the academic year 2024-2025.

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TAMASOMA JYOTIRGAMAYA
Estd. 1995

DECLARATION

We declare that the course based project work entitled "**CROP RECOMMENDATION SYSTEM USING MACHINE LEARNING**" submitted in the Department of **CSE-(CyS, DS) and AI&DS**, Vallurupalli Nageswara Rao Vignana Jyothi Institute of Engineering and Technology, Hyderabad, in partial fulfilment of the requirement for the award of the degree of **Bachelor of Technology in CSE-Data Science** is a bonafide record of our own work carried out under the supervision of **G. Sathar, Assistant Professor, Department of CSE-(CyS, DS) and AI&DS , VNRVJIET.** Also, we declare that the matter embodied in this thesis has not been submitted by us in full or in any part thereof for the award of any degree/diploma of any other institution or university previously.

Place: Hyderabad.

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ABSTRACT

Agriculture is one of the main sectors that guarantee food security and economic stability, especially in agrarian economies. Farmers usually face problems when choosing the right crops to plant on their land due to different soil conditions, climatic factors, and market demand. To address these problems, this project proposes a Crop Recommendation System using Machine Learning to help farmers make the right decisions.

The system analyses the key parameters such as soil properties (pH, nitrogen, phosphorus, and potassium levels), climatic conditions (temperature, rainfall, and humidity), and geographical factors. The system uses machine learning algorithms, including Decision Trees, Random Forest, and Support Vector Machines (SVM), to predict the most suitable crops for a given set of inputs.

The recommended system will focus on agricultural productivity optimization, reducing the risk of crop failure, and promoting sustainable farming. Integration with user-friendly interfaces like mobile or web applications would ensure accessibility to farmers from a wide range of technical levels.

By leveraging data-driven insights, this system allows farmers to enhance yield, profitability, and resource utilization in a step toward achieving broader goals related to agricultural sustainability.

CHAPTER-1

INTRODUCTION

Agriculture is still a backbone for many economies; it is providing sustenance and livelihoods for billions of people across the globe. However, farmers face numerous challenges in maximizing their yields and achieving sustainability, mainly due to factors such as soil degradation, climate variability, and limited access to advanced agricultural insights. For any farmer, one of the most important decisions is that of selecting the right crop for cultivation. This decision demands consideration of numerous factors like soil quality, climatic conditions, and market trends.

The Crop Recommendation System tackles this challenge by making intelligent, data-driven crop suggestions by utilizing Machine Learning. Various parameters such as soil properties, like pH and the levels of nitrogen, phosphorus, and potassium; weather conditions, like rainfall, temperature, and humidity; and other data from a particular location can be used to determine which crop would be suitable to grow in a given location.

Machine learning algorithms find patterns and relationships within data to predict with a proper accuracy. The project also looks at the aspect of user-friendliness and easy availability through mobile applications or online interfaces so that the actual farmer can easily interface and use the system.

The system aims to enhance agricultural productivity and reduce waste in the resources by empowering farmers with precise recommendations. The project therefore aligns with the much larger goals of food security, environmental conservation, and economic growth in the agricultural sector.

CHAPTER-2

METHOD

Development of Crop Recommendation System Involves systematic steps of gathering data, preprocessing it, analyzing data, and then deploying the machine learning-based solution. Here's a methodology below:

1.Problem Definition:

Identify objective: It's about crop recommendation based on soil and climatic parameters.

Define the input features such as pH, nutrients, temperature, rainfall, humidity, and target output as the recommended crop.

2. Data Collection:

Collect agricultural datasets from credible sources, such as:

- Government agricultural agencies.
- Open-source datasets (e.g., Kaggle, FAO databases).
- Remote sensing data (weather conditions, soil analysis reports).

Include parameters such as:

- Soil characteristics: pH, nitrogen (N), phosphorus (P), potassium (K) levels.
- Climatic factors: rainfall, temperature, humidity.
- Location-specific data: latitude, longitude, elevation.

4. Exploratory Data Analysis (EDA)

- Analyze feature correlations (e.g., pH vs. crop type).
- Visualize data trends using heatmaps, scatter plots, or bar graphs.
- Identify patterns or anomalies to refine feature selection

STEP 5: MODEL IMPLEMENTATION

Index.html:

```
<!doctype html>
<html lang="en">
  <head>
    <meta charset="utf-8">
    <meta name="viewport" content="width=device-width, initial-scale=1">
    <title>Bootstrap demo</title>
    <link href="https://cdn.jsdelivr.net/npm/bootstrap@5.3.0-
alpha3/dist/css/bootstrap.min.css" rel="stylesheet" integrity="sha384-
KK94CHFLLe+nY2dmCWGMq91rCGa5gtU4mk92HdvYe+M/SXH301p5ILy+dN9
+nJOZ" crossorigin="anonymous">
  </head>
  <style>
                h1 {
                        color: green;
                        text-align: center;
                }

                .warning {
                        color: red;
                        font-weight: bold;
                        text-align: center;
                }
                .card{
                margin-left:410px;
                margin-top: 20px;
                color: white;
                }
                .container{
                background:#edf2f7;
                font-weight: bold;
                padding-bottom:10px;
                border-radius: 15px;
                }
        </style>



  <body style="background:#BCBBB8">
```

```
 <!--
======================navbar=================================
======================-->
<nav class="navbar navbar-expand-lg navbar-dark bg-dark">
 <div class="container-fluid">
  <a class="navbar-brand" href="/">Crop Recommendation</a>
  <button class="navbar-toggler" type="button" data-bs-toggle="collapse" data-bs-
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 me-auto mb-2 mb-lg-0">
    <li class="nav-item">
     <a class="nav-link active" aria-current="page" href="#">home</a>
    </li>
    <li class="nav-item">
     <a class="nav-link" href="#">Contact</a>
    </li>
    <li class="nav-item">
     <a class="nav-link disabled">About</a>
    </li>
   </ul>
   <form class="d-flex" role="search">
    <input class="form-control me-2" type="search" placeholder="Search" aria-
label="Search">
    <button class="btn btn-outline-success" type="submit">Search</button>
   </form>
  </div>
 </div>
</nav>

<!--
================================================================
================================-->
 <div class="container my-3 mt-3">
   <h1 class="text-success">Crop Recommendation System <span class="text-
success">🌱</span></h1>

<!--    adding form-->
   <form action="/predict" method="POST">
     <div class="row">
       <div class="col-md-4">
```

```
                                    <label for="Nitrogen">Nitrogen</label>
                                    <input type="number" id="Nitrogen"
name="Nitrogen" placeholder="Enter Nitrogen" class="form-control" required
step="0">
                                </div>
                <div class="col-md-4">
                                    <label for="Phosporus">Phosphorus</label>
                                    <input type="number" id="Phosporus"
name="Phosporus" placeholder="Enter Phosphorus" class="form-control" required
step="00">
                                </div>
                                <div class="col-md-4">
                                    <label for="Potassium">Potassium</label>
                                    <input type="number" id="Potassium"
name="Potassium" placeholder="Enter Potassium" class="form-control" required
step="0">
                                </div>
            </div>

            <div class="row mt-4">
                                <div class="col-md-4">
                                    <label for="Temperature">Temperature</label>
                                    <input type="number" id="Temperature"
name="Temperature" placeholder="Enter Temperature in °C" class="form-control"
required step="0">
                                </div>
                                <div class="col-md-4">
                                    <label for="Humidity">Humidity</label>
                                    <input type="number" id="Humidity"
name="Humidity" placeholder="Enter Humidity in %" class="form-control" required
step="0">
                                </div>
                                <div class="col-md-4">
                                    <label for="pH">pH</label>
                                    <input type="number" id="Ph" name="Ph"
placeholder="Enter pH value" class="form-control" required step="0">
                                </div>
                            </div>

            <div class="row mt-4">
                                <div class="col-md-4">
                                    <label for="Rainfall">Rainfall</label>
```

```
                                        <input type="number" step="0.01"
id="Rainfall" name="Rainfall" placeholder="Enter Rainfall in mm" class="form-
control" required>
                                    </div>
                                </div>



        <div class="row mt-4">

        <div class="col-md-12 text-center">
                                    <button type="submit" class="btn btn-primary btn-
lg">Get Recommendation</button>
                                </div>
                                </div>
    </form>



     {% if result %}
                <div class="card bg-dark" style="width: 18rem;">
                  <img src="{{url_for('static', filename='img.jpg')}}" class="card-img-
top" alt="...">
                  <div class="card-body">
                        <h5 class="card-title">Recommend Crop for cultivation
is:</h5>
                        <p class="card-text">{{ result }}</p>
                  </div>
                </div>
            {% endif %}
  </div>

   <script src="https://cdn.jsdelivr.net/npm/bootstrap@5.3.0-
alpha3/dist/js/bootstrap.bundle.min.js" integrity="sha384-
ENjdO4Dr2bkBIFxQpeoTz1HIcje39Wm4jDKdf19U8gI4ddQ3GYNS7NTKfAdVQS
Ze" crossorigin="anonymous"></script>
  </body>
</html>
```

PYTHON.IPYNB:

```
from flask import Flask,request,render_template
import numpy as np
```

```
import pandas
import sklearn
import pickle

# importing model
model = pickle.load(open('model.pkl','rb'))
sc = pickle.load(open('standscaler.pkl','rb'))
ms = pickle.load(open('minmaxscaler.pkl','rb'))

# creating flask app
app: object = Flask(_name_)

@app.route('/')
def index():
    return render_template("index.html")

@app.route("/predict",methods=['POST'])
def predict():
    N = request.form['Nitrogen']
    P = request.form['Phosporus']
    K = request.form['Potassium']
    temp = request.form['Temperature']
    humidity = request.form['Humidity']
    ph = request.form['Ph']
    rainfall = request.form['Rainfall']

    feature_list = [N, P, K, temp, humidity, ph, rainfall]
    single_pred = np.array(feature_list).reshape(1, -1)

    scaled_features = ms.transform(single_pred)
    final_features = sc.transform(scaled_features)
    prediction = model.predict(final_features)

    crop_dict = {1: "Rice", 2: "Maize", 3: "Jute", 4: "Cotton", 5: "Coconut", 6:
"Papaya", 7: "Orange",
                 8: "Apple", 9: "Muskmelon", 10: "Watermelon", 11: "Grapes", 12:
"Mango", 13: "Banana",
                 14: "Pomegranate", 15: "Lentil", 16: "Blackgram", 17: "Mungbean", 18:
"Mothbeans",
                 19: "Pigeonpeas", 20: "Kidneybeans", 21: "Chickpea", 22: "Coffee"}

    if prediction[0] in crop_dict:
        crop = crop_dict[prediction[0]]
        result = "{} is the best crop to be cultivated right there".format(crop)
```

```
    else:
        result = "Sorry, we could not determine the best crop to be cultivated with the
provided data."
    return render_template('index.html',result = result)

# python main
if _name_ == "_main_":
    app.run(debug=True)
```

Step 6: Deploy the Model

1.API Creation: Using Flask

2.Test the API: Use tools like Postman, cURL, or a simple Python script to test the /predict endpoint.

INTEGRATION

You can integrate the API with:

Web App: Use a front-end framework like Flask-based index.html.

STEP 7: MONITOR AND IMPROVE

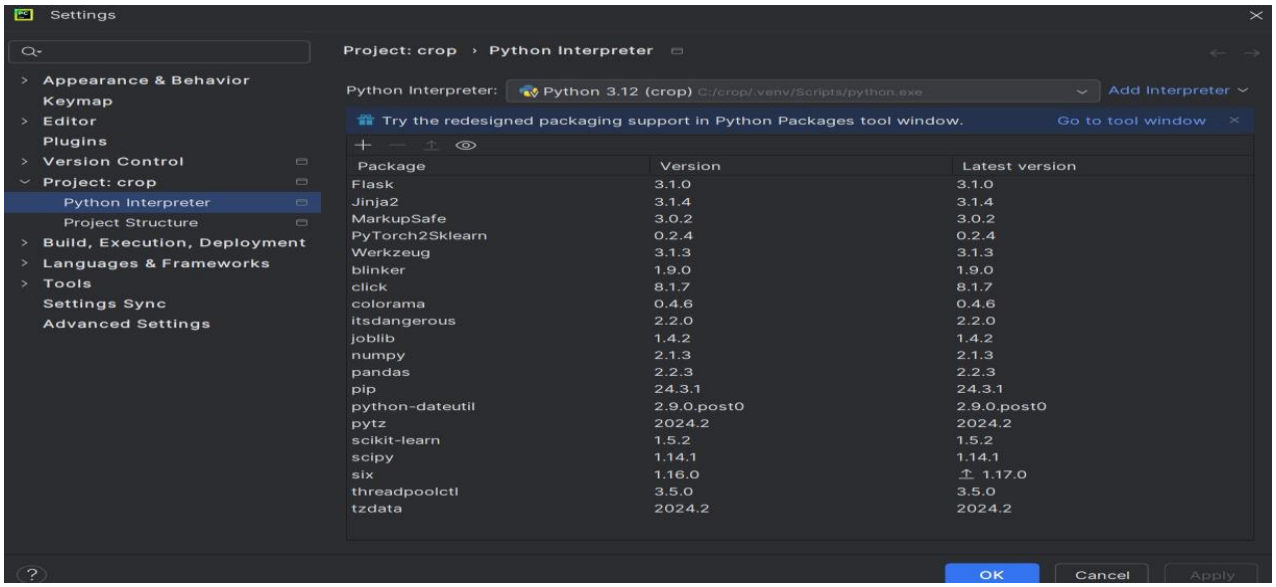
1. Collect Feedback

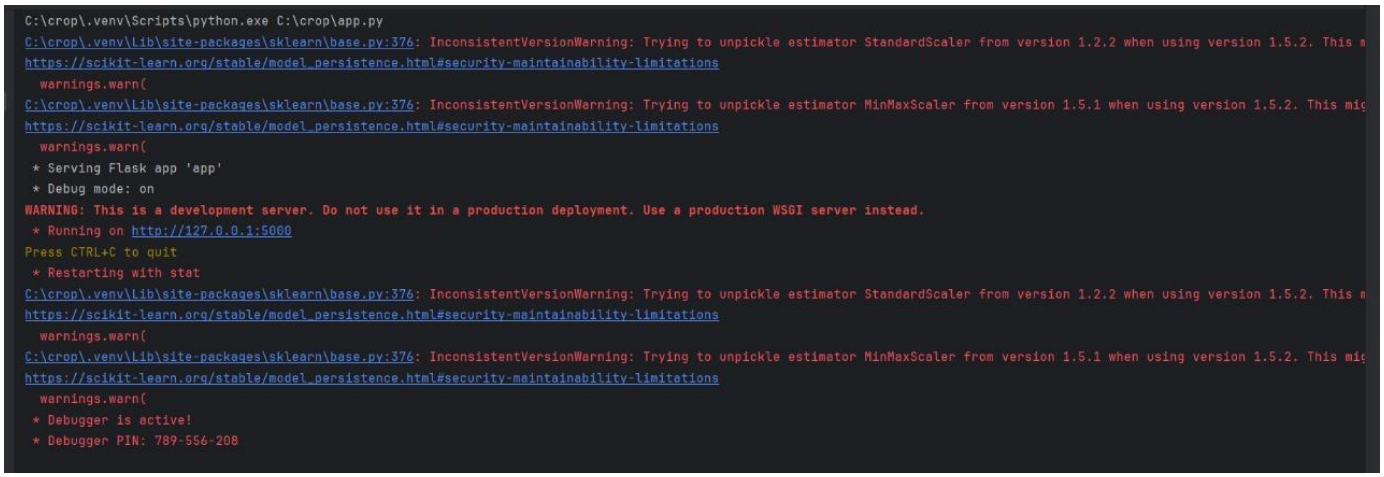
User Feedback:

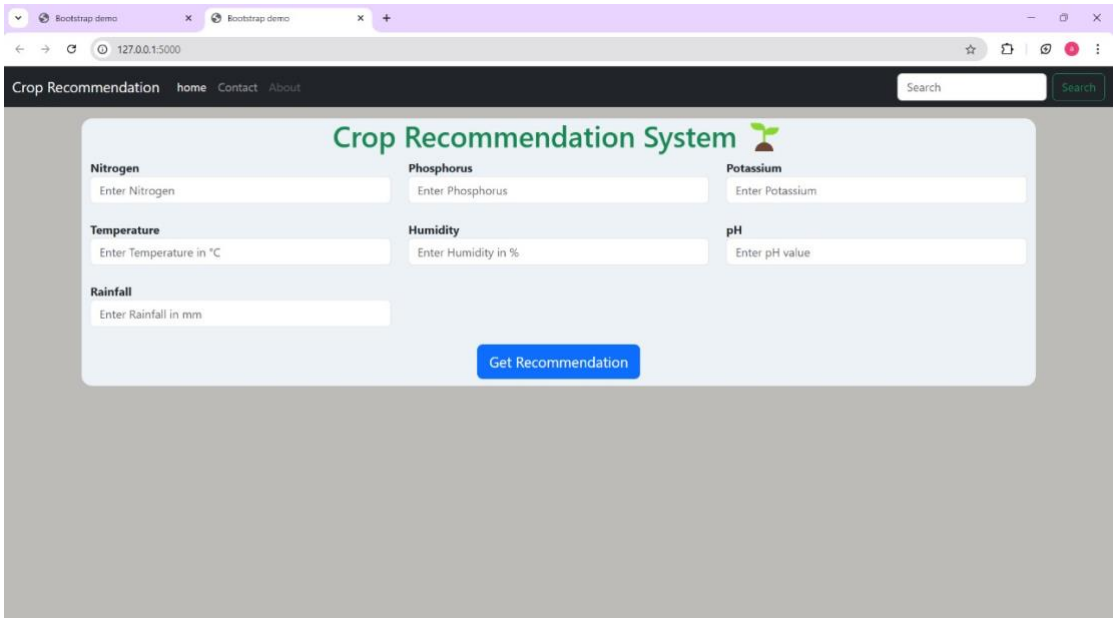
Add a feedback mechanism (e.g., a simple form) where users rate the accuracy of predictions.

CHAPTER-3

TEST CASES/ OUTPUT





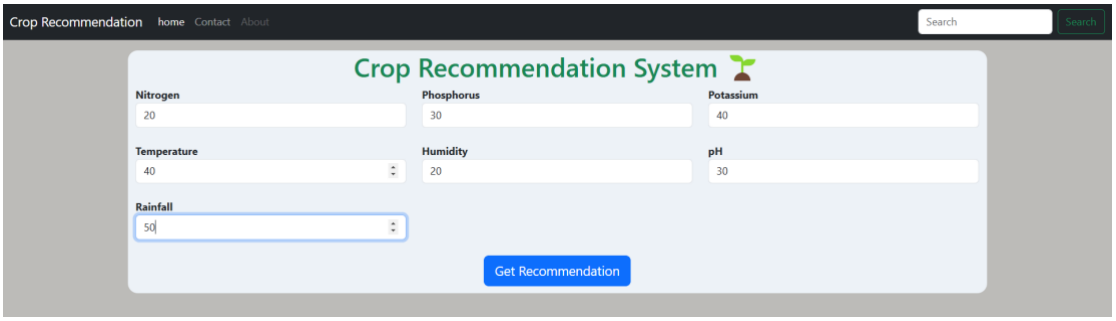


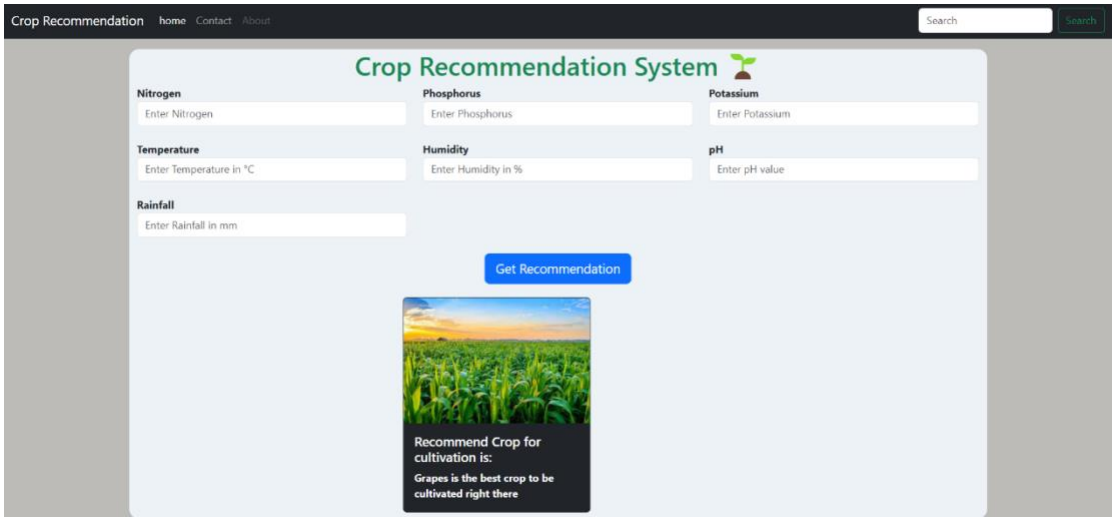
FROM JUPYTER

```
N=20
P=30
K=40
temperature=40.0
humidity=20
ph=30
rainfall=50

predict=recommendation(N,P,K,temperature,humidity,ph,rainfall)
crop_dict = {1: "Rice", 2: "Maize", 3: "Jute", 4: "Cotton", 5: "Coconut", 6: "Papaya", 7: "Orange",
                8: "Apple", 9: "Muskmelon", 10: "Watermelon", 11: "Grapes", 12: "Mango", 13: "Banana",
                14: "Pomegranate", 15: "Lentil", 16: "Blackgram", 17: "Mungbean", 18: "Mothbeans",
                19: "Pigeonpeas", 20: "Kidneybeans", 21: "Chickpea", 22: "Coffee"}

if predict in crop_dict:
    crop = crop_dict[predict]
    print("{} is a best crop to be cultivated ".format(crop))
else:
    print("Sorry are not able to recommend a proper crop for this environment")
```

```
Apple is a best crop to be cultivated
```

FROM WEB-APPLICATION

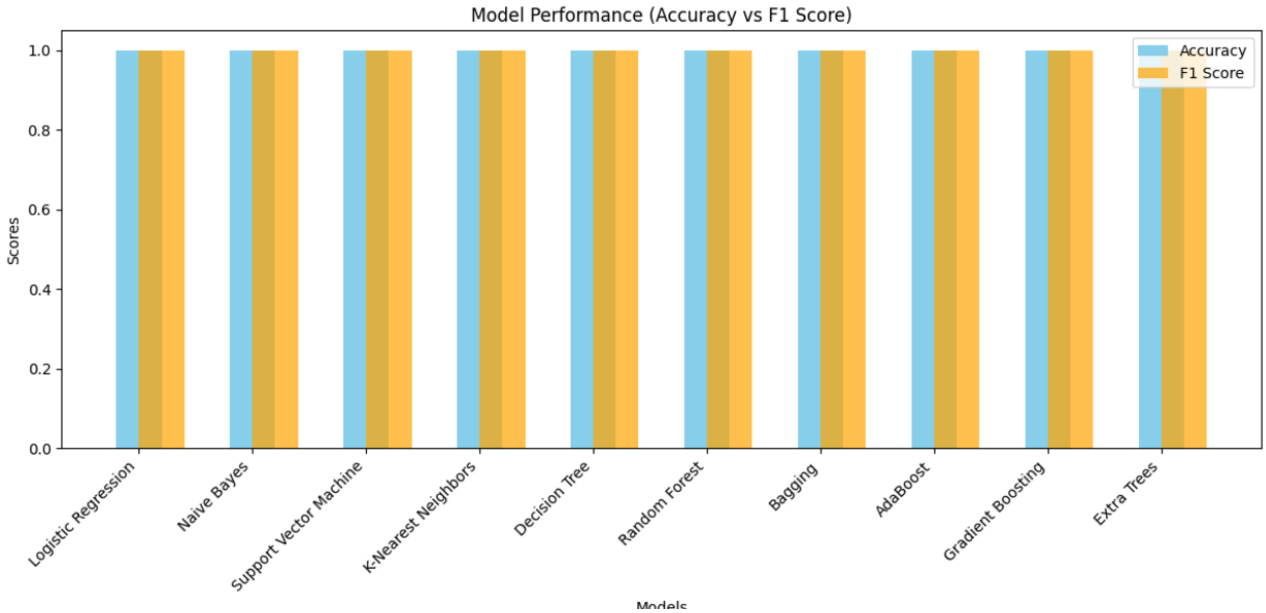



Crop Recommendation
home
Contact
About
Search
Search
Crop Recommendation System
Nitrogen
Enter Nitrogen
Phosphorus
Enter Phosphorus
Potassium
Enter Potassium
Temperature
Enter Temperature in °C
Humidity
Enter Humidity in %
pH
Enter pH value
Rainfall
Enter Rainfall in mm
Get Recommendation
Recommend Crop for cultivation is:
Grapes is the best crop to be cultivated right there

CHAPTER-4

RESULTS

```
Metrics for the Model:
   Training Time  Prediction Time  Accuracy : Test  Accuracy : Train  \
0       0.002228         0.001013              1.0             0.975

   F1 Score : Test  F1 Score : Train  Precision : Test  Precision : Train  \
0              1.0          0.975004               1.0           0.975208

   Recall : Test  Recall : Train
0            1.0           0.975

Min and Max Values for the Metrics:
     Training Time  Prediction Time  Accuracy : Test  Accuracy : Train  \
min       0.002228         0.001013              1.0             0.975
max       0.002228         0.001013              1.0             0.975

     F1 Score : Test  F1 Score : Train  Precision : Test  Precision : Train  \
min              1.0          0.975004               1.0           0.975208
max              1.0          0.975004               1.0           0.975208

     Recall : Test  Recall : Train
min            1.0           0.975
max            1.0           0.975
```



	Model	Accuracy	F1 Score
0	Logistic Regression	1.0	1.0
1	Naive Bayes	1.0	1.0
2	Support Vector Machine	1.0	1.0
3	K-Nearest Neighbors	1.0	1.0
4	Decision Tree	1.0	1.0
5	Random Forest	1.0	1.0
6	Bagging	1.0	1.0
7	AdaBoost	1.0	1.0
8	Gradient Boosting	1.0	1.0
9	Extra Trees	1.0	1.0

```
Accuracy: 1.0
F1 Score: 1.0
Precision: 1.0
Recall: 1.0
```

CHAPTER-5

SUMMARY, CONCLUSION, RECOMMENDATION

SUMMARY:

The Crop Recommendation System uses Machine Learning to suggest crops suitable for a given set of soil properties, weather, and location data. It empowers farmers to make informed decisions, thus improving productivity and sustainability. Bridging the gap between technology and agriculture is done through user-friendly platforms like web or mobile apps.

CONCLUSION:

This system shows potential in agriculture through machine learning with regard to crop selection and resource utilization. It becomes successful by having quality inputs and data updates, providing sustainable solutions towards yield improvement and food security.

RECOMMENDATIONS:

Data Gathering:

Seek collaboration with organizations in order to have better data sets. Integrate IoT sensors.

Expanding Features:

Add the modules of market-based profitability and the module of prediction of pest.

Accessibility:

The system supports multiple languages, and there is offline capability.

Education:

Train farmers on how to use the system and its benefits.

Continuous Updates:

Update the model continuously to maintain accuracy.

This approach ensures a scalable and impactful solution for modern agriculture.

REFERENCES

[1]. https://www.fao.org/home/en/

[2]. https://www.kaggle.com/

[3]. https://scikit-learn.org/stable/