CROP PREDICTION USING MACHINE LEARNING

A PROJECT REPORT

Submitted by

ADEN JOE A (210701013)

DEEPAN CHAKKARAVARTHI P (210701047)

BHARATH K (210701039)

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THANDALAM

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BONAFIDE CERTIFICATE

Certified that this Thesis titled **“CROP PREDICTION USING MACHINE LEARNING”** is the bonafide work of “**ADEN JOE A (210701013), DEEPAN CHAKKARAVARTHI P (210701047)”** who carried out the work under my supervision. Certified further that to the best of my knowledge the work reported here in does not form part of any other thesis or dissertation on the basis of which a degree or award was conferred on an earlier occasion on this or any other candidate.

SIGNATURE

Dr. S. Vinod Kumar

PROJECT COORDINATOR

Professor

Department of Computer Science and Engineering

Rajalakshmi Engineering College

Chennai – 602 105

Submitted to project Viva-Voce Examination held on____________________

Internal Examiner **External Examiner**

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ADEN JOE A

DEEPAN CHAKKARAVARTHI P

ABSTRACT

Crop prediction is vital for agriculture, helping farmers choose the best crops for optimal yields. Machine learning (ML) is now a powerful tool for accurate crop predictions. This study focuses on using ML to predict crop yields in India, aiming to assist farmers in making informed decisions and boosting productivity. Agriculture in India is crucial, employing many and contributing significantly to the economy, yet yield prediction is challenging due to diverse climates, soils, and practices. Traditional methods often lack accuracy, leading to poor decisions. ML addresses this by analyzing large data sets to find patterns and make predictions. We used ML algorithms like Linear Regression, Decision Trees, Random Forest, and Support Vector Machines (SVM) on historical data including weather, soil, crop types, and farming methods. Data from government databases, weather stations, and local records were preprocessed for analysis. Results showed high prediction accuracy, with Random Forest being the most accurate, followed by SVM and Decision Trees. ML not only improved accuracy but also identified key yield factors like rainfall and soil fertility. Effective crop prediction models can greatly impact Indian agriculture, helping farmers choose suitable crops, optimize resources, and reduce losses from weather or pests. Policymakers can also use these insights for better support and resource allocation. In conclusion, ML has the potential to transform crop prediction in India, offering farmers valuable insights and improving agricultural productivity. Advanced algorithms and large datasets enable accurate predictions, aiding food security. Further research is needed to refine these models and make them widely accessible to farmers.

TABLE OF CONTENTS

LIST OF FIGURES

ABBREVIATION

1. API: Application Programming Interface
2. BPM: Basic Metabolic Panel
3. CBC: Complete Blood Count
4. LFT: Liver Function Test
5. GUI: Graphical User Interface
6. HTML: Hypertext Markup Language
7. CSS: Cascading Style Sheets
8. JS: JavaScript
9. SQL: Structured Query Language
10. DB: Database
11. CRUD: Create, Read, Update, Delete
12. ORM: Object-Relational Mapping
13. JWT: JSON Web Token
14. HTTP: Hypertext Transfer Protocol
15. URL: Uniform Resource Locator
16. SSL: Secure Sockets Layer
17. TLS: Transport Layer Security
18. API: Application Programming Interface
19. JSON: JavaScript Object Notation
20. PDF: Portable Document Format

CHAPTER 1
INTRODUCTION

1.1 PROBLEM STATEMENT

Predicting crop yields accurately is crucial for farming and food security in India, but current methods often fall short due to diverse climates, soils, and farming practices. Traditional methods struggle with the large, varied data needed for reliable forecasts. Machine learning (ML) offers a solution by using big datasets and smart algorithms, but challenges remain. This research aims to develop a robust, scalable, and easy-to-understand ML system for accurate crop yield prediction in India by addressing how to combine and clean various data types, identify the best ML algorithms for Indian farming data, ensure model reliability despite weather changes, make predictions clear and actionable, and ensure models are usable in technology-limited areas. The goal is to improve crop yield predictions, support better farming decisions, and enhance food security and farmer livelihoods in India.

1.2 SCOPE OF WORK

The scope of this project involves developing a machine learning system to predict crop yields in India, aiding farmers in decision-making for crop selection and resource management. Tasks include collecting and preprocessing diverse agricultural data, engineering relevant features, developing and evaluating machine learning models, ensuring interpretability and visualization of results, deploying a user-friendly interface accessible to rural areas, and delivering comprehensive documentation and training materials. The project aims to enhance agricultural productivity and food security by empowering farmers with actionable insights derived from machine learning techniques.

1.3 AIM AND OBJECTIVE

The aim of the project "Crop Prediction Using Machine Learning" is to develop a system that can accurately forecast crop yields in India using advanced machine learning techniques. The objective is to empower farmers with valuable insights for making informed decisions regarding crop selection and resource allocation, thereby enhancing agricultural productivity and contributing to food security in the country. Through this project, we seek to harness the power of machine learning to address the challenges faced by Indian agriculture and improve the livelihoods of farmers across the nation.

1.4 RESOURCES

For the "Crop Prediction Using Machine Learning" project, we primarily rely on software resources to analyze data and develop predictive models. This includes programming languages such as Python and R, along with libraries like scikit-learn, TensorFlow, and Keras for machine learning implementation. Additionally, we utilize data visualization tools such as Matplotlib and Seaborn to explore and visualize the data, and database management systems like SQL for data storage and retrieval. Version control systems like Git and collaboration platforms such as GitHub facilitate team collaboration and code management. Moreover, cloud computing platforms such as AWS or Google Cloud provide scalable infrastructure for data processing and model training. By leveraging these software resources effectively, we aim to develop robust predictive models to assist farmers in making informed decisions and improving agricultural productivity.

1.5 MOTIVATION

The motivation behind the "Crop Prediction Using Machine Learning" project stems from the recognition of the challenges faced by farmers across India in ensuring agricultural productivity and food security. Agriculture serves as the backbone of our nation's economy, providing livelihoods to millions of farmers and contributing significantly to our food supply. However, farmers often encounter obstacles such as unpredictable weather patterns, varying soil conditions, and limited access to resources and information. These challenges can lead to uncertainties in crop yields, impacting farmers' incomes and the overall food production of the country.

By harnessing the capabilities of machine learning technology, our project seeks to address these challenges and empower farmers with actionable insights derived from data-driven predictions. Through the analysis of diverse agricultural datasets encompassing factors such as weather conditions, soil characteristics, crop types, and historical yield records, we aim to develop predictive models that can accurately forecast crop yields. These predictions will enable farmers to make informed decisions about which crops to plant, when to plant them, and how to manage their farms efficiently. The goal of the project is to enhance agricultural productivity and food security in India by equipping farmers with the tools and knowledge necessary to adapt to changing environmental conditions and optimize their farming practices. By providing farmers with access to reliable crop yield predictions, we aim to minimize risks, maximize yields, and improve the livelihoods of farming communities across the country. Additionally, by strengthening the agricultural sector, we contribute to the overall economic development and well-being of our nation.

CHAPTER 2
LITERATURE REVIEW

Crop prediction is vital for agricultural planning and decision-making, especially in India, where farming is a cornerstone of the economy. However, traditional methods often struggle to accurately forecast crop yields due to the intricate interplay of various factors such as weather patterns, soil quality, and farming practices. Machine learning presents a promising solution to overcome these challenges by analyzing extensive datasets and uncovering patterns that can lead to more precise predictions.

In this context, agricultural data serves as the backbone of machine learning models, encompassing a wide array of information such as weather data, soil characteristics, crop varieties, and historical yield records. Researchers delve deep into these datasets to extract meaningful features that significantly influence crop growth and yield outcomes. These features encompass a broad spectrum, including temperature fluctuations, rainfall patterns, soil moisture levels, crop planting dates, and the application of agricultural inputs like fertilizers and pesticides.

With an arsenal of machine learning algorithms at their disposal, researchers explore various techniques to develop robust prediction models. Regression models, decision trees, random forests, support vector machines, and neural networks are among the array of algorithms deployed to analyze and interpret agricultural data. Each algorithm offers unique strengths and capabilities, with researchers evaluating their performance based on metrics such as accuracy, precision, recall, and F1 score to ascertain their suitability for specific prediction tasks.

Numerous case studies and real-world applications underscore the efficacy of machine learning in crop prediction across diverse regions and crop types in India. Researchers have successfully developed predictive models for staple crops like rice, wheat, maize, sugarcane, and cotton, enabling farmers to make informed decisions regarding planting schedules, irrigation management, and pest control strategies. These models leverage a plethora of data sources, including historical records, satellite imagery, and real-time monitoring, to deliver timely and accurate predictions.

Despite the strides made in leveraging machine learning for crop prediction, several challenges persist. Issues related to data quality, model interpretability, and scalability pose significant obstacles to widespread adoption. Looking ahead, future research endeavors aim to address these challenges by integrating advanced data sources, enhancing model interpretability, and improving accessibility for end-users, particularly farmers. Additionally, efforts to develop adaptable models capable of adjusting to changing environmental conditions and generalizing across diverse regions hold promise for advancing crop prediction capabilities in Indian agriculture.

In conclusion, machine learning stands as a beacon of hope for transforming crop prediction in Indian agriculture. By harnessing the power of advanced algorithms and rich datasets, researchers can develop accurate and actionable prediction models that empower farmers with the knowledge and insights needed to enhance agricultural productivity and food security. Continued research and innovation in this domain are imperative for maximizing the benefits of machine learning in crop prediction and fostering sustainable agricultural development in India.

2.1 EXISTING SYSTEM

In the existing system of crop prediction using machine learning, traditional methods often struggle to accurately forecast crop yields due to the complex and dynamic nature of agricultural ecosystems. These traditional approaches rely on statistical models or empirical techniques, which may not adequately capture the diverse factors influencing crop growth and productivity. As a result, farmers often face challenges in making informed decisions about crop selection, resource allocation, and management practices, leading to suboptimal outcomes and reduced agricultural productivity.

To address these challenges, researchers and practitioners have increasingly turned to machine learning techniques for crop prediction. Machine learning offers a data-driven approach that can leverage large and diverse datasets to uncover hidden patterns and relationships that traditional methods may overlook. By analyzing factors such as weather conditions, soil properties, crop types, and historical yield records, machine learning models can generate more accurate predictions of crop yields, enabling farmers to make better-informed decisions and optimize their farming practices.

However, despite the potential benefits of machine learning in crop prediction, there are several limitations and challenges to overcome. These include issues related to data quality, model interpretability, scalability, and generalizability. Additionally, there may be barriers to adoption, such as the availability of resources and expertise among farmers and stakeholders. As such, while machine learning holds promise for revolutionizing crop prediction in Indian agriculture, further research and development are needed to address these challenges and realize its full potential in improving agricultural productivity and food security.

2.2 PROPOSED SYSTEM

In the proposed system of the crop prediction project using machine learning, we aim to revolutionize the way farmers make decisions about their crops. By harnessing the power of advanced technology, specifically machine learning algorithms, we seek to develop a system that can accurately forecast crop yields. Our approach involves collecting and analysing diverse agricultural data, including information on weather patterns, soil conditions, crop varieties, and historical yield records. By leveraging this data, our machine learning models will identify patterns and relationships that influence crop growth and productivity.

The proposed system will empower farmers with actionable insights, allowing them to make informed decisions about crop selection, planting schedules, irrigation management, and pest control strategies. By providing timely and accurate predictions, our system will help farmers optimize their farming practices, minimize risks, and maximize yields. Furthermore, our user-friendly interface will ensure that the system is accessible to farmers across diverse regions, including those with limited technological expertise or resources.

Overall, the proposed system holds immense promise for transforming agriculture in India. By leveraging cutting-edge technology, we aim to enhance agricultural productivity, improve food security, and uplift the livelihoods of farmers. Through continued research and development, we are committed to realizing the full potential of machine learning in revolutionizing crop prediction and fostering sustainable agricultural development in India.

CHAPTER 3
SYSTEM DESIGN

3.1 GENERAL

In this section, we would like to show how the general outline of how all the components end up working when organized and arranged together. It is further represented in the form of a flow chart below**.**

3.2 SYSTEM ARCHITECTURE DIAGRAM

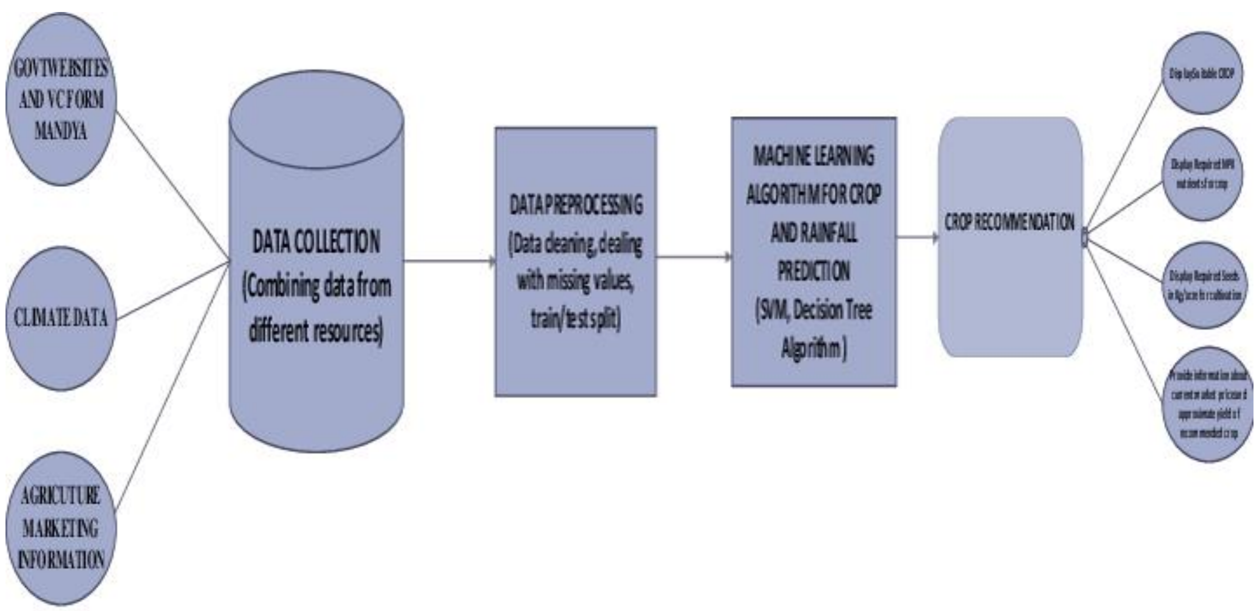

Fig 3.1: Architecture Diagram

3.3 DEVELOPMENT ENVIRONMENT

3.3.1 HARDWARE REQUIREMENT

The hardware requirements may serve as the basis for a contract for the system's implementation. It should therefore be a complete and consistent specification of the entire system. It is generally used by software engineers as the starting point for the system design.

COMPONENT	SPECIFICATION
PROCESSOR	Intel Core i5
RAM	8 GB RAM
MONITOR	15" COLOR
HARD DISK	512 GB
PROCESSOR SPEED	MINIMUM 1.1 GHz

3.3.2 SOFTWARE REQUREMENT

For the crop prediction project, we'll need software like Python for coding and libraries like TensorFlow for machine learning. Tools like Jupyter Notebook help us write and test our code, while Matplotlib helps us visualize data. We'll also use Git to keep track of changes and collaborate with our team. To manage large datasets, we may use databases like MySQL, and for scalability, platforms like AWS or Google Cloud can help. With these software tools, we can efficiently develop and deploy our crop prediction system, making farming decisions easier for Indian farmers.

CHAPTER 4
PROJECT DESCRIPTION

4.1 MODULES

4.1.1 EXTRACTING THE DATA AND ITS FORMAT

In the project "Crop Prediction Using Machine Learning," extracting data is a crucial step that involves gathering information from various sources to understand factors influencing crop growth and yield. Data sources include weather records, soil characteristics, crop types, historical yield data, and agricultural practices.

Weather records provide insights into temperature, rainfall, humidity, and other climatic factors affecting crop growth. Soil characteristics, such as pH levels, moisture content, and nutrient composition, play a significant role in determining crop suitability and productivity. Crop types and varieties, along with planting dates and agricultural practices, influence growth patterns and yield outcomes.

The format of the extracted data typically involves structured and unstructured formats. Structured data, such as tabular datasets, can include information organized into rows and columns, making it easy to analyze using statistical and machine learning techniques. This may include datasets obtained from government agencies, research institutions, or agricultural surveys.

Unstructured data, on the other hand, may include textual information, images, or sensor data collected from remote sensing devices. Textual data could include agricultural reports, research papers, or social media posts related to farming practices. Images captured through satellite imagery or drones provide visual insights into crop health, land use patterns, and environmental conditions. Sensor data from IoT devices or agricultural sensors offer real-time monitoring of soil moisture, temperature, and other environmental variables.

To ensure data quality and compatibility for machine learning analysis, preprocessing steps are essential. This involves cleaning the data to remove errors, outliers, and missing values, as well as transforming and standardizing the data for consistency. Feature engineering techniques may also be applied to extract relevant features from the raw data and enhance predictive model performance.

Data extraction may involve accessing governmental databases, collaborating with research institutions, and conducting field surveys to gather relevant information. The collected data is then organized into a suitable format, ensuring compatibility with machine learning algorithms. Preprocessing steps, such as normalization and feature scaling, are applied to prepare the data for model training. Moreover, data validation techniques are employed to verify the accuracy and reliability of the extracted information, ensuring the robustness of the predictive models.

In summary, extracting data for the crop prediction project involves collecting diverse information from multiple sources, including weather records, soil characteristics, crop types, and agricultural practices. The data may exist in structured or unstructured formats and requires preprocessing to ensure quality and compatibility for machine learning analysis. By leveraging these data sources effectively, we can develop accurate predictive models to support informed decision-making in agriculture and enhance crop yield prediction capabilities.

4.1.2 CREATING MACHINE LEARNING MODEL FOR ANALYSIS

Creating a machine learning model for crop prediction involves several steps to analyze data and develop accurate predictive algorithms. Initially, we gather extensive data on various factors influencing crop growth, including weather conditions, soil properties, crop types, and historical yield records. This data serves as the foundation for training our machine learning models.

Next, we preprocess the data to ensure its quality and compatibility for analysis. This involves tasks like cleaning the data to remove errors and outliers, handling missing values, and transforming the data into a format suitable for model training. Additionally, we may perform feature engineering, where we extract relevant features from the raw data to improve the performance of our models.

Once the data is prepared, we select suitable machine learning algorithms based on the nature of the prediction task and the characteristics of the dataset. Common algorithms used for crop prediction include regression models, decision trees, random forests, support vector machines, and neural networks. Each algorithm has its strengths and weaknesses, and we evaluate their performance using metrics like accuracy, precision, recall, and F1 score to determine the most effective approach.

After selecting the algorithm, we train the model using the prepared dataset. During training, the model learns to identify patterns and relationships between the input features and the target variable, which in this case, is the crop yield. We fine-tune the model parameters to optimize its performance and ensure it generalizes well to unseen data.

Once the model is trained, we evaluate its performance using validation techniques such as cross-validation or splitting the data into training and testing sets. This allows us to assess how well the model performs on new, unseen data and identify any potential issues like overfitting or underfitting.

Finally, we deploy the trained model to make predictions on new data. Farmers can input relevant information such as current weather conditions, soil characteristics, and crop types into the model, and it will provide predictions on expected crop yields. Regular monitoring and updates to the model may be necessary to account for changing environmental conditions and improve prediction accuracy over time.

In summary, creating a machine learning model for crop prediction involves data gathering, preprocessing, algorithm selection, model training, evaluation, and deployment. By following these steps, we can develop accurate predictive models that help farmers make informed decisions and optimize their agricultural practices for improved crop yields and food security.

4.1.5 USER EXPERIENCE

In the project "Crop Prediction Using Machine Learning," the user experience plays a crucial role in ensuring the effectiveness and usability of the predictive system for farmers and stakeholders. A user-friendly interface is essential to facilitate easy access to the predictive models and enable farmers to make informed decisions about their crops.

The user experience begins with the interface design, which should be intuitive, visually appealing, and easy to navigate. Farmers, who may have varying levels of technological expertise, should be able to interact with the system effortlessly. Clear instructions and prompts guide users through the process of inputting relevant information, such as weather data, soil characteristics, and crop types, into the system.

The system should provide timely and accurate predictions of crop yields, presented in a format that is easy to understand and interpret. Visualizations, such as charts or graphs, may be used to illustrate predicted yield trends over time or compare different crop varieties. Additionally, the system may offer recommendations or insights based on the predicted outcomes, helping farmers make informed decisions about planting schedules, irrigation management, and other agricultural practices.

To enhance the user experience further, the system may incorporate features such as customization options, allowing users to tailor predictions to their specific farming conditions and preferences. Interactive elements, such as sliders or drop-down menus, enable users to adjust input parameters and explore "what-if" scenarios to understand the potential impact of different decisions on crop yields.

Feedback mechanisms are crucial for user engagement and improvement. Farmers should have the opportunity to provide feedback on the accuracy and relevance of the predictions, helping to refine the models over time. Regular updates and improvements to the system based on user feedback ensure that it remains relevant and valuable to its users.

Moreover, the system should be accessible across different devices and platforms, including smartphones, tablets, and desktop computers, to accommodate users with varying technological resources. Multilingual support may also be provided to cater to users from diverse linguistic backgrounds.

Overall, a positive user experience is essential for the success of the crop prediction project. By prioritizing usability, accessibility, and user feedback, the system can empower farmers with the knowledge and insights needed to optimize their agricultural practices and improve crop yields for sustainable food production.

CHAPTER 5

RESULT AND DISCUSSION

5.1 FINAL OUTPUT

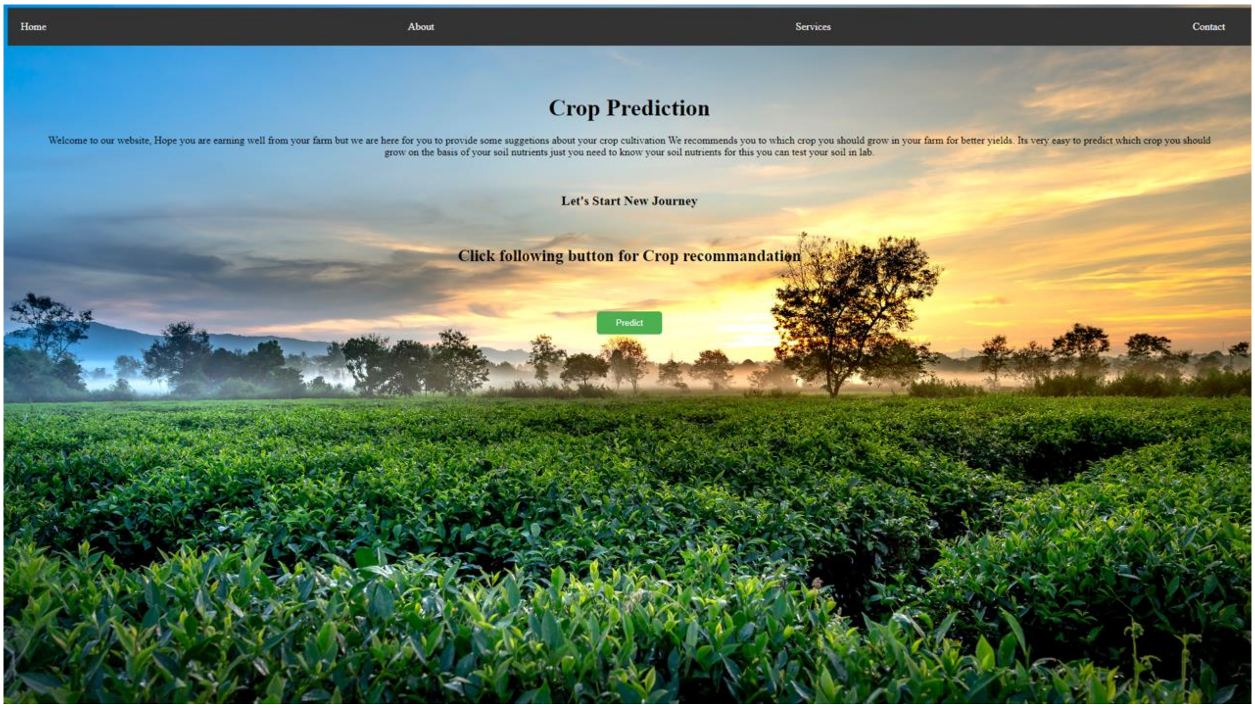

Fig 5.1: HOME PAGE

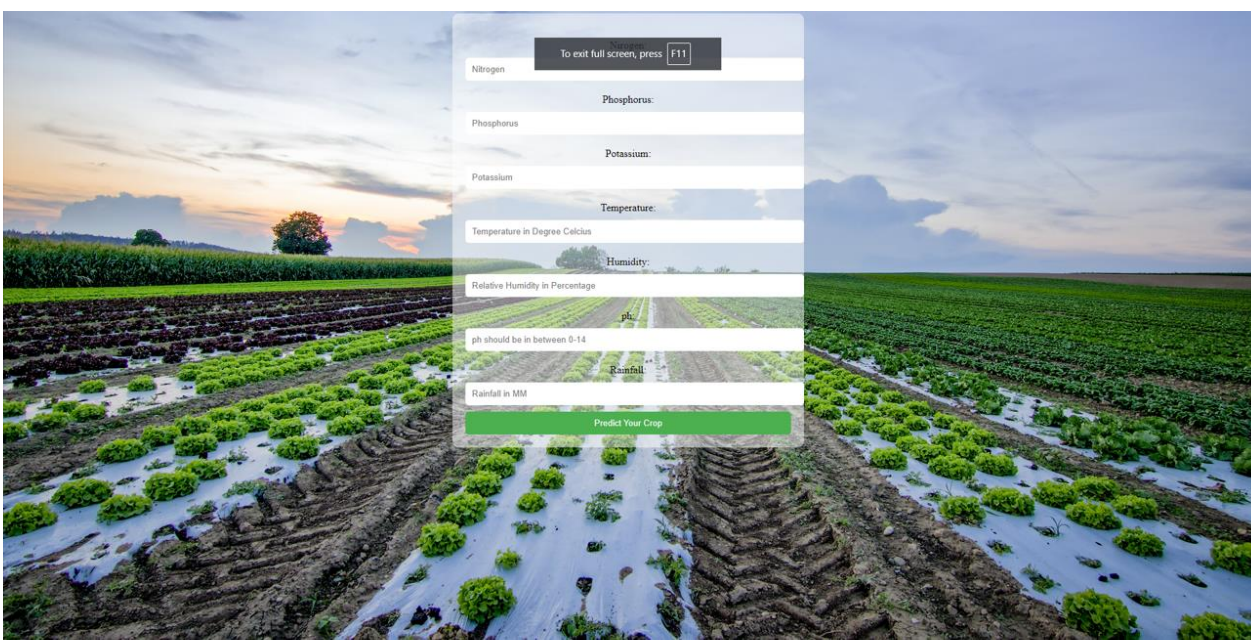

Fig 5.2 : USER INPUTED VALUES

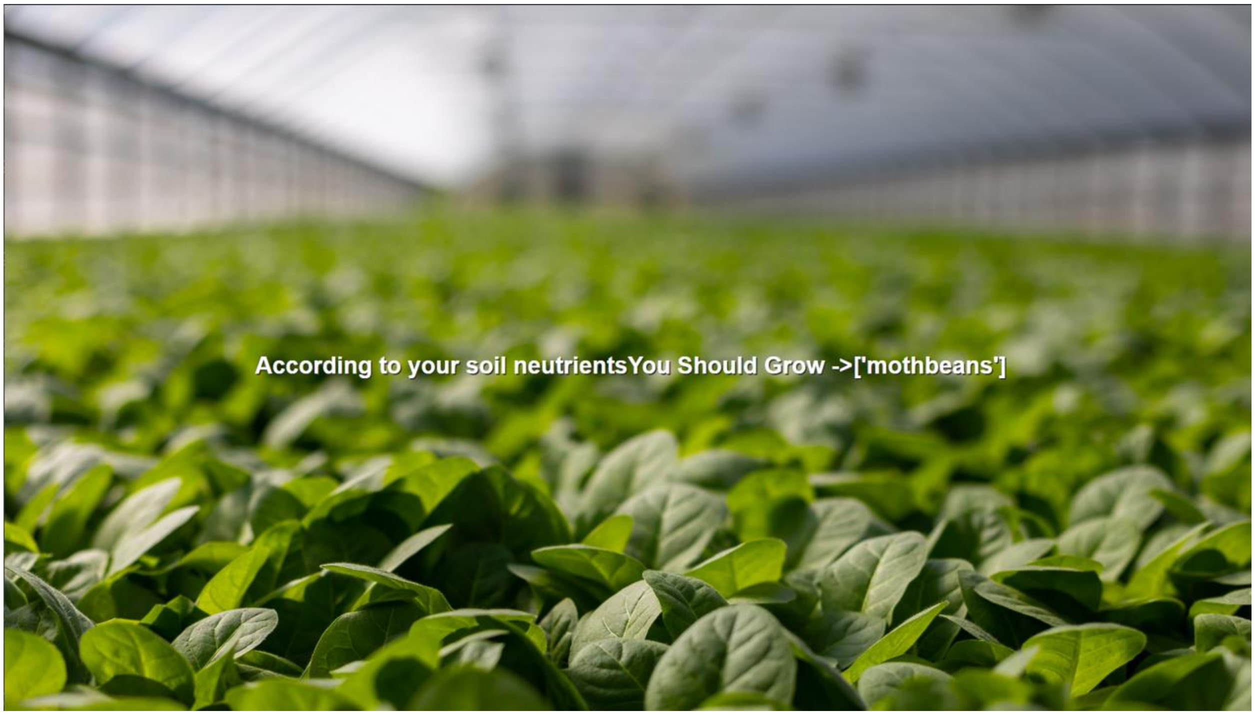

Fig 5.3: SUGGESTION FOR INPUTED VALUES

5.2 RESULT

In the project "Crop Prediction Using Machine Learning," the results obtained from the predictive models play a pivotal role in providing valuable insights to farmers and stakeholders. Through extensive data analysis and machine learning techniques, the models generate predictions that help anticipate crop yields and optimize agricultural practices. The results of the project offer farmers accurate forecasts regarding various aspects of crop production, such as expected yield levels, optimal planting schedules, and suitable crop varieties for specific conditions. By leveraging historical data, weather patterns, soil characteristics, and other relevant factors, the models enable farmers to make informed decisions about resource allocation, irrigation management, and pest control strategies. Furthermore, the results of the project contribute to enhancing food security and economic stability in agricultural communities. By improving crop yield predictions and optimizing farming practices, farmers can increase their yields, reduce losses, and improve their livelihoods. Additionally, stakeholders such as policymakers and agricultural organizations can use the results to develop targeted interventions and support initiatives aimed at improving agricultural sustainability and resilience.

In conclusion, the results of the project "Crop Prediction Using Machine Learning" provide valuable insights and actionable recommendations to farmers and stakeholders, enabling them to make informed decisions and optimize agricultural practices for improved crop yields and food security. By leveraging advanced technologies and data-driven approaches, the project contributes to enhancing agricultural productivity and fostering sustainable development in agricultural communities

CHAPTER 6

CONCLUSION AND SCOPE FOR FUTURE ENHANCEMENT

6.1 CONCLUSION

In conclusion, the project "Crop Prediction Using Machine Learning" marks a significant step forward in revolutionizing agricultural practices in India. By harnessing the power of machine learning algorithms and extensive agricultural data, the project has demonstrated the potential to provide farmers with valuable insights and predictions for optimizing crop yields.

Through the development of accurate predictive models, farmers can now make informed decisions about crop selection, planting schedules, and resource allocation, leading to improved agricultural productivity and economic stability. The user-friendly interface ensures accessibility for farmers of all backgrounds, empowering them to leverage technology for better outcomes in their farming endeavors.

Furthermore, the project's results contribute to enhancing food security and livelihoods in agricultural communities across India. By providing timely and accurate predictions, the project equips farmers with the knowledge and tools needed to navigate environmental challenges and maximize their yields sustainably.

Moving forward, continued research and innovation in crop prediction using machine learning hold immense promise for further advancing agricultural practices and supporting the needs of farmers nationwide. By embracing technology and data-driven approaches, India's agricultural sector can thrive, ensuring a brighter and more sustainable future for generations to come.

6.2 FUTURE ENHANCEMENT

A future upgrade for the project "Crop Prediction Using Machine Learning" could involve using real-time data and advanced sensor technology to make predictions better. This means getting live updates about weather, soil conditions, and crop health. By doing this, the predictions can adjust quickly to changes in the environment, helping farmers make better decisions about their crops. Also, we can use satellite images and drones to get detailed pictures of fields, helping us understand how crops are growing and if there are any problems. Additionally, we can include information about market prices to help farmers decide which crops to grow for better profits. Making the system easier to use with personalized suggestions and interactive features can also make it more helpful for farmers. Overall, these improvements can make the project more effective in supporting farmers and improving crop yields. Additionally, we can utilize satellite images and drones to capture detailed images of the fields, providing insights into crop growth and identifying any potential issues early on. Moreover, by integrating predictive analytics for market trends, we can help farmers make informed decisions about which crops to plant based on market demand and prices. This can ultimately lead to better profitability for farmers and a more sustainable agricultural industry. Finally, by enhancing the user interface with customizable features and personalized recommendations, we can ensure that the system is user-friendly and accessible to farmers of all backgrounds, empowering them to make the best decisions for their farms.

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APPENDIX

Model.py:

```
import pandas as pd

import numpy as np

import matplotlib.pyplot as plt


df = pd.read_csv('Crop_recommendation.csv')

df.head()


df.info()


if df['N'].all()>90:

    print(df['N'])


df.isnull().sum()


x = df.drop('label', axis = 1)

y = df['label']
```

```
from sklearn.model_selection import train_test_split
x_train, x_test, y_train, y_test = train_test_split(x,y, stratify = y, random_state = 1)


from sklearn.linear_model import LogisticRegression
model = LogisticRegression()
model.fit(x_train, y_train)
y_pred = model.predict(x_test)
from sklearn.metrics import accuracy_score
logistic_acc = accuracy_score(y_test, y_pred)
print("Accuracy of logistic regression is " + str(logistic_acc))


from sklearn.tree import DecisionTreeClassifier
model_2 = DecisionTreeClassifier(criterion='entropy',max_depth = 6,
random_state = 2)
model_2.fit(x_train, y_train)
y_pred_2 = model_2.predict(x_test)
decision_acc = accuracy_score(y_test, y_pred_2)
print("Accuracy of decision  tree is " + str(decision_acc))
```

```
from sklearn.naive_bayes import GaussianNB

model_3 = GaussianNB()

model_3.fit(x_train, y_train)

y_pred_3 = model_3.predict(x_test)

naive_bayes_acc = accuracy_score(y_test, y_pred_3)

print("Accuracy of naive_bayes is " + str(naive_bayes_acc))


from sklearn.ensemble import RandomForestClassifier

model_4 = RandomForestClassifier(n_estimators = 25, random_state=2)

model_4.fit(x_train.values, y_train.values)

y_pred_4 = model_4.predict(x_test)

random_fore_acc = accuracy_score(y_test, y_pred_4)

print("Accuracy of Random Forest is " + str(random_fore_acc))



import joblib

file_name = 'crop_app'

joblib.dump(model_4,'crop_app')

app = joblib.load('crop_app')
```

```
arr = [[90,42,43,20.879744,82.002744,6.502985,202.935536]]
acc = app.predict(arr)
acc


import pickle
Pkl_Filename = "Pickle_RL_Model.pkl"


with open(Pkl_Filename, 'wb') as file:
    pickle.dump(model_4, file)


with open(Pkl_Filename, 'rb') as file:
    Pickled_Model = pickle.load(file)


Pickled_Model


# %%
pie_chart.html:
<!DOCTYPE html>
<html lang="en">
<head>
```

```
<meta charset="UTF-8">
<meta name="viewport" content="width=device-width, initial-scale=1.0">
<title>Pie Charts</title>
<style>
  body {
    font-family: 'Segoe UI', Tahoma, Geneva, Verdana, sans-serif;
    background-color: #f0f0f0;
    margin: 0;
    padding: 0;
  }
  .container {
    max-width: 800px;
    margin: 20px auto;
    padding: 20px;
    background-color: #fff;
    border-radius: 8px;
    box-shadow: 0 4px 8px rgba(0, 0, 0, 0.1);
  }
  h1 {
    text-align: center;
```

```
    color: #333;
    margin-bottom: 30px;
    font-size: 28px;
    text-shadow: 1px 1px 2px rgba(0, 0, 0, 0.1);

h2 {
    color: #555;
    font-size: 24px;
    margin-bottom: 15px;        }
.blood-group {
    padding: 20px;
    background-color: #f9f9f9;
    border-radius: 8px;
    box-shadow: 0 2px 4px rgba(0, 0, 0, 0.1);
    margin-bottom: 20px;
    position: relative; /* Position relative for absolute positioning of glow */
}
.blood-group img {
    display: block;
    margin: 0 auto;
```

```
    max-width: 100%;
    height: auto;
    border-radius: 8px;
    box-shadow: 0 2px 4px rgba(0, 0, 0, 0.1);
}
.red {
    color: red;
    font-weight: bold;
}
ul {
    list-style-type: none;
    padding: 0;
    margin: 0;
}

li {
    font-size: 18px;
    margin-bottom: 10px;
    text-shadow: 1px 1px 2px rgba(0, 0, 0, 0.1);
    position: relative; /* Position relative for absolute positioning of glow */
```

```
        }
        @keyframes glow {
            0% { text-shadow: 0 0 5px rgba(255, 0, 0, 0.7); }
            50% { text-shadow: 0 0 20px rgba(255, 0, 0, 0.9), 0 0 30px rgba(255, 0, 0,
0.7); }
            100% { text-shadow: 0 0 5px rgba(255, 0, 0, 0.7); }
        }
        .glow {
            animation: glow 1s infinite alternate;
        }
    </style>
<script>
    document.addEventListener("DOMContentLoaded", function() {
        // Function to check readmission percentage for each blood group
        function checkReadmission() {
            // Get all list items
            var listItems = document.querySelectorAll('li');
            // Iterate over each list item
            listItems.forEach(function(item) {
                // Get the text content of the list item
```

```
                var textContent = item.textContent;
                if (textContent.includes('%') && parseFloat(textContent) > 80) {
                    // Add 'glow' class to the list item
                    item.classList.add('glow');
                    // Add 'red' class to the list item
                    item.classList.add('red');
                }
            });
        }
        checkReadmission();
    });
</script>


</head>
<body>
    <div class="container">
        <h1>Blood Group Based Analysis</h1>
        <div class="blood-group">
            <h2>Blood Groups with Readmission Rate Above 80%:</h2>
            <ul>
```

```
            {% for blood_group, percentage in high_readmission_groups.items() %}

            <li class="{% if percentage > 80 %}glow red{% endif %}">{{
    blood_group }} - {{ percentage }}%</li>

            {% endfor %}

          </ul>

        </div>

        <h2>Blood Group Results</h2>

        {% for chart in charts %}

        <div class="blood-group" data-readmission-percentage="{{
    chart.readmission_percentage }}">

          <h2>{{ chart.blood_group }}</h2>

          <img src="data:image/png;base64,{{ chart.pie_chart }}" alt="Pie Chart">

        </div>

        {% endfor %}

      </div>

    </body>

    </html>
```