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Crop Master

Crop Recommendation, Disease Prediction andFertilizer Recommendation.

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Abstract: Considering a nation where agriculture is still a dominant occupation and traditional farming methodsare still in practice, thereby giving limited crop yields to the farmer which ultimately is less beneficial to the farmers compared to the inputs given by them. Hence, in order to maximize the yields of crops for given input, we are showcasing different methods which will be useful to develop a recommendation system for smart farming. The proposed system of IoT and ML is enabled for soil testing using the sensors, is based on measuring and observing soil parameters. This system lowers the probability of soildegradation and helps maintain crop health. Present-day recommendations are based on farmers' communication between farmers, experts and various experts have a variety of recommendations. Recommendation can be provided to farmers who use past agricultural activities data. The application provides recommendations to farmers to determine the appropriate fertilizer and crop. This application can be used to increase crop yield and also recommend suitable crops.

I.INTRODUCTION

1.1 Introduction

Agriculture is a significant area for the Indian economy and human survival. It is one of the primary occupations which is essential for human life. It likewise contributes a huge part to our day-to-day life. There is no such universal system to assist farmers in agricultural India. Hence, our rich collection of previous agricultural data can be used for recommendation. Data extraction techniques and algorithmscan be used to recommend crops as well as yield prediction. Many studies have been conducted to improve agricultural planning. The crop can be recommended using a machine learning technique.

1.2 MOTIVATION

In India, agriculture plays a significant role in theeconomy. Recent years have seen a decline in soil strength as a result of industrialization and overuse of pesticides. Many of the practices used in agriculture now are insufficient to boost output. The main issue facing Indian farmers is that they lack knowledge on the best crop to plantdepending on their soil's requirements, which lowers productivity.

1.3 Problem Statement

Farmers face a lot of challenges in deciding the right crop to grow in their fields, as it depends on various factors such as soil type, climate conditions, rainfall, temperature, and other factors. Deciding on the right crop can help farmers optimize their yield and maximize profits while minimizing the risk of crop failure. Therefore, the problem statement is to develop a crop recommendation system that can help farmers make informed decisions aboutthe type of crops they should plant in their fields based on the analysis of relevant data such as soil quality, weather patterns, and other environmental factors. The system should be easy to use and provide accurate and personalized recommendations to farmers based on their specific location and requirements. This will help farmers make informed decisions, optimize their yield, and ultimately increase their income while reducing the risk of crop failure. 7

1.4 Objectives

- Create a predictive model that uses the symptoms observed to precisely identify and categorize the diseases impacting crops.
- Create a user-friendly interface with the predictive modelso that farmers may input symptoms and get prompt advice on how to treat diseases.
- assemble and maintain a sizable collection of agricultural diseases and associated signs and symptoms that can be utilized to develop and test the predictive model.
- To guarantee real-time performance and availability,implement the predictive model on a scalable and dependable infrastructure.
- Continually enhance the predictive model by adding freshdisease information and enhancing the precision of disease identification and management advice.
- Educate and teach farmers on the usage of the predictivemodel, as well as how to understand and apply its findings.
- Work together with stakeholders and agricultural organizations for further application of the predictive modeland enhance crop disease control procedures.

1.5 Organization of the Report

The report is divided in specific sections. The abstract of the project is mentioned in the beginning of the report. We have also included the abbreviations used in the report. Coming to the further three sections, the first section contains introduction of the project, motivation to choose this topic, problem statement and objectives. The next section consists of a survey of the existing systems in a tabular form. We have also included the limitationsof the existing systems. Contribution of each memberin our team is mentioned. Further section gives details regarding our proposed system which includes the framework of the project along with algorithms followed. Flowcharts are also added for better understanding. Software details and results of projects are displayed. The report is concluded with future work. Lastly, we have mentioned a few references regarding our topic.

II. Literature Survey

2.1 Survey of Existing System (Table No.1)

Sr No.	Author	Description
1	**Dr.V. Geetha (2016)**	She has proposed a paper in which they have used a Machine Learning algorithm named as Random Forest algorithm for analyzing the growth of the crop in relation to the different climatic conditions like dried period, increasing in temperatures and biophysical changes.
2	**Zeel Doshi, (2010)**	She has proposed a paper in which they come up with an intelligent system called AgroConsultant. This system aims to support the Indian farmer in making a concise decision about the growth of a crop on the basis of sowing season, geographical location of the farmer, characteristics of the soil and environmental factors like temperature and rainfall.
3	**Priyadharshini A, (2008)**	She has proposed a paper in which they have proposed a system which will assist the farmer to choose the right crop by providing the intuition which cannot be tracked. It decreases the chances of crop failure and increases productivity. It helps the farmer by preventing them from suffering losses. For efficient yield forecasting prediction real time monthly weather data is taken.

4	**Dr. Y. Jeevan Nagendra Kumar,(2009)**	He has implemented a Supervised Machine Learning approach for Crop Yield Prediction in the Agriculture Sector. In this paper, authors take the past data and use it to predict the future yield. Mainly crop yield depends on weather and pesticides. The dataset used from Kaggle repository which consists of parameters like rainfall, perception, temperature, and production. The data set has 3101 instances that have taken from the past historic data.
5	**Ms Kavita, (2018)**	She has implemented a system in which they have predicted the crop yield for India by using the data from 1950 to 2018. For the prediction five crops were used which are Rice, Wheat, Jowar, Bajra, Tobacco, and Maize. The data consists of 745 instances in which 70% is used for training and 30% is used for testing. The dataset consists of parameters like rainfall, area, area under irrigation, crop names, seasons, production, and yield from 1950 to 2018. Proposed models are compared with Decision Tree, Linear Regression, Lasso Regression And Ridge Regression. Decision Trees provide accuracy 98.62% which is more than other algorithms. .

2.2 Limitation Existing system or research gap

Agriculture and its allied sectors are undoubtedly the largest providers of livelihoods in rural India. The agriculture sector is also a significant contributor factor to the country's Gross Domestic Product (GDP). The proposedsystem provides connectivity to farmers via a mobile application.[9] GPS helps to identify the user's location. Theuser provides the area & soil type as input. Machine learning algorithms allow choosing the most profitable croplist or predicting the crop yield for a user-selected crop.

ADVANTAGES OF PROPOSED SYSTEM:

- For the supplied data sets, the proposed model forecastscrop yield. By raising yields and maximizing the use of available resources, integrating agriculture and ML willhelp the agriculture sector go further. The most important factors in predicting present performance arehistorical data.
- The suggested approach makes recommendations on when to apply fertilizers using a recommender system.
- The approaches in the suggested system include improving agricultural yield, real-time crop analysis, choosing effective parameters, making wiser decisions, and improving yield.[1]

DISADVANTAGE OF EXISTING SYSTEM:

- Lack of awareness of the shifting climatic changes is the key issue facing the agriculture sector. Every crop has its own unique ideal climatic characteristics. With the aid of precise farming practices, this can be managed. Crop productivity is upheld by precision farming, which also boosts production yield rates.
- The current crop production prediction method is either hardware-based, expensive to maintain, or difficult to use.
- Despite numerous new solutions being put out, there are still unresolved issues with regards to developing a user-friendly application for crop recommendation.

III. Proposed System

3.1 *Introduction*

With billions of people's livelihoods dependent on it, agriculture is one of the most important industries for ensuring global food security and sustainability. By 2050, the world's population is predicted to exceed 9.7 billion people, increasing the pressure on the agricultural industry to increase food production while reducing its negative environmental effects. By boosting crop output and enhancing food security, crop prediction and crop disease prediction are two crucial fields of research that can greatly benefit the agricultural sector.

Crop diseases, on the other hand, can result in considerable production losses, reducing farmer revenue and causing food scarcity for the populace. By diagnosing and categorizing crop illnesses based on the symptoms noticed, crop disease prediction models can help farmers prevent and control disease outbreaks. This can assist in creating prompt and efficient management techniques to stop further spread and reduce yield losses.[2]

Utilizing machine learning algorithms and sophisticated data analytics techniques, vast databases of environmental and crop-related data are analyzed in order to create predictive models for crop prediction and crop disease prediction.

We can support sustainable agricultural practices, contribute to food security, and reduce yield losses from crop diseases by increasing crop yields and reducing yield losses from crop diseases.

3.2 Architecture/ Framework

The architecture for crop recommendation, disease prediction, and fertilizer prediction involves several components working together to provide recommendations to farmers. [3]

1. **Data Collection:** Data collection from numerous sources, including weather stations, satellite imaging, drones, and ground sensors, is the initial step. Information on the soil composition, weather patterns, crop growth phases, and disease signs areall included in this data. The system receives the real-time data and processes it for further analysis.

2. **Data Preprocessing**: To remove any discrepancies,mistakes, or missing values after data collection, pre-processing is necessary. This comprises activities like data normalization, feature engineering, and data cleaning. A database is then used to store the pre-processed data for later analysis.

3. **Crop Recommendation Model:** Based on variablesincluding soil type, weather, and past yield statistics, a machine learning model is trained on the pre-processed data to forecast the optimum cropto produce. The model predicts the best crop type based on the existing conditions by combining supervised and unsupervised learning algorithms. To boost its accuracy, the model is regularly updated with fresh data.

4. **Disease Prediction Model**: In order to predict the likelihood of crop illnesses based on variables including weather patterns, soil conditions, and previous disease occurrence, a machine learning model is trained on the pre-processed data. To forecast the likelihood of crop illnesses, the model combines supervised and unsupervised learning algorithms. To boost its accuracy, the model is regularly updated with fresh data.

5. **Fertilizer Recommendation Model:** Based on elements including soil nutrient levels, crop kind, and growth stage, a machine learning model is trained on the pre-processed data to make recommendations for the best fertilizer type, quantity, and timing. The model predicts the ideal fertilizer type, quantity, and timing using a combination of supervised and unsupervised learning methods. To boost its accuracy, the model is regularly updated with fresh data.

6. **User Interface:** An intuitive user interface, such as a web application or mobile app, is used to present the end-user with the recommendations and forecasts from the models. A dashboard displaying the current crop and soil conditions, suggested cropand fertilizer types, and any disease warnings may be included in the user interface. In order to receive more individualized recommendations, the user can also upload their own data into the system.

7. **Feedback Loop:** The system gathers user feedback and makes use of it to increase the precision of the prediction and recommendation models. For instance, if a user detects a disease epidemic, the system may utilize this information to modify its model for predicting diseases and issue future alerts that are more precise. To keep the models current and accurate, the feedback loop is essential.

Overall, the architecture for crop recommendation, disease prediction, and fertilizer prediction involves collecting and preprocessing data, training machine learning models, presentingrecommendations and predictions to the end-user, and incorporating feedback to improve the accuracy of the models. The system is continuously learning and adapting to provide the best recommendations to farmers.

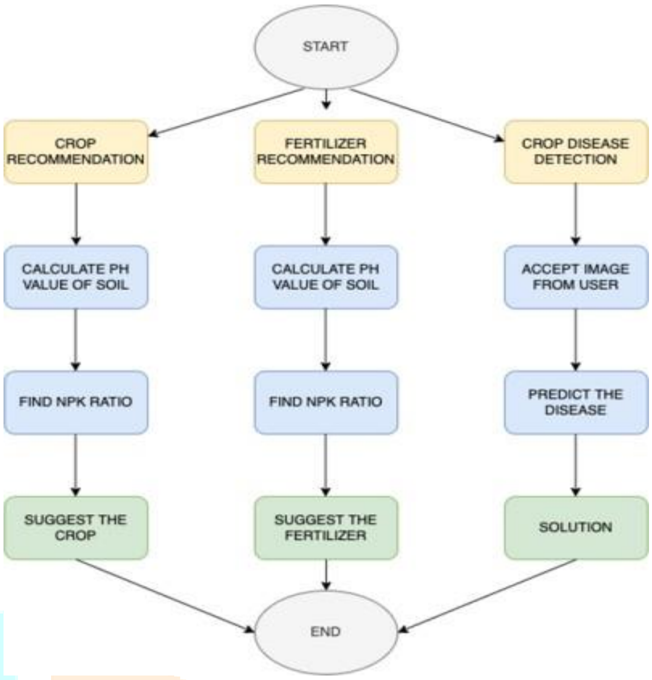


FIGURE1: FLOWCHART OF PROPOSED SYSTEM

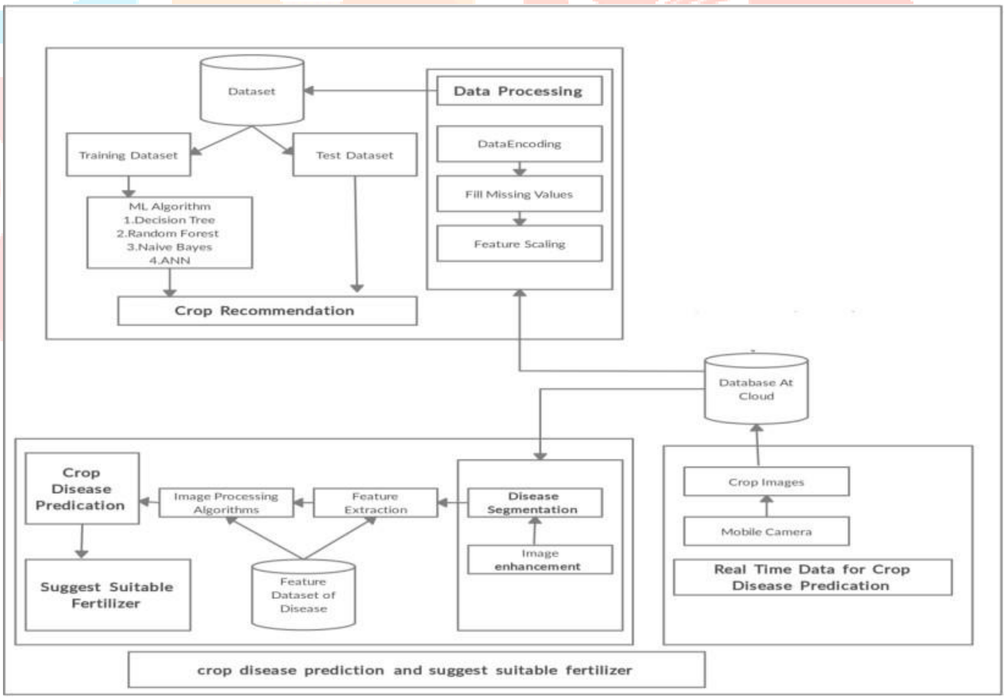


Figure2: System Architecture

Building a UI

Under the following phase, we created a user interface (UI) for the user to enter his data. Once the user inputs the data, such as soil N, P, and K values, temperature,humidity, rainfall, etc., the model will process the information and recommend the best kind of crop to be grown under those conditions. The machine learning algorithm will forecast the crop that the user needs to grow as soon as the user enters the following values and presses submit.

Dataset

The dataset for this topic was taken from Kaggle. Itis a crop recommendation dataset giving us information about various types of crops and the features that decide which crop is suitable for growing.

Features of the Dataset
N: ratio of Nitrogen content in soil
P: ratio of Phosphorus content in soilK: ratio of Potassium content in soil
Temperature: temperature in degree CelsiusHumidity: relative humidity in % pH:
pH value of the soil rainfall: rainfall in mm 5.

Machine Learning Algorithms UsedRandom Forest

A supervised ensemble machine learning approachcalled Random Forest is applied to classification and regression issues. It has a variety of decision trees, and the output is calculated by taking their average. It is based on the idea of bagging, where output is produced by averagingthe results of numerous decision trees. Random forest is helpful in lowering the effect of overfitting and so producinga more accurate output because decision trees are prone to overfitting.

Decision Tree

One of the most widely used machine learning methods is the decision tree, which is mostly used for classification problems but may also be applied to regression-type issues. It operates using a straightforward mechanism in which a yes-or-no question is posed, and depending on the response, the tree is divided into smaller nodes. Either information gain (which measures the change in entropy) or Gini impurity (which calculates the measure of impurity) might cause the nodes to divide. Decision trees are prone to overfitting, which may result in less accuracy being obtained. A random forest technique can be applied tothis issue to find a solution. Rational Regression One of the simplest machine learning algorithms is this one. It helps with classification problems. It does a mathematical calculation of an observation's likelihood before classifying it according to the result using a sigmoid function. When calculating whether an observation has a probability of 0 or1, a threshold value is chosen, and classes with probabilitiesabove the threshold are assigned the value 1, and classes with probabilities below the threshold are assigned value 0.

XGBoost

One of the most widely utilized algorithms today isXGBoost. It is a gradient boosting-based tree-based algorithm. This algorithm is based on a feedback technique,in which the decision tree's performance is "boosted" by feedback from the user in order to further increase the tree'seffectiveness and accuracy.

FRAMEWORK:

The framework for crop and disease prediction involves thefollowing steps:

- Data Collection: This entails gathering pertinent information on crops, soil, weather, and fertilizers. Sensors, satellites, and ground observations are just a few of the sources from which the data can begathered.
- Data Pre-processing: For the machine learning models, the gathered data is cleaned, converted, and prepared. Tasks like feature selection, normalization, and data augmentation fall under this category.
- Feature Selection: Determine the key characteristics or signs that are the best indicators of a specific crop disease.[4]
- Model Training: Using the pre-processed data, traina machine learning model using a suitable technique, such as Decision Trees, Random Forests, or Deep Learning Models.
- Deployment: To guarantee real-time performance and availability, deploy the predictive model on a scalable and trustworthy infrastructure.
- User Interface: Create a user-friendly interface with the predictive model so that farmers may inputsymptoms and get prompt advice on how to treat diseases.
- Education and Outreach: To promote the use of thepredictive model and enhance crop disease management practices, work with agricultural organizations and stakeholders. Provide educational materials and training to farmers on how to use the predictive model and how to interpret and implement its suggestions.

Overall, the framework for crop disease prediction providesa systematic approach to develop accurate and efficient predictive models that can benefit farmers and improve cropyield and quality. [4]

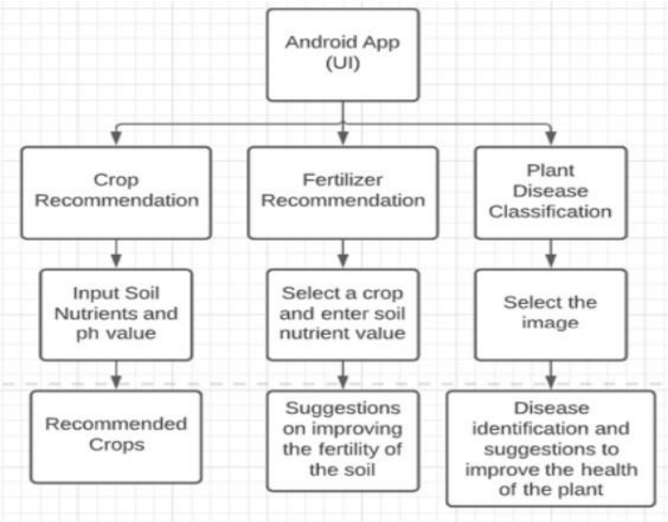


Figure 3

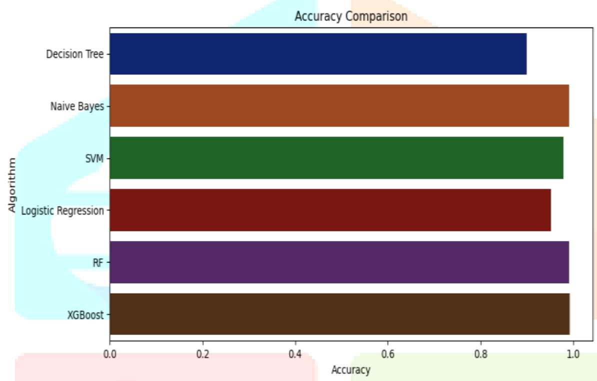


FIG. 4. ACCURACY COMPARISON OF ALGORITHM

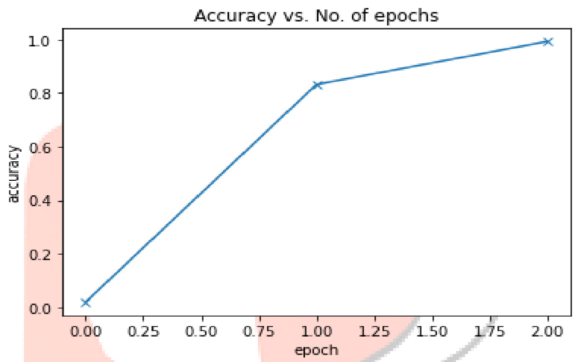


FIG. 5. VALIDATION ACCURACY

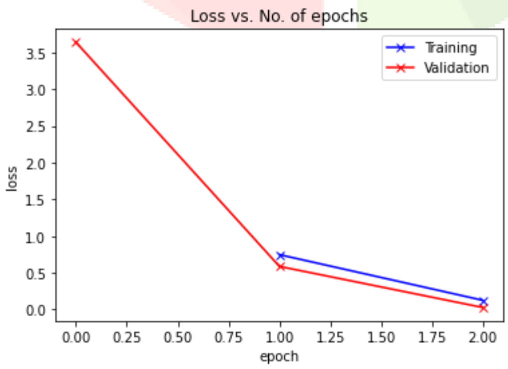


FIG. 6. VALIDATION LOSS

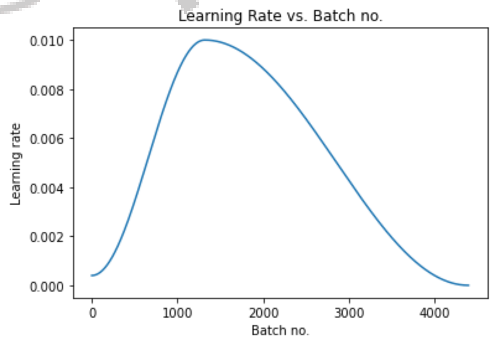
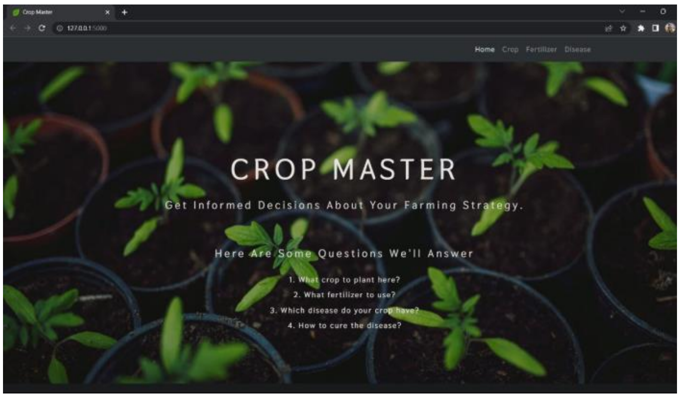


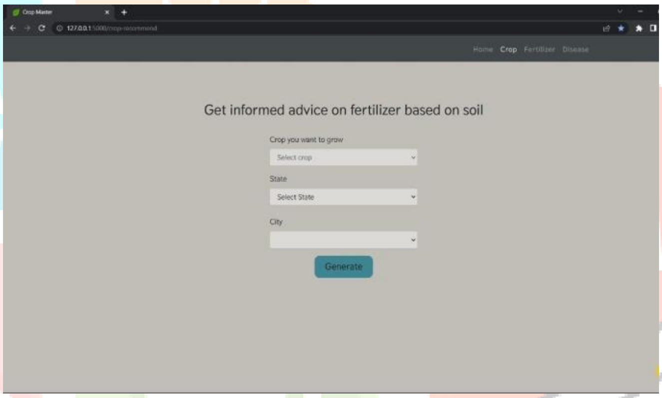
FIG. 7. LEARNING RATE OVERTIME

3.3 Algorithm and Process Design

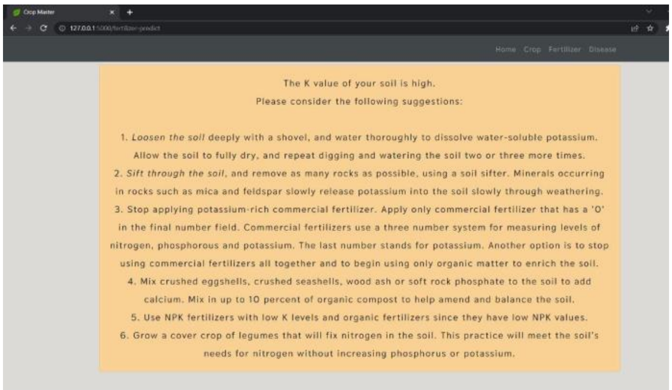


3.4 Experiment and Results

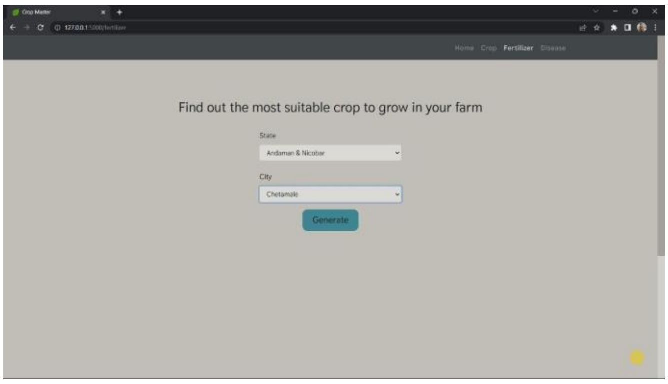
Crop Recommendation:



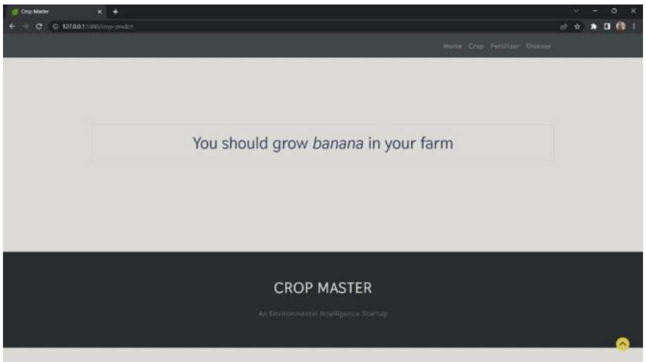
Output 1:



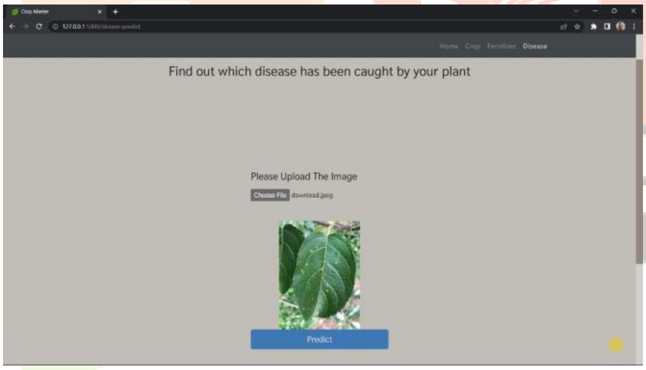
Fertilizer Recommendation:



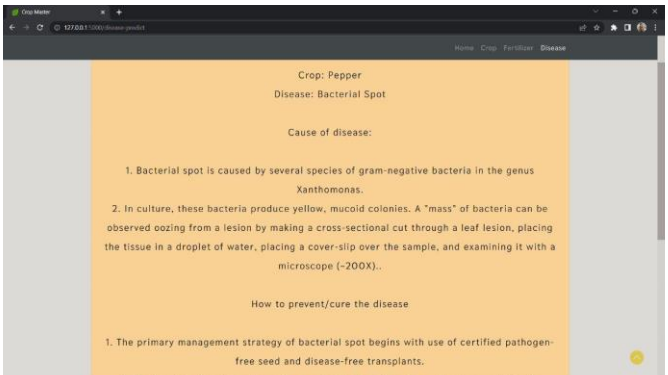
OUTPUT 2:



Disease Prediction:



OUTPUT 3:



3.5 Future work.

The system we created can be enhanced further to add more functionality where the future aim is to improve the dataset with a larger number of attributes. We need to build a modelthat can classify between healthy and diseased crop leaves and also if the crop has any disease, predict which disease is it.

- The accuracy of crop and its disease prediction canbe increased by using multimodal models using a variety of data kinds, including text, photos, and sensor data.
- By utilizing pre-trained models, transfer learning can be utilized to train crop and its disease prediction models on smaller datasets.[5]
- By creating AI models that are easy to comprehendand implement, farmers will be more inclined to believe the model's predictions about their crops and their susceptibility to disease.
- The efficiency of crops and the ability to detect disease can both be considerably increased by integrating precision agricultural techniques like variable rate fertilization, irrigation, and spraying.
- Working with farmers can aid in gathering first-hand information and creating models that are tailored to their requirements and practices.

Overall, these future works can help improve the accuracy and efficiency of crop and its disease prediction models, leading to increased crop yield and food security

3.5 CONCLUSION

Crop and its disease prediction is an important area of research that can significantly benefit the agricultural sector by increasing crop yield and improving food security. The development of predictive models using machine learning and data analytics techniques can enable farmers to prevent and mitigate disease outbreaks and makeinformed decisions regarding crop management practices.[6]

Since farming is a significant component of our economy, it is crucial to make sure that even the smallest investment made in the agriculture sector is taken care of. Crop seeds are one such investment. Therefore, it is crucial to confirm that the right crop has been selected for the right soil and that it meets its requirements in order to benefit the farmer. With the use of this technology, farmers would be better able to choose the right crop to plant based on arange of geographical and environmental parameters. By substituting intuition and inherited knowledge with more trustworthy data-driven ML models, the ML-based recommendations will considerably inform the farmer and assist them in minimizing costs and making strategic decisions. This makes it possible to find a dependable, scalable solution to a significant issue that affects hundreds of millions of people. Our ongoing research attempts to expand this model's selection of soil properties and data sources.

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