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Smart Crop Cultivation and Disease Prediction for Cotton

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Abstract: ***Cotton is the most valuable agricultural product in the world. Annual cotton production is 27 million tons. The three major producers—India, China, and the United States—accounted for more than half of global output. Due to its tropical climate cultivation, Effective remedies are needed since it is the target of a wide range of agricultural pests and illnesses. Additionally, it might be challenging for the producer to correctly identify a lesion since the signs of the major pests and illnesses cannot be distinguished in the early stages. The current research offers a solution based on artificial intelligence and machine learning in the screening of cotton leaves, which makes it possible to monitor the health of the cotton crop and make better management decisions.***

Keywords: Disease Detection, Machine Learning, Smart Farming, Cultivation, CNN, Disease

I. INTRODUCTION

About 70% of the population of India depends on agriculture, making it an agricultural nation. Farmers can choose from a wide variety of acceptable fruit and vegetable crops. However, the cultivation of these crops for the best yield and highest-quality output requires a high level of technical skill. With the use of technology, it may be enhanced. The management of perennial fruit crops necessitates constant observation, particularly for the control of diseases that can adversely influence production and subsequently the post-harvest period. Cotton, sometimes known as "The White Gold" or the "King of Fibers," is the main raw material for the nation's thriving textile sector. About 60 million people depend on it for their livelihood, and it is a vital agricultural product that pays millions of farmers in developed and developing nations. This project discloses the automated disease detection on cotton leaves. There are several problems with field crops, such as identifying nutritional deficiencies in plants, numerous illnesses, and pests that harm crops. Every problem has, significance. One of these is pest identification so that the appropriate steps may be taken to manage it, minimizing loss. Farmers may control the problem by taking the appropriate action when one of these conditions arises, but if they lack the necessary information, they may misidentify any pests. Most importantly, it might cause major issues for agriculture. The diagnostician has to be an excellent detective in addition to having excellent observational abilities. It is crucial to maintain an open mind until all relevant information about the issue has been gathered. It's important to keep in mind the possibility of many causative variables. The effectiveness of control efforts depends on accurate illness and cause identification. As a result, diagnosis is a crucial part of a plant pathologist's curriculum. Illness control procedures can be a waste of time and resources and can result in additional plant losses if the disease and its cause are not correctly identified. Therefore, accurate illness diagnosis is essential. In this study, we demonstrate how to identify diseases in cotton plants utilizing automated vision systems for agricultural fields. The study of automatic plant disease detection is crucial to agriculture since it allows for the automatic identification of disease signs as soon as they occur on plant leaves while monitoring vast fields of crops. It is exceedingly challenging for a farmer to recognize different plant diseases. $60 billion is the projected yearly crop loss globally as a result of plant disease. Traditional methods and instruments are not very effective since they require a lot of physical labor and time. An anomaly in physiology is a plant disease. Once a plant is afflicted by a disease. Any illness that affects plants causes distinct symptoms. The physical changes to the eyes' external appearance are symptoms. Wilted leaf patches, rots, cankers, and many other conditions serve as examples of symptoms. This model's primary objective is to identify a cotton plant's ailment and offer treatment.

Here, a location on the plant's leaves is used by the CNN model to determine if the plant is sick or not. The notion of ensemble learning is used in the suggested study effort and is applied using a deep learning algorithm. The results are compared after deployment to determine which model has the best accuracy.

II. MOTIVATION

Our Indian economy is majorly based on agriculture. As farmers are committing suicide due to less agricultural production on their farms.

Agriculture is the most unpredictable sector because of many natural aspects such as climate, soil contents, and others as well. Foreign countries are getting more productivity and better results using technologies. As we know technology is helping every sector and field to grow drastically with the help of proper analysis and different techniques, also using newly developed technologies like ML and AI. This is the small contribution of technology in the Agri sector which will help farmers to increase their productivity and mostly focus on precision farming.

III. LITERATURE SURVEY

1) Geetha Chillarge, and Mayuri Pawar, proposed a system that informs farmers about toxicity levels present in their soil using J48 and Decision Tree algorithms as today the rate of pollution increasing very fast with industrialization. If toxicity is present the farmer or user can take appropriate actions for enabling their field for farming.
2) Sandeep Kumar presented a thorough examination of various machine-learning algorithms for disease detection in cotton plants. It also displays the elements of the various algorithms used to check the cotton plant. In this research, we found that numerous bacteria cause illnesses in cotton plants, affecting cotton crop yield. Cotton is very significant in the Indian economy. Late disease diagnosis in cotton plants has an impact on the farmer's financial situation
3) Jayraj Chopda designed a system that can forecast cotton crop illnesses using a "Decision Tree Classifier" proposed in order to address traditional issues. We now know that using an Android application benefits farmers by enabling higher-quality output. Temperature and soil moisture are important predictors of cotton disease. The system uses a decision tree to forecast the cotton crop disease based on data from past years and sensors.
4) Adhao Asmita Sarangdhar proposed a Support Vector Machine-based regression approach for identifying and classifying five cotton leaf diseases, namely Bacterial Blight, Following illness identification, farmers will be given the identity of the disease as well as its treatment via an Android app. This study demonstrates the utilization of IoT devices and sensors with the assistance of a machine-learning model. The software may display many environmental parameters related to soil and crop. The Raspberry Pi, one of the most frequently used IoT microprocessors, is utilized to link all of the sensors with machine learning, such as support vector-based regression. This method has an accuracy of around 83.26
5) Vani Rajasekar presented a method that employs deep learning to automate and speed up the procedure. This work introduces CNN with deep learning and RES-NET, which improves the system's feature extraction capabilities. The suggested approach worked effectively in detecting cotton plant disease using images. By placing it on the cloud, this technology may be utilized on mobile devices in the future.
6) Saeed Khaki proposed a system using vast datasets of corn hybrids, this system achieved superior performance in the 2018 Syngenta Crop Challenge. This system employs a feature selection strategy based on the DNN model and backpropagation. This strategy assisted in estimating crop yield depending on genotype.

IV. SYSTEM ARCHITECTURE

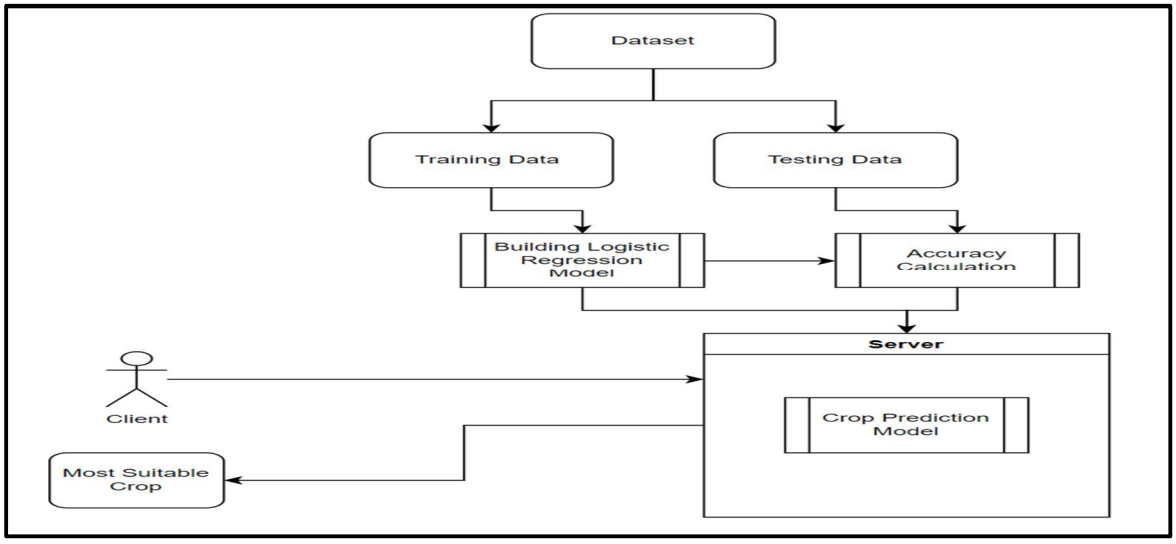

Fig.1: Smart Crop Cultivation

A. Smart Crop Cultivation

The dataset has been divided into two sections: Training Data and Testing Data. The Testing Dataset is then used to construct the Logistic Regression Model. The testing data is applied to compute the accuracy when creating the model. The user interacts with the user interface (UI) to enter the established parameters and offer input to the algorithm. Based on user input, the logistic regression method predicts the best-suited crop from the farm.

1) *Dataset Analysis:* In the dashboard, we have analyzed the whole dataset which shows us the types of crops in the dataset, different crops as per the seasonal environment, environmental factors which affect the crop yield, etc. This dashboard can show a comparative study of the dataset contents in detail which makes us easy to go through the dataset.
2) *Crop Prediction Model:* The crop prediction model is using logistic regression for the classification and accuracy calculation of the input parameters given by the user. This helps in accurately predicting the most suitable crop for the soil whose parameters are entered by the user in the dashboard.

B. Disease prediction for cotton

A dataset containing photographs of cotton diseases such as bacterial blight, bronze wilt, curly lift, and fouler fungal disease is used in a purpose system. We provided certain photos for training and others for testing. To begin, we take photos from the real-time dataset and feed them to the algorithm to identify the cotton illness.

We utilized the CNN method to develop the model. The model takes an image of a cotton plant as input and predicts crop illness using image processing, as well as describing the condition. It also provides pesticide recommendations and pesticide dosages.

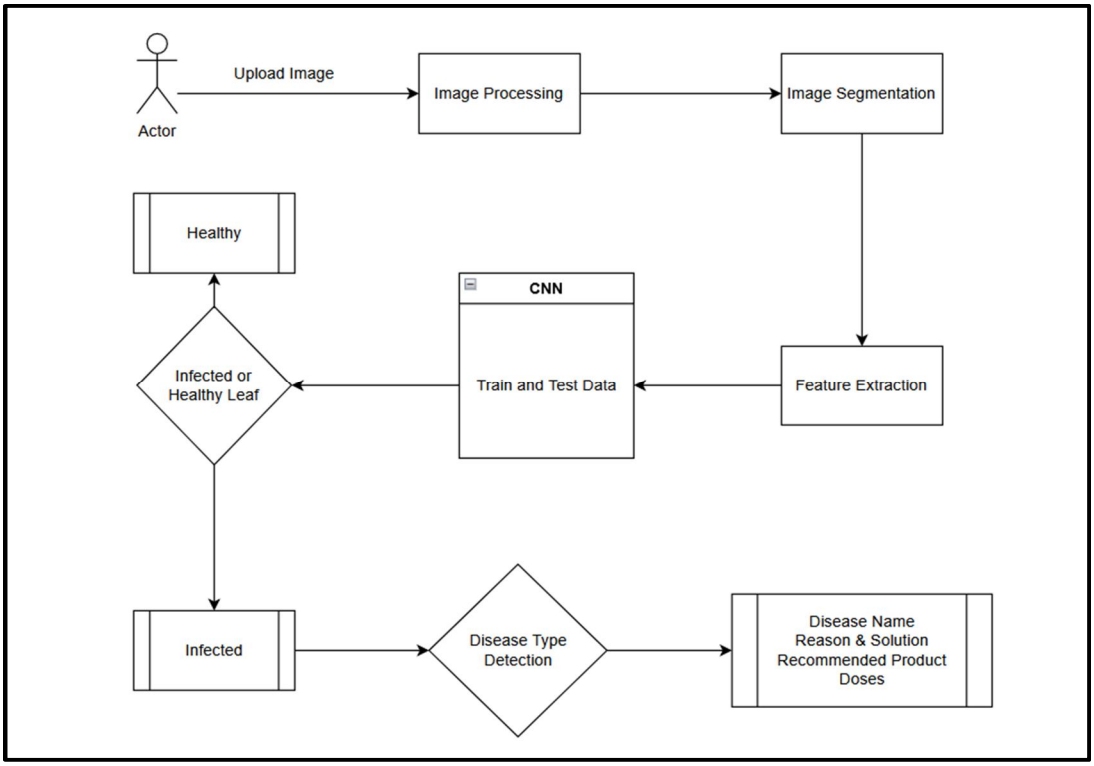

Fig. 2: Disease Prediction

1) A dataset containing photographs of cotton diseases such as bacterial blight, bronze wilt, curly lift, and fouler fungal disease is used in a purpose system.
2) We provided certain photos for training and others for testing. To begin, we take photos from the dataset and feed them to the algorithm to identify the cotton illness.
3) Convolutional Neural Network(CNN)

Step 1: Upload Dataset
Step 2: Input Layer
Step 3: Convolutional Layer

Step 4: Pooling Layer
Step 5: Secondary Convolutional Layer and Pooling Layer
Step 6: Dense Layer
Step 7: Logit Layer

V. USE CASE DIAGRAM

A. Smart Crop Cultivation

In this model first of all the user enters the different parameters as input like N, P, K, Temperature, Rainfall, pH value, etc. Then the input is processed using a logistic regression model which will give the output as the best suitable crop for the climatic condition, and soil contents of the farm based on which will be helpful for farmers in decision making.

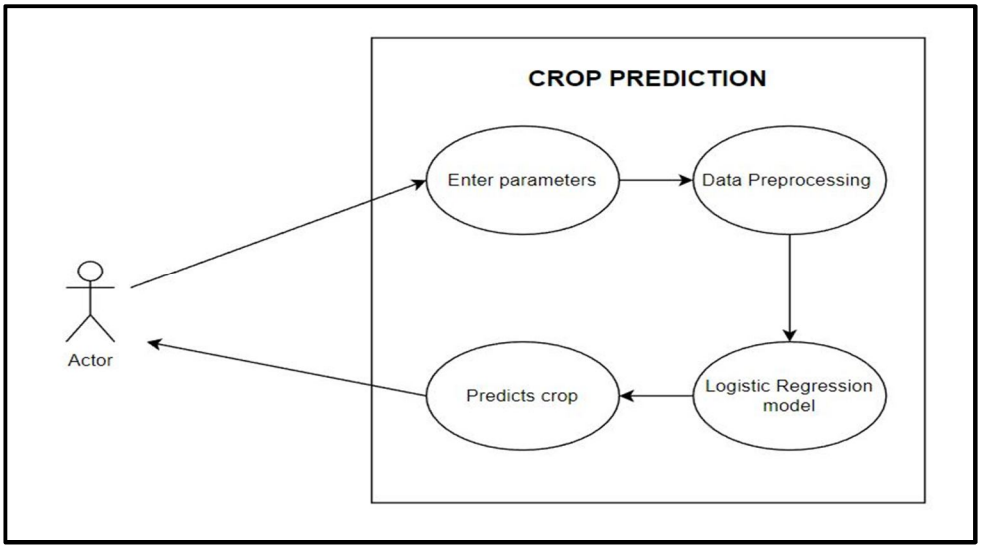

Fig.3: Use case Diagram for Smart crop cultivation

B. Disease Prediction in Cotton

In the second model of cotton disease detection, the user will upload an image as an input which will further be processed using the CNN algorithm resulting in the output as the plant is diseased or not healthy along with this model will suggest disease description, recommended pesticides and the doses for same.

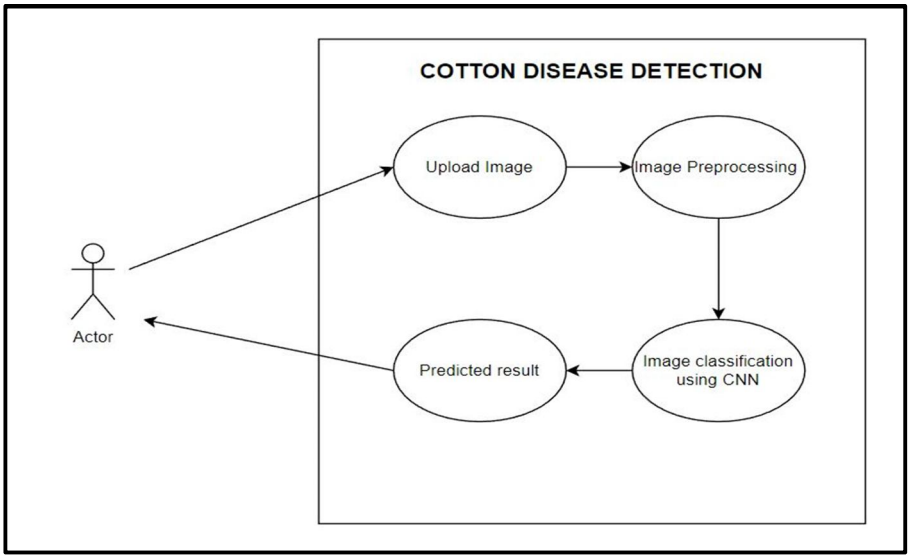

Fig.4: Use case Diagram for Disease Prediction in Cotton

VI. CONCLUSION

To estimate the crop with high accuracy, a supervised machine learning system based on logistic regression is created. The crop is therefore anticipated as an output for the specified input value. The poor farmers who are unable to accurately estimate the crops needed to build a sustainable future may benefit immensely from this work. In the future, it might even go as far as to recommend crops, proper recommendations for algorithms will assist the user in isolating the contaminated crop according to the disease so that preventive action can be taken as early as possible. The algorithm will contribute to reducing pesticide consumption, which will benefit the environment and ecological equilibrium. The suggested technique has numerous applications to aid Indian farmers in detecting illnesses that affect cotton crops early.

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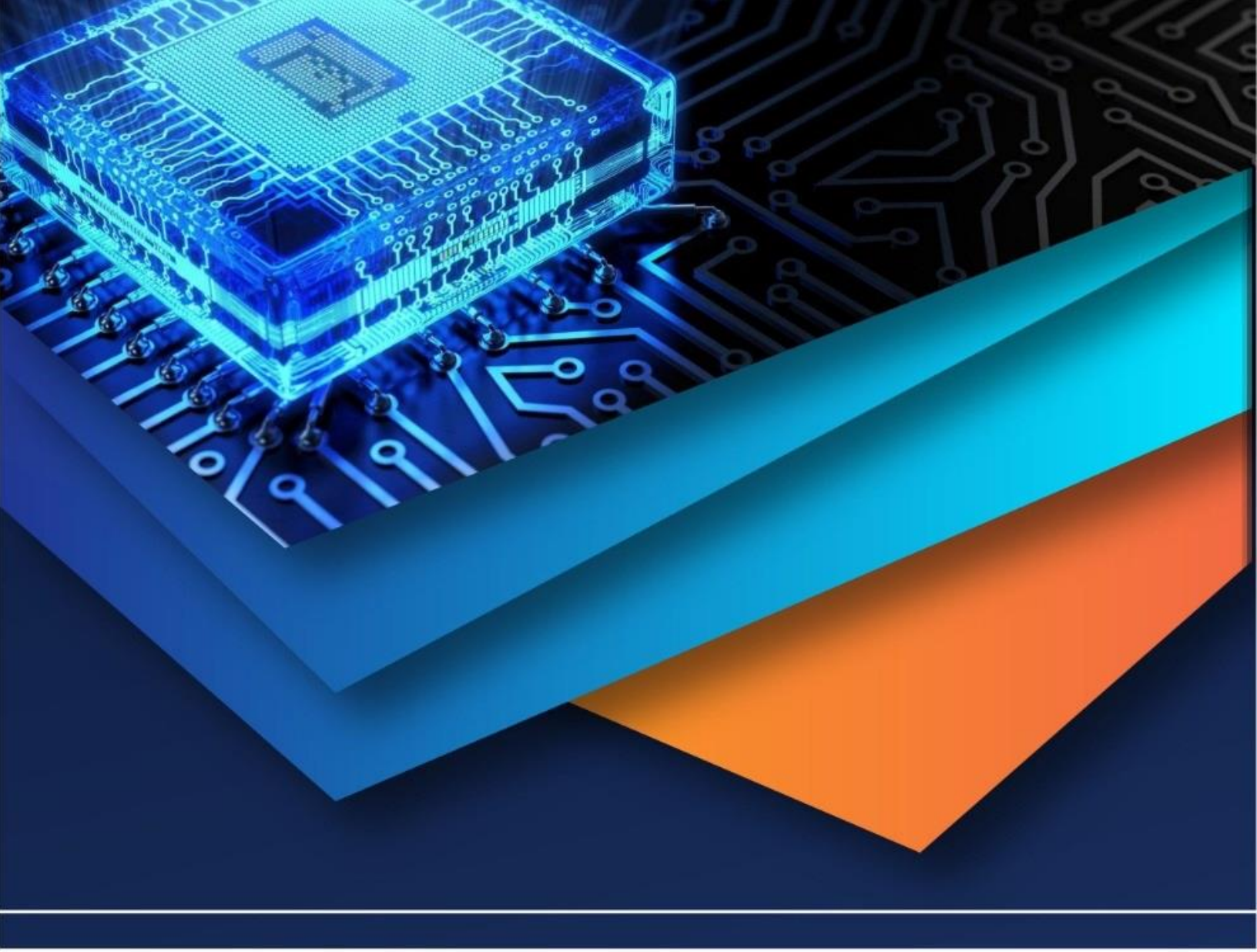

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