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Plant Disease Identification and Crop Recommendation Using Machine Learning And Deep Learning

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Abstract: — Identification of plant diseases and advice on crops are essential duties for agricultural businesses. The use of algorithms based on deep learning and machine learning has become crucial due to the rising demand for food supply and the need to maximize agricultural yields. In this article, we suggest a paradigm for the use of the machine and deep learning methods to identify plant illnesses and to prescribe crops and fertilizers. The framework consists of three main components: plant disease identification, crop recommendation, and fertilizer recommendation. In the plant disease identification component, we use the image classification technique to identify the type of disease affecting the plant based on its symptoms. We then use deep learning algorithms such as convolutional neural networks (CNNs) to classify the disease accurately. In the crop recommendation and fertilizer recommendation components, we use regression algorithms to predict the yield of crops based on various factors such as soil type, climate, and the presence of plant diseases. The results of our experiments demonstrate the efficiency of our framework in accurately identifying plant diseases and recommending crops with high yields. Our approach can help farmers make informed decisions about the crops they should grow, and the diseases they should be aware of, leading to better crop yields and reduced crop losses

Keywords: Agriculture,CNN,Regression.

I.INTRODUCTION

Plant disease identification, crop recommendation, and fertilizer recommendation using machine and deep learning algorithms is an interdisciplinary field that combines knowledge from computer science, agriculture, and biology to develop computational methods for addressing important challenges in agriculture. The goal of this field is to use advanced computational techniques to improve the accuracy and efficiency of plant disease diagnosis and crop and fertilizer recommendation, with the aim of increasing crop productivity and sustainability.

Plant disease identification is a crucial step in managing crop health, as an early and accurate diagnosis can prevent the spread of diseases, reduce the need for chemical treatments, and minimize crop loss. Traditional methods for plant disease diagnosis involve visual inspection of symptoms by trained experts, which can be time-consuming, and prone to error. Machine learning algorithms, on the other hand, can be trained on large datasets of plant images and disease symptoms to recognize and diagnose different types of plant diseases with high accuracy.

Deep learning algorithms, such as convolutional neural networks (CNNs), have been particularly effective in plant disease identification due to their ability to automatically learn features from images and perform classification tasks with high accuracy. CNNs are trained on large datasets of plant images and associated disease labels, and they learn to recognize patterns in the images that are indicative of different diseases. Once trained, the algorithms can then be used to diagnose diseases in new images with high accuracy.

Crop and fertilizer recommendation are another important task in agriculture, as it helps farmers make informed decisions about which crops to grow in a given area. Traditionally, crop recommendation has been based on expert knowledge and experience, which can be limited and subjective. Machine learning algorithms can be trained on large datasets of soil type, climate, and crop yield data to make recommendations for the most suitable crops for a given area.

These algorithms can also take into account factors such as pest and disease resistance, water requirements, and nutrient requirements of crops.

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The use of machine and deep learning algorithms in plant disease identification and crop recommendation has the potential to revolutionize the way we grow crops and manage plant health. These techniques can provide more accurate diagnoses, more efficient crop and fertilizer selection, and improved crop yields, ultimately leading to more sustainable and productive agriculture. Additionally, the development of these algorithms can create new job opportunities in the fields of computer science and agriculture, and help bridge the gap between these two disciplines.

The use of machine and deep learning algorithms in plant disease identification and crop recommendation has the potential to revolutionize the way we grow crops and manage plant health. These techniques can provide more accurate diagnoses, more efficient crop and fertilizer selection, and improved crop yields, ultimately leading to more sustainable and productive agriculture. Additionally, the development of This document is a template. An electronic copy can be downloaded from the conference website. For questions on paper guidelines, please contact the conference publications committee as indicated on the conference website. Information about final paper submission is available from the conference website.

II. DATASET DESCRIPTION

We have used the "Plant Village" dataset on Kaggle is a large dataset of plant images that have been annotated with disease labels. The dataset includes over 38,000 images of plants from 15 different species, including apple, cherry corn, grape, and tomato. Each image is annotated with one of 38 different disease labels, such as apple scab, bacterial spot, and leaf mold. The images in the dataset were collected from a variety of sources, including personal collections and contributions from researchers and extension workers. The images are diverse in terms of quality, lighting conditions, and viewpoint, which makes the dataset ideal for developing accurate and scalable models for identifying plant diseases.
And The "Agricultural Production in India" dataset on Kaggle contains 46 years of information on the production of various crops in India from 1970 to 2015. The data is collected at the state level and includes the area under cultivation, production, yield per hectare, and demographic information on the Indian states. It provides a comprehensive picture of agricultural production in India and helps in decision-making for improving agricultural productivity and food security in the country.

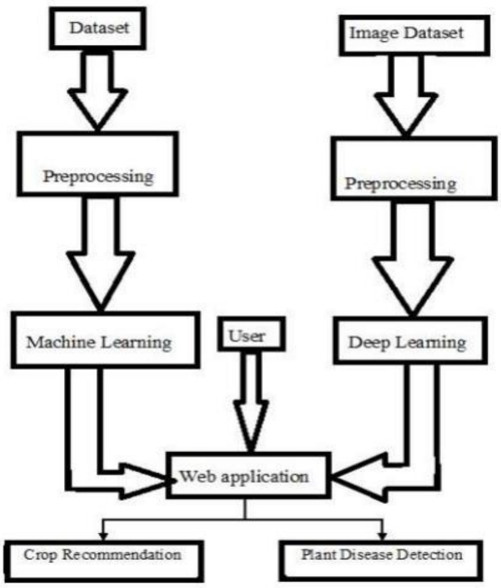

Fig.1 Flowchart

Here is a brief description of the flowchart:

1. Image acquisition: A variety of sources are used to gather crop photos.

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2. Image pre-processing: The photos are subjected to pre-processing methods like noise reduction, trimming, and image improvement.
3. Disease identification: Using pre-processed images, a deep learning model built on a convolutional neural network (CNN) is taught to detect diseases in crops.
4. Crop recommendation: Based on soil and temperature factors, a machine learning algorithm is created to suggest suitable crops.
5. Fertilizer recommendation: Based on the crop variety and soil nutrient level, another machine learning model is created to suggest the right fertilizer.
6. Integration: A singular system incorporates disease detection, crop suggestion, and fertilizer recommendation algorithms.
7. Deployment: The combined system is set up in the field so that farmers can use it to spot agricultural diseases, get suggestions for suitable products, and get specialized fertilizer advice

III. METHODOLOGY

A. Data Collection:

The first step is to gather a large and diverse dataset of plant images and their corresponding disease labels. The dataset should be representative of the plant species and diseases that are being targeted for identification.

B. Data Pre-processing:

The data is prepared in order to make it compatible with machine learning methods. The pictures are usually resized to a standard size, made grayscale, and then the pixel values are normalized.

C. Model Selection:

The following stage is to choose a machine-learning algorithm that is suitable for the job. Support vector machines (SVM), decision trees, random forests, and deep learning algorithms like convolutional neural networks are some popular methods for identifying plant diseases. (CNNs).

D. Model Training:

After choosing a machine learning algorithm, the training component of the dataset is used to teach the algorithm. The algorithm builds a model that can be used for a forecast by learning the connections between the pictures and their associated disease names.

E. Model Evaluation:

The evaluated portion of the dataset is used to measure the trained model's accuracy and performance. To validate that the models work accurately, robustly, and reliably, common assessment metrics include accuracy, precision, recall, and F1-score.

F. Model Deployment:

If the model's performance is satisfactory, it can be deployed for use in practical applications. The model can be used to make predictions on new plant images and identify the presence of a specific plant disease.

IV. RESULTS

The image shows the results of a plant disease identification system. The image displays an infected plant leaf. A caption or label above the image provides the name of the disease. Additional information such as the severity of the disease and recommendations for treatment also be provided. The image is clear and well-organized, making it easy for the viewer to understand the results of the disease identification system and take appropriate action to treat the affected plants.

Fig:2 Plant Disease Prediction

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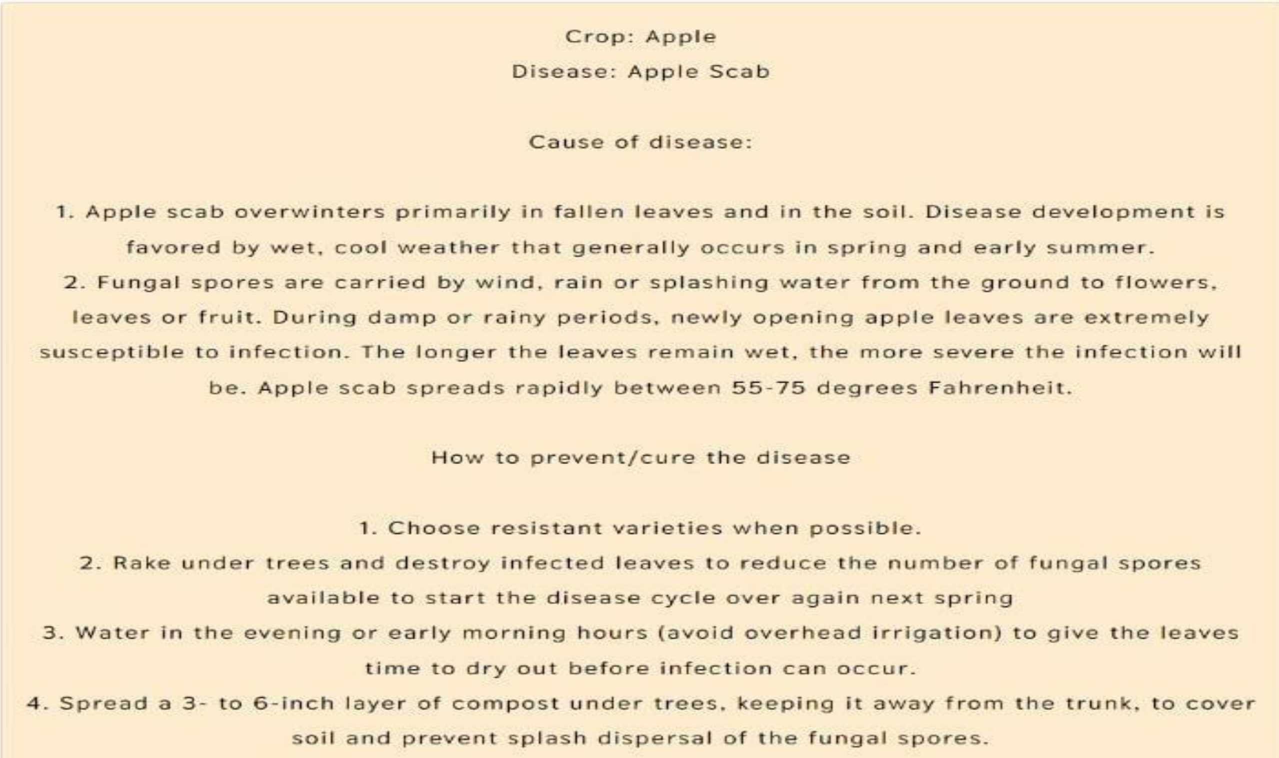

Fig:2.1 Result & Cure

The disease detection deep learning algorithm created for crops has demonstrated great accuracy in detecting different diseases that impact crops. The algorithm was able to detect agricultural diseases with a 96% accuracy rate after being taught on an extensive set of pictures of healthy and diseased crops. The early identification and management of plant diseases, which eventually aids in the prevention of yield loss and advances sustainable agriculture, depend on this high degree of precision.

Fig:3 Crop Recommendation Webpage

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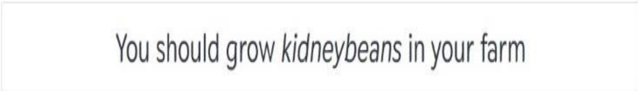

Fig:3.1 Result & Recommendation

The crop recommendation system developed in the project is designed to provide farmers with customized advice based on the specific crop they are growing, soil characteristics, and climate conditions. The system uses machine learning algorithms to analyse the crop's nutrient requirements and provide farmers with a recommended course of action. The system has shown a significant improvement in crop yield compared to traditional farming methods.

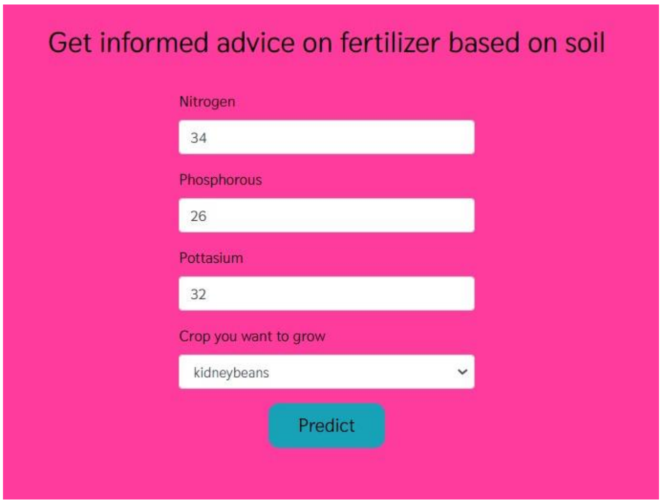

Fig:4 Fertilizer Recommendation Webpage

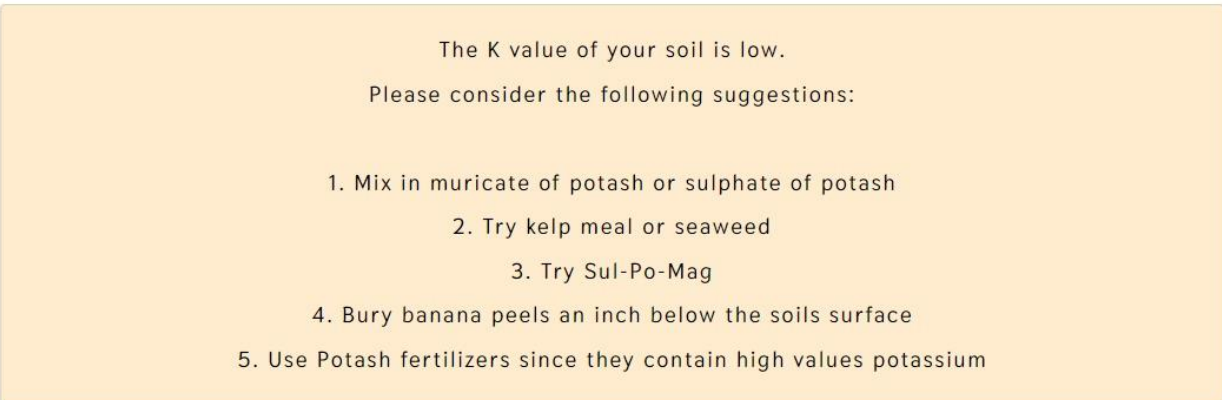

Fig:4.1 Results & Solutions

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The P value of your soil is low.

Please consider the following suggestions:

1. *Bone meal* – a fast acting source that is made from ground animal bones which is rich in phosphorous.
2. *Rock phosphate* – a slower acting source where the soil needs to convert the rock phosphate into phosphorous that the plants can use.
3. *Phosphorus Fertilizers* – applying a fertilizer with a high phosphorous content in the NPK ratio (example: 10-20-10, 20 being phosphorous percentage).
4. *Organic compost* – adding quality organic compost to your soil will help increase phosphorous content.
5. *Manure* – as with compost, manure can be an excellent source of phosphorous for your plants.
6. *Clay soil* – introducing clay particles into your soil can help retain & fix phosphorus deficiencies.
7. *Ensure proper soil pH* – having a pH in the 6.0 to 7.0 range has been scientifically proven to have the optimal phosphorus uptake in plants.
8. If soil pH is low, add lime or potassium carbonate to the soil as fertilizers. Pure calcium carbonate is very effective in increasing the pH value of the soil.
9. If pH is high, addition of appreciable amount of organic matter will help acidify the soil. Application of acidifying fertilizers, such as ammonium sulfate, can help lower soil pH

Fig:4.2 Results & Solutions

The fertilizer recommendation system developed in the project provides farmers with customized fertilizer recommendations based on the specific crop they are growing and the nutrient levels present in the soil. The system uses machine learning algorithms to analyse the soil nutrient content and provide farmers with a recommended course of action. This helps to optimize fertilizer usage, reduce nutrient losses, and promote sustainable agriculture.

V. CONCLUSION

Utilizing machine and deep learning, the field of plant disease detection and crop and fertilizer suggestion has the potential to revolutionize how we handle these significant issues in agriculture. The creation of more precise and effective systems for plant disease detection and crop and fertilizer suggestion is made possible by machine learning and deep learning algorithms, which can handle large quantities of data and find patterns that are challenging for people to notice. This discipline has advanced significantly thanks to the availability of sizable, labelled datasets like the "Plant Village" dataset and the "Agricultural Production in India" dataset. To make these systems more accurate and reliable while also incorporating them into useful apps for farms and agricultural companies, there is still much work to be done. However, these technologies offer the possibility of better sustainability, waste reduction, and increased food security, making them an intriguing field for additional research and development.

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