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Agricultural Information System Using Machine Learning

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ABSTRACT

Artificial intelligence includes machine learning as a subfield. A lot of academic and industrial circles have been concerned about it recently because of the benefits of autonomous learning and feature extraction. Processing of images and videos, audio, and natural language has all made extensive use of it. A research hotspot for agricultural plant protection, including the identification of plant diseases and the evaluation of pest ranges, has also emerged at the same time. Plant disease feature extraction can become more objective through the use of machine learning, which can also reduce the drawbacks associated with artificial selection of disease spot features. Additionally, machine learning can speed up technological transformation and increase search efficiency. Plant disease detection, crop growth forecasts for the field, and fertilizer recommendations are all included in the proposed work.

Keywords: ANN, CNN, Machine Learning, Pattern Recognition.

I. INTRODUCTION

The search of sustainable practices and higher production in agriculture is fraught with difficulties. The variability of weather patterns and the ongoing threat of plant diseases have a substantial impact on crop productivity and present considerable challenges to farmers globally. In order to deliver timely and informed strategies for agricultural process optimization, addressing these difficulties requires creative solutions that make use of technology. The Smart agricultural System, an integrated framework powered by state-of-the-art machine learning techniques, is a novel concept that this study introduces. This system intends to transform conventional farming operations by combining data-driven insights, predictive modeling, and picture analysis.

Its main goals are to forecast crop productivity, provide customized fertilizer recommendations, and identify plant illnesses early on. The system's core capability is the extensive use of past weather data, which makes precise weather forecasting possible.

These predictions are essential in helping to make well-informed irrigation decisions and guarantee the best possible growing conditions for crops. Furthermore, precise predictions of agricultural production are made using machine learning models that utilize data on crop growth, soil characteristics, and meteorological factors.

II. RELATED WORKS

[1] Gives a brief explanation of the fundamentals of CNN and explains how voice recognition can be done with it. [2] Artificial Neural Networks (ANNs) exhibit remarkable adaptability to many issue scenarios and may be tailored to virtually any form of data representation. [3] Discussed supervised pattern recognition.[4] In order to predict traffic volumes in

TCP/IP networks with accuracy, this paper offers three approaches: two significant adaptive time series methods (ARIMA and Holt-Winters) and a unique neural network ensemble approach.[5] Using pattern recognition algorithms, weather patterns linked to previous extreme events are found. Future day weather patterns are classified as extreme or non-extreme based on how closely they resemble past extreme event patterns.

III. PROPOSED SYSTEM

By providing farmers with practical insights, this data-driven method enables them to make well-informed decisions on irrigation schedules and resource allocation. Also, by evaluating soil properties and nutrient requirements, the Smart Irrigation System incorporates fertilizer recommendations that are specifically tailored to the needs of crops and soil. This reduces resource waste and optimizes agricultural practices, supporting sustainable farming practices and to forecasting.

These predictions are essential in helping to make well-informed irrigation decisions and guarantee the best possible growing conditions for crops. Additionally, machine learning models accurately predict crop yield by utilizing data on crop development, soil characteristics, and meteorological factors. Farmers are able to make well-informed decisions on irrigation schedules and resource allocation thanks to this data-driven strategy, which provides them with practical insights. Moreover, fertilizer suggestions appropriate to crop demands and soil composition are included into the agricultural System.

It contributes to sustainable farming methods by minimizing resource waste and optimizing agricultural activities through the analysis of soil properties and nutrient requirements. Apart from forecasting Farmers are empowered with meaningful information from this data-driven strategy, enabling them to make well-informed decisions about irrigation schedules and resource allocation. Additionally, the Smart Irrigation System incorporates fertilizer recommendations made specifically for the needs of different crops and soil types.

It eliminates resource waste and optimizes agricultural processes, supporting sustainable farming approaches, by assessing soil properties and nutrient requirements. The system uses deep learning and convolution neural network (CNN)-driven image processing algorithms to estimate yield and optimize resource utilization. This feature allows the system to precisely recognize and diagnose plant illnesses from photos of the leaves.

By taking a proactive approach, crop damage can be mitigated, and higher yields can be guaranteed by prompt intervention. The goal of this project is to provide an interface that farmers can easily use, providing them with useful information and technological assistance. This system aims to improve agricultural sustainability, reduce disease-related losses, and promote more effective resource use by providing easily accessible tools that support decision-making.

i) ADVANTAGES

- Ensures data-driven decision-making by using machine learning for disease diagnosis, fertilizer advice, and agricultural production prediction.
- Provides accurate irrigation scheduling that optimizes water usage and minimizes waste by utilizing weather forecasts.
- Employs AI algorithms and image processing to detect diseases early and accurately, allowing for quick action to reduce crop damage.
- Enhances agricultural productivity and quality by offering customized fertilizer recommendations based on crop requirements, soil composition, and predictive modeling.

IV. SYSTEM ARCHITECTURE

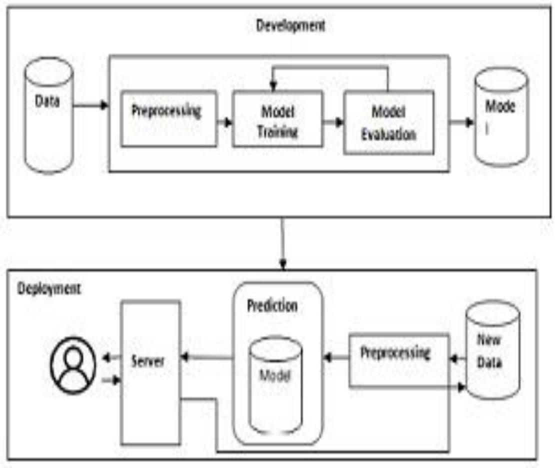

Fig 1. Architecture

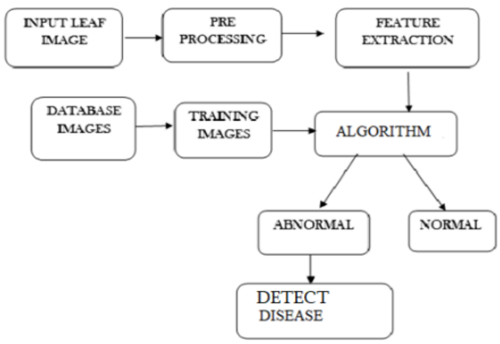

Fig. 2 Data Flow Diagram

Use Case

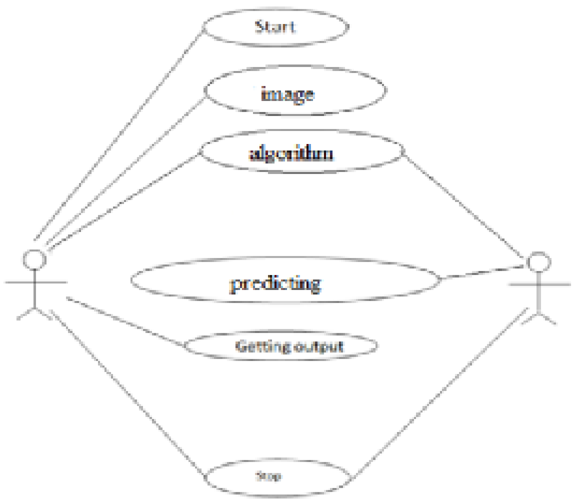

Fig 3. Use Case diagram

Sequence Diagram

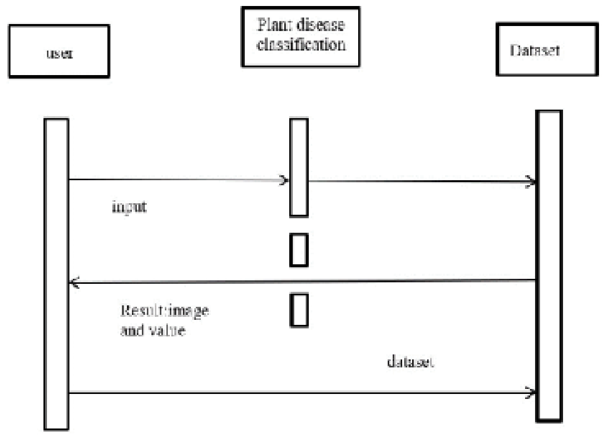

Fig 4. Sequence Diagram

E-R DIAGRAM

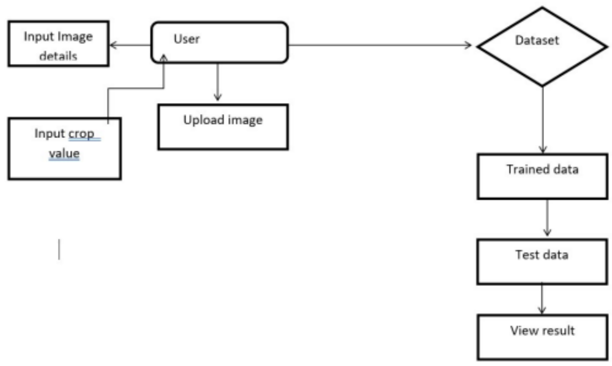

Fig 5. E-R Diagram

A) MODULE DESIGN

- Image Input Module
- Pre-processor Module
- Feature Extraction Module
- Segmentation Module
- Validation Module

MODULES DESCRIPTION

Image Input Module

Any data or information provided to a computer for processing is referred to as input in this module. Input, to put it simply, is the process of entering data into a computer. The system is provided with a diseased plant image input so that it can carry out the stated task.

Pre-processor Module

The signals that are received in this module contain a wealth of information that may be utilized to extract the chemical and physical characteristics of the target tissue. Assigning distinct attributes to every voxel is connected to the idea of identifying the statistical pattern. Anybody wishing to use sets with different attributes must process the entire amount of data because the resulting database grows exponentially with each additional attribute.

Feature Extraction Module

The target we're searching for and the processing that needs to be done on the image determine which feature extraction approach is used in this module. A system architecture diagram demonstrates it. First and higher-order operators, as well as Gamma Correction for textural feature analysis, are among the techniques have been used on the plant and weather data.

Segmentation Module

After feature extraction, it is appropriate for segmentation because of the following five key features

1. Big databases can be managed by it.
2. Thousands of variables can be controlled by it
3. The segmentation variable's significance is estimated.
5. It produces a non-biased estimator from the generalized error, and
4. It balances the error of the unbalanced datasets.

Validation Module

Some significant parameters must be taken into account in order to validate the algorithm's performance. The system will use the training dataset to validate the image and make a decision based on the given parameters.

CNN vs ANN

The advent of the Artificial Neural Network (ANN) has brought about a significant transformation in the field of machine learning. In common machine learning tasks, these computer models with biological inspiration can perform significantly better than earlier versions of artificial intelligence. Convolution Neural Networks (CNNs) are among the most striking examples of artificial neural network architecture. CNNs are mostly employed to tackle challenging image-driven pattern recognition applications, and their exact yet straightforward architecture makes it easier to begin using ANNs.

V. OUTPUT

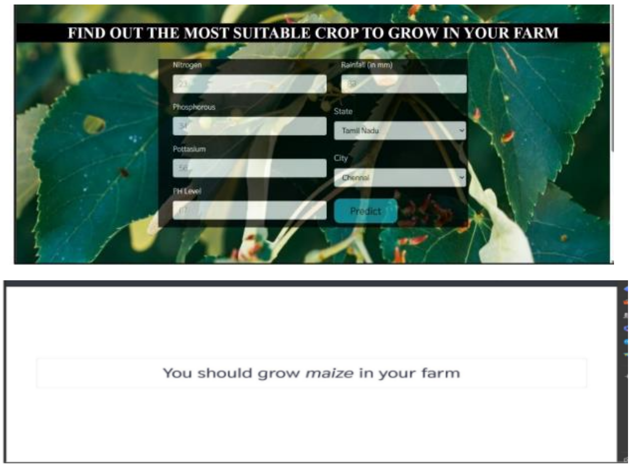

Fig 6. Suitable Crop for soil

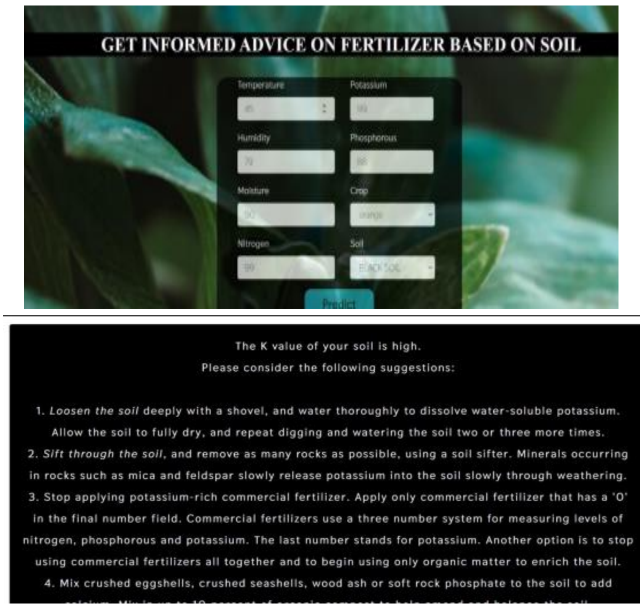

Fig 7. Fertilizers Suggestion

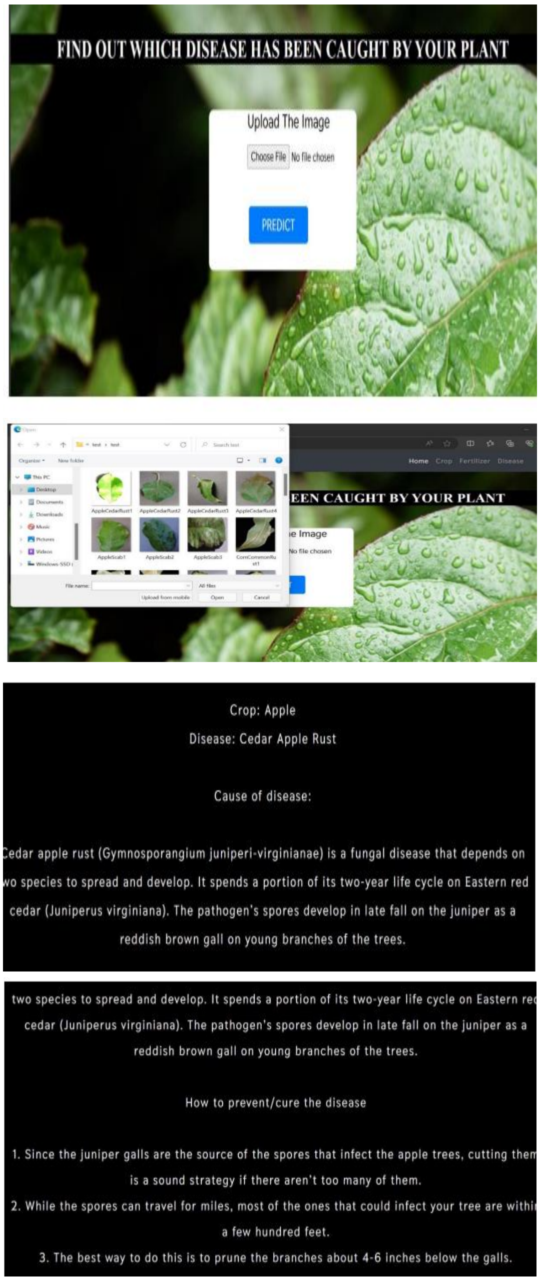

Fig 8.Plant Disease Prediction

VI. CONCLUSION

This project gives an overview of deep learning fundamentals and a thorough analysis of current research on deep learning-based plant leaf disease detection. Deep learning approaches may identify plant leaf diseases with high accuracy, if there is enough availability for training. Large datasets with high variability should be gathered, data augmentation, transfer learning, and CNN activation map visualization should be done in order to improve classification accuracy. The significance of hyper-aspect reimaging for early plant disease detection and small sample plant leaf disease detection should also be considered.

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