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Intelligent System to Analyse Plant Diseases Using Machine Learning Techniques

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Abstract: ***Agriculture is the main backbone occupation for Indians. It is critical to diagnose plant illnesses early in order to avoid crop loss and disease spread. The disease is apparent on the leaves of most plants, including apple, tomato, cherry, and grapes. These observable patterns can be recognized in order to accurately forecast the disease and implement preventative measures early on. To overcome this, it's better to use two techniques one is machine learning and another one is deep learning. So, this paper proposes a system for identifying plant disease (tomato, corn, paddy, and cotton) from their leaf photos. The method is carried out using the machine learning technique that is Support Vector Machine and the deep learning technique called Convolutional Neural Network. After the algorithms have been trained on the dataset, the accuracy of the algorithms is compared, the photos are categorised, and preventions for unhealthy plants are proposed***

I. INTRODUCTION

The integration of machine learning in plant disease analysis represents a significant advancement in agriculture. This intelligent system leverages algorithms to examine patterns and anomalies in plant health, offering a proactive approach to disease detection. By analyzing various data sources such as images, sensor readings, and historical records, the system aims to provide accurate and timely diagnoses. This not only enhances crop yield prediction but also facilitates early intervention strategies, ultimately contributing to more sustainable and resilient farming practices plant diseases can be classified as infectious or noninfectious, depending on the causative agent .Infectious diseases are caused by the living organisms such as fungi, bacteria, viruses, nematodes and parasitic plants

II. PROBLEM STATEMENT

In India, farmers still use traditional methods to detect plant diseases. They rely on their naked eye observation to identify the symptoms of diseases. However, with the advent of technology, there has been a shift towards more advanced techniques for detecting plant diseases. One such technique is deep learning-based image to identify patterns in the images and classify them as healthy or diseased . Recent research has shown that deep learning-based methods are more accurate than traditional image-based methods for detecting plant diseases. These methods use convolutional neural networks (CNNs) to extract features from images and classify them as healthy or diseased.

III. LITERATURE SURVEY

A literature review on the topic of using intelligent systems and machine learning for the analysis of plant diseases reveals a growing body of research aimed at developing effective and efficient solutions for detecting, diagnosing, and managing plant diseases.

The integration of technology, particularly machine learning, has shown great promise in revolutionizing traditional methods of plant disease identification. Below is a summary of key findings and trends in the literature:

A. Image Processing and Computer Vision

Many studies focus on utilizing image processing and computer vision techniques to analyze visual symptoms of plant diseases. High-resolution images of leaves, stems, and fruits are commonly used for disease detection.

Techniques such as image segmentation, feature extraction, and pattern recognition are employed to identify specific symptoms associated with various plant diseases.

B. Dataset Creation and Augmentation

The availability and quality of datasets play a crucial role in the success of machine learning models. Researchers often create or curate datasets containing labeled images of healthy and diseased plants.

Data augmentation techniques, such as rotation, scaling, and flipping, are frequently used to increase the diversity of the training data and improve the model's generalization.

C. Machine Learning Algorithms

Various machine learning algorithms are employed for plant disease detection, including but not limited to convolutional neural networks (CNNs), support vector machines (SVMs), decision trees, and random forests.

Deep learning techniques, especially CNNs, have shown superior performance in capturing intricate patterns in images, leading to accurate disease identification.

D. Remote Sensing and IoT Integration

Some studies explore the integration of remote sensing technologies and the Internet of Things (IoT) for continuous monitoring of plant health. This involves the use of sensors and other devices to collect real-time data from the field.

Remote sensing data, such as satellite imagery and drone-based images, provide a holistic view of crop health, aiding in early disease detection and management.

E. Transfer Learning and Model Interpretability

Transfer learning, where pre-trained models are fine-tuned for plant disease detection, has gained popularity. This approach is particularly useful when limited labeled data is available for a specific crop or disease.

Researchers are increasingly focusing on enhancing the interpretability of machine learning models to provide actionable insights for farmers and stakeholders.

F. Challenges and Future Directions

Despite the progress, challenges such as limited labeled datasets, environmental variations, and the need for real-time disease monitoring still exist. Future research directions include exploring multi-modal approaches, integrating domain knowledge, and developing user-friendly applications for farmers.

In conclusion, the literature indicates a significant advancement in leveraging machine learning for plant disease analysis. The integration of advanced technologies not only improves the accuracy of disease detection but also holds the potential to revolutionize precision agriculture practices, contributing to sustainable crop management.

IV. REQUIRED TOOLS

A. Software System Requirements

1) Operating System: Windows XP/7/8/8.1/10, Linux and Mac

2) Coding Language: Python

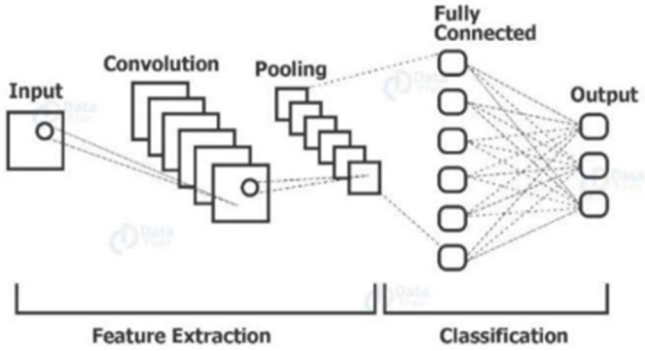
3) Tools:

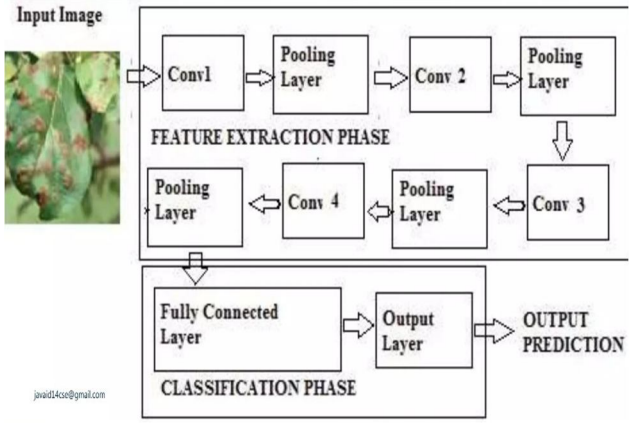
- Pandas
- NumPy
- TensorFlow
- Keras
- Sickitlearn
- opencv

V. METHOLOGY

The methodology for automatic plant leaf disease detection involves collecting a diverse dataset of plant leaf images, preprocessing them to enhance quality, extracting meaningful features, training a machine learning or deep learning model on the extracted features, evaluating the model's performance using validation metrics, tuning, hyper parameters for optimization, testing the model on an independent dataset, and deploying it in a suitable environment. Iterative refinement and regular updates may be required. This methodology enables accurate disease detection, allowing for timely interventions and contributing to sustainable agriculture practices.

Once the model is trained and validated, test it on an independent test dataset to evaluate its generalization ability.Finally,deploy the model in a suitable environment, such as web application or a mobile application or a mobile app,to make it accessible for real-world use.





VI. EXPERIMENT RESULTS

Here we will get the type of the disease effected from the given image. The following figures shows the ill ness of the plant and the given converted image after the process of the segmentation and the same image in form of gray scale. And the last image is the feature extracted image.

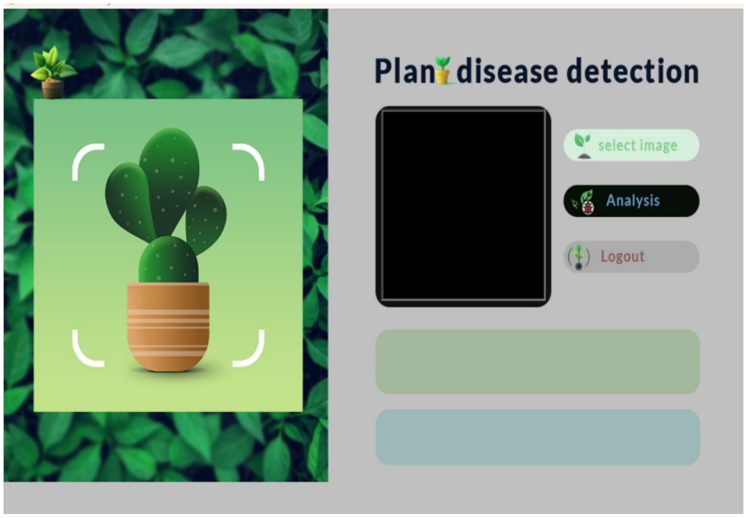


Figure : The Home screen

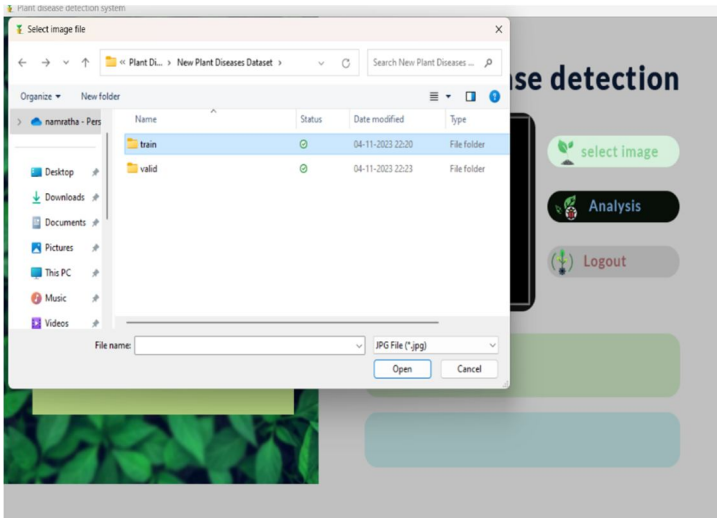


Figure : Shows train and valid datasets

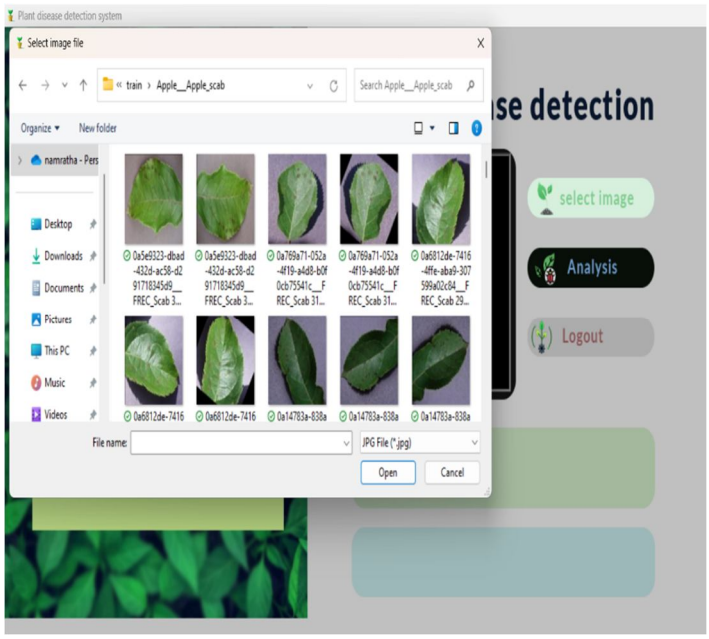


Figure : Selecting a leaf for analysis of disease

Figure: Detection of disease

VII. CONCULSION

In conclusion, the intelligent system designed for analyzing plant diseases using machine learning techniques has proven to be a valuable tool in agriculture. Through the utilization of image recognition algorithms and data analysis, the system demonstrated efficient identification of various plant diseases, aiding in timely and accurate diagnosis. The integration of machine learning not only enhances disease detection but also enables continuous learning and improvement over time. This project contributes to the advancement of precision agriculture, offering farmers a proactive approach to manage and mitigate crop diseases, ultimately promoting higher yields and sustainable farming practices.

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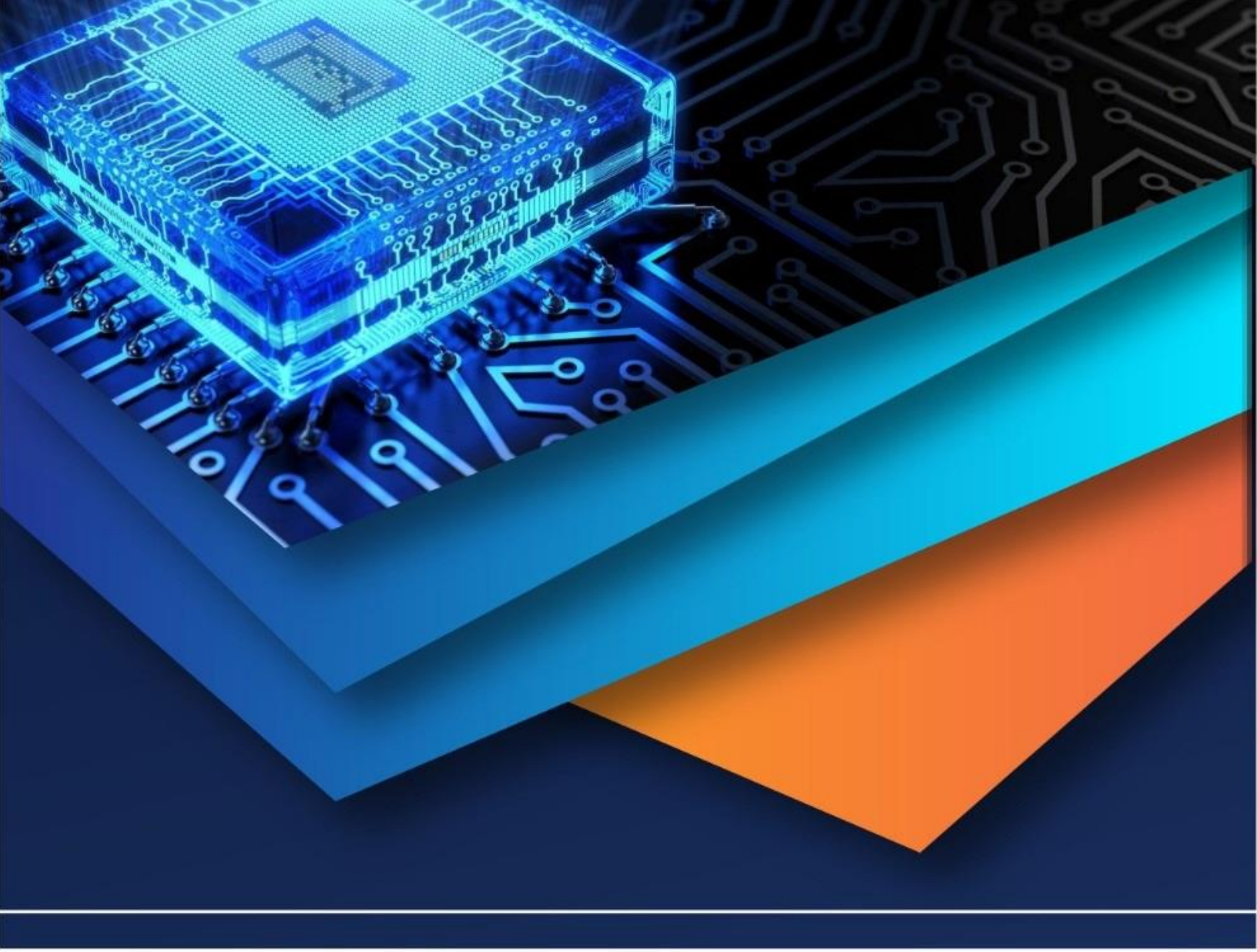

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