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Plant Disease Detection Using Machine Learning

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Abstract: Agricultural practises are essential to maintaining food security and sustaining our growing global population. on the other hand, plant disease pose a serious threat to crop harvests, causing financial losses and food shortages.

The study begins by collecting high resolution photos of plant leaves, paying particular attention to leaves that show signs of illness. The images then pre-processed to enhance their quality and standardize them for analysis. Various machine learning algorithms including Convolutional Neural Networks (CNNs), are trained on this dataset enabling accurate classification of healthy and diseased plant leaves.

The best things is that by developing web-platform for field deployment of the trained machine learning models. This makes it possible to detect disease easily, which helps farmers manage their crops more intelligently. Furthermore, the detecting system made to be user friendly, offering a simple web platform for users to interact with the detecting system.

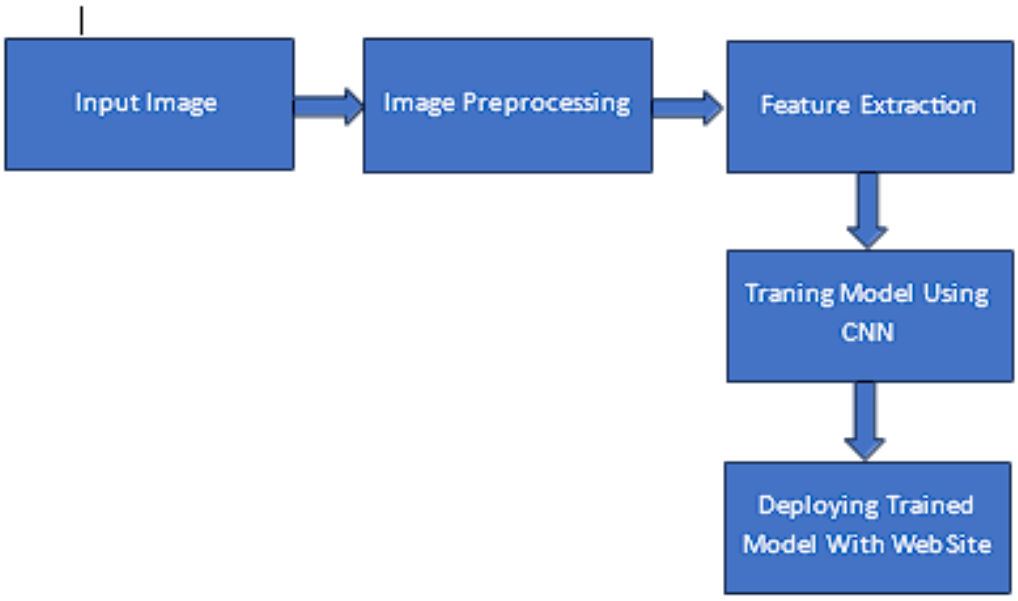
Keywords- : Plant disease Detection, Machine learning, Web developement, Image processing, Computer vision, Deep learning, Convolutional neural networks, Training dataset, Python programming, TensorFlow.

I. INTRODUCTION

Plant disease have been a persistent problem since many years. The conventional way of detecting the disease was done by farmers but it was not that much convenient because farmers do not have that much proper knowledge of some disease.

This might cause their crops to be lost. Then some of the expertise in this field were also there to detect the disease but that process is too much time consuming. In recent years there is growing interest in using technology in the agriculture sector causing to develop in the plant disease detection system.

Flowchart of Methdology:



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II. LITERATURE SURVEY

This paper reviews recent research focused on the intersection of Machine learning and Plant disease detection system. In a study, by Uday Pratap Singh, Sidhhart Chouhan, Sukrity Jain and Sanjeev Jain. They provides an overview of Anthracnose disease in mango trees, its symptoms, causes and the importace of early detection and classification of disease management. They explained why image classification is valuable tool for diagnosing plant diseases including "Anthracnose" in mango leaves. They used convolutional neural network for image classification. They described architecture, layers, and any novel techniques or innovations used the model. The paper includes detailed dataset including number of samples, data agumentation techniques and any specific challenges related to collecting and preparing the dataset. They also shared result convolutional neural networks (CNNs) and suggests potential future research directions in the area of mango leaf disease classification using deep learning[1].

In the paper of Peng Jiang, Yuehan Chen, Bin Liu, Dongjian He and Chunquan Liang they firstly gives introduction to apple leaf disease, their economical and environmental impact and importance of early detection and classification for disease management of apple orchards. Then they discussed the significance of imagebased disease detection in agriculture. Particularly in the context of apple leaf diseases. They Highlight the need of accurate and efficient methods for disease classification.Then they collect the dataset for their project which includes the images of apple leaves corresponds to five claases: Alterneria spot, brown spot, grey spot, mosaic, and rust. Then they developed some models for detecting this types of diseases quickly and more accurately. Then they provided result and conclusion of the project[2].

In the plant leaf disease detection using machine learning, the study by Amrita Tulshan and Nataasha Raul Maria delves into the fusion of matlab and machine learning algorithms. They used other classifiers such as KNN for classifying data more than two classes. Total seven diseases were detected by their systems. More additionally they assures that their system detects disease name as well as accuracy percentage of affected area.

The discussed diseases in their paper are Down mildew, early blight, mosaic virus, leaf miner, white fly. Then they explain methodology which includes the working flow, pre-processing, image segmentation,etc. Then they trained dataset which includes training and testing data and performed experiments in matlab. After that they shared result, conclusion and future work and particular references which they had taken in their paper[3].

Furthermore, the work by Kaucher ahmed, Tasmia shahidi, syed alam and sifat momen emphasizes the rice as a stable crop and the impact of diseases on rice yeild and quality. They also explained why automated disease detection is crucial for early intervention and crop prevention. After that it includes the significance of machine learning techniques such as deep learning and traditional algorithms in automating the detection of rice leaf diseases. Then the paper includes literature survey consist of previous project studies that have used machine learning methods for detection of diseases. Then they provided the block diagram of their entire work flow. Then they created the dataset. The dataset was created by Harshadkumar, et al. manually by separating infected leaves into three classes:

Bacterial leaf blight, brown spot andleaf smut. Then they used some classifiers for classification like logistic regression, KNN, Decision tree and after that their paper concludes with results, conclusion, future work and references[4].

1. CNN technique:

Convolutional Neural Networks (CNNs) have proven to be highly effective in the field of plant disease detection using machine learning. This neural networks are to be designed to recognize patterns and features in images, making them ideal for analyzing plant images and diagnosing diseases. CNNs are typically used in context:

Data Collection: The first step in using CNNs is to gather large dataset of images. These images includes healthy plants as well as those infected with various diseases. It is crucial to have a diverse and well labeled dataset to train and test the CNN effectively.

Preprocessing: Before feeding the images into CNN, preprocessing steps are often applied. This may include resizing images to a consistent resolution, normalizing pixel values and agumenting the dataset with variations like rotation, flips and brightness adjustments. This steps helps CNN to learn invariant features and improve its generalization.

CNN Architecture: The CNN architecture consist of :
a. Convolutional Layers : These layers apply a set of filters to the input image, scanning of pictures like edges, textures and shapes.

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b. Pooling Layers : Pooling layers reduces the spatial dimensions of the feature map helping to retain important information while reducing computational complexity.

c. Fully Connected Layers : These layers are typically used in the final part of network to make predictions based on the features extracted in the previous layers.

Training: The CNN is trained using labeled dataset.
During training the network learns to associate image features with disease labels.This process involves feeding forward an image, calculating the error between the predicted and acutal label, then using backpropogation to adjust the networks parameters to minimize the error.

Validation and Testing: After training CNN is validated and tested on separate datasets.The validation set helps fine tuned the model while testing set provides an evolution of the model's performance. Metrics like accuracy, precision,recall and F1 score commonly used to assess model's effectiveness.

Model Evaluation and Deployment: Once the CNN demonstrates satisfactory performance, it can be deployed for real world plant disease detection. This might invlove integrating it with hardware like Raspberry Pi, drones or mobile apps for on site disease monitoring.

Continuous Improvement : To keep the model accurate and up to date, the CNN can be continually retrained with new data to adapt to changing disease patterns and environmental conditions.

CNN have proven to be powerful tool for automating plant disease detection, saving time and resources for farmers and potentially reducing crop losses. They can analyze a large number of images quickly, perfectly and more accurately, helping to identify diseases at early stage and mitigate their impacts on crops.

III. CONCLUSION

The project on "Plant disease detection using machine learning" gives a noteworthy advancement in the field of agriculture and technology. This creative idea has the potential to completely change how we monitor and manage plant health by utilising the power of machine learning algorithms.

Through the project we have demonstrated the feasibility of creating an web-platform that can easily identify and diagnose plant diseases, there by enabling the farmers to take timely and targeted actions to protect their crops. It also has the potential to increase agricultural yeilds and reduce the reliance on chemical pesticides, promoting more sustainable, helpful and environment friendly farming practises. Moreover, the project showcases the synergy between cutting edge technologies like machine learning and easily accessible web platform making it feasible to farmers in diverse region to adopt and benefit from this system.

Furthermore, there is room for further improvement and expansion of this project. Enhancing the accuracy of disease detection models, integrating more sensors for environmental modeling and extending the platform to cover wide range of plant species and diseases are all exciting avenues for future development.

Ultimately, this project is testament to the immense potential of technology to address real world challenges and it paves the way for brighter and more sustainable future for agriculture, one in which farmers can make informed decisions to ensure food security and environmental preservation.

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