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Tomato Plant Disease Detection System

Mansi Jadhav[1], Sabah Bagwan[2], Parth Jaiswal[3]

Guided by **Prof. Usha Walke**

[1,2,3]Department of Electronics & Telecommunication,

Pune Vidyarthi Griha's College of Engineering and Technology – Pune, India

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ABSTRACT

In many households and farming practices across India, plantations play a crucial role in sustaining livelihoods and providing essential resources. These practices face some setbacks in the by diseases due to various environmental or nonenvironmental factors. Such factors could be dealt on early if the factors and diseases are identified at an early stage. This report discusses a solution with the help of Machine Learning algorithms and a web-based interface that will help improve farming practices and render a reliable solution for early diagnosis of relevant plant diseases. In this project, we deliver a handheld solution for these afflictions.

Keywords: Plant disease, ML Model training, Disease Detection, Diseased Leaves, Advanced Algorithms.

I. INTRODUCTION

Be it farming on larger lands or cultivating on a smaller scale at home plantations serve a crucial function in sustaining livelihood. Plantation practices are however prone to various diseases like bacterial diseases, fungal diseases, various soil borne, etc. Thus a way of preventing the effects of these diseases can be significantly reduced with the help of technological advancements such as Artificial Intelligence and Machine Learning Models which are trained to precision with larger group of data which is in the form of images, analyzing disease patterns. The Project delivers a system which uses ML Model to make identification of diseases easier and allows the user to render early on solutions to the problems they face.This Project circulates around a single specimen that is The Tomato plant. The system uses Data uploaded by the user as an input to the pretrained ML model which processes the uploaded input and compares the result with the previously trained training patterns and predicts the output. This Model is trained with a Dataset which consists of approx. 1700-1800 images of 5 different categories including images of both healthy and diseased plant leaves. This Output and Input is provided on an interactive User interface of the App/Website. With the use of the Inception Model and by leveraging effective algorithms, our solution will accurately identify various diseases affecting tomato plants, providing early detection and enabling prompt intervention strategies. This project not only addresses the pressing need for efficient disease management in agriculture but also contributes to the advancement of technology-driven solutions for precision farming.

II. LITERATURE SURVEY

[1] Early Detection and Classification of Tomato Leaf Disease Using High-Performance Deep Neural Network. | December 2021.
This research article elaborates on deep neural network model for identifying and distinguishing tomato plant leaf diseases types. It also considered morphological traits such as color, texture, and leaf edges of the plant. This research article introduces standard profound learning models with variants. This research article discusses biotic diseases, particularly tomato leaf blight, blast, and browning, that are brought on by bacterial and fungal pathogens.

[2] Wheat Leaf Disease Detection Using Machine Learning Method - A Review
This review advocates that the support vector machine's exhibits the properties of robustness and is feasible for wheat disease detection. The identification of wheat leaf has been developed using the different software. The important features on which disease detection is identified of wheat leaf are speed and accuracy. It helps in the increase of throughput and detection in any wheat leaf disease. Wheat disease is detected by the SVM classifier. All the diseases and various methods are mentioned in this paper. It deals with various methods for wheat disease detection. For more accurate results different algorithms will be used.

[3] Deep Learning Based Plant Diseases Monitoring and Detection System.
This research paper describes a system which provides an easier way for the farmers upload a picture of a leaf and receive relevant details about it, such that whether it is healthy or, diseased if it is diseased then suggest some alternative remedies. The researchers used Convolutional Neural Networks (CNNs), which is a subset of ANN to train

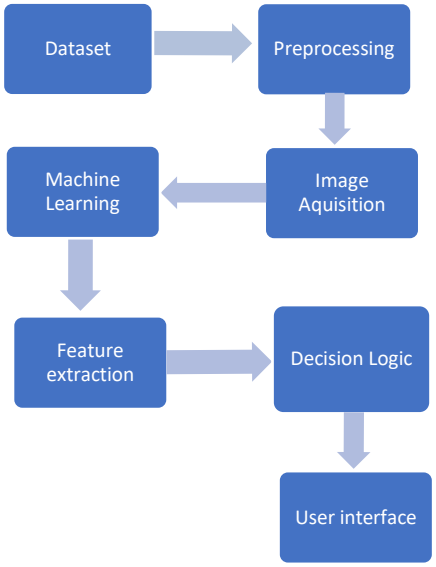
their model. They used 4,500 leaf imagesdifferentiates into four different classes as the training set for their CNN model. The researchers created three sections of their dataset: training (60%), validation (20%) and testing (20%). The model is proposed, created, and trained with its validation accuracy and results show 96% and its test accuracy was 93%.

[4] Improved AlexNet with Inception-V4 for Plant Disease Diagnosis.
The paper makes uses the combination of the two complementary network structures, which is Inception-V4 and AlexNet. Superposition of Inception-X (X represents A, B, C) modules in Inception-V4 is removed, which greatly reduces training and inference time with a sacrifice of negligible performance. Our Project uses the concept of inception for image classification and better feature extraction which helps with the disease detection process.

[5] Plant Disease Detection and Classification by Deep Learning - A Review
This Review article discusses the importance of collecting large datasets with high variability, data augmentation, transfer learning, The significance of hyper-spectral imaging for early plant disease identification, the value of small sample plant leaf disease detection, and the visualization of CNN activation maps in enhancing classification accuracy illness have been talked about in this article. In order to detect plant illnesses early, this paper combines deep learning models with hyperspectral imaging.

III. System Description

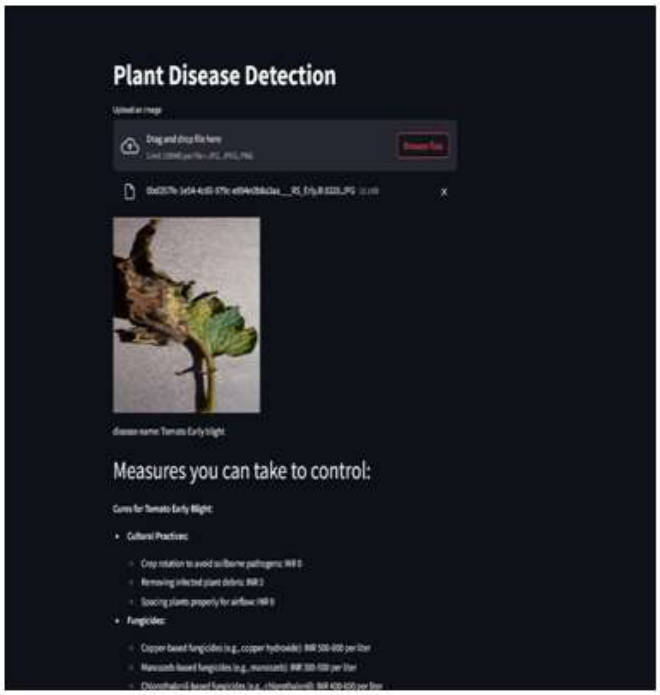
A. System Block diagram:



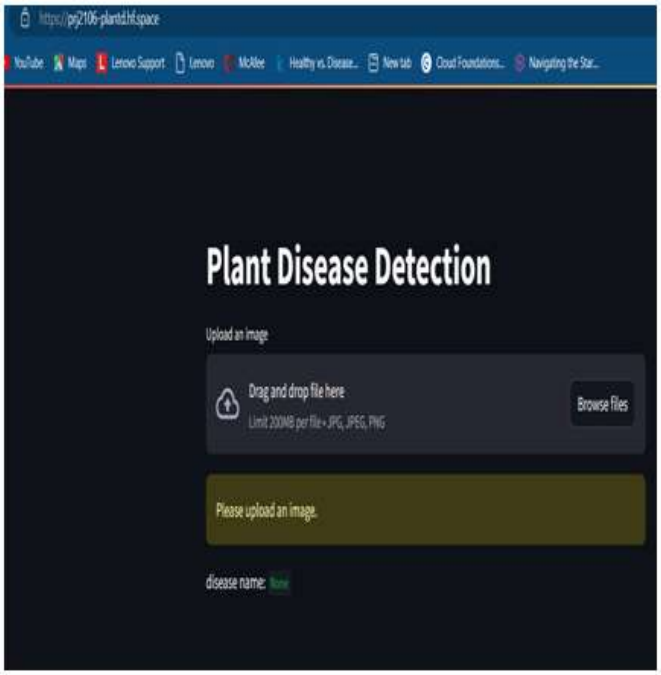
B. Working of the Project:

In this project we have utilized the concept of Machine Learning which uses “Inception Model” to analyze the input which will be uploaded by the user using a user interface on the website.
The Webpage allows the user to upload images which may be of different formats supported in terms of images such as JPEG, JPG, PNG. We start with the first step that is Data collection. Large dataset with labelled images distinguished into 9 categories have been downloaded from various preexisting online Datasets. This dataset contains around 1700 - 1800 images of 5 different category of diseased leaf images including healthy leaf images. After obtaining the dataset we perform preprocessing on the training data such as rotate, shift, resizing, flip. This step plays a crucial role for the further machine learning model as it increases the number of training images in their different orientation.
The Preprocessed data is then trained using the Inception Machine Learning model. This model makes use of the Inception model which is a pretrained model of 48 deep layers.It introduces the concept of inception modules. These are the building blocks that allow for the parallel processing of different scales of features within the network. We then define additional layers for transfer learning of our model on top of pretrained model. We then compile the model with specified loss function and optimizer. After this we start training the model using training and validation generators, specifying number of epochs and steps per epoch.After training the Model with labelled set of data the model generates different det of patterns for detecting differences in the different diseases. The ML model is thus trained with number of

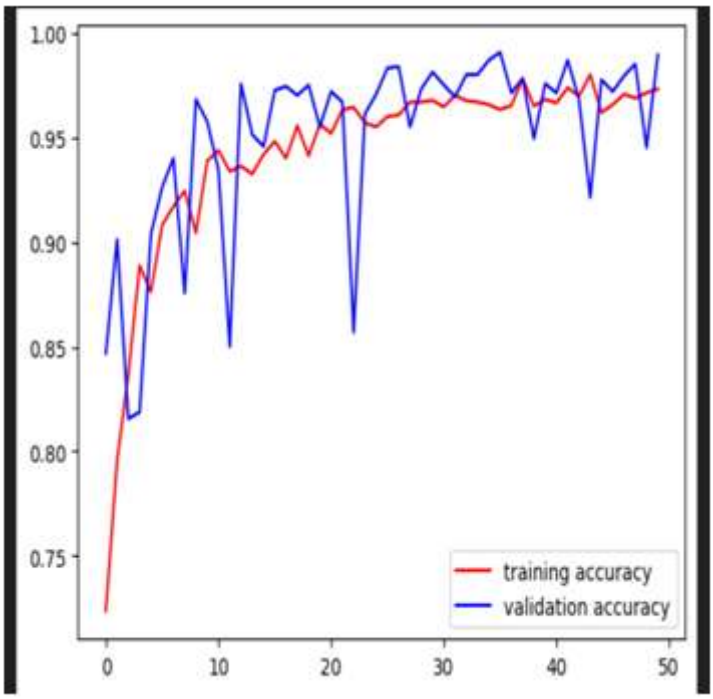
epoch cycles which increases the model accuracy in predicting the output.Saved the trained model in HDF5 or H5 format. We then used streamlit for front-end website within VS code; this is library used to develop a front-end interface in python language. It is necessary to develop the front-end in python helps the integration of front-end and back-end easy. Hugging Face provides an online platform and mobile application where users can access, share, and deploy models. It is mostly used for NLP but we are going to use this platform to create an environment for deployment of project. For this we need to upload 3 files: main code(.py), model file(.h5), text file for libraries used(.txt). uploaded API of gemini as secrets in huggingface, this helps is providing remedies and action against the disease detected by the model. This System uses input from the user in the form of image files. When the user uploads the image, the Frontend works to check that the uploaded image is of the predetermined extension which are permitted. If not, it displays with the error message and prompts the user to stick to the specifications. After uploading the image, the backend processes and prediction algorithms determine the type of disease. The user then gets a display of the Predicted Plant disease along with its preventive measures and remedies.



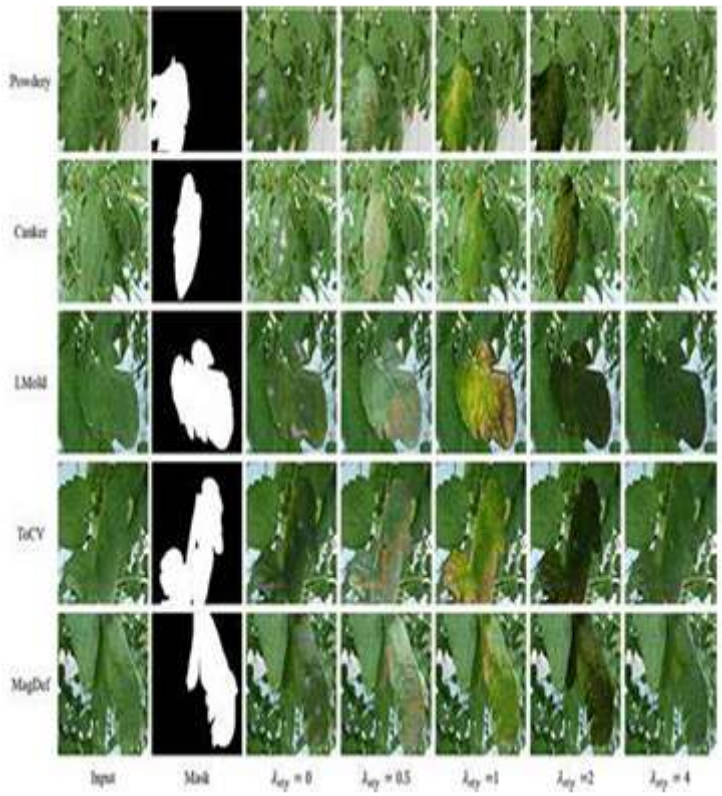
C. Front-End Of the Project:



D. Accuracy Graph



E. Dataset used for Project:



Training cycle	Loss	Accuracy	Validation loss	Validation accuracy
Epoch 1/50	76.12%	72.37%	40.61%	84.69%
Epoch 4/50	34.57%	88.88%	47.09%	81.88%
Epoch 8/50	22.11%	92.44%	32.43%	87.56%
Epoch 12/50	18.55%	93.37%	44.55%	85.00%
Epoch 16/50	15.08%	94.81%	07.82%	97.25%
Epoch 20/50	12.81%	95.63%	11.55%	95.50%
Epoch 24/50	13.23%	95.69%	09.98%	96.13%
Epoch 28/50	09.05%	96.69%	12.34%	95.50%
Epoch 32/50	09.09%	97.00%	08.48%	96.94%
Epoch 36/50	10.37%	96.33%	03.25%	99.06%
Epoch 40/50	99.06%	96.81%	07.14%	97.56%
Epoch 44/50	05.74%	98.00%	21.52%	92.12%
Epoch 47/50	09.17%	97.06%	05.73%	97.94%
Epoch 50/50	09.09%	97.31%	03.42%	98.94%

IV. PROJECT DESCRIPTION

(A) MODEL :

➢ GPU	2.8GB
➢ RAM	8GB
➢ INPUT TYPE	Jpg
➢ OUTFUT TYPE	Text
➢ FRONT END	streamlit
➢ PLATFORM FOR MODEL	kaggle
➢ MODEL TRAINING SPEED	90 minutes (approx.)

(B) DATASET:

1.	Image Type	jpg
2.	Avg. Size of 1 image :	20KB
3.	Total Size	0.7 GB
4.	Augmented	Yes
5.	Resolution	256x256

(C) RESULT ANALYSIS:

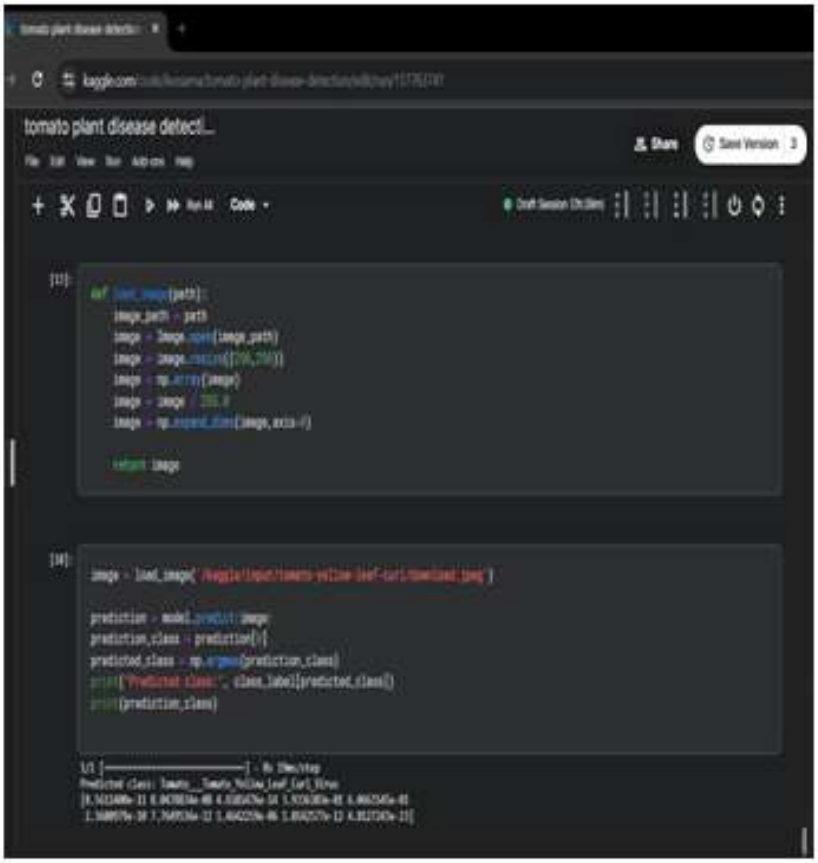
We observed the increase in rate of accuracy and simultaneously decrease in rate of loss with increase in epoch.

Number of epochs	Accuracy	Loss
1st epoch	72.37%	76.12%
10th epoch	93.88%	17.85%
20th epoch	95.63%	12.81%
30th epoch	96.77%	10.18%
40th epoch	96.81%	07.90%
50th epoch	97.31%	09.09%

(D) TESTING AND TRAINING OF ML MODEL:

Checking Accuracy and loss over different training cycle (values of epoch).

1. MODEL TESTING RESULTS:



Thus the Developed model gives an accurate prediction when the user uploads an image for detecting plant disease.

V. CONCLUSION

In this project, we started a journey to use machine learning to detect plant diseases in the field of agriculture. hoping to develop a state-of-the-art ML-based plant disease detection system with an intuitive web interface. The scope of this project extended far beyond its immediate applications. It ventured into a domain where technology meets agriculture, a realm where innovation meets sustainability.

VI. ACKNOWLEDGMENT

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