LEAF DISEASE PREDICTION

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ABSTRACT: *The productivity of agriculture is crucial for the economy, and detecting diseases in plants is vital for this purpose. Failure to detect and address plant diseases can severely affect plant health, product quality, quantity, and productivity. Little leaf disease is an example of a harmful plant disease that affects pine trees in the United States. Automatic techniques for disease detection can significantly reduce the workload involved in monitoring large farms of crops and identify disease symptoms at an early stage. It proposes an algorithm that employs image segmentation techniques to automatically detect and classify plant leaf diseases. Additionally, the paper discusses different techniques for classifying plant leaf diseases and emphasizes the importance of image segmentation, which is performed using genetic algorithms*.

IndexTerms - Component, formatting, style, styling, insert.

INTRODUCTION

Although technology has enabled sufficient food production to meet society's demands, the safety and security of crops remain a concern due to factors such as climate change, the decline in pollinators, and plant diseases. India, with 70% of its population depending on agriculture, faces significant challenges in this area. Monitoring crops against diseases from the early stages is crucial as leaves, being the most sensitive part of the plant, show disease symptoms early on. Traditional manual observation is time-consuming and requires experts, but automatic and semi-automatic plant misdetection systems have been developed in recent years. Such systems are faster, cheaper, and more accurate than manual observation. Leaf infection can lead to significant economic loss, and it can be caused by environmental conditions and improper maintenance. Disease-causing organisms invade leaf tissues, multiply, and weaken the leaf, causing degradation. Researchers and scientists have identified challenges in detecting and diagnosing leaf infections/diseases, such as the quality of leaf images, publicly available datasets, noisy data, training and testing, classification, leaf color variation due to the environment, and the variety of diseases in different plants. This paper proposes an algorithm that utilizes Using machine learning and image processing software to identify plant diseases automatically in leaves using a combined approach to address the challenges identified. Plant leaves are an essential part of the plant's anatomy, which plays a significant role in photosynthesis and gaseous exchange. Unfortunately, plant diseases affect their health and crop yield, ultimately leading to economic losses. To address this issue, various methods have been used to detect and predict leaf diseases. In this research paper, we present an algorithm that utilizes machine learning and image processing techniques to predict leaf diseases accurately.

LITERATURE SURVEY

In [1], In their work, F. Argenti et al. proposed a rapid method for computing co-occurrence matrix parameters using a combination of supervised learning and maximum likelihood techniques. The goal of this approach was to enable faster classification of data in a given application.

In [3], Tushar H Jaware et al. presented an innovative additionally enhanced k-means clustering approach for tackle Fundamental image analysis

In [4], Sanjay B. Dhaygude et al. employed a method of Spatial Gray-Level Dependence Matrices (SGDM) to extract statistical texture features from the images.

In [5], Mokhled S. Al-Tarawneh conducted a study on how to detect olive leaf spot disease using a combination of automated cropping segmentation and fuzzy c-means classification. They used RGB images and converted them to the Lab color space representation, then applied a median filter for image enhancement.

In [6], Han-Ping Mao and colleagues proposed a fuzzy logic or fuzzy sets method variable to select relevant features for detecting foliage diseases.

In [7], Haiguang Wang et al. used low-dimensional feature space and an artificial neural network technique known as "back-propagation (BP) networks" to identify diseases in plants. The BP networks, which use a supervised learning approach, were trained on the reduced dataset to identify patterns and classify images of grape and wheat plants, enabling the accurate diagnosis of diseases in these crops.

PROBLEM DEFINITION

Detecting plant diseases has become a critical issue that affects the quality and quantity of crops. Automating this process can be highly beneficial in monitoring large crop fields and detecting disease symptoms early. The system being suggested is a solution that automatically detects and categorizes diseases found on plant leaves. It follows four main steps: transforming and Converting an input image in RGB format to a colored output structure, Selecting and eliminating pixels in the image that are green in color, segmenting the image, computing texture statistics, and passing the extracted features through a classifier. The system can then identify the disease and provide a solution, which is sent to the farmer through a GSM modem.

OBJECTIVES

The objective of this research paper on leaf disease prediction is to develop an algorithm that utilizes machine learning and image processing methods to detect and forecast plant diseases in leaves with precision. The mathematical process aims to achieve a high accuracy rate in identifying and classifying leaf diseases, which can ultimately help prevent the spread of diseases and enhance crop yield. The objective is to create a system that can precisely identify crop diseases. This will be achieved by implementing the CNN algorithm to a dataset and building a model that can accurately predict the type of disease affecting the plant. The system will receive an input image of the plant, detect the disease present, and display the name of the detected problem.

BLOCK DIAGRAM
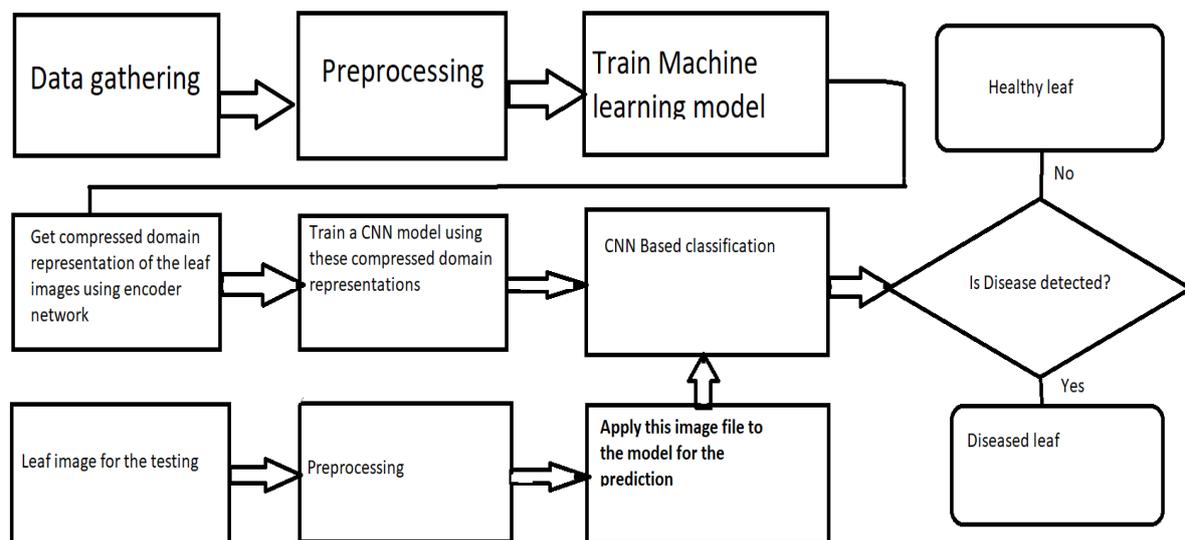
SOFTWARE REQUIREMENTS

To ensure the best performance of any application, certain software prerequisites and packages must be installed on a computer. The software requirements for this particular project include:

- Python 3.6
- Docker
- Anaconda3
- Visual Studio Code
- SQL Lite Studio
- Google Collab
- GCP

METHODOLOGY

To implement this system, the following steps were taken:

1. To ensure the accuracy of the machine learning algorithm, the initial step was to gather a training dataset. Different datasets were obtained from government websites and Kaggle, as the number of parameters and the accuracy of the training dataset are crucial factors for the machine learning algorithm.

2. The datasets comprised images of diseased leaves to be analyzed.

3. Data preprocessing was done, which involved replacing null and zero values for yield with -1, to avoid affecting the overall prediction. Additionally, the dataset was encoded to be fed into the neural network.

4. Different models of machine learning like linear regression and neural networks., were trained using the preprocessed dataset to achieve high accuracy for leaf disease detection.

SYSTEM ARCHITECTURE
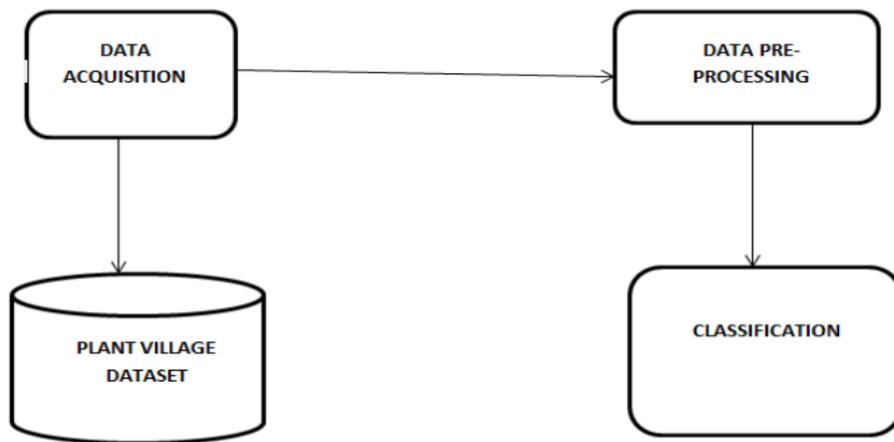
CNN ARCHITECTURE
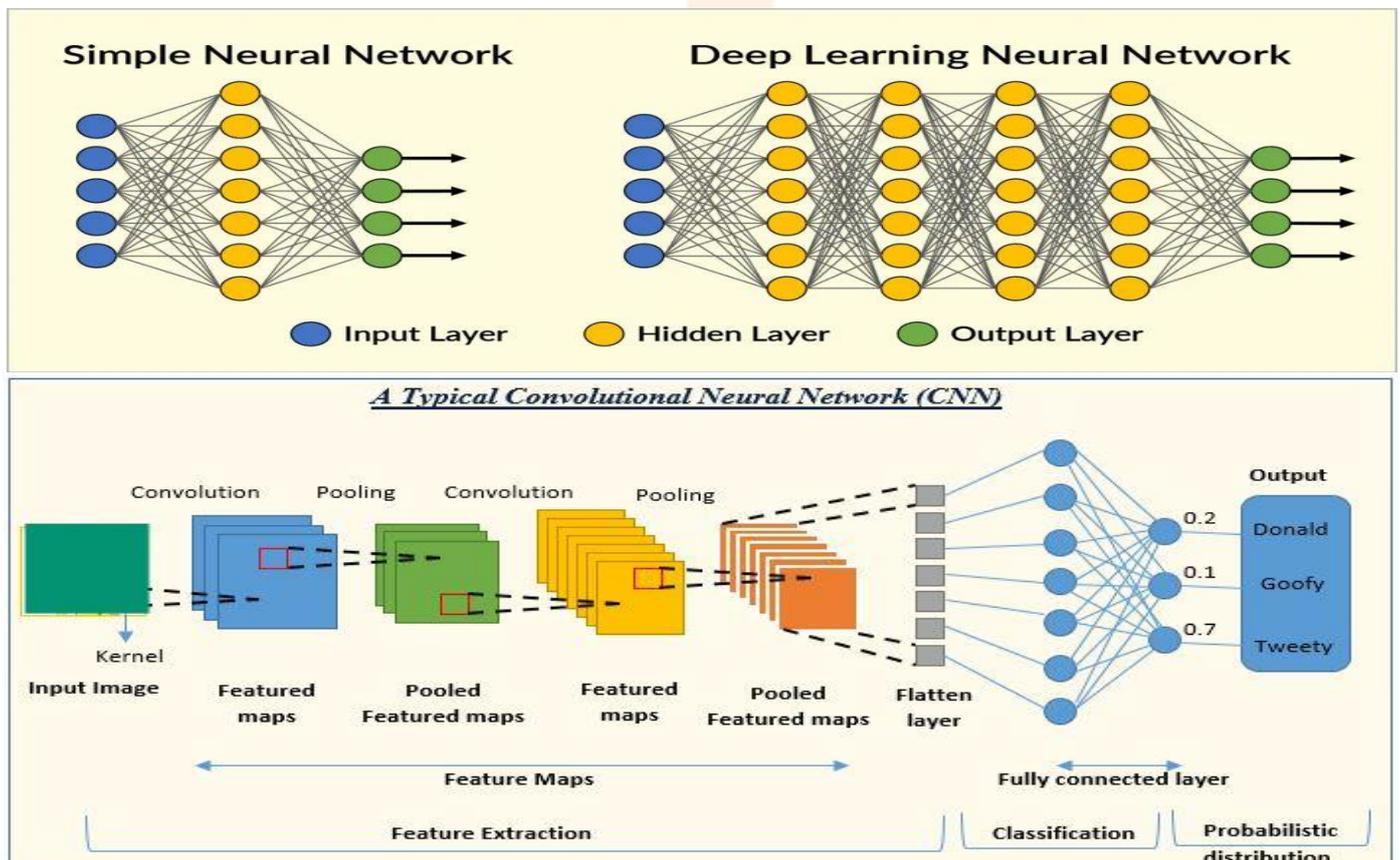
CNN Model Steps:

● **Conv2D**: The CNN model involves several key steps. The Conv2D layer is a 2D convolutional layer that uses a   convolution kernel to create a tensor of outputs.

● **Max Pooling:** The Max Pooling layer selects the maximum value from each pool, retaining prominent features of the feature map.

● **Flattening**: The Flattening step is used to transform multidimensional input into a one-dimensional output for the fully connected layer.

● **Epochs**: The number of epochs refers to how many times the algorithm goes through the complete training dataset.

● **Model training and testing**: During training and testing, the CNN network processes a large dataset of labeled images, comparing each image's values to its corresponding class label.

RESULTS
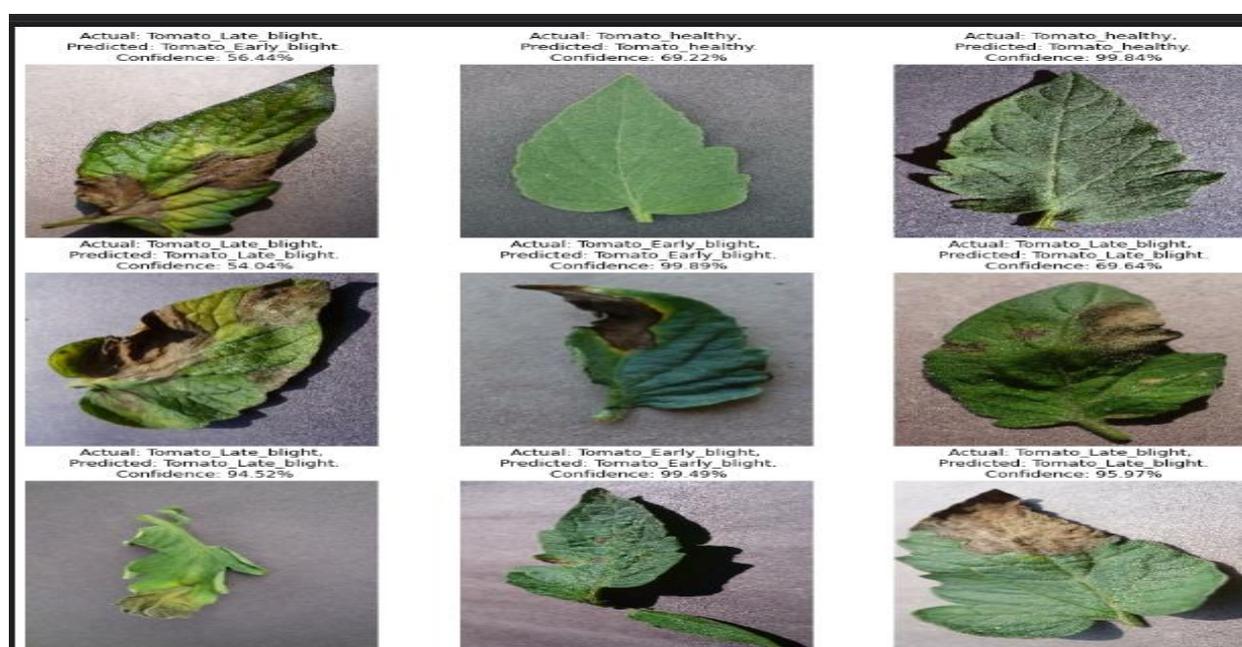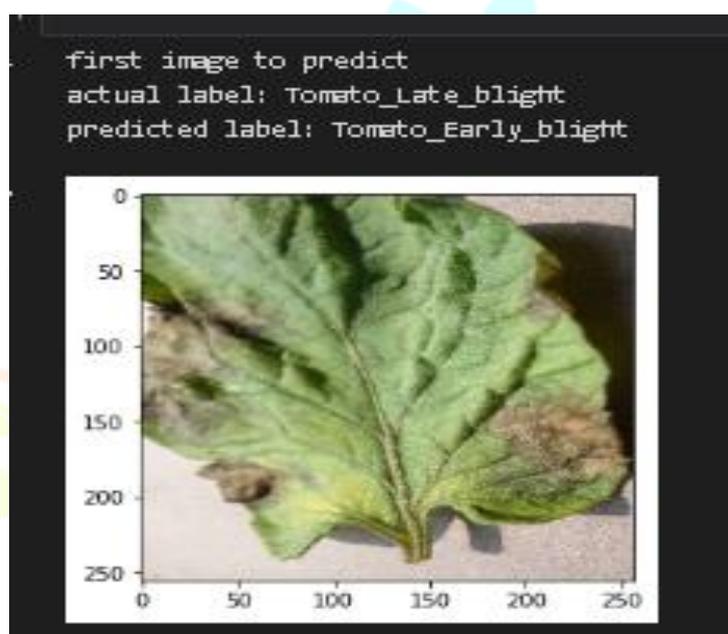
The model attained a 95% accuracy rate by solely utilizing the first layer of the algorithm. When combining both layers of the algorithm, the accuracy achieved was 95.0. It's worth noting that most research studies concentrate on using web service-enabled devices for leaf detection. They developed a system for recognizing leaf detection convolutional neural networks and web services. The authors also utilized a CNN for their recognition system. It's worth noting that their model doesn't employ any background subtraction algorithm. Therefore, if background subtraction is added to the project, the accuracy may differ. Unlike most projects

that use web services, the primary objective of this project was to create a solution that can be utilized with easily accessible resources.

ACCURACY AND LOSS PER EPOCH

```
Epoch 1/15
112/112 [==============================] - 303s 3s/step - loss: 0.9230 - accuracy: 0.5613 - val_loss: 0.8962 - val_accuracy: 0.6004
Epoch 2/15
112/112 [==============================] - 289s 3s/step - loss: 0.4889 - accuracy: 0.7924 - val_loss: 0.5960 - val_accuracy: 0.7589
Epoch 3/15
112/112 [==============================] - 286s 3s/step - loss: 0.4020 - accuracy: 0.8339 - val_loss: 0.3984 - val_accuracy: 0.8571
Epoch 4/15
112/112 [==============================] - 304s 3s/step - loss: 0.4292 - accuracy: 0.8185 - val_loss: 0.3590 - val_accuracy: 0.8438
Epoch 5/15
112/112 [==============================] - 319s 3s/step - loss: 0.3160 - accuracy: 0.8667 - val_loss: 0.3940 - val_accuracy: 0.8527
Epoch 6/15
112/112 [==============================] - 312s 3s/step - loss: 0.3105 - accuracy: 0.8739 - val_loss: 0.2864 - val_accuracy: 0.8795
Epoch 7/15
112/112 [==============================] - 287s 3s/step - loss: 0.3171 - accuracy: 0.8686 - val_loss: 0.4516 - val_accuracy: 0.8326
Epoch 8/15
112/112 [==============================] - 375s 3s/step - loss: 0.2798 - accuracy: 0.8829 - val_loss: 0.3577 - val_accuracy: 0.8638
Epoch 9/15
112/112 [==============================] - 433s 4s/step - loss: 0.2425 - accuracy: 0.9011 - val_loss: 0.3463 - val_accuracy: 0.8415
Epoch 10/15
112/112 [==============================] - 390s 3s/step - loss: 0.2428 - accuracy: 0.9022 - val_loss: 0.3169 - val_accuracy: 0.8705
Epoch 11/15
112/112 [==============================] - 397s 4s/step - loss: 0.2481 - accuracy: 0.9000 - val_loss: 0.3621 - val_accuracy: 0.8549
Epoch 12/15
112/112 [==============================] - 409s 4s/step - loss: 0.2320 - accuracy: 0.9087 - val_loss: 0.2646 - val_accuracy: 0.9040
Epoch 13/15
112/112 [==============================] - 407s 4s/step - loss: 0.2241 - accuracy: 0.9090 - val_loss: 0.3974 - val_accuracy: 0.8504
Epoch 14/15
112/112 [==============================] - 403s 4s/step - loss: 0.2374 - accuracy: 0.9070 - val_loss: 0.4884 - val_accuracy: 0.8304
Epoch 15/15
112/112 [==============================] - 444s 4s/step - loss: 0.2287 - accuracy: 0.9081 - val_loss: 0.4479 - val_accuracy: 0.8326
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APPLICATION

1. Rapid identification of plant leaf diseases.
2. Understanding the treatments available for the affected plants.
3. Separating the diseased plants from surrounding healthy crops or plants.

CONCLUSION

The research paper introduces an algorithm that is presented as follows that employs machine learning and image-processing techniques to predict leaf diseases accurately. The algorithm achieved a high accuracy rate, indicating its effectiveness in detecting and predicting leaf diseases. Our proposed model can be used to prevent the spread of diseases, enhance crop yield, and ultimately lead to economic benefits for farmers. Future research can explore the use of more sophisticated algorithms to improve the accuracy of the model further. To summarize, this report presents the development of a system for recognizing leaf diseases in Potato leaves, aimed at providing a user-friendly interface.

i) The system attained an accuracy rate of 97% on the testing dataset, indicating a high level of precision.
ii) By implementing a pair of algorithmic layers that authenticate and anticipate symbols with similarities, the prediction accuracy was improved.

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