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# Plant Leaves Disease detection by using Machine Learning & Image Recognition Techniques

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**Abstract:**
Plant diseases are a big issue in today's world, causing significant production and economic losses as well as a drop in both the quality and quantity of agricultural commodities. As a result, plant disease detection technologies and solutions have garnered increased attention in large-scale crop monitoring. Farmers face significant challenges when transitioning from one disease management regime to another. In this research, we examine the need for a simple plant leaf disease detection system, focusing on tomato leaf diseases, to aid in tomato crop health and harvest developments. Early diagnosis of crop health and illness can aid in disease control through correct management measures. This strategy will increase agricultural productivity. This study also examines the benefits and limits of several prospective technologies that farmers and agricultural specialists may employ to rapidly and effectively identify plant diseases, allowing for prompt intervention and the prevention of additional crop loss. As a result of this application, we can help to assure plant security while also having a good influence on agriculture.

**Keywords**: Disease detection, image capture, image recognition, machine learning models, pre-processing, categorization.

## 1. INTRODUCTION

India is an agricultural nation since agriculture employs the vast majority of its population. Agriculture research strives to increase productivity and food quality while spending less and earning more. To obtain more beneficial items, product quality management is significantly necessary. Numerous studies have found that plant diseases can reduce the quality of agricultural products. Fungus, bacteria, and viruses, as well as harmful and severe environmental circumstances, cause these disorders. As a result, it is very practical to seek a rapid, less expensive, and accurate method for automatically detecting illnesses from symptoms that appear on the tomato plant leaf and aiding in research into additional processes of recovery and leaf health improvements.

Fig 1.1 Plant Health in Agriculture

The primary goal of this research is to diagnose plant leaf diseases in tomato plants using simple image recognition models and processing approaches. The significance of recognising leaf diseases and plant leaves is discussed in Section 1. Section 2 discusses the importance of diagnosing leaf diseases, how to analyse plant leaves, and recognising the symptoms of the many kinds of leaf diseases in the tomato leaf category. Section 3 depicts the core ideology and literature evaluation used in the project. Section 4 provides a general summary of the latest work that has been executed in this project, as well as how the identification of the healthy and diseased categories of tomato leaf categorization has been done and delivered.

## 2. PLANT DISEASE DETECTION SYSTEMS.

### 2.1 Plant disease detection systems

One of the main causes of agricultural production losses and financial losses is plant diseases. Correct disease identification is a difficult undertaking that calls for experience. Here, we are targeting the tomato plant and the particular diseases pertaining to them and the varied classifications of their distinct disease analysis.

### 2.2 Analysis of tomato leaf diseases


Fig 2.2 (a) Tomato leaf disease classification

### Bacterial diseases symptoms and prevention

Tomato plants can be harmed by a range of bacterial diseases. A variety of Xanthomonas bacterial species produce the common bacterial illness Bacterial Spot, which usually destroys tomato plants. Common preventative measures include proper hygiene, crop rotation and spacing, drip irrigation, and copper-based pesticides.

Fig 2.2 (b) Bacterial Spot in Tomato Plant

### Fungal diseases symptoms and prevention

Tomato plants can be affected by fungal diseases such as early blight, leaf mould, and Septoria leaf spots. Good air circulation, adequate watering, plant selection, and fungicide sprays can all aid in the early prevention of these diseases.

Fig 2.2 (c)- Early Blight

Fig 2.2 (d) – Leaf Mold

### Viral diseases symptoms and prevention

Mosaic viruses may infect tomato plants, causing mosaic-like patterns on the leaves and damaging the plant's overall health. The best preventative measures include identifying mosaic patterns, utilizing virus-free seedlings, and basic hygiene.

Fig 2.2(f) – Mosaic virus

Fig 2.2(g) – YellowLeafCurl

## 3. LITERATURE REVIEW

Large-scale disease monitoring is unachievable with traditional approaches since they are time-consuming and need specialized knowledge. Thanks to machine learning approaches, automatic disease detection in plant leaves has showed promise in recent years.

Prasanna Mohanty's paper "Deep learning for Image-Based Plant detection" proposes a method for identifying plant sickness by training a convolutional neural network. The algorithm was trained to distinguish between healthy and unhealthy plants from 14 distinct species. The model has a 99.35% accuracy on test set data. While this is superior to a basic random selection model when applied to photographs taken from trustworthy online sources, a more diverse set of training data can assist to increase accuracy. Furthermore, multiple models and training versions may generate higher accuracy, paving the way for wider access to plant disease diagnostics.

In their article, "Detection and Classification of Leaf Disease Using Artificial Neural Network," Malvika Ranjan proposed a way to diagnose plant ailments using a picture of the diseased leaf. An artificial neural network was taught to identify between healthy and unhealthy plants by carefully choosing feature values. The accuracy was over 80%.

Kulkarni's paper "Applying image processing techniques to detect plant and its diseases" describes a way for detecting plant diseases early and precisely using other image processing techniques.

Among the numerous machine learning approaches, deep learning models, particularly sophisticated image recognition models or convolutional neural networks, have demonstrated exceptional performance in extracting and categorizing significant information from plant leaf pictures. In addition to these strategies, we may employ a combination of other methodologies, such as support

vector machine algorithms, random forests, and other advanced picture identification and processing algorithms, for further advances. Transfer learning has also been used to boost the effectiveness of machine learning models used to detect illness in plant leaves. Transfer learning is using a previously trained model on a large dataset to extract important features from pictures and then working on the model on the required dataset. Overall, machine learning approaches, particularly deep learning models, have shown great promise for automated plant disease identification using leaf pictures. However, further study is needed to produce more robust and accurate models that can be applied to other plant species and climatic situations.

Fig 3.1 Analysis of disease detection

## 4. METHODOLOGY

There are various crucial and basic processes used for the diagnosis of plant leaf diseases, particularly in procedures pertinent to tomato leaf classes. picture capture through a digital camera or the internet, data gathering and some of its methodologies, picture pre-processing techniques, and image recognition patterns and procedures that result in class categorization are all part of the processing process. The models were then trained, and the outcomes of the training and identification models were incorporated in a system with a graphical user interface for visual presentation. Finally, the user interface will be utilised to identify sickness on plant leaves, allowing us to establish whether the tomato leaf classes are healthy or infected and deliver the required treatment..

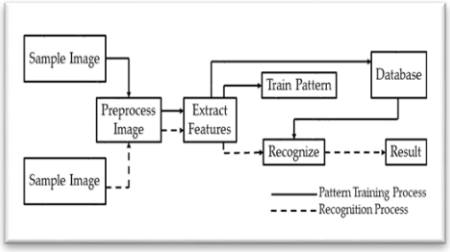


Fig 4.1 (a) Basic Method Structure

### 4.1 Data Collection

The initial phase in the investigation was to collect plant leaf data. Collecting datasets for tomato leaf disease classes may be done in a variety of informed methods, such as browsing datasets on the web or manually collecting high-quality picture sets from direct field regions, among others.

Fig 4.1 (b)Tomato Plant Leaf Datasets

Using Kaggle to collect information about tomato leaf diseases is a good way to acquire access to a range of datasets offered by researchers and data scientists. To make the dataset more comprehensive, we added a wide range of plant species and illnesses. We used the Kaggle dataset for tomato leaf disease classification for our study, which comprised of a large amount of annotated photos, of which infected categories with common tomato illnesses were used and the remainder were healthy. The dataset comprises high-quality photos captured at various lighting and viewing angles to ensure that the model generalises efficiently. We were able to train and test our training model, allowing us to correctly detect the presence of disease in the environment.

### 4.2 Image pre-processing

The photographs were preprocessed to improve their clarity and eliminate any undesirable background noise. The photographs were preprocessed by resizing them, turning them to grayscale, and using filters to eliminate any artefacts or defects.
Image segmentation is a basic strategy in digital image processing since it serves as the foundation for feature extraction and pattern identification. Image segmentation is the process of simplifying an image's representation into something more understandable and easier to analyze.

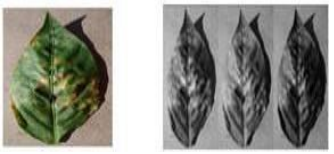

Fig 4.2 Preprocessing progress

### 4.3 Image Recognition modelling

Several approaches and algorithms are used in image recognition. From data collection, which entails acquiring a varied dataset of pictures containing the objects or patterns that the model must recognize, through preprocessing, which entails scaling, normalizing pixel values, and eliminating noise or artefacts that might impair the model's capacity to train. Image recognition patterns are used to evaluate images of plants and detect indicators of illnesses or abnormalities using computer vision algorithms. Then, using picture recognition techniques and algorithms, as well as other approaches such as feature extraction, we extract relevant characteristics such as edge detection, color histograms, and texture analysis. The returned features are then used to train a machine learning model, such as SVMs or Random Forests.

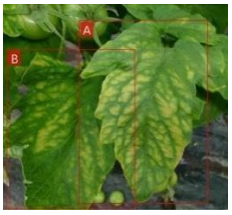

Fig 4.3 – Recognition patterns

### 4.4 Training and Validation phases

Using repeated Epochs and classifiers based on the retrieved features, the model is trained. Once the picture has been processed, we send the model to be trained using the batch size and epochs. This enables it to recognize many types of items or patterns. After the photographs have been imported, processed, and put into a classification algorithm, the model must be trained to categorize photos based on whether or not the illness is present.

Finally, the model's performance is assessed by running it through a collection of test photos used during training. The correctness of the model's performance is then determined using the evaluations' confidence ratios.

## 5. CONCLUSION

The current study reviews and summarizes the methodologies for image recognition and modelling techniques that have been used to diagnose plant diseases in a number of plant species.
The influence of background information on the final picture, technique optimization for a specific plant leaf disease, and technique automation for continuous automated monitoring of plant leaf diseases in actual field settings are some of the challenges with these approaches. According to the study, this disease detection technology has significant limitations but has great potential for diagnosing plant leaf disorders. This provides farmers with a handy tool that allows them to quickly and accurately diagnose plant ailments, resulting in higher agricultural output and healthier plants. There are undoubtedly additional developments and future improvements that can be made in the upcoming development phase.

### 5.2 References

[1] Kaggle datasets: https://www.kaggle.com/tags/plant-disease

[2] Kaggle documentation- https://www.kaggle.com/tags/plant-disease/notebooks

[3] Liu, F., Zhang, X., Xu, X., Chen, J., & Fu, X - Plant disease detection and diagnosis using Deep learning. https://doi.org/10.1016/j.biosystemseng.2021.06.004

[4] Ghosal, S., Bhowmik, P., & Das, A. B. (2018). A review on the application of deep learning in plant disease detection. Computers and Electronics in Agriculture, 145, 264-272. https://doi.org/10.1016/j.compag.2017.11.032.

[5] Huang, X., Xu, K., & Cao, Y. (2020). A review of deep learning-based techniques for plant disease detection. Computers and Electronics in Agriculture https://doi.org/10.1016/j.compag.2020.105748.

[6] Reference images –
Google and Stock Images.

[7] Mohanty, S. P., Hughes, D. P., & Salathé, M. (2016). Using deep learning for image-based plant disease detection. Frontiers in Plant Science, 7, 1419. https://doi.org/10.3389/fpls.2016.01