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# Android Based Plant Diseases Detection Using Convolutional Neural Network

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**Abstract – In the near future, the global human population is projected to reach 8.6 billion, driven by exponential growth. This substantial increase in population will necessitate a corresponding surge in both food production and consumption. Crop diseases, which can adversely affect agricultural products during their growth, pose a significant threat to food security. However, the timely identification of such diseases across various regions of the world remains challenging due to insufficient infrastructure. This research harnesses the power of computer vision technology and deep learning techniques to facilitate the early detection of crop diseases, thereby supporting the field of agriculture. The study employs computer vision technology and deep learning methods to assist in predicting crop diseases for agricultural purposes. Using a publicly available dataset containing 54,306 photos of both damaged and healthy plant leaves, a convolutional neural network (CNN) is trained. The validation data split is used to assess the model's performance after it has been trained on the training set, by analyzing images of the leaves and comparing them with the dataset. The dataset encompasses various plant species in image format.**

***Keywords: Smart Farming, Plant disease detection, Convolution neural network, Green house, Android, Data model.***

## I. INTRODUCTION

India is predominantly an agrarian nation, with approximately 75% of its population depending on agriculture for their livelihoods. Farmers have a wide array of crop options to choose from, along with the task of identifying suitable pesticides for their plants. Consequently, any damage to the crops can result in significant losses in productivity, ultimately impacting the economy. The leaves of a plant are particularly sensitive and often exhibit disease symptoms at an early stage. Monitoring crops for diseases should commence from the initial stages of growth and continue throughout their development until they are ready for harvest. Traditionally, disease monitoring involved time-consuming visual inspections by experts, relying on manual surveys of crop fields. In recent years, there has been a shift towards creating automatic and semi-automatic systems for disease detection, with observing symptoms on plant leaves emerging as a more convenient and cost-effective approach. In many instances, disease symptoms manifest on the leaves, stem, and fruit. This paper focuses on using plant leaves as indicators for disease detection. Farmers often lack comprehensive knowledge about crops and the diseases that can afflict them. This paper serves as a valuable resource for farmers, enabling them to increase their yield without the need for expert consultations. The primary objective is not only to detect diseases using image processing technologies but also to guide users to an e-commerce platform where they can purchase the necessary medicine for the detected disease, allowing for comparison of prices and appropriate usage according to provided instructions. A greenhouse, also known as a glasshouse or, with heating capabilities, a hothouse, is a structure primarily constructed with transparent materials like glass. It is designed for cultivating plants that require controlled environmental conditions. Greenhouse farming is gaining prominence, and this paper aims to provide effective assistance to greenhouse farmers. It delves into various techniques for plant disease detection, taking into account different parameters.

## II. LITERATURE SURVEY

Common apple diseases, including Alternative leaf spot, Brown spot, Mosaic, Grey spot, and Rust, have a significant impact on apple yield. However, current research lacks an accurate and swift apple disease detector, which is crucial for ensuring the health of the apple industry. Object detection algorithms like SSD, DSSD, and R-SSD consist of two key components: the pre-network model, acting as a fundamental feature extractor, and an auxiliary structure that employs multi-scale feature maps for detection [1]. In this process, K-means segmentation is employed to divide leaf images into four clusters based on squared Euclidean distances. The Color Co-occurrence method is then used for feature extraction, capturing both color and texture characteristics [4]. Subsequently, classification is carried out using a neural network detection algorithm that employs backpropagation. The overall accuracy of disease detection and classification in the system was determined to be around 93%. Different methods have been applied to detect fungal diseases on various crop types, including fruit crops, vegetable crops, cereal crops, and commercial crops [5]. For fruit crops, k-means clustering is used for segmentation, with a focus on texture features and classification achieved using ANN and nearest neighbor algorithms, resulting in an average accuracy of 90.723%. For vegetable crops, the chan-vase method is employed for segmentation, local binary patterns for texture feature extraction, and SVM and k-nearest neighbor algorithms for classification, yielding an average accuracy of 87.825%. Commercial crops are segmented using the Grab-Cut algorithm, and for feature extraction, wavelet-based methods are utilized, with Mahalanobis distance and Probabilistic Neural Network (PNN) as classifiers, resulting in an average accuracy of 84.825%. Cereal crops are segmented using k-means clustering and the Canny edge detector. Various features, including color, shape, texture, color texture, and

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random transform features, are extracted. Support Vector Machine (SVM) and nearest neighbor classifiers are employed, resulting in an overall average accuracy of 83.72%. Additionally, a separate technique was developed for assessing the health status of chili plant leaves, ensuring that chemicals are applied only to diseased chili plants. MATLAB was used for feature extraction and image recognition in this study, with preprocessing involving Fourier filtering, edge detection, and morphological operations. Computer vision incorporates the image processing paradigm for object classification, utilizing a digital camera for image capture and the LABVIEW software tool to create the GUI [7].

## III. METHODS OF DISEASE DETECTION

The plant disease detection system follows a four-phase process, as illustrated in Figure 3.1. Initially, images are acquired using either a digital camera, mobile phone, or from the web. In the second phase, the image is segmented into multiple clusters, employing various techniques. The subsequent phase encompasses feature extraction methods, and the final phase focuses on disease classification.

Fig.3.1 Phases of plant disease detection system

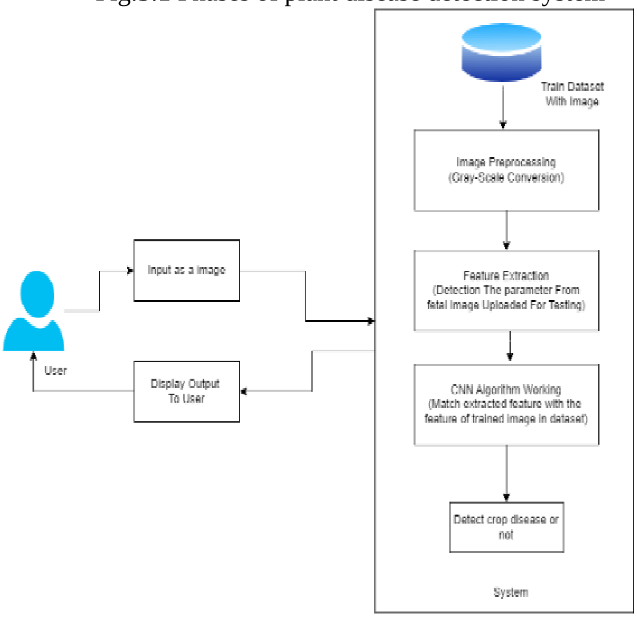


***Image Acquisition***

During this phase, plant leaf images are gathered using digital devices like cameras or mobile phones, ensuring the desired resolution and size. Alternatively, images can be sourced from the web. The process of constructing an image database is left to the discretion of the application system developer. The quality and quantity of images in the database significantly impact the efficiency of the classifier in the final phase of the detection system.

***Image Segmentation:***

This phase aims to simplify the representation of an image, making it more interpretable and easier to analyze. Feature extraction relies on this phase and is a fundamental aspect of image processing. Various methods, including techniques like k-means clustering, Otsu's algorithm, and thresholding, can be employed for image segmentation. In the case of k-means clustering, it categorizes objects or pixels into K classes based on a set of features. Classification is achieved by minimizing the sum of squares of distances between the objects and their respective clusters.

***Feature Extraction:***

In this step, the goal is to extract features from the region of interest (ROI) in an image. These features are essential for comprehending the content and significance of a given sample image. The extracted features can be based on color, shape, and texture. Recently, many researchers have shown a preference for using texture features for plant disease detection.

***Classification:***

The classification phase involves determining whether the input image is healthy or diseased. If the image is identified as diseased, some previous works have further classified it into specific diseases. For classification, a software routine needs to be written in MATLAB, also known as a classifier. Over the past few years, researchers have utilized various classifiers such as k-nearest neighbor (KNN), support vector machines (SVM), artificial neural network (ANN), backpropagation neural network (BPNN), Naïve Bayes, and decision tree classifiers. Among these, SVM is the most commonly used classifier, known for its simplicity and robustness. Each classifier has its own set of advantages and disadvantages, but SVM stands out for its ease of use and reliability.

## IV. OVERVIEW OF PLANT DISEASE

Plant diseases typically arise from infections by various infectious agents, including fungi, bacteria, and viruses. Signs of plant diseases are the observable and tangible evidence of these infections, while symptoms represent the visible effects. Fungal infections often manifest with signs like visible spores, mildew, or mold, and common symptoms include leaf spots and yellowing of plant tissue. Fungal diseases in plants are caused by fungi, which can be single-celled or multicellular. In both cases, they infect plants by extracting nutrients and breaking down plant tissues. Among plant infections, fungal diseases are the most prevalent. They

exhibit characteristic symptoms, which are observable effects of the disease. Symptoms of fungal infections include spots on plant leaves, yellowing of leaves, and distinctive "bird's-eye" spots on berries. In some cases, the organism itself can be observed on the leaves, appearing as a growth or as mold.

Fig 4.1Cotton Leaf affected by fungal infection

Diseases in plants caused by fungi may lead to deformations on stems or the lower surface of leaves. These observable effects, induced by the disease-causing organism, are referred to as "signs" of infection. In contrast, bacteria are single-celled, prokaryotic organisms. While many bacteria are ubiquitous and can be beneficial, some can be pathogenic and induce diseases in both humans and plants. Detecting signs of bacteria can be more challenging than with fungi, given that bacteria are microscopic. When a contaminated stem is cut, a milky white substance known as bacterial ooze may emerge, serving as one indicator of a bacterial infection. Additional signs encompass water-soaked lesions, which are damp spots on leaves that exude bacteria.

Fig 4.2 Corn Leaf affected by bacteria

Viruses are minuscule infectious particles that are too tiny to be discerned using a light microscope. They infiltrate host cells and manipulate the host's cellular machinery to generate numerous copies of the virus. In plants, viral diseases do not manifest visible "signs" because viruses themselves are not detectable even with a light microscope. However, there are noticeable "symptoms." These symptoms encompass a mosaic leaf pattern, yellowing, or crinkling of leaves, which are characteristic indicators of viral infections. This distinctive pattern of discoloration often contributes to the naming of many plant viruses, such as the tobacco mosaic virus. Reduced plant growth is also a common hallmark of viral infections.

Fig 4.3 Leaf affected by virus

So, these are our observation on how to classify the various plant disease and how to be cautious about that.

## V. PROPOSED SYSTEM

The proposed system encompasses an end-to-end Android application integrated with TF Lite. The system aims to develop an Android application designed to identify plant diseases. It employs algorithms and models based on Convolutional Neural Network (CNN) to accurately recognize both plant species and diseases in crop leaves. The development process involves utilizing Colab for source code editing. The dataset utilized consists of a total of 54,305 images, capturing both diseased and healthy plant leaves.

These images were gathered under controlled conditions and are part of the Plant Village dataset. They encompass 14 different species of crops, including apple, blueberry, cherry, grape, orange, peach, pepper, potato, raspberry, soy, squash, strawberry, and tomato. The dataset encompasses images depicting 17 distinct basic diseases, 4 bacterial diseases, 2 diseases attributed to mold (oomycete), 2 viral diseases, and 1 disease caused by a mite. Additionally, there are images of healthy leaves for 12 crop species, which show no visible signs of disease. The dataset covers a diverse range of plant textures.

1. Peach bacterial spot
2. Peach healthy
3. Pepper bell bacterial spot
4. Pepper bell healthy
5. Potato early blight
6. Potato late blight
7. Squash powdery mildew
8. Strawberry leaf scorch
9. Tomato bacterial spot
10. Tomato early blight
11. Tomato late blight
12. Tomato leaf mold
13. Tomato Septoria leaf spot
14. Tomato spider mites two spotted spider mite
15. Tomato target spot
16. Tomato yellow leaf curl virus
17. Tomato mosaic virus

We have established data generators to read images from our source folders, convert them into float32 tensors, and then input them, along with their corresponding labels, into our network. In order to enhance the network's processing capabilities, it's customary to normalize the data fed into neural networks. In our case, we'll preprocess our images by adjusting the pixel values to fall within the [0, 1] range, originally ranging from [0, 255]. It's essential to ensure the input data is resized to either 224x224 pixels or 299x299 pixels, as specified by the networks. You have the option to incorporate image augmentation as well. In addition to plant disease detection, our system guides users to an e-commerce website. This platform showcases all available pesticides suitable for the detected disease, along with their respective Maximum Retail Price (MRP). The website also provides instructions for usage. By comparing the prices and features of the pesticides, users can make informed purchase decisions.

## VI. CONCLUSION

A specialized application has been developed to distinguish between diseased and healthy plants. This endeavor places a strong emphasis on achieving precise results in real-world field conditions, drawing from an extensive collection of plant images. Moreover, this study has successfully introduced an innovative approach to evaluating soil quality, providing valuable insights into the optimal quantity and type of fertilizers that can benefit future generations. The overarching objective of establishing an economical system for small-to-marginal-scale producers has been realized. With the integration of this technology, landowners can now inexpensively appraise their soil quality and ascertain the appropriate category of fertilizers, particularly for enhancing crop production.

## VII. REFERENCES

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