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# Multi Class Classification of Plant leaf disease using CNN and LBP

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***Abstract*— Plant diseases are one of the primary causes of decreased agricultural production quality and quantity [1]. With ongoing changes in plant structure and cultivation techniques, new diseases are constantly arising on plant leaves [2]. Thus, accurate classification and detection of plant leaf diseases in their early stages will limit the spread of the infection and support the healthy development of plant production [3]. This work proposes a novel lightweight deep convolutional neural network (CNN) model for obtaining high level hidden feature representations [4]. The deep features are then fused with traditional handcrafted local binary pattern (LBP) features to capture local texture information in plant leaf images. The proposed model is trained and tested on three publicly available datasets (Apple Leaf, Tomato Leaf, and Grape Leaf). On the three datasets, the proposed approach achieves 99%, 96.6%, and 98.5% validation accuracies, respectively, and 98.8%, 96.5%, and 98.3% test accuracies, respectively. The results of the experiments show that the proposed approach can provide a better control solution for plant diseases [5].**

**Keywords: Plant Leaf Disease Classification, Multi-Class Classification, Image Classification, Convolutional Neural, Networks (CNN), Local Binary Patterns (LBP), Deep Learning, Machine Learning, Supervised Learning, Model Training, Model Evaluation, Image Pre-processing, Feature Extraction, Texture Analysis**

## I. INTRODUCTION

One of the most critical areas of precision agriculture research is detecting diseases in plant leaves via image analysis. The traditional method of recording the severity of plant diseases is based on the visual examination of plant tissues by trained experts[1]. Expert systems in cultivation and management have become widely used due to the widespread adoption of digital cameras and the advancement of information technology in agriculture, considerably increasing plant production capacity [2]. However, pest and disease extraction and description characteristics in expert systems mainly depend on experts' expertise, resulting in high costs and low efficiency.

[3] This project proposes a deep convolutional neural network model (DCNN). The traditional convolution layers are replaced by deeper separable convolutions, which reduce the number of model parameters and iteration time. Then, the deep features are combined with the local binary pattern (LBP) features, where LBP efficiently captures the local information to supplement deep features.

We could summarize the main contributions of this project in the following points:

1) The proposed DCNN model significantly reduces the training parameters and iteration times compared to the common transfer learning models such as Alex Net, Google Net, and VGG16.

2) An integrated model was developed by concatenating deep features and traditional handcrafted features (LBP). This model effectively captures the local spatial texture information found in images of plant leaves.

## II. SCOPE OF THE PROJECT

[1] One of the most critical areas of precision agriculture research is detecting diseases in plant leaves via image analysis. The traditional method of recording the severity of plant diseases is based on the visual examination of plant tissues by trained experts. Expert systems in cultivation and management have become widely used due to the widespread adoption of digital cameras and the advancement of information technology in agriculture, considerably increasing plant production capacity. [3] However, pest and disease extraction and description characteristics in expert systems mainly depend on experts' expertise,

resulting in high costs and low efficiency, so we have chosen to implement automated system.

## III. EXISTING SYSTEM

Various artificial intelligence techniques for detecting and classifying plant diseases have been introduced. The most common techniques are the K-nearest neighbours (K- NN), logistic regression, decision tree, support vector machine (SVM), and CNN [1]. These techniques are used with different image pre-processing techniques to promote the extraction of features. The K-NN is a supervised learning algorithm[2]. It is based on similarity measures for classifying the data. For K-NN, unlabelled objects are classified using neighbouring labelled objects. The Decision tree is a flow-chart learning algorithm. Each node denotes the decision attribute, the branches represent the possible outcomes from the nodes, and leaves signify the classes. However, decision trees possess certain limitations such as overlapping nodes and overfitting of data.

## IV. PROPOSED SYSTEM

The proposed architecture fuses deep features with local binary pattern (LBP) features for plant disease classification, which includes two main phases: feature extraction, fusion, and classification. The proposed architecture first extracts the deep features of a plant leaf. It combines the local binary features with the deep features to generate the final distinctive features of a leaf image for plant disease classification. A deep CNN model captures the deep features while LBP effectively extracts the local texture information. We combine these two sets of features to obtain the final feature vector of plant disease samples. In this project, we directly concatenate the extracted LBP features with deep features via the flattened layer in the proposed DCNN model. The combined features are then fed to the first fully connected layer, and SoftMax is applied for classification.

## V. SYSTEM DESIGN

### *A. SYSTEM ARCHITECTURE*

The proposed architecture fuses deep features with local binary pattern (LBP) features for plant disease classification, which includes two main phases: feature extraction, fusion, and classification. As shown in Figure 4.1, the proposed architecture first extracts the deep features of a plant leaf.

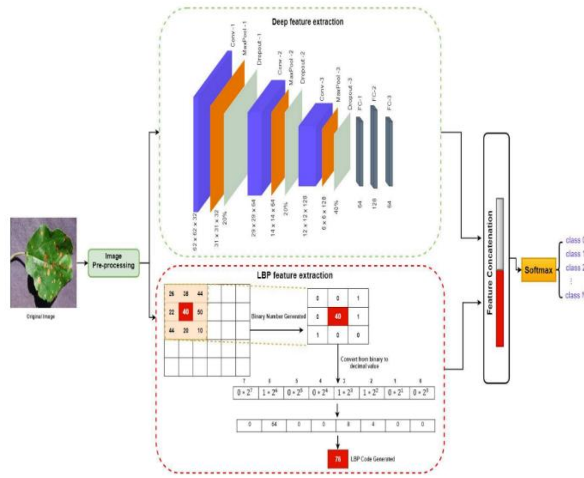


Fig 1 System Architecture

### *B. Flow diagram*

A data flow diagram (DFD) is a graphical representation of the flow of data within a system. It's a powerful tool used in system analysis and design to illustrate how data moves through different processes and interactions in system.

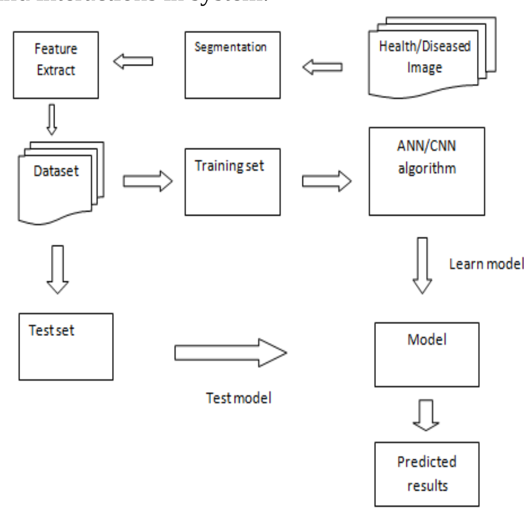


Figure 2-Flow diagram

## VI. IMPLEMENTATION

Data Pre-processing: The collected dataset comprises images of plant leaves, which may vary in size and dimensions. To ensure uniformity and facilitate input to the training model, pre-processing steps are applied to standardize the images. The following techniques are employed as part of the data pre-processing pipeline: Resizing Images: The collected dataset contains images of varying sizes. To ensure consistency, the OpenCV resize function is utilized to resize the images to a fixed size of 50x50 pixels. This resizing operation standardizes the dimensions of all images in the dataset, ensuring compatibility with the input requirements of the training model.

Feature Selection and Reduction: Feature selection and reduction are critical steps in optimizing the performance of machine learning models, particularly in image classification tasks such as plant leaf disease detection. Feature selection involves identifying the most relevant features from the dataset that contribute significantly to the prediction task, thereby enhancing the model's accuracy and efficiency. Techniques such as Local Binary Patterns (LBP) are used to extract texture features from leaf images, which are crucial for distinguishing between different diseases. However, not all extracted features are equally important, and some may be redundant or irrelevant, potentially leading to overfitting and increased computational complexity.

Classification Modelling: Classification modelling for plant leaf disease involves developing a system that can accurately identify and categorize leaf images into various disease classes or as healthy. This process starts with collecting a diverse dataset of leaf images and applying pre-processing techniques such as resizing, normalization, and data augmentation to enhance the data's quality and variability. Feature extraction is performed using Local Binary Patterns (LBP) to capture texture information and Convolutional Neural Networks (CNN) for their powerful capability to learn spatial hierarchies of features from the images.

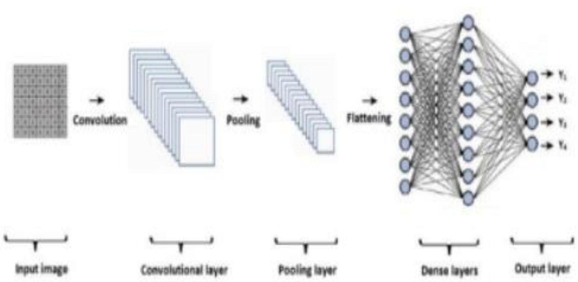


Figure 3-CNN Architecture

## VII. CONCLUSION

We are successful in creating disease classification techniques used for plant leaf disease detection. A deep learning model that can be used for automatic detection and classification of plant leaf diseases is created. Tomato, Cotton, Paddy, Banana, on which the proposed model is tested. 17 classes of plant disease were taken for identification through this work. We were successfully able to work with the image data generator API by Keras. Through this, we were able to do image-processing tasks. We were also able to create the CNN model which is an advanced convolution model and train the model with the data for prediction. The prediction is done by our model is almost correct.

## ACKNOWLEDGMENT

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