**PLANT DISEASE DETECTION SYSTEM FOR SUSTAINABLE AGRICULTURE**

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TASK NO : 01

Title: CNN-Based Plant Disease Detection and Classification System

**1. Problem Statement**

The agricultural sector faces significant losses due to plant diseases, many of which remain undetected until they have caused substantial damage. Traditional disease identification methods are time-consuming and often require expert intervention. There is a pressing need for automated and accurate disease detection systems that can assist farmers in early diagnosis and management of plant health.

**2. Objective**

The objective of this project is to develop a Convolutional Neural Network (CNN)-based model capable of detecting and classifying plant diseases using images of leaves. The system aims to identify whether a leaf is healthy or diseased and, if diseased, determine the specific type of disease affecting crops such as apple, cherry, grape, and corn.

**3. Scope**

- Classification of both healthy and diseased leaves.

- Detection of specific diseases for multiple crops.

- Integration of deep learning techniques to improve accuracy.

- Potential deployment as a mobile or web-based application for real-time diagnosis.

**4. Significance**

This project will contribute to precision agriculture by:

- Enhancing early disease detection capabilities.

- Reducing reliance on manual inspection.

- Supporting farmers with timely insights for disease management.

- Potentially increasing crop yield and reducing economic losses.

**5. Expected Outcome**

A reliable and accurate CNN model that:

- Accepts leaf images as input.

- Predicts the crop type and specific disease.

- Differentiates between healthy and diseased conditions.

Title: CNN Model Pipeline for Plant Disease Detection

1. Introduction

The development of a Convolutional Neural Network (CNN) for plant disease detection involves a structured pipeline of sequential steps. Each stage plays a crucial role in building an accurate and efficient model. This document outlines the key components of the pipeline as discussed in the lecture.

**2. Pipeline Overview**

The pipeline consists of the following stages:

2.1 Data Collection and Data Loading

The first step in building any machine learning model is acquiring and organizing data. In this project, images of healthy and diseased plant leaves are collected and categorized.

**Dataset Split into Three Types**:

1. Training Set: Used to train the CNN model by learning patterns.

2. Testing Set: Used to evaluate the model’s performance after training.

3. Validation Set: Used during training to tune the model and avoid overfitting.

- Each Dataset Contains Two Categories:

- Healthy Leaves

- Diseased Leaves

This binary classification helps the model to distinguish between the two classes effectively.

2.2 Image Processing

Before feeding images into the CNN model, they must be preprocessed to ensure consistency and enhance features. This step typically includes:

- Resizing images to a standard dimension.

- Converting image color channels (e.g., RGB).

- Normalization to scale pixel values between 0 and 1.

- Noise reduction and sharpening for clarity.

2.3 Image Augmentation

To improve the model’s ability to generalize, data augmentation is applied. This artificially increases the size of the training dataset and helps in reducing overfitting.

**Common augmentation techniques include:**

- Rotation

- Flipping (horizontal/vertical)

- Zooming

- Shifting

- Brightness adjustments

2.4 Convolutional Neural Network (CNN)

CNN is a deep learning algorithm widely used for image classification. It consists of the following components:

- Convolutional Layers: Detect features using filters/kernels.

- Activation Function (ReLU): Introduces non-linearity.

- Pooling Layers: Reduce spatial dimensions while retaining key information.

- Fully Connected Layers: Perform the final classification.

- Output Layer: Uses Softmax or Sigmoid to predict the class label (Healthy/Diseased).

**3. How the Model Works**

1. Input leaf image is passed to the CNN model.

2. The model extracts features using convolution and pooling.

3. The image is passed through multiple layers, and classification is done.

4. The output indicates the health status of the leaf and identifies the disease if present.

**4. Conclusion**

This pipeline provides a complete workflow from data collection to model deployment. Each step is critical in ensuring that the CNN model accurately detects and classifies plant diseases, aiding in timely agricultural intervention.