An Expert System For Disease Prediction And Fertilizer Recommendation Using Deep Learning

K.Geethika, G.Krishna Prathibha, G.Sneha

Under the esteemed guidance of

Mr. A. Rajashekar Reddy

Assistant Professor

Bachelor of Technology

Department of Information Technology

BVRIT HYDERABAD college of engineering for Women

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Overview

Introduction

- Deep Learning has led to great performance in various fields like Image Recognition, Speech Recognition, and Natural Language Processing.
- Convolutional Neural Networks (CNNs) are a specialized type of deep learning model designed for processing grid-like data, such as images and videos.

Problem Statement

- Delayed disease detection and imprecise fertilizer application pose significant challenges in tomato crop management, leading to yield losses and compromised quality. This project integrates advanced technologies, such as image recognition and data-driven analytics, to provide early disease detection and personalized fertilizer recommendations, aiming to revolutionize and optimize tomato cultivation practices.

Objectives

- Data Collection and Pre-processing
- Pre-trained Model Selection
- Feautres Extraction
- Model Training
- Disease Detection
- Fertilizer Recommendation

Literature Survey

S No	Title	Objective	Methods	Description	Performance	Author & Year
1	Vegetable Plant Disease Detection And Fertilizer Recommendation System [1]	Detects diseases in vegetable plants using advanced image processing and fertilizer recommendation.	CNN & Machine learning algorithms	For various types of vegetable plant images, the system achieved a disease detection	Disease Accuracy-95% Fertilizer Recommendation Accuracy-90%	Prof.Suhas Chavan, 2023
2	A real-time application-based convolutional neural network approach for tomato leaf disease classification [2]	User-Friendly Interface	CNN – VGG- 19	Website is created for determination of tomato diseases with CNN	Accuracy – 95%	Showmick Guha Paul, 2023
3	Detection of Tomato Leaf Diseases for Agro - Based Industries Using Novel PCA DeepNet [3]	Accurately identifies diseases affecting tomato plants	Pipeline Method which includes GANs, PCA, CNN and F-RCNN	contribute to the advancement of disease detection in tomato plants.	Accuracy – 99.6%	KYAMELIA ROY1, 2023

4	DCNet: DenseNet77-based CornerNet model for the tomato plant leaf disease detection and classification [5]	Enhance accuracy in identifying disease patterns	Corner net DenseNet	DCNet combines DenseNet77's feature extraction capabilities with CornerNet's.	Accuracy - 99.7%	Saleh Albahli1, 2022
5	Tomato Disease Detection Model Based on DenseNet and Transfer Learning [6]	Developed a disease detection model by leveraging DenseNet and transfer learning techniques	DenseNet201	Using DenseNet and transfer learning with pre-trained features	Accuracy- 95%	Mahmoud BAKR,2022
6	Less Is More: Lighter and Faster Deep Neural Architecture for Tomato Leaf Disease Classification [7]	Design a streamlined deep neural architecture and efficient tomato leaf disease classification	mobile net v2	develop a lightweight and faster deep neural architecture to enhance the speed and efficiency	Accuracy- 99.30%	SABBIR AHMED, 2021

Key Findings

- Fertilier Recommendation system is not added to tomato disease detection before.
- Excessive changes in the mass, color, and size of plant leaves, and the incidence of noise, blurring, and brightness variations in the images complicate the classification task.
- Accuracy's are varied according to dataset and types of CNN's

DataSet

- Collected the dataset from the Plant Village Data set
- **Link :** Dataset
- Under the Plant Village dataset, we have considered "Tomato DataSet".
- **Size:** 18,021 images.
- DataSet includes both healthy leaves and leaves affected by various diseases.
- For the purpose of training and testing the proposed model, an 80:20 dataset split.
- DataSet is divided into 10 classes

Steps

- **Data Collection and Preprocessing :**
  - Collection of a large dataset of images of healthy and diseased crop leaves and ensure that the images are high-quality and well-lit.
  - Label the images with the corresponding disease class (e.g., healthy, early blight, late blight).
  - Preprocess the images to normalize the size, format, and intensity.
  - Augment the dataset by applying techniques such as flipping, rotating, and cropping.
  - Split the data into training and testing sets.

Dataset Structure

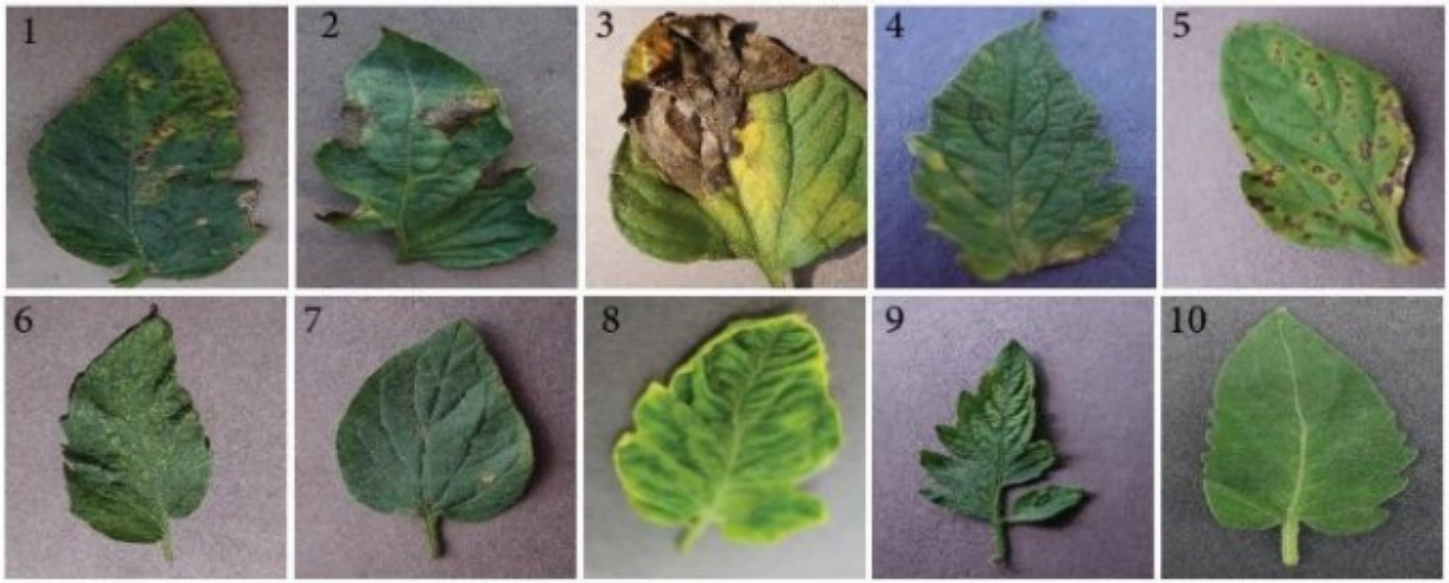


Fig. 2. Examples of tomato 10 classes – (1) Bacterial spot, (2) Early blight, (3) Late blight, (4) Leaf mold, (5) Septoria leaf spot, (6) Spider mites two spotted, (7) Target spot, (8) Yellow leaf curl virus, (9) Mosaic virus and (10) Tomato healthy

- **Pre-trained Model Selection**
  - Choosing a suitable pre-trained model known for its effectiveness in image recognition tasks.
- **Feature Extraction**
  - Extract features from the pre-trained model's remaining layers using the pre-processed Tomato leaf images.
  - These features serve as a rich representation of the input images and are crucial for the subsequent disease classification

Architecture

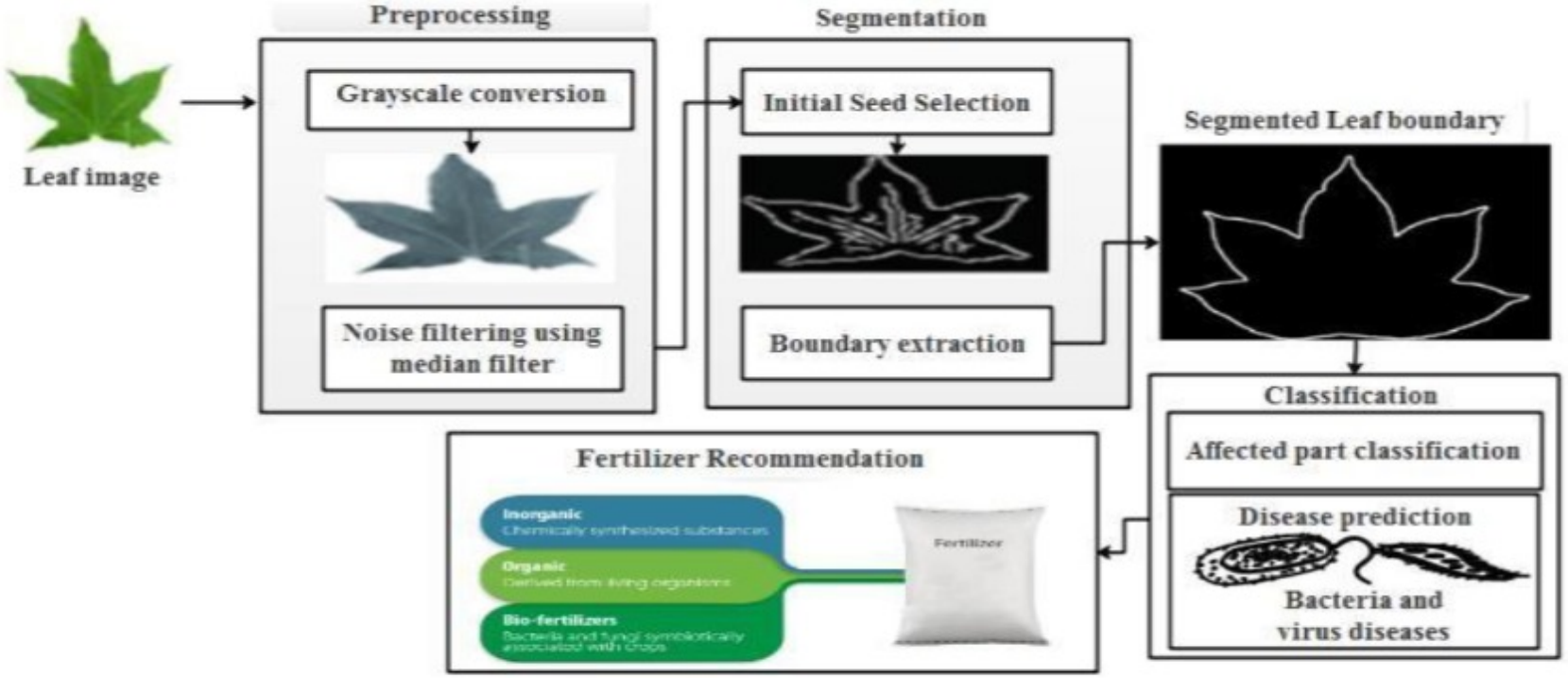


Figure.1 Proposed Architecture

Figure: Proposed Architecture for Tomoto Crop

Model Training

- **MobileNet:**
  - MobileNet is a good choice for applications with strict constraints on model size and latency.
  - It is a lightweight architecture that performs well in scenarios where computational resources, memory, and power consumption are limited.
  - **Source:** https://www.researchgate.net/figure/Architecture-Diagram-of-MobileNetV2-Deep-Learning-Model-38-The-block-diagram-of_fig2_360258281

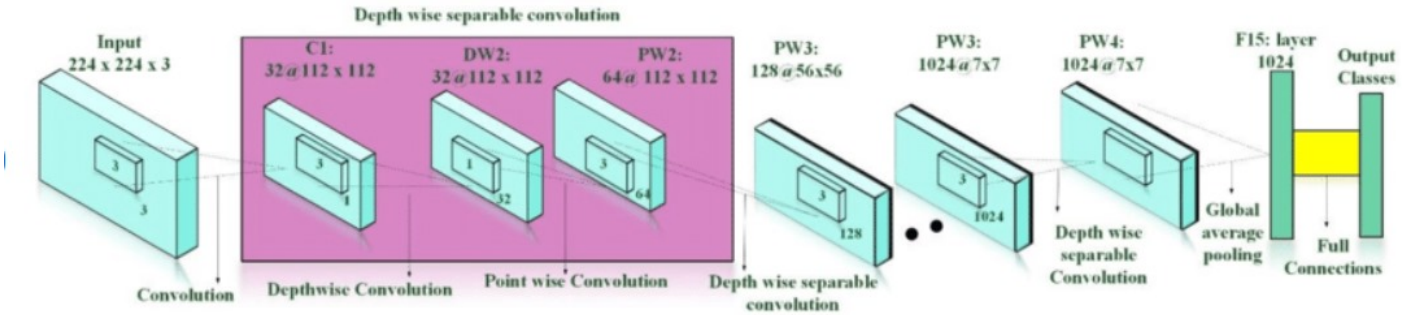
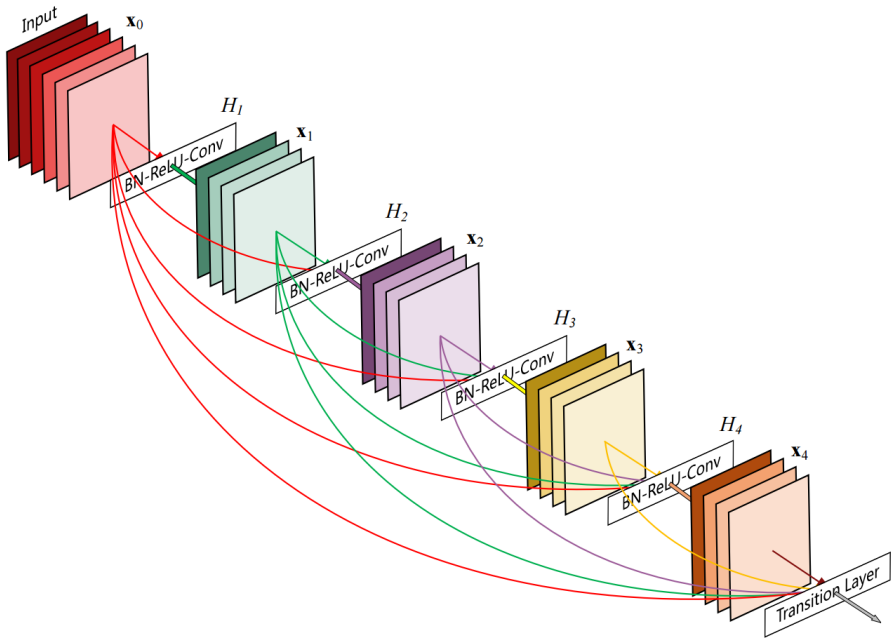


Figure: MobileNet Architecture

Model Training

- **DenseNet:**
  - DenseNet's key innovation lies in its dense connectivity, where each layer receives input from all preceding layers.
  - The Transition layers contribute to the overall efficiency and effectiveness of the DenseNet architecture.
  - **Source:** http://incredible.ai/deep-learning/2017/07/29/Dense-Convolution-Network/



Disease Detection

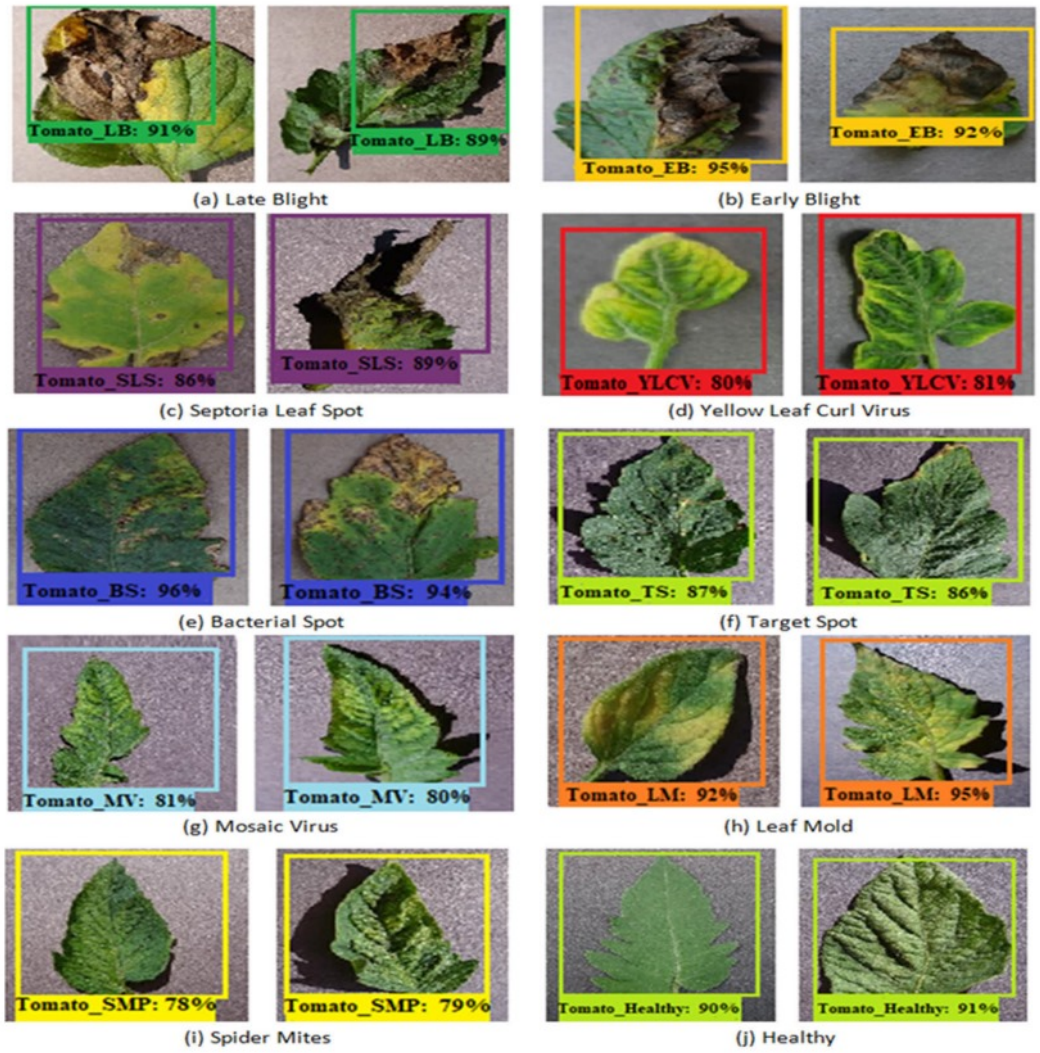


Figure: Source - KYAMELIA ROY1,2023 [3]

Fertilizer Recommendation

Disease	Causes	Symptoms	Treatment
Tomato Bacterial Spot	Bacteria (Xanthomonas campestris pv. vesicatoria)	- Small, dark spots with a halo on leaves, expanding over time. - Lesions may have a target-like appearance. - Fruits may have spots with raised centers.	- Copper-based sprays. - Bactericides. - Rotate crops. - Avoid overhead irrigation.
Tomato Early Blight	Fungus (Alternaria solani)	- Dark brown concentric rings on lower leaves. - Yellowing and wilting of foliage. - Formation of concentric rings on tomatoes.	- Fungicides containing chlorothalonil or copper. - Crop rotation. - Mulching to reduce soil splash.
Tomato Late Blight	Fungus (Phytophthora infestans)	- Water-soaked lesions on leaves that turn brown/black. - White mold may appear on the undersides. - Rapid wilting and death of plant.	- Fungicides containing copper or mancozeb. - Remove infected plants. - Good air circulation.
Tomato Leaf Mold	Fungus (Passalora fulva)	- Yellow, then brown, lesions on older leaves. - Fuzzy white or gray mold on the undersides of leaves. - Affected leaves may drop prematurely.	- Fungicides containing chlorothalonil. - Provide good air circulation. - Avoid overhead watering.
Tomato Septoria Leaf Spot	Fungus (Septoria lycopersici)	- Small, dark spots with a light center on lower leaves. - Spots may coalesce, leading to yellowing. - Premature	- Fungicides with chlorothalonil or copper. - Remove infected leaves. - Mulching to reduce splashing.

Tools

- **TensorFlow :** It can be used across a range of tasks but has a particular focus on training and inference of deep neural networks
- **sklearn :** Scikit-learn supports a wide range of machine learning tasks.
- **keras :** It provides a high-level abstraction for building neural networks
- Google Colaboratory

Progress from last review

- Identified the proper Dataset
- Progressing with the code implementation part1 (MobileNet and DenseNet With Transfer Learning)

Upcoming tasks and Milestones

S.No	Module Implementation
1	Disease Detection and Fertilizer Recommendation
2	GUI Implementation
3	Report

References

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Any Questions ?

Thank you