Machine Learning

Mini Project

Title: Plant Disease Detection

BE C11 - Group 1

Group Members:

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Problem Statement

Project Title: Plant Disease Detection Using Machine Learning and ResNet

This project focuses on building a machine learning model for detecting diseases in plants using image analysis. The model allows users to upload an image of a plant's affected part, and it identifies the disease accurately. The solution is built using a deep learning model, specifically the ResNet (Residual Networks) architecture, which is highly effective for image classification tasks.

The project automates the manual process of disease detection in agriculture, providing a scalable solution that reduces human error, enhances efficiency, and offers early intervention in crop disease management. By leveraging machine learning, farmers and researchers can benefit from timely and accurate diagnosis of plant diseases.

Motivation

- This project aims to assist the agricultural community by:
- Providing a tool for fast and accurate detection of plant diseases.
- Reducing reliance on expert inspections and minimizing delays in disease identification.
- Enhancing crop health management through early detection and intervention.

Problem description

Manual Detection of Plant Diseases

Traditional plant disease detection involves visual inspection by experts, which is prone to delays, human error, and subjectivity. In large-scale farming, this manual process becomes infeasible. Moreover, many farmers lack access to skilled professionals for timely disease identification, leading to the unchecked spread of diseases and crop loss.

Challenges in Image-Based Detection

One of the main challenges is the accurate classification of diseases based on visual symptoms. Different diseases may cause similar symptoms like spots or discoloration, and the system needs to distinguish between them effectively. The model must also work with images of varying quality, taken under different environmental conditions, and still provide reliable results.

Effective Disease Classification Using ResNet

ResNet, a state-of-the-art deep learning architecture, addresses these challenges by using residual learning techniques to improve the model's ability to extract features from images. By employing skip connections in its layers, ResNet can train very deep networks without performance degradation, making it ideal for complex image classification tasks.

System Requirements

Functional Requirements

The chatbot must be able to:

- Accept natural language questions from users.
- Process the input using NLP techniques to understand the intent of the query.
- Retrieve information from a pre-trained dataset that includes data from the TSEC website.
- Provide accurate and relevant responses based on the question.
- Handle a wide range of topics, such as departments, teachers, subjects, fees, and general college information.

Non-Functional Requirements

- The system should be:

- **User-friendly**: The interface should be simple, enabling users to easily upload images and access results.
- **Fast**: The system should analyze images and return diagnoses in a timely manner.
- **Scalable**: The model should handle multiple requests simultaneously and scale to accommodate various types of plant diseases.
- **Accurate**: High classification accuracy is critical to ensure reliable diagnoses.
- **Maintainable**: The system should be flexible enough to allow for the integration of new data or diseases as required.

Design and Architecture

System Overview

1. The plant disease detection system consists of several components:
2. **User Interface**: A web-based or mobile application interface that allows users to upload plant images. The user interface is designed to be accessible and easy to navigate for farmers and agricultural professionals.
3. **Image Preprocessing Module**: Once the image is uploaded, the system preprocesses it by resizing, normalizing, and enhancing its features to ensure consistent input quality for the machine learning model.
4. **ResNet Model for Disease Classification**: The core of the system is a ResNet-based model trained on a dataset of plant disease images. The ResNet architecture, known for its deep learning capabilities, is used to analyze the input image and extract meaningful features for classification.
5. **Disease Classification Module**: The system classifies the detected disease into predefined categories based on the features extracted by the ResNet model.
6. **Diagnosis and Feedback**: After classification, the system provides the user with the diagnosis of the disease, along with relevant information and possible treatment recommendations.

System Flow

1. **Image Upload**: Users upload an image showing the affected plant part.
2. **Image Preprocessing**: The image undergoes preprocessing, including resizing and normalization, to prepare it for model analysis.
3. **Model Analysis**: The image is fed into the ResNet model, which analyzes the visual features and detects the disease.
4. **Disease Classification**: The system classifies the disease based on the patterns and features recognized by ResNet.
5. **Diagnosis and Feedback**: The system provides a detailed diagnosis and offers suggestions for disease management.

Machine Learning Techniques

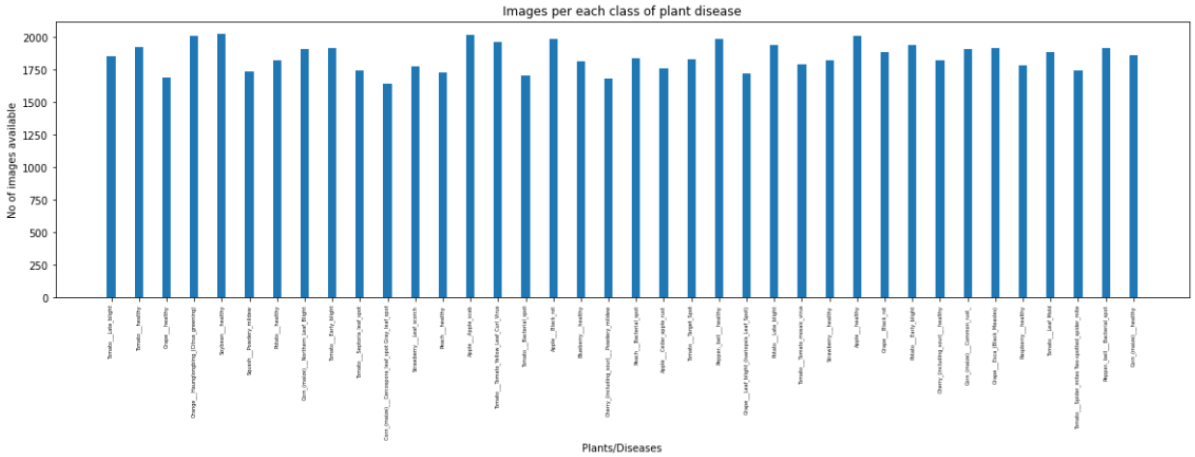
ResNet (Residual Networks)

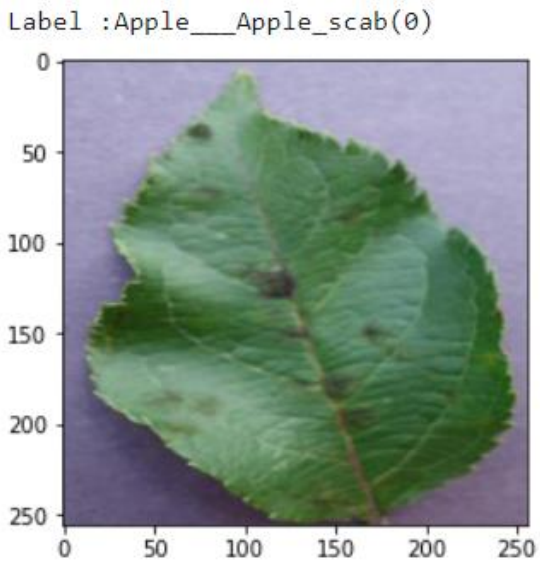
ResNet is a powerful deep learning architecture that overcomes the vanishing gradient problem common in deep networks. By introducing residual connections, ResNet enables the training of very deep networks (with layers exceeding 100) while maintaining high performance. This makes it ideal for image classification tasks, especially when subtle visual patterns, like those found in plant diseases, need to be detected.

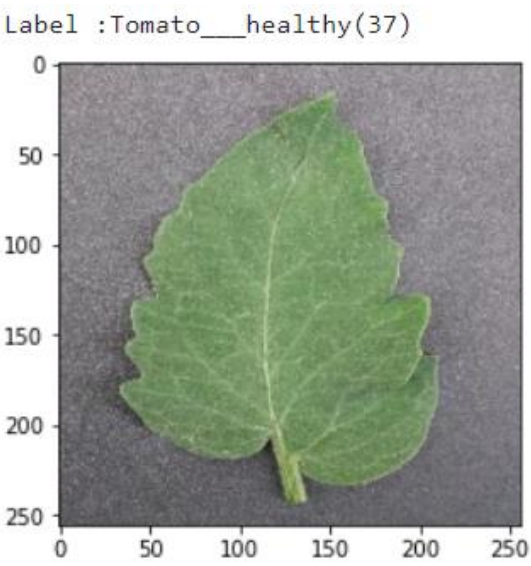
ResNet's architecture consists of:

- **Residual Blocks**: These blocks use skip connections, allowing the model to learn identity mappings and improve performance with deep layers.
- **Convolutional Layers**: ResNet applies convolution operations to the input image, extracting features such as edges, textures, and patterns that are important for disease detection.
- **Pooling Layers**: These layers reduce the spatial dimensions of the feature maps, making the model more computationally efficient while retaining important information.
- **Fully Connected Layers**: The fully connected layers take the features learned by the convolutional layers and use them to make predictions about the plant disease.

Training and Dataset




Label :Apple___Apple_scab(0)
0
50
100
150
200
250
0
50
100
150
200
250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0
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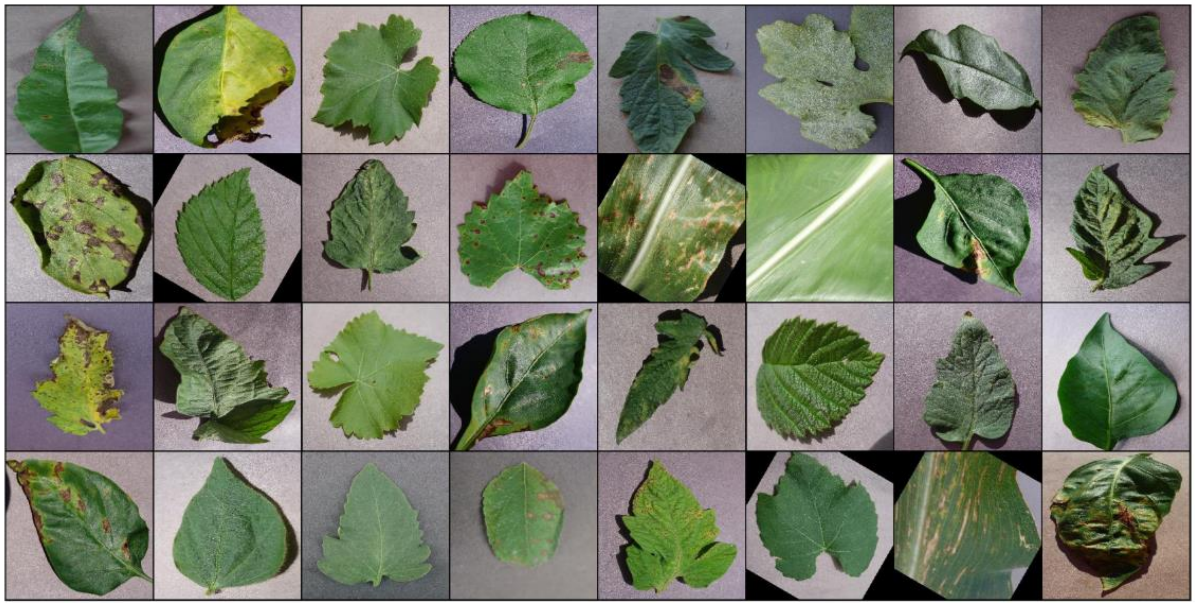
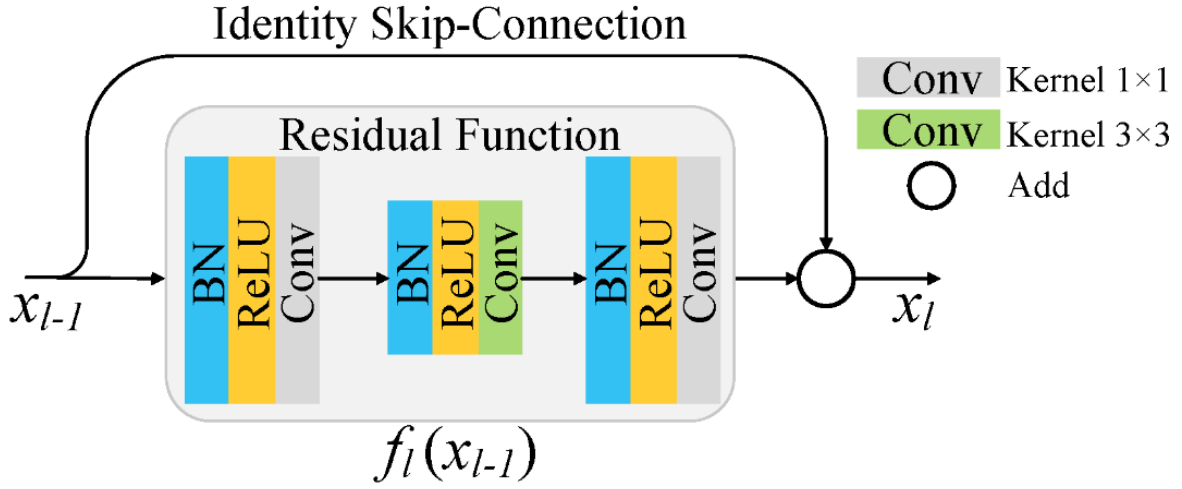
100
150
200
250
0
50
100
150
200
250



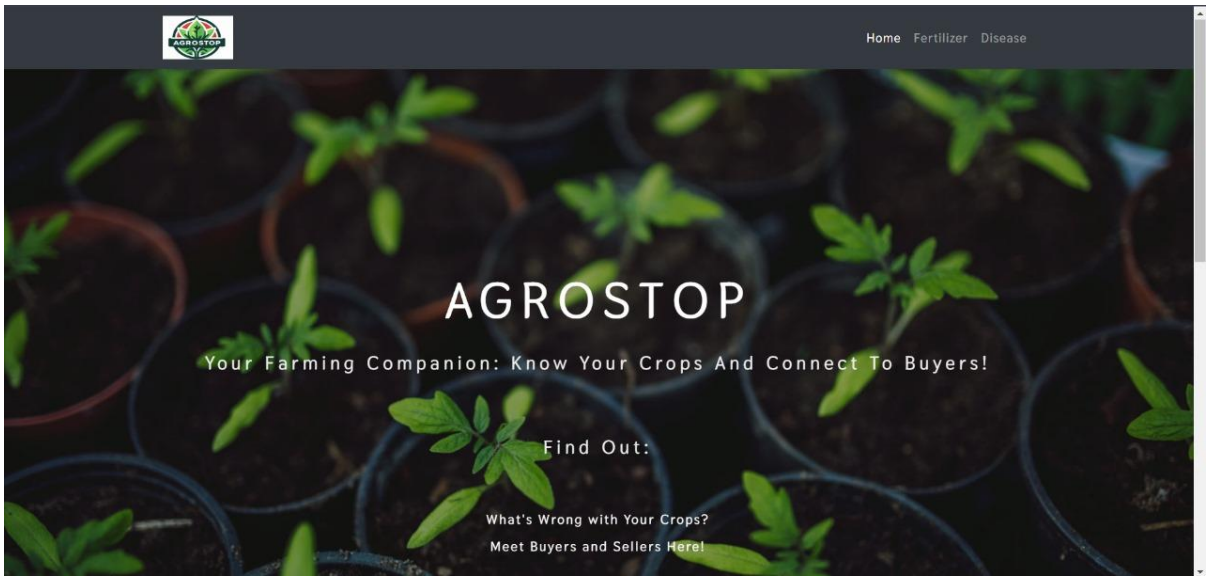

Identity Skip-Connection
Residual Function
BN
ReLU
Conv
BN
ReLU
Conv
BN
ReLU
Conv
x_{l-1}
x_l
$f_l(x_{l-1})$
Conv Kernel 1×1
Conv Kernel 3×3
Add

Conclusion

The plant disease detection system developed in this project uses a deep learning approach based on ResNet to detect plant diseases from images with high accuracy. By automating the disease detection process, the system offers a scalable solution to assist farmers in diagnosing plant diseases early, helping prevent crop loss and improving agricultural productivity.

The ResNet model provides reliable and accurate classification of diseases, and the system’s user-friendly interface makes it accessible to a wide audience. This project demonstrates the potential of machine learning to revolutionize agriculture by enabling fast, accurate, and scalable plant disease detection.

Output



About Us

At AgroStop, we are committed to enhancing agriculture, improving livelihoods, and increasing farmers' profits. We utilize machine learning to guide you through your entire farming journey. Our focus is on helping you make informed decisions by providing crop health Join us in cultivating success for your farming

Agrostop

Find out which disease has been caught by your plant

Please Upload The Image

Choose File plan3.webp

Predict

Crop: Pepper

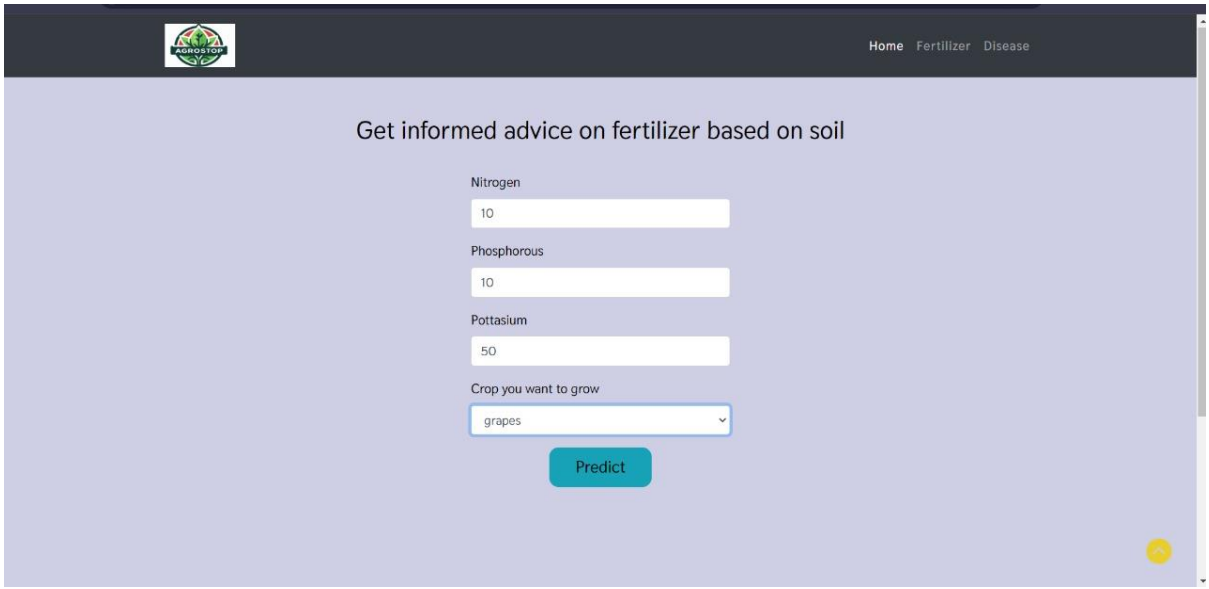
Disease: Bacterial Spot

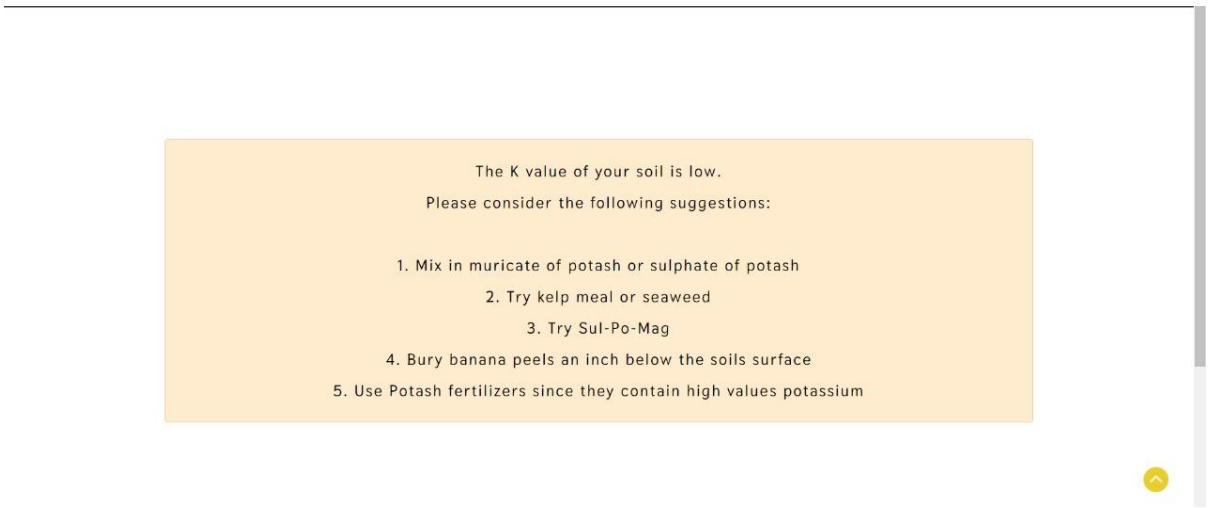
Cause of disease:

1. Bacterial spot is caused by several species of gram-negative bacteria in the genus Xanthomonas.
2. In culture, these bacteria produce yellow, mucoid colonies. A "mass" of bacteria can be observed oozing from a lesion by making a cross-sectional cut through a leaf lesion, placing the tissue in a droplet of water, placing a cover-slip over the sample, and examining it with a microscope (~200X)..

How to prevent/cure the disease

1. The primary management strategy of bacterial spot begins with use of certified pathogen-


Home
Fertilizer
Disease
Get informed advice on fertilizer based on soil
Nitrogen
10
Phosphorous
10
Pottasium
50
Crop you want to grow
grapes
Predict


The K value of your soil is low.
Please consider the following suggestions:
1. Mix in muricate of potash or sulphate of potash
2. Try kelp meal or seaweed
3. Try Sul-Po-Mag
4. Bury banana peels an inch below the soils surface
5. Use Potash fertilizers since they contain high values potassium