Project Proposal: Potato Leaf Disease Detection Using AI Techniques

# Introduction

Potato is one of the most important staple crops worldwide, and the presence of diseases can significantly impact its production and quality. Early detection and accurate diagnosis of potato leaf diseases are crucial for effective disease management and prevention. With advancements in artificial intelligence (AI) techniques, we propose to develop a solution for potato leaf disease detection using machine learning algorithms.

# Problem Statement

The goal of this project is to build an AI-based system that can accurately identify various diseases affecting potato leaves. By analyzing leaf images, the system will classify the leaves into different disease categories, enabling early detection and timely intervention to minimize crop damage.

# Dataset and Sources

To address this problem, we will utilize the PlantVillage dataset available on Kaggle. The dataset consists of a collection of high-resolution images of healthy potato leaves as well as leaves affected by various diseases. The dataset provides a rich source of labeled images for training and evaluating our AI models. The dataset can be accessed using the following link: <https://www.kaggle.com/datasets/emmarex/plantdisease>

# AI Techniques

We plan to employ the following AI techniques to develop a robust potato leaf disease detection system:

## a) Data Analysis and Exploration

* Perform exploratory data analysis to gain insights into the dataset.
* Preprocess the images, including resizing, normalization, and augmentation techniques, to enhance model performance.

## b) Random Forest

* Train a Random Forest classifier using the preprocessed image data.
* Evaluate the model using accuracy, precision, recall, and F1 score metrics.
* Assess feature importance to understand the contribution of different image features in disease detection.

## c) Multi-Layer Perceptron (MLP)

* Develop an MLP neural network architecture to learn complex patterns from the image data.
* Train the MLP model using the preprocessed dataset.
* Assess the model's performance using evaluation metrics such as accuracy, precision, recall, and F1 score.

## d) Convolutional Neural Network (CNN)

* Design and implement a CNN model for automatic feature extraction from leaf images.
* Train the CNN model using the preprocessed dataset.
* Evaluate the model's performance using standard metrics and compare it with the Random Forest and MLP models.

## e) Clustering

* Apply clustering techniques, such as K-means or DBSCAN, on the image data to identify similar patterns and groupings.
* Analyze the clusters to gain insights into different disease types and their characteristics.

# Evaluation

The proposed AI models will be evaluated using various metrics, including accuracy, precision, recall, and F1 score. We will assess the models' performance on a separate test dataset to ensure their generalization ability. The clustering results will be analyzed based on the within-cluster similarity and between-cluster dissimilarity.

# Conclusion

The proposed project focuses on utilizing AI techniques to develop a robust potato leaf disease detection system. By leveraging machine learning algorithms such as Random Forest, MLP, and CNN, we aim to achieve accurate disease classification. The analysis of the PlantVillage dataset and the application of clustering techniques will provide valuable insights into the patterns and characteristics of different potato leaf diseases. Ultimately, this project aims to contribute to the development of sustainable agriculture practices by assisting farmers in effective disease management.