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Potato Plant Leaf Disease Detection

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***Abstract*: The foundation of the Indian economy is its agricultural production, which accounts for about 17–18% of GDP and is the main source of income for the vast majority of people. India leads the world in net cultivated area, hence maintaining the country's economic stability depends critically on the health of its crops. However, a variety of illnesses and pests constantly endanger the amount and quality of agricultural goods, making early detection methods necessary. The goal of this project is to effectively detect and identify plant diseases by utilizing cutting-edge technologies including computer vision, deep learning, and machine learning. Our research specifically focuses on the leaves of potato plants with the goal of measuring the affected leaf area and differentiating between healthy leaves and those affected by early, late, and blight illnesses. A customized convolutional neural network (CNN) was used to accomplish this, and the outcome was an astounding 96.0% accuracy rate for disease categorization.**

***Keywords*: Plant Disease Detection, Deep Learning Techniques, Machine Learning-based Techniques**

I. INTRODUCTION

Potatoes are a staple crop in India's agrarian landscape, where they account for around 28.9% of all agricultural crop production and are crucial to the country's economy. This adaptable crop's importance goes beyond its financial contribution because it is essential to the country's food chain. India is the world's second-largest producer of potatoes, with an astounding 48.5 million tons produced year. The state of Uttar Pradesh leads the way, accounting for more than 30.33% of the overall production.

However, illnesses that affect both plants and agricultural fields provide a threat to this essential crop. These agricultural diseases are caused by microorganisms, genetic abnormalities, and infectious agents such as viruses, fungus, and bacteria. Among these are potato leaf diseases, which are mostly caused by bacteria and fungi and pose a serious danger to crop productivity and farmer livelihood. Potato plants face numerous enemies, including common scab, soft rot, and late and early blight.This review paper explores the development of strategies for classifying potato leaf diseases, highlighting the shift from traditional image processing methods to the use of cutting-edge deep learning architectures. The categorization and identification of healthy and disease-infected leaf conditions is the main focus of the suggested research technique. In particular, the VGG16 architecture—a member of the CNN family—is used in this study. in addition to other CNN designs, such as ResNet50 and Google Net. Figure 1 shows the original images of potato plant leaf. We hope to shed light on the potential effects of these technologies on improving crop yield, raising farmer profitability, and significantly boosting the agricultural industry and the US economy overall by investigating the effectiveness of deep learning approaches.

Figure 1. Original image of Potato Plant Leaf

II. LITERATURE REVIEW

This study explores the current state of potato plant leaf disease detection, emphasizing novel strategies that make use of state-of-the-art technologies.

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An overview of recent research, techniques, and developments in the field is given in the literature review that follows, with a focus on the application of convolutional neural networks (CNNs), data augmentation methods, and other machine learning-based tactics. This review attempts to add to the body of knowledge and guide future research endeavors in the pursuit of more precise and effective disease detection in potato plants by analyzing the current state of the field.

In 2022, Aditi Singh and Harjeet Kaur utilized a Kaggle dataset with 300 samples, achieving a validation accuracy of 95.99%. Their approach incorporated Convolutional Neural Networks (CNN) and Image Processing.

Anushka Bangal, Dhiraj Pagar, Hemant Patil, and Neha Pande also employed a Kaggle dataset in 2022, comprising 1150 samples. Their CNN-based model achieved a validation accuracy of 91.4%, emphasizing high precision. In the same year, Deep Kothari, Harsh Mishra, Rashmi Thakur, Vishal Pandey, and Mihir Gharat used a Kaggle dataset of 1200 samples, achieving an impressive 97% accuracy. Their model employed CNN, Google Net, and ResNet50, showcasing robust application through data augmentation. Moving to 2023,Varsha P. Gaikwad and Dr. Vijaya Musandey utilized a Kaggle dataset with 2340 samples, achieving 96% accuracy with a focus on 91% validation accuracy. Their approach primarily involved CNN.

III. PROPOSED METHODOLOGY

Using a customized Convolutional Neural Network (CNN), a thorough methodology is proposed in this research project on Potato Leaf Disease Classification to efficiently identify and categorize the health status of potato plant leaves. The first stage is to compile a varied dataset of images of potato leaves that represent different environmental conditions, early and late blight diseases, and health stages. The dataset is then standardized by applying image preprocessing techniques likeresizing, normalization, and augmentation. To aid in the development and assessment of the model, the dataset is subsequently divided into training, validation, and testing sets.

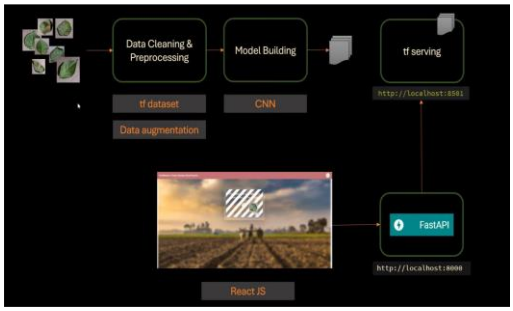

Figure2. Systematic outline of CNN based system for potato disease detection

IV. DATASET

We have used only 1000imagesof Early blight, late blight and healthy of each to train our model. The dataset used is a Kaggle dataset: Plant Village Dataset | Kaggle The dataset has images belonging to classes like Early blight, late blight and healthy. I n figure 3 below shown the images of different classes of Potato disease namely, potato healthy, potato early blight, potato late blight.

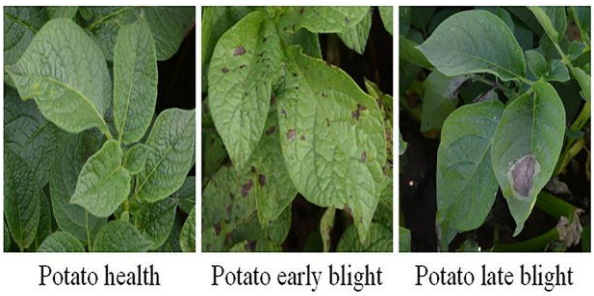

Figure 3. Different category of Potato disease

V. RESULT

Figure4 below illustrates how the training process uses two graphs for accuracy and loss and the convolution neural network's training procedure for potato plant leaf images is depicted in. When the epoch hits its peak and the loss graph hits zero, the graph reaches 96.48%. Table 1 provides information about the training procedure.

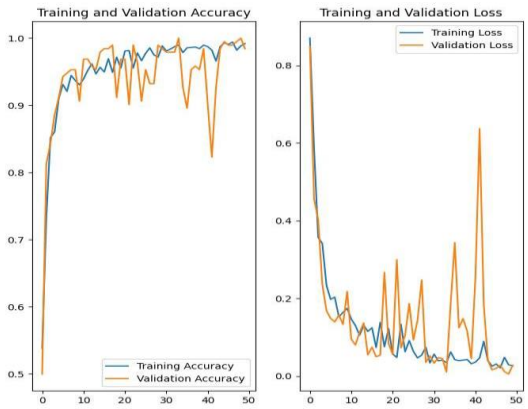

Figure 4. Training and Validation accuracy and loss Graph

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