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A Machine Learning Approach for Detection and Classification of Potato Disease

Gopesh Kumar Bharti, Mr.Mahadev Bag, Dr. Tanushree Chatterjee, Dr. Vivek Kumar Sinha
Research Scholar, Department of Computer Science and Engineering, Raipur Institute of Technology, Raipur, Raipur, India
gopeshkumarbharti3@gmail.com
Assistant Professor, Department of Computer Science and Engineering, Raipur Institute of Technology, Raipur, Raipur, India
bagmahadev1010@gmail.com
Associate Professor, Department of Biotechnology and Engineering, Raipur Institute of Technology, Raipur, Raipur, India
tanushree52004@yahoo.com
Assistant Professor, Department of Computer Science and Engineering, Lovely Professional University , Punjab
sinha.vivekkumar7@gmail.com

ABSTRACT — Potato farming faces huge financial losses every year due to the prevention of diseases like early blight and late blight. A fungus causes early blight, and a specific microorganism is the most common culprit that causes late blight. The disease primarily affects leaves and stems, potentially causing defoliation and, under favorable conditions, increased susceptibility to tuber infection. Early detection and accurate identification of this disease are important to implement appropriate treatment and reduce economic losses. Fungi cause early blight, while a specific microorganism causes late blight. Prompt adoption of appropriate treatment can save resources and prevent crop waste. The objective of this project is to develop a classification system capable of identifying the type of disease present in potato plants. The three target classes are healthy, early blight, and late blight. By leveraging advanced techniques in image processing and machine learning, we aim to provide farmers with a reliable tool for early disease detection and accurate differentiation, allowing them to take timely and appropriate action to protect their potato crops and reduce financial losses.

Keywords — Healthy, early blight, late blight disease classification.

I. INTRODUCTION

The agriculture sector faces significant challenges, and one of the critical concerns for potato farmer is the economic impact of disease such as early blight and late blight on their crops [1]. These diseases, caused by fungi and specific microorganisms, respectively, can lead to defoliation, increased vulnerability to tuber infection, and substantial financial losses [2]. Timely and accurate identification of this disease is paramount for implementing effective treatments and mitigating the impact on potato crops [3].

To address these challenges, we introduce the SmartGuard System-an intelligent tool designed to empower farmers with precise disease detection and differentiation capabilities [4]. SmartGuard combines cutting-edge image processing and machine learning techniques to provide farmers with actionable insights for prompt decision-making and crop protection [5].

II. LITERATURER REVIEW

Several previous studies that have constructed in trails in potato leaf disease detection in the following:

In a research paper titled "Potato Leaf Disease Detection and Classification using CNN, there has been a growing interest in employing deep learning techniques, particularly convolutional neural networks (CNNs), for the automated detection and classification of plant diseases [6]. This research endeavours to focus on the application of CNNs to identify late blight, early blight, and healthy leaf images in potato plants [7].

In a research paper titled "Deep Learning for Advanced Agriculture Disease Detection Technique (2017), this study provides insights into the broader application of deep learning in agriculture disease detection [8]. It discusses the potential impact of such technologies on transforming the agriculture sector, especially in regions with limited literacy, echoing the potential benefits outlined in the present project [9].

In a research paper titled "Fuzzy Clustering: Enhancing Precision in Agriculture Image Analysis for Sustainable Crop Management (2018), this study focuses on fuzzy clustering in agriculture image processing [10]. This review discusses the versatility of fuzzy c-mean

clustering techniques [11]. It explores applications in image segmentation and highlights their potential in handling varied conditions, a crucial aspect for uncontrolled environments [12].

In a research paper titled "Harvesting Intelligence: Neural Networks in Agriculture for Crop Disease Detection and Severity Assessment," the authors embark on a comprehensive review of the application of neural networks in agriculture, with a specific emphasis on their crucial role in detecting and assessing the severity of crop disease[13] published in 2019, the study illuminates the landscape where artificial intelligence intersects with agriculture, envisioning a future where neural networks contribute significantly to crop health [14].

In a research paper titled [15] " Exploring New Horizons: Opportunities and Challenges of Computer Vision in Agricultural Technology for Sustainable Food Systems (2020), the research paper delves into the dynamic landscape of computer vision within the agro-food industry [16]. It discusses issues related to uncontrolled environments, such as variable lighting and background conditions, and highlights the need for robust algorithms capable of handling diverse situations.

In a research paper titled [17] "Machine Learning Application for Crop Disease Detection and Classification (2021)," this study provides an overview of machine learning applications in crop disease detection.[18] It discusses the challenges associated with uncontrolled environments and emphasises the need for models that can handle variations in lighting, angle, and background.[19] The study sets the context for addressing similar challenges in the severity identification of late blight.

III. PRAPOSED METHODOLOGY

The proposed framework comprises four pivotal steps: -

Data Collection: A diverse dataset is curated, including images of healthy potato plants, those affected by early blight, and those affected by late blight. Images are captured under various conditions, encompassing different lighting, backgrounds, and growth stages.

Sample	Number
Early blight	1000
Late blight	1000
Healthy	152

Data pre-processing: Techniques for data cleaning, normalization, and augmentation are implemented to ensure uniformity and enhance dataset robustness. Address variation in image resolutions, colors, and backgrounds to create a standardized input for the classification model.

Feature Extraction with Convolutional Neural Networks (CNNs): to train a CNN-based feature extraction model to capture intricate patterns in potato plant images. Cascade convolutional layers with pooling layers enhance robust feature extraction.

Model Training and Validation: Train the classification model using the pre-processed dataset, incorporating healthy, early blight, and late blight classes. Validate the model to ensure high accuracy and generalization on unseen data, utilizing techniques like cross-validation.

Softmax Classification Layer: Integrate a softmax classification layers to categorize potato plants into healthy, early blight or late blight classes based on input images.
Integration with Image Processing Techniques: Leverage advanced image processing techniques to enhance the model's adaptability to variations in size, shape, and illumination.

CONCLUSION

SmartGuard represents a significant advancement in precision agriculture, offering farmers a reliable and efficient solution for early disease detection and accurate differentiation. By combining sophisticated image processing and machine learning, SmartGuard equips farmers with the tools they need to protect their potato crops, minimize financial losses, and make informed decisions for sustainable and prosperous agriculture.

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