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Intelligent Plant Disease Classification Using Deep Learning Techniques

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ABSTRACT: In this study, we developed a plant disease detection system using imaging technology that autonomously identifies symptoms on the leaves and stems of plants, promoting the growth of healthy plants on the farm. The system tracks all alterations detected in plants and distinctive traits like leaves and stems, automatically recognizes the modifications, and alerts the user. This study offers an assessment of current plant disease detection systems. The most recent convolutional neural network (CNN) based on deep learning has significantly improved image classification precision. Motivated by CNN's achievements in image classification, this paper focuses on the pre-trained deep learning approach for identifying plant diseases. This work's contribution has two facets: the most sophisticated large-scale architectures, like AlexNet and GoogleNet. The pre-trained models of AlexNet and GoogleNet were developed and evaluated using datasets obtained from the Kaggle website. Training, testing, and experimental findings indicate that the suggested architecture can achieve a higher GoogleNet model with an accuracy of 99.10% in comparison to other models.

Keywords-Deep Learning Techniques, Plant Disease, Convolutional Neural Network, GoogleNet model.

Introduction

The domain of image processing encompasses multiple methods. The necessary steps include gathering image data, pre-processing, segmenting, analyzing, defining images, and identifying and classifying them in the real world. Image processing, known as machine learning, is a growing field encountering difficulties, particularly in developing artificial and intelligent systems that transform information and data into digital formats via images. Machine learning is the combination of industry, automation, and architecture. Recent advances in computers have made image processing and machine learning easier through automation. Data processing for information collection, essential farming activities, event tracking, interaction with the environment, brain signaling, process administration, and numerous practical applications for the operation of automated machine learning include, for example, data processing for information collection, essential farming activities, event tracking, interaction with the environment, brain signaling, process administration, and comparable duties. These are critical and helpful occasions. As a consequence, the systematic application of IT systems, methods, and technologies like as image processing, artificial intelligence, neural networks, and machine learning is enhancing the development of IT systems and processes in "breath practice." Image processing and machine learning technologies are rapidly being integrated into agriculture and livestock management.

The internet and the World Wide Web are profoundly interconnected in today's digital world (www). It's a never-ending well of wisdom. Ordinary users had access to this data consumption in the early days. Just a few experts and industries developed and disseminated such knowledge [6]. Web browsing, multimedia, picture capturing, and storage devices have advanced in recent years, bringing a massive revolution to the digital system. It made it easier to build and share new online papers. This has prompted millions of people to create their web pages and update them with new text, images, and videos from virtually every area. The size of the image collections, database, text content, and videos has expanded. Obtaining information from such an extensive collection is a challenging challenge. It necessitates recovery frameworks. It could be set up to recover data, text, documents, and images, among other things. Retrieval systems are a form of the retrieval system.

Plant Diseases

Plant diseases refer to any interruption in a plant's usual physiological processes that leads to observable symptoms. A symptom is an occurrence related to something and serves to demonstrate its reality. Pathogens responsible for plant diseases might be found in leaves, stems, bulbs, fruits, and roots of plants. Alterations in the size, form, and look of leaves, branches, blooms, and fruits indicate symptoms of disease. Figure 1. illustrates the leaf illnesses affecting soybean, potato, and maize. It demonstrates how the illness has changed the green sheet, featuring shifts in color, shape, and rough texture variations.

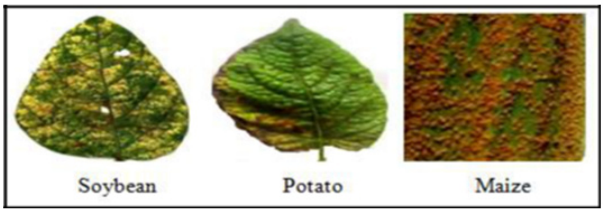

Figure 1: Examples of Leaf Diseases

Plant diseases are categorized into different groups according to their occurrence, intensity, and origin [9]. Plant diseases are categorized as either localized or systemic. Plant diseases are commonly categorized as soil-borne, airborne, or seed-borne, depending on their natural spread and method of infection. A range of illnesses is grouped into a classification category according to symptoms. Rust, smuts, leaf spotting, mildew, powdery mildew, and similar conditions are examples. Plant diseases are referred to as cereal, vegetable, fruit, and forest diseases based on the host plants involved. In agriculture, plant diseases are identified as diseases affecting maize, soybean, etc. Plant diseases are classified into three groups based on the diseased organ: root and fruit diseases, leaf diseases, and shooting diseases. Plant diseases are characterized as chronic, epidemic, seasonal, or pandemic based on their prevalence and transmission. A disease is considered prevalent in a certain location if it is observed on a constant and moderate basis year after year. The viral sickness frequently presents itself in big agricultural regions. Intermittent sickness appears in irregular and unpredictable ways. It is designed in a modest to substantial manner. Infectious illnesses have spread over the continent.

PROPOSED METHODOLOGYAND RESULTS

Transfer learning is significantly easier to apply than any CNN structure with weights defined at random.

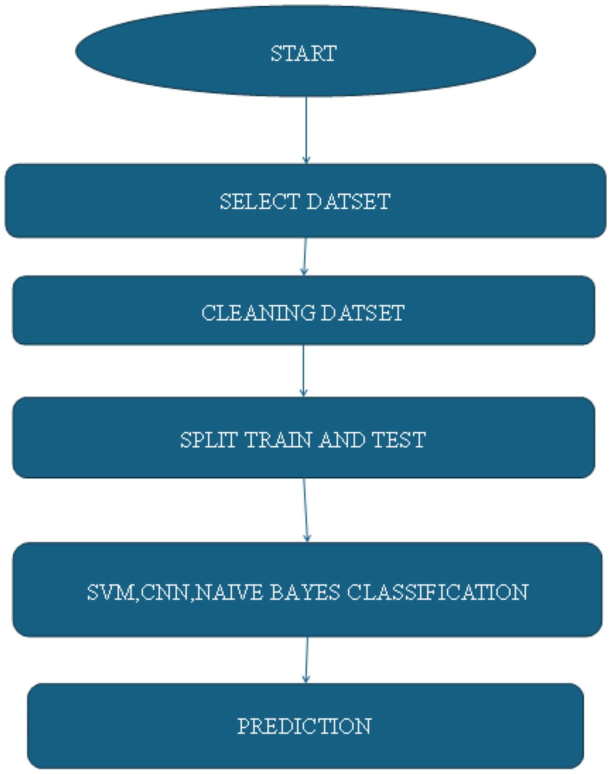

Figure 2: Flow Diagram

Module Description

Input Image

Pre-processing

Segmentation

Feature extraction

Classification

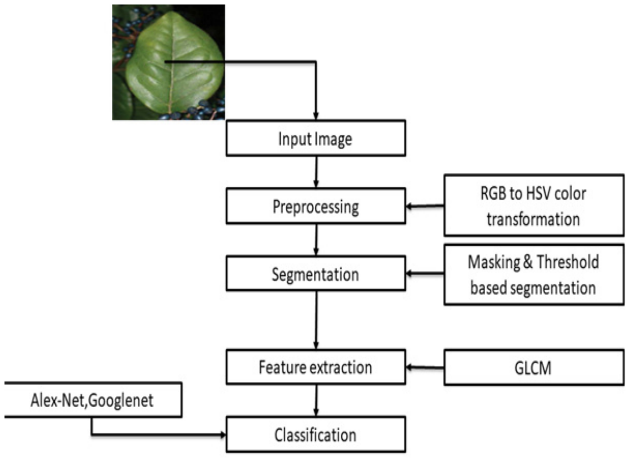

Figure 3: Proposed Diagram

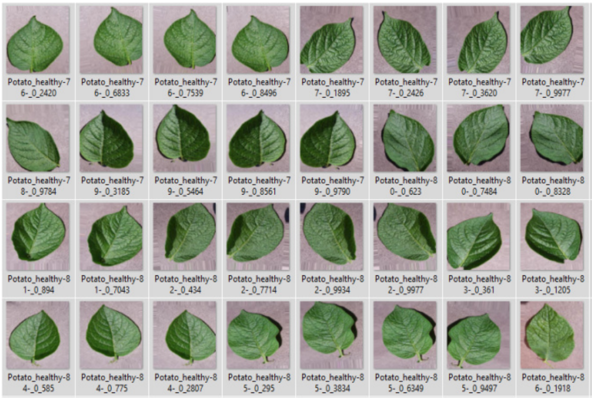

Figure 4: Healthy Image Dataset

Figure 5: Late Blight Image Dataset

Figure 6: Early Blight Image Dataset

Simulation Results

The classification process is carried out using a deep learning model backpropagation method Considered in the map learning mechanism. A feed-forward propagation neural network comprises three layers: an input layer, an input, and an output layer. The neural network is trained in the available data table 4.1, which shows the performance parameters of the two-deep learning models.

Table 1: Performance Comparison

Deep Learning Model/ Performance Parameter	AlexNet	Google Net
Specificity	99.16	99.1
Sensitivity	99.16	96.66
Accuracy	98.14	98.33
Recall	98.88	96.66
Precision	98.33	96.66
Jaccard Coefficient	99.074	97.77
AUC	0.22	0.22
Dice	99.53	98.87
Classification Error	1.85	0.8

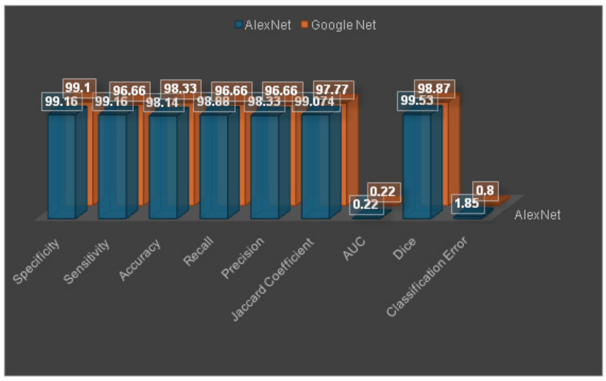

Figure 7: Performance Comparison of Deep Learning Models

Table 2: Comparison Result of Different Deep Learning Architecture With Existing Technique

	Deep Learning Architecture	Accuracy
Proposed Techniques	Alex Net	98.17
	Google Net	99.1
Existing Work	CNN	98

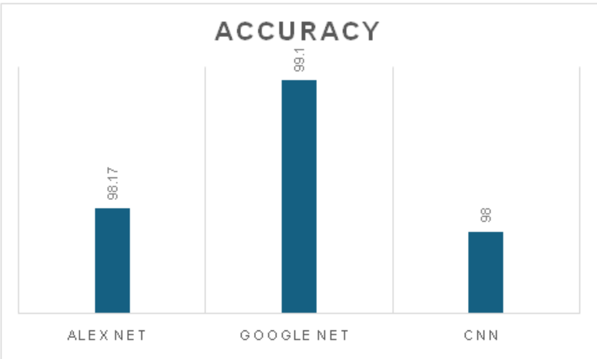

Figure 8: Comparison Result of Different Deep Learning Architecture with Existing Technique

Figure 8illustrating the relative performance of the suggested model against current methods. The suggested model is contrasted with another deep learning model. Following the training and testing phases, the GoogleNet model achieved a higher accuracy of 99.10 compared to the AlexNet model. When compared to existing models, the GoogleNet model demonstrates superior accuracy.

Conclusion

Algorithms for image processing aimed at detecting and diagnosing illnesses are suggested. The plant's leaves are used to diagnose leaf disorders. This algorithm delivers improved results, allowing a human to discern between safe and dangerous plants. This image analysis system can identify healthy crops on farms, increase output, and maintain the quality of pepper plants. This method aids in disease detection by analyzing visual markers found on plant leaves.

A approach for image analysis is presented to identify and diagnose illnesses. The leaves of pepper plants are used to diagnose leaf disease.The program can discern between healthy and ill plants, resulting in improved performance. This image analysis system can detect healthy pepper plants in agricultural regions, increasing pepper fruit yield while maintaining plant quality. This program uses visual signals from plant leaves to identify illness. We offer image analysis techniques for illness recognition and diagnosis. When detecting leaf disease, a plant's leaves are grouped together. The algorithm delivers good results and can assist distinguish between healthy and diseased plants. This image analysis approach may identify healthy crops on farms, increasing productivity and ensuring the quality of peppers and plants.

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