

# Convolutional neural networks for leaf image-based plant disease classification

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## ABSTRACT

Plant pathologists desire soft computing technology for accurate and reliable diagnosis of plant diseases. In this study, we propose an efficient soybean disease identification method based on a transfer learning approach by using a pre-trained convolutional neural network (CNN's) such as AlexNet, GoogleNet, VGG16, ResNet101, and DensNet201. The proposed convolutional neural networks were trained using 1200 plant village image dataset of diseased and healthy soybean leaves, to identify three soybean diseases out of healthy leaves. Pre-trained CNN used to enable a fast and easy system implementation in practice. We used the five-fold cross-validation strategy to analyze the performance of networks. In this study, we used a pre-trained convolutional neural network as feature extractors and classifiers. The experimental results based on the proposed approach using pre-trained AlexNet, GoogleNet, VGG16, ResNet101, and DensNet201 networks achieve an accuracy of 95%, 96.4%, 96.4%, 92.1%, 93.6% respectively. The experimental results for the identification of soybean diseases indicated that the proposed networks model achieves the highest accuracy.

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## 1. INTRODUCTION

Soybean crops are profoundly affected by diseases, which causes severe losses in the agriculture economy [1]. For instance, bacterial blight, frog eye leaf spot (FLS), and brown spots are the most common diseases that cause considerable damage to crops and a decrease in yield. The proposed pre-trained AlexNet convolutional neural network (CNN) model used for the classification of these three common diseases. Thus, accurate identification and diagnosis of soybean diseases are vital for high crop yield. In the naked eye approach, which is usually preferred by plant pathologists for detecting soybean diseases, subjective bias can occur because of the decision based on the experience and knowledge of experts [2]. In recent years, various soybean diseases, like fungal such as brown spot, frog eye, rust, bacterial such as pustule and blight, and viral such as bean pod mottle virus explored for automatic detection. To obtain accurate diagnosis results, several researchers have deliberated automated soybean disease diagnosis based on digital image processing [3], pattern recognition [4], and computer vision [5].

A few systems able to work on images captured in fields with different conditions developed. Images acquired with a mobile phone, a method detects and classifies two soybean diseases, such as brown spot and frog eye [6]. For fifty testing samples, the K-NN classifier trained with a shape-based feature vector