Chapter 1
AI-Driven Plant Leaf Disease Detection for Modern Agriculture

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ABSTRACT

Due to the diseases that affect the crop, farmers as well as the buyers face a critical loss. About 60% of the farmers confront losses in crop yield. As a result, there have been numerous reports of deaths of the farmers. Later progressions in artificial intelligence and through the use of deep learning techniques, automated systems are distinguished and also recognize infections in images. This model can extract the features of the disease that's shown within the given image. In this literature survey the authors recognized the tomato crop diseases and focused on certain aspects which include image dataset, no. of diseases (classes), precision of the model etc. They created a model using convolution neural network (CNN) for classifying images and explainable artificial intelligence (AI) by using a local interpretability technique called as local interpretable model-agnostic explanations (LIME) to explain the predictions that are made by the model. Evaluation of the images from the tomato disease image dataset shows that our model's accuracy is 97.78%.

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1. INTRODUCTION

For Indian farmers, tomatoes have been identified as their most important source of earnings. Over half of the world's population depends upon tomatoes as it is most important part of cooking. It provides 20% of the world's energy supply unchanged and is considered to be an integral part of many traditions and is also able to grow anywhere. In addition, it is also a good source of thiamine, niacin and riboflavin. Especially in India the dishes that are made using tomato also includes animal products such as fish to ensure a perfect nutrient balanced diet. The production of these tomatoes is declining day by day because the crop that is being affected by various diseases. Some of the major tomato crop diseases that are affecting the crop are Bacterial blight, tomato Blast, Brown spot, False smut, Tungro, Leaf Scald, Bakanae etc. It is the responsibility of the farmers to ensure the good yield of the crops. In order to ensure a better yield, the farmer must have thorough knowledge on the diseases that occur and should also have the knowledge on the correct use of pesticides and fertilizers. There are several solutions that have been proposed using some machine learning techniques. In the past few decades there is a rise in the Deep learning technology as it is being used for classifying the images. Deep learning methods are also promising because they are able to achieve high accuracy and existing research aims to increase the efficiency as well as affordability. These created new opportunities in the agriculture domain. By applying these machine learning and deep learning techniques, the farming agriculture is developing as it minimizes the overall losses in the crop production. The solutions that have been proposed until now only focused on the output i.e., they only describe the name of the particular disease that the crop is being affected. Our model which is implemented using CNN and LIME not only talks about the disease but also describes about the features of the diseased crop. It works by approximating the behavior of the model locally, in the vicinity of a particular instance, by training an interpretable model such as a linear model or a decision tree on perturbed versions of that instance. The overall goal of LIME is to identify an interpretable model. Firstly, CNN is used to detect and classify the images which belong to their classes respectively. Then LIME creates a local interpretable model based on these images which can then be useful to explain the features (Liang et al.,2022). This model is now useful to predict the image with the custom trained model. The performance of the model is evaluated on the tomato Image Dataset which contains healthy and four disease classes.

2. LITERATURE SURVEY

In plant disease detection, several studies have used traditional machine learning methods to identify and categorize different disorders in giant leaves. (Shruthi et al.,2020) (Ahmad et al.,2020). These are the papers which involved plant disease detection using machine learning the papers discussing "Machine Learning Classification Techniques for Plant Disease Detection" offers a detailed summary of the diverse machine learning methods that have employed to detect plant diseases. The authors evaluate the limitations of traditional machine learning (ML) methods and highlight the advancements and potential of deep learning (DL) in this field. Recent advancements in the field of agriculture have brought about noteworthy changes in agriculture sector, business management and decision-making processes. Technological innovations in the agricultural industry are transforming the gay farming is done. These innovations, which rely on hardware, software, algorithms, machine learning, deep learning, artificial intelligence, modeling, and simulation applications, are helping farmers increase efficiency, reduce