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A Survey on Identification of Plant Disease Caused by fallarmy worm in Maize Field in Machine Learning

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ABSTRACT:Maize (*Zea mays* L) is one of the most saleable cereal crops grown worldwide and a dominant staple food in many developing countries. The severe outbreak of fall armyworm in maize causes massive yield loss. Modern technologies, including smartphones, can assist in detecting recognising the fall armyworm infestation in maize. The objective of this study was to develop an automated Artificial Intelligence Powered Expert System (AIPES) for identifying fall armyworm infestation in maize. In addition, it put forward a deep learning-based model that is trained on photographs of healthy and fall armyworm infested leaves, cobs and tassels from a dataset and furnished an application that will be detecting maize fall armyworm infestation using Convolutional Neural Network (CNN) architecture and Mobile Net V 2 framework model. The study developed an Artificial Intelligence (AI) based maize fall armyworm infestation detection system using a DCNN (Deep Convolutional Neural Network) to support maize cultivating farmers. The model executed the objective by accurately identifying the fall armyworm infested maize plant and also classified them vis-c-vis the healthier crop. The deep learning models were trained to detect and recognise fall armyworm infection using more than 11000 images of fall armyworm infested leaves, cobs, and tassels. The created application (AIPES for identifying fall armyworm infestation in maize) using CNN detected and recognised the fall armyworm infestation in maize with a 100 per cent training accuracy rate and 87 per cent validation accuracy. So, the detection of maize fall armyworm and the treatment of fall armyworm-infested maize could lead to a higher maize crop yield.

KEYWORDS:Artificial intelligence, Convolutional neural networks, Deep learning, Fall armyworm infestation detection, Maize, Mobile app.

I.INTRODUCTION

Maize has emerged as a crucial cereal crop in peninsular India, where states like Andhra Pradesh, which ranks fifth in terms of area (0.79 m ha), have recorded the highest production (4.14 m t) and productivity (5.26 t ha⁻¹) in the country, despite the fact that productivity in some of Andhra Pradesh's districts is more or equal May 2018 (Sharanabasappa et al., 2018). Automatic diagnosis of plant diseases from captured images through computer vision and artificial intelligence research is feasible to technological advancements (Wang et al., 2013; Cheng et al., 2017).

This research proposes the expert system that will enable to detect fall armyworm infestation in the field using the new technology of artificial intelligence to identify and classify the fall armyworm infestation in the maize crop. Image processing techniques are now widely employed in agriculture and it is concerned with the detection and recognition of infestations of plants. Computer vision and image processing technology are widely engaged in a variety of industries, and they have a wide range of applications in modern agriculture (Wang et al., 2013). Compared to the visual method of detecting plant disease, automatic detection proceeds less time and effort and is more accurate (Singh and Misrab, 2016). Machine learning technologies afford numerous opportunities to promote an automatic disease classification. However, these consume a lot of time manually extracting the features from the images and feeding them as input to the algorithm to classify the plant disease (Huddar et al., 2012).

Currently, more deep learning models have been delineated to be gaining popularity than others. Deep learning is a novel technology for image processing and object recognition that improves the accuracy of crop disease classification.



Transfer learning is a prominent deep learning approach in which pre-trained models are converted to perform a new task (Cheng et al., 2017; Nanni et al., 2020; Alves et al., 2020). A Convolutional Neural Network (CNN) is a deep learning model widely used in image processing and simply detects and categorises the images through its multi-layered structure. CNNs are at the heart of most cutting-edge computer vision solutions for a spacious range of applications (Szegedy et al., 2016). Deep learning has a wide range of applications, including computer vision, image categorization, restoration, speech, and video analysis. Since 2015, image categorization research has leaned heavily on deep learning (Barbedo et al., 2018). In their study, Kawasaki et al. (2015) and Kulkarni (2018) illustrated a unique plant disease detection system based on convolutional neural networks.

CNN can procure great classification performance using only training photos. Deep convolutional networks were employed to innovate a plant disease recognition model based on leaf image categorization (Sladojevic et al., 2016). In the realm of image classification, convolutional neural networks (CNN) have rendered excellent results. Yao et al. (2017) used image processing to advocate a threelayer detection approach for detecting and identifying White-backed planthoppers. For the identification of distinct developmental stages of planthoppers on rice plants, the proposed method was proven to be viable and successful. It is effective at evaluating graphical images and extracting the relevant features. The present work aimed to study a convolutional neural network's probability of classifying fall armyworm infested plant leaves, cobs, and tassels images taken directly from maize research plots of Tamil Nadu Agricultural University (TNAU) and eight blocks in Tiruvannamalai districts. Fall armyworm infested leaves, cobs and tassels were classified utilising the pretrained Mobile Net V2 framework which was adopted for building the neural network. Furthermore, the model was deployed in android mobile.

II.METHODS:

Image pre-processing

Images were reduced in size and cropped to fit a certain input. It improves and processes the image to the required colour scale. Image pre-processing is done for reducing noise and segmenting the image, which boosts the accuracy of the CNN model. The acquired images are usually messy and un-normalized since it comes from different sources. To feed them to the algorithm, they need to be pre-processed, normalized and cleaned up. More often, image pre-processing and normalization is done to cut down the complexity and strengthen the accuracy of the applied algorithm by generating accurate results.

Data augmentation

When training a deep learning model, data augmentation is necessary to avoid the overfit problem produced by a small dataset. Supplemented the dataset acquired in the image acquisition to increase the dataset size and offer some variation (Random rotation, random flip, random brightness, random zoom) in image distortion. Augmentor, a Python image augmentation package for machine learning, is used in the data augmentation process.

Feature extraction and image analysis:

Image analysis entails breaking down an image into its constituent parts to retrieve useful data. Image analysis includes finding shapes, recognising edges, eliminating noise, counting objects, and computing texture analysis or image quality. Feature extraction is a step in the feature dimensionality reduction process, which divides and reduces a large amount of raw data into smaller groupings to make processing easier. Convolution and pooling layers of Convolutional Neural Networks (CNN) are used to accomplish this process.



Image classification:

Fully connected layers of Convolutional neural network (CNN) are used for the classification of image datasets, whereas convolutional and pooling layers are used for feature extraction. The categorization technique classifies plant portions infested with fall armyworm.

III.CONCLUSION

The agricultural industry relies on early detection and recognition of these FAW infestations. In the present study, CNN was used to classify photos of maize affected by the autumn armyworm. Using images collected from maize research plots, the CNN architecture was trained. The present model had a training accuracy of 100% and a validation accuracy of 87% in terms of classification. This demonstrated that the CNN extracts essential information from photos with an unmanaged backdrop, which is necessary for classifying plant pest infestations. Experiments further revealed that the suggested CNN architecture could classify fall armyworm infested maize into twelve categories. The number of datasets will be increased as part of this project's extension as the study can boost the high accuracy in the validation.

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