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PLANT LEAF DISEASE DETECTION USING CONVOLUTIONAL NEURAL NETWORKS

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ABSTRACT

Plant diseases can have a significant impact on crop yield and quality, resulting in substantial financial losses for farmers. Early detection of plant diseases can help prevent their spread and increase crop yield. With the increasing availability of digital image datasets, machine learning algorithms can be used for automated detection of plant diseases. In this paper, we propose a plant leaf disease detection system using the Convolutional Neural Network (CNN) algorithm. The system uses a dataset of plant leaf images of six different crops - apple, cherry, corn, grape, orange, and potato - to train and test the CNN model. The results show that the proposed system can accurately detect the plant leaf diseases in the given images. In this paper, during preprocessing we have passed resizing, Rescaling, Shuffling, Dropout, Zoom/Brightness adjustment, Rotation, Background correction, horizontal flipping, etc. parameters So that we can convert our image data into augmented image data which will help our CNN model to learn for low-resolution images. We aim is to analyze the success rate of the proposed models and compare the outcome with other strategies. The model achieved 97.2% accuracy in identifying diseased plants using image processing. This model achieves a good accuracy. This approach creates a path for wireless-based crop analysis towards AI solutions for small holder farmers.

Keywords: Leaf Diseases, Machine Learning, Deep Learning, Convolutional Neural Networks

INTRODUCTION

Plant diseases are one of the major causes of crop loss worldwide, leading to significant economic losses and threatening global food security. The early detection and diagnosis of plant diseases are crucial for controlling the spread of infections and minimizing crop losses. Manual inspection of plants is a time-

consuming and labour-intensive process, and it can be challenging to accurately identify the symptoms of diseases in their early stages. Therefore, there is a need for an automated system that can detect and classify plant diseases accurately and efficiently.

There are various causes which can be characterized by their effect on plants, disturbances due to environmental conditions such as temperature, humidity, excessive or insufficient food, light. The most common diseases such as bacterial, viral and fungal diseases. An approach in this case is use of CNNs in plant disease classification. However, with the help of disease detection these difficulties will prevent.

A formal definition of deep learning is- neurons Deep learning is a particular kind of machine learning that achieves great power and flexibility by learning to represent the world as a nested hierarchy of concepts, with each concept defined in relation to simpler concepts, and more abstract representations computed in terms of less abstract ones. In human brain approximately there are 100 billion neurons, all together this is a picture of an individual neuron and each neuron is connected through thousands of their neighbours. The question here is how it recreates these neurons in a computer. So, it creates an artificial structure called an artificial neural net where we have nodes or neurons. It has some neurons for input value and some for-output value and in between, there may be lots of neurons interconnected in the hidden layer.

There are several ways to detect plant pathologies. Some diseases do not have any visible symptoms, or the effect becomes noticeable too late to act, and in those situations, a classy analysis is obligatory. However, most diseases generate some quite manifestation within the visible spectrum, therefore the eye examination of a trained professional is that the prime technique adopted in practice for disease possess good observation skills in order that one can identify characteristic an unsuitable diagnosis since unprofessional gardeners and hobbyists could have more difficulties determining it than knowledgeable plant pathologist. an automatic system designed to assist identify plant diseases by the plant's appearance and visual symptoms might be of great help to amateurs within the gardening process and trained professionals as a confirmation system in disease diagnostics.

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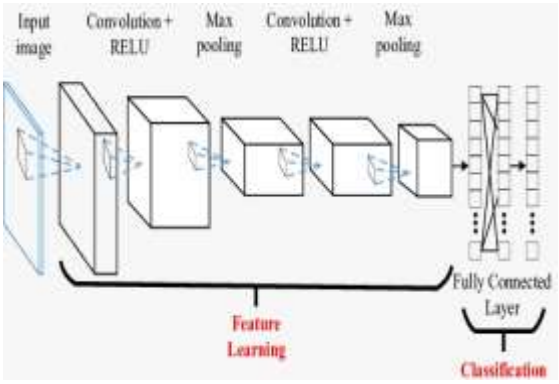


Figure 1: Architecture of CNN

EXISTING SYSTEM

Several existing systems have been proposed for plant disease detection using machine learning algorithms. However, these systems were designed for specific plant species and may not be suitable for detecting diseases in other plant species. The Existing System works on K-Mean Clustering and SVM (Support Vector Machine) classifier algorithm. SVM classifier process on particular linear classifier. The K-Mean clustering process on dividing the leaf into different clusters. Such clusters K- value calculation taken place and then division. On division of image segmentation features extraction later detection taken process. Finally Classified by disease of a leaf.

PROPOSED SYSTEM

It is very difficult for farmers to identified various diseases in plants. The estimated annual crop losses due to plant diseases at worldwide is $60 Billions. The traditional tools and techniques are not very useful since it takes up lots of time and manual work. However, with the help of disease detection these difficulties will prevent. We use the CNN algorithm to detect disease in plant leaves because with the help of CNN the maximum accuracy can be achieved if the data is good. CNN classifiers are trained to identify diseases in each plant. These results are used to call up a classifier, which is trained to classify various diseases in that plant. If not present, the leaves are classified as "healthy". It displays detected disease in the leaf.

The proposed plant leaf disease detection system using the CNN algorithm is designed to automatically detect the presence of plant diseases in leaf images. The system uses a pre-trained CNN model to extract features from the input images. The extracted features are then passed through fully connected layers to predict the disease class. The system also includes pre-processing and data augmentation techniques to improve the performance of the model. The proposed system is implemented using Python and the TensorFlow library. The proposed plant leaf disease detection system using CNN algorithms consists of the following modules: data collection, data pre-processing, data splitting, model selection, deep learning,

hyperparameter tuning, model evaluation, and results visualization.

In the data collection module, a dataset of plant leaf images of six different crops – apple, cherry, corn, grape, orange, and potato is collected. The dataset consists of 9966 different images from different classes. The images are collected from different sources and annotated with their respective disease labels.

In the data pre-processing module, the images are pre-processed by resizing, normalizing, and augmenting the dataset to increase its size. The images are resized to 224 x 224 pixels and normalized to have zero mean and unit variance. Data augmentation techniques such as random rotations, flips, and shifts are used to increase the size of the dataset.

In the data splitting module, the dataset is split into training, validation, and testing sets. The images are randomly split into 60%, 20%, and 20% for the training, validation, and testing sets, respectively.

In the hyperparameter tuning module, the hyperparameters of the model, such as the learning rate, batch size, and number of epochs, are tuned on the validation set. The performance of the model is evaluated on the validation set using metrics such as accuracy, precision, recall, and F1 score. The best set of hyperparameters is selected based on the performance on the validation set.

In the results visualization module, the results of the model are visualized using various plots and graphs. The accuracy and loss curves are plotted to analyse the training and validation performance of the model. The confusion matrix is visualized using a heat map to analyse the performance of the model in detail.

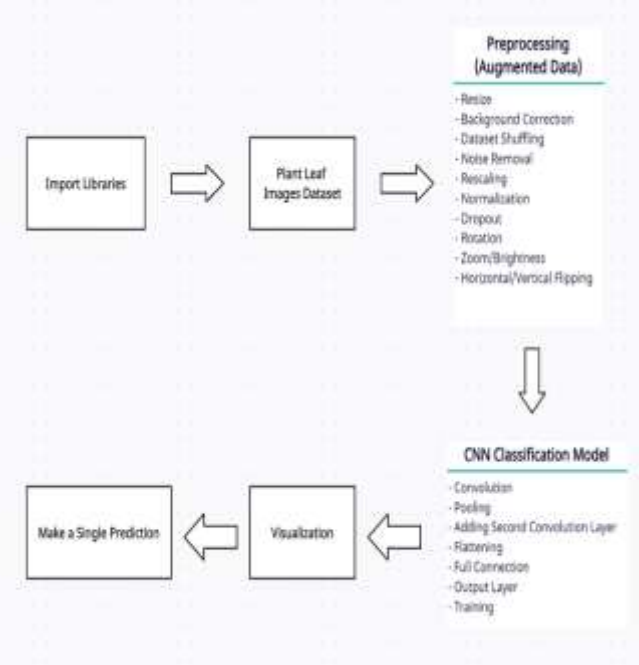


Figure 2: Flowchart of the proposed system.

LITERATURE SURVEY

Several studies have been conducted to detect and diagnose plant diseases using different techniques. Adhikari et al., [1] (2020) proposed a deep learning-based approach for plant disease detection and classification. They used the transfer learning technique to fine-tune pre-trained CNN models such as VGG16 and

Inception-v3 on a dataset of tomato leaf images. Their results showed that the proposed system achieved an accuracy of 96.4% in classifying tomato leaf diseases.

Kemble et al., [2] (2019) developed a mango plant leaf disease detection system using CNNs. They collected a dataset of mango leaf images and used transfer learning to fine-tune pre-trained CNN models such as Alex Net and Google Net. Their results showed that the proposed system achieved an accuracy of 92.67% in detecting mango leaf diseases.

Saah et al. [3] (2019) proposed a novel approach for plant disease detection using CNNs. They collected a dataset of potato leaf images and used a pre-trained CNN model as a feature extractor. The features extracted from the CNN model were fed to a Support Vector Machine (SVM) classifier for disease classification. Their results showed that the proposed system achieved an accuracy of 94.44% in classifying potato leaf diseases.

IMPLEMENTATION

The main modules are CNN, tensorflow, numpy etc.. Using tensorflow and Keras API the CNN model was built and CNN acts as a model to perform classification. Opencv and numpy are used for resizing and arranging arrays to reshape the image size. We have used flowfromdirectory method to load the images from the directory and used ImageDataGenerator for generating batches of tensor image data with real time augmentation. We trained the CNN model with the images and tested through test folder images. Hence, the result can be either name of the disease or healthy followed by the leaf image if it is diseased leaf. This gives accuracy upto 97.2% as it works on. In future there can be chances of inserting different plant leaves and display its nutrient level.

RESULT ANALYSIS

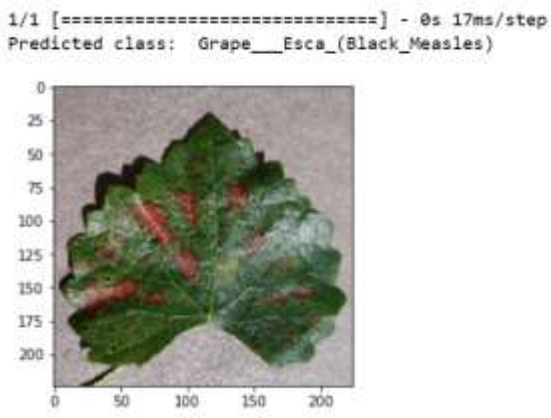


Figure 3: Result of detection and recognition disease in Grape leaf .

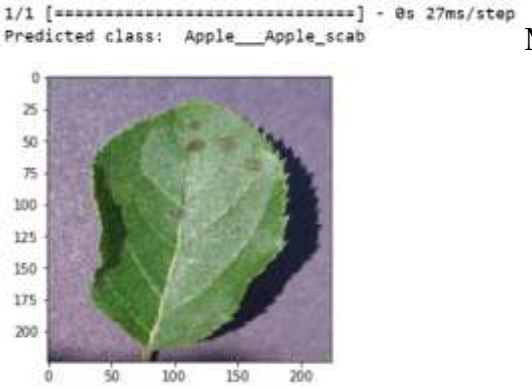


Figure 4: Result of detection and recognition disease in leaf of a Apple plant.

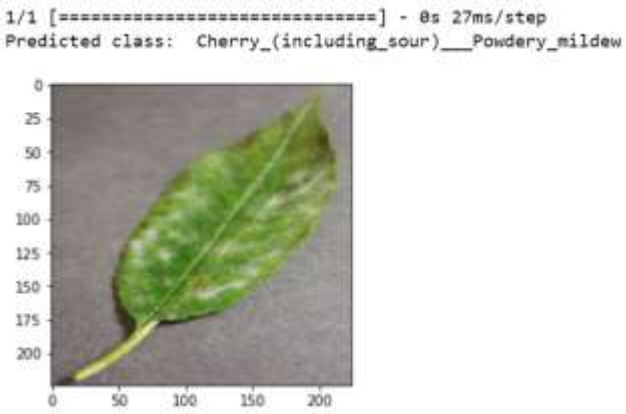


Figure 5: Result of detection and recognition disease in Cherry leaf

Figure 6: Result of detection and recognition disease in Corn leaf.

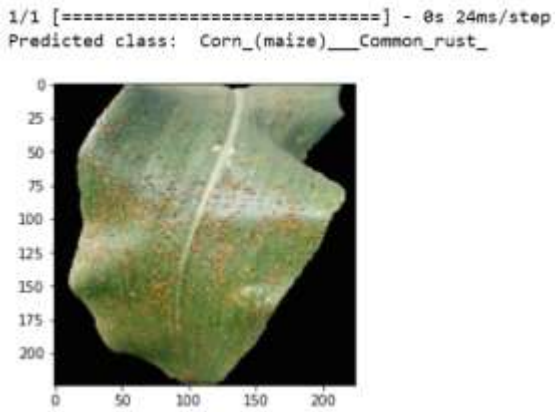


Figure 7: Result of detection and recognition disease in leaf of a Potato plant

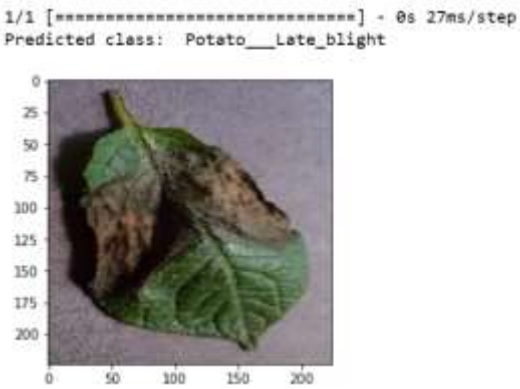
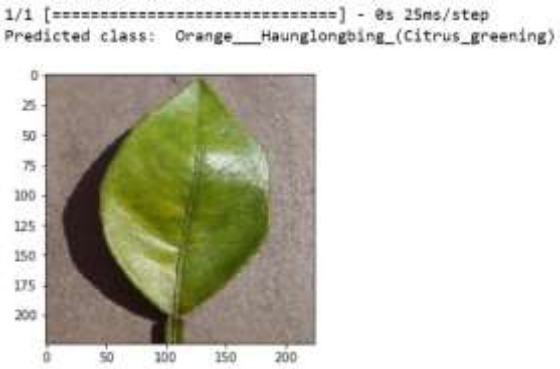
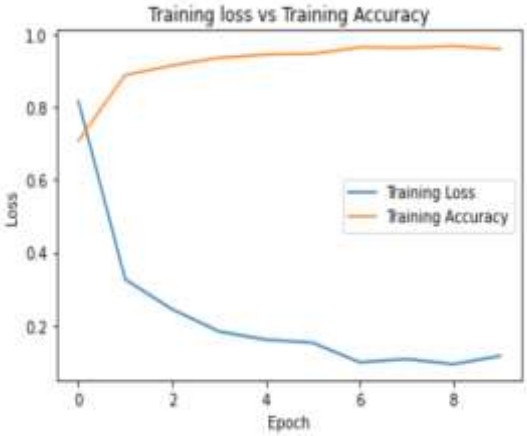


Figure 8: Result of detection and recognition disease in Orange leaf.

Figure 9: Graph depicting Training loss vs accuracy.



The graph shows here depicts the two curves- Blue curve showing training loss and Orange curve showing training accuracy. The accuracy



achieved is around 97.2%.

CONCLUSION

Protecting crops in organic farming is not an

easy task. This depends on a thorough knowledge of the crop being grown and possible pests, pathogens and weeds. In our system, a special deep learning model has been developed based on a special architectural convolution network to detect plant diseases through images of healthy or diseased plant leaves. To detect and classify diseases of various plants, an accurate and successful method should be used and this can be done by this Convolutional Neural Networks. By using this we can easily detect the disease and can protect our plants from infections. We would like to conclude that the project we took up will stipulate the actual perception behind detecting leaf diseases of the plants.

FUTURE SCOPE

Future work can be extended in this system by improving the accuracy level, detecting more plant leaf diseases, detection of nutrient level for a plant and suggesting correct pesticide. Some plant leaf disease detection automatic techniques are beneficial for large work of monitoring in farm of crops disease detection. We can also add more classes of leaves and disease type. The state of the plants can be tracked around the clock using hyper spectral imaging. Following this works, the farmers can be benefitted, and their worries of damaging the crops can be reduced.

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