Volume 11, Special Issue I, May 2020

ISSN No. 0976-5697

International Journal of Advanced Research in Computer Science

CONFERENCE PAPER

Available Online at www.ijarcs.info

EARLY DETECTION OF LEAF DISEASE USING DEEP LEARNING

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***Abstract*:** In India most of the rural population depends on agriculture. One of the problem in agriculture is leaf diseases. Due to leaf disease the yield of a crop is decreased and also affects the quality of fruits and vegetables. Identification of leaf disease plays an important role. By early detection of disease and providing right pesticides at proper time disease can be controlled easily. Nowadays in deep learning approach CNN is widely used for various computer vision tasks. In this paper we proposed system for detection of leaf disease and recommendation of the pesticides using CNN-Alex NetModel.

Keywords: CNN, AlexNet Model

INTRODUCTION

India's agribusiness struggles to support the quickly developing population due to plant diseases. The production in agriculture needs to be increased to fulfill requirements of food. Without proper knowledge of disease management, farmers struggle to diagnosis disease and spend lots of money. Biotic and abiotic are two main factors that cause leaf diseases. Biotic factors such as viral, bacteria, fungi are living components causes diseases can be diagnosed by spraying suitable pesticides and abiotic factors which cause diseases are nutritional deficiencies and improper cultural practices.

The significant challenge in agriculture to diagnosis leaf disease accurately. Traditional method for identification of plant disease through naked eye cannot be accurate. Nowadays it is substituted with the various technologies such as machine learning, deep learning to identify plant disease accurately.

A convolutional Neural Network (CNN) is a class of Deep Neural Networks (DNN) in deep learning, which is mostly used for visual imagery analyzing. The widely used classification approach for pattern recognition in the field of crop disease detection is CNN. We proposed system to identify disease and to recommend right pesticide for the disease detected.

The remaining section of this paper is organized as follows. In section 2 related works is introduced and summarized. Section 3 gives system design. Section 4 gives methodology used for proposed system. Section 5 analyses results. Section 6 provides the conclusion.

RELATEDWORKS

Mohammed A. Hussein et al. proposed plant disease detection using the support vector machine. Authors have collected a data from various sources and also from the field visit. Image processing techniques such as cropping, image resize and fuzzy histogram equalization is performed to further improvethe quality of images. Feature extraction method GLCM is used in order to obtain important features such as texture, color and shape from the image. SVM used as classifier to classify the images into two classes such as healthy andunhealthyand88.1% is the accuracy of the plant disease detection system [1].

Gaun Wang et al. presented fine grained classification using deep learning models for automatic detection diseases verity in apple leaf. Deep learning models such as VGG16, VGG19, Inception-v3 and ResNet50 of CNN used and showedVGG16 is best among the other models[2].

Aravindhan Venkataramanan et al. proposed system for detection and classification of leaf disease using deep learning models. Authors have used YOLOv3 object detector to extract the leaf from the image and through series of ResNet18 models to analyze the extracted leaf. Trained ResNet18 models using transfer learning. One layer determines the type of leaf and remaining layers checks diseases occur in plant [3].

Taruna Sharma et al. presented a review on various deep learning techniques used for disease detection of leaf and classification and discussed about the basic steps for designing plant disease detection system[4]

D. Deva Hema et al. presents automatic detection of mul-berry leaf disease using CNN. Images are converted into black and white and these images are given convolutional neural network for training. Test data is feed to CNN to detect

mulberry leaf disease [5]

Meena Prakashe et al. used image processing for the plant leaf disease detection and classification. Using the digital camera images are acquired and resized. As image processing- color transformation is performed to find luminosity and chromaticity layers and K-means clustering algorithm or Lloyd's algorithm is used to simplify the representation of the image. Gray-Level-Co-Occurrence Matrix to extract features like contrast, energy, homogeneity and correlation and these features are given to SVM classifier and accuracy of the classification is 90%[6]

Saradhambal G et al. presented system to detect the plant disease and also to provide the solution to leaf disease. Images obtained from the public repository. Image processing is done to remove unwanted regions from images. K-means Clustering Algorithm and Otsu's classifier are used for image segmentation and gives name of disease identified [7]

PROPOSEDSYSTEM

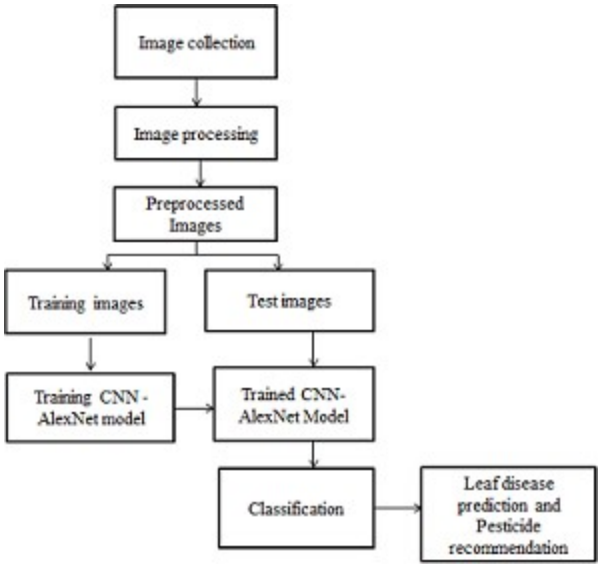

Fig. 1. System design.

METHODOLOGY

A. Image collection

We collected images from the open database containing 54306 images of leaves of both healthy and infected plants was used for training and testing of CNN-AlexNet model. The database that was used here contains 38 classes, where each class have pair of plant name and corresponding disease, while there are some classes contain only healthy leaves.

Fig. 2. Sample of unhealthy and healthy leaf.

B. Image Processing

Before feeding images into AlexNet model of CNN, images need to be resized because AlexNet model requires all the images to be in same size, so we resized all the images in database to 224*224 pixels.

Initially entire database is divided into two sets that is training set and testing set, by randomly splitting the 54306 images so that 80% images are used training and 20% used for testing. Trained CNN with the resized images and once the network is successfully trained with images. Image feed to classify, predict the disease in the leaf and recommend the pesticides based on type of disease occurred in the leaf.

C. Network architecture

We used AlexNet model of CNN with 5 Convolutional layers and 3 fully connected layers as showed in fig 3

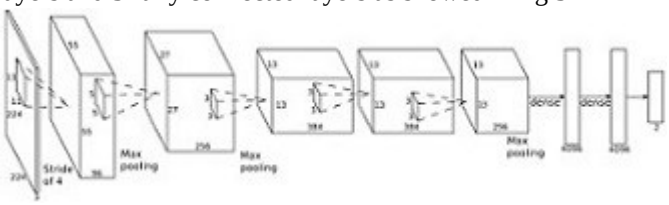

Fig. 3. Architecture of CNN-AlexNet

- Convolutional Layer:
  In CNN, input image first passes through the convolutional neural layer, which convert image into a matrix (224 x 224 x 3 size) and these image matrix multiples with the filters or kernel matrix and results in the Feature Map matrix. CNN uses strides which defines the number of pixels to be a shift over the input matrix. If the value of stride is 1 then filter matrix shift the cell by 1 pixel and if the value is 2 then slides with the 2 pixels and so on. By end of the process inthis layer smaller size matrix of input image is created.
- Pooling Layer:
  After the convolutional layer usually pooling layer is applied. The output matrix obtained from the Convolutional layer is reduced by size Max pooling function is used select the largest value from the sub window and using this value new matrix is obtained
- Activationfunction:

We have used Activation function ReLu to find the curvi- linear relationship between the input and output layers and advantages of the using the ReLu activation function, its gradient is indeed non-saturation and accelerates the stochastic gradient descent convergence

- Fully Connected layer: Fully Connected layer takes matrix as input that is obtained from previous layer. Classification and predictions are performed in these layers.

Performance of the trained Convolutional neural network is given in table 1. Performance evaluation is made under the following factors such as accuracy, precision, recall and F1.

TABLE PERFORMANCE EVALUATION OF CNN

Method used	Accuracy	Precision	Recall	F1
AlexNet model	0.97	0.95	0.96	0.94

RESULTS

In the presented paper we used convolutional neural network-Alex Net model for leaf disease detection. For trained CNN-AlexNet model, test image is given and we obtain the detection of the leaf disease and recommendation of the pesticide as shown in fig 3.

Fig. 4. screenshot of result.

CONCLUSION

The proposed system provides the benefit for farmers and also for agriculture sector by early detection of leaf disease and providing recommendation of the pesticides for the disease detected. By proper knowledge of disease suitable remedy can be taken to improve the health of the plants.

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