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Time saving malady expert system in plant leaf using cnn

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Abstract

Diseases in plants are quite natural but the Protection of plants in whole cultivation is a difficult process. It needs a clear knowledge of the plants behavior of growth and their likely affected bacteria and microorganisms.Commonly the botanists observe the leaf with naked eye for the classification of diseases. But this method can be time consuming, expensive and less accurate and it affects the agricultural production of the country . This system deals with an advanced deep learning neural network approach to the development of plant malady recognition expert systems based on the external changes occurring in the leaves. This system works by capturing the images of leaves by using a camera or uploading an image so that it classifies the infected diseases. Innovative type of learning methods facilitate a rapid and simple classification execution put into practice. The methodology proposed in this system is a innovative move toward in detect diseases in plants using deep learning trained and fine-tuned to fit precisely to the file of a plant's leaves .The Innovation of the developed model includes its easiness; disinfected leaves and environment images are in procession with other classes, allow the model to distinguish between infected leaves and normal ones from the data and also recommend the pesticides for the infected diseases.

Keywords: *Diseases, Deep Learning, Convolution Neural Networks (CNN), Artificial Intelligence (AI), Train Time Augmentation Test Time Augmentation, K-Means Clustering, Artificial Neural Network (ANN), Support Vector Machines (SVM), K-Nearest Neighbours (KNN).*

1. Introduction

Most of the agricultural production contributed by small holder farmers. More than half of loss in yield is due to weeds and diseases. The major part of below poverty line included in this small holder farming house holds making these farmers a group that is particularly vulnerable to pathogen descriptions in food supply[7]. There are various efforts have been developed to prevent this loss due to diseases. Identifying a disease correctly at an early stage is a crucial step for disease management, traditionally the disease identification is an expensive and time consuming process where the agricultural specialists or botanists were visually inspected and identified the diseases. The advancement in new technology likes computer vision and object recognition in particular has made a latest way to identifying crop disease.

Plant life is vulnerable to numerous disorders and attacks caused by variety of pests. There are numerous reasons that cause diseases on the plants, diseases due to the climatic change reasons, such as rise in temperature, varying humidity, change in the structural component of soil and the majority of the affected disorders are due to the micro organisms like fungi, bacteria etc [8]. Those malady symptoms show different morphological variations on the leaves, such changes in structure, shade etc. Due to related patterns, the changes are difficult to be predicted and identified, which makes the identification be little difficult, and an previous discovery and management can avoid numerous fatalities in the entire agricultural sector. This system discuss about Automatic leaf disease detection a web application which will help the users to identify the diseases in crops by seeing their symptoms in leaves.

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2. Literature Review

There are enormous work which has been done related to plant leaf disease prediction system using different techniques in the field of healthcare. It focuses on technique which can predict leaf disease by using the data containing and records using deep learning algorithms. The main purpose of the study is performed of the classifier to major good performance and accurate rate.

[1] Badnakhe M & Deshmukh P, "Application of Artificial Intelligence and K-Means Clustering in Crop Disease Pattern Recognition"

Proposed method which indirectly contributes to improving plant quality. It is a recognition system focused on machine learning that will aid in the Indian economy. This system suggested the methodology for the classification and identification of the various plant diseases. The important thing about that is the plant's optical color analysis. It also has to do with cost-effective method. Because the changed color is a reliable measure of plant health, efficiency and survivable. Instead, it is possible to measure visual scales and cheap crop color. Changing the color of the plant is the important aspect of the notification. If they use computer vision then the plant will be identified and labeled more easily at each time. That affects the efficiency of the classifier. For agriculture this is the best use of digital image processing. This work will again discover the technique of image processing, which visually distinguishes the various crop diseases found in different crop parts. This system's disadvantages are selecting K values manually and it must depend on initial values [1].

[2] Kulkarni A., Patil A, "Applying image processing technique to detect plant diseases"

It suggests an approach for the early and reliable detection of plant diseases, using different techniques for processing images and an advanced neural network (NN). The aim of the present work is developing a simple plant disease detection system. The work starts with the photos being taken. Filtered with Gabor filter and segmented. Subsequently, texture and color characteristics are extracted from the segmentation test, and then Artificial Neural Network (ANN) is skilled by selecting the characteristic values that could better differentiate healthy samples from diseased ones. They focused on three different diseases in this research which attacked pomegranate crop. 1) Otherwise. 2) Infectious blight. 3) Anthracnose. 4) Anthracnose-fruits. 5) Anthracnose stem 6) Bacterial blight of fruits. The downside of this method is that for feature point computation, it is a time-consuming operation [2].

[3] Chaudhary P, Chaudhary A, Dr. Cheeraan A & Godhara S, "Color Transform Based Approach for Disease Spot Detection on Plant Leaf"

An algorithm for spot disease segmentation is implemented in this system using techniques in image processing of plant leaf. This is the initial and prior phase to automatically detect and classify plant diseases. The spots of disease are distinctive in color, but not in severity relative to the color of the plant leaves. So we can use color transformation of RGB image to better segment disease shots. In this system a differentiation is made of the impact of color space CIELAB, HSI, and YCbCr in the spot detection process of disease. Median filter is used to smooth out images. Threshold can finally measured by applying the Otsu method to the components of color to find the spot of the disease. An algorithm was developed that is independent of background noise, plant type and disease spot color and experiments were performed on various "Monocot" and "Dicot" family plant leaves with both noise-free (white) and noise-free background. The accuracy of the tests depends on the system used for spot detection of the disease. The main obstacle in spot detection of disease is noise, which is introduced by camera flash, shift in lighting, noisy backdrop and vein presence in the plant leaf. A method which wipes out the noise so provides better segmentation of the spot of the disease is therefore required. This system has two

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disadvantages. The histogram should be bimodal, and there is a fair ratio of comparison between context and ROI [3].

[4] Patil S & Dr. Bodhe S, "Leaf Disease Severity Measurement Using Image Processing"

Proposed system that helps target disease sites with the exact amount and concentration of pesticides by using the image processing techniques to estimate the extent of the illness. Simple threshold and triangle threshold methods are used, respectively, to segment the leaf region and the lesion field. Lastly, diseases are categorized by measuring the quotient of the lesion area and the seed area. Research shows this approach to determining the intensity of the leaf disease is fast and accurate. Disadvantages of this approach are Simple threshold optimization is used to measure the area of the leaf but this process is not appropriate for calculating the area of the tumor area due to the different characteristics of the tumor region [4].

[5] Bashir S & Sharma N, "Remote Area Plant Disease Detection Using Image Processing"

Here the proposed system focuses on color and texture features that are used to distinguish and classify various agricultural / horticultural products into normal and affected areas. The combination of features is proving very successful in the identification of diseases. The experimental results suggest that the proposed solution significantly increases the sensitivity of normal and affected product automatically detection. This system introduces an effective method of disease detection at Malus Domestica using methods such as clustering of K-means, color and texture analysis. Using computer vision toolbox the identification of disease in plants is effective and does not take time. The diagnostic method used in plants (i.e., identification of symptoms and signs of diseases) is based entirely on the use of scientific techniques. Identification of diseases is made easier on the basis of the symptoms of particular diseases and with the help of agricultural scientists. Plant pathologists can use the digital image processing toolbox in the mat lab to analyze digital images for plant disease diagnosis. This system has disadvantages in selecting K values manually and it has to be dependent on initial values [5].

3. Proposed Model

Plant disease detection through naked eye observation is a time consuming and complex. In order to overcome this challenge sand huge quantity of cultivated plants and their presented pathological issues, even experienced farmers and botanists may chance to fail to successfully identify the disorders, and also arrive in the wrong conclusion[6]. An malady identification expert system is designed which spot the various common crop diseases by considering the colour change in the leaves of plants and make the advanced technologies in the development of the agricultural sector..

A. Block Diagram

The block diagram of the system is shown in Figure 1.

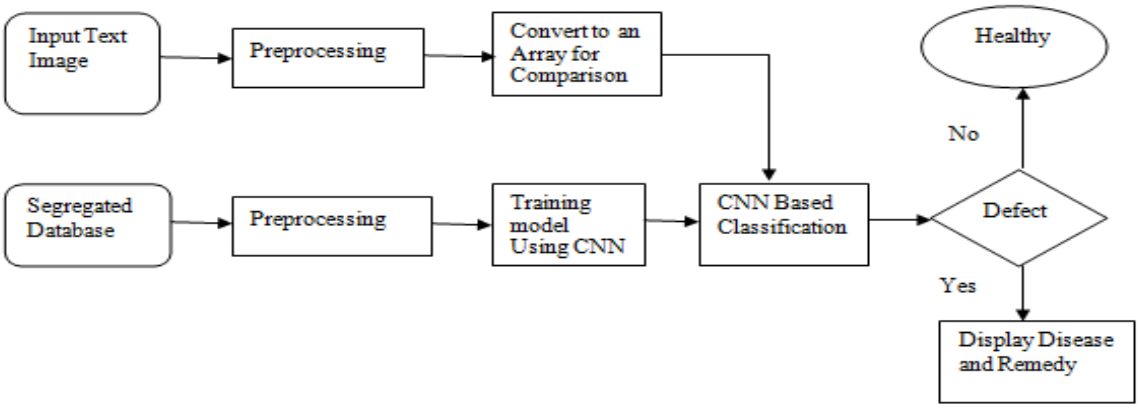

FIGURE I. Working design model of our system [2]

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The entire system process or stages were shortly described in the above block diagram.Initially collection of suitable dataset the dataset is from online PlantVillage Dataset so the dataset is already undergone some preprocessing. Convert this image to a corresponding array of pixels and make them suitable to the required model and trained the model using the dataset. Before training we preprocess the model by train-time augmentation. Note that the dataset is divided and some part is reserved for testing for determining the quality testing of the learned model. The division ratio taken is 8:2 ie, 80% data taken for training and rest 20% for testing. After proper training of the model using CNN the builded model is tested with reserved dataset this test dataset should be preprocessed using test- time augmentation. By this working we are able to make a CNN model disease prediction system for real time working we should train the model with real time images and make suitable changes in some of the CNN layers and thus able to get a system which predict the disease of the plant perfectly. Here for the testing process input an sample image before giving to the saved model the image should be preprocessed and converted to an array form and fed to the model where it compare with learned dataset and do the proper analysis and classify the affected diseases. In case the sample input leaf have no any defect it display or classify as healthy leaf.

B. Data Preprocessing:

Data preprocessing is a two step process. The original dataset can contain lots of missing values. So, start it by removing these missing values[7]. Missing values are represented in the original dataset by putting a dot in them. The occurrence of lost values in the dataset can deteriorate the value of the data and it can also reduce the overall execution of the machine learning models. So, we are replacing them with large negative values in order to solve the problem of lost values. These negative values will be treated as outliers by the trained model[7].

The second step is to create the class labels[7]. Since we are using supervised learning, we should have labels of different classes for the dataset. The original dataset does not have any labels, so we must create them during the preprocessing step.

C. Experimental and Technical Design:

To see the characteristics visualizing strategies are used in the plant diseases data set. We compared four visualization method. categories as below: with respective images generated in each of this layers[5].

a. Hidden layer output visualization
b. Visualization feature
c. Semantic dictionary
d. Attention map

D. Dataset and Network for Diagnosis:

This system deals with mainly 3 plants (Pepper,Potato,Tomato) and 4 diseases and we add one leaf not found class which does not contain a leaf image. The online Plant Village dataset is adopted for the system . The dataset includes both healthy and diseases images of the leaf classified into 38 labels in that we had taken only 4 classes.(4000 images, 4 diseases, 3 crop species the leaf not found class contains 1000 sample which are some random images) a sample dataset is shown in Figure 2. The 4 classes' leaf diseases are:

a. Pepper Bell Bacterial Spot
b. Pepper Bell healthy
c. Potato Early Blight
d. Tomato Target Spot

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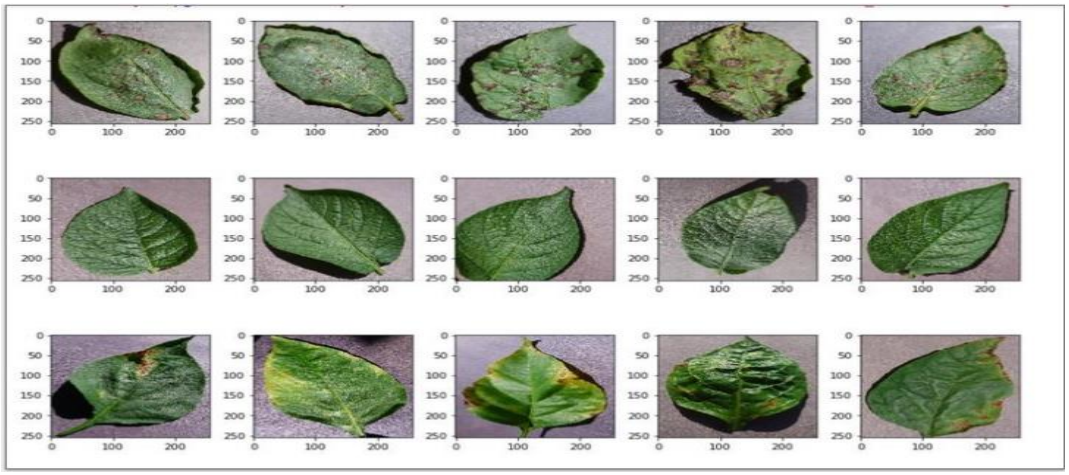

FIGURE II. Sample Dataset

With these four classes system include one more random class dataset which contain random images, so as in total the dataset contain five classes. Images were split into training and test datasets with a ratio of 8:2. The splitted train data is given to for the preprocessing techniques we use Train-Time Augmentation method. This preprocessing method includes a horizontal flip, the images are rescaled by dividing the image set 255, the zoom range is given as 0.2 and a shear range is given as 0.2. The batch size of the model is fixed to 32. The target size of every images in the dataset fixed to 256 * 256 and the images received is a three-channel image. (ie, images are color images) The CNN is trained using a Python library called Keras with Tensor flow backend it is a deep learning framework.

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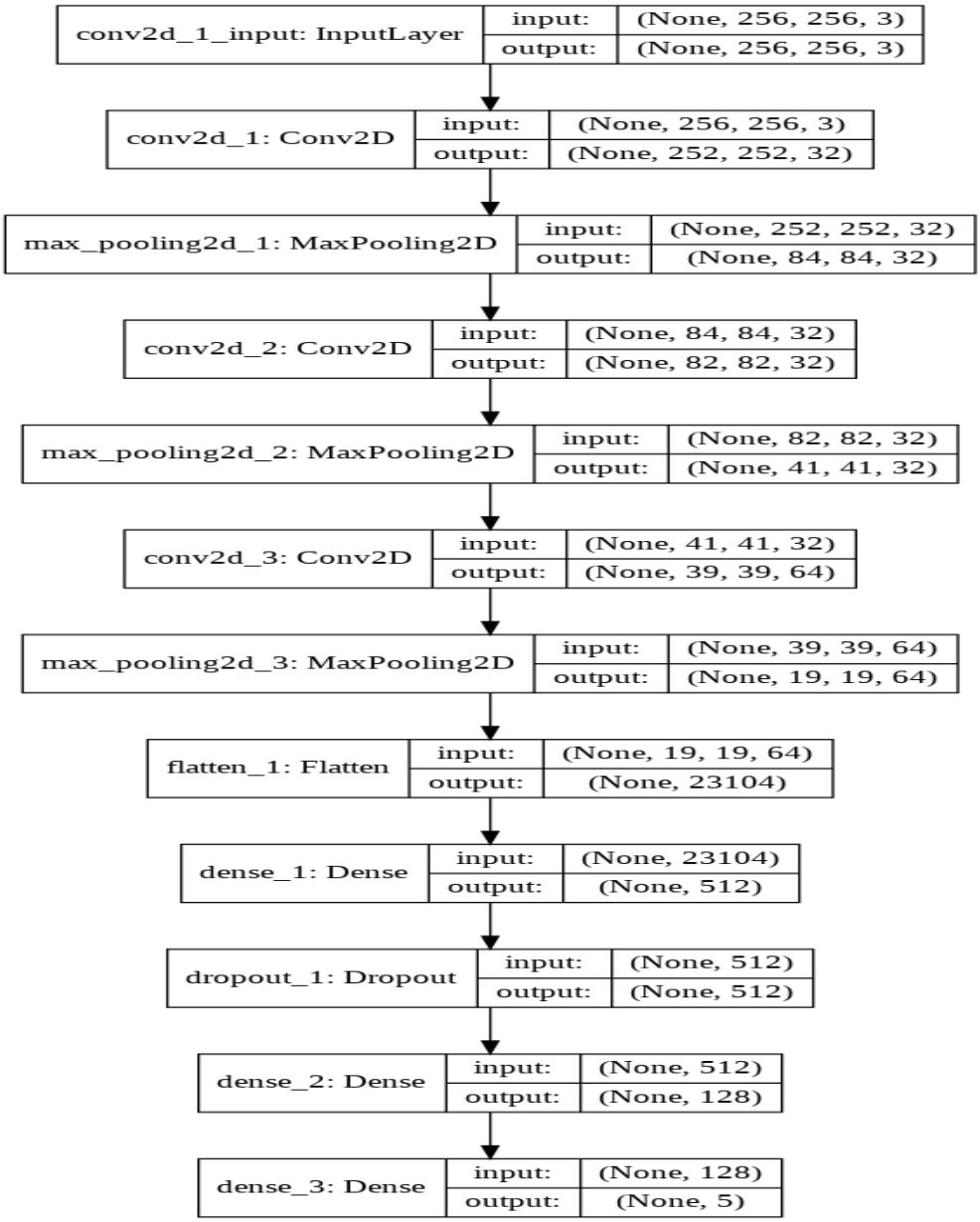

FIGURE III. Model Summary of the system

The rescaling of image is normalizing the image dataset within a range [0.0 to 1.0] this helps to optimize the results of the model. Random weights were initialized at the network. The System model use categorical cross-entropy loss metric, the Adam is the optimizer and the learning rate is 0.0001. A set of 100 images of size 256 * 256 three channels is fed to the Convolution Neural Network as a batch per iteration. It required 4 to 6 minutes to complete a single epoch; there are 15 such epochs. CNN has many layers such as Dense, Dropout, Activation, Flatten, Convolution2D, and MaxPooling2D. The designed model is shown in Figure 3.After the completion of training the model is able to capture specific features from the images of the plants and diagnose the diseases.

The test dataset is used to test the model working accuracy. The test images also preprocessed before taking to the model for evaluation. The preprocessing technique used is validation(test)-Time Augmentation. This augmentation was performed in order to give a fit model each possibility of making a

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stout forecast. As preprocessing technique rescaling of test images is done and these rescaled image is given to the model for testing

E. Remedy:

Remedy Recommendation is another module in this system .Other than identification of diseases or diagnose the disease, The remedies of these identified plant diseases and the causes of the diseases full details about the diseases are also displayed.

4. Experimental Results

Before coming up the CNN model various models are applied to the data set for testing and comparing the performance of each of this models and coming up with an efficient and optimized model some of such classifier that we used are SVM, KNN, Decision Tree there results and comparisons are given in the below table:

SI NO	ALGORITHM	ACCURACY (%)
1.	SVM	77.3
2.	KNN	44.5
3.	DECISION TREE	54.5
4.	CNN	94

TABLE I. Comparison of CNN with other models

The result of the system working is shown in Figure IV.

FIGURE IV. Sample Working Output

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5. Conclusion and Future Work

The results shows that development in real world object detection pay a way to improve the use of accurate crop preservation and widen the marketplace of Artificial Intelligence (AI) related applications in the field of agriculture[8].Automatic detection using data pre- processing methods provide fast and accurate results.

When compared with other conventional image processing and machine learning algorithms the DL neural network is able to fruitfully identify diverse disorders in different crops and also give solutions for specific diseases. Maladies in plant species are not a major issue in organic agriculture, so non infected crops living in proper soil with proper fertilizer applications are improved and capable of fighting against the infected diseases[8].

The proposed system will make a redolent involvement in the cultivation exploration.This system can be improved or more developed in future by using a drone with camera facility and cover large area and also expanded to other crops and make a drastic change in the agricultural sector

References

1. Badnakhe M & Deshmukh P, “An Application of K-Means Clustering and Artificial Intelligence in Pattern Recognition for Crop Diseases”, International Conference on Advancements in Information Technology 2011 IPCSIT vol.20 (2011)
2. Kulkarni A & Patil A, “Applying image processing technique to detect plant diseases”, International Journal of Modern Engineering Research, Vol.2, Issue.5, pp-3661, Sep-Oct (2012)
3. Chaudhary P, Chaudhary A, Dr. Cheeraan A & Godhara S, “Color Transform Based Approach for Disease Spot Detection on Plant Leaf”, International Journal of Computer Science and , Volume 3, Issue 6, June (2012)
4. Patil S & Dr. Bodhe S, “Leaf Disease Severity Measurement Using Image Processing”, International Journal of Engineering and Technology Vol.3 (5), 296-301 (2011)
5. Bashir S & Sharma N, “Remote Area Plant Disease Detection Using Image Processing”, IOSR Journal of Electronics and Communication Engineering, ISSN:2278-2834 Volume 2, Issue 6, PP 31-34, (2012)
6. Saleem , Potgieter, Arif M, "Plant Disease Detection and Classification by Deep Learning", Plants,(2019)
7. Doshi Z, Nadkarni S, Agrawal R, Shah N, “AgroConsultant: Intelligent Crop Recommendation System Using Machine Learning Algorithms”, 2018 Fourth International Conference on Computing Communication Control and Automation (ICCUBEA), (2018)
8. Khandelwal I, Raman S, “Chapter 23 Analysis of Transfer and Residual Learning for Detecting Plant Diseases Using Images of Leaves”, Springer Science and Business Media LLC(2019)

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