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Image Processing based Plant Disease Detection using CNN

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Abstract: ***In the era of Scientific Development, many technologies and new ways of solving real-life problems are being invented every day. The basic need of the food is increasing parallelly, due to an increase in population. According to FAO of the UN, annually 20 to 40 percent of crops were lost due to diseases. That's why technological development in the agricultural field is important to improve the productivity of crops. This major issue can be overcome by implementing disease detection techniques to identify the disease from an input image. This process involves steps like dataset collection, image pre-processing and training a classification model. The dataset consists of plants like cotton, grapes and tomatoes. CNN classification model is used for disease classification. The proposed model gives an accuracy of 96%. After disease classification it also provides information like causes, symptoms, management and diagnostic solutions.***
Keywords: Identification of diseases, Deep learning, Solutions, Convolution Neural Network (CNN)

I. INTRODUCTION

Agriculture is a vital component of the global economy, particularly in underdeveloped countries. It is the primary source of employment, income, and food, and these basic needs are fulfilled by agriculture all over the world. According to the Food and Agriculture Organization (FAO), the share of the agricultural population is 67% of the total population. 58% of indian population is dependent on agricultural practices.

According to the Food and Agriculture Organization of the United Nations (FAO), up to 40% of food crops worldwide are lost every year due to pests and plant diseases. The farmers use traditional naked eye observation techniques to identify diseases in plants. Because of this traditional technique most of the time famers cannot identify the correct disease which may cause loss in productivity of crops. If no immediate action is taken by farmers it is very difficult to manage the diseases in crops. Farmers are also unaware of many diseases of plants. Hiring an expert for this purpose is not affordable for them. So in this paper a model has been proposed to identify the diseases in plants from an input image.

The proposed system will detect the diseases of plants like cotton,grapes and tomato through image processing where farmers will have to provide image of the disease affected leaves, where initially the image will undergo various steps like resizing, rescaling, rotating(if required), etc.After that the processed image will be passed to the classification model, where the trained model will identify the disease.The two main things which needs to be focused are accuracy and speed.

Here the proposed system uses the CNN model for classification. In this work a total of 7,800 leaf images are used for model training. It consists of 4 diseases of Cotton plants, 3 diseases of grapes, 9 diseases of Tomato plants and healthy leaves of each plant.

II. LITERATURE REVIEW

Paper by A. Jenifa, R. Ramalakshmi and V. Ramachandran gives solutions to the plant disease with image classification. In their approach they collect 500 images for training and 100 images for testing the model. There were a total of 5 classes that include 4 disease classes and one normal healthy leaf class. Removal of noise is done with some image preprocessing and then conversion into lab color model was done.Classification is done using Deep Convolutional Neural Network. They have achieved 96% as average accuracy [1].

Another paper named "Classification Of Plant Leaf Diseases Using Machine Learning And Image Preprocessing Techniques" clarifies that they have used Gaussian Blur for image-preprocessing, k-means segmentation, CNN model for the leaf disease classification.In their methodology they have used a dataset of 20,000 images divided into 19 classes.They achieved accuracy 66.4% using logistic regression, 54.5% using KNN , 53.4% using SVM and 98% using CNN. Their proposed model was for tomato and grapes related diseases [2].

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Another paper by S. V. Militante, B. D. Gerardo and N. V. Dionisio used the CNN for the classification purpose.Image dataset was gathered from the plant village repository. It consists of 35,000 images with 32 classes of diseases.Their proposed model was for tomato and grapes related diseases.They have achieved average accuracy of 96.5% [3].

Paper by N. R. Bhimte and V. R. Thool has taken a cotton plant for disease detection. In their approach, the collection contains 130 photos, including 50 photos of Bacterial blight, 50 images of Magnesium shortage, and 30 images of healthy leaves, according to their method. They have used k-means for segmentation, GLCM for feature extraction and CNN model for the leaf disease classification. They have achieved 98.46% as average accuracy [4].

R. G. de Luna, E. P. Dadios and A. A. Bandala's "Automated Image Capturing System for Deep Learning-based Tomato Plant Leaf Disease Detection and Recognition" uses faster R-CNN and CNN for the classification purpose.The dataset consists of 4,923 images of tomato plant leaves which are categorized into Healthy and diseased leaves..Their proposed model was only for tomato related diseases.They have achieved accuracy of 91.67% using CNN and 80% using F-RCNN[5].

"Plant Leaf Disease Detection and Classification using Image Processing" clarifies that they have used k-means segmentation and SVM for the leaf disease classification.In their methodology dataset consist of total 560 images divided into 4 classes. They achieved average accuracy 98%.Their proposed model was for grapes and cotton related diseases [6].

"Grape Leaf Disease Identification Using Improved Deep Convolutional Neural Networks" clarifies that they have used DICNN and SVM for the leaf disease classification.In their methodology dataset consist of total 7,669 images divided into 5 classes.They achieved accuracy of 67.82% using SVM and 97.22% using DICNN.Their proposed model was only for grapes related diseases [7].

N. Agrawal, J. Singhai and D. K. Agarwal proposed to have image processing techniques used in the early detection of plant diseases through leaf features inspection. They mentioned implementing image analysis and classification techniques for the extraction and classification of leaf diseases. Furthermore, the authors focused on image preprocessing, they transformed the image into the LAB color model and also the HSI color model and the classification is done well using SVM. The given system using features from both LAB and HSI color model gives 90% average accuracy for all three-diseased leaf and healthy leaf compared to 82.5% in case of taking only LAB color model for feature extraction [8]

III. PROPOSED SYSTEM

A. Architecture

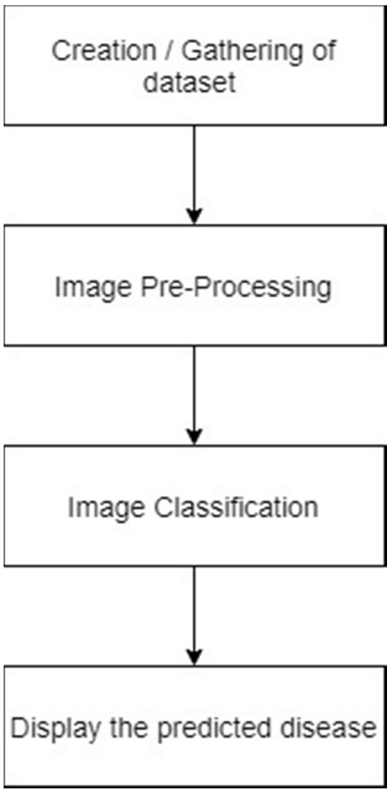

Fig No. 3.1 - System Architecture

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To classify and find the type of disease in plants, our proposed model consists of following stages:

1) *Collection / Gathering of Dataset:* We have gathered the images of cotton plants by visiting the field and capturing the images of leaves. The dataset of grapes and tomato has been collected from kaggle. The dataset consists of 7,800 leaf images containing 19 classes.
2) *Image Preprocessing:* Image Preprocessing are the steps taken to preprocess the images into standard format. It helps to increase model execution speed and to reduce model training time. In this system 'Keras' library is used for image preprocessing. The image pre-processing consists of resizing , rescaling , removing noise, shearing, rotating, zooming and flipping .Images are resized to 150 x 150 resolution for processing.
3) *Image Classification:* For disease classification Deep Convolutional Neural Network (CNN) is used. The CNN model consists of 4 layers

a) Convolution Layer
b) Pooling Layer
c) Dense Layer
d) Output Layer

The activation function used in the proposed model are :

- ReLU
- Softmax for output layer

IV. SYSTEM IMPLEMENTATION

The website consists of 2 modules:

A. *User Panel*

This module consists of submodules which will provide various functionalities to user like :

1) Register him/her to the website. Login by using credentials.
2) If the user wants to detect the disease of the plant then he needs to follow the steps likes first select the type of plant whose disease need to be detect.

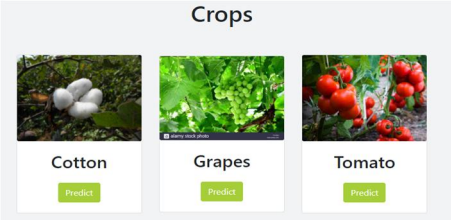

Fig. No. 4.1 - Crops Selection

3) Then upload the image of the plant leaf.
4) Then the user has to click on the predict button If the system predicts that it is an infected leaf, then our system will show the type of disease detected ,it's causes , symptoms, precautions need to be taken and solutions to cure the disease. Otherwise the system will show it is a healthy leaf
5) If the user wants some expert advice then he can post queries on the portal.
6) Users can also view the agricultural posts and weather forecasting details.

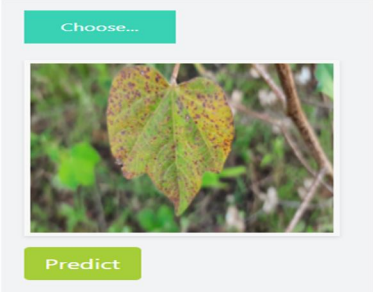

Fig. No. - 4.2 - Upload Image

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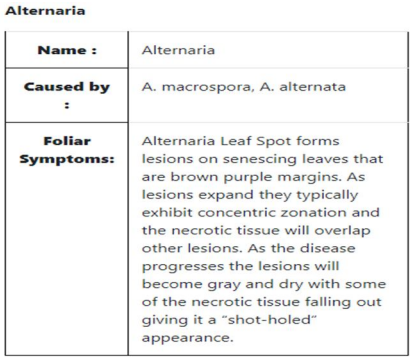

Fig. No. 4.2 - Predicted Disease

B. Admin and Support Panel

This module consists of submodules which will provide various functionalities to admin like :

1) View / Add / Delete user profile.
2) Modify / Add new plant species.
3) Modify / Add diseases information of a plant
4) Display and provide support to user queries
5) Add / Update / Delete informative news and post for the users
6) Admin can also view the weather forecasting details.

V. EXPERIMENTAL ANALYSIS

A. Cotton Plant

Tested for 10 images of each disease.

Table 5.1 – Cotton Plant

Sr. No.	Disease name	Accuracy
1.	Alternaria	90%
2.	Bacterial blight	80%
3.	Grey Mildew	90%
4.	Chlorosis	90%
5.	Healthy	100%

B. Grapes Plant

Tested for 10 images of each disease.

Table 5.2 – Grapes Plant

Sr. No.	Disease name	Accuracy
1.	Black rot	90%
2.	Leaf blight	100%
3.	Black Measles	100%
4.	Healthy	100%

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C. Tomato Plant

Tested for 20 images of each disease.

Table 5.3 – Tomato Plant

Sr. No.	Disease name	Accuracy
1.	Late blight	80%
2.	Leaf Mold	65%
3.	Septoria Leaf spot	70%
4.	Target spot	80%
5.	Bacterial spot	95%
6.	Early blight	75%
7.	Mosaic virus	85%
8.	Spider mites	65%
9.	Yellow Leaf Curl virus	95%
10.	Healthy	90%

VI. CONCLUSION

In this paper, a web application has been implemented for disease classification of multiple plants. The proposed CNN model has been trained for diseases like Cotton, Grapes and Tomatoes. The input image has been preprocessed and then passed to the classification model. The major diseases occurring in this plants are taken into consideration. The average accuracy of cotton plant is 90%, grapes plant is 97.5% and tomato plant is 80%.After the disease prediction the web application also provides information about the disease like causes , symptoms, preventive measures and diagnostic solution for disease.

VII. FUTURE SCOPE

In future work, we would like to add a new plant and its diseases to web applications to enhance its functionality. Provide a good marketing environment for the farmers to help them to gain good agricultural income. Provide information and notifications about government schemes .

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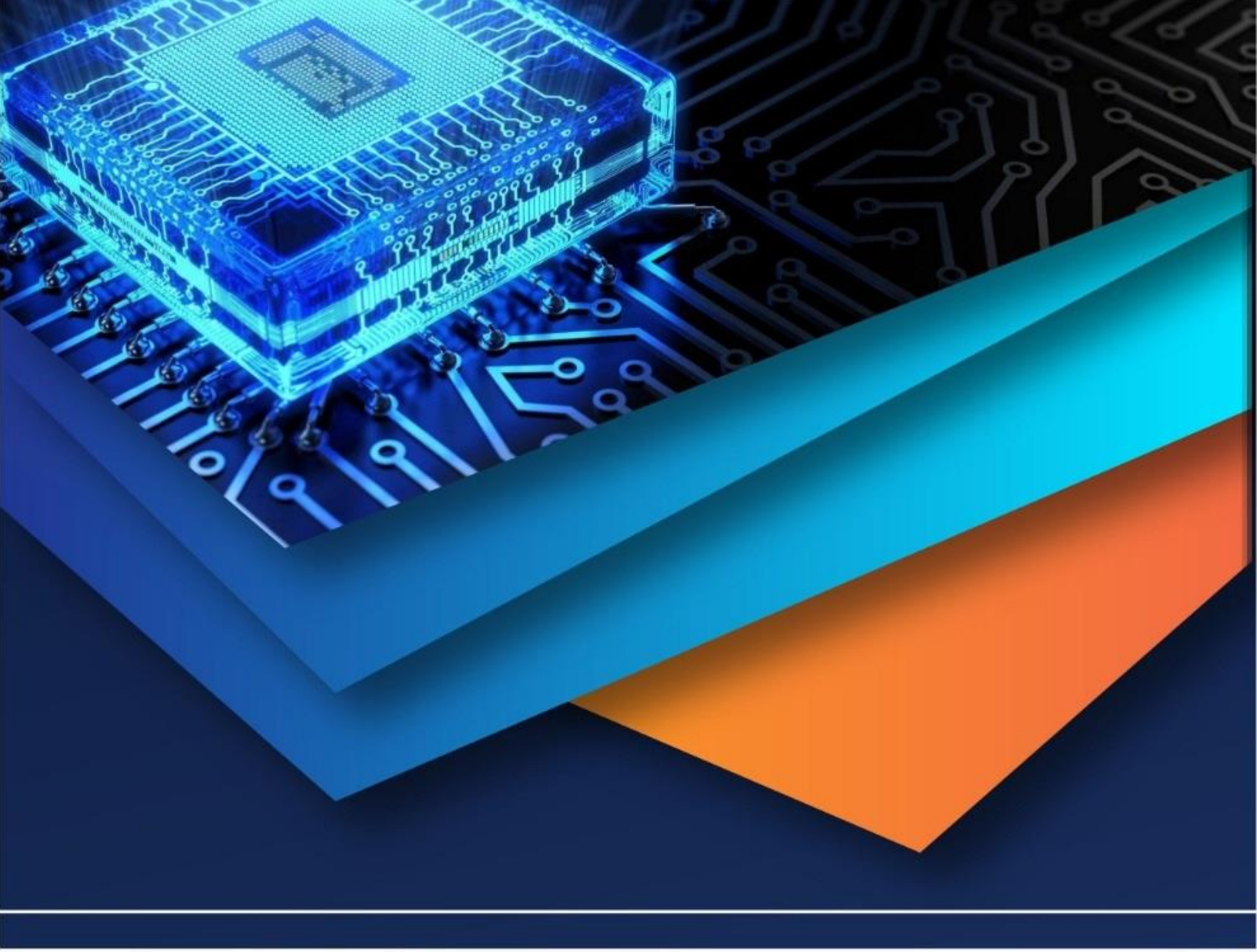

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