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CNN based Leaf Disease Identification and Remedy Recommendation System

Mr. Yeresime Suresh[1], Ragini[2]
[1, 2]*Department of Computer Networks and Engineering, Ballari Institute of Technology and Management, Ballari, Karnataka, India*

Abstract: ***In this present era, agriculture has become simply a means to feed ever growing population. It is very important where in more than 70% population depends on agriculture in India. The plant diseases effect the humans directly or indirectly by health and also economically. To detect these plant diseases we need an automatic way without much of human intervention. We attempt to analyse the disease using image processing and automate the detection by implementing machine learning methodology. Traditional methods were used to detect the diseases which lead to the use of large amount of pesticides harming the fertile soil and also the nature. A solution to this is to use current methodologies like Image Processing and Machine Learning that helps the farmers to detect the diseases faster and increase the crop yield.***
Keywords: Plant Disease, Remedy, Image Processing

I. INTRODUCTION

Agriculture is one field which has a high impact on life and economic status of human beings. Improper management leads to loss in agricultural products.

Farmers lack the knowledge of disease and hence they produce less production. Kisan call centers are available but do not offer service 24*7 and sometimes fail to communicate due to network glitches. Just through call farmers won't be able to explain leaf disease properly and it's better to have visual analysis of the image of affected leaf.

Due to the improvement and development in technology where devices are smart enough to recognize and detect leaf diseases. Recognizing illness can prompt faster treatment in order to lessen the negative impacts on harvest. The design and implementation of CNN based leaf disease identification and remedy recommendation system therefore focuses upon leaf disease detection using image processing approach. This utilizes an open dataset of 500 pictures of unhealthy and solid leaf images, where convolution neural network system techniques are used to characterize leaf disease and classify into 4 different categories.

II. RELATED WORKS

M. Sardogan *et al.* proposed "Plant Leaf Disease Detection and Classification Based on CNN with LVQ Algorithm", a Convolutional Neural Network (CNN) model and Learning Vector Quantization (LVQ) algorithm based method for tomato leaf disease detection and classification.

In this model, the filters are applied to three channels based on RGB components. The experimental results validate that the proposed method effectively recognizes four different types of tomato leaf diseases.

R. Amog Shetty *et al*. proposed "CNN Based Leaf Disease Identification and Remedy Recommendation System", which focuses upon plant disease detection using image processing approach. This work utilizes an open dataset of 5000 pictures of unhealthy and solid plants, where convolution system and semi supervised techniques are used to characterize crop species and detect the sickness status of 4 distinct classes.

Nalini Kanta *et al.* proposed "Deep Feature based Rice Leaf Disease Identification using Support Vector Machine", which evaluates the performance of 13 CNN models for rice disease identification in transfer learning and deep features plus SVM approach. In addition, the study is carried four varieties of rice leaf diseases with a dataset of 5932 on-field images.

III. DATA AND METHODOLOGY

A. Existing System

The existing system detects insects of only one color. Non efficient image processing algorithms were used in earlier systems. This traditional approach gives lower accuracy and is time consuming. This drawback of the existing system propelled us towards the idea for developing a system that could ease this effort.

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B. Disadvantages of Existing System

1) Although the existing system detects the diseases, it is done based on only one color of the insect which does not provide accurate results.
2) Time-management is an issue using this approach.
3) The existing system only identifies the disease but does not recommend the remedy to be taken for the disease.

C. Proposed System

There are many issues to farmers regarding diseases of plants, many times they do not get proper guidance to detect and cure diseases of plants. Proposed system helps user in detection and prevention of plant diseases with the use CNN model which is very useful, simple and efficient. This technology can be used by any user facing problem related to plant disease. In this project we aim to design a system that detects the disease in plants and recommend the remedy by using image processing techniques and machine learning concepts. Image processing and Machine learning is one of efficient methodology for detecting the disease both in medical and agriculture. By integrating technology in this field we can help farmers to detect the disease caused to leaf or educate him that the crop yielded is diseased and can take precautionary methods to overcome those.

D. Advantages of the Proposed System

1) Due to no manual intervention and system is already trained with datasets, it saves time to know whether the leaf is affected with disease or not.
2) Proposed system provides accurate results hence it is efficient and reliable process to detect diseases in leaves.
3) Machine learning based predictions will be more helpful to analyze different variants of data.

IV. IMPLEMENTATION DETAILS

The implementation stage in system project involves careful planning investigation of the current system and its constraints on implementation design of the methods to achieve change over etc. The errors in the code will be rectified during the phases of testing.

A. Major Modules

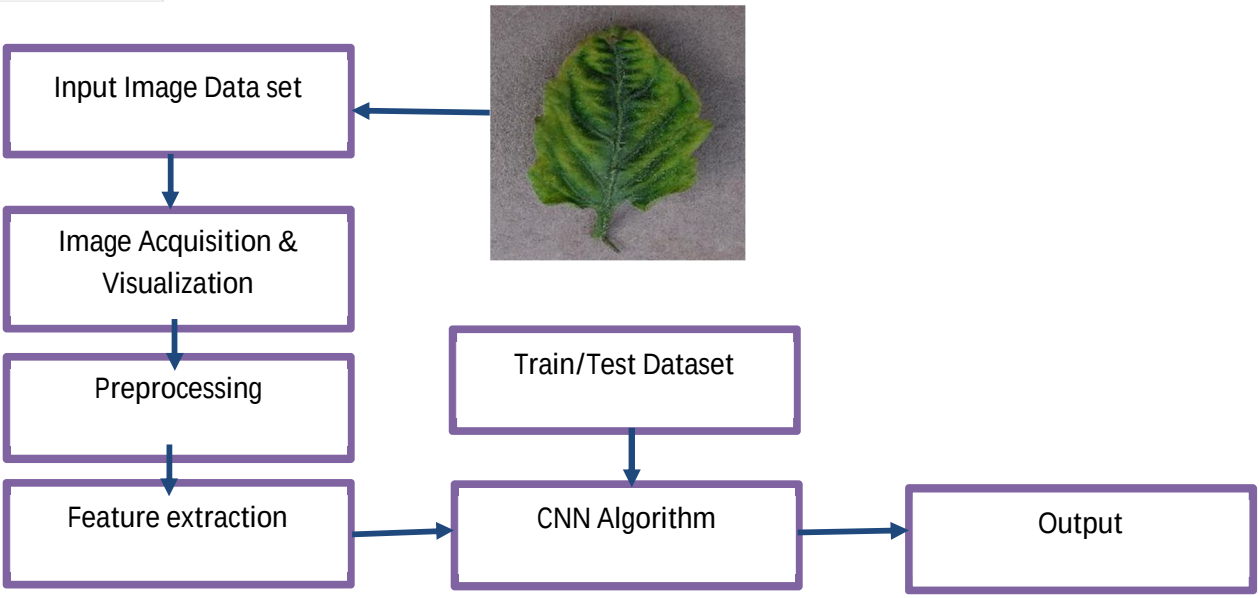
1) Leaf images are taken as input image.
2) For Blurriness removal purpose the input image is converted into gray scale
3) Noise reduction we are using the Gaussian Blurring filter
4) Hysteresis Thresholding: For this step it selects from the pixels that are left in the image to determine if the intensity gradient changes quickly enough to be selected for the final image. For this step you will need to specify two threshold values, a lower and an upper threshold. You can changes these parameters to bring out different levels of intensity gradients.

The main steps of proposed methodology to leaf disease recognition are shown:

a) Dataset Visualization
b) Processing of the data
c) Feature extraction
d) CNN Algorithm
e) Output

- *Image Acquisition:* The images are obtained using the webcam that is connected to the system or an inbuilt camera in laptops. The images captured are subjected to further preprocessing.
- *Image Preprocessing:* The images obtained from the camera are subjected to preprocessing for increasing the quality of the images. The preprocessing steps may include color transformation, noise removal, histogram equalization, green masking etc. Here we use the technique of color transformation for increasing the quality of the image. Conversion of RGB image into Grey and also HSI to increase the quality.
- *Image Segmentation:* Image segmentation are of many types such as clustering, threshold, neural network based and edge based. In this implementation we are using the neural network algorithm called mean CNN for image segmentation.
- *Feature Extraction:* There are many features of an image mainly color, texture and shape. Here we are considering three feature that are color histogram, Hu moments and Harlick Texture which resembles color, shape and texture.

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V. RESULTS AND CONCLUSION

The below output displays the sample images of each of the 4 classes.



Fig 1.8 Sample Images of 4 Classes

The below output displays the epochs completed for the entire training dataset by the CNN algorithm. Given: Epoch Cycle = 10.

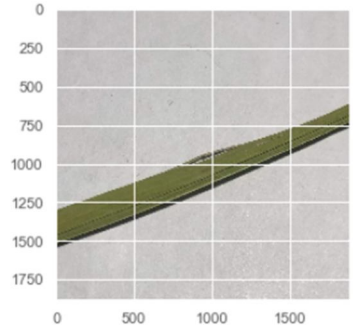
```
Start Training

Epoch 1/10
2270/2270 [==============================] - 280s 123ms/step - loss: 1.5202 - accuracy: 0.4185
Epoch 2/10
2270/2270 [==============================] - 272s 120ms/step - loss: 1.3729 - accuracy: 0.4291
Epoch 3/10
2270/2270 [==============================] - 278s 122ms/step - loss: 1.3094 - accuracy: 0.4401
Epoch 4/10
2270/2270 [==============================] - 276s 122ms/step - loss: 1.2504 - accuracy: 0.4573
Epoch 5/10
2270/2270 [==============================] - 281s 124ms/step - loss: 1.2016 - accuracy: 0.4599
Epoch 6/10
2270/2270 [==============================] - 274s 121ms/step - loss: 1.1871 - accuracy: 0.4863
Epoch 7/10
2270/2270 [==============================] - 272s 120ms/step - loss: 1.1540 - accuracy: 0.4907
Epoch 8/10
2270/2270 [==============================] - 273s 120ms/step - loss: 1.1583 - accuracy: 0.4912
Epoch 9/10
2270/2270 [==============================] - 274s 121ms/step - loss: 1.1487 - accuracy: 0.4802
Epoch 10/10
2270/2270 [==============================] - 272s 120ms/step - loss: 1.1520 - accuracy: 0.4824
Training End
```

Fig. 1.9 Epochs

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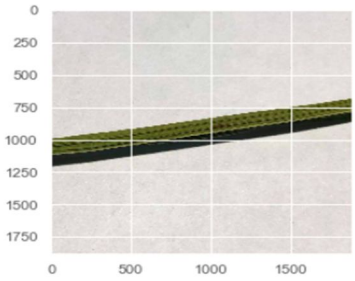
The below output displays the image of a healthy rice leaf after completing 10 epoch cycles on the training data set.




```
[[0.37603906 0.02501674 0.01830957 0.5806346 ]]
3
Healthy
```

Fig. 1.10 Output of a Healthy Rice Leaf

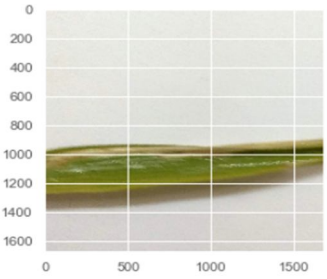
The below output displays the image of a rice leaf with Brown Spot disease after completing 10 epoch cycles on the training data set. Even the recommended remedies have been suggested for the Brown Spot disease.




```
[[0.3630753  0.01929845 0.01409981 0.6035264 ]]
3
BrownSpot
Remedies
1. Pseudomonas Seed Treatment
2. Spraying of Fungicide
3. Use Antibiotic - Aureofungin
4. Spray Mancozeb
```

Fig. 1.11 Output of a Brown Spot Rice Leaf

The below output displays the image of a rice leaf with Hispa disease after completing 10 epoch cycles on the training data set. Even the recommended remedies have been suggested for the Hispa disease.

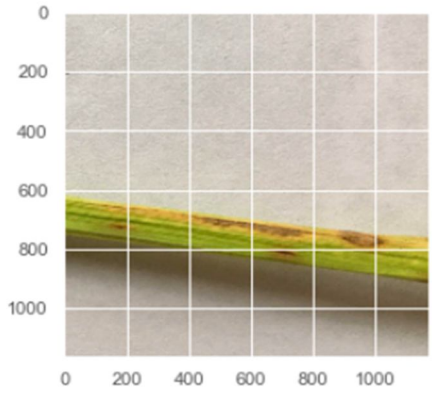



```
[[0.59014344 0.05742653 0.05175398 0.30067602]]
0
Hispa
Remedies
1. Avoid Over Fertilizing
2. Leaf tip containing blotch mines should be destroyed
3. Manual collection and killing of beetles - Hand Nets
4. Spraying of Methyl Parathion 0.05% or Quinalphos 0.05%
```

Fig. 1.12 Output of a Hipsa Rice Leaf

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The below output displays the image of a rice leaf with Leaf Blast disease after completing 10 epoch cycles on the training data set. Even the recommended remedies have been suggested for the Leaf Blast disease.




```
[[0.50959253 0.00915143 0.00768587 0.47357014]]
0
LeafBlast
Remedies
1. Planting resistant varieties
2. Avoid excess N-fertilizer application
3. Apply Nitrogen in three split doses
4. Avoid noon hours for spraying
```

Fig. 1.13 Output of a Leaf Blast Rice Leaf

VI. CONCLUSION

The project deals with Leaf Disease detection using image processing techniques in python. It involves loading an image, image preprocessing, image segmentation, feature extraction and classification. Development of automatic detection system using advanced technology like image processing, facilitates farmers to identify the disease caused to the leaf at an early or initial stage and supply helpful data for its management.

In this digital world, CNN based leaf disease identification system helps the farmers to pace with the technology and helps them to detect the leaf disease by just uploading the image of the leaf. With Machine Learning techniques, farmers can easily sit in home and check whether the leaf is affected with any disease and get the recommended remedy.

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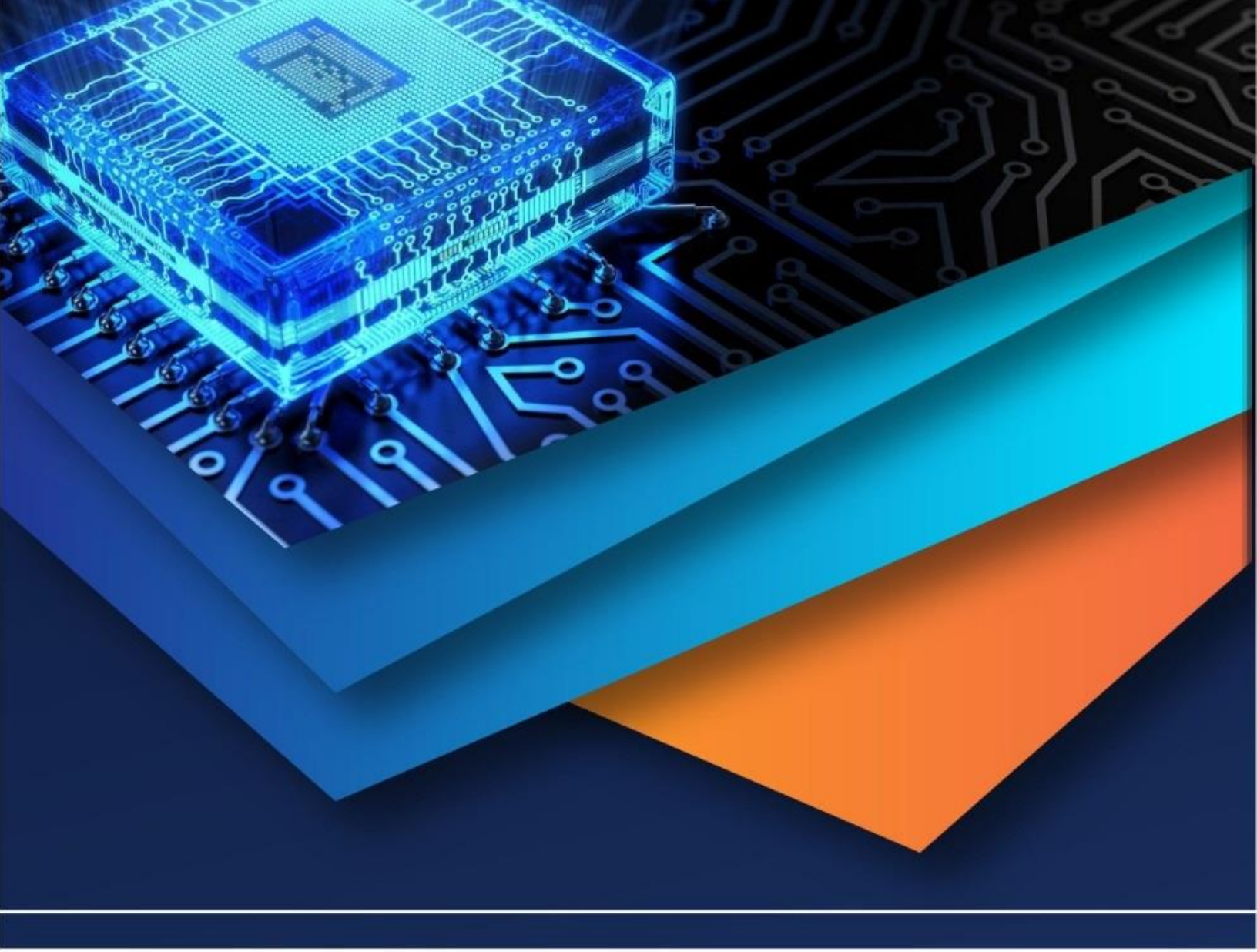
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