DISEASE IDENTIFICATION IN LEAF USING CONVOLUTIONAL NEURAL NETWORK

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Abstract: Crop disease detection is an emerging field as agriculture is the foremost sector in economic life. It is important to minimize the disease that induced damage in crops during growth and harvest as well as to increase the agricultural productivity. The crop disease recognition model is based on leaf image classification by using Convolutional Neural Networks. In machine learning, Convolutional Neural Network is a class of deep, feed-forward artificial neural network that uses a variation of multilayer with little pre-processing compared to other methods. The Gray Level Co-Occurrence Matrix functions are used to characterize the texture of an image by calculating spatial relationship of pixels that occur in an image and then extracts the statistical measures from the Gray Level Co-Occurrence Matrix. Convolutional Neural Network technique is beneficial as it reduces a large work of monitoring in big farms and help in detecting symptoms at earlier stage. The proposed system provides an analysis of leaf disease and pesticides to overcome the detected disease thereby increasing the productivity.

Keywords: Convolutional Neural Networks, Crop Disease Detection, Co-Occurrence Matrix.

Introduction: Agriculture is the backbone of all the nations. It is a primary factor of food providence on which economy highly depends. The agricultural yield is dependent on various factors like quality of the soil, rainfall, climatic conditions, and fertilizers. The control of plant diseases is a major challenge faced by Indian farmers as diseases pay a large contribution in loss of crop every year.

Identification of the diseases in the plant is the key to prevent the losses in the yield of the agricultural products. This requires continuous diagnosis and timely handling to protect the crops from heavy loss. Disease detection involves the steps like image acquisition, image pre-processing, and plant diseases detection using the leaf images. The paper focuses on segmentation and feature extraction algorithm for plant disease detection.

Color feature extraction and texture feature extraction is employed and colors of the image sample is extracted. Then the diseases in the leaf images are classified using Back propagation neural network where the training is performed by extracting seven invariant moments from diseased leaves images. Image classification is done to find the type of disease in the leaf by using Convolutional Neural Network (CNN).

2. Literature Survey

A. Detection of Disease using Extraction Technique: Ajay A. Gurjar and Viraj A. Gulhane used an Eigen feature regularization and extraction technique and able to detect three diseases from the leaf image. This system is having sufficient accuracy, than that of the other feature detection techniques. With this technique about 60% of detection of Red spot, fungal diseases present in the leaf can be identified. [1]

B. Image Processing Using K-Means Techniques: Dheeb Al Bashish& et al. suggested image processing based work that comprises of the following main steps: In the first step, K-means algorithm is used to

divide the obtained images and then secondly the divided images are passed through a neural network for processing. Five different diseases that are common in leaves were considered in this research; Early scorch, Cottony mold, Ashenmold, late scorch, tiny whiteness. The practical output describes that the neural network classifier is based on statistical International Journal of Recent Advances in Engineering & Technology (IJRAET). Using this approach, leaf diseases can be detected automatically with the accuracy of around 93%. [2]

C. Classification of Leaf Disease using Back Propagation: Diagnosis system for grape leaf diseases is proposed. The suggested system is comprises three main parts: Firstly color of the grape leaf can be extracted from complex background; second step is grape leaf disease color extraction and finally classification of disease in the grape leaf will be done. Back-propagation NN and self-organizing characteristic map are combined together to identify the colors of grape leaf. This system can classify the grape leaf diseases into three classes as Scab disease, rust disease and no disease. Even though there are some restrictions in extracting ambiguous color pixels from the background of the image. This system provides good performance for any agricultural productive analysis. [3]

D. Disease Identification using Color Co-Occurrence Technique: S. Arivazhagan has proposed four principles to identify the plant diseases during earlier stage. First, color transformation structure is generated from the input RGB image, then the green pixels in the leaf are marked and removed using particular threshold value and segmentation, third step is texture features evaluation using color co-occurrence method for the identified valuable segments, finally the extracted features are processed through anyone classifier. This approach is used to detect the plant diseases at the earlier stage itself and the pest control methods can be applied to eliminate the pest problems and also minimizing environmental risks. [4]

E. Detection and Classification of Plant Leaf Disease using Image Processing Techniques: Savita N. Ghaiwat, ParulArora has presented a analysis on different classification techniques available for plant leaf disease identification. A classification technique separates each pattern as one different class. It is used to separate the leaf images related to its different morphological features. There are so many classification techniques are available such as K-Nearest Neighbor algorithm, Probabilistic Neural Network, Support Vector Machine Classifier, Principal Component Analysis, Artificial Neural Network, and Fuzzy based approaches. Choosing a suitable classification technique is always a tough task because the result quality can vary for different inputs. Classification of plant leaf disease techniques has extensive applications in different fields such as in Artificial Intelligence, Agriculture and etc. [5]

F. Color Transform Based Approach for Disease Spot Detection on Plant Leaf: Piyush Chaudhary et al developed a system to spot the diseases in the plant leaf using different image processing techniques. Disease spots are identified with color difference. Then the color transformation of RGB image can be used for better segmentation process and the detection of disease spots from the leaf. Image smoothening is done by median filter method. Finally threshold value can be measured by using Otsu method on color component of the leaf to identify the disease spots accurately. [6]

G. Agricultural Plant Leaf Disease Detection using Image Processing: Many of the plant leaf diseases are originated by the following: Fungi are detected using their biological structures present in the leaf. Bacteria's are present as one cell, it will increase its size by separating into two cells and this process will be continued to increase in numbers rapidly; this process is called binary fission. Viruses are very small particles with protein and genetic material. In this scheme, first structure of color transformation for the input color image is done, and secondly this transformed image is converted to HSI. In third step, the green pixels identified in the leaf are marked and removed using threshold value, then the image is divided and the required segments are extracted, finally the texture statistics of the image is computed for easy disease detection and recovery. [7]

3. Research Methodology:

3.1 Description of Architecture

The input sample is classified using four functions. They are Contrast, Correlation, Homogeneity, and Energy. Based on calculated values the disease is identified with the pesticide to be used.

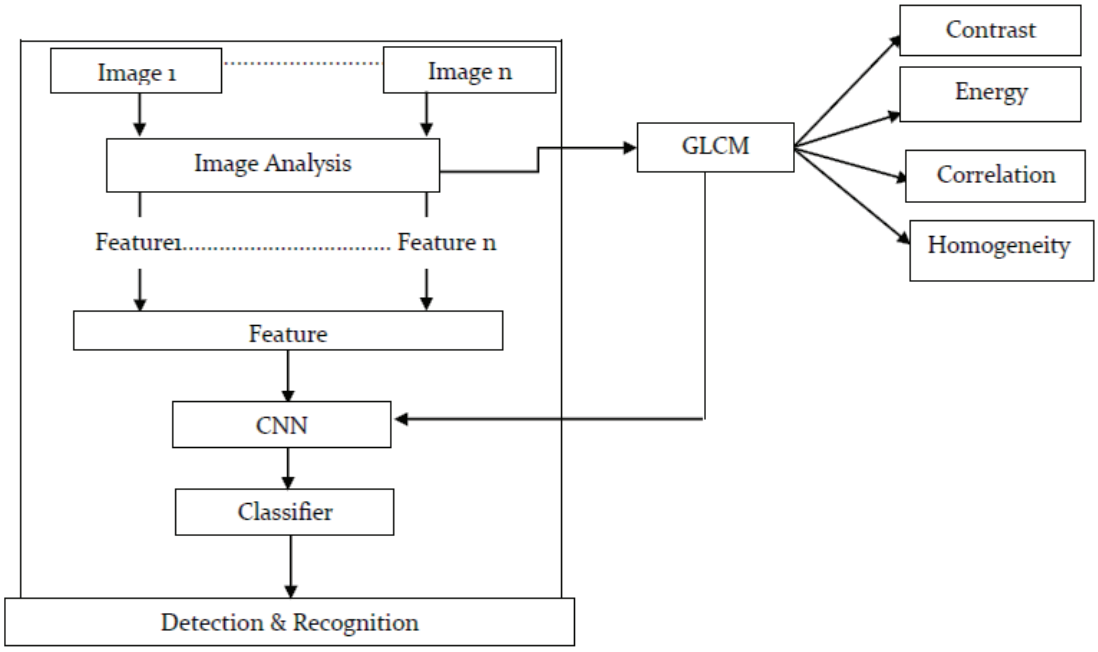

Figure 4.1 Architectural Design

3.2 Motion Detection: The motion detection module gets a raw camera image as input and calculates the difference between other images within a local field. The motion detection process receives a digitized 120x120 size image from the camera for processing. Input images are stored in a continuous three frame buffers; two frame buffers are used to hold the recent complete image.

3.3 Object Tracking: Neural network is applied to object tracking while playing the video file in the current axis; the objects present in the video can be tracked. In object tracking, once motion has been detected, the moving object is to be extracted from its background. Once the object tracking is completed, the particulars like character of the moving object, size and motion direction can be obtained.

3.4 Convolution Neural Networks: A CNN contains an input and an output layer and multiple hidden layers. The hidden layers are convolution, pooling or fully connected.

Convolution layer applies a convolution operation as input and the output of this layer will be passed as input to the next layer. Each convolution neuron processes data only for its receptive field. Fully connected feed forward neural networks can be used to learn features as well as for classification; practically it can't be applied to images.

Convolution network consist of different pooling layers, which combines the output of clustered neurons in one layer and single neuron to the subsequent layer. Max pooling value uses the maximum value from each neuron cluster at the previous layer. Then average pooling uses the average value from each cluster of neurons at the previous layer.
Fully connected layers can connect a piece of neuron from one layer to a piece of neuron present in the next layer and this process will be continued until all neurons will be connected. That is known as the multi-layer perceptron neural network (MLP).

3.5 GLCM Features: A statistical method of testing the texture will considers the spatial relationship of pixels in the gray scale matrix. Gray scale matrix and associated texture value calculations are image analysis techniques. The various texture properties are Energy, Entropy, Contrast, Homogeneity, Correlation, Shade and Prominence.

4. Results and Discussion

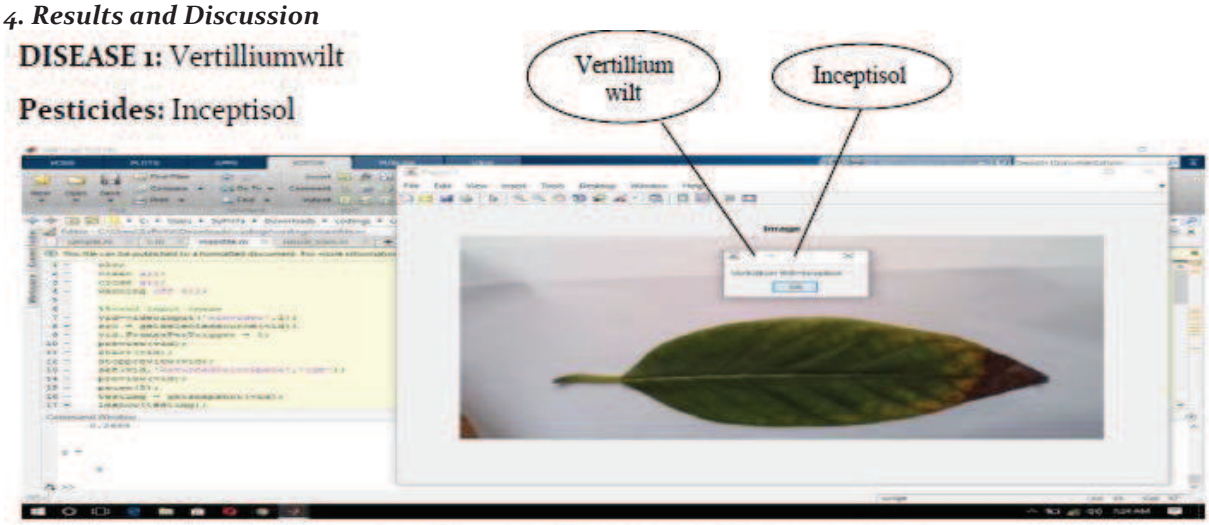

Figure 4.1 Disease 1 displayed with the pesticide

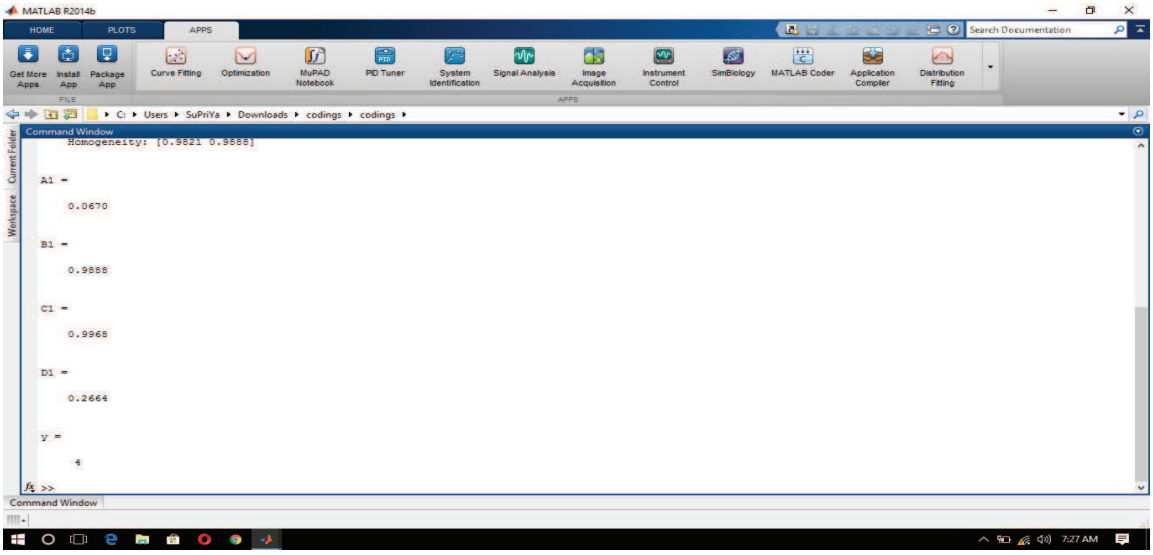

Figure 4.2: Classification Values for Disease 1

5. Conclusion and Future Work: The proposed system will detect the diseases in the leaf of the plants at early stage and suggests proper pesticides for the detected disease. The experimental outcome shows that the proposed approach can identify the leaf disease with little calculation effort. Advances in computer technology such as image processing, Convolutional Neural Network are used to expand and enhance the practice of plant disease detection and it helps in extending the market of computer vision applications in the field of agriculture.

In the future, the proposed methodology can be applied to many plant infections by adding datasets of various leaf diseases and early warning systems can be developed by using advanced CNN method.

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