Leaf Disease Detection

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Abstract- Our project presents an analysis of the characteristics of the leaf using image processing techniques for an automated vision system used in agricultural lands. In agriculture, the search for automatic detection of leaf characteristics is essential for monitoring large fields and automatically detects the symptoms of the leaves as soon as they appear on the leaves of the plants. The proposed decision-making system uses the characterization of the content of the image and a network of supervised classification neurons. Image processing techniques for this type of decision analysis include pretreatment, feature extraction and classification steps. During processing, the size of an input image will be resized and the region of interest will be selected. Here, the characteristics of color and texture are extracted from an input for the formation and classification of the network. Color characteristics as an average, standard deviation of the HSV color space and texture characteristics such as energy, contrast, homogeneity and correlation. The system will be used to automatically classify the test images to determine the characteristics of the leaf. For this approach, the automatic Neural Network classifier can be used for classification based on learning with examples of learning in this category. This network uses the sigmoid tangent function as a function of the kernel. Finally, the simulated result shows that the network classifier used provides a minimum error during training and better classification accuracy.

Keywords— **Plant disease, Pre-processing, DWT, Feature Extraction, NN classifier**

I. INTRODUCTION

Crop diseases are major sources of famine and food insecurity all over the world. In fact, it is estimated that plant diseases may account for lose in annual crop yield of up to 16% globally. Furthermore, the current solutions to fight different diseases demand the massive use of crop protection products, which are dangerous for the environment and the user. To identify and discover different kinds of diseases effectively, Microscope and DNA sequencing-based methods are being preferred. Even though many of the farmers around the world do not have access to these diagnostics tools, the vast majority of them possesses a cell phone. In fact, the Ericsson Company forecasts that mobile subscriptions will reach 9.3 billion in 2019 and 5.6 billion of these will be smart phone subscriptions.

Thus, a promising solution for diagnosing crop diseases based on capturing and analyzing automatically a picture of a plant leaf is by a phone based tool. In this paper, we take a first step towards such a tool. Leaf speckle is a fungal disease commonly found in plants. Its symptoms start as light brown little spots and with time they increase in size and become black. If these are left untreated, these diseases will destroy the plant. But, if they are diagnosed early, they can be treated and the plant can be saved.

Computer vision and machine learning techniques are applied to completely different unwellness detection like tomatoes, grapes, potatoes and cotton. Motivated by advances in computer vision, especially neural networks (NN), which managed to produce remarkable results in the field of image classification, we propose a new system based on NNs which requires minimal image preprocessing. The model will learn visual options directly from pictures. The developed model is ready to acknowledge two differing kinds of pathological leaves out of healthy ones. The rest of the paper is organized as follows: in part II of the paper, we present the literature review. Part III explains technical details of the proposed approach and the architecture of the used convolution neural network. Furthermore, experimental evaluation and results are reported in part IV. Finally, part V concludes the paper and provides an outlook to future work, and the part VI shows the references of the proposed model.

II. LITERATURE REVIEW

[1] Santanu Phadikar and Jaya Sil focused on identifying identifying rice disease and examined the two diseases, Leaf Blast and Brown Spot. The methods of edge detection and spot detection are used to extract the characteristics of the infected parts of the leaves of the plant. The authors introduced the SOM neural network (Self Organizing Map) in a zoom algorithm for the classification of diseased rice images. The method to create the input vector in SOM is the filling of the zeros and the interpolation of the missing points, resulting in the zoom algorithm.

[2] Dheeb Al Bashish, Malik Braik and Sulieman Bani-Ahmad considered the authors considered five plant diseases, namely Late scorch, Cottony mold, Early scorch, Ashen mold and Tiny whiteness of the Al-Ghori area of Jordan for testing. The k- means clustering method is used for image segmentation and the CCM method (Co-color occurrence method) is used for the analysis of the texture of the infected leaf. For the classification of plant diseases, BPNN (Back Propagation Neural Network) is used.

[3] Zulkifli Bin Husin, Abdul Hallis Bin Abdul Aziz, Ali Yeon Bin Md Shakaff and Rohani Binti S Mohamed Farook introduced a technique detect Malus's domestic leaf disease. The grayscale images are obtained by means of equalization of histograms and the analysis of the texture in the segmentation of images is done using the algorithm of the co-occurrence matrix method. In the threshold matching process, there is a comparison between the value of the individual pixels and the

threshold value. For the detection of plant diseases, the texture and colour images are compared with the images of previously obtained leaves.

[4] Sabah Bashir and Navdeep Sharma described a technique detect bacterial infection by fire blight. In image segmentation, the k-means classification algorithm is applied to separate background and background images. The grouping in the segmentation is based on the subtraction of the images of the grouped leaf and the intensity map to highlight the area of the leaf. k-means is very effective and simple to detect the infected area.

[5] Murali Krishnan and Dr.M.G.Sumithra introduced the citrus leaf diseases detection technique and they are: anthracnose, citrus canker, excess water and greening of citrus fruits. Image pre-processing involves converting the color space by applying the CyBC color system and the L * a * b * color space, as well as improving the color image by applying a discrete cosine transformation. The grey level co-occurrence matrix is used for feature extraction to show various statistics such as energy, contrast, homogeneity and entropy. Finally, SVMRBF and SVMPOLY are used for the detection of diseases of citrus leaves.

[6] Ms. Kiran R. Gavhale, Prof. Ujwalla Gawande and Mr. Kamal O. Hajari presented technique for detection of Sun scorch Orchid Black leaf & spot leaf disease. Pre-processing is achieved by equalizing the histogram, adjusting the intensity and filtering to improve the image. Segmentation involves a thresholding process and three morphological processes applied to eliminate and preserve small and large objects, respectively. Finally, the classification is done by calculating white pixels in the image of the leaf and diseases are recognized.

[7] Wan Mohd Fadzil W.M.N, Shah Rizam M.S.B and R. Jailani, Nooritawati M. described the technique to detect diseases of tomato leaves, Powdery mildew & Early blight. The pre-processing of images involved several techniques such as smoothing, noise elimination, resizing, isolation and background suppression to improve the image. Gabor wavelet transformation is applied to the extraction of characteristics for feature vectors also in the classification. The Cauchy kernel, the Laplacian kernel and the Immelt kernel are applied in SVM for the decision of exit and training for the identification of the disease.

[8] Usama Mokhtar, Mona A. S. Alit, Aboul Ella Hassenian, Hesham Hefny described a technique for detecting spot and scorch disease in which, by creating a color transformation structure, the color values become a space value in the pre- treatment of image. Hidden cells within limits are suppressed by hiding the green pixels after applying the k-means method. The color co-occurance method extracts characteristics such as color, texture and edge, and finally the neural network is used for the recognition and classification of diseases.

[9] Sachin D. Khirade, A. B. Patil introduced the technique with the improved k-means clustering method. After acquiring images, RGB images are converted to gray scale and HSV. In the threshold process, the histogram and multilevel threshold are obtained to isolate the relevant image while limit detection is performed to obtain the required image area. The centroid value is calculated using the improved k-Means method and compared to the database to obtain the result.

[10] Ghulam Mustafa Choudhary and Vikrant Gulati introduced technique to detect diseases of mango fruit. The authors made a video of mango disease during the acquisition of the image and the original image was converted to binary, then a histogram is calculated. The watershed algorithm in image segmentation is applied to identify defective regions and features are extracted by spot extraction using the pattern matching algorithm. The diseases are classified by a standardized correlation method and show a defective region in the image of the fruit.

III.METHODOLOGY

We introduce a deep learning-based approach to classify and identify leaf diseases. The general architecture of the proposed framework is illustrated in following block diagram. Later, each block will be explained in detail. Mainly, the proposed framework consists of Preprocessing, Discrete wavelet transform, Features Extraction, NN classifier

Block Diagram

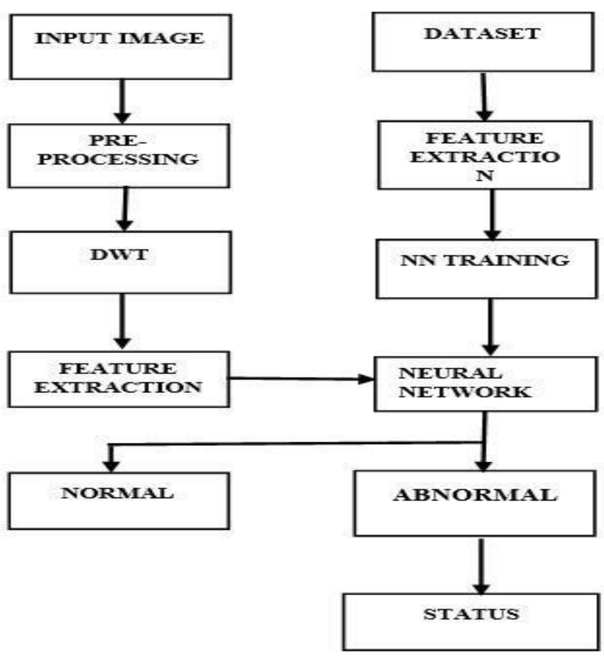

Fig 1. Block Diagram

Image Preprocessing

The dataset stored in local or global repositories contains many images of healthy, infected leaves. Images are taken with a standard digital camera. Each image has three red (R), green (G) and blue (B) channels. We will test the applicability of our approach to RGB images and grayscale images. To this end, we perform a preprocessing step in which each image in our dataset is resized to 60 × 60 pixels and converted to gray scale. Pretreatment of images can greatly increase the reliability of an optical control. Several filtering operations that intensify or reduce certain details of the image allow easier or faster evaluation. Users can optimize an image of the camera in a few clicks.

Discrete wavelet transform

A discrete wavelet transform (DWT) is a wavelet transform for which the wavelets are discretely sampled. As with other wavelet transformations, temporal resolution is one of the main advantages of Fourier transformations: it captures frequency information and location (location in time).

Characteristics analysis

Characteristic analysis is performed in the proposed work using a gray level co-occurrence matrix (GLCM). This is a statistical method for examining the texture taking in account the spatial relationship of the pixels, also called the spatial dependence

matrix of the gray levels. GLCM functions characterize the texture of an image by calculating the frequency at which pairs of pixels are produced with specific values and in a specific

spatial relationship in an image, creating a GLCM and then extracting statistical measures from that matrix.

NN Classification

Neural systems are prescient models inexactly dependent on the activity of natural neurons. The determination of the name "neural system" was one of the incomparable PR triumphs of the Twentieth Century. It unquestionably sounds more energizing than a specialized depiction, for example, "A system of weighted, added substance esteems with nonlinear exchange capacities". Be that as it may, regardless of the name, neural systems are a long way from "thinking machines "or "artificial brain". A regular counterfeit neural system may have a hundred neurons. In correlation, the human sensory system is accepted to have about 3x1010 neurons. We are still light a very long time from "Information". In spite of the fact that the usage is altogether different, neural systems are theoretically like K- Nearest Neighbor (k-NN) models. The fundamental thought is that an anticipated target estimation of a thing is probably going to be about equivalent to different things that have close estimations of the indicator factors. Consider this figure:

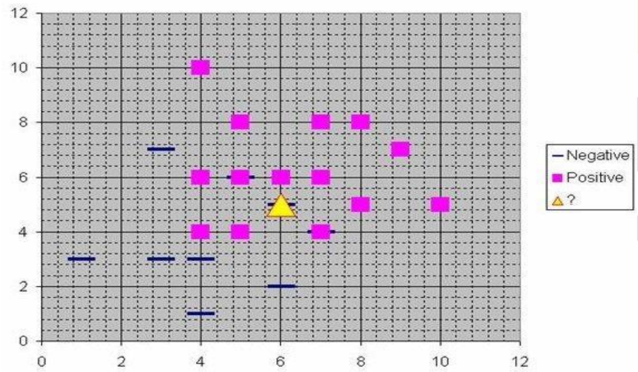

Fig.2. Neural network Classifier

Expect that each case in the preparation set has two indicator factors, x and y. The cases are plotted utilizing their x, y arranges as appeared in the figure. Likewise accept that the objective variable has two classifications, positive which is indicated by a square and negative which is signified by a dash. Presently, assume we are attempting to foresee the estimation of another case spoken to by the triangle with indicator esteems x=6, y=5.1. Would it be advisable for us to anticipate the objective as positive or negative? Notice that the triangle is position precisely over a dash speaking to a negative esteem. Be that as it may, that dash is in a genuinely bizarre position contrasted with different dashes which are bunched beneath the squares and left of focus. In this way, it may be the case that the hidden negative esteem is an odd case

The closest neighbor grouping performed for this precedent relies upon what number of neighboring focuses are considered. In the event that 1-NN is utilized and just the nearest point is considered, at that point obviously the new point ought to be delegated negative since it is over a known negative point. Then again, if 9-NN arrangement is utilized and the nearest 9 points are considered, at that point the impact of the encompassing 8 positive focuses may overbalance the nearby negative point. A neural system expands on this establishment and sums it up to think about the majority of different focuses. The separation is figured from the fact of the matter being assessed to every one of different focuses, and a spiral premise work (RBF) ((also called a *kernel function*) is connected to the separation to register the weight (impact) for each point. The spiral premise capacity is so named in light of the fact that the sweep separation is the contention to the capacity.

Weight = RBF (*distance*)

The further some other point is from the new point, the less influence it has.

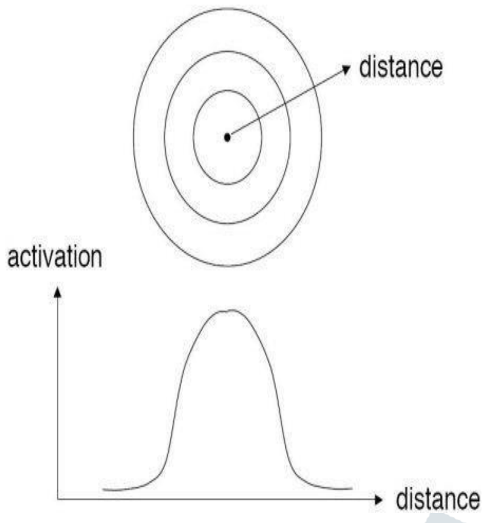

Fig.3. Distance computation of each point

IV. RESULT AND DISCUSSION

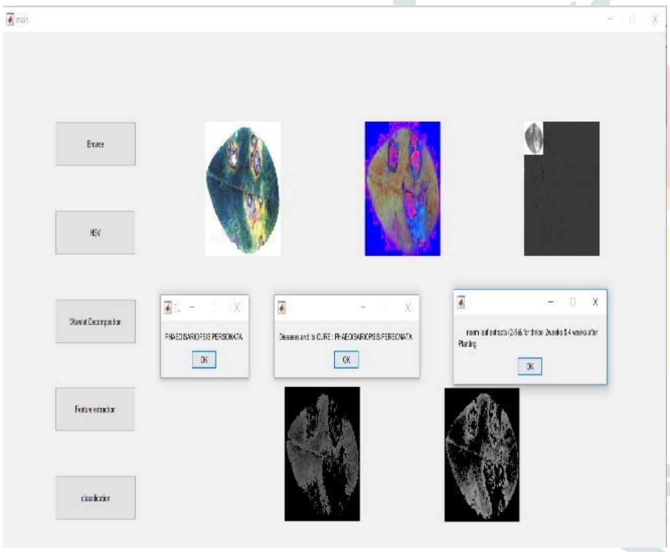

Fig 4. Result and Discussion

As discussed in the introduction, solution is composed of four phases. We have tabulated results up to three phases. Graphical user interface (GUI) is built for the system to carry out different image processing steps. Dataset folder is created consisting of various images of leafs under test. The crops we have selected for experimental purpose are Plant leafs. In phase 1, input image is selected from dataset folder as shown in Figure 4. Color transformation structure is created from RGB to CIELAB color space. Then color based segmentation using k-means clustering is applied to get the infected region of interest. The choice of selection of number of clusters is user dependent. Generally best results come up. The sample results of clustering on phaeoisariopsis personata Leaf Spot of Plant leaf (fungal) are shown in next Mat lab figures. We can see that Figure 4. (Cluster 1,2,4) represent the intact (healthy) parts of leaf.

Whereas figure 4. (Cluster 3) consists of diseased portion of leaf. This is the region of interest for further processing.

In phase 2, infected cluster is selected. Green pixels are masked based on threshold value set. Also Pixels on the boundaries are also removed as they both do not contribute to disease identification process. Then resultant image is converted from RGB to HSI color format. In phase 3, feature extraction & statistical analysis on modified infected cluster obtained in previous phase is carried out. In practice, analysis can be done on five different models also known as color features. Reason behind this selection is the variation in accuracy that we get during the neural network based classification.

In phase 4, neural network based classification is to be carried out. Feed-forward Back propagation neural network is preferred as it has best performance being a function of Mean Square Error (MSE) with number of iterations be 10,000 and maximum allowed error is 10-5. First, the network is trained using training feature sets in order to get target output. After that it is tested for different types of diseases & accuracy is computed. It is experimentally found that using HS color feature (M4) we can get highest classification accuracy of 94-96% compared to other models. To measure the severity of disease, grading can be assigned based on affected pixel area. Image is binary thresholder so as to measure number of black and white pixels. As per the percentage, disease grades 0, 1, 2 etc. can be assigned. This can be calculated by using next equation.

Total % affected area = (No. of affected leaf pixels /Total no. of leaf pixels) $*$ 100

When disease is classified, information related to it such as causes, symptoms and cure techniques is to be displayed. For that purpose, we have prepared Diagnosis database with the help of GUI. One such sample is shown in Figure 4.

V.CONCLUSION

Agriculture suffers from a severe problem, plant diseases, which reduces the production and quality of yield. Besides, the shortage of diagnostics tools in underdeveloped countries has a devastating impact on their development and quality of life. Hence, there is an urgent need to detect the plant diseases at the early stage with affordable and easy to use solutions. To this end, in this paper, we presented an approach based on convolution neural networks to identify and classify banana diseases. The proposed model can serve as a decision support tool to help farmers to identify the disease in the various plant. Hence, the farmer can take a picture of the leaf with the symptoms and then the system will identify the type of the disease. Our main contribution is to apply deep neural networks to detect different leaf diseases under challenging conditions such as illumination, complex background, different images resolution, size, pose and orientation. After several experimentations our system was able to find good classification results. This has proven that the proposed method can significantly support an accurate detection of leaf diseases with little computational effort. Encouraged by the obtained results, we intend in our future work to test more leaf and plants diseases with our model. Besides, we will target the automatic severity estimation of the detected disease since it is an important problem that can help the farmers in deciding how to intervene to stop the disease

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