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Survey on ML Based Banana Leaf Disease Classification

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ABSTRACT—Machine Learning based banana leaf disease classification project is a useful application for farmers to identify, analyse and manage plant pathogens within fields as effectively and automatically at minimum cost. Major banana diseases express their symptoms on leaf area in their earlier stage of infection. These infections can be analysed and classified automatically through computer vision and machine vision systems that use image processing techniques for information interpretation. Image processing techniques produces higher degree of accuracy in automatic identification and classification of diseases in banana leaves. Machine learning technology typically improves efficiency and accuracy over time. Thus, this project ensures consistency and accuracy at a low and affordable cost and also ensure less time consumption for disease identification. Plant diseases are important factors as they result in serious reduction in quality and quantity of agriculture products.

Keywords: *Back Propagation Neural Network, Principal component analysis, Support vector machine, Image processing, Artificial Neural Network Fuzzy Interference System.*

I. INTRODUCTION

Agriculture is an important sector as it provides food and livelihood for millions of people. It also gives support to the country's economy. Banana is one of the major foods as well as fruit crop that has capability to provide abundant income to the farmers and country's economy. But this contribution of banana crop is not fully utilized by the farmers as there are various diseases that decrease the production. Major threat in banana agriculture is caused by pests and diseases that reduce crop productivity, leading to heavy financial loss for farmers. Identification and diagnose of banana plant diseases accurately in early stage facilitate farmers to have a better control over the crop. Symptoms of these diseases are varied. In some crops' diseases are visible in early stage and in other, they are visible only in later stage, as there will be no possibility to rescue the crop.

Persistent monitoring over the plant helps to identify the pest and disease in early stage and also sustains the plant quality with minimized yield loss. Many farmers are not aware of the disease identification based on the symptom expression on plants. Hence the support of diagnostic services provided by sources such as agricultural research institutions and state farm advisory services are becoming mandatory for banana cultivators. This always involves more time consumption and need additional cost towards advisory services. Development of an automated system is the need for farmers to avoid these inconveniences and to have a user-friendly suggestion.

II. LITERATURE SURVEY

[1] Deep learning is a novel method for image processing and object detection with greater accuracy in the classification of various crop diseases.Transfer learning is one such popular approach in deep learning, where pre-trained models are adapted to do a new task. Deep transfer learning (DTL) generates a fresh framework for digital image processing and predictive analytics, with greater accuracy and has huge potential in crop disease detection. our results showed that the dcnn was a robust and easily deployable strategy for digital banana disease and pest detection. using a pre-trained disease recognition model, system was able to perform deep transfer learning (dtl) to produce a network that can make accurate predictions. Dataset consists of various types of data, including images with various resolutions (cell phone, tablets, standard RGB camera); light conditions depending on time of image taking (e.g., illumination), season (e.g., temperature, humidity), and different environmental locations. performance metrics:1.loss functionclassification loss is used to measure the model's confidence by classifying the pixels region delimitated by the bounding box and the localization loss measures the geometric distance between the predicted bounding box and the ground truth annotation.Map score:The mean average precision (map) was used as the validation metric for banana disease and pest detection. Precision refers to the accuracy. System's methodology computing a confusion matrix (CM) for each selected model based on the object detection script.certain diseases are localized in a particular country, region or continent, such as, Xanthomonas wilt of banana which is very specific to Africa. Therefore, reliable and accurate image collection at hotspots and strong labeling is very important. Since we are aiming for a global solution, we collected the image dataset of major banana diseases from different disease hotspots through our CGIAR network. To build a detection model, we retrained three different convolutional neural network (CNN) architectures using a transfer learning approach. A total of six different models were developed from 18 different classes (disease by plant parts) using images collected from different parts of the banana plant.

[2] The paper applies deep-learning technique to detect and classify the banana leaf disease. It also makes use of LeNet architecture as a convolutional neural network to classify image data sets. This system detects the disease and also proposes the remedies for the disease being classified. This system makes use of K nearest neighbors (KNN) algorithm. This algorithm stores all the input data sets and classifies given input data based on distance function. The feature extraction is done using CNN (Convolutional Neural Network) algorithm. CNN is deep artificial neural network that is mainly used to classify image, cluster them based on similarity and executes the recognition process. In this system user upload image as an input. Using CNN Classifier, given image file will be processed. KNN algorithm is used to identify the correct combination of the components to validate the disease. K nearest neighbors (KNN) is a simple algorithm that stores all available cases and classifies new cases based on a similarity measure (e.g., distance functions). This system is used to determine and predict an automated system to accurately detect banana leaf diseases for the user.

[3] The author exploits the fusion of close range hyperspectral (HS) image and high-resolution (HR) visible RGB image for potential disease detection in banana leaves.Typical morphological features used for characterizing thespatial information of very high-resolution images are generated by applying morphological openings and closings byreconstructionon a grayscale image, using a structuralelement (SE) of predefined size and shape. An opening acton objects that are bright compared with their surroundings,while closings act on dark objects. This approach applies the joint bilateral filter to transfer the textural structures of HR RGB image to low-resolution HS image and obtain an enhanced HS image. Initial experimental results on Musa acuminate (banana) leaf images demonstrate the efficiency of our fusion approach, with significant improvements over either single data source or some conventional methods. This paper took morphological filters as an example to generate spatial features and joint bilateral filter for textural structures transferring. Many approaches have been conducted to transfer the spatial information into hyperspectral imagery, e.g., hyperspectral image pansharpening. However, the objective ofthese approaches is to obtain an enhanced hyperspectral image, focusing on the optimized preservations on both spectraland spatial information.Morphological filters are applied togenerate the spatial profile, which includes not only boundaryinformation,our approach first decorrelates the original low-resolutionHS image into PCA domain, and separates the informationcontent from the noise.We can find that for certain objects, spectral information is enough to obtain good results for example the dead and dying leaf categories. This is consistent with the expected differences in spectra of such leaf areas. However, either hyperspectral data or HR color image alone is not enough for reliable classification, especially for potential banana diseases (class 'spot'). Fusion by simply stacking spectral information and morphological features can improve the accuracies of most classes. However, no improvements for the potential diseases, indicating that the complementary information from both sensors are not well fused. The proposed method produces higher classification accuracy for most classes, compared with the other approaches. This means that our fusion method is capable to fuse the complementary information from multi-sensor and multi-resolution data.

[4]The system identifies two prominent banana diseases namely banana sigatoka and banana speckle by applying deep neural network technology. The author here has made use of LeNet architecture as a convolutional neural network to classify image data sets. The preparatory results illustrate the effectiveness of the proposed approach even under challenging conditions such as illumination, complex background, different resolution, size, pose, and orientation of real scene images. This system accepts both RGB and greyscale images. During image pre-processing every image is resized into 60 *60 pixel henceforth converted to greyscale image. The study is limited to only two prominent diseases of banana leaf. Neural networks contain multiple neurons arranged in layers. The neurons in the adjacent layers are connected to each other. These neurons learn how to convert inputs (pre-extracted and pre-processed features) into corresponding output (labels). In particular, convolutional neural networks (CNNs). The feature extraction model is the part where the network learns to detect different high-level features from the input images. It consists of a sequence of convolution and pooling layers. Convolution map. The convolution layer is an elementary unit in the CNN architecture. The goal of convolution is to extract features from the input image. It consists of a set of learnable filters. Convolution map. The convolution layer is an elementary unit in the CNN architecture. Max-pooling map: In the architecture of

convolutional neural network, convolution layers are followed by sub-sampling layers. Each sub-sampling layer reduces the size of the convolution maps, and introduces invariance to (low) rotations and translations that can appear in the input. Within the classification step we use fully connected layers where each neuron provides afull connection to all learned feature maps issued from the previous layer in the convolution neural network.

[5] In this paper, author has proposed software solution for automatic plant disease detection and finally the percentage infection using image processing technique.All the acquired images are stored in jpg format on the disk, which creates the database. The proper database creation is the important part as it is responsible for the accuracy of classification. Image processing techniques are employed to enhance the quality of images. Besides, the proposed work uses Artificial Neural Network to classify the Banana plant diseases. The ANN consists of three layers: input layer, hidden layer and the output layer. The two important steps in designing an accurate training model are the training process and the validation process. The dataset i.e. the feature file is divided into two parts. 1. The training feature file which is used to train the neural network model. 2. The testing feature file which is used to validate the accuracy of the trained neural network. This system involves several steps, which include- dataset creation, image pre-processing, HOT (Histogram of Template) feature extraction and artificial neural network-based training and classification. Finally, a system is developed that extracts the features from images and classifies the diseases is using ANN (Artificial Neural Network) algorithm. The Banana plant disease detection system is developed using the MATLAB application. The system developed involves images acquisition, pre-processing, feature extraction, feature file creation, wherein a set of features are selected and computed during the feature extraction phase which are used further for classification of the disease. Grading was done and the control methods for the respective disease are displayed.

[6]This system is a well-organized module that identifies the Black sigatoka disease and Panama wilt disease on banana leaf. The disease grading has been done using ANFIS (Artificial Neural Network Fuzzy Interference System) classifier. Finally, classifiers comparison has been performed using confusion matrix. This work consists of identifying and grading the affected part banana Black Sigatoka disease and Panama wilt disease. It uses video as input. Banana leaf spot diseases were segmented efficiently according to color, texture and shape features. Initially Image segmentation is done, along with image analysis and important features are extracted and classification of diseases is performed using SVM (Support Vector Machine) classifier. If the leaf is disease affected then disease grading is done using ANFIS classifier. Finally, classifiers comparison has been performed with SVM or ANFIS classifiers using confusion matrix. The classifier comparison results 100 % accuracy for ANFIS and 92% for SVM. The Multilevel SVM replaces Linear SVM which result 100 % accuracy for SVM. For implementing the proposed system, here we used sample data from Mohandas College Banana farm by using Samsung Galaxy phone which contains50 video samples of both normal banana leaf and diseased banana leaf. Then image frames are generated using video reader function in mat lab 2013a. The Banana Leaf diseases are classified using Multi layered Support Vector Machine. That is, it detects whether the disease is Black sigatoka disease or Panama wilt disease. It uses video as input. Banana leaf spot diseases were segmented efficiently according to color, texture and shape features. Initially Image segmentation is done, along with image analysis and important features are extracted and classification of diseases is performed using SVM classifier.

[7] This paper provides a various method to detect plant diseases using image processing technique. This system is also a well-organized module that identifies the Black sigatoka disease and Panama wilt disease on banana leaf. The disease grading has been done using ANFIS classifier. Finally, classifiers comparison has been performed using confusion matrix. The strategy for image segmentation described effectively detects and selects the regions that, from the point of view of a human expert, are considered diseased. The strength of this algorithm is the ability to identify the correct target (diseased region) in images with different range of intensities distribution. The algorithm was tested on a very diverse set of images and segmentation performance was estimated. Because of the complexity of the images used in this study, the strategy proposed here may be suitable for other type of images whose targets are different to that of images showing diseased plants. The next stage of developing a disease classification system is to extract parameters of the diseased region and classify the image accordingly. To test the accuracy of the algorithm, manually segmented images were compared with those segmented automatically. Results showed that the developed algorithm was able to identify a diseased region even when that region was represented by a wide range of intensities. This study reports on an algorithm for the detection of visual symptoms of disease by the analysis of colored images. The algorithm was divided into four stages: (1) image pre-processing: to specify a suitable color transformation that best highlighted the diseased regions shown in the picture; (2) image enhancement: to develop a filter that could highlight those regions considered targets (possible diseased regions); (3) image segmentation: to identify regions in the image that were likely to qualify as diseased region; (4) image post-processing: to remove unwanted background regions.

[8] The paper identifies the BBTV (banana bunchy top infection), CMV (cucumber mosaic infection), BSV (banana streak infection) and BBMV (banana bract mosaic infection) are the four most essential infection sicknesses influencing bananas. Tragically, they are all present in the Asia and Pacific locale. This paper identifies the infected leaves using Economic Threshold Level (ETL) algorithm. It detects and prevents the banana streak viral disease using Embedded Linux development board interfaced with a camera. The algorithm sets pixel value of the healthy banana leaf as the threshold value. Then the pixel value of the given input image is calculated. If pixel value of input image is beyond the threshold value then the image is classified as disease affected. The accuracy of disease identification is somewhere around 81%-84% if the leaves are affected and 88% if the leaves are healthy and unaffected.

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III.PROPOSED SYSTEM

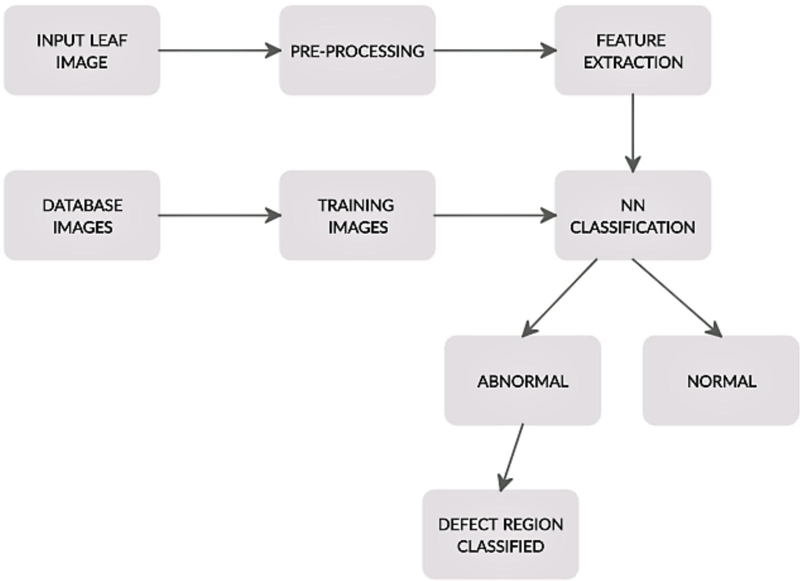

Figure 1: ML based banana leaf disease classification

As shown in above Figure 1 the proposed system has six major processes, which have been explained below briefly.

A. Image formation

Image formation, capturing the images of banana leaf is an initial step in disease analysis. Images of the leaves can be captured either as an entire region or as a fractal region based on the analysis.

B. Image processing

Image processingis a manipulation process performed on an image to provide enhanced information about the infected region in a leaf image information in an effective manner with proper visual understanding.

C. Image analysis

Image analysis is a method used for quantitative measurements and abstraction of information from an image. Methods like feature extraction, image segmentation, classification and measurements come under the category of image analysis.

D. Pattern classification

Pattern classification is used in the interpretation of extracted diseased region in an image to identify the type of disease infection in leaves. Classifiers make the process of interpretation in images easier and understandable.

E. Back Propagation Neural Network

Back Propagation Neural Network (BPNN) is a widely used self-training classifier in most of the applications related to image classification. BPNN is to adaptively build association between known pattern of input and specific output.

F. Support vector machine

Support vector machine (SVM) is one of the best suitable supervised learning methods used in automatic detection of disease due to its higher accuracy in disease identification.

G. Principal component analysis

Principal component analysis (PCA) is a classical statistical tool used in disease identification. PCA reduces the dimensionality in data by performing transformation.

IV. ANALYSIS

Paper	Methodology 1	Methodology 2	Methodology 3
[1]	MaP score:The mean average precision (mAP) was used as the validation metric for banana disease and pest detection.	Deep transfer learning (DTL) generates a fresh framework for digital image processing and predictive analytics, with greater accuracy.	Loss functionclassification is used to measure the model's confidence by classifying the pixels region delimitated by the bounding box and the localization loss measures the geometric distance between the predicted bounding box and the ground truth annotation.
[2]	The paper applies deep-learning technique to detect and classify the disease.	Makes use of LeNet architecture as a convolutional neural network to classify image data sets.	KNN algorithm is used to identify the correct combination of the components to validate the disease.
[3]	Fusion of close range hyperspectral (HS) image and high-resolution (HR) visible RGB image for	Decorrelates the original low-resolution HS image into PCA domain, and separates the information	Applies the joint bilateral filter to transfer the textural structures of HR RGB image to low-resolution HS image

	potential disease detection.	content from the noise.	and obtain an enhanced HS image.
[4]	System accepts both RGB and greyscale images. The paper applies deep-learning technique to detect and classify the disease.	Makes use of LeNet architecture as a convolutional neural network to classify image data sets.	Identifies only two prominent banana diseases namely banana sigatoka and banana speckle.
[5]	Image processing techniques are employed to enhance the quality of images. Besides, the proposed work uses Artificial Neural Network to classify the Banana plant diseases.	This system involves dataset creation, image pre-processing,Histogram of Template feature extraction.	Developed using the MATLAB application.
[6]	Diseases are classified using Multi layered Support Vector Machine. That is, it detects whether the disease is Black sigatoka disease or Panama wilt disease.	The grade of the disease has to be determined from PI to detect the disease. Fuzzy Logic has been employed for this purpose.	SVM classifier will determine whether the leaf is diseased or not. If the leaf is diseased, then calculate the AT (total area) and AD (diseased area). Once AT and AD are known, the percent-infection (PI) is calculated by using ANFIS Toolbox.
[7]	Image pre-processing: to specify a suitable color transformation that best highlighted the diseased regions shown in the picture.	Image enhancement: to develop a filter that could highlight those regions considered targets.	Image segmentation: to identify regions in the image that were likely to qualify as diseased region
[8]	This paper identifies the infected leaves using Economic Threshold Level (ETL) algorithm.	It detects and prevents the banana streak viral disease using Embedded Linux development board interfaced with a camera.	The algorithm sets pixel value of the healthy banana leaf as the threshold value. Then the pixel value of the given input image is calculated. If pixel value of input image is beyond the threshold value then the image is classified as disease

			affected.

V. CONCLUSION

Strategy of disease detection is effectively described and selecting the particular region out as per the human expert point of view. Thus, appropriate area of disease was able to identify out of the whole leaf by distinguishing the intensity. The next part of the implementation of the system was to classify diseases based upon the parameters of the affected region. These automatic machines implemented by various techniques help a farmer to identify the disease and hence he can think of the better way to reduce the diseases on his own rather than depending upon the human source which resulted in the better way of time efficiency.

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