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EARLY IDENTIFICATION AND EXTRACTION OF PESTS ON LEAVES USING SUPPORT VECTOR MACHINE

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Abstract
This project deals with a new type of early detection of pests system. Images of the leaves affected by pests are acquired by using a digital camera. The leaves with pest images are processed for getting a gray colored image and then using image segmentation, image classification techniques to detect pests on leaves. The image is transferred to the analysis algorithm to report the quality. The technique evolved in this system is both image processing and soft computing. The image processing technique is used to detect the pests and soft computing technique is used for doing this detection over a wide population. The images are acquired by using a digital camera of approximately 12 M-Pixel resolution in 24-bits color resolution. The images are then transferred to a PC and represented in MATLAB software. The RGB image is then segmented using blob like algorithm for segmentation of pests on leaves. The segmented leave part is now analyzed for estimating pest density in field. The Support Vector Machine classifier is used to classify the pest types. It is also implemented in FPGA kit by converting the MATLAB coding into HDL coder. In FPGA, the input image is downloaded to the memory. It reads the image from memory, process it and display the output image on monitor.

***Index Terms*: Blob like Segmentation, Classification, Early detection of pest, Image Processing, Support Vector Machine.**

I. INTRODUCTION

Agriculture is the backbone of India. Most of the scientists are doing research to increase the cultivity of crops. But one problem still exist which is a major concern of the cultivation of crop and that is crop pests. Due to these problems, the cultivation decreases and hence all the farmers and in turn the country suffers from lack of cultivation of crop. Different types of pesticides are there in market which are used to avoid the damage to fruit and vegetable, but the amount of pesticides to be used is not known due to which the cost as well as the environmental pollution gets affected. A strong demand now exists in many countries for non-chemical control methods for pests or diseases. Greenhouses are considered as biophysical systems with inputs, outputs and control process loops. Most of these control loops are automatized (e.g., climate and fertirrigation control). However no automatic methods are available which precisely and periodically detect the pests on plants. In fact, in production conditions, periodically observes plants and search for pests. This manual method is too time consuming. Diagnosis is a most difficult task to perform manually as it is a function of a number of parameters such as environment, nutrient, organism etc. With the recent advancement in image processing and pattern recognition techniques, it is possible to develop an autonomous system for pest classification. Early detection of pest or the initial presence of a bioagressor is a key-point for crop management. The detection of biological objects as small as such insects (dimensions are about 2mm) is a real challenge, especially when considering greenhouses dimensions (10– 100m long). For this purpose different measures are undertaken such as manual observation of plants. This method does not give accurate measures. Hence automatic detection is very much important for early detection of pests.

II. LITERATURE SURVEY

Earlier papers are describing to detect mainly pests like aphids, whiteflies, thrips, etc using various approaches suggesting the various implementation ways as illustrated and discussed below.[1] proposed an cognitive vision system that combines image processing, learning and knowledge-based techniques. They only detect mature stage of white fly and count the number of flies on single leaflet. They used 180 images as test dataset .among this images they tested 162 images and each image having 0 to 5 whitefly pest. They calculate false negative rate (FNR) and false positive rate (FPR) for test images with no whiteflies (class 1), at least one white fly (class 2) and for whole test set.[2] extend implementation of the image processing
algorithms and techniques to detect pests in controlled environment like greenhouse. Three kinds of typical features including size, morphological feature (shape of boundary), and color components were considered and investigated to identify the three kinds of adult insects, whiteflies, aphids and thrips. [13] Promote early pest detection in green houses based on video analysis. Their goal was to define a decision support system which handles a video camera data. They implemented algorithms for detection of only two bioagressors name as white flies and aphids. The system was able to detect low infestation stages by detecting eggs of white flies thus analyzing behavior of white flies.[21] proposed pest detection system including four steps name as color conversion, segmentation, reduction in noise and counting whiteflies. A distinct algorithm name as relative difference in pixel intensities (RDI) was proposed for detecting pest named as white fly affecting various leaves. The algorithm not only works for greenhouse based crops but also agricultural based crops as well. The algorithm was tested over 100 images of white fly pest with an accuracy of 96%. [5] proposed a new method of pest detection and positioning based on binocular stereo to get the location information of pest, which was used for guiding the robot to spray the pesticides automatically.[14] introduced contextual parameter tuning for adaptive image segmentation, that allows to efficiently tune algorithm parameters with respect to variations in leaf color and contrast. [4] Presents an automatic method for classification of the main agents that cause damages to soybean leaflets,i.e., beetles and caterpillars using SVM classifier.[12] proposed Back propagation neural network for recognition of leaves, diseases, pests.

III. OVERVIEW OF CLASSIFIERS

A software routine was written in MATLAB. In which training and testing performed via several neural network classifier. Texture Feature Classification Methods are as follows.

1. K-nearest neighbor: K-nearest neighbor classifier is used to calculate the minimum distance between the given point and other points to determine the given point belongs to which class. Goal is to computes the distance from the query sample to every training sample and selects the neighbor that is having minimum distance.

2. Radial basis function: A radial basis function (RBF) is a real-valued function whose value depends only on the distance from the origin. The normally used measuring norm is Euclidean distance. RBF's are the networks where the activation of hidden units is based on the distance between the input vector and a prototype vector .

3. Artificial neural networks: ANNs are popular machine learning algorithms that are in a wide use in recent years. Multilayer Perception (MLP) is the basic form of ANN that updates the weights through back propagation during the training[16]. There are other variations in neural networks, which are recently, became popular in texture classification *Probabilistic Neural Network (PNN):* It is derived from Radial Basis Function (RBF) network and it has parallel distributed processor that has a natural tendency for storing experiential knowledge. PNN is an implementation of a statistical algorithm called kernel discriminate analysis in which the operations are organized into a multilayered feed forward network having four layers viz. input layer, pattern layer, summation layer, and output layer.

Back propagation network: A typical BP network consists of three parts: input layer, hidden layer and output layer. Three parts in turn connect through the collection weight value between nodes. The largest characteristic of BP network is that network weight value reach expectations through the sum of error squares between the network output and the sample output, and then it continuously adjusted network structure's weight value. It is popular and extensively used for training feed forward networks. Also it has no inherent novelty detection, so it must be trained on known outcomes for training feed forward networks.

4. Support vector machine : SVM is a non-linear classifier, and is a newer trend in machine learning algorithm. SVM is popularly used in many pattern recognition problems including texture classification.

SVM is designed to work with only two classes. This is done by maximizing the margin from the hyper plane. The samples closest to the margin that were selected to determine the hyper plane is known as support vectors[12]. Multiclass classification is applicable and basically built up by various two class SVMs to solve the problem, either by using one-versus-all or one. Another feature is the kernel function that projects the non-linearly separable data from low-dimensional space to a space of higher dimension so that they may become separable in the higher dimensional space too.

IV. PROPOSED WORK

The proposed system is as shown in fig 1. It consist various stages including collection of images of agricultural pests for creation of database. Image segmentation is performed using clustering techniques. Features of segmented images are stored in database with respective image of agricultural pests. Using support vector machine classifier we would be finding out type of pest presents in image and give remedies to control it.

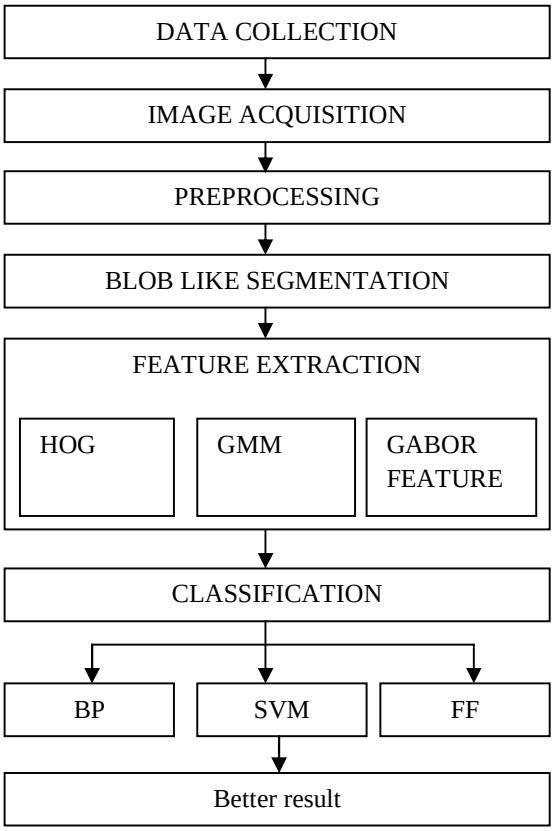

Figure 1: Flow Chart

A. Data Collection & Image Acquisition

The first step in the proposed approach is to capture the sample from the digital camera and extract the features. The sample is captured from the digital camera and the features are then stored in the database.

B.Image Preprocessing

Preprocessing images is used to removing low-frequency background noise. Normalizing the intensity of the individual particles of images. It enhance the visual appearance of images. Improve the manipulation of datasets. It is the technique of enhancing data images prior to computational processing.The caution is enhancement techniques can emphasize image artifacts, or even lead to a loss of information if not correctly used. The steps involved in preprocessing are to get an input image and then the image has to be enhanced. Then the RGB image is converted to an gray scale image to get an clear identification of pests on leaves. Noise removal function can be performed by using filtering techniques. Mean filtering: The 3x3 sub-region is scanned over the entire image. At each position the centre pixel is replaced by the average value. Median filtering: The 3x3 sub-region is scanned over the entire image. At each position the centre pixel is replaced by the median value.

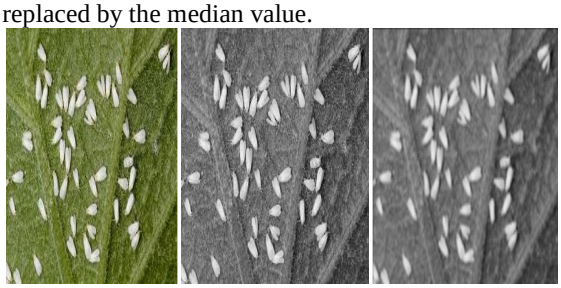

Figure 1.1: a)Input image Figure 1.2: b)Gray scale Figure 1.3: c)Mean filter

The PSNR value is calculated for both the mean and meadian filter.Based on the PSNR value one of the filtering image is taken for an further process. For mean filtering, the PSNR value is 23.78 and the PSNR value for median filtering is 12.89. The higher the PSNR, the better the quality of the compressed or reconstructed image. Therefore the mean filtering is taken for the further process.

C. Image Segmentation

Image segmentation in general is defined as a process of partitioning an image into homogenous groups such that each region is homogenous but the union of no two adjacent regions is homogenous.[11] Image segmentation is performed to separate the different regions with special significance in the image . These regions do not intersect each other. Blob detection helps to obtain Regions of Interest for further processing. It is applied for the presence of same type of objects in multiples. Segment the objects of interest (white flies) from the complex background (leaves).

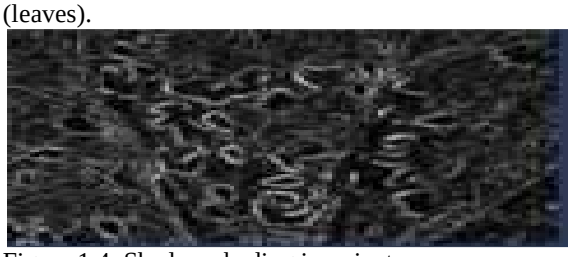

Figure 1.4: Shadow shading invariant

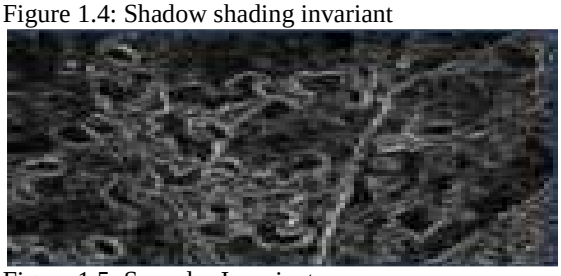

Figure 1.5: Specular Invariant

Figure 1.6: Shadow Shading Specular Invariant

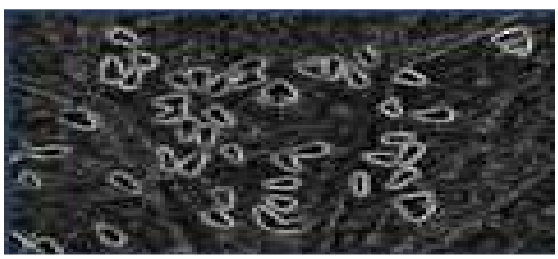

Figure 1.7: Shadow Shading Variant

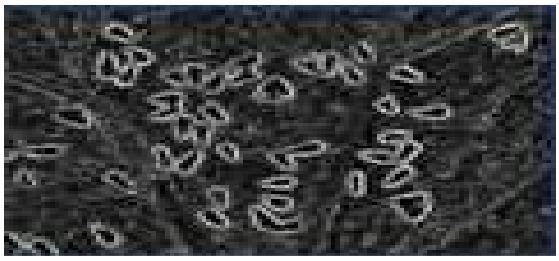

Figure 1.8: Shadow Shading Specular Variant

D. *Feature Extraction*

Image features usually include color, shape and texture features. Feature extraction is performed related to the Majority Based Voting method There are 3steps involved*:* 1) Histogram Oriented Gradient(HOG), 2) Gaussian Mixture Model (GMM), 3) Gabor Feature. HOG is the feature descriptors used for the purpose of object detection. Gaussian mixture model is used for the texture analysis. Gabor Feature is calculate the relationship between groups of two pixels in the original image. In this proposed work, the image can be sub divided into small block. Then in each block the three steps are involved. HOG is used for detecting the distribution of color ratio in an image. GMM used for the detection of shape of pests present in an image. Gabor feature can be used to find the orientation of pests. Finally, the feature values are fed as input to the classifiers.

E. Image Classifier

There are 3types of classifier are used to which classifier gives the better result. The back propagation and feed forward classifiers are not detecting a some pests in an image. But SVM gives better result. SVM is a non-linear classifier, and is a newer trend in machine learning algorithm. SVM is popularly used in many pattern recognition problems including texture classification. SVM is designed to work with only two classes. This is done by maximizing the margin from the hyper plane. The samples closest to the margin that were selected to determine the hyper plane is known as support vectors[12]. Multiclass classification is applicable and basically built up by various two class SVMs to solve the problem, either by using one-versus-all or one. Another feature is the kernel function that projects the non-linearly separable data from low-dimensional space to a space of higher dimension so that they may become separable in the higher dimensional space too. It is used to detect the pest on leaves and also gives information about a type of pests. It gives a result of number of pests are

presented. Then, it gives a remedy to take over for controlling a pest. Finally, the feature values are fed as input to the Support Vector Machine classifier, allow us to accurately distinguish the pests and leaves. This is an important step towards the identification of pests and to take the corresponding remedies.

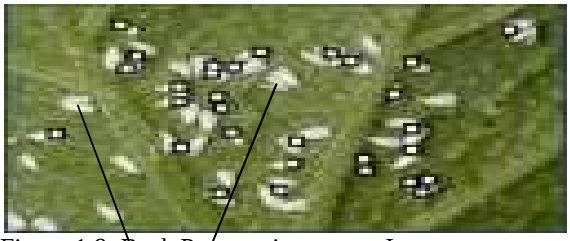

Figure 1.9: Back Propagation output Image

Not detect as pest

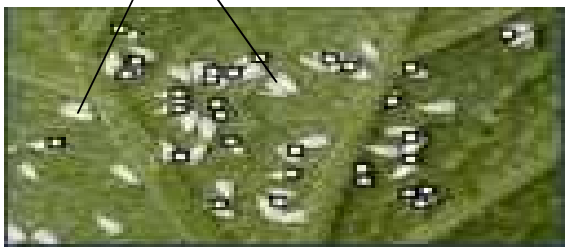

Figure 1.10: Feed Forward Output Image

Detect as pest

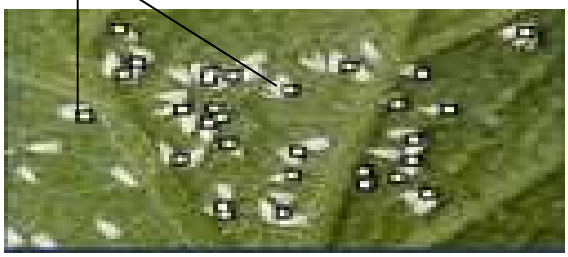

Figure 1.11 SVM output Image
Thus the SVM classifier gives the better result.

Figure 1.12 Pest Analysis
It gives the pest type, pest count, pesticide and its ratio are calculated and produced the result as above.

V. CONCLUSION

Early detection and extraction system was presented, different image processing techniques were used to detect and extract the pests in the captured image. The presented system is simple and yet efficient. It used background modeling to detect the presence of insect pests in the captured image, and a mean filter was used to remove the noise produced by different lighting conditions. The mechanism used to extract the detected objects from the image is simple by using blob like segmentation. Then different texture and colour features are extracted from the processed image. Finally, the feature values are fed as input to the Support Vector Machine classifier, allow us to accurately distinguish the pests and leaves. This is an important step towards the identification of pests and to take the corresponding remedies. In future, a single advanced technique which works in detecting the different types of pests. Also for this project work, the implementation process can be carried out using a FPGA kit. In FPGA, the input image is downloaded to the memory. It reads the image from memory, process it and displays the output image on monitor.

VI. EXPECTED RESULT

The objective result of this paper is to detect the pest type and gives the information about the pesticide for the related pests. The number of pests

on leaves will be counted. Reduce the costs and amount of pesticide used for crops. And also gives the mixture ratio of pesticide to be used in a field within a particular days. The discussion of the result shown as : Figure 1.1 is the captured image of leaves with pests. After gray scale conversion figure 1.2 is obtained, this is subjected to mean filtering. The filtered image is figure 1.3. To find the region of object, shadow shading invariant of the image is taken figure 1.4. Then the validity of detected regions as shadows is further verified by making use of specular invariant is got figure 1.5. The shadow shading invariant image and specular invariant image are combined to get figure 1.6. To extract the region of pest Shadow Shading Variant figure 1.7 and Shadow Shading Specular Variant figure 1.8 are obtained. Then the segmented image is given to classifiers and classified output image using Back Propagation figure 1.9 and Feed forward classifier output image as figure 1.10. The better result of output image is obtained by Support Vector Machine figure 1.11.

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