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Classification of Agricultural Pests Using DWT and Back Propagation Neural Networks

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***Abstract*— Plant pest identification and detection is vital for food security, quality of life and a stable agricultural economy. Enormous agricultural yield is lost every year, due to rapid infestation by pests and according to experts, minimum 10% of crop yield to pigeon pea crop is lost due to pod borer (Helicoverpa armigera) pest attacks. Various methodologies were proposed earlier for identification and detection of agriculture pests. Mostly work was done for identification of whitefly pest on sticky traps in greenhouse environments and in real fields. We propose a new approach which exposes advance computing technology that has been developed to help the farmer to identify agricultural pests and take proper decision about preventive or control measure of it. Diagnosis of agricultural pests in the field is very critical and difficult. In our proposed work, we would be capturing images of pests from various crops like cotton, pigeon pea, chickpea, etc. Agricultural pest which need to be extracted available in foreground and hence from an image foreground need to be separated. For this saliency map based segmentation will be carried out. After segmentation, various features of segmented pests will be extracted. Feature vector includes energy is calculated with the help of discrete wavelet transform. These features will be stored in database with name of pest. With the help of back propagation neural networks, we would be classifying type of pest and give preventive and control measures to user.**

***Keywords*— Agricultural pests, back propagation neural networks, saliency map, discrete wavelet transform, pod borer.**

I. INTRODUCTION

India is an agricultural country wherein most of the population depends on agriculture and agriculture is one of the major domains which decides economy of the nation. The quality & quantity of the agricultural production is affected by environmental parameters like rain, temperature & other weather parameters which are beyond control of human beings. Another major biological parameter which affects productivity of the crop is the pests, disease where human beings can have control to improve the productivity of crop [10]. The position of the any country in the world depends on its economy and the economy of most of the countries depends on agricultural production. In country like India the farmers have wide diversity to select their crop for cultivation to produce maximum yield depending on environment available. However there are certain issues with field crop like to identify deficiency of nutrition in plants, to identify various diseases, various pests which affects crops. Each issue has an importance. Among one is identification of pests in real field so that when symptoms of any pests take place on crops in fields, proper action should be taken to control it leading to minimize loss to farmer. For this farmers should have proper knowledge about pests so that correct action can be taken place. When any of such a condition occurs then farmers uses his experience or knowledge and also refers some guide books. If they aware about the pest ,then they can take correct action to control the situation but if farmers does not have correct knowledge, then misidentification of any pests can be possible and incorrect controls measure like non-affecting pesticides can be used leading to wasting of work and money and most importance it may lead to serious problem to crops. Otherwise they may approach to any agricultural experts who give them suggestion regarding detection of infected pests and the treatment of incidence of pest for their crop/plant in order to prevent and control crop and increase the crop productivity.

a) Sometimes they have to go long distances for approaching the expert
b) Even though they go such distances expert may not be available at that time
c) Sometimes, the expert whom a farmer contacts, may not be in a position to advise the farmer with the available information and knowledge.

To break or avoid this long procedure, some decision system need to be design so that easy approach can be use by farmers to solve the issue of detection of pest [3].Conventionally Manual pest monitoring techniques, sticky traps, black light traps are being utilized for pest monitoring[1].

Fig. 1 pod borer affecting chickpea crop.

Mostly there are commonly four stages of pest in their life cycle as eggs, larvae, pupa and adult stage. Out of which eggs and pupa stage is inactive stage means it does not affect the crops but larva and adult are active stages of pests which affects crops mostly. Hence identifying these two stages is most important to prevent yield loss.

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.[6] 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.[9] 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. [2] 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.[1] 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%. [7] 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.[15] 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.[14] proposed Back propagation neural network for recognition of leaves, diseases, pests.

III. PROPOSED WORK

The proposed system is as shown in fig 2. It consist various stages including collection of images of agricultural pests for creation of database. Image segmentation is performed using saliency map techniques. With the help of discrete wavelet transform, features of segmented images like energy of an image is extracted and these features 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.

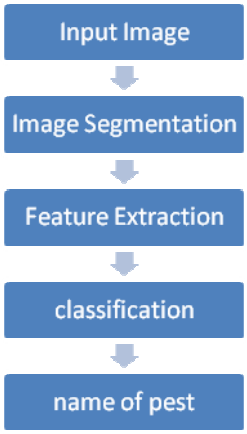

Fig. 1 Proposed approach for identification agricultural pests

A. *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 [16].image segmentation is performed to separate the different regions with special significance in the image . These regions do not intersect each other [21]. The purpose of the saliency map is to represent the conspicuity— or "saliency"—at every location in the visual field by a scalar quantity and to guide the selection of attended locations, based on the spatial distribution of saliency. A combination of the feature maps provides bottom-up input to the saliency map [19]. Using segmentation, we would be segmenting out pest image which is in the foreground. Segmented output will be given to feature extraction stage.

B. *Feature Extraction*

The feature is defined as a function of one or more measurements, each of which specifies some quantifiable property of an object, and is computed such that it quantifies some significant characteristics of the object. In image processing, image features usually included color, shape and texture features. We will be calculating energy of image as a feature vector using discrete wavelet transform. Discrete Wavelet Transform is a time/frequency analysis algorithm which has the characteristic of multi-resolution analysis. It not only analyzes signals in the time domain or frequency domain but in the combined domain with time and frequency so that the signal has a good frequency resolution in the low frequency sub-band and a good time resolution in the high frequency sub-band. Discrete Wavelet Transform for two-dimensional image is to perform multi-resolution decomposition for the image, which decomposes the image into the low frequency sub-band and the high frequency sub-band whose resolutions are different. The main energy of the image is accumulated in low frequency sub-band where records the feature information of the image.

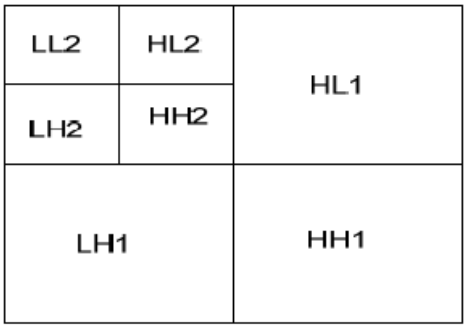

Fig. 2 2-level DWT transform for NxN.

Calculation formula of energy value of the low-frequency sub-band E is:

$$E = \frac{1}{N^2} \sum_{i=1}^{N} \sum_{j=1}^{N} X^2(i, j)$$

Where N denotes the low frequency sub-band size of color component after wavelet transformed, *X* (i, j) denotes the position coefficient of the low-frequency sub-band (i, j)[20].

This feature vector is stored in database with respective image of pests. Next stage will be classification stage.

C. Classification

With the help of Back Propagation Networks, we would be identifying type of pest which is present in image and give preventive as well as control measure to it. BP Network (Back Propagation Network) is called back propagation neural network. It can move to meet a given input / output relation from the direction of the organization neural network, the typical structure is shown in Figure 4.

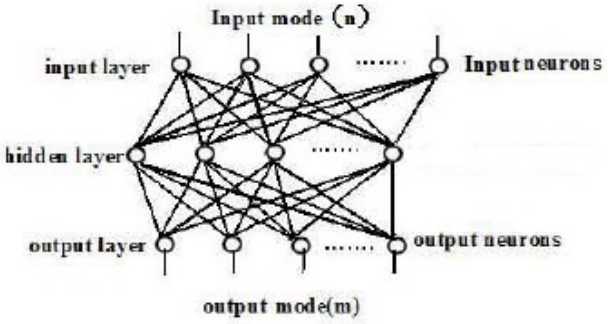

Fig. 4 Back propagation neural networks

A typical BP network consists of three parts: input layer, hidden layer and output layer. Three parts in turn connect through the Connection weight value between nodes. Three layers of BP neural network can accomplish any n to m dimension of mapping. The largest characteristic of BP network is that network weight value reach expectations through the sum of error squares of which between the network output and the sample output, and then it continuously adjust network structure's weight value [21].

IV. CONCLUSIONS

In this paper, with the help of image processing techniques likes image segmentation, feature extraction, classification; we will be identifying various agricultural pests on various crops. After identification particular pests, system would give preventive as well as control measures which help the farmers to take correct action to increase production.

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