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Identification of Agricultural Pests Using Radial Basis Function Neural Network

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ABSTRACT
The 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. Diagnosis of agricultural pests in the field is very critical and difficult. We propose a decision support system 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 on it. In our proposed work, we will collect images of pests from various fields. These images will be preprocessed for enhancement. Then segmentation will be carried out for extraction of pest from foreground of image. After segmentation, various features of pests including color and shape will be extracted. Using radial basis function neural network classifier, we would be identify name of pest and give preventive and control measures to farmer.

Keywords : Agricultural pests, decision support system, image segmentation, radial basis function neural network, gram pod borer.

I. INTRODUCTION

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 and India is one of them. In country like India, most of the population depends on agriculture and its related work. India with diversified agro-ecosystems responded spontaneously to the technologies of green revolution with introduction of several components in crop production like developing and adopting high yielding varieties, hybrids usage of new agro-chemicals and adoption of intensive crop cultivation techniques. The gains of green revolution in India reflected in the shape of production of million tons of food grains. But adding to the population explosion, there were frequent setbacks to crop production experienced in the shape of abiotic and biotic stresses during the last decades in several food crops.

In abiotic stresses includes rain, temperature, & other weather parameters which are beyond control of human beings which affects quality & quantity of the agricultural production. 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 periodical unabated explosions of aphids, whiteflies, bollworms, pod borers, hornworms etc., as direct crop damagers and disease transmitters in different regions of the country have made agriculture less remunerative and highly risk prone. Figure 1 shows gram pod borer affecting chick pea crop. Experts assessment reveal that around 22 per cent of yield losses in major crops like Rice, Cotton, Groundnut, Sugarcane, Sorghum, Tomato, Chillies, Mango, Grapes, etc., can be attributed to insect pests. Hence, there is need to reduce if not eliminate these losses by protecting the crops from different pests through appropriate techniques.

Figure 1. Gram pod borer affecting chickpea crop.

II. PREVIOUS WORK

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.[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.[13] proposed Back propagation neural network for recognition of leaves, diseases, pests.

III. PURPOSE

At present day the role of crop protection in agriculture is of great importance and a challenging process than before, as the so called resistant species should be brought under check. All other management practices of crop husbandry will be futile if the crop is not protected against the ravages of pests. In absence of crop protection the yields may be drastically declined. The entire effort of growing a crop will be defeated in absence of crop protection resulting in financial loss to the grower. So the crop protection against various pests is a must in agriculture. For taking action for crop protection against agricultural pests before that there is necessity for identification of agricultural pests.

It is extremely important that farmers should become familiar with the pests which occur in their fields. When symptoms of any agricultural pests occur on crops in fields, conventionally farmers uses his experiences or knowledge for identification of pests. If they aware about the pests ,then they can take correct action and 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. However they may approach to nearer agricultural experts for taking guidance for prevention or control measures of pests. But commonly they may face problems like they may have to go long distances for approaching experts, even though they go such long distances experts may not be available at that time, etc. 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 identification of pests [3].

IV. CONTRIBUTION

Our proposed methodology is aimed to develop a decision support system which identify various different agricultural pests and gives preventive or control measures to farmers leading to increase in crop production. The proposed methodology consists of several steps such as collection of agricultural pests samples from various fields for creation of database. After collection of sufficient images of agricultural pests further we will perform image segmentation for extraction of pests from input image. Then various features of segmented pest including color and shape will be calculated. Using radial basis function neural network classifier we would be finding out type of pest presents in image and give remedies to control it.

V. CONTENTS

In section I, we have given a brief introduction including nature of problem, previous work, purpose, contribution to the paper. In Section II, our decision support system having various stages described in details. In section III, we concluded our paper.

VI. PROPOSED WORK

The decision support system has various steps which are as follows.

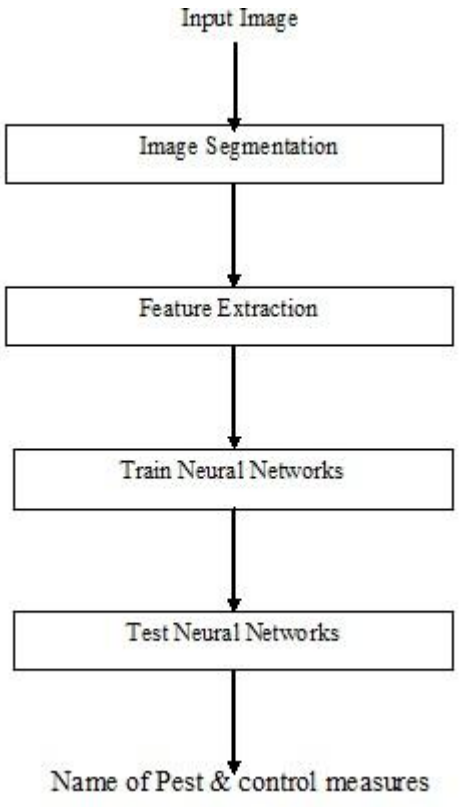

Figure 2. Proposed decision system

The proposed decision support system contain following steps as

- Image Segmentation
- Feature Extraction
- Train Neural Networks
- Test Neural Networks

VII. IMAGE SEGMENTATION

The Images of various pests like gram caterpillar on pigeon pea, green pod borer on chickpea, etc are collected from various fields with the help of mobile camera or Sony camera. 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 [15].image segmentation is performed to separate the different regions with special significance in the image. Using various thresholding technique, segmentation will be performed for extraction of pest from an input image which is available in the foreground.

VIII. FEATURE EXTRACTION

Good segmentation process leads to perfect features extraction process and the later play an important role in a successful recognition process. 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. In proposed system, we would extract color and shape features. The color feature is one of the most widely used visual features in image processing. Color features have many advantages like robustness, effectiveness, Implementation simplicity, Computational simplicity, Low storage requirements. Color descriptors of images can be global or local and color descriptors represented by color histograms, color moments, color coherence vectors or color correlograms [11]. Shape features includes length, width , aspect ratio, rectangularity, area ratio of convexity, perimeter ratio of convexity, sphericity, circularity and form factor, etc. after calculation of features ,this features were stored in database with corresponding the name of particular pest.

IX. TRAIN & TEST NEURAL NETWORKS

Feature vector obtained from the feature extraction step is used as the input of the classifier that recognizes the pest. Training and generalizing are the most basic and important properties of the neural networks. Hence ,Artificial neural network is used as the classification tool. Different network models exist for training the neural net and depending on the feature vectors, the best neural net training method is chosen.Radial Basis Function (RBF) neural networks are found to be very attractive for many engineering problems because (1) they are universal approximates, (2) they have a very compact topology and (3) their learning speed is very fast because of their locally tuned neurons. An important property of RBF neural networks is that they form a unifying link between many different research fields such as function approximation, regularization, noisy interpolation and pattern recognition. Therefore, RBF neural networks serve as an excellent candidate for pattern classification where attempts have been carried out to make the learning process in this type of classification faster than normally required for the multilayer feed forward neural networks [19]. In this paper, an RBF neural network is used as a classifier in pest identification where the inputs to the neural network are feature vectors derived from the proposed feature extraction technique described in previous section.

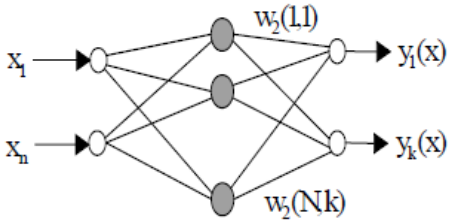

Figure 3. Radial basis function neural network

A RBFN is an artificial neural network that uses radial basis functions as activation functions. It is a linear combination of radial basis functions. The Basic architecture for a RBF is a 3-layers network, The input layer is simply fan-out layer and does no processing .The second or hidden layer performs a non-linear mapping from the input space into a higher dimensional space in which the patterns become linearly separable. The final layer performs a simple weighted sum with a linear output. RBFs networks where the activation of hidden units is based on the distance between the input vector and a prototype vector [21]. The training phase includes various features of different pests which was stored in database will be given as a input to classifier. After training phase was completed, the user will give an input to a classifier. The segmentation technique will be performed after that features of segmented pest will be calculated. These features were compared with stored features. Classifier will give the name of pests such that minimum distance between features of input image and stored image.

X. CONCLUSION

In this paper, we proposed a decision support system which identifies various agricultural pests on various crops with the help of radial basis function neural network. After identification particular pest, system would give preventive as well as control measures which help the farmers to take correct action to increase production.

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