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Early Detection and Classification of Pests Using Image Processing

Sreelakshmi M[1], Padmanayana[2]

2nd Year M.Tech, Srinivas Institute of Technology, India[1]

Associate Professor, Srinivas Institute of Technology, India[2]

Abstract: Early pest detection is a major challenge in agriculture field. The easiest way, to control the pest infection is the use of pesticides. But the excessisive use of pesticides are harmful to plants, animals as well as human beings. Integrated pest management combines biological and physical methods to prevent pest infection. The techniques of machine vision and digital image Processing are extensively applied to agricultural science and it have great perspective especially in the plant protection field, which ultimately leads to crops management. This paper 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 feature extraction, image classification techniques to detect pests on leaves. The images are acquired by using a digital camera . The images are then transferred to a PC and represented in MATLAB software. The RGB image is then converted into gray scale image and the feature extraction techniques are applied on that image. The Support Vector Machine classifier is used to classify the pest types.

Index Terms: Early pest detection, feature extraction, image processing, pests, SVM (Support Vector Machine).

I. INTRODUCTION

India is an agricultural country. 70 percent of the people mainly depends upon agriculture. So increasing the productivity of crops is an important matter now. Most of the scientists are doing their researches on this field. By using their new techniques and practical implementations this is very easy. But one of the most important problem now exists is 'pest infection' on plants. This paper mainly focuses on greenhouse crops. There are different crops cultivated under greenhouse. for example, vegetables like cucumber, potato, tomato etc and flower plants like rose, jasmine etc. The most common pests which will affect on this green house crops are whiteflies a, aphids and thrips.
One way to control the pest infection is by using the pesticides. Pesticides will suppress particular species of pests. Pesticides are detrimental for the environment and produce considerable damage to eco systems.

The excessicive use of pesticides will pollute air, water, and soil. Carried by the wind pesticides suspensions contaminate other areas. In this paper, we focus on early pest detection. This implies to regular observation the plants. Images are acquired using cameras. Then the acquired image has to be processed to interpret the image contents by image processing methods. The focus of this paper is on the interpretation of image for pest detection.

II. LITERATURE SURVEY

In this section we will discuss some methods which are presently used for the early detection of pests in greenhouse crops along with their advantages and disadvantages. The methods are explained below with their features and drawbacks.

A. Detection of Pests Using Video Analysis

This work combines image processing techniques as well as knowledge based technique[1] .It will detect only whiteflies. The resulst of this system are more reliable and accurate than that of the manual methods. This is actually a multidisciplinary cognitive vision system that combines different types of techniques like computer vision , artificial intelligence, image processing etc. In this work, they chose rose plant as the testing crop and white fly as the pest for testing. The early stage of detection was quite difficult. So they chose adult flies. But some problems were there in detection of adult also. The adult may fly away during the image capturing time. So they chose to scan the leaves of rose when flies were not active. The future scope of the work is to detect whiteflies in its early stage.

B. Method which use Sticky Traps.

The goal of Detection of insects by a video camera network[2] is to detect the pest infection on leaves by using a video analysis. The traditional methods will take more time to detect and count the pests. Because of this reason they have developed an automatic system based on video analysis. They used 5 wireless cameras in greenhouse. They chose rose as a crop for testing . sticky traps are used in this work. Sticky traps are nothing but a sticky material which is having some colours to attract the pests. For the detection of insects, they used video segmentation algorithms with learning and adaptation

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techniques. The adaptive system can be used in any weather conditions. The future scope of this system is to detect new types of pests in early stage.

III. PROPOSED METHOD

For this study, whiteflies and aphids are chosen because this pest requires early detection and treatment to prevent durable infection. Samples are collected by using the pan tilt camera with zoom in greenhouse as shown in Fig.1.The acquired Images are given to the local machine and the image processing techniques will takes place.

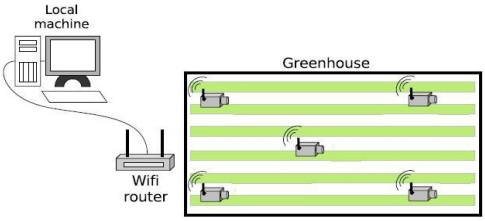

Fig. 1. Proposed System architecture

A. Methodology

1) Image capturing

The first step of every image processing application is image acquisition or image capturing. The images of leaves are captured by using the camera and it will store it in some formats like .PNG, .JPG, .JPEG etc.

2) Image pre-processing

Image preprocessing is used to create an enhanced and please full version of the captured image. The image preprocessing steps used in the system are: 1) Conversion of RGB image to gray image 2) Resizing of the image 3) Filtering of the image.

a) Conversion of RGB to Gray Image

In RGB color model, each color appears in its primary spectral components of red, green, and blue. The color of a pixel is made up of three components; red, green, and blue (RGB). The disadvantages of RGB models are, it requires large space to store and it will take more time to process. So there is a need for converting the RGB model to Gray model .

b) Resizing of the Image

Resizing is an important step in image preprocessing. The acquired image is resized according to the requirement of the system. Resizing of the image: Resizing is nothing but, changing the dimensions of an image.

The captured image is resized using some resizing methods according to the requirement of the system. There are different methods for the resizing of images. Blinear, Bicubic and Nearest neighborhood interpolation are the common resizing methods. Here in our system, we are using bicubic method.

c) Filtering of the image

Filtering is nothing but, eliminating the unwanted portion of the image. Different types of filters are available. Low pass filters are smoothening filters, it will pass only low frequency signals and eliminate all the high frequency signals. High pass filters are sharpening filters, and it will eliminate all the low frequency signals and pass only high frequency signals. Band pass filters will pass the signals which is having a specific range of frequencies. In our system we are using smoothening filter. The purpose of smoothing is to reduce noise and improve the visual quality of the image. Spatial filters are applied to both static and dynamic images, whereas temporal images are applied only to dynamic images. The simplest smoothening filter is average filter. It consists of a 3X3 matrix of 1 and it is divided by 9.

3) Feature Extraction

Feature extraction is the most important part of this project. Some properties of the images are considered here. The different types of properties includes region properties, gray covariance matrix properties etc. The properties standard deviation, entropy, contrast etc are extracted from the image and are used to train the dataset for the SVM classification. Support Vector Machines (SVM's) are a relatively new learning method used for binary classification. The basic idea is to find a hyper plane which separates the d-dimensional data perfectly into its two classes. The different types of properties of an image is listed in the table below.

TABLE I: PROPERTIES OF AN IMAGE

Mean	Returns the mean value of the elements along different parameters of an array
Standard Deviation	Computes the standard deviation of the values in matrix.
Contrast	Returns a measure of intensity contrast between pixels.
Energy	Returns the sum of squired elements in the glcm.
Filled Area	Scalar specifying the number of pixels in filled area

4. Detection and Classification

In this module the affected and unaffected images are compared by using the dataset provide in the SVM. If it is an affected image again it is compared by using the second dataset provided in the SVM.
From this comparison the type of pest can be detected

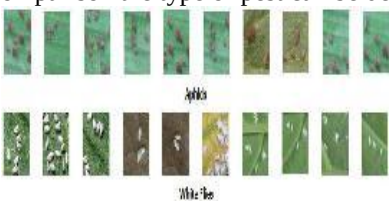

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Fig. 2. Database for classification

IV. FLOWCHART

Flowchart for the proposed system is given in figure 3. The images are acquired by using camera and it is filtered by using bicubic filters to avoid unwanted noise portions. This is actually the image preprocessing step. The next step is svm classification to detect the pest infection. If the image is affected, then again it is applied to the svm to detect the type of pest.

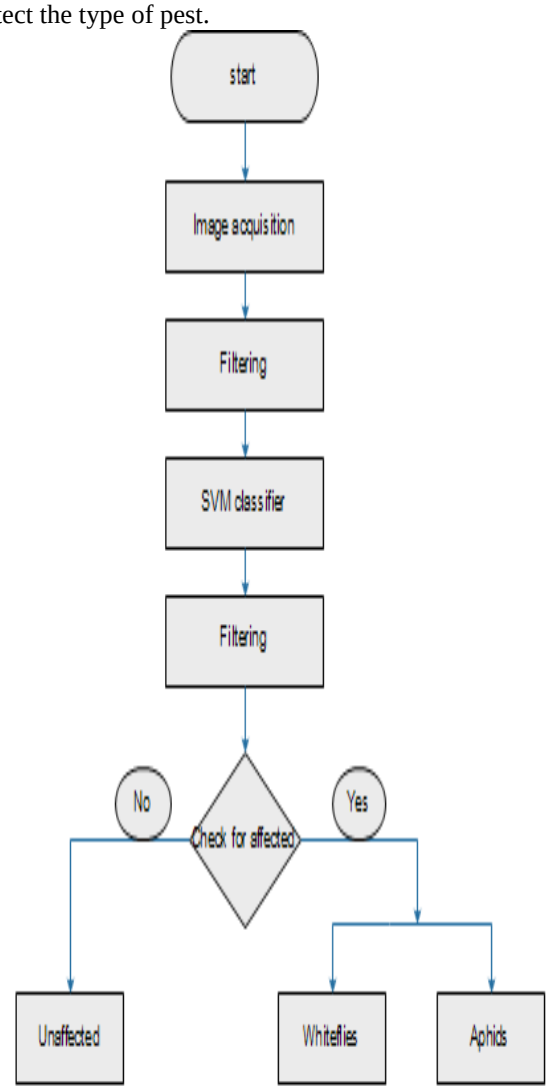

Fig. 3. Flowchart for the proposed method

V. RESULTS

The results obtained by performing the operations are shown below. The different parameters which are calculated for given data base are shown in table 2. The graph of the different parameters is also shown in fig. 4 and from the analysis of that we have decided to choose Standard deviation and contrast as deciding or classification factors. The graph shown in fig. 6 shows that the training to the SVM is done with 100% accuracy. We have divided it into two categories affected and unaffected. Here 1 represents unaffected and 0 represents affected. Also further the affected category is divided into two classes, aphids and whiteflies. For this classification we have used one more SVM classifier.

The different properties which decide that they are whiteflies or aphids are shown in table 3. The graph for different properties is shown in figure 5. Based on this the SVM is trained and input image of affected leaf is given to the second support vector machine which will generate the output as 1 or 0 based on the parameters of the input image. 1 is for aphids and 0 is for whiteflies.

TABLE II. DIFFERENT PARAMETERS

Parameters	Entropy	Mean	Standard deviation	Contrast	Correlation	Eccentricity
Unaffected Images	5.111022	128.9804	8.784494	0.099495	0.788207687	0.08005621
	5.704047	122.7276	13.36848	0.088384	0.817424865	0.0369198
	5.356719	119.6399	11.23865	0.065354	0.775523552	0.06858617
	4.956636	118.4778	7.785343	0.053232	0.666828028	0.08068627
	5.266736	107.8553	10.09207	0.06	0.661228997	0.24282954
	5.335025	99.7185	10.26094	0.094747	0.7433882	0.11856729
	4.750367	120.2329	6.788967	0.04899	0.759140928	0.05610738
	5.552168	118.4309	11.68626	0.063838	0.825014884	0.07377056
	4.706327	120.4082	6.939394	0.044646	0.774875913	0.06434045
Affected Images	5.169737	120.4206	19.33133	0.18697	0.713766094	0.10776177
	5.743359	124.3191	17.72068	0.100303	0.849842034	0.06283355
	5.849869	93.6361	16.42084	0.112828	0.841796732	0.18596007
	5.703574	125.1937	17.29079	0.123232	0.830376481	0.08401726
	5.826912	127.2926	17.94776	0.113232	0.844825531	0.05584843
	5.902958	126.3397	18.74501	0.105556	0.85344753	0.12640911
	6.084404	131.414	21.01807	0.128182	0.859443699	0.86873436
	5.825271	127.2334	17.8611	0.115051	0.841136478	0.08528723
	5.809195	126.9435	18.45275	0.120606	0.842934082	0.03635498
	5.336148	110.0158	13.31124	0.14101	0.816806901	0.05226187
	5.540607	136.7816	17.02995	0.123131	0.808520036	0.0907478

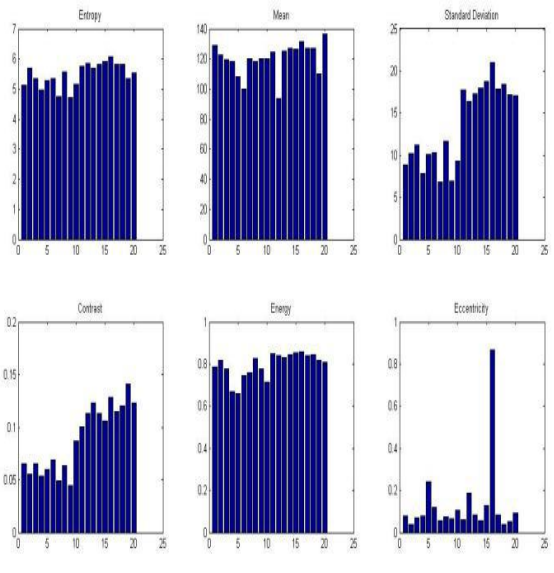

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Fig. 4. Graph of different parameters

TABLE III. DIFFERENT PARAMETERS FOR CLASSIFICATION

Parameters	Entropy	Standard Deviation	Contrast	Eccentricity	Euler's Number
Affected with Aphids	0.241974	0.1958067	0.040022	0.47946715	112
	0.241974	0.1958067	0.040789	0.303154	124
	0.244457	0.1970767	0.040899	0.5103298	115
	0.243465	0.1965699	0.040899	0.29788011	111
	0.241974	0.1958057	0.039912	0.47548961	109
	0.242968	0.1963159	0.041009	0.36370833	99
	0.24693	0.1983371	0.042105	0.56804004	84
	0.243465	0.1965699	0.041228	0.50649518	98
	0.243465	0.1965699	0.042544	0.3016139	113
	0.243961	0.1968235	0.041667	0.31537708	111
Affected with Whiteflies	0.327893	0.2377087	0.069956	0.51147809	76
	0.357723	0.251445	0.07182	0.418625	44
	0.305539	0.2271689	0.066667	0.45601103	63
	0.301057	0.2250285	0.060855	0.39285678	106
	0.285105	0.2173283	0.049452	0.39021232	110
	0.296089	0.2226441	0.064474	0.59140669	75
	0.28741	0.218449	0.056031	0.32758873	146
	0.280933	0.2152929	0.055811	0.54562806	178
	0.281398	0.2155203	0.055044	0.39666599	151
	0.275793	0.2127727	0.054167	0.50532207	160

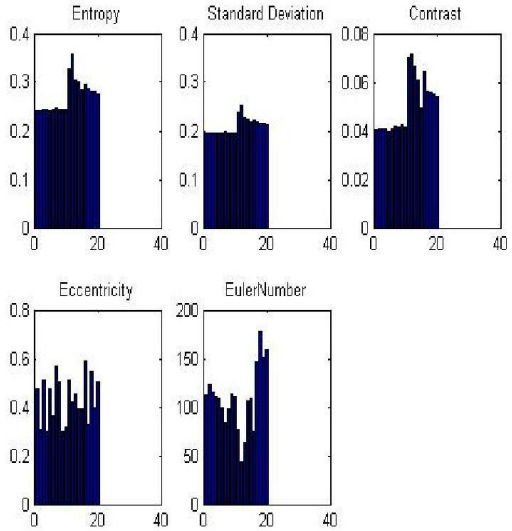

Fig. 5. Graph of different parameters

VI. CONCLUSION

Image processing technique plays an important role in the detection of the pests. Our first objective is to detect whiteflies, aphids and thrips on greenhouse crops. We propose a novel approach for early detection of pests. To detect objects we use pan tilt camera with zoom. So without disturbing the pests we are able to take the image. It illustrates the collaboration of complementary disciplines and techniques, which led to an automated, robust and versatile system. The prototype system proved reliable for rapid detection of pests. It is rather simple to use and exhibits the same performance level as a classical manual approach. Our goal is to detect the pests as early as possible and reduce the use of pesticides.

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