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Automatic Pesticides Spraying Robot using Machine Vision Technique

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Abstract: Early disease detection was a major challenge in agriculture field. Hence proper measures has to be taken to fight bioagressors of crops while minimizing the use of pesticides. Our goal is early detection of bioagressors and prevention. Various different pests including whiteflies, thrips, aphids, etc affect agricultural crops leading to decrease in production of yield. Images of the infected leaf are captured by a camera and processed using image processing techniques to detect presence of pests. Depending upon the pests robot will spray the pesticides. It is designed to minimize the human effort in addition to increasing the speed and accuracy of the work.

Key Words: Matlab, RGB, Machine Vision Technique, SVM.

I. INTRODUCTION

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. 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.

A. Proposed system

In agriculture, the opportunities for robot-enhanced productivity are immense and the robots are appearing on farms in various guises and in increasing numbers. We can expect the robots performing agriculture operations autonomously such as spraying. It is designed to minimize the labour of farmers in addition to increasing the speed and accuracy of the work. It uses machine vision technique for detection and classification of pests. It gradually appear advantages in agricultural production to increase productivity, improve application accuracy and enhance handling safety.

II. TECHNOLOGY OVERVIEW

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.

A. 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.

For this study, whitefly Trialeurodes vaporariorum was chosen because this bioagressor requires early detection and treatment to prevent durable infection. Eggs and larvae identification and counting by vision techniques are difficult because of critical dimension (eggs) and weak contrast between object and image background (larvae). Every image processing application always begins with image acquisition. The images are captured by using a camera with 20X zoom maintaining equal illumination to the object. All the images should be saved in the same format such as JPEG, TIF etc. The camera is interfaced with the system which will take the image captured by the camera as an input.

B. 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), described by their corresponding intensities. RGB color image require large space to store. In image processing we have to process the three different channels. It consumes large time. So we are going to convert the RGB image into gray scale image. The formula to covert RGB to gray is given below.

I(x, y) = 0.2989*R + 0.5870*G + 0.1140*B

The information retained by gray scale image is enough for our method so we convert RGB image to gray scale image for image processing.

C. Resizing of the Image

The acquired image is resized according to the requirement of the system. The different methods available for image resizing are Nearest-neighbor interpolation, bilinear, and bicubic. In Nearest-neighbor interpolation the output pixel is assigned the value of the pixel that the point falls within. No other pixels are considered. In bilinear interpolation the output pixel value is a weighted average of pixels in the nearest 2-by-2 neighborhood. In bicubic interpolation the output pixel value is a weighted average of pixels in the nearest 4-by-4 neighborhood. Here in our system we are using bicubic interpolation as it generates more accurate results than any other method.

D. Filtering of the image

Filtering in image processing is a process that cleans up appearances and allows for selective highlighting of specific information. A number of techniques are available and the best options can depend on the image and how it will be used. Both analog and digital image processing may require filtering to yield a usable and attractive end result. There are different types of filters such as low pass filters, high pass filters, median filters etc. The low pass filters are smoothening filters where as the high pass filters are sharpening filters.

E. Image segmentation

Image segmentation is the process of partitioning a digital image into multiple segments (sets of pixels, also known as super pixels). The goal of segmentation is to simplify and/or change the representation of an image into something that is more meaningful and easier to analyze. Image segmentation is typically used to locate objects and boundaries (lines, curves, etc.) in images. More precisely, image segmentation is the process of assigning a label to every pixel in an image such that pixels with the same label share certain characteristics.

F. 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.

Table 1. Parameter Definitions

Entropy	A scalar value representing the entropy of grayscale image I. Entropy is a statistical measure of randomness that can be used to characterize the texture of the input image. Entropy is defined as -sum(p.*log2(p))
Mean	Returns the mean values of the elements along different dimensions of an array
Standard deviation	computes the standard deviation of the values in matrix or array
Eccentricity	Scalar that specifies the eccentricity of the ellipse that has the same second-moments as the region.

Equation for different parameter:

Entropy=-sum(p.*log2(p)),

Here 'p' is a pixel value.

Mean=sum(image/(r*c))Here 'r' is the number of rows in matrix of a pixel. 'c' is the number of columns in matrix of a pixel.

Total Variance= sum(Totaldiff);Nele=(r*c)-1

Totaldiff=(mean)^2;

Standard deviation=square root(total variance)

G. Detection and Classification

Support Vector Machines is a classification system derived from statistical learning theory. The main idea of SVM is to find a decision surface (H) determined by certain points of the training set, termed as support vectors between two point classes. This surface divides the training data (x1, x2) without mistake, that is, all points of the same class are divided in the same side while the minimum distance between either of the two classes and this surface is maximal margin. This surface can be obtained from the solution of a problem of quadratic programming. Non-linear mapping function ϕ transform these data into a new function space. The equation is given as,

$$\phi\binom{x1}{x2} = \begin{cases} \begin{pmatrix} [\![6-x_1]+[x_1-x_2]^2 \\ [6-x2]+[x1-x2]^2 \end{pmatrix} & \text{if } \sqrt{{x_1}^2+{x_2}^2} \geq 2 \\ \binom{x1}{x2} & \text{otherwise} \end{cases}$$

This is used to find support vectors to classify two classes, then to select support vector (E). Then vectors are biased using a value 1.biased vector is represented by over tiled ($\tilde{E}_i$). Then consider the parameter same as support vector, α_i. using a linear equations is to find value of α_i.were i is the number of support vector chosen.

H. Output of classifier

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 Table 3. and from the analysis of that we have decided to choose Standard deviation and contrast as deciding or classification factors. The tables 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.

Table 2: Different Parameters Aphids or whiteflies

Parameters	Entropy	Mean	Standard deviation
Unaffected Images	5.111022	128.9804	8.784494
	5.704047	122.7276	13.36848
	5.356719	119.6399	11.23865
	4.956636	118.4778	7.785343
	5.266736	107.8553	10.09207
	5.335025	99.7185	10.26094
	4.750367	120.2329	6.788967
	5.552168	118.4309	11.68626
	4.706327	120.4082	6.939394
Affected Images	5.169737	120.4206	19.33133
	5.743359	124.3191	17.72068
	5.849869	93.6361	16.42084
	5.703574	125.1937	17.29079
	5.826912	127.2926	17.94776
	5.902958	126.3397	18.74501
	6.084404	131.414	21.01807
	5.825271	127.2334	17.8611
	5.809195	126.9435	18.45275
	5.336148	110.0158	13.31124
	5.540607	136.7816	17.02995

Parameters	Entropy	Standard Deviation
Affected with Aphids	0.241974	0.1958067
	0.241974	0.1958067
	0.244457	0.1970767
	0.243465	0.1965699
	0.241974	0.1958067
	0.242968	0.1963159
	0.24693	0.1983371
	0.243465	0.1965699
	0.243465	0.1965699
	0.243961	0.1968235
Affected with Whiteflies	0.327893	0.2377087
	0.357723	0.251445
	0.305539	0.2271689
	0.301057	0.2250285
	0.285105	0.2173283
	0.296089	0.2226441
	0.28741	0.218449
	0.280933	0.2152929
	0.281398	0.2155203
	0.275793	0.2127727

III. IMPLEMENTATION

In this section, detail description about the step by step procedure required to implementing this module working and also program is explained in terms of flowchart.

The below flow chart Fig 1. shows the detection and classification of pest.

When click on the start button in graphical user interface that time web camera will be open and capturing the image of the leaf is named as img1.

After taking the image it processed in matlab and it first converts into RGB to gray. Using syntax img2=rgb2gray(img1).

To remove the noise and then it converts binary in segmentation process.

It detect and classifies pest.Whether leaf is affected or not by looking the mean and entropy value. If mean value >= 161 and entropy <=5 then it display leaf is unaffected. If not there in that range then it display affected. Once pest will be identified then it determine which type of the pest is affected by looking the mean, entropy,standard deviation. If the mean value>=161, entropy>7.2 and the standard deviation>9 then leaf is affectd by the whiteflies. If the values are not in that range then leaf is affected by aphides.

A. Machine Vision Technique

The Machine Vision Technique (MVT) provides many functions that are useful in machine vision and vision-based control. It includes over 90 functions spanning operations such as image reading and writing, acquisition, display, ltering, blob, point and line feature extraction, mathematical morphology, homographies, visual Jacobians, camera calibration and color space conversion.

The Toolbox, combined with Matlab and a modern workstation computer, is a useful and convenient environment for investigation of machine vision algorithms. For modest image sizes the processing rate can be sufficiently realtime. to allow for closed-loop control. Focus of attention methods such as dynamic windowing (not provided) can be used to increase the processing rate. With input from a rewire or web camera (support provided) and output to a robot (not provided) it would be possible to implement a visual servo system entirely in Matlab.

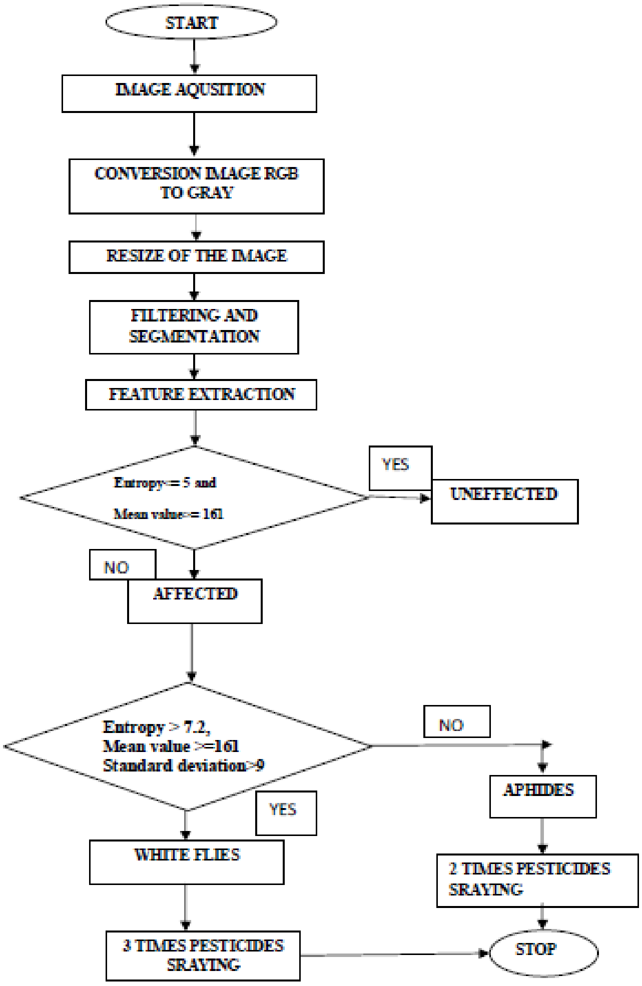

Fig 1. Flow chart of proposed system

IV. EXPERIMENTAL RESULTS

It contains all about the outcome of this project. All the result, findings and observations are noted down here so as to have a fair analysis as if our designed module is working in the desired manner or not.

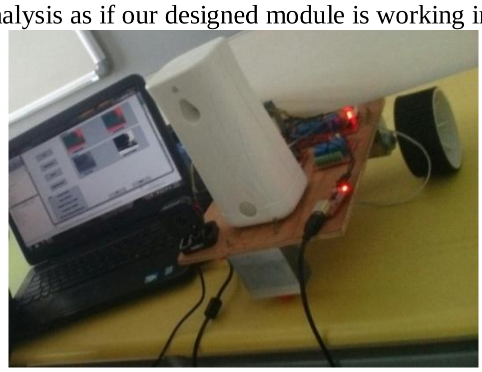

Fig 2. Complete system top view

Fig 2. Complete system top view

The forward movement of the robot. The 0110 combination showing the movement of the robot forward direction. Below Fig 3 and 4 shows the output of the leaf affected by aphides and whiteflies.

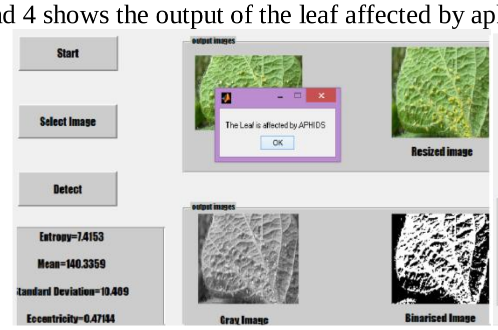

Fig 3: Output of the leaf affected by aphides

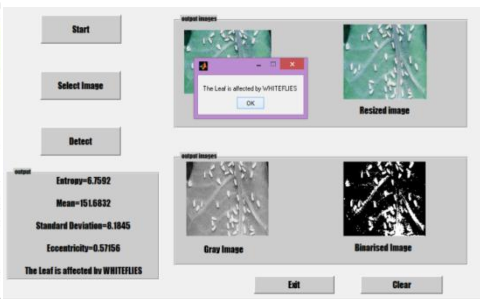

Fig 4: Output of the leaf affected by whiteflies

V. CONCLUSION AND FUTURE SCOPE

This paper has set out a vision of how aspects of crop production could be automated one. Although existing manned operations can be efficient over large areas there is a potential for reducing the scale of treatments with autonomous machines that may result in even higher efficiencies. The development process may be incremental but the overall concept requires a paradigm shift in the way we think about mechanization for crop production that is based more on plant needs and novel ways of meeting them rather than modifying existing techniques.

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.

REFERENCES

[1] Giacomelli G.A., and Ting K.C. (1995) \Transporta-tion and Robotics for Greenhouse Crop ProductionSystems", Acta Hort (ISHS), Vol 399, pp. 49-60.

[2] Gan-Mor S., Ronen B., Kazaz I., Josef S., Bilanki Y. (1997), \Guidance for Automatic Vehicle for Greenhouse Transportation", ACTA Horticulture, Vol 443, pp. 99-104.

[3] Michelini R. C., Razzoli R. P, Acaccia G. M, Mol¯no R. M., (1998), "Mobile Robots in greenhouse Cultivation: Inspection and Treatment of plants" ACTA Horticulture, Vol 453, pp52-60.

[4] IOSR Journal of Electronics and Communication Engineering (IOSR-JECE) e-ISSN: 2278- 2834,p- ISSN: 2278-8735. Volume 5, Issue 6 (Mar. - Apr. 2013), PP 57-63 “Detection and Classification of Pests in Greenhouse Using Image Processing” Rupesh G. Mundada, Dr. V. Gohokar.

[5] Bak, T. and Jakobsen, H. 2003, Agricultural Robotic Platform with Four Wheel Steering for Weed Detection. B systems Engineering 87 : 2125-136.

[6] Yi, Z., H. Y. Khing, C. C. Seng, and Z. X. Wei. 2000. Multi-ultrasonic sensor fusion for mobile robots. Proceedings of the IEEE on Intelligent Vehicles Symposiums, Dearborn, MI, Page(s): 387-391.

