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Image Processing Techniques for Pests Detection in Green House Crops

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***Abstract:** Pest detection and identification of diseases in agricultural crops is essential to ensure good productivity. The productivity of plants will reduce due to diseases and presence of pests. Image processing can be used to identify the pests and thereby can reduce the use of pesticides. Image processing involves capturing the image and applying various pre-processing techniques and detects the pest in the image. By using the classifier we can classify the pests and plant diseases. This paper presents the study of various image processing techniques and applications for pest identification and detection.*
***Keywords:** Image processing, Segmentation, Classification, Pest Detection*

I. INTRODUCTION

Agriculture is one of the most important sources for human sustenance on Earth. Not only does it provides the much necessary food for human existence and consumption but also plays a major vital role in the economy of the country. Several millions of dollars are spent worldwide for the safety of crops, agricultural produce and good, healthy yield. It is a matter of concern to safeguard crops from Bio-aggressors such as pests and insects, which otherwise lead to widespread damage and loss of crops. In a country such as India, approximately 18% of crop yield is lost due to pest attacks every year which is valued around 90,000 million rupees.

In a farmer's perspective, such initiatives would assist them in producing better yield and safeguarding their produce, thus improvising their lifestyles as well. However, even though such programmers exist, farmers continue to be plagued by three major areas of concern – inadequate water supply (irrigation), attack of crops by pests & insects and thirdly - failure in properly storing produce which in turn might be attacked by pests and rodents.

Over the past few years, a lot of research has been carried out to overcome the aforementioned problems. Usage of cloud seeding techniques and construction of barrages or dams near villages have reduced the water crisis to some extent.

Modern storage techniques which include utilizing rodent exterminators keep rodents at bay. But when it comes to prevention of pests or insects from attacking crops, the usual practice is to spray incessant amounts of pesticides. Though effective, this practice comes with its own set of disadvantages.

Excessive use of pesticide can lead to irreparable damage to the environment. Being at the top end of the food chain, this would also create hazardous health issues to humans, including birth defects. With respect to farmers, direct contact to these chemicals often lead to skin diseases and prolonged use might lead to cancer.

Manual pest monitoring techniques are time consuming and subjective to the availability of a human expert to detect the same. Sticky traps and black light traps are less effective and also prone to cause harm to environmental friendly insects. As a preventive measure farmers spray pesticides in bulk, which are detrimental and hazardous to the ecosystem.

In order to address these disadvantages, several pest detection and control methodologies exists in the literature which include image processing based pest identification and also video analysis for sticky traps. These two methodologies involve several complex image processing algorithms to achieve the same and are limited to a greenhouse environment. The setup consists of a camera being focused on a sticky trap. Images are captured whenever an insect comes into contact with the trap. An average of pests accumulated on the trap on a particular day gives us the density of pest population in the greenhouse. Remedial measures can be taken based on the density.

II. LITERATURE SURVEY

Paul Boissard et al.[1] Cognitive Technique, Knowledge based system, Filtering is done by Gaussian Blur. Cognitive vision system that combines image processing, learning knowledge based technique. System detects and counts whitefly at mature stage. The generic model is reusable. It cannot detect other whitefly stages (eggs, larvae). It cannot detect bioagressors (aphids). The improvement in the camerawork in the green house is required.

Sushma et al.[2] RDI Algorithm : It is based on relative intensity is applied on the pixel to identify weather the pixel belongs to background or it is part of whitefly. The 255 value represent whitefly and 0 represents background. It reduces the computational complexity. The pest detection not only in a green house but it is also extended in a farm. The algorithm utilizes only two subtractions and one comparison per pixel. Accuracy is 96% of whitefly detection. It cannot detect other whitefly stages (eggs, larvae).To restore the size of image dilation process is required. The generic knowledge based model is not present.

Rajalakshmi et al.[3] SVM is a machine learning algorithm and used in pattern recognition problems including texture classification. RGB image is segmented using blob algorithm. It detects the pest type and counts the whitefly on leaves. This information helps the farmer to reduce the cost and amount of pesticide used for crops. It cannot detect other whitefly stages (eggs, larvae). It cannot detect bioagressors (aphids). The improvement in the camerawork in the green house is required.

Sivasangari. A et al.[4] Pests detection using K means and fuzzy c means algorithm to find out accurate location of white fly. The performance of clustering is measured using consistence parameters like peak signal to noise ratio, normalized correlation coefficient, structural contents, average difference and normalized absolute error. K-means provides poor result in performance analysis. FCM consumes more time in performance analysis.

Thippeswamy G et al.[5] The first phase of the algorithm deals with the actual unripe tomato detection on the plant and latter phase of the algorithm concentrate on finding the borer insect. The algorithm is efficient than K-Means and PCA. Noise removal is performed by Erosion. Erosion causes even the edges of the tomatoes to disappear. To get unripe tomato, Dilation process is carried to image.

A Martin et al.[6] Extended Region growing algorithm has two methods they are: Region splitting , Region merging. The experiment provides the identification and counting is 90%. It cannot detect other whitefly stages (eggs, larvae). It cannot detect bioagressors (aphids). The improvement in the camerawork in the green house is required.

Yan Li Chunlei et al.[7] Multifractal analysis is a feasible methodology in identifying whiteflies (Genus Bemisia) from the leaf images compared to other methods, such as Watershed and EGBIS. Multifractal analysis with MF_MIN is the best option for the detection of small objects under variable light conditions. Considering the highly variable light conditions in greenhouses due to varying weather and time, dynamic processes are required to deal with variable image features both locally and globally. No counting technique is used.

Yao qing et al.[8] three layers methodology is used to detect and count white planthoppers on rice plant images to achieve up to 85% detection rate and 9% false detection rate. The three layers are: the first layer of detection is an AdaBoost classifier based on Haar features, the second layer of detection is the support vector machine classifier based on histogram of oriented gradient features, the third layer of detection is the threshold judgment of the three features.

Kannesh venugoban et al.[9] they have used gradient-based features using Bag-of-words method for 20 classes of paddy field insect pest from Google images and then classified using region of interest with SIFT descriptors, construction of codebooks which provides a way to map the descriptors into a fixed length vector in histograms using SVM. Then HOG descriptors were applied in classification.

Then combining HOG descriptors with SURF features yield 90% in classification.

Prabira K Sethy et al.[10] to classify pest of rice crop using SVM classifier and Bag-of-words method for 5 classes of rice crop were collected from Google images. SVM classifier detects the pest and the classification of the pest based on the three features color, shape (SIFT) and texture with 97.5%. K-means is used to construct a vocabulary with a set of words.

M.A. Ebrahimi et al.[11] to detect thrips on the crop canopy images using SVM classification on strawberry plant. SVM with difference kernel function was used for classification of parasites and detection of thrips. The ratio of major to minor diameter as region index with Hue, Saturation and Intensity as color indexes were utilized to design SVM structure. SVM with region index and intensity as color index make best classification with mean percent error of less than 2.25%.

Chunlei Xia et al.[12] an automatic pest identification method suitable for scale, long term monitoring for mobile embedded devices in situ with low computational cost.

Watershed algorithm was used to segment insects from the background images. Color feature of the insects were subsequently extracted by Mahalanobis distance for identification of pest species. Accuracy and computational costs were evaluated across different image resolutions. The resulting method gives the 0.943 for whitefly, 0.925 for thrips, 0.945 for aphids even with low resolution compared to conventional method.

In a greenhouse crop major difficulty is to deliver accurate pest detection with respective to different lighting. Different lighting may be due to weather conditions or earth rotation. Due to weather conditions, the image may change with color, intensity, contrast. There are many plants with many pests. High speed image processing on image classification and segmentation is really challenging and complex.

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Table 1. Summary of Segmentation techniques.

Technique	Description	Merits	Demerits
Thresholding method	The threshold value is computed using peak value of image histogram.	It is suitable for real life applications.	Image cannot guarantee that the segmented regions are contiguous.
Region based method	It works on the principle of homogeneity with the fact the adjacent pixels inside specific region flocks related characteristics and unrelated to the pixel in the other region.	Gives more accurate result compare to other methods.	It takes more computation time and memory.
Clustering method	Cluster an image into different parts based on the features of the image,	Computationally faster.	Poor worst-case behaviour.
Edge based method	Detect edge first and then segment regions. It is based on discontinuity detection in edges.	It works well for images with better contrast between regions.	It works poor images with more edges.

Table 2. Summary of Color techniques.

Method	Description	Merits	Demerits
RGB	It consists of three primary color red, green, blue with independent planes,	Suitable for display.	Highly correlative, not good for color image processing.
YUV	Chrominance components U and V carry the color information.	Less computational time.	Correlation exists but less than RGB.
HSV	It is Hue, Saturation and Value.	Accuracy is more.	Sensitivity to lighting variations is less.
L*a*b	Luminance and other two are chromaticity.	It can measure small color differences.	Singularity problem as other nonlinear transformation.

Table 3. Summary of Feature extraction techniques.

Method	Description	Merits	Demerits
Gray level co-occurrence matrix	Pixels are represented in matrix.	Feature vector length is small.	Many matrices to be computed.
Gabor filter	It is used to analyse frequency content in region interest.	It is multi resolution and multi-scale filter.	Computation cost is more.
Wavelets transform	It works better on frequency domain rather than spatial domain.	Best features with high frequency.	Complex and slow.

Table 4. Summary of Classification techniques.

Method	Merits	Demerits
K-nearest neighbour	Simple in implementation.	Computationally expensive.
Radial basis function	Trains dataset faster and easy to interpret hidden layer.	Computation is slow.
Probabilistic Neural networks	Tolerant of noisy inputs.	Training time is more.
Support vector machine	Less over fitting, robust to noise.	Computationally expensive.

III. CONCLUSION

This paper addresses how the pest detection is possible in agriculture field. In this survey different image processing techniques for pest detection are studied. Different image techniques are proved in machine vision system for agriculture fields. Various segmentation and classification methods are compared. The SVM classification gives better results in detection of pest in most cases. The SVM provides better execution time.

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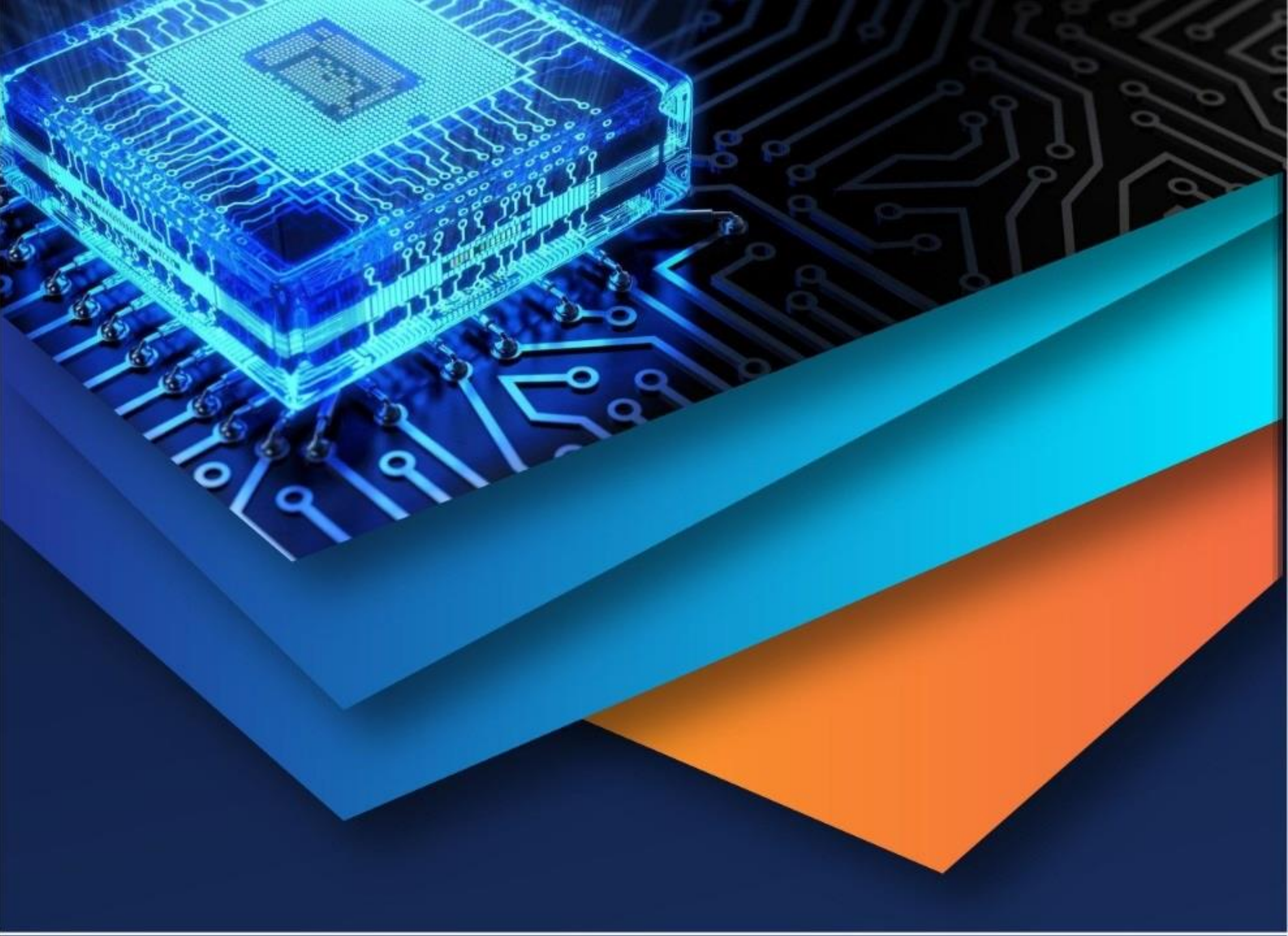

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