Pest Detection and Recognition in Rice Crop Using SVM in Approach of Bag-Of-Words

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***Abstract*—In Odisha Rice is synonymous with food; agriculture in Odisha to a considerable extent means growing Rice. Rice covers 69 % of cultivated area and is the major crop covering about 63% of total area under food grains. It is the staple food of almost entire population of Odisha; therefore the state economy is directly affected by the improvement in production and productivity in the State. In Agriculture in Odisha is aimed towards the increase of productivity and food quality at reduced expenditure and with increase profit. The technique of image processing is extensible applied to agriculture science and it has great prospective especially in the plant protection field, which alternatively leads to pest control. This paper offers a technique to classify pest of Rice crop using SVM classifier though the bag-of-word approach. Images of five classes of pest of Rice crop were collected from Google images and images provided in Manual for Rice Pest Surveillance provided by, Indian Council of Agricultural research.SVM classifier detects the pest and the classification of the pest based on the features with an accuracy of 97.5%.**

***Index Terms*—Image Processing, Rice Crop,SVM,Bag-of-Words, Pest Detection, Pest Recognition.**

I. INTRODUCTION

Research in Rice production is aimed towards the increase of productivity and food quality with less expenditure and having good profit, which is very important in recent time. A strong demand now exists in our country to control pest by applying less and proper pesticides. It is only possible when the farmer can able to identify the type of Pest. In fact, the farmer periodically visits the crop field to observe whether the crop is affected by the Pest or not. And also tries to identify the type of pest, so that proper pesticides can be applied. This traditional method is unreliable and time-consuming. The advancement of the image processing technique is used to identify and classify the Pest reliably with less time [1].

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Chandan K. Sahu et al. developed a prototype, for a fully automatic device for detecting insects using the camera and image-processing tool and counting the density of insects in a farm field [2].

There are different pests which are affected to the Rice Crop e.g Leaf Folder, Grass Hopper, Thirps, White flies and paddy stem borer [3].White flies and thrips are very small in size. Generally, the size of adult whitefly is 1/12 inch in length. The female of whitefly is sap-sucking pest may lay 150 eggs at the rate of 25 per day. The entire life cycle of whiteflies is 21-36 days [4].Thrips is tiny, slender pest about 1/25-inch long in length. They range in color from light brown to black. Thrips grows on flower plants and fruit plants [4].Leaf Folder has a wing expansion varying from about 4/5 inch to nearly 1 1/4 inches [5]. The color of the wings is very Light green, almost green, with a silvery or bluish iridescence. The forewings in both sexes have two nearly oval black spots. The hind wings of the male have one black bar in which the female is partly or completely divided into two spots. Both sexes have various amounts of white on the fringes of the wings and parts of the head, body, and legs [6]. Grasshoppers range in length from 19 to 38 mm. The differential grasshopper is basically brownish-yellow or olive green with contrasting black markings. The two-striped grasshopper is greenish-yellow with contrasting black or brown markings. It has two light color stripes which run from the head to the tips of the wings [7]. For effective cultivation, pest detection is very essential. Detection of the pest in leaves using SVM and blog segmentation is given very accurate result [8]. A major challenge in the agricultural field is the earlier detection of a pest. For detection of such pest tensors segmentation process has used. Finally, the extracted features have classified by neural network classifier [9]. The section II describes the literature survey and section III explains the material and methodologies and section IV describes the model description. At last conclusion of the paper in section V.

II. LITERATURE REVIEW

Kanesh Venugoban et al., the authors have used gradient-based features using Bag-of-words approach they had taken 20 classes of paddy field insect pests from Google Images and then classified by using the system that involves identification of region of interest and representation of those regions as SIFT descriptors, construction of codebooks which provides a way to map the descriptors into a fixed length vector in histograms using SVM. Then the histograms of oriented gradient descriptors were applied in classification [10]. The author claims that when HOG descriptor combined with SURF features yield 90% classification accuracy.

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Rupesh G. Mundada et al., the authors have used a prototype to detect whiteflies, aphids, and thrips on the affected crops in the greenhouse at their early stage. Images of the infected leaf are captured by a pan tilt camera with 20x zoom and pre-processed using image processing methods such as transforming images from RGB to gray scales, resizing and filtering in order to improve the visual quality of image [4]. In feature extraction, some properties of the image are considered. A variety of region properties and gray covariance matrix properties such as entropy, mean, standard deviation, contrast, energy, correlation and eccentricity are extracted from those images [11]. The classification was performed by the use of SVM. The authors' claim that the system proved rapid detection of pests and exhibits the same performance level as a classical manual approach. Faithpraise Fina et al., the authors have used a combination of the k-means clustering algorithm and the correspondence filter to accomplish pest detection and recognition [11]. The detection has done by extracting the different distinctive features between the pest and surrounding and used correspondence filter to identify the plant pests. These works further establish that the recognition probability from the pest image is directly proportional to the height of the output signal and inversely proportional to the viewing angles, which further confirmed that the recognition of plant pests is a function of their position and viewing angle. Saeed Azfar et al., the authors have used various crops with respect to their respective pest. Using both technical and non-technical method in addition to the wireless sensor network, pests have detected [12]. Thermal remote sensing technology is a non-destructive technique used to determine thermal properties of any objects of interest. This technology has grown into an important technology which has used for pest detection. For accurate detection of pest, this tool is one of the best tools among all detection and classification tools [13].

Table 1.1

Analysis of various Algorithms

Authors and Year	Goal	Prototype
Kanesh Venugoban and Amirthalingam Ramanan	Detection and classification	Bag of words and SVM
Rupesh G. Mundada and Dr. V. V. Gohokar	Early stage detection and classification	SVM
Faithpraise Fina, Philip Birch, Rupert Young, J. Obu, Bassey Faithpraise and Chris Chatwin	Detection and classification	K-means clustering

It is encouraging to state that the corresponding filter can achieve rotational invariance of pests up to an angle of 360 degrees, which proves the effectiveness of the algorithm for the detection and recognition of plant pests. There are many existing methods that detect and identify different types of pests like whiteflies, aphids, thrips and borers. Whiteflies and aphids are detected on yellow sticky traps by Rupesh G. Mundada et al. Using pan tilt camera with zoom features. The features like eccentricity, color, mean, standard deviation etc, are extracted and given to the support vector machine (SVM) and these features are used for detecting and classifying whether the bio-aggressors are aphids or whiteflies. Pratibha et. al. Use digital image processing methods to detect borers on tomato plants. The system stores the image to a borer detection algorithm. RGB to gray scale image conversion takes place here. Image undergoes segmentation to detect or find the target area. The morphological operation is done by distinguishing the border and the tomato pixels so as to remove noise. The target object is extracted which is the borer. It also gives a count of the borers in the tomato. Chang-woo et. al. used three kinds of features including size, boundary shape, and color components were considered and investigated to identify the three kinds of adult insects, whiteflies, aphids, thrips and their average values for these features. Analysis of various algorithms is given in Table-1.1.

III. MATERIAL AND METHODOLOGY

A. System Overview

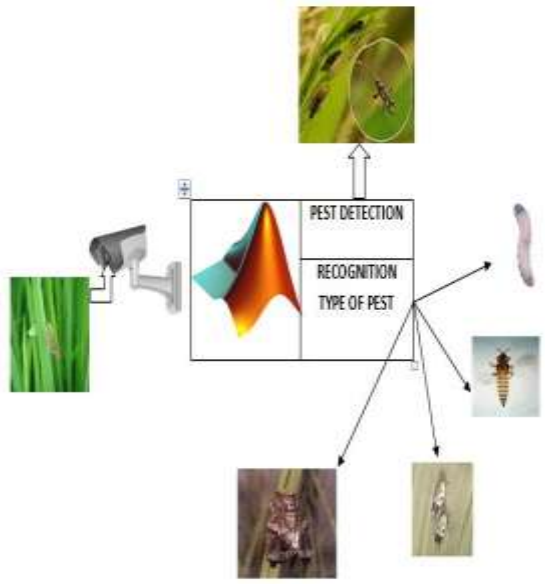

Fig. 1. Overview of System

B. *Data Set*

TABLE II

Pests	Images	Remarkable Features
Thrips		1/25 inch in length Texture-Yellowish black and Brown
White fly		1/12 inch in length Triangular in shape Texture-Yellow and White
Aphid		¼ inch in length Texture- White, Black, Brown, Gray, Yellow, Light green and pink. Pear-shaped bodies with long antennae
Stemborer		20 mm in length Texture-white and yellowish white
Green Grasshopper		19 to 38 mm in length. Texture-Brownish yellow and Olive green with black markings. It has two light color strings which run from head to wings.

C. *Frame work of Detection*

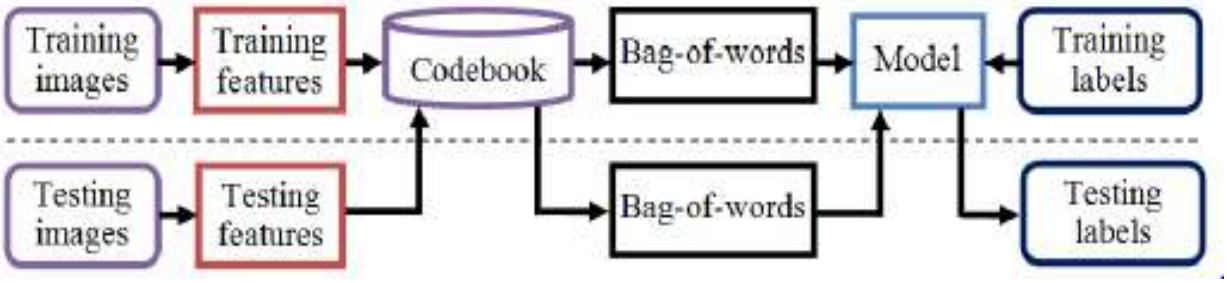

Fig. 2. System Frame Work

D. Block Diagram

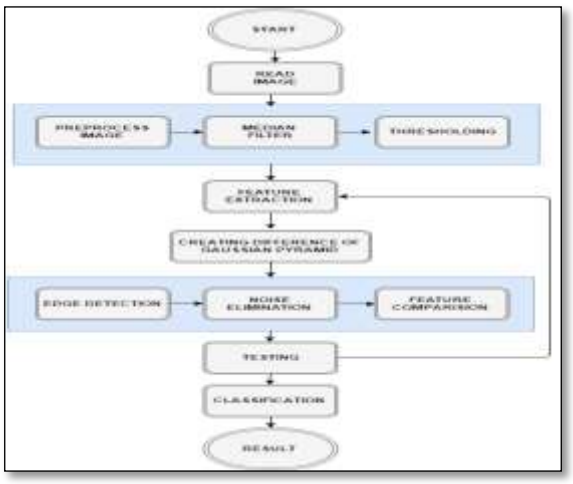

Fig. 3. Flow Chart for Pest Detection and Recognition

IV. MODEL DESCRIPTION

A. Image Acquisition

Acquisition of image, in image processing, can be broadly defined as the action of retrieving images from some sources by using any conventional RGB camera, so it can be passed through whatever processes need to occur afterward. Acquisition of image, in image processing, is always the initial step in the algorithm sequence. The image that is acquired is completely in unprocessed form and is the result of whatever software was used to generate it, which can be very important in some fields to have a consistent baseline from which to work. The ultimate aim of this process is to have such source of input that processes within such controlled and measured guidelines that the same image can process successfully by using different methodology.

B. Contrast Enhancement

There is a strong influence of contrast ratio on resolving energy and detection capability of images. Various techniques for improving image contrast are there. Contrast enhancement is one of the effective techniques among them. In this process, it is important to utilize the entire brightness range of the display medium.

C. Thresholding

Thresholding of image is a simple way of partitioning an image into its foreground and background. This analysis technique is a type of image segmentation that isolates objects by converting gray scale images into binary images. Image thresholding is most accurate and effective technique in images with high levels of contrast.

D. Feature Extraction

This is an effective technique, which is basically used in computer vision method to detect and describe local features in an image. In SIFT method, objects are first extracted from a set of reference images and have stored in a database which has already created. An object is identified in a new image by individually comparing each feature with the new image to the database and finding required matching features. The subsets of key points that agree on the objects and its location, scale, and orientation in the new image are identified to filter out good matches.

E. Edge Detection

Detection of an edge in image processing method is to find the boundaries of objects within images. Edge detection process is basically used for image segmentation. In the proposed work median filter has used for edge detection. The median filter is a non-linear filter technique, often used to remove noise. This work has done during the pre-processing of the image.

F. Gaussian Pyramid

The pyramid is a type of multi-dimension signal representation developed by the image processing, computer vision, and signal processing communities, in which an image is subject to repeated smoothing and sub sampling. In the Gaussian pyramid, subsequent images are weighted down using a Gaussian average and scaled down. Each pixel is containing a local average that is corresponding to a pixel neighborhood on a lower level of the pyramid. This technique is basically used for texture synthesis. In this case, the original image is convolved with a Gaussian kernel. Cut-off frequency can be controlled using the parameter.

The Gaussian pyramid on the image I is denoted as:

$$G_0(x, y) = I \tag{1}$$

$$G_{i+1}(x, y) = REDUCE\big(G_i(x, y)\big) \tag{2}$$

The Gaussian kernel is defined by:

$$\omega(r, c) = \omega(r)\ \omega(c) \tag{3}$$

G. Feature Comparison

Feature comparison process has done by comparing the features i.e. SIFT with the clustering feature. This comparison is very effective to get the best result.

H. Testing

This is a common concept in machine learning testing consists in the testing prediction of the relation on another part of the dataset. In the classification process, the test image can compare the training image to get the result.

I. Classification

1) Bag-of-words model:

The proposed methodology has used 'Bag-of-words' model to classify various insects. We combine this with the use of maximally stable color region (MSCR) features. The methodology is well established in detection and tracking of pedestrians and here we explore its potential to evaluate the need for many different shapes and size of templates to detect our highly variable insect's shapes.

2) Feature Extraction:

To determine whether an insect is present in a support window, we describe the window using two different features sets: MSCR features and texture features obtained by local rang filters. An MSCR feature set is a set of descriptors of colored in a window. These are found using MSCR detector.

3) Bag-of-words(BOW)frequency distribution:

In this case a set of insects images by creating an insect vocabulary, using three different vocabularies for color, shape (SIFT features) and texture. K-MEANS has used to construct a vocabulary with a set of 'words' to represent the MSCR features and similarly for the local range features.

4) SVM classifier:

Finally, a support vector machine (SVM) classifier was used on all the frequency distributions of the train data to represent the insects. In effect, the BOW model represents each image by a frequency distribution of its visual vocabularies.

V. RESULT AND DISCUSSION

Detection and Recognition system was presented, SVM with Bag of Words approach were used to detect and classify the pests in the captured image and illustrate the training & test result in Table III.

TABLE III

TRAINING AND TESTING RESULT OF PROTOTYPE SYSTEM

Pest Samples	No. of images used for training	No. of images used for testing	No. of pest image recognized successfully	Accuracy
Green Grasshopper	32	10	10	100
Stem borer	32	14	10	100
Thirps	32	10	9	90
White fly	32	10	10	100
Aphids	32	12	10	100
Overall Accuracy				97.5

VI. CONCLUSION

The proposed prototype have the ability to detect and recognize five different type of pest present in Paddy crop, where 32 number of pest of each type are trained and tested 10 samples of Green Grasshopper, 14 samples of Stem borer, 10 samples of Thirps, 10 samples of white fly and 12 samples of Aphids and obtained an accuracy of 100% in detection and recognition of Green Grasshopper, Stem borer, Aphids, White fly and 90% for Thirps where the overall Accuracy is 97.5%.

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