INSECT SHAPE DETECTION AND CLASSIFICATION USING DIGITAL IMAGE PROCESSING

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Abstract: **Due to contagious pests and illnesses that have been hurting agricultural products recently, agriculture businesses all over the world have suffered productivity and financial losses. The agriculture industry has a lot of potential to meet the growing demand for food while also producing meals that are wholesome and nutritious. Farmers find it challenging to identify crop insects since pest attacks severely damage and reduce the quality of the produce. The early detection of agricultural insects by an autonomous insect identification system based on computer vision and data processing enables farmers to increase crop productivity. In order to clarify the morphologies of insects, computer image processing techniques are frequently employed to pre-process, divide, and extract features from crop pest images and then make use of the machine learning algorithm (KNN) in order to classify different crop pest. The current work has been implemented using MATLAB 2019b and the Image Analysis Toolbox.**

Keywords: ***crop pest, computer vision, machine learning, KNN***

1 INTRODUCTION

Infectious diseases and pests have been affecting agricultural crops in recent years, resulting in production losses and financial losses for the agricultural business around the world. The agriculture sector has enormous potential to meet rising food demands while also providing healthy and nutritious meals. Crop insect identification is a difficult undertaking for farmers because pest attacks ruin a large amount of the crop and decrease its quality an autonomous technique for identifying insects based on computer vision and signal processing yields quicker recognition of agricultural crop pests at early stage, enabling farmers to increase crop productivity. Throughout this study, digital image processing techniques are often used to perform pre-processing, segmentation, and extraction of features on crop pest photographs in order to interpret the shapes of insects. while using artificial neural networks and some other machine learning approaches (ANN), This insect shape detection approach functions effectively and yields correct results for crop pests with round (perfect circle), obovate(ovule), triangular, and rectangular shapes. After detection of various insect shapes the next is classification of the insects which is done with the help of machine learning algorithm specially K-nearest neighbour algorithm (KNN).

Crop pests

The greatest variety of animals on earth can be found in insects. Crop pest (Insects) can be discovered in any surroundings, including wetlands, rainforests, and steppes, and sometimes also in incredibly brutal conditions like pools of petroleum, except from the open sea. Insects are considered as the most adaptive form of life since they dominate all other animal species by a wide margin. The majority of insects play significant role in maintaining both the human health and the environs. some insect represents a major threat not only to the plants but also a major threat to human health. Crop pests, such as seed eaters, herbivores, and diseases (including insects, fungi, germs, and viruses), in the worst-case circumstances, may result in decreased productivity or complete crop loss. Agricultural pests have the power to destroy entire crops intended to feed hundreds of people in addition to destroying gardens. Farmers fight a variety of pests every year to ensure the successful growth of their fruits, vegetables, and grains. In the agricultural sector, locusts are well-known. Large swarms of locusts can reach 460 square miles in size and destroy the plants all around them. The damage is terrible because they may eat their bodyweight in plants every day. In the United States, maize is a very important crop and corn rootworms have just recently become an issue for farmers due to their resistance to pesticides. There are 50,000–80,000 different insect species that fall under the umbrella term "true bug," although aphids and whiteflies are the most common genuine bugs. In addition to feeding on the sap of plants and weakening them (especially when these real bugs attack in huge numbers), these pests are also known to feed on the stalks and blooms of plants. Even while they are destructive on their own, they can also spread to plants deadly viruses and diseases that can further injure them.

Computer vision system

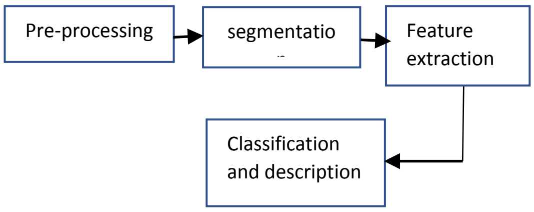


Fig. 1: Computer vision system for detection of crop insects

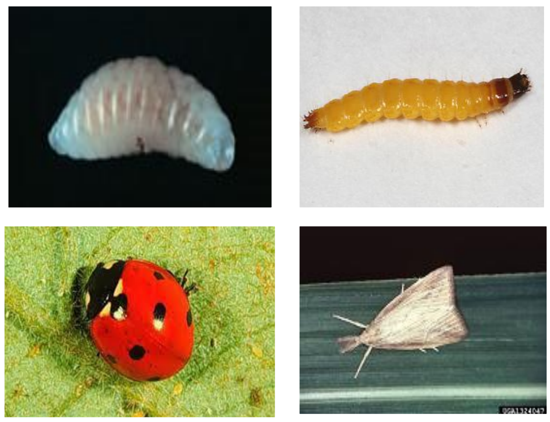
The proposed computer vision system is presented in Figure 1. An image is first pre-processed, which could include data representation that is obviously correct, enhancement, or restoration. After features are retrieved for breaking the image down into its constituent parts, such as separating various objects by removing their boundaries, which is basically a segmentation process, the a divided (segmented) picture is only sent to a classifier or an image understanding system. Image categorization is the process of grouping different regions in to one of the multiple objects, each bearing a label. To give the descriptions, an image identifying system creates links between the various items in a scene. Segmentation is a key component of computer vision systems since errors in this process have a tendency to slide up to more complex processes later on, making the task at hand more difficult.

2 LITRATURE SURVEY

In this research, the writers identified plant diseases and took into account those that affect both leaves and fruits. Uses computer - based picture analysis methods to quickly and thoroughly identify pest [1] This author concentrated on a technique to find areas of citrus leaves that were diseased. Citrus canker, anthracnose, overwatering, and citrus greening are the four different forms of citrus illnesses. Pre-processing, colour space conversion, Gray-Level Co-Occurrence Matrix are used Using the Gray-Level Co-Occurrence Matrix it is possible to extract features such as brightness, energies, uniformity, and entropy. The classification is done using the two (SVM) classifiers, SVMRBF and SVMPOLY [2]. The process used here identifies medicinal plants relying on their distinctive characteristics The grayscale version of the image is obtained from the input colour pictures. Calculate the border histogram from this grayscale image. To do this, use a clever edge detection technique. The suggested technique calculates the subsequent information, which is the area. In Ayurveda medications, the medicinal plants are utilized. It takes prior expertise to manually identify therapeutic herbs. The RGB colour spaces are used to create the colour histograms. This medical approach is helpful in the treatment of a number of persistent problems such as hyperglycaemia, malignancy, increased blood pressure, and skin disorders, etc. But because the specialists don't share their knowledge with others, the knowledge of these plants dies with the experts. As a result, it's essential to utilize the technologies and create a method for identifying and using medicinal plants based on their images. [3]. Pests in stored grain can be detected using spectral residual saliency detection as an edge detection technique. The edge of the pests is bright and obvious, so it can locate them with accuracy. It offers a new technique for detecting pests in stored grain and enhances the edge detection effect. [4]. In this study, researchers employed image processing methods to identify weed. The automatic sprayer will then get input from the regions where weeds were detected This is a robotic vehicle that only sprays weedicide in locations where weeds have been spotted [5].

3 DATASETS

Since this work is intended for all type crop insect detection the dataset on insects available in the https://images.bugwood.org/.http://www.nbair.res.in/database.php.andhttps://www.ipmimages.org/.Is considered here for detection and classification.



1.Braconid wasp's insect with size 182*192

2.Sward grass insect image with size 512*512

3. Lady bug insect image with size 512*512

4.suger cane borer image with size 512*512

Fig 2: different crop pest images

4. METHADOLOGY

The collected insect image dataset is further processed as below block diagram

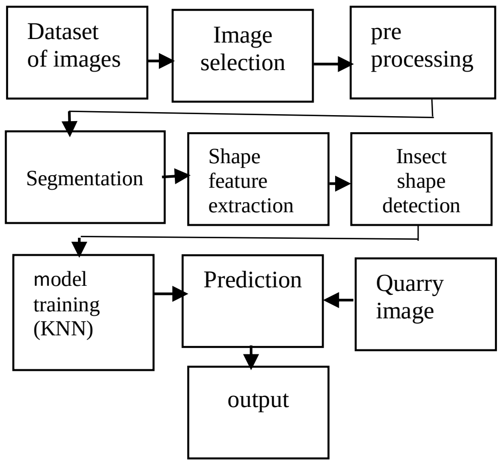


Fig3: block diagram of insect shape detection

Image Acquisition

Braconid wasp's is considered here for this automatic detection

Fig 4: braconid wasp's (click beetle) insect image of dimension 512*512

Pre-Processing

RGB TO GRAY CONVERSION: Grayscale image created by converting the original RGB insect image using the below mentioned equation; Greyscale intensity = 0.299R + 0.587G + 0.114B; where the letters R, G, and B stand for the colour red, green, and blue, respectively.

Fig 5: input image is converted into gray scale with size 512*512

BINARISATION (OTSU'S THRESHOLDING):

Automatic picture-based thresholding is achieved using Otsu's technique in field of computer vision and image processing. In its simplest form, the algorithm generates a single intensity threshold which categorizes pixels into two group, foreground and background. By maximizing the interclass variance or, equivalently, reducing the intraclass intensity variance, the threshold is established, here calculated threshold level is 0.4

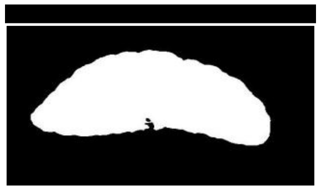


Fig 6: Binarized image (Otsu's thresholding)

Segmentation

The method of segmenting an image involves breaking it up into different regions. According to the present findings, Sobel operators outperform all other edge detectors in the agricultural sector when it comes to the recognition of different insect shapes. The Sobel edge operator is taken into account in this project work for insect shape detection in field crops since it only provides information about the continuous edge of an object.

Sobel edge detector techniques

The stages listed below are used in the Sobel edge detection method:

Step 1: Reading the insect image as input

Step 2: The masks Gx and Gy (gradient in x and y directions, respectively) are applied to the input pest image.

Step 3: It utilizes the gradient and Sobel edge detection technique.

Step 4: On the insect image, independent Gx, Gy mask alteration is carried out.

Step5: determine an image's gradient. $|G|=JG_x^{2}+G_y^{2}$, where Gx denotes a gradient in the x-direction and Gy denotes a gradient in the y-direction.

Step 6: The edges of the insect image are determined by the absolute magnitude.

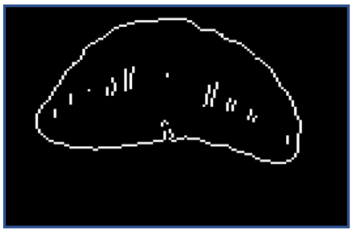


Fig 7: Image with Sobel edge detection

Shape Feature Extraction

The Eigen feature detector determines where an image's corners are located for the Eigen feature detector, each pixel will normally evaluate the picture gradient (G) in the x and y directions, which are Gx and Gy, and then the correlation matrix for each pixel is produced

$$M = \begin{pmatrix} G_x^2 & G_xG_y \\ G_xG_y & G_y^2 \end{pmatrix}$$

The response of every pixel can be calculated using a formula. R=min (λ1,λ2), The pixel could be seen as a corner point, only when the response is greater or larger than the threshold value. (corner =R>threshold).

Fig 9: corner detected insect image using detectmineigenfeature function

In computer vision, a local feature detector and descriptor known as Speeded Up Robust Features (SURF) is employed. It is capable of performing a variety of tasks, including object identification, picture registration, classification, and 3D reconstruction. interest points can be found by using SURF. The algorithm comprises two main components: identification of possible interest points, neighbourhood description, and matching.

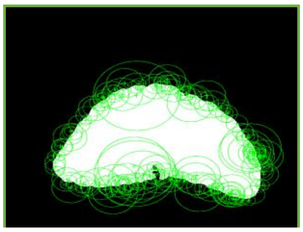


Fig 10: SURF feature extracted inect image

Table 1: SURF calculated features

Valid corners	153
orientation	153*1 single
location	153*2 single
Features	153*64

These retrieved features have been used to identify the various insect forms seen in agricultural.

Fig 11: rectangle shape is detected in a braconid wasp's insect image (click beetle)

K-NN classification

In this work for classification of different insect images the K-nearest neighbour (KNN) machine learning algorithm is selected. The "k-nearest neighbours" procedure, often known as KNN or k-NN, it is a supervised learning classifier that employs closeness to classify or predict how a single data point will be grouped in a non-parametric setting. Here in this work, we mainly define the three classes for insect classification as click beetle which belongs to class A, moth belongs to class B and sward grass which belongs to class C, and P_t in figure 12 is a new data point or quarry image to classify.

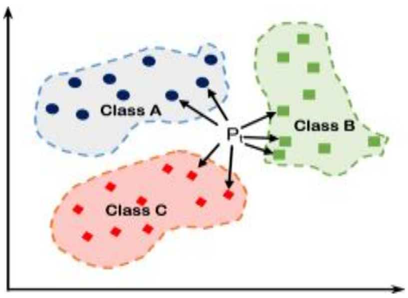


Fig 12: KNN diagram

Determining Distance Metric: Despite the fact that there are many different distance measures available, for this project we have used the Euclidean distance. the most used distance metric is the Euclidean distance (p=2), which can only be employed with real-valued vectors. The formula below is used to determine the straight-line distance between the query location and the other point being measured.

$$d(x, y) = \sqrt{\sum_{i=1}^{n} (x_i - y_i)^2}$$

Where d (x, y) is the distance.

DEFINING K VALUE: The k parameter in the k-NN technique specifies how many neighbours will be examined to determine a particular query point's classification. Here in this work, we select the k value as 3.

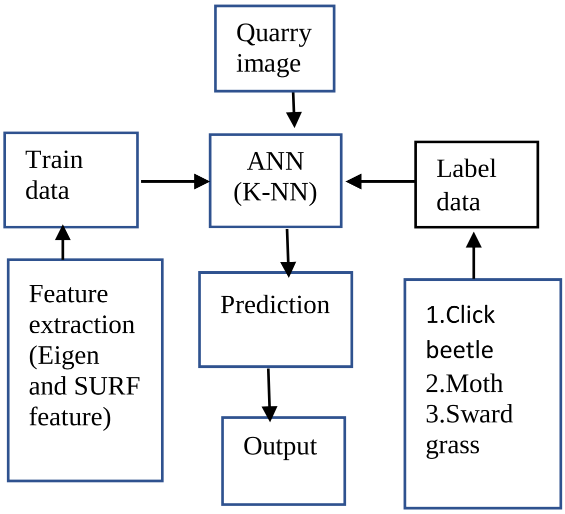


Fig 13: working model of KNN

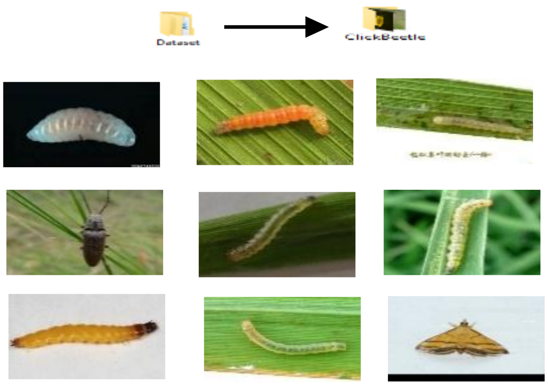


Fig 14: insects under click beetle class

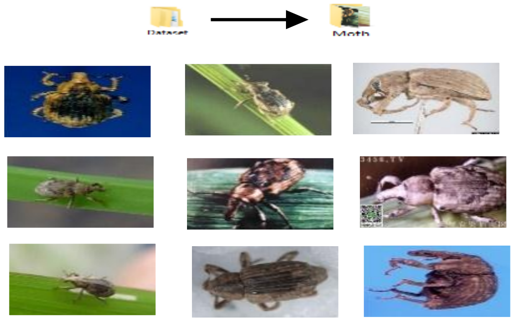


Fig 15: insects under moth class

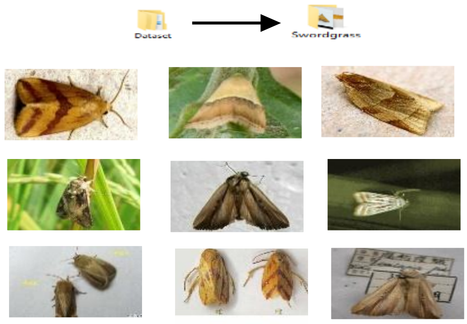


Fig 16: insects under sward grass class

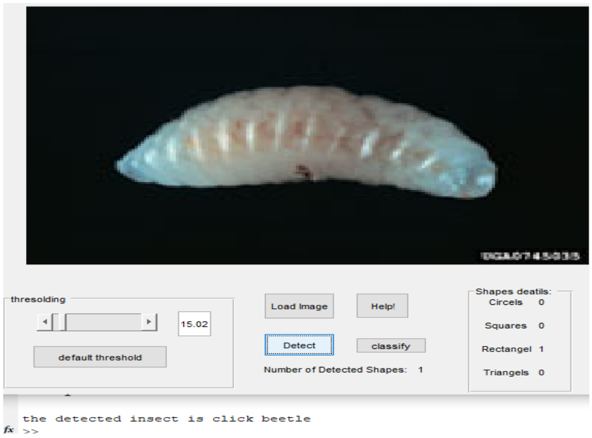
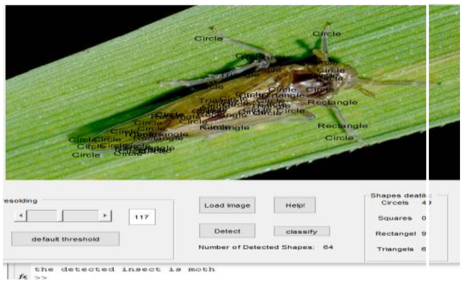


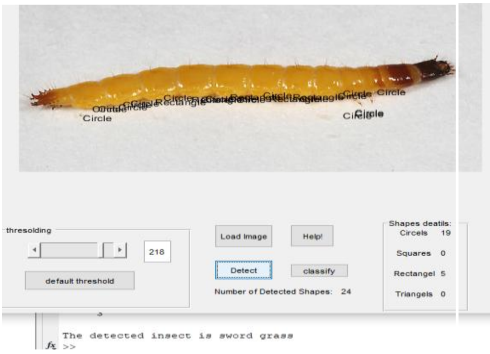
Fig 15: classification of insect image into click beetle class

5.RESULT AND DISCUSSION

During this project work, main concern is to detect the various shapes in a crop pest image and further classify these images based on their similar features. Here by selecting the one of the crop pest's images which is braconid wasp's insect image (click beetle) which undergo certain digital image processing techniques that help us to detect the shapes in the crop pest images, and further by making use of using machine learning techniques we are able to categorize the shapes detected insect image to one of the classes which it belongs to. Here mainly consider the three classes like click beetle, moth and sward grass the machine learning algorithm helps in classifying one the insect to either off the class the insect belongs. This model proves to work for all the crop pest images.



The detected insect is moth



The detected insect is sword grass

6. CONCLUSION

Insect detection at the early stage is considered as a challenging task for the formers in agriculture sector. The proposed work effectively detects the insect shape at the early stage by using different image processing technique like image reading and analysis of images, edge detection, extraction of features and training, later the detected shapes in an insect image are classified under different classes using machine learning and here classification model is developed using K-NN algorithm to classify the insect into three different classes. Different insect images were evaluated in this experiment, and it was discovered that they all performed well. This work contributes to environmental maintenance by reducing the cost and use of pesticides in agriculture and by offering an effective approach for crop pest shape recognition at the initial stages of crop development and insect classification, which leads to crop management.

REFERENCES

[1] Detection of plant leaf diseases using Image Processing First Author1, Second Author2, Third Author3 1Maria Margaret J (162MCA31) 2 Shyla J (162MCA33) 3Ms. Senthil Vadivu 1, 2 Student, Dept. of MCA, Jyoti Nivas College 3Asst prof, Dept. of MCA, Jyoti Nivas College).

[2] Unhealthy region of citrus leaf detection using image processing techniques Article · April 2015 DOI: 10.1109/I2CT.2014.7092035

[3] Identifying Healthy and Infected Medicinal Plants Using Canny Edge Detection Algorithm and CBIR Vinita M. Tajane, Computer Science & Engineering, Rajiv Gandhi College of Engineering, Research & Technology Chandrapur, India, E-mail: vinitatajne@gmail.com. Prof. N.J.Janwe, Department of Computer Technology, Rajiv Gandhi College of Engineering, Research & Technology, Chandrapur, India, E-mail: Nitinj_janwe@yahoo.com.

[4] Method for pests detecting in stored grain based on spectral residual saliency edge detection a) College of Information Science and Engineering, Henan University of Technology, Zhengzhou 450001, China b) Key Laboratory of Grain Information Processing and Control, Henan University of Technology, Ministry of Education, Zhengzhou 450001, China c) Henan Academy of Science, Applied Physics Institute Co., Ltd, Zhengzhou 450001, China d) Luoyang Institute of Science and Technology, Department of Computer and Information Engineering, Luoyang 471000, China.

[5] Quality Monitoring System in Agriculture Using Image Processing Ranganatha Gowda L R Under Graduate BE student, SIET, Tumkur, Karnataka; Tel: 8105108424 Email: ranganathgowda6@gmail.com.

[6] C.H. Chen, Pattern Recognition and Computer Vision, World Scientific, USA, 1993.F.J. Leong, A.S. Leong, "Digital Imaging Applications in Anatomic Pathology", Advances in Anatomic Pathology", vol. 10, pp. 88–95, March 2003.

[7] P. Arena, A. Basil, M. Bucolo, L. Fortuna, "Image processing for medical diagnosis using CNN", Nuclear Instruments and Methods in Physics Research, vol. A 497, pp. 174–178, January 2003.

[8] Bussard, V. Martin, S. Moisan, “A cognitive vision approach to early pest detection in greenhouse crops”, Computers and electronics in agriculture, vol. 62, pp.81–93, July 2008.