Identification of Insects using Support Vector Machine

Dr. Sanket B. Kasturiwala[1], Dr. Devashree Marotkar[2]
[1]*Faculty, Department of Electronics & Telecommunication, G.H. Raisoni, Institute of Engineering and Technology, Nagpur, Maharashtra, India.*

[2]*HOD, Department of Electronics & Telecommunication, G.H. Raisoni, Institute of Engineering and Technology, Nagpur, Maharashtra, India.*

Abstract: *Plant diseases have caused major havoc as it can cause substantial diminution in both quality and quantity of agricultural products. It causes massive damage. It is estimated that in India, crop loss due to pests ranges from 10-30 percent a year, out of which 26% is due to the insect pests. We have proposed here a novel cloud based IoT technique to automatically identify the insect infesting the plant. We have particularly chosen the region of Vidarbha (Maharashtra, India) and insects associated with the crops of this region. It is an improvement in existing technology as it provides faster and more accurate solution. The developed scheme consists of 3 main phases. The first phase is training. The first stage is segmentation which uses saliency mapping, which is followed by Feature extraction. In feature extraction we extract component values of colourmap, texture map and edge map. Then the extracted values are then fed to the database for further comparison. Training is followed by Testing where we give the input to our program and test if it recognizes the object (in our case, insect). And the third and the last phase includes the introduction of server to upload images, hence making it accessible at any part ofe world at all times.*

Keywords: Plant diseases, cloud based IoT technique, saliency mapping.

1. INTRODUCTION

In India, agriculture is a primary sector that generates income for the country. India ranks second worldwide in farm outputs. As per 2018, agriculture employed more than 50 of the Indian work force and contributed 17–18% to country's GDP. India ranks first in the world with highest net cropped area followed by US and China. Thus, making agriculture digitization a priority. The changing agro-climatic conditions contributed largely to the infestation of various insect pests in different parts of the country. The naked eye observation of experts is the main approach adopted in practice for detection and identification of insects of plant. Automatic detection of insects is an essential research topic as it may prove benefits in monitoring large fields of crops, thereby preventing major losses due to delay in identification of infestations.

Figure 1: Infestation on plant

In our work, we address the problem related with the insect manifestation and how these insects have caused a huge havoc to the society and the farmers. There are numerous insects which cause infestation to the plant and plant could be dead within few days. So if these insects could be detected at an early stage, there would be minimum loss and maximum benefit, and we also know that prevention of insects can be done using insecticides so if these insects are detected at an early stage it will even minimize the use of insecticides. The device that could be a smartphone or a camera, which should have access to internet, which will then detect presence of insect and classify it accordingly. This will provide an aid to agricultural sector with technology to eliminate labor and wastage.

So, to study about insects and their properties and which insects to work on in the project, we have visited "Dr. Panjabrao Deshmukh Krishi Vidyapeeth (PDKV), Nagpur" Then we decided the insects to work on as in the region of Vidhrabha which is in the state of Maharashtra. These insects are Pink Cotton Bollworm, Stem Borer, Girdle Beetle and Mealy Bugs. To get more information about the insect which infest on cotton we have visited "Central Institute for Cotton Research (CICR), Nagpur".

2. Literature Survey

Many automated web development programs are also developed such as the automated bee identification system (ABIS), digital automated identification system (DAISY), identification, automated and web accessible (SPIDA) which are highly effective for controlled environment such as controlled lighting, green house environment etc., and small database projects. However, the features extracted were not sufficient anddetailed which will lead to the false alarm and most of these systems required manual manipulation.So, further image feature extraction algorithms are needed for precise recognition.

(Xie et al., 2015) proposed a larger dataset made by 1440 samples evenly divided into 24 classes of insect pests that infest crop. (Deng et al., 2018) proposed anovel dataset containing 563 images divided in 10 different classes. They trained a Support Vector Machine (SVM) on hand-crafted features to classify their dataset. Training support vector machines on hand-crafted features was the common approach, especially before the rise of deep learning and was still competitive on small datasets also after the advent of neural networks (Rani and Amsini, 2016). However, in recent years, CNNs outperformed every previous technique in tasks like image classification, image segmentation and object recognition, especially on large datasets.

An attempt to automatically classify pests using CNNs was made by (Daweiet al., 2019). The authors used a pretrained version of AlexNet (Krizhevsky, Sutskever

and Hinton, 2012) to classify a portion of the dataset used in (Deng et al., 2018) using transfer learning. In order to have a baseline comparison, they calculated the accuracy rateof six human experts on the same dataset. Their network managed to reach a higher accuracy than four of the six human experts. More recently, (Wu et al., 2019) collected and shared the IP102 dataset, which contains over 75000 pest images divided in 102 classes, providing a useful benchmark dataset for researchers. Their effort on the collection and labelling of such a large number of images shows the importance of having a high-performing automatic pest classifier. (Ren, Liu and Wu, 2019) trained different convolutional neural networks on this dataset and proposed their own architecture for theclassification.

Earlier papers are describing to detect mainly pests like aphids, whiteflies, thrips, etc using various approaches suggesting the various implementation ways as illustrated and discussed below. Proposed early pest detection in defect tomatoes plants and identifies the borer in it by using morphology segmentation technique.

3. Proposed Methodology

The proposed system is the technique for the detection of the presence of insect on the leaf or plant. First of all, the image of the insect which is being infested on the plantor leaf is clicked and uploaded to the server. After uploading the insect image, it is evaluated and detected (the name of the insect infested on the plant or leaf) using Digital Image Processing via MATLAB. The general concept, which is the framework for any image related algorithm of image classification is almost similar. First, the digital images in need of identification are uploaded on the server. Then image-processing algorithms are used on the acquired images to extract informative features that are necessary for further analysis. After that, several analytical discerning techniques are used to categorize the images according to the specific problem at hand.

3.1 Training: Image Segmentation using Image Saliency Mapping

Training is the feeding of the correct data or answers to the designed code or machine. The more the training the better is the results. Image segmentation is the process of partitioning a digital image into multiple segments(sets of pixels, also known as image objects). The goal of segmentation is to simplify and/or change the representation of an image into something that is more meaningful and easier to analyse. Image segmentation is typically used to locate objects and boundaries (lines, curves, etc.) in images.

It is also the process of assigning a label to every pixel in an image such that pixels with the same label share certain characteristics.

The result of image segmentation is a set of segments that collectively cover the entire image, or a set of contours extracted from the image. Each of the pixels in a region is similar with respect to some characteristic or computed property, such as colour, intensity, or texture. Adjacent regions are significantly different with respect to the same characteristic(s). Its not easy task to accurately detect and crop the entire salient object from images with complex background. So we use a deep learning strategy is adopted to train a large data-set of images, to get saliency map from the input image using edge-based segmentation and gray level adjustment to enhance and extract more accurate and clear saliency map.

Saliency methods identify the most relevant regions of an image. They are currently used in many computer vision tasks to have supervised information about which pixels are important for a given task. A saliency map is an image that shows each pixel's unique quality. The goal of a saliency map is to simplify and/or change the representation of an image into something that is more meaningful and easier to analyze.

Saliency maps are functions that take an image as an input and output those locations where the image has its most relevant features. It is usually made of three different steps: a linear feature extraction, the application of a nonlinearity (activation) to the extracted features, and, at last, the fusion of the features.

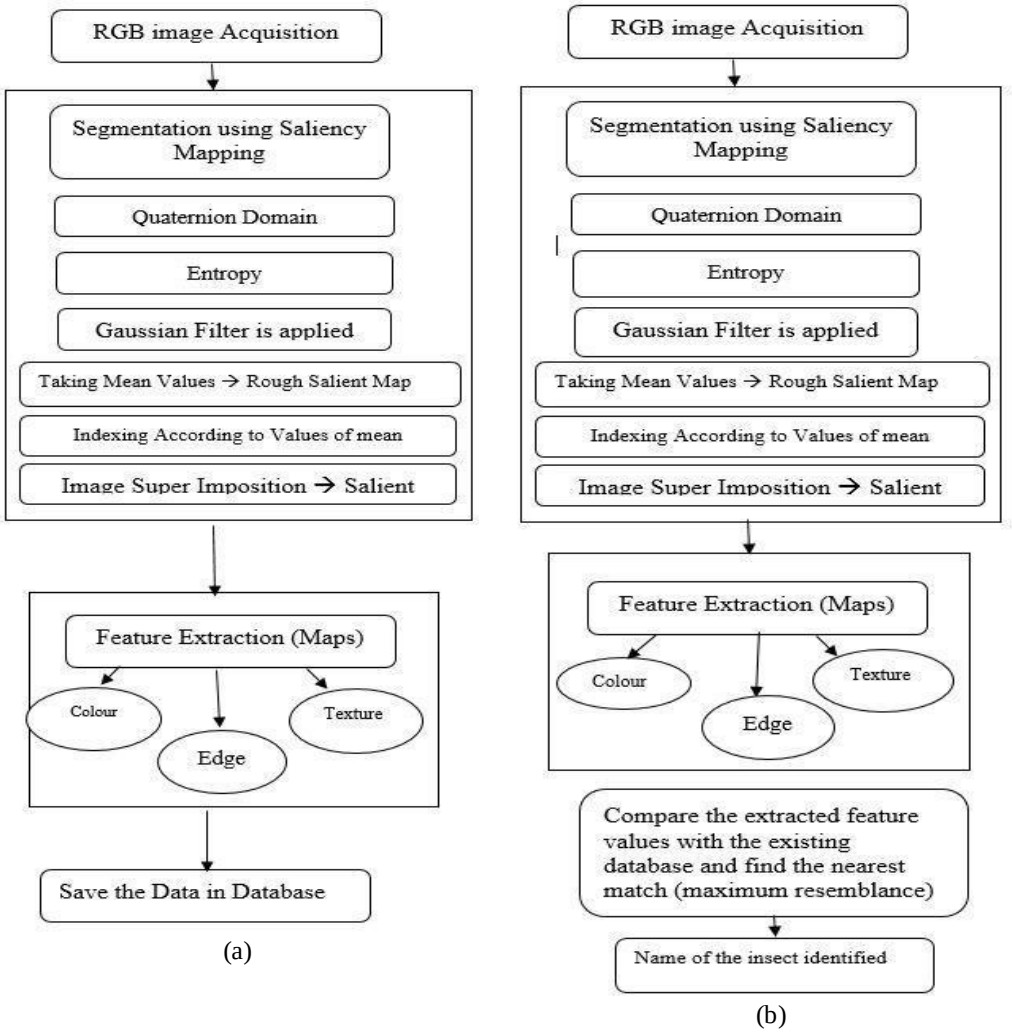

Figure 2: Steps involved in the proposed algorithm (a) Training (b) Testing.

3.2 Testing: Support Vector Machine.

Following training, testing is performed on the images, which is achieved by Support Vector Machine (SVM). The image which is saved to the database is further processed using SVM. Support vector machines are supervised learning models with associated learning algorithms that analyze data used for classification and regression analysis.

On the whole, the image is classified to find which is the insect and accordingly tells the name of the insect. Feature Extraction identify the species through the feature and patterns that are minute is the key point for recognition. The process of converting the image into digital descriptors from the micro structural patterns is a feature extraction. Global feature approach describes the overall characteristics of the pest image. Several metrics like statically and spectra methods, colour distribution, density of specific objects and oriented edge response are computed to quantify the global appearance. To do this effectively Colour Coherence Vector (CCV), GLCM, LTP features are computed. Standard pre-processing and filtering required for the feature are done. SVM is a classification technique which is

based on the concept of decision hyper planes that ascertain decision boundaries in input space or high dimensional feature space.

SVM creates linear functions from a set of categorized training data set. Thishyper plane will try to separate the positive samples the positive samples from the negative samples. The linear separator is generally structured with maximum distance from the hyper plane to the closest negative and positive samples. This causes precise classification for training data, which is near, but not equal to the testing data. All through the training phase SVM takes data matrix as input data and labels each and every samples as either fitting to a given class (positive) or not (negative). SVM considers each sample in the matrix as a row in a input space or high dimensional feature space, where the number of traits classifies the space dimensions. The trained SVM can be used to predict about test samples.

4. Experimental Result Analysis

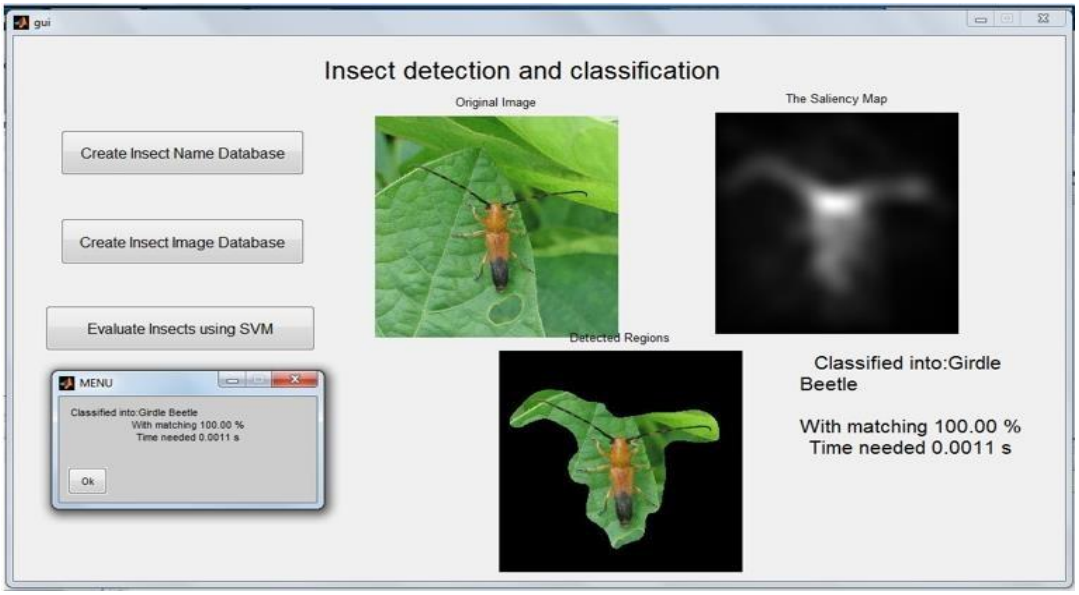

Figure 3: Output interface at the MATLAB detecting and classifying Girdle Beetle

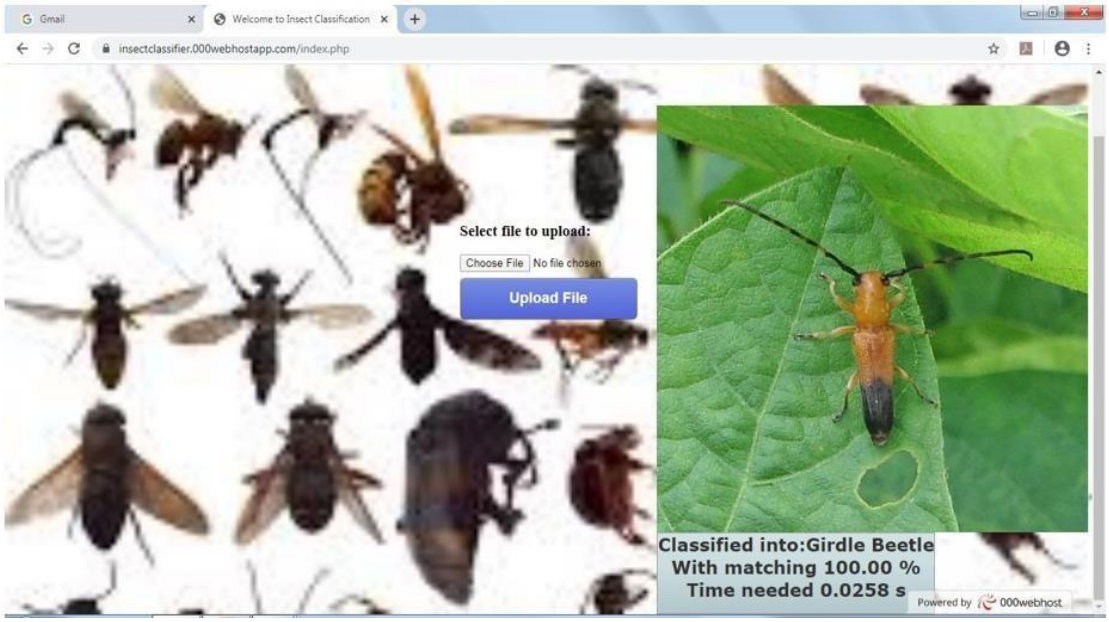

Figure 4: Output at the website classifying the insect as Girdle Bettle using test data set

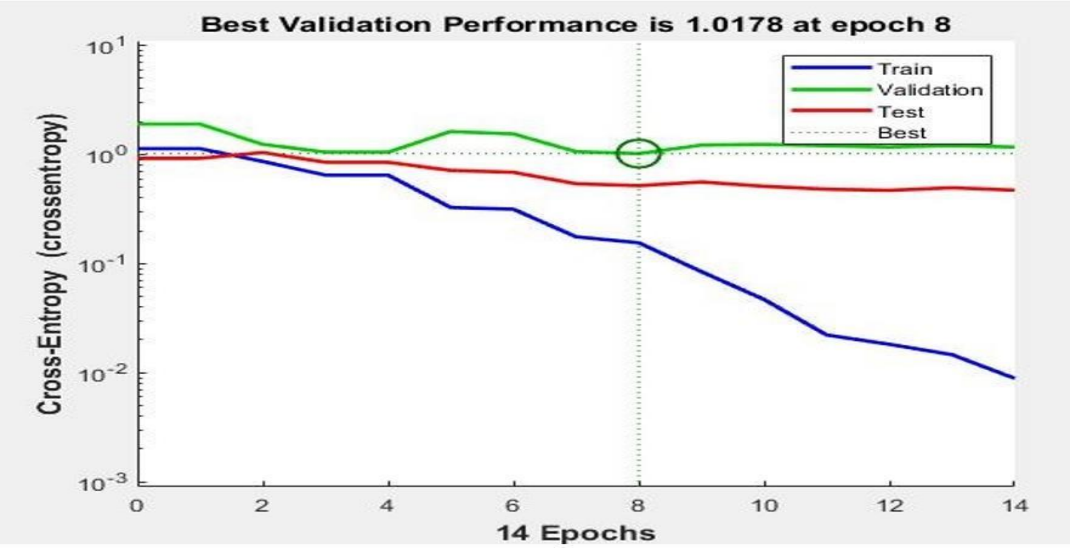

Figure 5: Performance Graph.

5. Conclusion

This project is made in such a way that it uses IoT in the form of server to make this product accessible to anyone in any part of the world at any time. It is very accurate and quick as compared to other solutions available out there [7] (apps name). It uses the latest technology and algorithm such as SVM [6] and saliency mapping. It is very handy asinformation is available to you with the click of a button.

Acknowledgments

I convey my sincere gratitude to Dr. Panjabrao Deshmukh Krishi Vidyapeeth, College of Agriculture (Nagpur) and Central Institute for Cotton Research, whose assistance gave me the direction for the completion of this project.

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