Detection of Pest from Crops using Computational Intelligence and Image Processing

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Abstract- *The work presents an automatic approach for early pest detection. Agriculture not only provides food for the human existence, it is also a big source for the economy of any country. Millions of dollars are being spent to safeguard the crops annually [10]. Insects and pests damage the crops and, thus, are very dangerous for the overall growth of the crop. One method to protect the crop is early pest detection so that the crop can be protected from pest attack. The best way to know about the health of the crop is the timely examination of the crop. Infests are detected, appropriate measures can be taken to protect the crop from a big production loss at the end. Early detection would be helpful for minimizing the usage of the pesticides and would provide guidance for the selection of the pesticides. It has become a wide area for research now a days and a lot of research has been carried out worldwide for automatic detection of pests. Traditional method of examination of the fields is naked eye examination but it is very difficult to have a detailed examination in large fields. To examine the whole field, many human experts are needed which is very expensive and time-consuming. Hence, an automatic system is required which can not only examine the crops to detect pest infestation but also can classify the type of pests on crops. Computer vision techniques provide effective ways for analysing the images of leaves. Support Vector Machine (SVM) is used for classification of images with and without pests based on the image features. This technique is simpler as compared to the other automated techniques and provides better results*

Keywords- Image Processing, Support Vector Machine, Segmentation, Image Filtering.

I. INTRODUCTION

Early detection of the pests in crops is a major challenge facing farmers these days. Different approaches have been used to deal with this problem. Manual techniques for pest analysis include black light traps and sticky traps, which are used for pest detection and monitoring in fields. Manual examination of wide crop fields is very time consuming and less efficient. It also requires availability of experts, so it becomes a very costly activity. One technique for pest monitoring is the use of sticky traps, on which pests get stuck when they come in contact with it. A camera is used to take an image of the sticky trap. This image is processed to get pest density estimates by taking the average pest count on the leaves for a particular time. These manual techniques not only provide inefficient results, but also prove to be a danger for environment. So as a preventative measure, farmers spray pesticides in bulk which is not only harmful for the crops but also harmful for the environment [10]. Recently different methodologies have been used for pest identification and monitoring, which employ image processing and complex algorithms for detection and classification of pests [17].

Automatic detection is the best way which uses image processing techniques for the detection of pests from the crops and classification algorithms to classify them on the basis of the different properties of the images. For this project, the images of leaves from the crop fields were taken and then various processing techniques were applied on them. For pest detection, ‘threshold technique’ was used to separate background from the pests on images of leaves.

This technique is very simple and accurate in detection of the pests from the images. Different properties of the images are extracted, which can be used as input for support vector machine (SVM) to classify images with pests and without pests [10].

In this project, the focus has been to examine white flies as these are very small and difficult to examine by the naked eye and can damage the fields on a large scale. The proposed algorithm identifies pests on leaves. This project introduces a method using which pests are automatically identified from the leaves. This proposed technique has proved to be very helpful for timely taking preventive measures, and saves the environment from harmful effect of massive usage of pesticides.

II. RELATED WORKS

Literature survey is mainly carried out in order to analyse the background of the current project which helps to find out flaws in the existing system & guides on which unsolved problems we can work out. So, the subsequent topics not solely illustrate the background of the project however additionally uncover the issues and flaws that driven to propose solutions and work on this project. a range of analysis has been done on power aware programing. Following section explores different references that discuss about several topics related to power aware scheduling.

The vegetation indices from hyper spectral data have been shown for indirect monitoring of plant diseases. But they cannot distinguish different diseases on crop. Wenjiang Huang et al developed the new spectral indices for identifying the winter wheat disease. They consider three different pests (Powdery mildew, yellow rust and aphids) in winter wheat for their study. The most and the least relevant wavelengths for different diseases were extracted using RELIEF-F algorithm.

The classification accuracies of these new indices for healthy and infected leaves with powdery mildew, yellow rust and aphids were 86.5%, 85.2%, 91.6% and 93.5% respectively [1].

Monica Jhuria et al uses image processing for detection of disease and the fruit grading in [3]. They have used artificial neural network for detection of disease. They have created two separate databases, one for the training of already stored disease images and other for the implementation of the query images. Back propagation is used for the weight adjustment of training databases. They consider three feature vectors, namely, color, textures and morphology [3]. They have found that the morphological feature gives better result than the other two features.

Zulkifli Bin Husin et al, in their paper [4], they captured the chilli plant leaf image and processed to determine the health status of the chilli plant. Their technique is ensuring that the chemicals should apply to the diseased chilli plant only. They used the MATLAB for the feature extraction and image recognition. In this paper pre-processing is done using the Fourier filtering, edge detection and morphological operations. Computer vision extends the image processing paradigm for object classification. Here digital camera is used for the image capturing and LABVIEW software tool to build the GUI.

The segmentation of leaf image is important while extracting the feature from that image. Mrunalini R. Badnakhe, Prashant R. Deshmukh compare the Otsu threshold and the k-means clustering algorithm used for infected leaf analysis in [5]. They have concluded that the extracted values of the features are less for k-means clustering. The clarity of k-means clustering is more accurate than other method.

The RGB image is used for the identification of disease. After applying k-means clustering techniques, the green pixels is identified and then using otsu's method, varying threshold value is obtained. For the feature extraction, color co occurrence method is used. RGB image is converted into the HSI translation. For the texture statistics computation the SGDM matrix is generated and using GLCM function the feature is calculated [6].

The FPGA and DSP based system is developed by Chunxia Zhang, Xiuqing Wang and Xudong Li, for monitoring and control of plant diseases [7]. The FPGA is used to get the field plant image or video data for monitoring and diagnosis.

Shantanu Phadikar and Jaya Siluses pattern recognition techniques for the identification of rice disease in [9]. This paper describes a software prototype for rice disease detection
based on infected image of rice plant. They used HIS model for segmentation of the image after getting the interested region, then the boundary and spot detection is done to identify infected part of the leaf.

There has been some earlier work in the field of automated pest detection in crops. A Relative Difference in pixel Intensities (RDI) algorithm has been used to detect the white flies from leaves [10]. It also counts the white flies to estimate density of the white flies in the field. This algorithm works well for both greenhouse and agricultural crops. It uses 100 images for evaluation and provides 97% accuracy. It works well when dealing with overlapping white flies, but does not detect the complete shape of the white fly. This can lead to false detections. An algorithm is suggested for differentiation between white fly and aphid in [11]. It also includes the method to differentiate between affected and unaffected leaves. This algorithm uses a support vector machine and extracts different image features to give as input to classify them. The 'Watershed method' takes highest time but performs best for occluded objects and Otsu's method takes least time for object detection . This method is oversensitive to noise and gives false positive in presence of very little noise.

In one of the approaches studied, the authors performed detection of white flies by using classification as a learning approach. It evaluates different classifiers like k-nearest neighbour,
radial basis function, artificial neural networks and support

vector machine. Support vector machine provides better results as compared to other classifiers by taking input parameters as colour, shape and texture features. It uses many irrelevant features of the image which resulted in erroneous results. Another proposed method for white fly detection is measuring white fly size and counting the white flies by using background subtraction of images with whiteflies [12]. Then Sobel edge detection operator is applied to detect edges of whiteflies in the image so that they can be differentiated easily.

This algorithm detects three times faster and covers three times more leaf surface. Edge detection algorithms perform poorly in presence of noise, as the noise is also considered as edges.

III. SYSTEM ARCHITECTURE

System architecture is the conceptual design that defines the structure and behaviour of a system. An architecture description is a formal description of a system, organized in a way that supports reasoning about the structural properties of the system. It defines the system components or building blocks and provides a plan from which products can be procured, and systems developed, that will work together to implement the overall system.

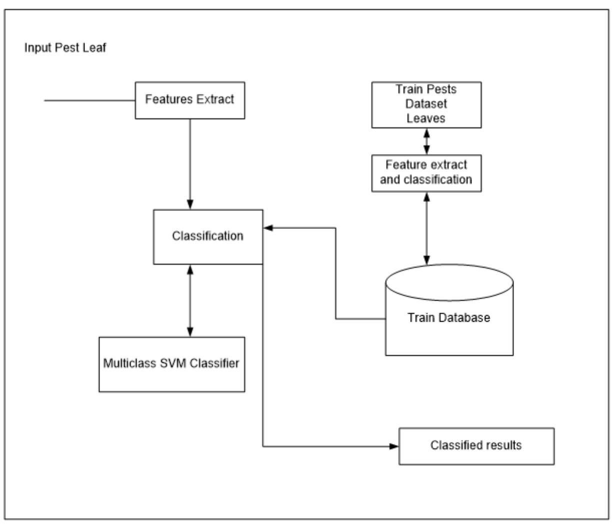


Figure 1: System Architecture

Algorithm Steps

1. Image Acquisition:

First we need to select the plant which is affected by the disease and then collect the leaf of the plant and take a snapshot of leaf and load the leaf image into the system.

2. Segmentation:

It means representation of the image in more meaningful and easy to analyse way. In segmentation a digital image is partitioned into multiple segments can defined as super-pixels.

3. Contrast:

Image pixel values are concentrated near a narrow range.

4. Contrast Enhancement:

The original image is the image given to the system and the output of the system after contrast enhancement is Enhanced Image, this is the image after removing the sharp edges.

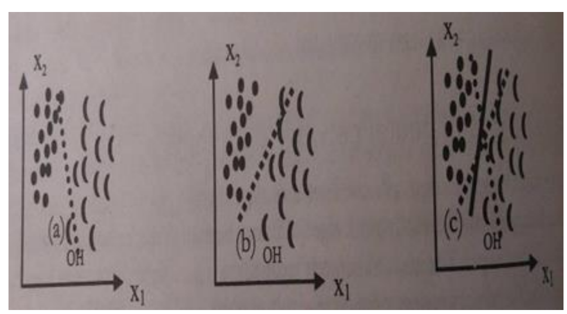
5. Converting RGB to HSI:

The RGB image is in the size of M-by-N-by-3,where the three dimensions account for three image planes(red, green, blue).if all the three components are equal then conversion is undefined.

Generally the pixel range of RGB is [0,255] in his the pixel range is [0, 1]. Conversion of pixel range can be done by calculating of the components; Hue, Saturation, Intensity.

SVM Classifier Algorithm

SVM is a statistical learning-based solver. Statistical is mathematics of uncertainty.it aims at gaining knowledge, making decisions from a set of data.



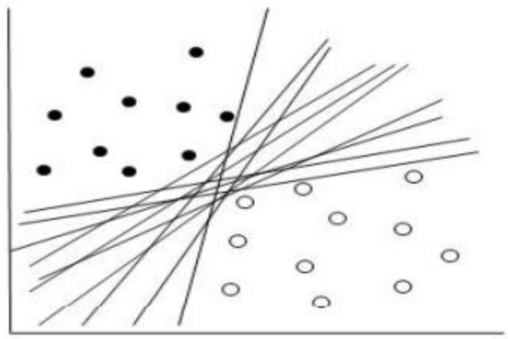


Figure 2: Statistical View of SVM

If we plot the data about X and Y axis and to classify it, we see that there are many hyper planes which can classify it. But to choose which one is the best or correct solution is very difficult task. For removing this type of problem SVM used.

There are many linear classifiers or hyper planes that separate the data, but only to choose those which one have maximum margin. Reason behind this if we use a hyper planes for classification it might be closer to one data set compared to other. So we use the concept of maximum margin classifier or hyper planes.

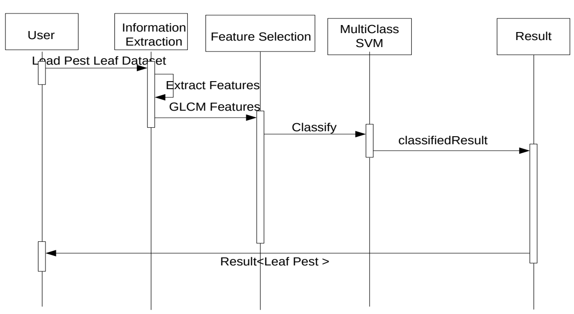


Figure 3: Sequence diagram of system

IV. CONCLUSION

In this paper work, we find with various experiments that the combination of the pre-trained Mobile Net deep neural network architecture with Multiclass SVM classifier show good accuracy for plant leaf pest classification. Mobile Net trained for the new task as a feature extractor machine and SVM classifier trained on the target dataset. The efficiency of the proposed method is evaluated on different botanical datasets and accuracy of more than 85 % is achieved respectively.

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