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Identification of Plant Leaf Disease Using Machine Learning Techniques

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Abstract: Agricultural productivity is something on which economy highly depends. The detection of plant leaf disease is a very important factor to prevent serious outbreak. Detection of plant disease through some automatic technique is beneficial as it reduces a large work of monitoring in big farms of crops, and at very early stage itself it detects the symptoms of diseases. Most plant diseases are caused by fungi, bacteria, and viruses. Thus, we propose a system for image segmentation technique which is used for automatic detection and classification of plant leaf diseases.

Keywords: Image Segmentation, Automatic Detection and Agricultural productivity.

I. INTRODUCTION

The agricultural land mass is more than just being a feeding sourcing in today's world. Indian economy is highly dependent of agricultural productivity. Therefore, in field of agriculture, detection of disease in plants plays an important role. Images form important data and information in biological sciences. Digital image processing and image analysis technology based on the advances in microelectronics and computers has many applications in biology and it circumvents the problems that are associated with traditional photography.

Plants exist everywhere we live, as well as places without us. Many of them carry significant information for the development of human society. As diseases of the plants are inevitable, detecting disease plays a major role in the field of Agriculture. Plant disease is one of the crucial causes that reduces quantity and degrades quality of the agricultural products. Disease management is a challenging task. Mostly diseases are seen on the leaves or stems of the plant. Precise quantification of these visually observed diseases, pests, traits has not studied yet because of the complexity of visual patterns. Hence there has been increasing demand for more specific and sophisticated image pattern understanding

Plant diseases cause periodic outbreak of diseases which leads to large scale death and famine. The naked eye observation of experts is the main approach adopted in practice for detection and identification of plant diseases. But, this requires continuous monitoring of experts which might be prohibitively expensive in large farms. Further, in some developing countries, farmers may have to go long distances to contact experts, this makes consulting experts too expensive and time consuming and moreover farmers are unaware of non-native diseases.

Automatic detection of plant diseases is an important research topic as it may prove benefits in monitoring large fields of crops, and thus automatically detect the diseases from the symptoms that appear on the plant leaves. This enables machine vision that is to provide image based automatic inspection, process control and robot guidance. Comparatively, visual identification is labor intensive, less accurate and can be done only in small areas.

A. OBJECTIVES

In Crops leaf plays a significant job as it gives data about the amount and nature of yield ahead of time contingent on the state of leaf. We propose the framework which should accomplish the following objectives,

1) To process the data of the leaf picture from plant dataset.
2) To extract the feature from pre-processed data.
3) To accurately classify the leaf disease.
4) To evaluate performance analysis.

B. PROPOSED SYSTEM

We propose an approach for image segmentation technique which uses different image processing algorithm along with genetic technique is used for automatic detection and classification of plant leaf diseases. Digital camera or similar devices are used to take images of leafs of different types, and then those are used to identify the affected area in leafs. Then different types of image processing techniques are applied on them, to process those images, to get different and useful features needed for the purpose of analyzing later.

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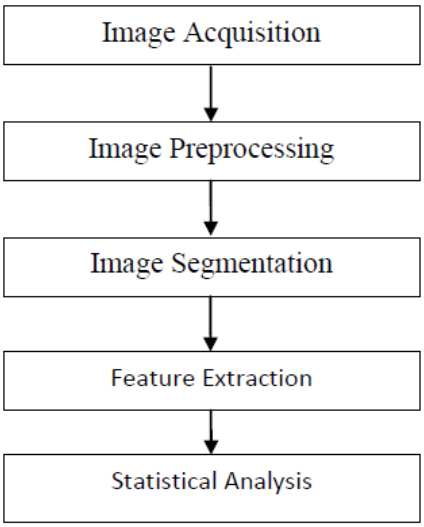

Fig. 1 Block Diagram of Proposed System

II. LITERATURE REVIEW

In 2007, Woods Keri provides the feasibility of using genetic algorithms to segment general colour images and discuss the issues involved in designing such algorithms. Colour images can increase the quality of segmentation, but increase the complexity of the problem. Genetic algorithms are well suited to optimising complex problems such as image segmentation.

In 2011, Al-Bashish D, Braik M, Bani-Ahmad S design, implement and evaluate an image-processing-based software solution for automatic detection and classification of plant leaf diseases. They show that relying on pure naked-eye observation of experts to detect and classify such diseases can be prohibitively expensive, especially in developing countries. Providing fast, automatic, cheap and accurate image-processing-based solutions for that task can be of great realistic significance. Their proposed detection models based neural networks are very effective in recognizing leaf diseases, whilst K-means clustering technique provides efficient results in segmentation RGB images.

In 2012, Kulkarni Anand H, Ashwin Patil R K proposes a methodology for detecting plant diseases early and accurately, using diverse image processing techniques and artificial neural network (ANN). The work begins with capturing the images. Filtered and segmented using Gabor filter. Then, texture and color features are extracted from the result of segmentation and Artificial neural network (ANN) is then trained by choosing the feature values that could distinguish the healthy and diseased samples appropriately. Experimental results showed that classification performance by ANN taking feature set is better with an accuracy of 91%.

In 2013, Naikwadi Smita, Amoda Niket propose and experimentally evaluate a software solution for automatic detection and classification of plant leaf diseases. Studies of plant trait/disease refer to the studies of visually observable patterns of a particular plant. The experimental results demonstrate that the proposed technique is a robust technique for the detection of plant leaves diseases. The developed algorithm's efficiency can successfully detect and classify the examined diseases with a precision between 83% and 94%.

In 2013, Chaudhary Piyush propose an algorithm for disease spot segmentation using image processing techniques in plant leaf is implemented. This is the first and important phase for automatic detection and classification of plant diseases. A comparison of the effect of CIELAB, HSI and YCbCr color space in the process of disease spot detection is done. Median filter is used for image smoothing. Finally threshold can be calculated by applying Otsu method on color component to detect the disease spot.

In 2013, Rathod Arti N, Tanawal Bhavesh, Shah Vatsal provides various methods used to study of leaf disease detection using image processing. The methods studies are for increasing throughput and reduction subjectiveness arising from human experts in detecting the leaf disease[1].digital image processing is a technique used for enhancement of the image. To improve agricultural products automatic detection of symptoms is beneficial.

In 2013, Dhaygude Sanjay B, Kumbhar Nitin P explains application of texture statistics for detecting the plant leaf disease. Firstly by colour transformation structure RGB is converted into HSV space because HSV is a good colour descriptor. Masking and removing of green pixels with pre-computed threshold level. Then in the next step segmentation is performed using 32X32 patch size and obtained useful segments. These segments are used for texture analysis by color co-occurrence matrix. Finally if texture parameters are compared to texture parameters of normal leaf.

In 2013, Arivazhagan S, Newlin Shebiah R, Ananthi S, Vishnu Varthini S proposed system which is a software solution for automatic detection and classification of plant leaf diseases. They developed processing scheme consists of four main steps, first a color transformation structure for the input RGB image is created, then the green pixels are masked and

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removed using specific threshold value followed by segmentation process, the texture statistics are computed for the useful segments, finally the extracted features are passed through the classifier. Their proposed algorithm's efficiency can successfully detect and classify the examined diseases with an accuracy of 94%.
In 2014, Ghaiwat Savita N, Arora Parul present survey on different classification techniques that can be used for plant leaf disease classification. A classification technique deals with classifying each pattern in one of the distinct classes. A classification is a technique where leaf is classified based on its different morphological features. There are so many classification techniques such as k-Nearest Neighbor Classifier, Probabilistic Neural Network, Genetic Algorithm, Support Vector Machine, and Principal Component Analysis, Artificial neural network, Fuzzy logic. Selecting a classification method is always a difficult task because the quality of result can vary for different input data. Plant leaf disease classifications have wide applications in various fields such as in biological research, in Agriculture etc. They provide an overview of different classification techniques used for plant leaf disease classification.

III. SYSTEM DESIGN

System design thought as the application of theory of the systems for the development of the project. System design defines the architecture, data flow, use case, class, sequence and activity diagrams of the project development.

A. SYSTEM ARCHITECTURE

This architecture diagram illustrates how the system is built and is the basic construction of the software method. Creations of such structures and documentation of these structures is the main responsible of software architecture.

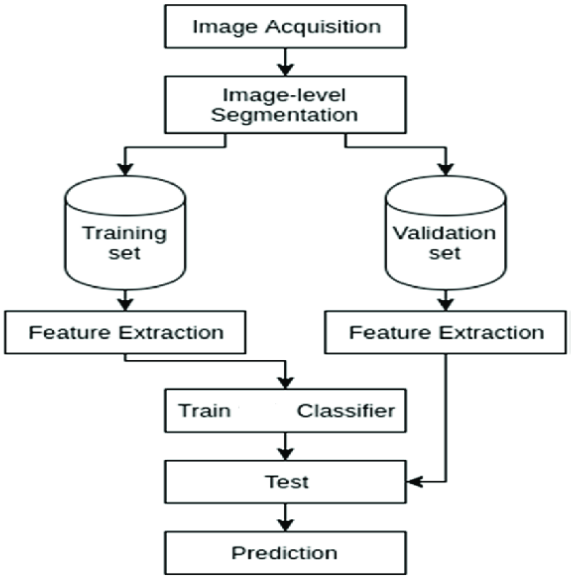

Fig. 2 Architecture of proposed system

Since, disease detection in plants plays an important role in the agriculture field, as having a disease in plants are quite natural. If proper care is not taken in this area then it can cause serious effects on plants and due to which respective product quality, quantity or productivity is also affected.
Plant diseases cause a periodic outbreak of diseases which leads to large-scale death. These problems need to be solved at the initial stage, to save life and money of people.
Automatic detection of plant diseases is an important research topic as it may prove benefits in monitoring large fields of crops, and at a very early stage itself it detects the symptoms of diseases means when they appear on plant leaves. Farm landowners and plant caretakers (say, in a nursery) could be benefited a lot with an early disease detection, in order to prevent the worse to come to their plants and let the human know what has to be done beforehand for the same to work accordingly, in order to prevent the worse to come to him too.
This enables machine vision that is to provide image-based automatic inspection, process control. Comparatively, visual identification is labor intensive less accurate and can be done only in small areas.
The project involves the use of self-designed image processing algorithms and techniques designed using python to segment the disease from the leaf while using the concepts of machine learning to categorize the plant leaves as healthy or infected.
By this method, the plant diseases can be identified at the initial stage itself and the pest and infection control tools can be used to solve pest problems while minimizing risks to people and the environment.

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B. SEQUENCE DIAGRAM

A sequence diagram it is a type of communicative diagram which demonstrates how the techniques or processes work with each other and also gives the information about in which order they are working. Sequence diagram, its develop communication arrangement graph. These figures some time named occurrence figures, occasion situations, What's more scheduling figures.

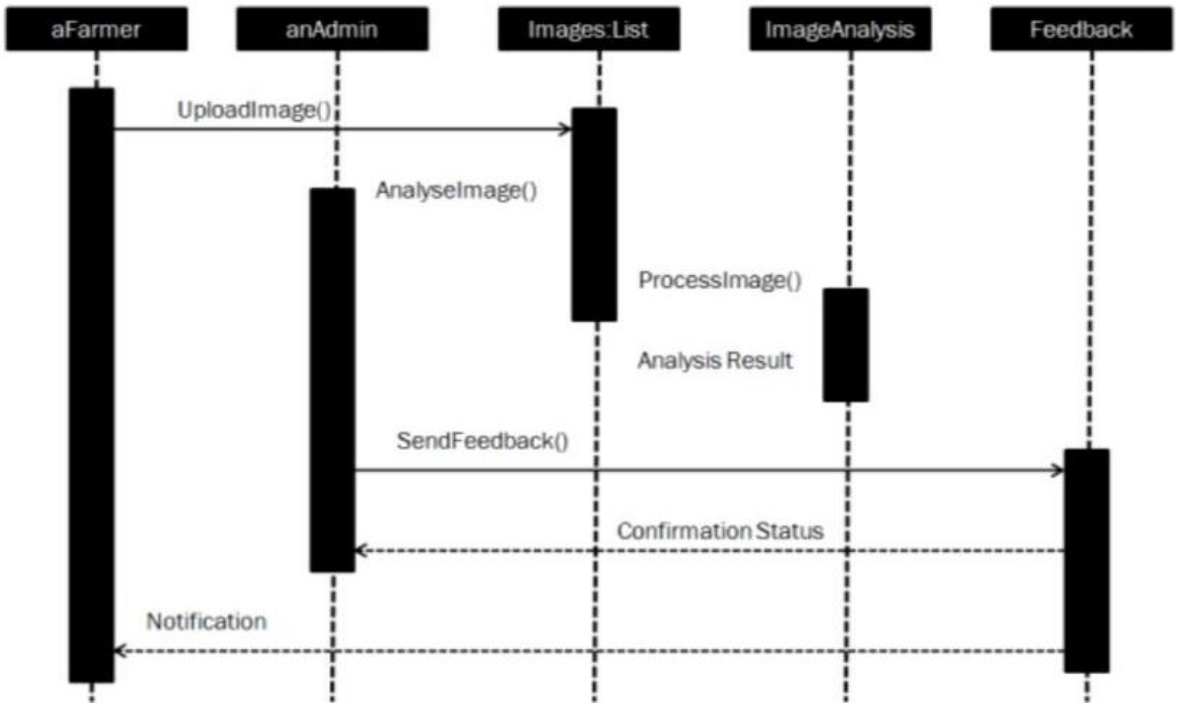

Fig. 3 Sequence Diagram.

Initially we take the leaf image as input and perform some pre-processing on it. After that we extract some features based on which training and testing sequence will occurs respectively. Here farmer is the one who needs to test the images. Admin is the proposed system.

C. DATA FLOW DIAGRAM

It also referred as bubble graph. This diagram is useful for representing the system for all degree of constructions. The figure is differentiated into parts which show maximizing data path & practical aspect.

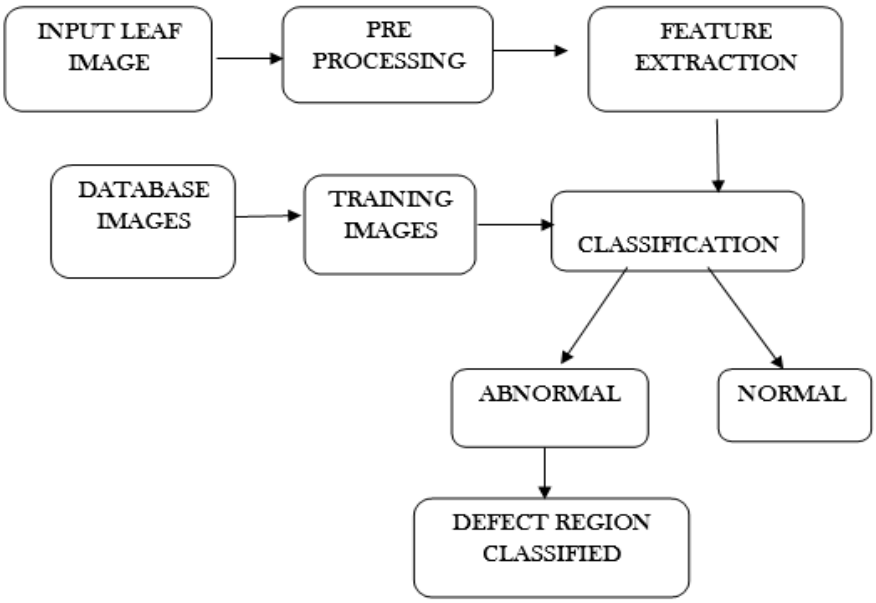

Fig. 4 Dataflow diagram

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IV. IMPLEMENTATION

Digital camera or similar devices are used to take images of leafs of different types, and then those are used to identify the affected area in leafs. Then different types of image processing techniques are applied on them, to process those images, to get different and useful features needed for the purpose of analyzing later.

Algorithm written above illustrated the step by step approach for the proposed image recognition and segmentation processes:

A. IMAGE ACQUISITION

This is the very first step that requires capturing an image with the help of a digital camera.

B. PREPROCESSING

This stage of input image to improve the quality of image and to remove the undesired distortion from the image. Clipping of the leaf image is performed to get the interested image region and then image smoothing is done using the smoothing filter. To increase the contrast Image enhancement is also done.

C. MOSTLY GREEN COLORED PIXELS

In this step, are masked. In this, we computed a threshold value that is used for these pixels. Then in the following way mostly green pixels are masked: if pixel intensity of the green component is less than the pre-computed threshold value, then zero value is assigned to the red, green and blue components of the this pixel.

D. REMOVING

Infected clusters, inside the boundaries, remove the masked cells.

E. CLUSTERING

Obtain the useful segments to classify the leaf diseases. Segment the components using genetic algorithm.

F. COMPUTING THE FEATURES USING COLOR CO-OCCURRENCE METHEDOLOGY

For feature extraction the method used is color co-occurrence method. It is the methodology in which both the texture and color of an image are considered, to come to the unique features, which shows that image. Over the traditional gray-scale representation, in the visible light spectrum, the use of color image features provides an additional feature for image characteristic. There are three major mathematical processes in the color co-occurrence method. First, conversion of the RGB images of leaves is done into HIS color space representation. After completion of this process, to generate a color co-occurrence matrix, each pixel map is used, which results into three color co-occurrence matrices, one for each of H, S, I.

G. CLASSIFICATION OF DISEASE

In this phase of classification, extraction and comparison of the co-occurrence features for the leaves with the corresponding feature values are stored in the feature dataset. First, the Minimum Distance Criterion and then classifier is used to done the classification.

V. RESULTS AND DESCRIPTIONS

The main window contains the overview of the project and steps of proposed system along with browse button for image acquisition.

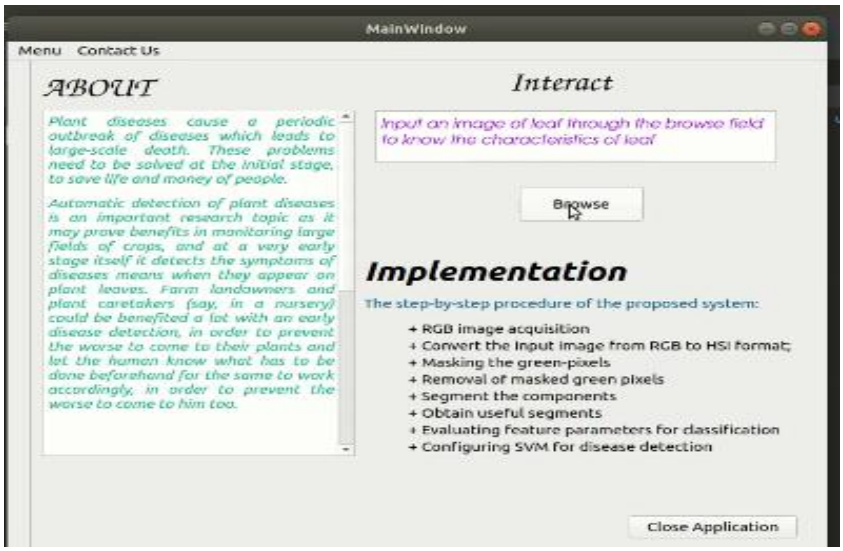

Fig. 5 Main window (GUI front end)

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After clicking browse button on main window we can select the image need to test in our image test dataset. Once we select the image need to be tested we get the different sub-windows each showing result of the respective steps in the proposed system. The following figures are the output of different steps of proposed system respectively.

Fig. 6 Original Image

Fig. 7 Contour step

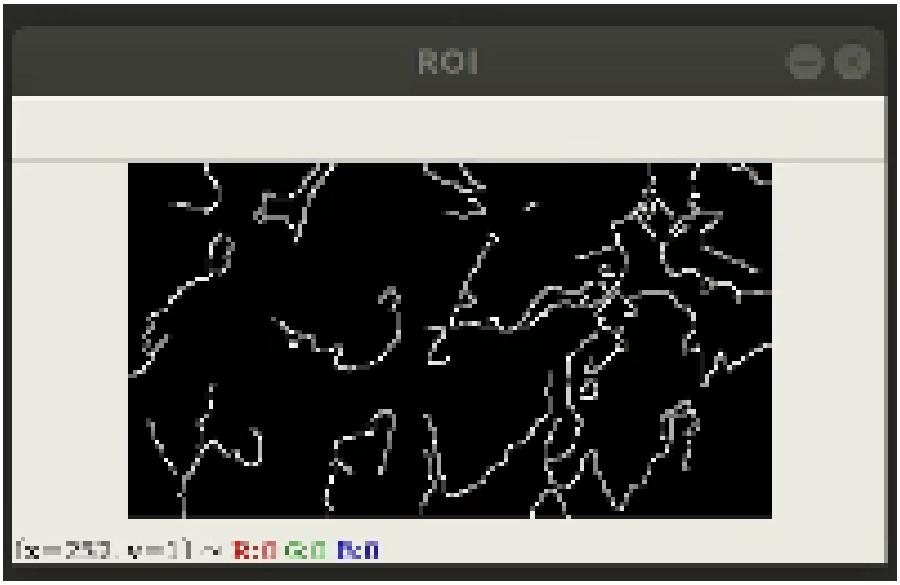

Fig. 8 ROI step

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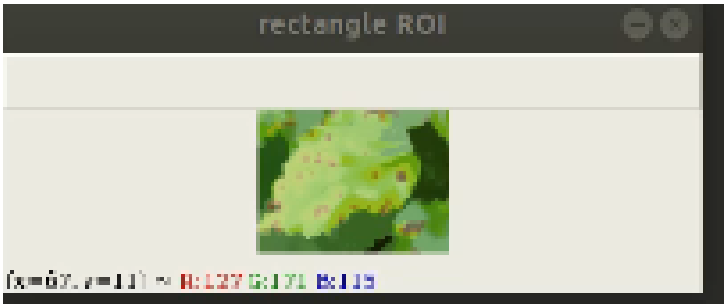

Fig. 9 Rectangle ROI

Fig. 10 HLS

Fig. 11 Masked out image

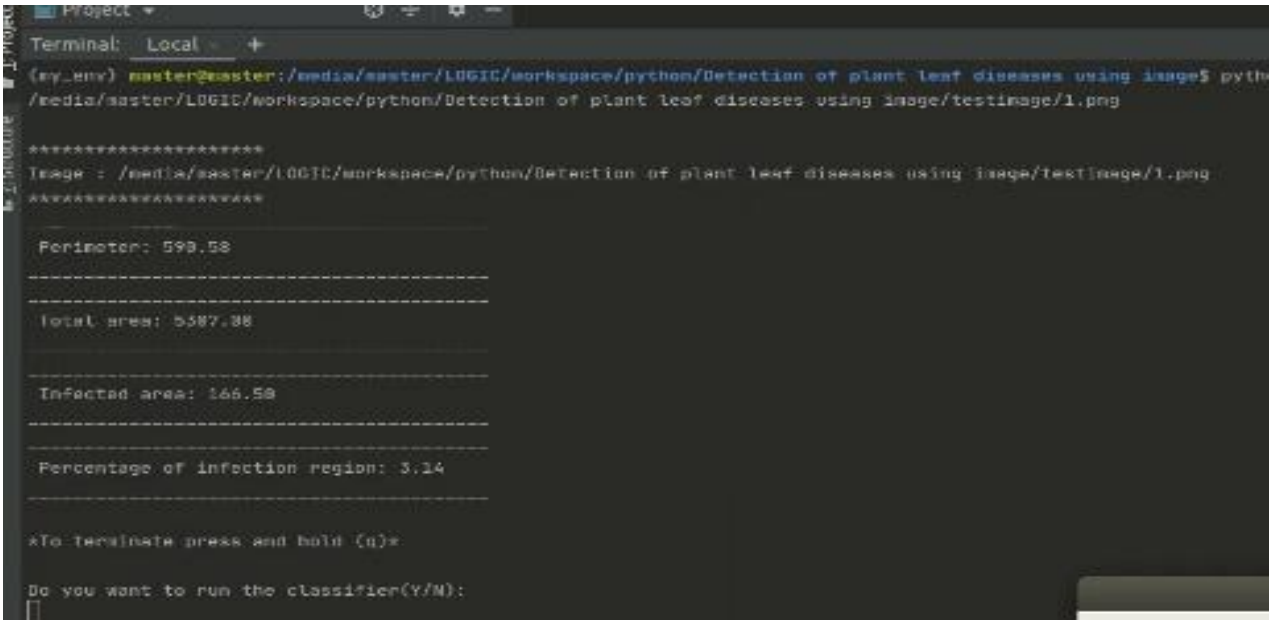

Fig. 12 Validation of disease affected area within image acquired

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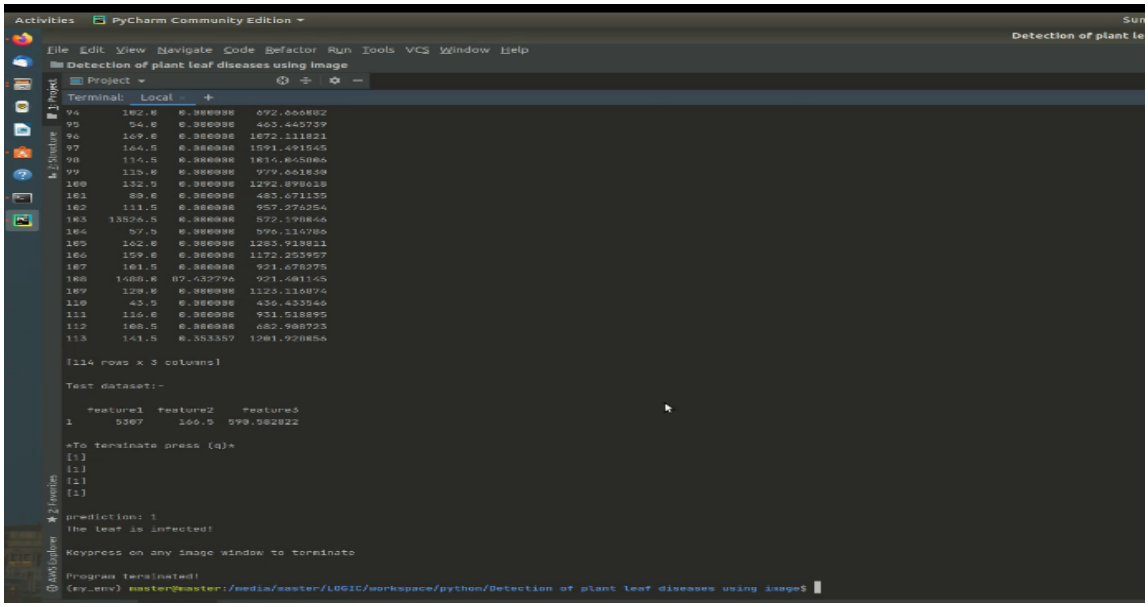

Fig. 13 Final prediction with test dataset and trained dataset

VIII. CONCLUSION

This project presents the survey on different diseases classification techniques used for plant leaf disease detection and an algorithm for image segmentation technique that can be used for automatic detection as well as classification of plant leaf diseases later. Grape, corn, tomato, pepper, apple, and blueberry are some of those species on which proposed algorithm is trained and tested. Therefore, related diseases for these plants were taken for identification. With very less computational efforts the optimum results were obtained, which also shows the efficiency of proposed algorithm in recognition and classification of the leaf diseases. Another advantage of using this method is that the plant diseases can be identified at early stage or the initial stage. To improve recognition rate in classification process Artificial Neural Network, SVM classifier, Fuzzy Logic and hybrid algorithms can also be used.

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