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Pomegranate Disease Classification using Ada-Boost Ensemble Algorithm

Pooja Kantale
Department of Electronics Engineering, Government College of Engineering Amravati, Maharashtra, India

Shubhada Thakare
Department of Electronics Engineering, Government College of Engineering Amravati, Maharashtra, India

***Abstract*— In farming plant ailments have arise to be a difficult as it forefront to the reduction in the yield, besides with that in several states the variety of the farming consequences is also affected. Fitness observation and the recognition of ailment in plant are extremely tough manually. Image processing is used to recognize ailment of pomegranate plants and classify in individual class with machine learning approach is used. The Ada-boost classifier utilized for classification of ailments in multiclass. Iitially, features optimization is performed using PSO algorithm and multiclass classification are executed. So, testing accuracy using Ada-boost algorithm 92.9% achieved.**

Keywords — Pomegranate plant diseases, data set, machine learning algorithm, PSO algorithm.

I. INTRODUCTION

Pomegranate is dominant bear fruit crops which have elevated healing along with nutritious value. Pomegranate produce in environment where the yearly rainwater is smaller than 20 inches, thus for that cause pomegranates are primarily produce in arid and semiarid sector. Pomegranate is useful in some motive for healing diarrhea, male and female infertility and as well this is a best anti-parasitic negotiator. There are numerous pomegranate ailments such as Alternaria, Anthracnose and bacterial blight. The Alternaria fruit rot ailment induced by Alternaria alternata. This ailment was recognizing in 2004 on pomegranate in Israel. Because of this malady small reddish brown disc-like fleck appear on pomegranate fruit. This disorder again and again takes place each period in the pomegranate plants give rise to enormous reduction in the yield and standard of production. To decrease the plant disorder lots of weed-killer can be used. At the first time Anthracnose seen in pattern of black mark on leaves. At the origin, these tanned dark marks are ring-shaped and then get down designing less in structure. These marks expand on part of fruit. Normally, this ailment appears because of moisture in the month of September or august. The bacterial blight is the disorder which was found in 1952, in Delhi (India).

The bacterial blight contaminates pomegranate fruits this was register in 2009 in Hanumanagarh which is district of Rajasthan. Like India, The bacterial blight contamination get a vast history in South Africa, Tunisia, Italy, etc that give rise to a tremendous reduction in the production farmers. To control this issue, repeatedly survey is done on bacterial blight on the pomegranate to manage the contamination. In early phase, the infection of bacterial blight is perceived on the plant cotyledon, further spotted over the stems as well as on fruits.

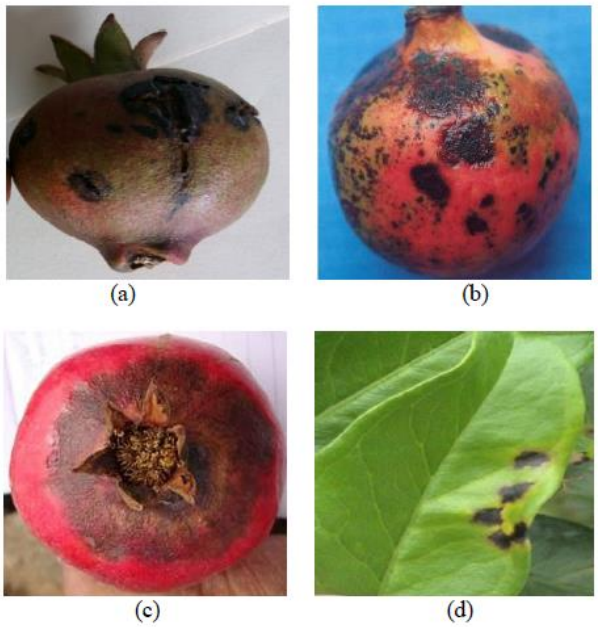

Fig 1.Various disease images of the pomegranate plant

Pomegranate is one of the fruit that has medicinal curing and advantageous value. The atmospheric problems are composite in creation and analogous with possibility and unreliability in pomegranate farming. Consequently, there is authentic requirement for a planned examination of different features of issues and their control by pomegranate producers which earn the awareness of researcher. The continuous assumption was established as regards place extra area under its cultivation by the producers. This presume specific importance for fruit farming in dry spell given sectors like study sector which is more frequently pretentious by different types of meteorology and hostess of more possibility and unreliability. So that causes reduce in earnings of the producers in consequence demeaning the quality of livelihood those pretentious. In spite of industrial and low-budget development the state of exhaustive trade fruit farmers like pomegranate producers carry on with to be unsteady due to wide scale of manufacturing limitations. On other side, several of them are regular issues; on the other hand, they are faced at separate extent. unlike from this, the issues are linked to different features namely natural, socio-economic, technological, institutional component elaborate in

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pomegranate cultivation. Therefore, due to composite and varied issues and limitation it was hard to classify those using unique norms. Consequently, the current work gives out with the atmospheric issue in consecutive sequence and to have knowledge of the cause and outcome link in the middle of problems. Some recommendations have been stated to manage with the complications.

II. LITURETURE SURVEY

Lately, image processing technologies used by researchers to recognize plant irregularity using pre-programmed techniques. Mrunmayee Dhakate, Ingole A. B. [10] presented Neural Network approach to diagnosis of pomegranate plant disease. The system which has been proposed consists of different steps such as the image database, after collecting images preprocessing of those images is perform form those pre-processed images features get extracted using k-means clustering based color segmentation method. For the extraction of features GLCM approach is used and finally the artificial neural network along with Back propagation Algorithm is used. The proposed technique gives the mean accuracy is about 90%.
Amrita A. Joshi, B.D. Jadhav [9], Used Image Processing Techniques for Monitoring and Controlling Rice Diseases. The two classifiers MDC along with k-NN has been utilized for the purpose of classification of ailments. The classifier which has been recommended for classification is Distance classifier, because of its severity of utilization and slighter classification duration. The accuracy given by proposed approach is up to 89.23%. Manisha Bhange[a,*], H.A. Hingoliwala[b] [9], they perform pomegranate disease detection using image processing. They proposed a tool which is web based. This tool helps farmers in recognition of fruit ailment by giving fruit image data to the system as a input. The system previously has an dataset of pomegranate fruit images which is trained. The Images of fruits are allowed as an input by the user goes through distinct processing stage to recognize the seriousness of ailment by equating with the trained dataset images. First of all, the size of image is changed and then the essential features are extracted for the extraction process such as color, morphology, and CCV. The clustering is performed using k-means algorithm. Next, for the classification of images SVM is used to classify the image as infected or non-infected.

In some papers, K means clustering is utilized for the image segmentation of the contaminated area and then all the needed features get extracted from the infected part. Further, for classification the artificial neural network is observed. The ailment grading is performed by evaluating the number of pixels, which display the consequences of microbes throughout the fruit or the leaf.

In order to recognize the contamination by evaluating the image, the specialist used mat lab to take out the features like contrast, correlation, energy, homogeneity, mean, standard deviation and entropy. By using these features, they can create a database at the beginning then by using this database the ailment recognition is performed.

III. PROPOSED SYSTEM

This part gives the explanation of system review and takes advantage of machine learning algorithms in this evaluation. It also represents how the dataset was created, pre-processed, after preprocessing of images that images get trained and tested. The "Fig. 1" introduced the complete strategy used to design the machine learning illustration in this evaluation. The system has two phases i.e. training and testing phase to built machine learning approach. The figure is diverging into training and testing phase. The testing examine for 60% of the total data. The persisting 40% are utilized as the test file. In training part, gradually process accompanying for complete set-up performance to forecast accurate outcome. Same process is followed in testing phase, all the important features are get extracted from test data. The Feature building assists to modify the raw input into relevant configuration.

A. Database:

Primary necessity of image processing is collecting of a database of images. To get images of plant ailments, one has to carry to distinct location. Data gathering will be a difficult since diversity of plant ailments may not be accessible at few farms and ailments appear only throughout some conditions. The database existing in the research is images which are in jpg. Format. The dataset gathered from the Horticulture College, Amravati. The acquired image is in the jpg format. One more source is available to gather dataset regards plant images from internet authority. The dataset containing images in RGB form on which pre-processing is applied for correct detection. We analyze 190 images of pomegranate plant, which have a spread of the following class labels assigned to them;

- Alternaria fruit rot
- Anthracnose
- Bacterial Blight

B. Pre-processing:- To collect input images as per the quality input of the recommended approach, pre-processing is carried out on the dataset. The focus of pre-processing is an advancement of the plant image data that conquer unpleasant change or improve several image features essential for other processing. In preprocessing definite action accomplished like resize image, remove noise and demolish unwanted mark or holes. This is valuable for precise recognition and classification of pomegranate plant diseases. The images are obtained in RGB form and transform into grey scale image. To eliminate noise, median filter can be used. To extract region of interest we are using segmentation technique. The pre-processing has three operations i.e. Resizing, Filtering and Enhancement.
In resizing, the size of image may increase or decrease regarding to our need. And then filtering operation is performs on that image and further image enhancement is perform. This is the process which is done by image cancellation.

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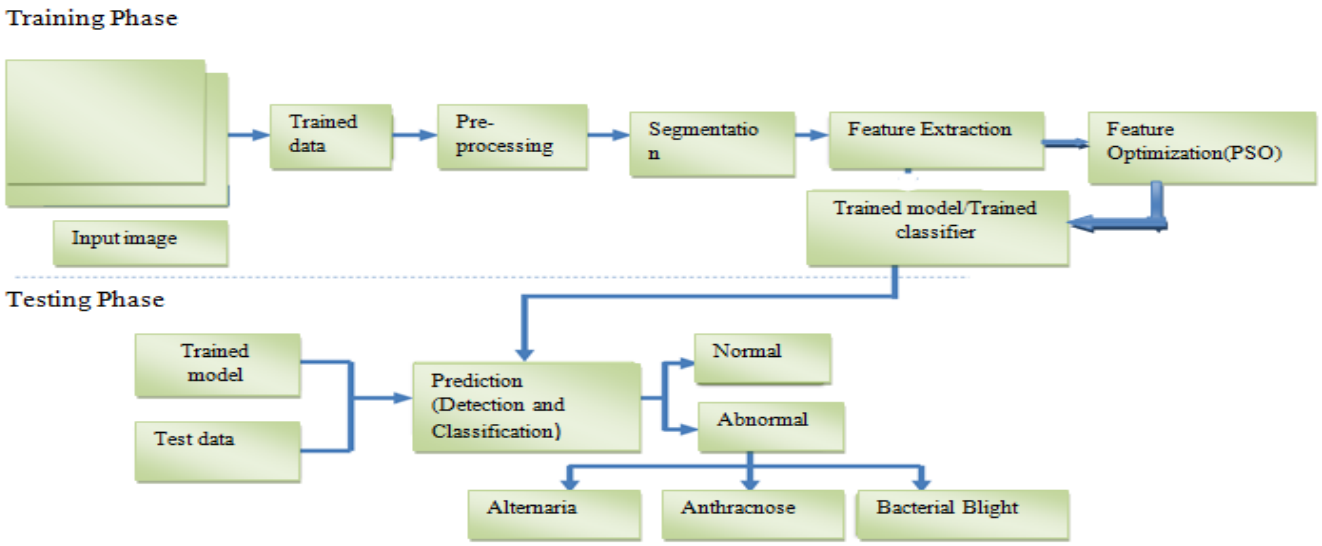

Fig.1 Proposed system

The noise elimination is the procedure of rectifying the value of pixels which do not return the correct severity of actual source. The surrounding of image is take away and is isolate to the black surrounding.

C. Segmentation:- Image Segmentation techniques build an enormous influence here. In this project, to take out the region of interest we are using segmentation from the input image. For the recognition of boundaries usually segmentation technique is used. This is the technique of separating a digital image into various sections. The paramount motive of segmentation is to identify objects or take out the associated details from the images, so that study of an image enhance simply. By using image segmentation objects and surrounding line of images are placed. Pixels with same label part give out separate properties for assigning a tag to all pixels in an image.

D. Feature Extraction:- The feature extraction take out the, features from images like shape and textural parameters can be extracted from the images. This process helps to extract useful knowledge available in the image. In feature extraction, a set of values are acquired which is called features from an image. These features provide useful knowledge regarding the image for additional processing. The procedure of recognizing ailments in plants features such as color, texture, morphological and color coherence vector are often used.

- Energy: Provides the sum of squared elements in the GLCM. Also known as uniformity or the angular second moment.

$$\text{Energy} = \sum_{i,j=0}^{N-1} (p_{ij})^2$$

- Correlation: Measures the joint probability occurrence of the Specified pixel pairs.

$$\text{Correlation} = \sum_{i,j=0}^{N-1} \left(p_{ij} \frac{(i-\mu)(j-\mu)}{6^2}\right)$$

- Contrast: Measures the local variations in the Gray level co-occurrence matrix.

$$\text{Contrast} = \sum_{i,j=0}^{N-1} (p_{ij}) (i-j)^2$$

- Homogeneity: Measures the closeness of the distribution of elements in the GLCM to the GLCM diagonal.

$$\text{Homogeneity} = \sum_{i,j=0}^{N-1} \frac{p_{i,j}}{1+(i-j)^2}$$

- Entropy: is a statistical measure of randomness that can be used to characterize the texture of the input image.

$$\text{Entropy} = \sum_{i,j=0}^{N-1} (-\ln (p_{ij}) p_{ij})$$

- Where, Pij = Elements i,j of normalized symmetrical GLCM
  N = Number of Gray levels in image as specified by number of levels in under quantization
  μ
  =the GLCM mean (being an estimate of the intensity of all pixels in the relationships that contributed to the GLCM), calculated as:

$$\mu = \sum_{i,j=0}^{N-1} i p_{ij}$$

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C. Feature optimization: The particle swarm optimization (PSO) is the approach utilized for feature optimization.

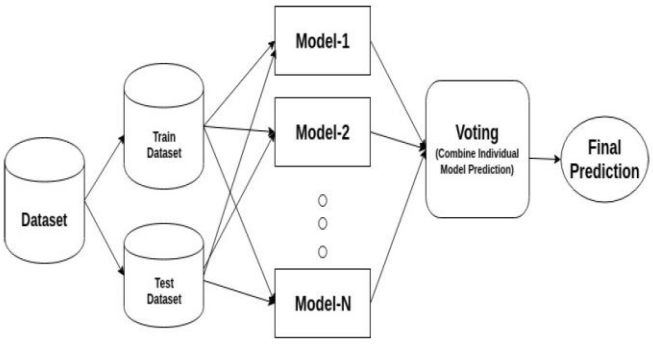
This is a metaheuristic method estimated by James Kennedy and Eberhart in 1995. This is the population based search algorithm which is utilized by birds group and fish schooling. The different parameters such as simplicity, accuracy and efficiency of this strategy accomplish excessive demand in the authentic planet issue. It traces two variable, personal best (pbest) and global best (gbest) to give best output. Corresponding to further progressive algorithm, PSO gives community of random suggestions. The design is maintaining the inhabitants of particles; here each and every particle is themselves represents the predictable suggestions of enhance issues namely more progressive metaheuristic design. Every bit in PSO is linked with the randomized velocity, possible solution is called particle, theses parameters are operate on the complication area.

PSO is an evaluation method that enhance an difficulty iteratively, which is complicated to upgrade a useful solution with suppose to a particular measure of group. It resolves complications by having a set of feasible solution. After the particles get labeled, these particles are movable throughout in the search-space in state to acquire simple mathematical formulae. This formula is obtained on the basis location and speed of the particle. Every particle has movement which has been influenced by its familiar best known location. But it is also leads to the well known position in the search-area. This are improved as a suitable locality those are obtain by other particles. This has awaited in introducing the swarm to the best solutions.

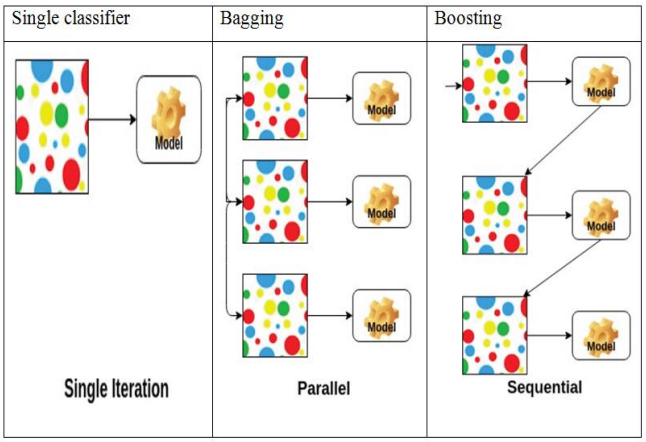
D. Ada-Boost Ensemble Algorithm:

To recognition of various ailments of the plants image classifier can be utilized. For doing so i.e. for recognition of ailments here boosting ensemble algorithm is used. This is an machine learning based algorithm in which various prototype are trained to resolve the corresponding complications and then combine it to get suitable consequences. The leading ideas are that when poor versions are precisely combining then we can get new precise models.

An Ensemble learning approach, elaborate meta-algorithms that combine some machine learning approach into a isolated anticipating type to upgrade functioning. This approach can reduce variance with the help of bagging technique, upgrade forecast employ stacking approach.



- **Bagging:** used as bootstrap aggregation. Bagging integrates many learners in such a way to limit the variance of evaluation. Namely, random forest trains M Decision Tree; we can learn M dissimilar trees on various random subspaces of the facts and execute designate for final prediction. Random Forest and Extra Trees are bagging ensemble approaches..
- Boosting algorithms integrates several less accurate classifiers (or weak classifier) to get highly accurate classifier (or strong classifier). The weak classifier gives the accuracy better than the flipping of a coin. Error rate of strong classifier near to 0. Boosting algorithm can trace the design that break down the correct prediction. Over fitting difficulties are does less affects to boosting algorithms. The three algorithms given have obtained enormous acceptance in data science conflict .
  - Adaptive Boosting
  - Gradient Tree Boosting
  - XG Boost
- **Stacking** is an ensemble learning approach that integrates many fundamental classification designs predictions into a new data set. For other classifier, as a input the new data is used.



To build more precise classifier the AdaBoost classifier integrates many weak classifiers. The fundamental theory initiating Ada-boost is to put the weights of classifiers and learning the data specimen in every repetition so that it established the correct predictions of abnormal examination. As a base classifier we can used any machine learning algorithm, only the condition is it should obtain weights on learning set. Ada-boost should reach two conditions:

1. The classifier should be learned repeatedly on different weighed training examples.
2. During each repetition, it attempt to give an better fit for these examples by reducing learning error.

AdaBoost is an ensemble learning approach which can be utilized for classification or regression. However, AdaBoost is extra impenetrable to over fitting than numerous machine learning approaches, it is frequently volatile to noisy data and outliers. Due to use of many repetitions to build single strong classifier AdaBoost is named as adaptive. They build the

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strong learner by repeatedly putting weak learners together. Throughout, every cycle of learning, a new weak learner is attached to the ensemble and a weighting vector is altered to concentrate on examples that were mislabeled in last cycles.

IV. EXPERIMENT RESULT

The proposed system can be applied on plant images of all size. The pomegranate plant images include number of normal and abnormal Fruits. The region of interest can be taken out and after that features are extracted from that region of each plant.

The tool which we have used is MATLAB. The results are shown in figure below. In fig. 1 we have developed Graphical user interface. It contains two different sections i.e. training and testing.

Fig. 1 Creating Graphical User Interface

In fig. 2(a), according to our methodology we have to load database.

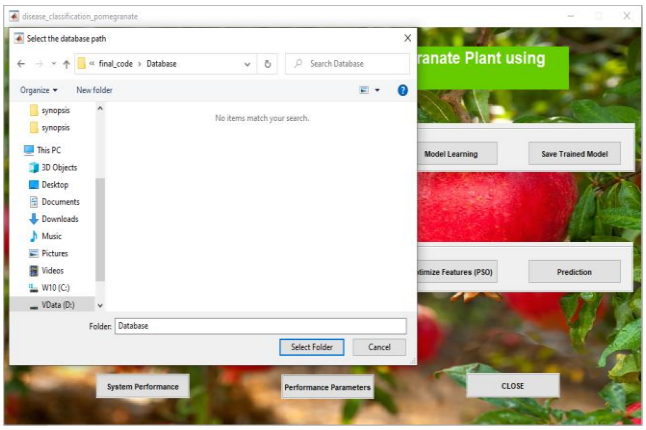

Fig. 2 (a) Loading Database

The fig. 2(b) shows that the database is loading; here we have to browse the database file.

Fig. 2 (b) Database Loading is in Process

The fig. 2 © shows that our database is successfully loaded. Now pre-processing operation is applied on that loaded database which is shown in fig 4.

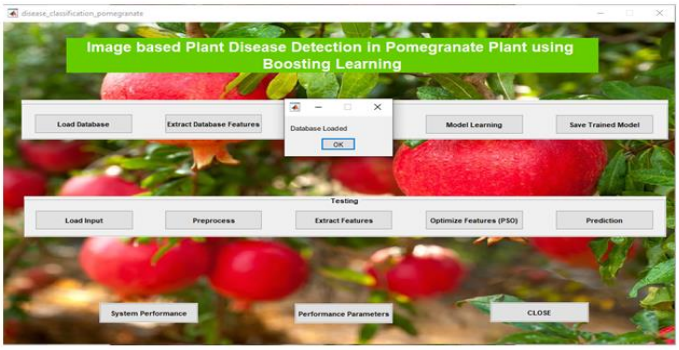

Fig. 2 (c) Database is successfully loaded

When we will click on extract database features, pre-processing and feature extraction operation is applied on the number of images present in database.

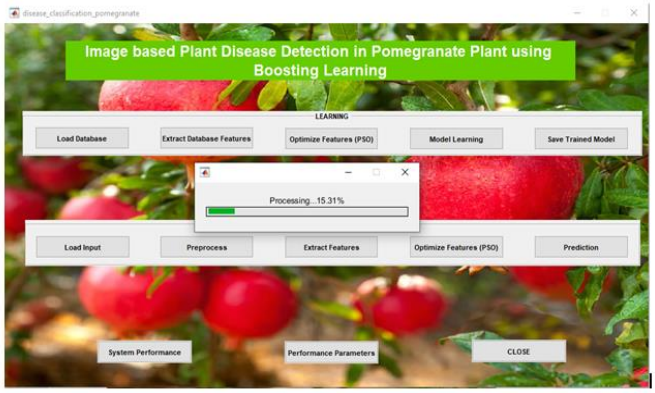

Fig. 3 Preprocessing

Here we get a conventional vector which is further converted into optimize feature vector.

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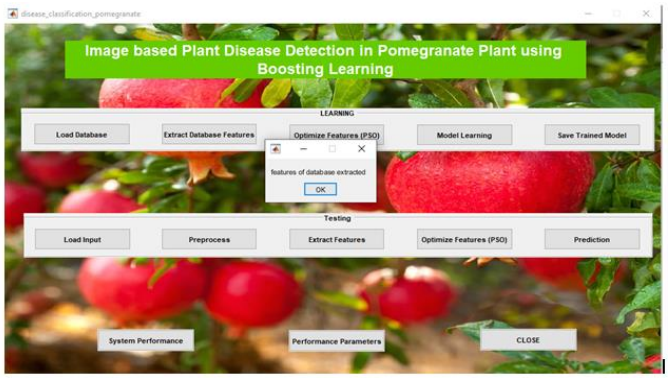

Fig 3 Feature Extraction

After all the features get extracted that features are further optimized using PSO algorithm.

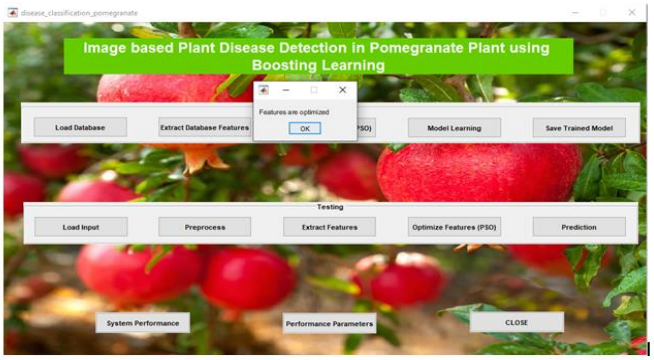

Fig 4 Feature Optimization

Fig. 4(a) shows the graph of BPSO i.e. Binary particle swarm optimization which show that how does the fitness value changes according to the number of iterations.

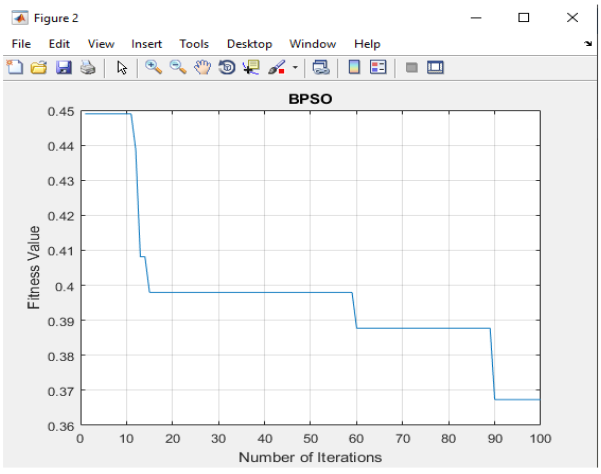

Fig 4 (a) Graph of BPSO

Then the fig. 4(b) shows the convergence curve which behaves same as that of BPSO in decreasing order. As the number of iterations goes up we achieve the minimum fitness value. If that value remains constant, then it indicates that objective function behaves as constant.

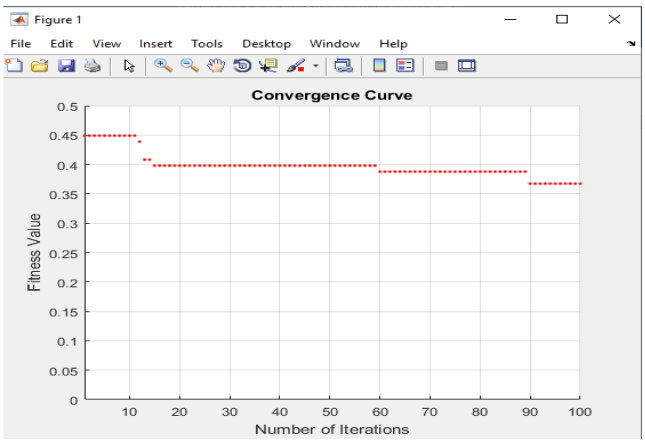

Fig 4 (b) Convergence Curve

After that fig. 4 © in which we perform model learning for that Boosting algorithm is used.

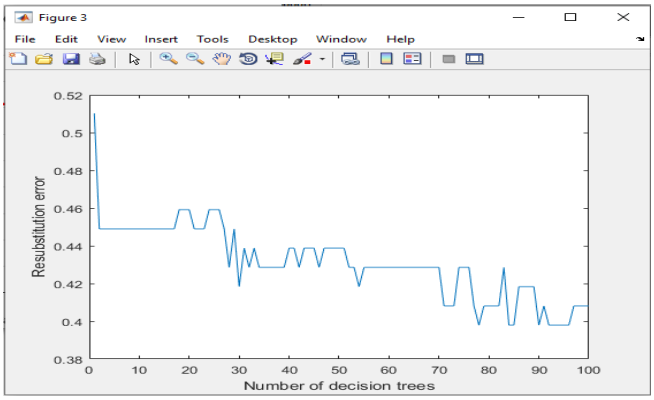

Fig. 4© Model learning for Boosting Algorithm

Fig. 5 shows the confusion matrix which contains four classes i.e. Class 1, class 2, class 3 and class 4. In which class1, class2 and class3 majorly consider on fruits not on leaves. But class 4 consists of both fruits and leaves. The confusion matrix is of 4*4 in which green color shows all elements and in red color there is '0' which shows that our classification is successfully performed and the blue color indicates 100% accuracy. The fig. 9 shows the evaluation time and also indicates the message that training is finished.

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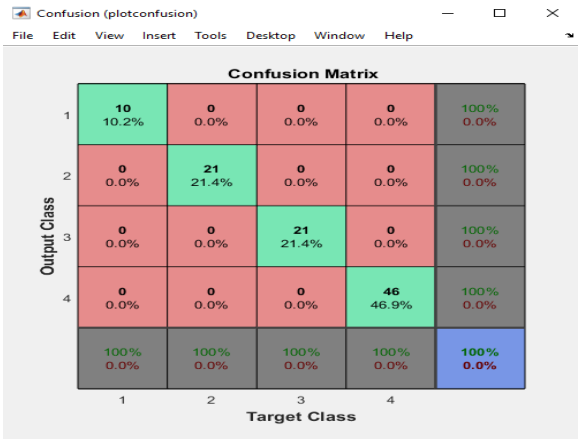

Fig 5 Confusion Matrix for Training

Now we are going to discuss the testing section, here we perform two types of testing.

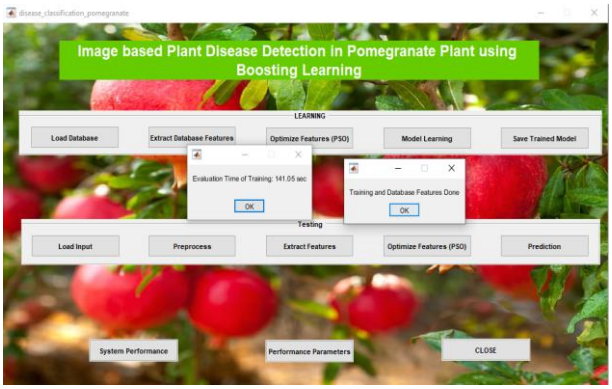

Fig. 6 Testing of an images

First one is for individual image and second type of testing is on whole images. Firstly we test a single image of pomegranate for which we get a HSV and Segmented image shows in fig. 7.

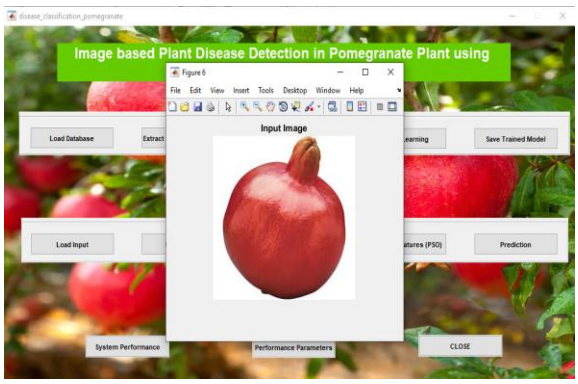

Fig. 7(a) Healthy input

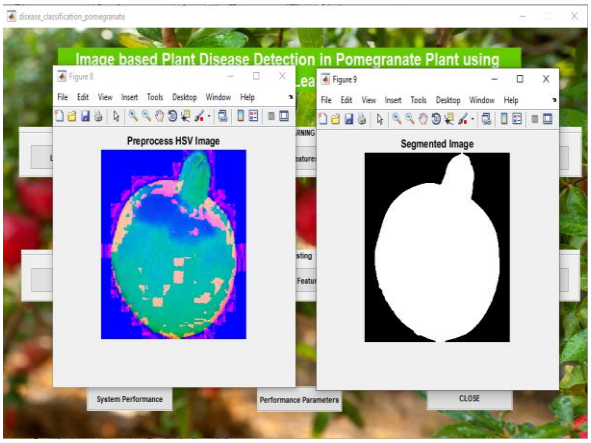

Fig. 7 (b) HSV and Segmented image

After that the features get extracted and that extracted features are further optimized using PSO. Here some input images are shown. If the input image is healthy then simple message is display, but for other diseases we create an image which contain symptoms, management and chemical solution for treatment of disease.

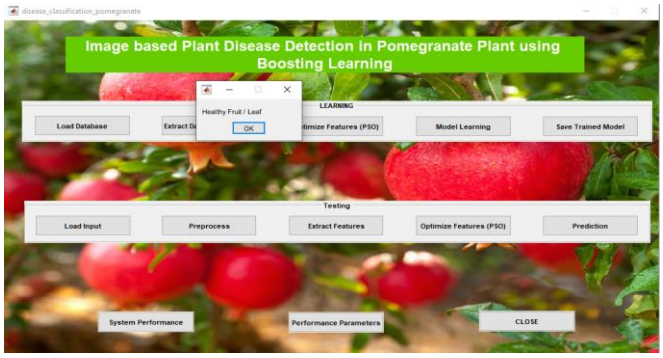

Fig. 7 © Healthy Fruit is identified

It the disease is detected then for that we get the image along with the information about that disease.

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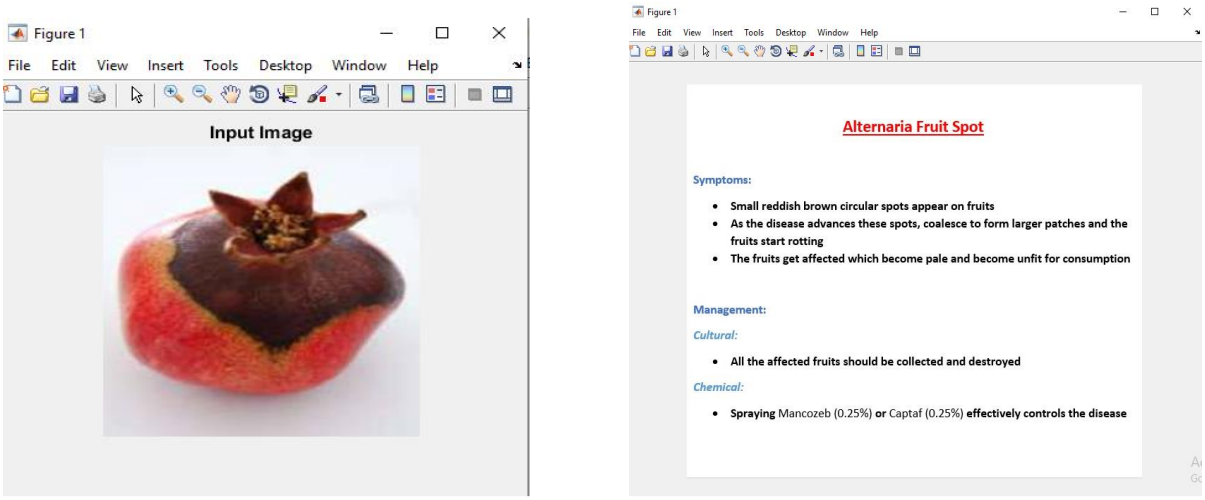

Fig. 8 (a) Input Image; (b) Output Image

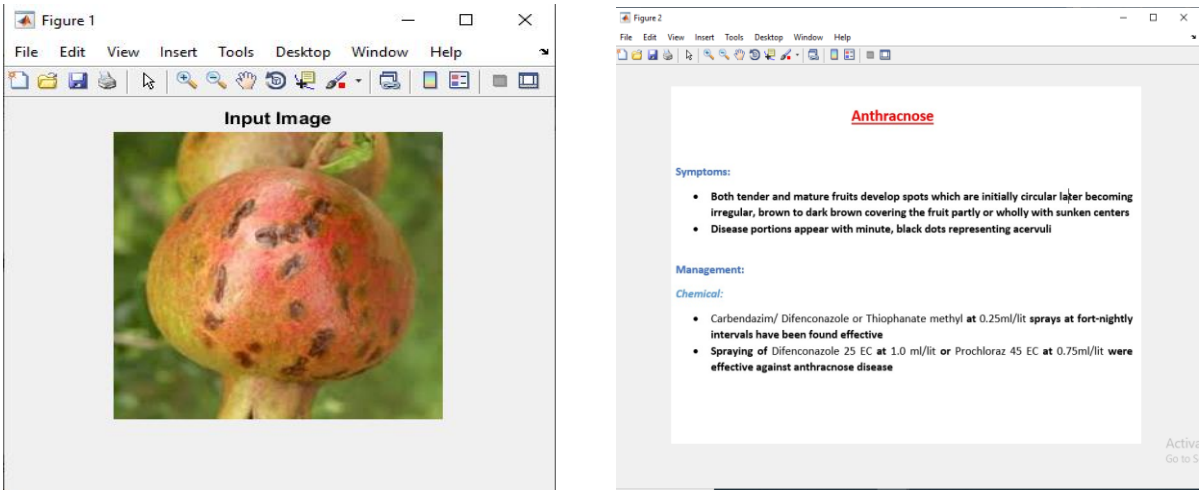

Fig. 9 (a) Input Image; (b) Output Image

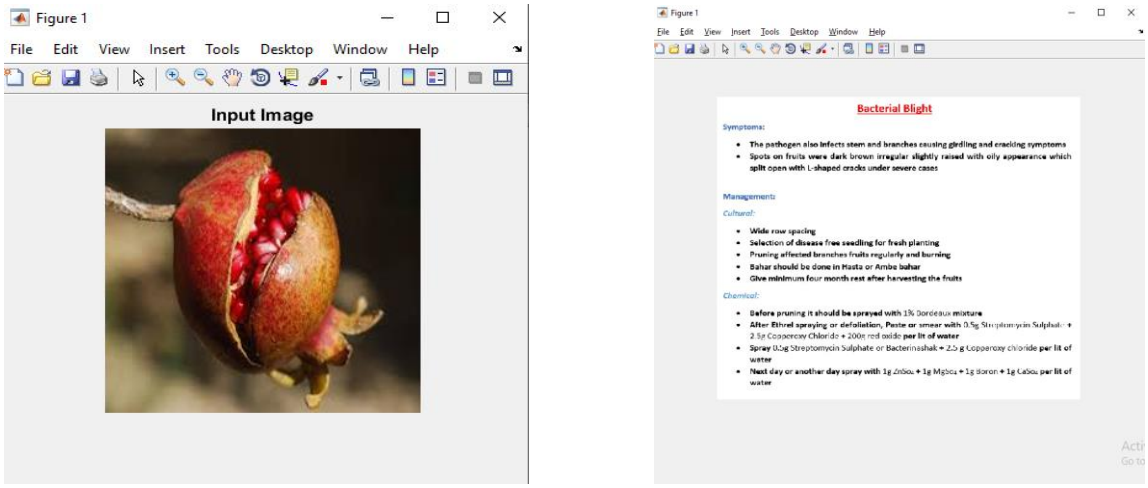

Fig. 10 (a) Input Image; (b) output image

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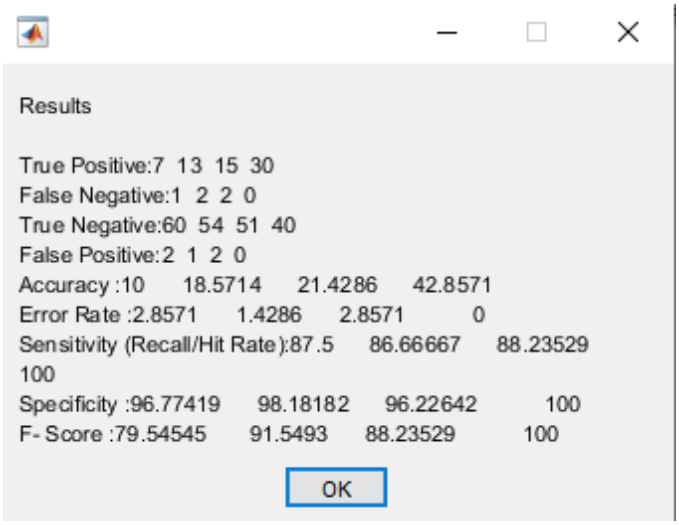
In single image testing, there are some limitations. To overcome this limitation we can perform testing of all images at the same time.

The fig. 10 shows the confusion matrix for testing. When we click on the system performance they ask us to brows testing image folder. Each image in the folder goes through the pre-processing, feature extraction and then that extracted features are optimized using PSO algorithm.

Fig. 10 Confusion Matrix for Testing

After all this the labels and target labels get compared and we get a confusion matrix for testing. The table shows parameters value for each class i.e. Accuracy, sensitivity, specificity and f-score.



IV. CONCLUSION

The existing work reveals the effectiveness of various features and the Extreme Gradient Boosting Algorithm for pomegranate ailment recognition and classification. On the basis of shape and texture features the ROI is segmented. To examine the various symptoms some important features are extracted such as Form factor, Aspect ratio, Circularity factors and Deviation Factors which perform important role in classification and recognition of plant ailments. The processing time of the Ada-Boost classifier for training is 14.15 sec. The classification accuracy obtain using Ada-boost classifier is 92.9%, 90.6% sensitivity and 89.83% f-score.

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