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An Application of LBP Technique for Stone Fruits of Meghalaya

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ABSTRACT:

Fruit Cultivation in Meghalaya is a prominent business sector for earning a good amount of state's revenue. Meghalaya being a home of wide variety of fruits and vegetables holds a unique position in production figures among other states of North-East. Fruit crops are capable of giving higher tonnage of yield per unit area than other field crops. Meghalaya produces several stone fruits such as plum,peach,apricot in a restricted scale. Pear is widely grown in the Khasi Hills districts of the state.The flesh of pear fruit contains stone cells. This paper focuses on quality detection of stone fruits using LBP approach. It will reduce labour cost, improve tree health, increase fruit production and will surely play an important role in the economic prosperity of Meghalaya.

Keywords: fruit quality detection, LBP, artificial neural network.

INTRODUCTION:

Meghalaya is a state in northeast of India. The name means "the abode of clouds". Its capital Shillong is known as the "Scotland of the East". Nature has blessed her with abundant rainfall, sun-shine, virgin forests, high plateaus, tumbling waterfalls, crystal clear rivers, meandering streamlets and above all with sturdy, intelligent and hospitable people. Meghalaya is subject to vagaries of the monsoon. The climate varies with altitude. The climate of Khasi and Jaintia Hills is uniquely pleasant and bracing. It is neither too warm in summer nor too cold in winter, but over the plains of Garo Hills, the climate is warm and humid, except in winter. The Meghalayan sky seldom remains free of clouds. The average annual rainfall is about 2600 mm over western Meghalaya, between 2500 to 3000 mm over northern Meghalaya and about 4000 mm over south-eastern Meghalaya. There is a great variation of rainfall over central and southern Meghalaya. At Sohra (Cherrapunjee), the average annual rainfall is as high as 12000 millimetres, but Shillong located at a distance of about fifty kilometres from Sohra receives an average of 2200 mm of rainfall annually.

Meghalaya has suitable climate for cultivation of wide variety of horticulture crops such as fruits, vegetables, spices, aromatic and ornamental plants, medicinal plants and plantation crops. The key fruits grown in the state are pineapple, citrus fruits, banana, papaya and strawberries. Other potential fruits include plums, peaches, apricot,pear, guava, mango, litchi, lemon, etc. Fruits are found to be a rich source of vitamins and minerals. Fruits crops are capable of giving higher tonnage of yield per unit area than other field crops. As the new technologies and developments have gradually become readily available in the country, the cropping and cultivating systems and production practices have also remained witness to

significant metamorphosis. Fresh fruits and vegetables export has steadily increased. In order to make the thriving business, the industrial strategy of India has been expanded beginning from the lower level to the huge markets to deal globally. Fresh fruits and vegetables which are cultivated are send to the small scale vegetable and fruit suppliers, then these items are dispatched to the fruit and vegetable exporters as well as to the local markets.The last few decades recorded an all time high of number of Indian fruit and vegetable exporters and suppliers. Fruit production and cultivation in this country has witnessed a growth of near about 3.9 %, while fruit processing units have also grown about 20 % per year. These fruits can also be processed in several products like canned fruit, concentrates and fruit juices, dehydrated fruit, jellies and jams. In this paper, the quality of fruit is determined by using features obtained with the help of Local Binary Pattern(LBP) approach. The proposed technique accurately detects the quality of fruits. The results are obtained for the chosen stone fruits of different colour, shape and size. This kind of system can be employed in juice plants, fruit and vegetable farms, packaging etc.

Cultivation of fruits chiefly depends upon the quality of soils, harvest, plantation and a perfect ambience of brilliant minds. There are ample investment opportunities for the expansion of export market for fruit cultivation in Meghalaya. But the low level of industrialization and the poor infrastructure base acts as a barrier to the interest of the state's economy. Plums, peaches, pear, apricots can be grown in abundance in Meghalaya. This is because Meghalaya has favourable soil and climatic conditions for stone fruit cultivation and thus holds a huge horticulture potential and also a great scope to augment business prospect.

Literature Review: Nagganaur and Sannanki [5] presented the sorting and grading of fruits using image processing techniques. The system starts the process by capturing the fruit’s image. Then the image is transmitted to the MATLAB for feature extraction, classification and grading .both classification and grading realized by fuzzy logic approach. C Arun Kumar [2] presented a system that utilizes image-processing techniques to classify and grade fruits. The developed system starts the process by capturing the fruit’s image using a regular digital camera. Then, the image is transmitted to the processing level where feature extraction, classification and grading is done using MATLAB. The fruits are classified based on color and graded based on size. Both classification and grading are realized by Fuzzy Logic approach .Effendi, Ramli and Ghani [3] developed a pattern recognition system to identify the Jatropha curcas fruit maturity and grade the fruit into relevant quality category. The system is divided into two stages: the first stage is a training stage that is to extract the characteristics from the pattern. The second stages is to recognize the pattern by using the characteristics derived from the first task. Back propagation diagnosis model is used to recognition the Jatropha curcas fruits. It is ascertained for the developed system is used in recognizing the maturity of Jatropha curcas fruits. The paper presents a pattern recognition system of Jatropha curcas using back propagation. Patel, Jain and Joshi [4] discussed the fruit detection using improved multiple features based algorithm. To detect the fruit, an image processing algorithm is trained for efficient feature extraction. The algorithm is designed with the aim of calculating different weights for features like intensity, color, orientation and edge

of the input test image. The weights of different features represent the approximate locations of the fruit within an image. S.Arivazhagan, Shebiah, Nidhya nandhan and Ganesan [7] has used color and texture features for fruit recognition. The recognition is done by the minimum distance classifier based upon the statistical and co-occurrence features derived from the wavelet transformed sub-bands. Bindu Tiger and Toran verma [1] discussed apple recognition techniques based on entropy, shape of apple, colour, and boundary attributes extraction. Proposed method classifies and recognizes apple images based on obtained features values by using two-layer feed-forward network, with sigmoid hidden and output neurons. The toolbox supports feed forward networks, radial basis networks, dynamic networks, self-organizing maps, and other proven network paradigms. This work represents the MATLAB 7.8.0 software and the recognition of generated signals by artificial neural network technique. Sandoval, Prieto and Betancur [6] have proposed a machine vision based classification system to sort coffee fruits (cherries) according their ripeness stage is presented. Eight categories were defined and they include the entire coffee cherry ripeness process, from the initial stage (early green) to over ripe and dry stages. A Bayesian classifier was implemented using a set of nine features which include colour, shape and texture computed on an image of the fruit.

In the proposed work, the classification of the stone fruit as ‘bad quality’ or ‘good quality’ is done on the basis of the values obtained after applying LBP approach and the LAB color space approach and ANN; and the accuracy of the proposed system is obtained. LBP technique is used due to its high discriminative power, computational simplicity, invariance to gray scale changes and good performance. This method reduces chance of human error as it accurately detects the fruit’s quality.

Fruit Quality Detection using LBP Approach:

Fruit quality is detected by employing color values of the fruit images by using MATLAB software. Diseased fruit is detected by taking images of a fruit and then applying certain techniques of image processing for analyzing the quality. The color of the fruit is analyzed for classifying the fruit as per its quality. The diseased fruit from the bunch of fruits is found by analyzing the images of the fruit. The classification of the fruit as ‘bad quality’ or ‘good quality’ is done on the basis of the values obtained after applying LBP approach and the LAB color space approach and ANN. At first the RGB image is converted to LAB color space. Conversion into LAB color space enhances or highlights the colors in a digital image. After the conversion of the image into LAB color space, LBP technique is implemented for making the pattern of that image. LBP technique generates histogram of the color patterns in the image and this histogram contains information about all the features and the distribution of edges in the image. Then neural network is used for training the data. The fruit sample is selected for testing from dataset. The testing of fruit sample is performed by using ANN training module. ANN based results are obtained that shows “good quality” or “bad quality” of fruit. Also the accuracy of the system is calculated. This method helps in reducing manual labour as now the quality of the fruit will be found from the images. It is also believed to be more accurate and reliable as it diminishes all the chances of human error. The accuracy of the proposed system is quite promising.

RGB:

It is also referred to as true color image which defines Red, Green and Blue color components for each individual pixel. This RGB array is of class double where each color component is a value between 0 and 1. This can be stored along the third dimension of data array.

Color Histogram:

It controls the appearance and behaviour of image. It converts color image into HSV image and preserves the hue and saturation components. The values are extracted and plotted in the graph. The intensity matrix is obtained from the HSI image matrix. This matrix is updated with histogram equalized intensity matrix.

Lab color space is a 3-axis color system with dimension L for lightness and a and b for the color dimensions. Working with the Lab color space includes all of colors in the spectrum, as well as colors outside of human perception.

The Lab color space is the most exact means of representing color and is device independent. This accuracy and portability makes it suitable in a number of different industries such as printing, automotive, textiles, and plastics.

Image Processing Toolbox in MATLAB provides a comprehensive set of reference-standard algorithms and workflow apps for image processing, analysis, visualization, and algorithm development. We can perform image segmentation, image enhancement, noise reduction, geometric transformations, and image registration using deep learning and traditional image processing techniques. The toolbox supports processing of 2D, 3D, and arbitrarily large images.

Image Processing Toolbox apps can automate common image processing workflows. We can interactively segment image data, compare image registration techniques, and batch-process large datasets. Visualization functions and apps can explore images, 3D volumes, and videos; adjust contrast; create histograms; and manipulate regions of interest (ROIs).

We can accelerate your algorithms by running them on multicore processors and GPUs. Many toolbox functions support C/C++ code generation for desktop prototyping and embedded vision system deployment.

Graphical User Interface: With MATLAB we can make our own particular Graphical User Interface, or GUI, which comprises of a Figure window containing menus, catches, content, representation, and so on. That a client can control intelligently with the mouse and console. There are two fundamental strides in making a GUI: One is planning its design, and the other is composing call back works that play out the craved operations when the client chooses distinctive elements. A graphical user interface (GUI) is a human-computer interface (i.e., a path for people to interact with computers) that utilizes windows, icons and menus and which can be controlled by a mouse (and regularly to a constrained degree by a console too). A GUI uses a blend of advances and gadgets to give a stage that the client can interface with, for the assignments of get-together and creating data. The most well-known mix of such components in GUIs is the WIMP ("window, icon, menu, and directing gadget") worldview, particularly in computers. Planning the visual synthesis and transient conduct of GUI is a vital part of programming applications. It will probably improve the productivity and usability for the fundamental legitimate configuration of a put away program, an outline discipline known as ease of use. Strategies for client focused outline are utilized to guarantee that the visual dialect presented in the outline is all around custom fitted to the undertakings.

Artificial neural network(ANN): Neural network is used to detect the quality of vegetables. A block diagram representation of neural network is shown below in fig.1. The block diagram shows that neural network consists of three layers which are input layer,hidden layer and output layer. The input layer defines the input given to the neural network which is processed in the middle layer which

consists of neurons and this middle layer is known as hidden layer. The hidden layer process the input at the training time to provides the desired output at the testing time. The last layer is the output layer which shows the output result.

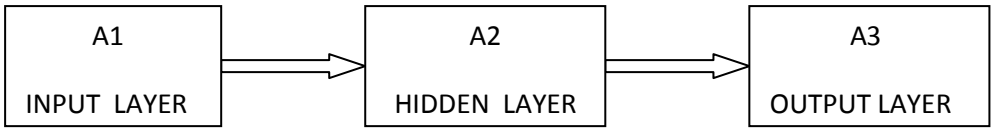


Figure 1

In training time neural network is trained to detect the quality of fruit image. The data generated during the training time are stored in the data base of neural network. When a new image is loaded during testing time,features are extracted from the new image which is compared with data stored in neural network. Artificial neural network (ANN) detects the fruit quality on basis of its knowledge gained during training time. Training and Testing model of neural network is shown in fig.2. This model consists of input layer, hidden layer and output layer. In the input layer colour features are calculated. Hidden layer consists of neurons which generate output. Output layer compares the results of extracted features and results provided at training time and generates the final output.

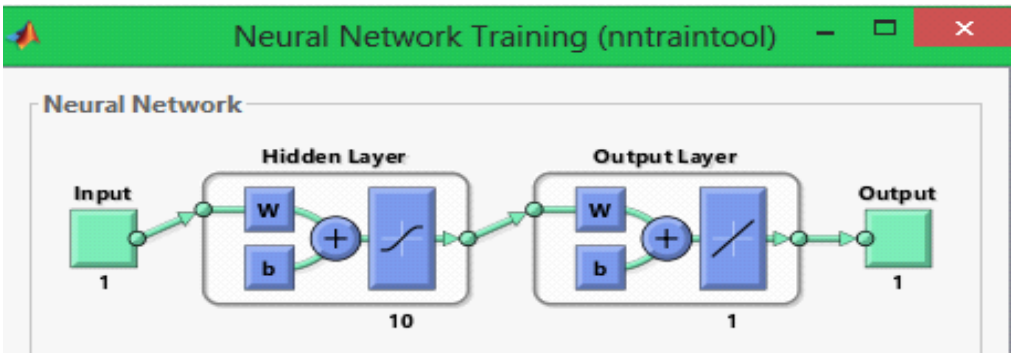


Figure 2

Local Binary Pattern (LBP):

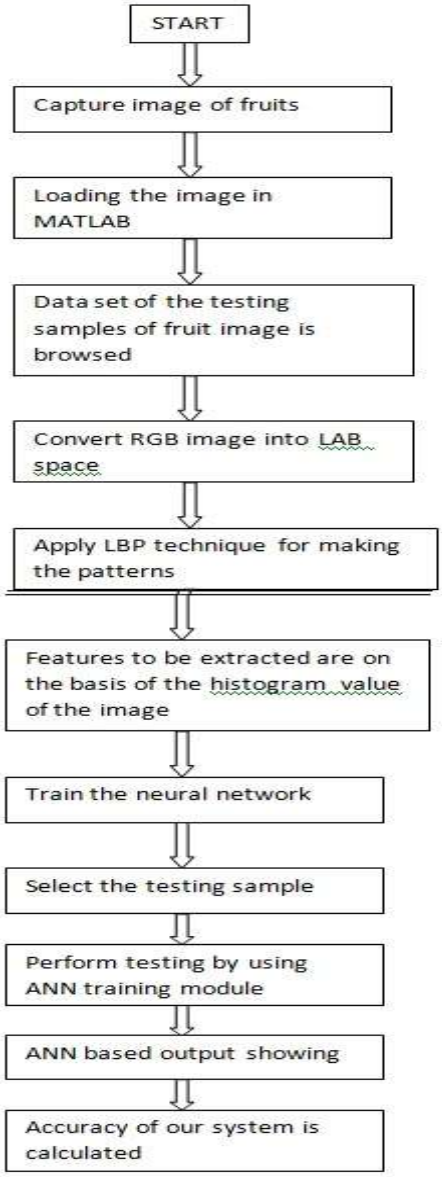
Local Binary Pattern (LBP) is a simple yet very efficient texture operator which labels the pixels of an image by thresholding the neighbourhood of each pixel and considers the result as a binary number [8]. Due to its discriminative power and computational simplicity, LBP texture operator has become a popular approach in various applications. It can be seen as a unifying approach to the traditionally divergent statistical and structural models of texture analysis. Perhaps the most important property of the LBP operator in real-world applications is its robustness to monotonic gray-scale changes caused, for example, by illumination variations. Another important property is its computational simplicity, which makes it possible to analyze images in

The local binary pattern operator is an image operator which transforms an image into an array or image of integer labels describing small-scale appearance (textures) of the image.These labels directly or their statistics are used for further analysis. It is assumed that a texture has locally two complementary aspects, a pattern and its strength.Local binary pattern operator works in a 3×3 pixel.

Advantages of LBP are high discriminative power, computational simplicity,invariance to grayscale changes and good performance.LBP is one of the most commonly used features for texture discrimination tasks like face, facial expressions, gesture, scene and object recognition. For calculating the LBP, the LBP code for each pixel is calculated and the histogram of LBP codes is constructed as the LBP feature. The block diagram of the proposed system is shown below:

Block Diagram :

(Figure 3)



There are eleven Steps for the fruit quality detection in proposed methodology. These steps are as following:

Step 1: Capture image of fruits.

Step 2: This image is loaded into the MATLAB.

Step 3: Data set of the testing samples of fruit image is browsed.

Step 4: Convert RGB image into LAB space.

Step 5: Apply LBP technique for making the patterns.

Step 6: Features to be extracted are on the basis of the histogram value of the image.

Step 7: Train the neural network.

Step 8: Select the testing sample.

Step 9: Perform testing by using ANN training module.

Step 10: ANN based output showing "good quality" or "bad quality" of fruit.

Step 11: Accuracy of our system is calculated.

Methodology:

The Graphical user interface(GUI **)** for proposed work is shown below in fig 4.

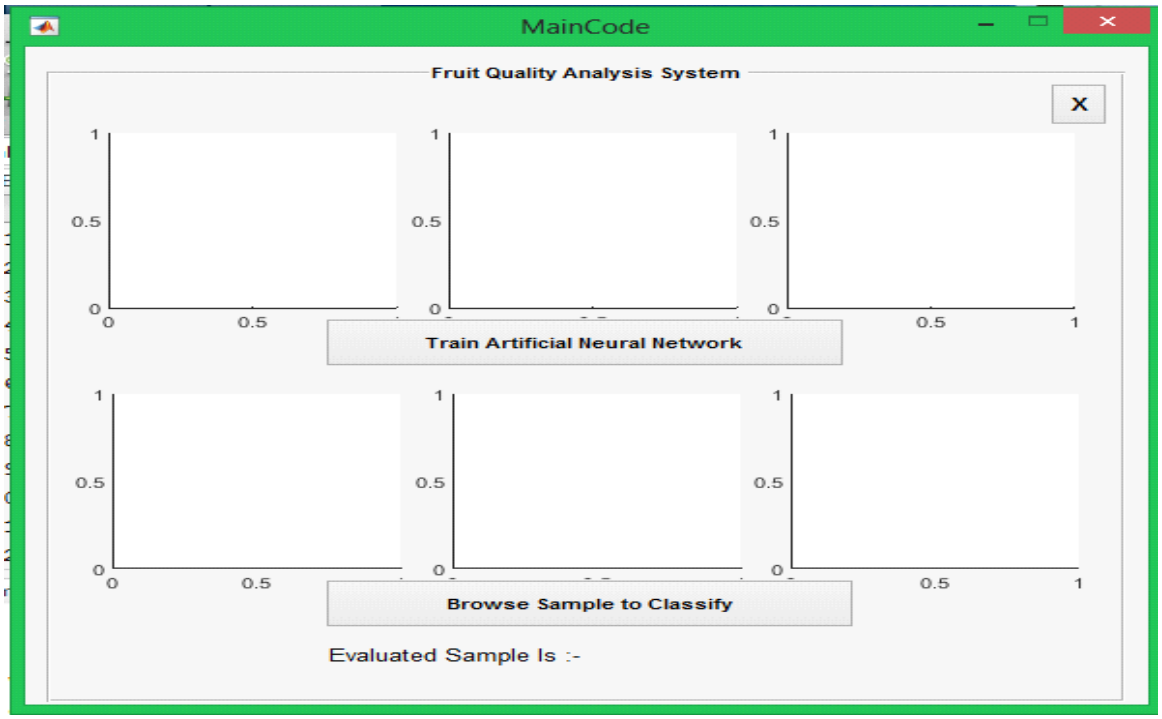


Figure 4

Select the fruit sample from 'Test Sample' folder (fig 5).

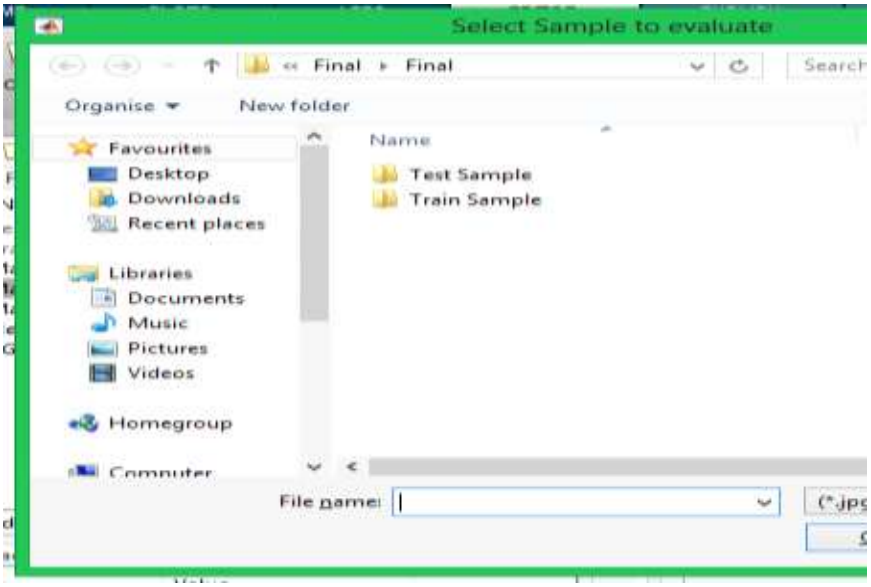


Figure 5

Data set of the testing samples of fruit image is browsed (fig 6).

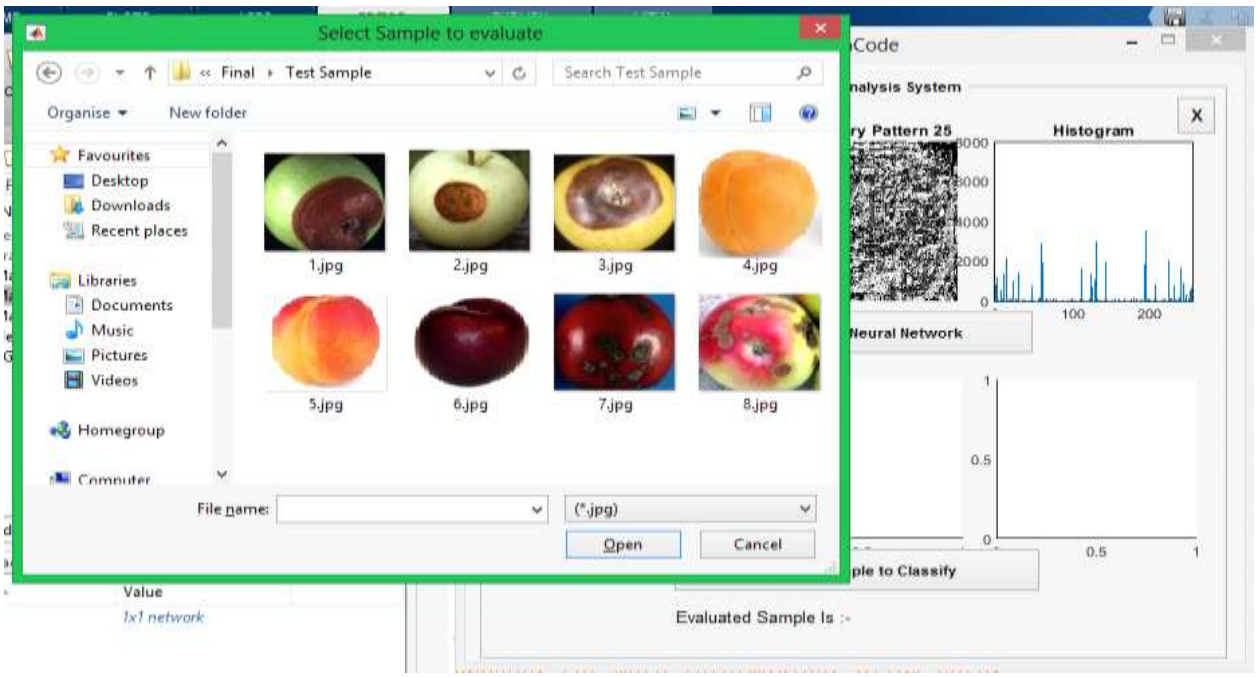


Figure 6

Now convert RGB image into LAB space and then apply LBP technique for making the patterns.The features of the sample fruit is extracted on the basis of the histogram value.

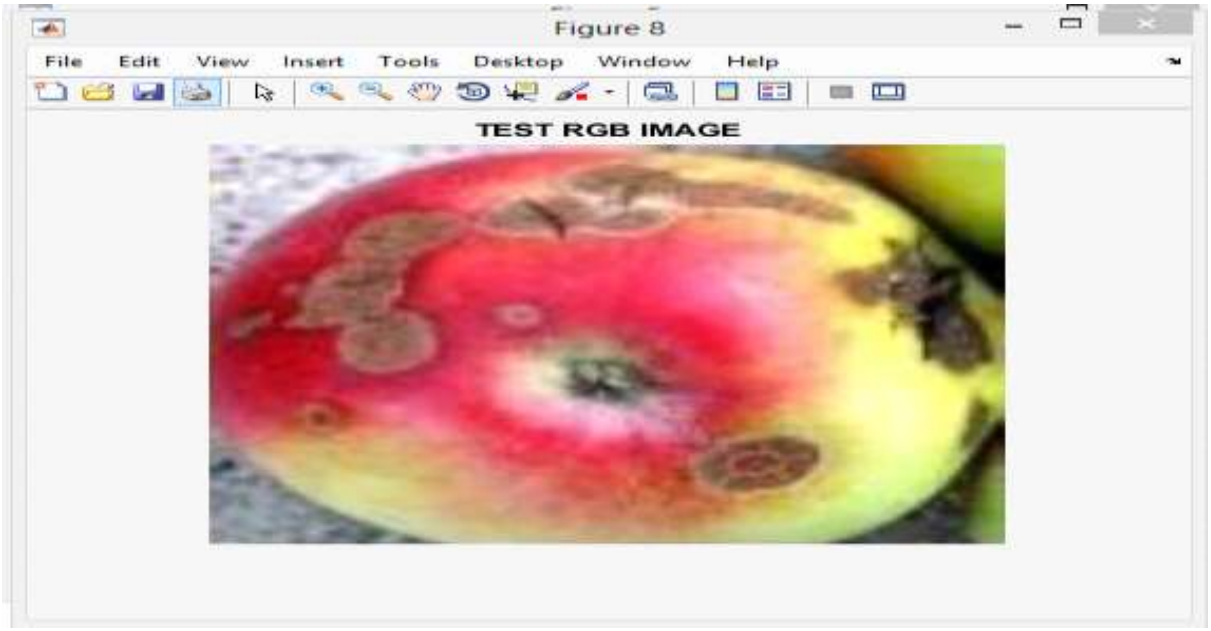


Figure 7

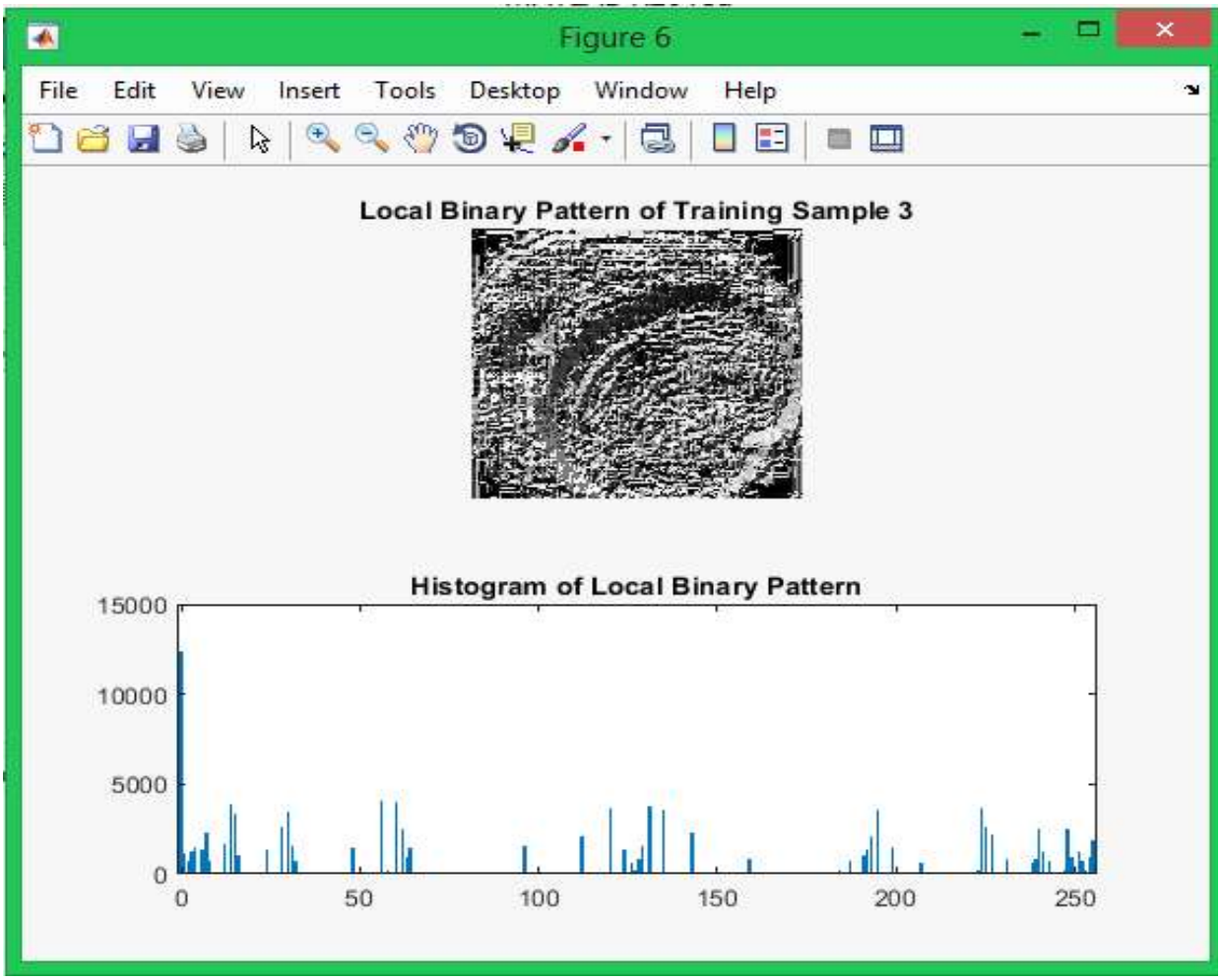


Figure 8

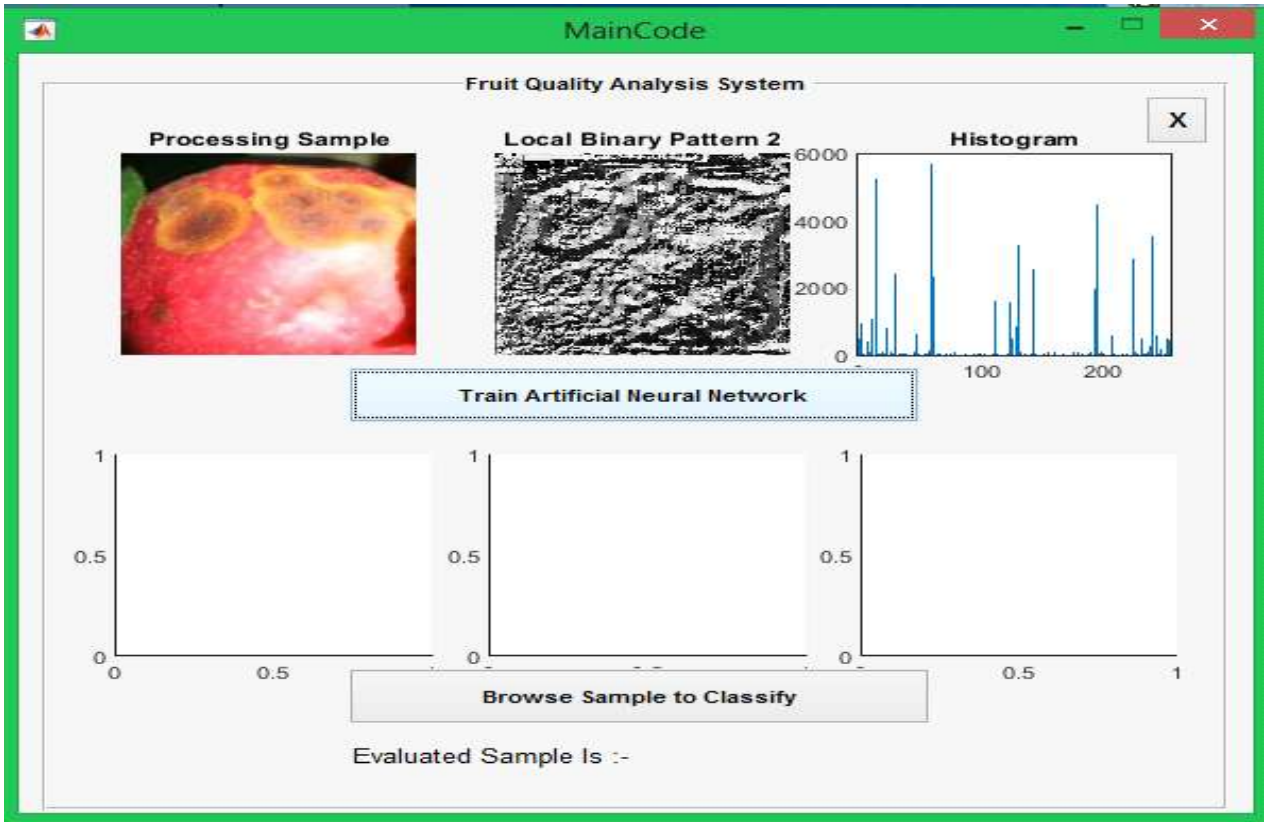


Figure 9

The next step is to train the neural network. In the graphical user interface,the user selects the testing sample and then click on ANN training module.It shows neural network training tool. After that click on 'performance' this will evaluate the fruit samples as 'good quality' or 'bad quality' sample (shown below in fig.).

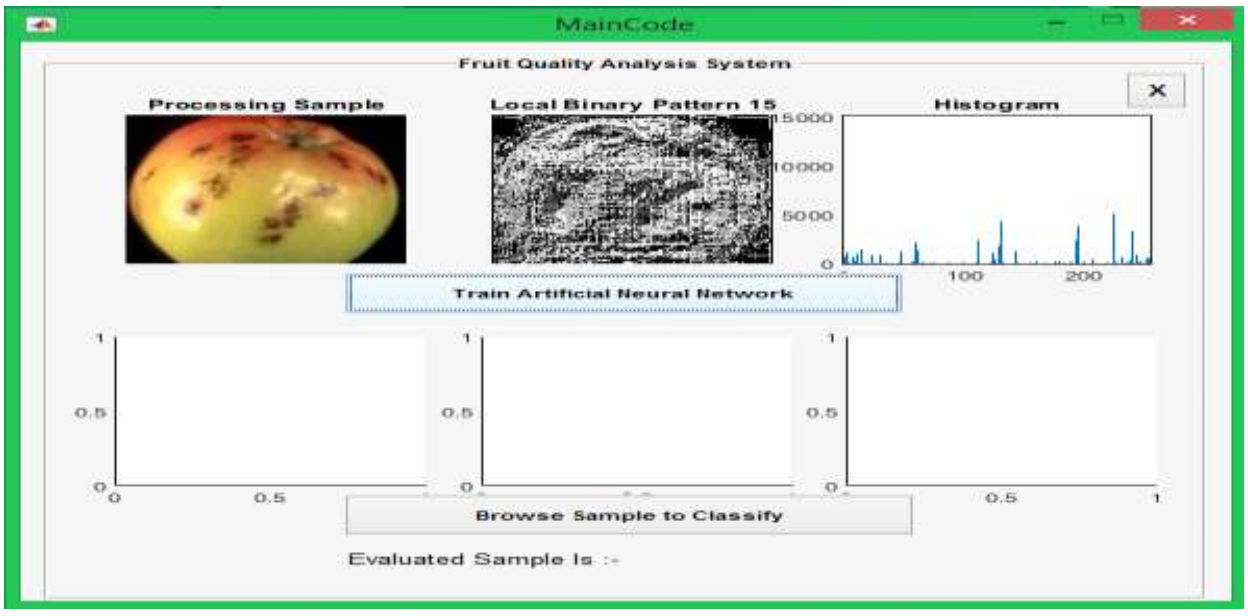


Figure10

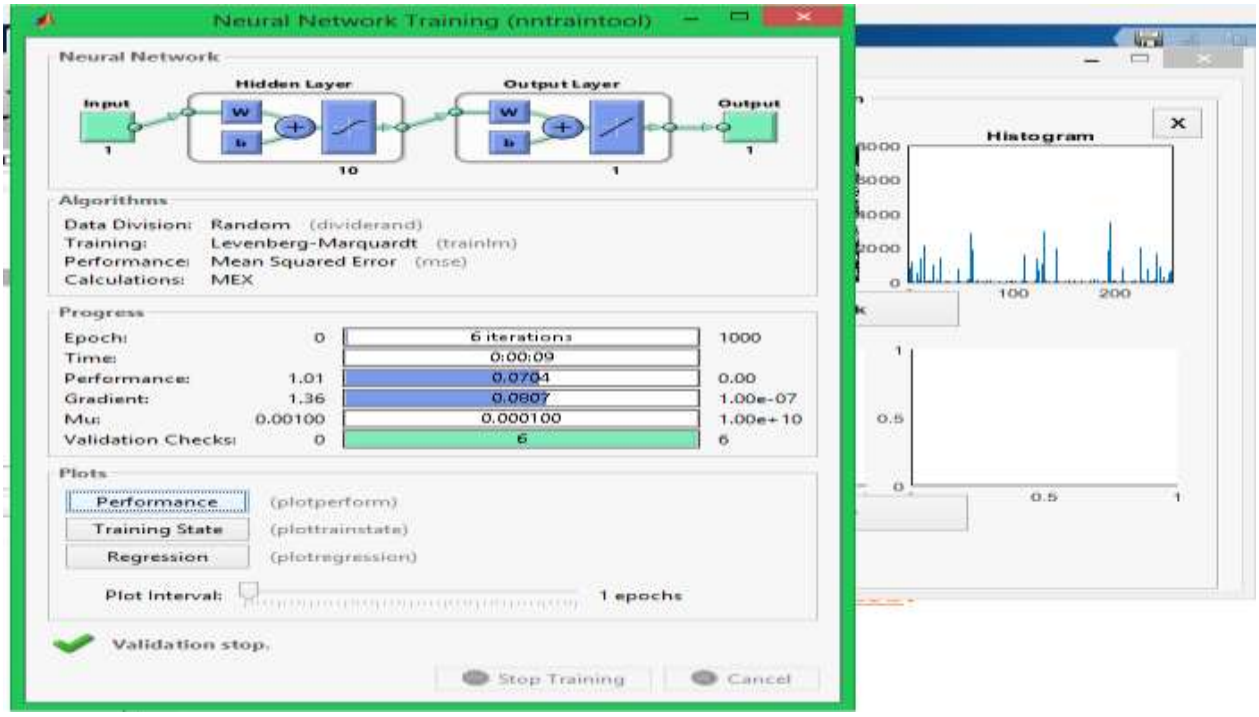


Figure 11

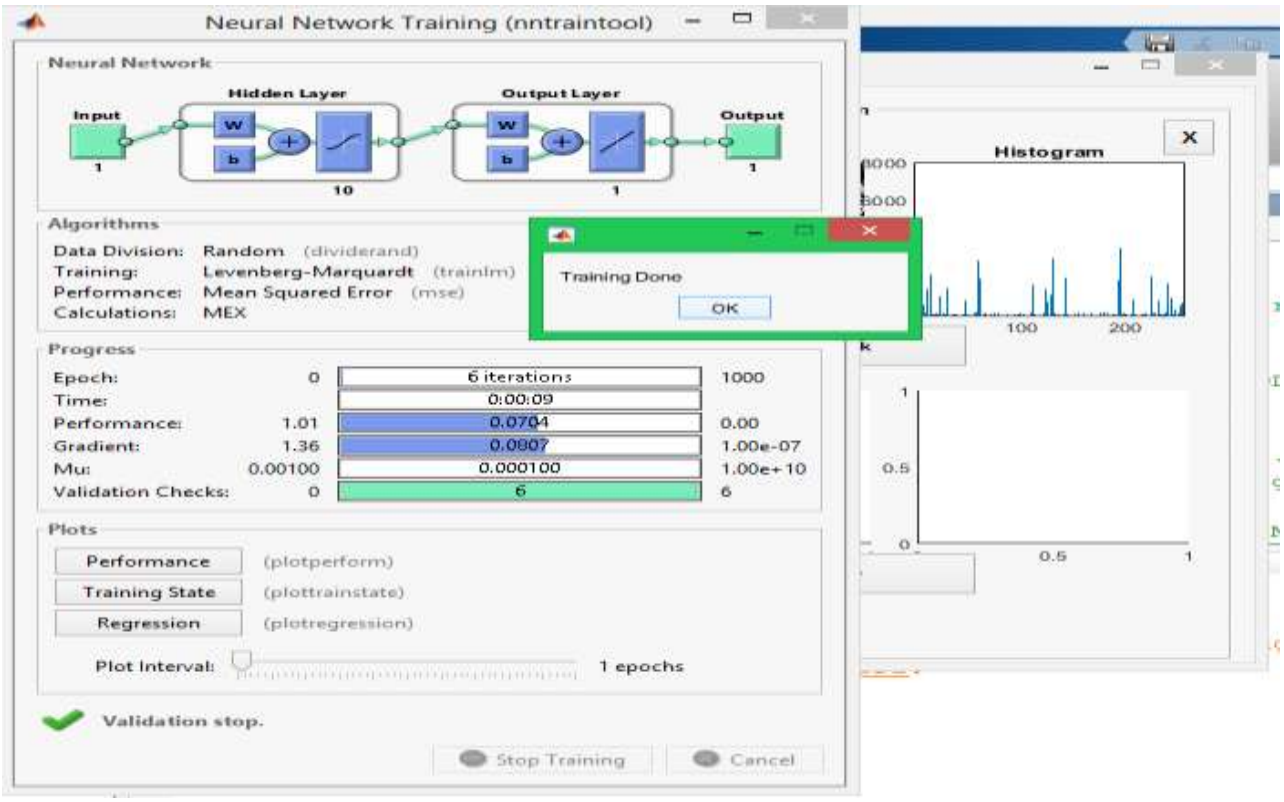


Figure 12

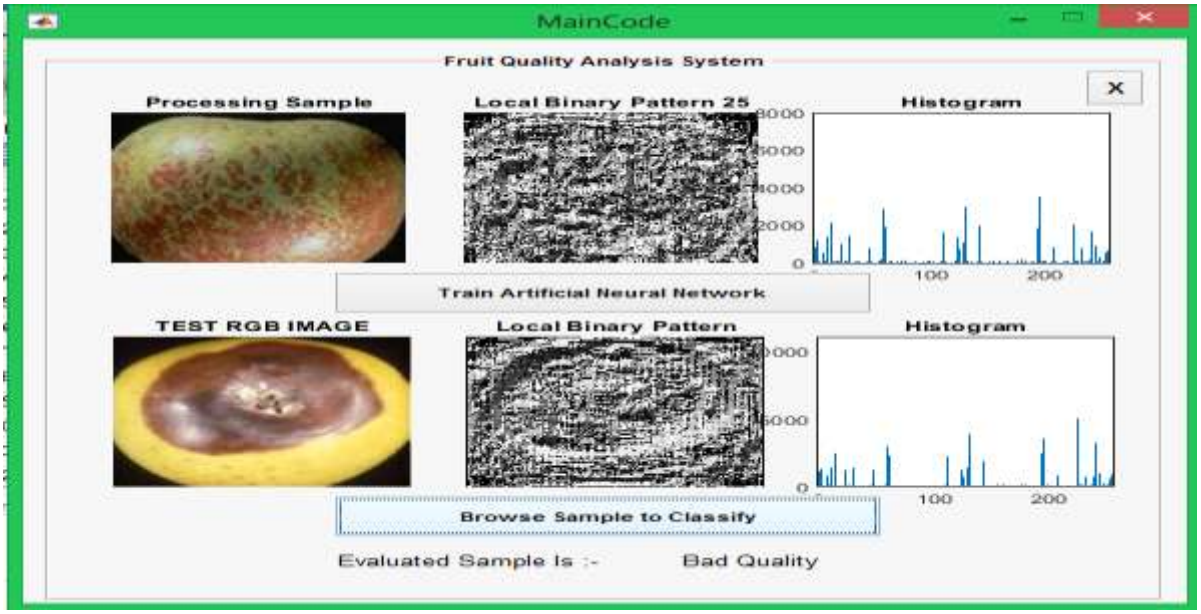


Figure 13

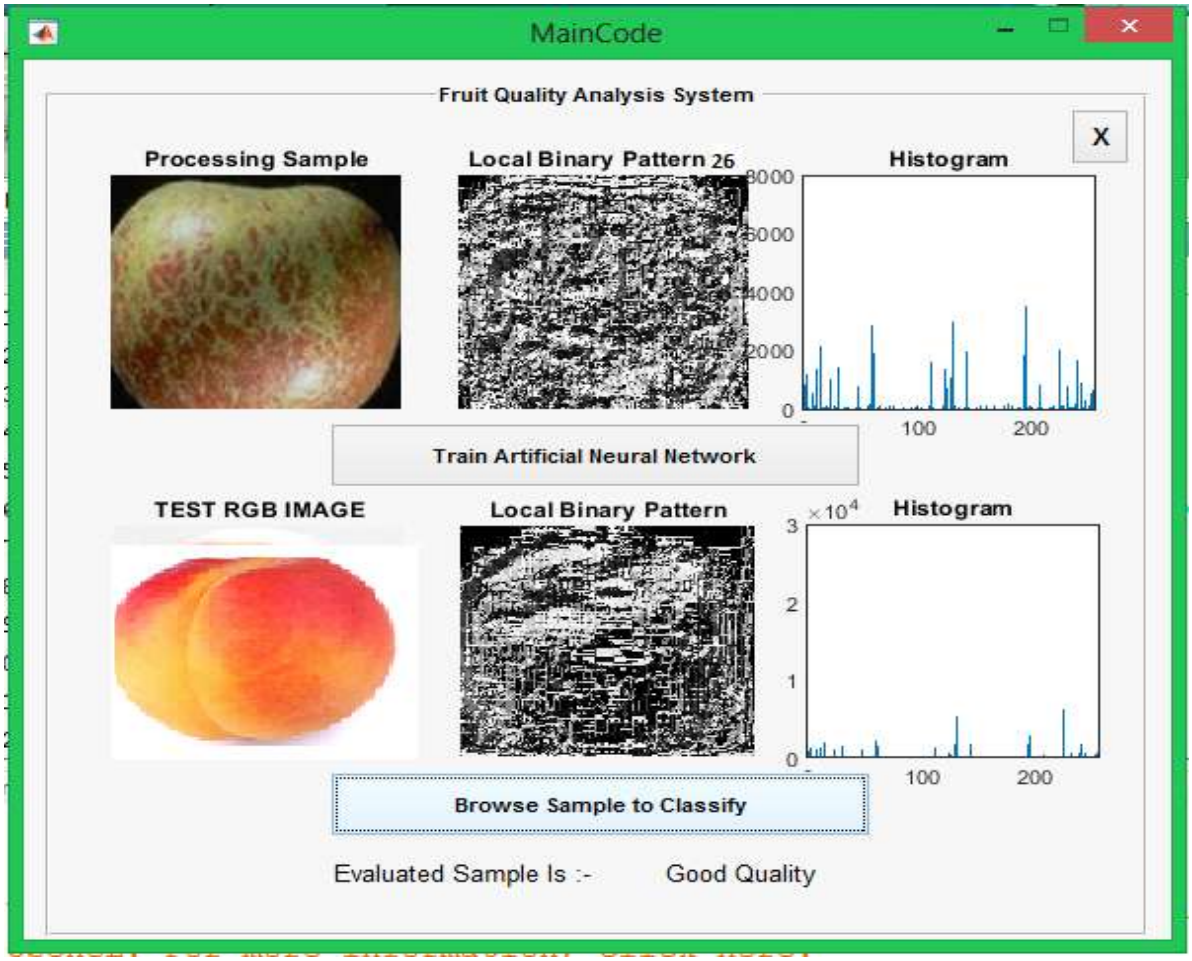


Figure 14

The accuracy of the proposed system is calculated. It is shown below:

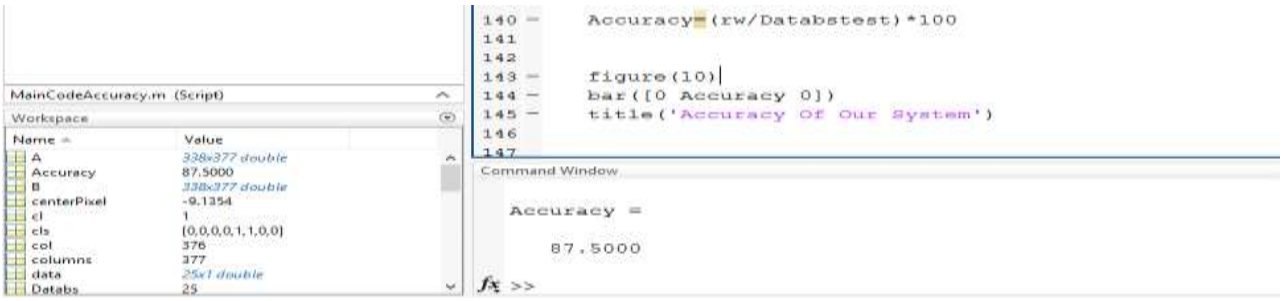


Figure 15

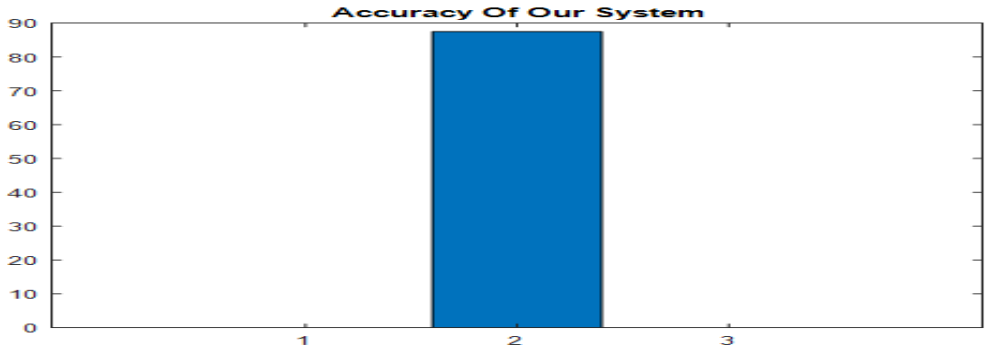


Figure 16

Results:

Final results for fruit quality detection of given fruit samples:

Serial No.	No. of Fruit Samples	Quality of Fruit Sample
1	Sample 1	Bad Quality
2	Sample 2	Bad Quality
3	Sample 3	Bad Quality
4	Sample 4	Good Quality
5	Sample 5	Good Quality
6	Sample 6	Good Quality
7	Sample 7	Bad Quality
8	Sample 8	Bad Quality

CONCLUSION:

Meghalaya is basically an agricultural state with about 80% of its total population depending entirely on agriculture for their livelihood .Stone fruits like plum, peach, apricot are found in the central plateau of East and West Khasi Hills and Jaintia Hills. Pear containing stone cells is widely grown in the Khasi Hills districts of the state. These fruits have good commercial value. Diseases in fruits can cause significant reduction in both quality and quantity of agricultural products. In the proposed work, LBP approach and artificial neural network(ANN) is used for detection and identification of normal and infected stone fruits. Hopefully, this will reduce labour cost, improve tree health, increase fruit production and will surely play an important role in the economic prosperity of Meghalaya.

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