Quality Evaluation Technique For Phyllanthus Emblica(Gooseberry) Using Computervision With User Friendly GUI

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Abstract--This paper proposes quality assessment method to classify a phyllanthus emblica (gooseberry) using computer vision by surface and geometric features. India is one of the most important gooseberry producers in North Asia, than Germany, Poland, U.K, Russia etc., but fruit sorting in some area is still done by hand which is tedious and inaccurate. Thus, the need exists for improvement of efficiency and accuracy of this fruit quality assessment that can meet the demands of international markets. Low-cost and non-destructive technologies capable of sorting gooseberry according to their properties would help to promote the gooseberry export industries. This paper propose the method of colorization and extracting value parameters, by this parameters the detection of browning or affected part and identification of the uniform shape and size. This differentiates the quality of gooseberries processed as well as fresh. For classification the decision tree is used.

Keywords: Image Processing; Phyllanthus Emblica (Gooseberry);Colorization using swtches and optimization; Texture feature; Non-Destructive method;Computer Vision; Canny Edge Detection;Decision Tree.

I. INTRODUCTION

Indian Gooseberry (Emblica officinalis Gaertn.) belongs to family Euphorbiaceae. It is one of the important indigenous fruits of Indian subcontinent. It is a rich source of vitamin C and it is one of the three constituents of the famous ayurvedic preparation, triphala, Ayurvedic medicines which cures digestive disorders, rheumatoid arthritis and osteoporosis, inflammation, cancer, age-related renal disease, and diabetes..It is used in making pickles and preserves. Quality standards of processed gooseberry for fresh consumption are mainly based on the presence of uniform colour (without browning effect), as well as an adequate shape, size. Automated quality evaluation is mainly required because many product of gooseberry are exported in foreign countries like U.S.A, Norway, South Africa, Canada Australia etc. form India. In India the major gooseberry producing states are U.P, Gujarat, Rajasthan, Maharashtra, Haryana, Mizoram, Tamilnadu etc. Shape, size are determined by various parameter and uniform colour is determined by various colorization algorithm. Colorization is a computer-assisted process of adding colour to a monochrome image. Recoloring is a process of changing colour in some part of an image [1]. Usually to colorize an image an artist segments the image into regions and assigns colours to them, and this is done by various computer assisted algorithms based on image segmentation algorithms which will give high degree of interactivity, which allows easy and intuitive correction. Other valuable advantages are simplicity, multi-label assignment, speed and easy extensibility. This process is required to identify the affected part. Machine vision is one of the important advanced technological fields where significant developments have been made [1].

This paper proposes the new direction for automated quality evaluation for gooseberry. In second section problem definition is identified and collection of data is shown. Third section comprises the algorithm and methods to calculate the various features. Fourth section represents the results of different samples. Fifth section gives the results of classification based on quality. Sixth section presents the user friendly GUI for this application. At last the conclusion of proposed method and algorithm is given.

II. PROBLEM DEFINITION

The Gooseberry has long been a part of local culture in the southern regions of the India. And quality factor is main consideration. Export industries face the problem to evaluate quality manually. Sometimes customer needs may not be satisfied by this method, so automated method is useful for quality evaluation. The gooseberry coming from different places those are in uneven shape, rotten, infected and many other impurities. Gooseberry pieces contains the browning effect as shown in the Figure 1 (a) and (b) Which is marked by red ellipse and very small and big pieces are marked by blue ellipse because those pieces are considered as some foreign elements and impurities those are added to increase the weight while exporting, this degrades the quality of gooseberry, so uniform shape is also considered in quality factor. So this paper gives quality evaluation in terms of two parts as shown in Figure 2. Part 1 is Geometric information which contains shape and size.Part2 is Surface information which contains colorization. Finally, this process would classify the Phyllanthus Emblica (gooseberries) in terms of small, normal, large and browning is also identified by colorization. For better classification decision tree is chosen and applied.

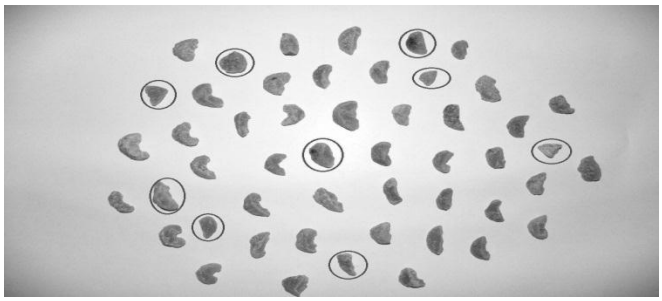

Fig (1): Processed Gooseberry Sample

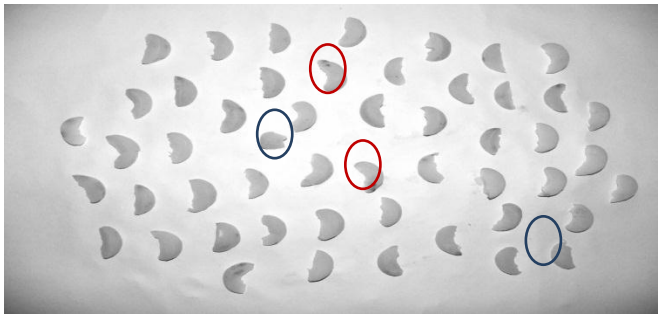

Fig (2): Fresh Gooseberry Sample

Fig 1,2 shows Gooseberries with browning and foreign elements

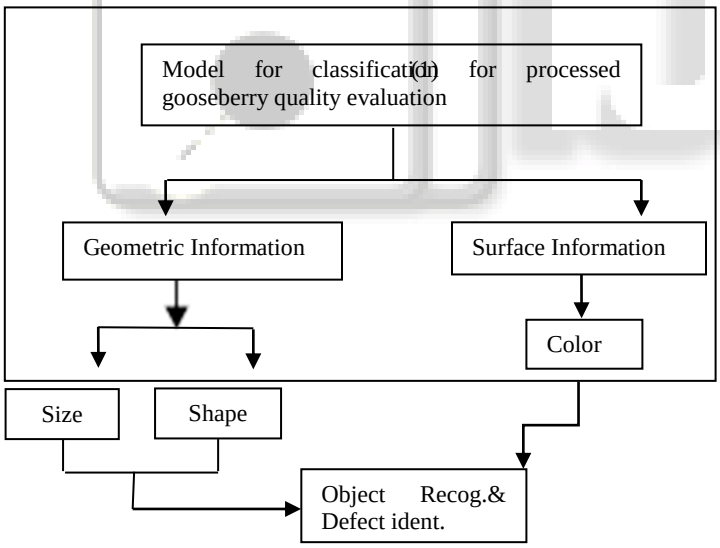

Fig (3): Process diagram of Quality evaluation

III. MATEIRAL AND PROPOSED ALGORITHM

In this section we discuss suggested algorithm. We have taken different samples of Phyllanthus Emblica (gooseberry) and defined the quality based on combined measurement technique. We calculate minor axis, major axis, area and eccentricity. For shape and size we give priority to area (small, normal ,large) and for browning effect we use different colorization algorithm, based on this result we give priority to minor axis(shrink, normal).

A. System Description

Experimental trials have been carried out following a procedure. As shown in Figure 4 samples of gooseberry are placed in white tray for visual inspection, Two side light illumination is chosen to improve the contrast between the gooseberry pieces and the background. Moreover, since gooseberry pieces become semi-transparent, a dark background would not be recommended, butter paper is chosen for background. This lightning is covered with a wooden box, whose internal walls are black painted, to avoid reflections and protect from external light. A Nikon Coolpix P90 12.1 Mega pixel camera, equipped with an 24x zoom lens, is fixed on a top of the box, and round hole was made on the top of the paper box to introduce the camera lens. Operation of proposed system is carried out in steps in Table1.

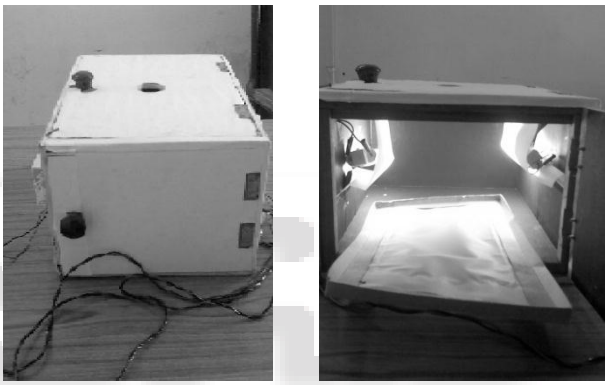

Fig (4): Proposed Image acquisition system

B. Proposed Algorithm

The captured images are transferred to the processing unit where the proposed algorithm of Table 2 is applied to measure the quality of the Phyllanthus Emblica (gooseberry) pieces. After the processing of the image the total number of gooseberry pieces with browning effect, number of small, normal, large pieces are displayed on the screen. This number would clearly give the quantified quality of the sample of the randomly selected gooseberry pieces.

Sr. No	Steps
1	Spread the pieces uniformly on the tray to avoid overlapping.
2	Take the image of the pieces by camera (12.1megapixels).
3	Analysis of digital image in computer.
4	Display number of small, normal, large pieces and for colorization shrink, normal pieces.5
5	Repeat step 1 to 4 for 30 samples.

Table (1): operation of proposed system

1) Surface Information:
RGB image is basically made from three colours so we separate the three planes of image as shown in Figure 4.and plot the histogram of three planes as shown in Figure 4. From the Figure 5 we can see in G plane the browning carries the light green color and it is easily identified so we pick up the G plane for further process. From figure 4 we can analyze the intensities of three planes and in first plane(R) the histogram tend toward the light intensity, in second plane (G) the histogram contains some dark side intensity and in third plane(B) histogram tend toward the dark intensity. we are concentrating the G plane so we are fixing the brown part intensity from histogram and try to hide that part of intensity while detecting the edges and calculating the geometric parameter.[2].

Sr. No	Steps
1	Database (sample) collection.
2	Apply Canny edge detection.
3	Calculate the Surface and Geometric parameters.
	Find the histogram of above features.
4	Classification based on histogram.
5	Display on the screen
6	1. Total number of the gooseberry pieces.
	2. Number of gooseberry with browning .
	3.Number of gooseberry pieces with small , normal ,large .

Table (2): Proposed Algorithm

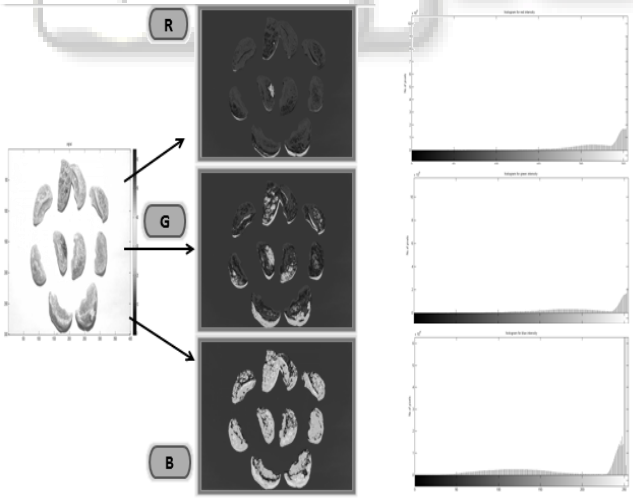

Fig (5): Red, Green, Blue plane separation with histogram

Second method is based on swatches .An RGB image as shown in Figure 6 is converted in to swatch image so it results in three planes Y(intensity) ,U(red difference), V(blue difference).Foreground image is scribbled with one colour while one piece out of all pieces is scribbled with another colour. The resultant image is a colorized image. Next we apply the canny edge detector & then calculate the geometric parameter.

2) Geometric Information:
For size and shape we calculate the area, major axis, minor axis and eccentricity, but for that first apply canny edge detector than calculate it. From that we can classify the small, normal and large pieces of gooseberry.

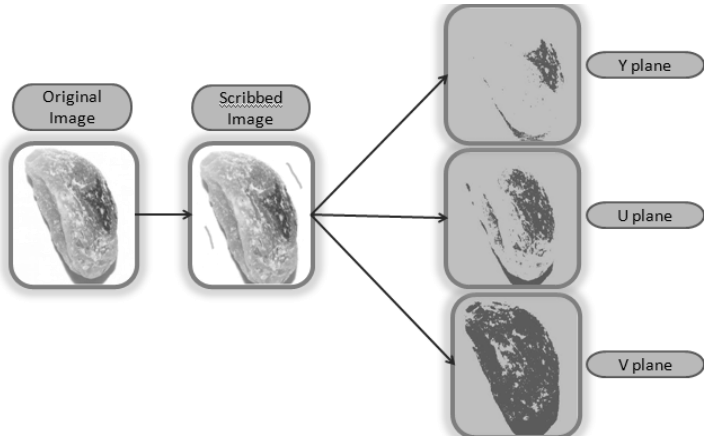

Fig (6): Process of colorization for one piece

C. Canny Edge Detector:

Edge detection is an essential preprocessing step in computer vision algorithms. Within this proposed work we implement one of these methods, the Canny Edge Detector. The Canny edge detector is a popular method for detecting edges that begins by smoothing an image by convolving it with a Gaussian of a given sigma value. Based on the smoothed image, derivatives in both the x and y direction are computed, these in turn are used to compute the gradient magnitude of the image. Once the gradient magnitude of the image has been computed, a process called 'non maximum suppression' is performed; in which pixels are suppressed if they do not constitute a local maximum. In Figure 7 the canny edge detector operator is shown and in Figure 8 the resultant image is shown after the canny edge detection.

$G_X =$

-1	-2	-1
0	0	0
1	2	1

$G_Y =$

-1	0	+1
-2	0	+2
-1	0	+1

Fig (7): Canny edge detection operator [14]

D. Parameter Calculation:

After edge detection operation we extract the different parameters like Minor Axis, Major Axis Length, Area and Eccentricity for evaluation of brown or infected, Small, normal, large pieces.

"The minor axis length M of an image is defined as the length (in pixels) of the minor axis of the ellipse that has the same normalized second central moments as the region."

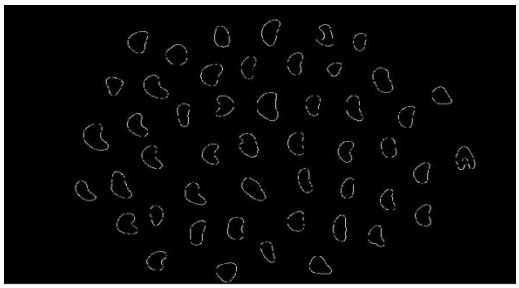

Fig (8) Resultant image of Canny edge detection

"The major axis length N of an image is defined as the length (in pixels) of the major axis of the ellipse that has the same normalized second central moments as the region."

"The area A of any object in an image is defined by the total number of pixels enclosed by the boundary of the object."

"The eccentricity is the ratio of the distance between the foci of the ellipse and its major axis length. The value is between 0 and 1." [3].

Now from the from this four parameter values we plot the histogram for each parameter Minor axis length, Major axis length, Area and Eccentricity as shown in the Figure 9 to 11. From the histogram of the minor axis Figure 9 we can clearly identified the range of brown or infected small, normal, large pieces. From the histogram of area Figure 11 we can also differentiate the range of small, normal, large pieces, same for other two parameter histogram shown in Figure 10 and 11. Here the same process is followed for other samples of processed and fresh goose berry.

IV. RESULTS

We do the assessment of all parameters like Minor axis length, Area, Major axis length, Eccentricity. Based on this we differentiate brown or infected small, normal, large pieces from the different samples. Table 3 shows the calculated parameter values based on histogram in one sample of processed gooseberry so same process is followed for fresh gooseberry sample.

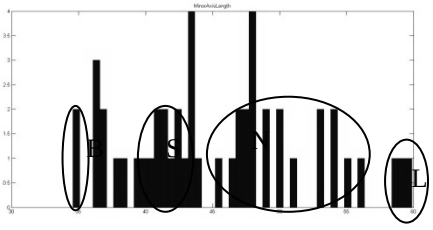

Fig (9): Histogram for Minor Axis of gooseberry pieces

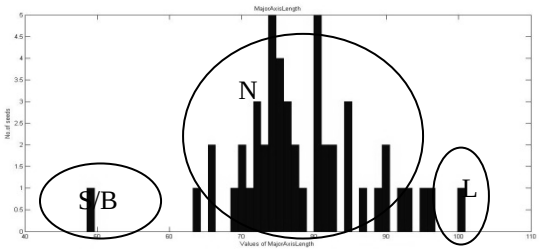

Fig (9): Histogram for Major Axis of gooseberry pieces

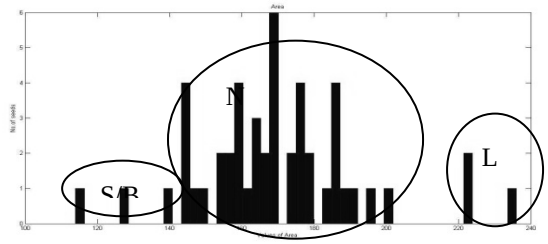

Fig (10) Histogram for Area of gooseberry pieces

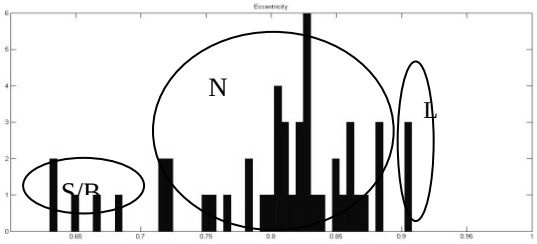

Fig (11) Histogram for Eccentricity of gooseberry pieces

Sr. No	Minor Axis	Area	Major Axis	Eccentricity
1	40.8996	168	73.2445	0.8296
2	59.8842	223	96.2771	0.7830
3	43.4062	145	66.0717	0.7539
4	48.1826	201	94.9262	0.8616
5	53.1405	174	76.3510	0.7180
6	49.0887	185	82.2626	0.8024
7	54.3147	177	78.7658	0.7242
8	46.8018	186	83.1020	0.8263
9	53.9448	195	87.1773	0.7856
10	48.7805	169	70.4576	0.7216

Table (3): Calculation of four parameters in one sample

Table 4 and Table 5 shows the four parameter results by proposed algorithm (A) based on percentage values for 30 different samples. In table 4 and 5 total number of the gooseberry pieces are 1500 (750 for processed and 750 for fresh) .From the table for high quality we consider only normal pieces and proposed algorithm gives the better accuracy compared to the human vision.

V. CLASSIFICATION

For classification we have used two techniques threshold based and decision tree based.

Sample No	Total Pieces	B (A)	S (A)	N (A)	L (A)
1	49	3	16	81	0
2	50	10	7	83	0
3	50	2	13	85	0
4	50	0	2	97	1
5	50	0	5	95	0
6	50	1	8	89	2
7	50	2	4	91	3
8	50	0	3	97	0
9	51	2	2	94	2
10	50	2	10	86	2
11	50	0	8	92	0
12	50	0	12	86	2
13	50	0	24	76	0
14	50	0	10	88	2
15	50	2	10	88	0
	AVG%	**2**	**9**	**88**	**1**

Table (4): Result analysis for 15 samples of processed gooseberry based on percentage value

Sample No	Total Pieces	B (A)	S (A)	N (A)	L (A)
1	50	2	8	90	0
2	50	4	10	86	0
3	50	6	14	82	0
4	50	6	8	86	0
5	50	6	8	86	0
6	50	6	10	84	0
7	50	6	14	82	0
8	50	0	2	98	0
9	50	0	6	94	0
10	50	0	2	98	0
11	51	2	0	98	0
12	50	2	6	83	0
13	50	4	4	83	0
14	50	2	10	88	0
15	50	2	12	86	0
	AVG %	**4**	**7**	**89**	**0**

Table (5): Result Analysis for 15 Samples of Fresh Gooseberry Based On Percentage Value

A. Threshold based:

For classification of brown or infected, small, normal and large gooseberry pieces, we calculate the thresholds values using the histograms of Figure 9 to 11 for minor axis length, major-axis length, area and eccentricity as mention in Table 4 and 5 for processed and fresh respectively. According to this range we can differentiate the various qualities of gooseberry pieces.

Parameter	Brown/ Infected Piece	Small Piece	Normal Piece	Large Piece
Minor Axis	33-42	42-47	47-70	80-95
Area	50-110	110-160	160-260	260-300
Major Axis	47-50	50-65	65-100	100-120
Eccentricity	0.2-0.5	0.5-0.7	0.7-0.9	0.9-1.0

Table (6): Cclassification range for 15 samples of processed gooseberry based on threshold

Parameter	Brown/ Infected Piece	Small Piece	Normal Piece	Large Piece
Minor Axis	20-36	37-50	51-80	81-95
Area	100-110	111-150	151-260	260-300
Major Axis	47-50	51-65	65-110	111-120
Eccentricity	0.2-0.5	0.6-0.7	0.8-0.9	0.9-1.0

Table (7): classification range for 15 samples of fresh gooseberry based on threshold

2) Decision Tree based:

Decision tree is a classification scheme which generates a tree and set of rules representing the model of different classes from given dataset. The set of records available for developing classification methods is generally divided in to two disjoint subsets-training set and test set. The former is used for deriving the classifier, while later is used to measure the accuracy of the classifier. The accuracy of the classifier is determined by the percentage of the test examples that are correctly classified. A decision tree is a decision-modeling tool that graphically displays the classification process of a given input for given output class labels. For developing decision tree we have used WEKA tool. In figure 9 the decision tree is developed on our data set it is for one sample and we have applied same thing for other samples also and taken the results as shown in table 6 and 7. By this classification technique we get 98% of accuracy. The detailed report is also generated by WEKA in which it gives relation name ,total attribute used ,size of tree ,decision rules ,error report ,error classifiers, detailed accuracy ,time taken to build tree and confusion matrix.

VI. GUI

With MATLAB you can create your own Graphical User Interface, or GUI, which consists of a Figure window containing menus, buttons, text, graphics, etc., that a user can manipulate interactively with the mouse and keyboard. There are two main steps in creating a GUI: One is designing its layout, and the other is writing call back functions that perform the desired operations when the user selects different features. We have developed the GUI for user friendly environment as shown in figure 12.

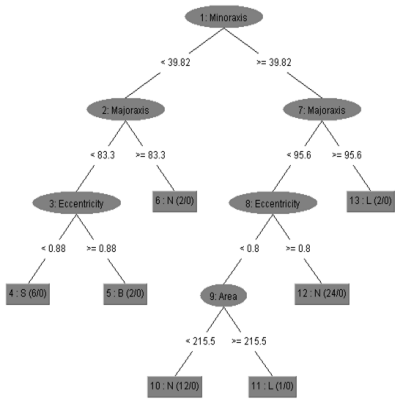

Fig (12): Decision tree using WEKA interface for one gooseberry sample

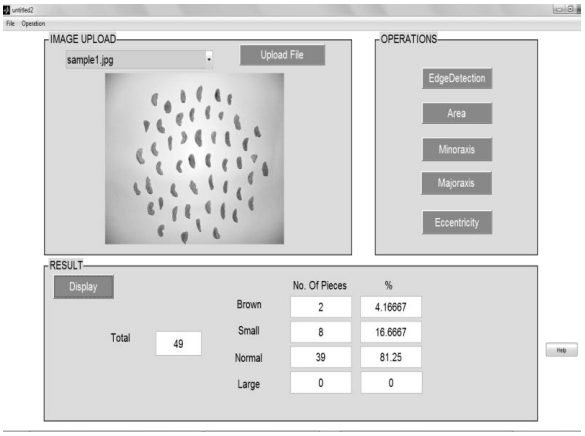

Fig (13): Graphical User Interface

VII. CONCLUSION

This paper gives non-destructive technique of the automated quality analysis of gooseberry pieces using computer vision. We are calculating Minor axis, major axis, area, eccentricity for classification of processed gooseberry pieces. We have also introduced the colorization algorithm and by this we identified the brown or infected part. From parameter calculation we differentiate the small, normal and large gooseberry pieces. For this classification we have applied the decision tree and threshold based techniques which gives 98% of accuracy.

SR. No	Total	B/I	S	N	L
1	49	2	6	38	3
2	50	5	4	41	0
3	50	1	7	42	0
4	50	0	1	48	1
5	50	0	3	47	0
6	50	1	4	44	1
7	50	1	2	45	2
8	50	0	2	48	0
9	51	2	1	47	1
10	50	1	5	43	1
11	50	0	4	46	0
12	50	0	6	43	1
13	50	0	12	38	0
14	50	0	5	44	1
15	50	1	5	44	0
Total	**750**	**14 (2%)**	**67 (9%)**	**658 (88%)**	**11 (1%)**

Table (8): classification result for 15 samples of processed gooseerry based on decision tree

SR. No	Total	B/I	S	N	L
1	50	1	6	43	0
2	50	2	5	43	0
3	50	3	7	40	0
4	50	3	4	43	0
5	50	3	5	42	0
6	50	3	5	42	0
7	50	3	8	39	0
8	50	0	1	49	0
9	50	0	3	47	0
10	50	0	1	49	0
11	51	1	0	50	0
12	50	1	3	46	0
13	50	2	3	45	0
14	50	1	5	44	0
15	50	1	6	43	0
Total	**751**	**24 (4%)**	**62 (8%)**	**665 (88%)**	**0 (0%)**

Table (9): classification result for 15 samples of fresh gooseerry based on decision tree

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