International Journal of Computer Engineering Science (IJCES)
Volume 2 Issue 4 (April 2012) ISSN : 2250:3439
https://sites.google.com/site/ijcesjournal http://www.ijces.com/

NON DESTRUCTIVE QUALITY EVALUATION OF NICOTIANA TABACUM USING OFF-LINE MACHINE VISION

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Abstract. A number of techniques have been proposed in the past for automatic quality evaluations of pre-processed tobacco using image processing. Although some studies have aimed to evaluate the quality of processed tobacco. There is no automatic system that is capable of evaluating the processed tobacco. This paper proposes a new method for counting the number of normal Chewing tobacco (Nicotiana tabacum) as well as foreign elements using machine vision. By proposed method a quality evaluation of processed chewing tobacco can be done which would be very beneficial for the purpose of its quality which is ready to be eat product.

Keywords: Features extraction, image processing system, nicotiana tabacum.

1 Introduction

Machine or electronic perception is one of the important advanced technological field where significant developments have been made [1]. The agricultural industry is probably too oldest and most widespread industry in the world. Quality control is of major importance in the agriculture industry after harvesting. Based on quality parameter agriculture product has been sorted and graded in different grades. In agriculture crops, India is one of the major producing countries of tobacco and because of the diversity and complexity of tobacco leaves; most of the classification and the quality evaluation of tobacco leaves are manually done which is a rigorous task [2]. The grading process is extremely laborious, making the classification and quality evaluation subjective and experience based. New technology and equipments are needed to automate the quality inspection process of processed tobacco. Most of these properties relate to the human vision [2].

In this paper the problem being faced by the Indian tobacco industry exporter, in particular chewing tobacco (*Nicotiana tabacum)* exporters is discussed in Section 2. Section 3 discusses the materials and methods proposed for quantifying the quality of Chewing tobacco. The proposed system is described in the same section. The proposed algorithm for computing normal Chewing tobacco as well as foreign elements [1] being present in the sample is also discussed in the same section. Section 4 comprise of results and discussion based on quality analysis. Section 5 concludes the paper [1].

2 Problem Definition

Previous all the researches have done for classification and quality evaluation on pre-processed flue-cured tobacco. Unfortunately there is no automatic system that is capable for quality evaluation of post-processed tobacco. As the most important part of tobacco comes into picture when the tobacco comes into the market without any quality evaluation which is open questionable issue. As a result up till now the processed tobacco exported or even consumed has no parametric quality and quantification technique which is the utmost requirement for its export.

In tobacco industry, Chewing tobacco (*Nicotiana Tabacum*) contains foreign elements as shown in fig.1.

Fig.1. Tobacco with foreign elements in samples

Foreign elements basically consist of sticks, barks of wood, midrib of tobacco leaves as shown in fig. 2.

Fig.2. Foreign elements in samples

For quality quantification these foreign elements needs to be removed. At the time of post-processing if proper removal of such foreign element is not done then it degrades the quality of tobacco.

This paper proposes a new method for quality quantification in Chewing tobacco *(Nicotiana Tabacum)* using machine vision technique based on combined measurement techniques. The geometrical measurements (size and shape) provide useful information regarding defect detection and the class discrimination of tobacco [3].

3 Materials and Method

In this section we will discusses the proposed machine vision system along with it the proposed algorithm for quality quantification of Chewing tobacco *(Nicotiana Tabacum)* will also be elaborated. The parameters on the basis of which the quantification is done will also highlight in this section.

3.1 System Description and Operating Procedure

Generally it is observed that major work of the industry is done by the technicians or laborers (layman) who are not well educated to operate complex systems. Our system and the proposed method to quantify quality are simple and easy to operate. Diagram of the proposed system is shown in fig.3. In the proposed system there is a camera which is mounted on the top of the box as pointed out by point 1 in fig.3. The camera is having 14.1 mega pixels quality with 5X optical zoom. The camera is connected with a processing unit which will store the captured images of tobacco samples. To ensure proper luminance for good quality of image, we placed the bulbs at point number 2 and 3 as shown in the fig.3. Butter paper is used for uniform distribution of light on the tray. In one side of the box an

opening is kept as can be seen from the fig.3 at point number 5 from which the tray containing tobacco samples will be inserted for image capturing. The simplicity of operation of system can be concluded from the operating procedure as in table 1.

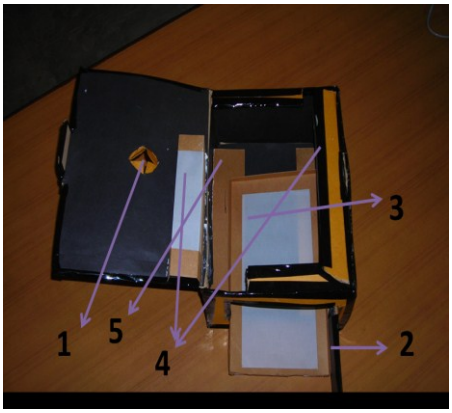

Fig.3. Proposed System

Table 1. Operating Procedure

Sr. No	Steps
1	Spread the samples of tobacco uniformly on the tray to avoid overlapping of samples.
2	Capture the image with the help of digital camera (Sony-DSC W210).
3	Pre-processing the Image in computer.
4	Display number of foreign elements on screen based on measured parameters.
5	Repeat the steps 1 to 4 for 10 to 12 samples.

According to the procedure the person should first of all select random samples from the bulk of Chewing tobacco *(Nicotiana Tabacum)* to be sent to the market before packaging. These samples are spread on tray in such a way that there is no overlapping of the tobacco. Image captured is now transferred to the processing unit where according to Table II quality of Chewing tobacco *(Nicotiana Tabacum)* is determined and displayed on screen [1].

3.2 Proposed Algorithm

Here table 2 is showing proposed method for quality evaluation of Chewing tobacco.

Table 2. Proposed Algorithm

Sr. No	Steps
1	Acquire the image *I(x,y)*.
2	Convert RGB image to gray scale image.
3	Apply thresholding to segment out the image.
4	Extract the required parameters from the segmented image.
5	Display number of normal Chewing tobacco, and foreign elements.
6	Repeat above steps for 7 to 8 samples.
7	Evaluate the quality of Chewing tobacco.

According to proposed algorithm after capturing image since color is not the parameter to be analyzed hence we convert color image into gray scale image as shown in fig.3.

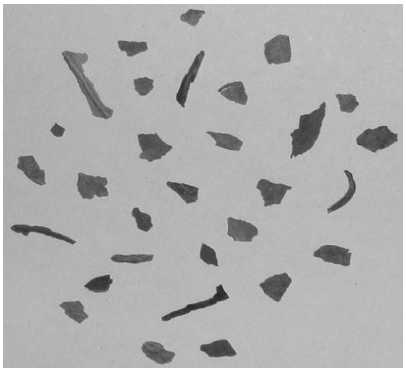

Fig.3. Gray scale image

To acquire a segmented image from the gray scale acquired image gray-thresholding is being done. This phase identifies individual object boundaries and marks the center of each object for further processing.

3.3 Parameter Calculation for Chewing Tobacco

The area, major axis length, minor axis length and eccentricity of Chewing tobacco are used as four of the prominent features to count the number of normal chewing tobacco as well as foreign elements. The area of any object in an image is defined by the total number of pixels enclosed by the boundary of the object. The minor axis length 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. The major axis length of an image is defined as Scalar specifying the length (in pixels) of the major axis of the ellipse that has the same normalized second central moments as the region. 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. (0 and 1 are degenerate cases; an ellipse whose eccentricity is 0 is actually a circle, while an ellipse whose eccentricity is 1 is a line segment.)

4 Result Analysis

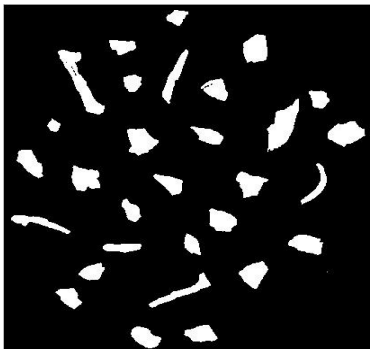

Fig.4. Image after gray-threshold performing on sample of Chewing tobacco

Fig.4 represents a gray-threshold image. Table 3 represents the geometric values of particles being present in fig.4. Based on these values histogram of four parameters are shown in fig.5 to 8 respectively. On the basis of histogram the number of normal Chewing tobacco and foreign elements were found. With the help of histogram we find thresholds values of area, minor axis length, major axis length and eccentricity. Area of a normal chewing tobacco is larger than area having foreign elements which can be seen from histogram of fig.5. For fig.5 threshold value of foreign element is in the range of 40 to 75. With the help of these threshold values we count the number of normal Chewing tobacco and foreign elements.

The histogram of major axis length is shown in fig.6. The threshold value in fig.6 of normal seed is having value of 90, threshold value of foreign element is 90 to 120. Here it can be clearly distinguished that difference between normal Chewing tobacco and foreign elements.

The histogram of minor axis length is shown in fig.7. And a threshold value in fig.7 of normal Chewing tobacco is having value of greater than 22, threshold value of foreign element is in the range of 15 to 22.

The histogram of eccentricity is shown in fig.8. And a threshold value in fig.8 of normal Chewing tobacco is having value less than 0.9, threshold value of foreign element is in the range of 0.9 to 1. Here for eccentricity calculation a foreign element having bigger value than the normal Chewing tobacco.

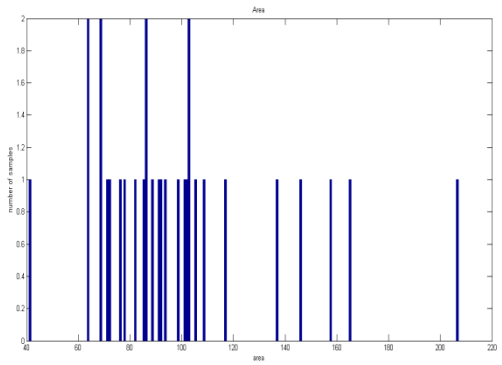

Fig.5. Histogram showing area of chewing tobacco

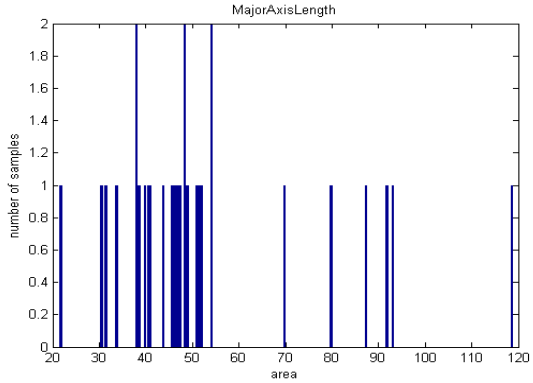

Fig.6. Histogram showing major axis of chewing tobacco

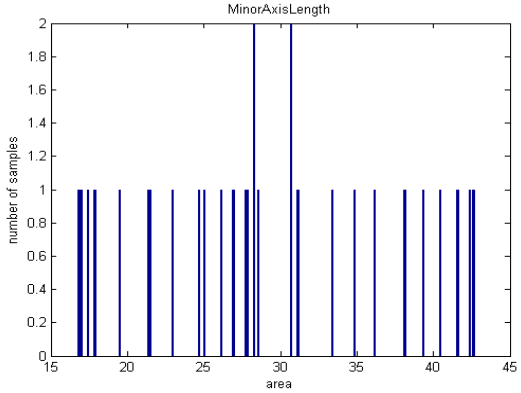

Fig.7. Histogram showing minor axis of chewing tobacco

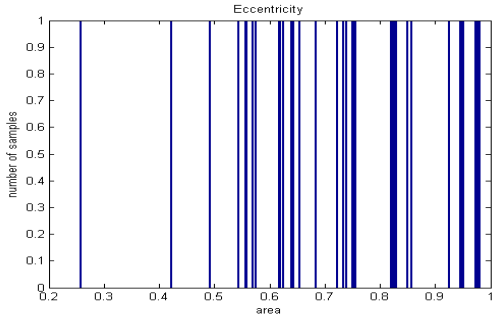

Fig.8. Histogram showing eccentricity of chewing tobacco

Table 3. Analysis for several Chewing tobacco available in one sample

	Area	Major Axis Length	Minor Axis Length	Eccentricity
1	41	21.55872	16.78868	0.256013
2	64	30.4922	16.97372	0.421311
3	64	31.37735	17.39226	0.49132
4	69	33.75336	17.89635	0.541321
5	69	38.01169	19.49093	0.557583
6	71	38.03796	21.37511	0.567884
7	72	38.48843	21.47786	0.57376
8	76	40.01057	22.93931	0.616805
9	78	40.58714	24.69762	0.624894
10	82	40.90204	25.0209	0.63856
11	85	43.79363	26.12653	0.640447
12	86	45.55786	26.89837	0.654035
13	86	46.27034	27.65387	0.681506
14	89	46.6006	27.78267	0.721376
15	91	47.07493	27.83665	0.734331

Table 4. Result analysis of various Chewing tobacco samples based on algorithm.

Sample No.	Normal tobacco count	Foreign element count	Total tobacco count
1	25	8	33
2	23	7	30
3	24	7	31
4	24	6	30
5	24	7	31
6	25	6	31
7	26	7	33
8	25	7	32

Table 5. Result analysis of various Chewing tobacco samples based on Human Sensory Evaluation Panel.

Sample No.	Normal tobacco count	Foreign element count	Total tobacco count
1	26	7	33
2	25	5	30
3	26	5	31
4	26	4	30
5	26	5	31
6	27	4	31
7	28	5	33
8	28	4	32

Table 4 shows calculated parameters value based on histogram for normal Chewing tobacco and foreign element for various sample from algorithm. We compare the results with ground truth data. Table 5 shows values calculated based on human sensory evaluation for calculation of normal Chewing tobacco and foreign element for various sample.

5 Conclusions

In this paper we present a one new method for quality analysis of processed Chewing tobacco product using image analysis. Here with image analysis we are calculating geometric information to distinguish normal Chewing tobacco and foreign element for a given sample. This technique is quite easy to implement and the results also obtained are good and can give better analysis of the quality as compared to human inspection sensory system. The time taken to obtain such results is also very less which clearly depicts its importance in the world o f automation. This new method for quality analysis of Chewing tobacco will replace traditionally quality evaluation and assessment of method for tobacco product by human sensory panel which is time consuming, may be variation in results and costly. For quality analysis more parameters can be added for further improvement.

Acknowledgement

The authors are thankful to V.R. Tobacco and Anand agriculture university for providing samples of tobacco. We are also thankful to the Dr. J.C. Chavda for his valuable suggestions for quality evaluating of chewing tobacco.

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