Classification of cashew based on the shape parameter

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***Abstract*— Cashew is one of the most popular tree nuts. It is very expensive and the prices of cashew depend on its quality.To ascertain the quality, grade standard have been designed by considering the length, width, color and the size (weight) of the cashew kernel as important characteristic.Cashew is a commercial commodity that plays a major role in earning foreign revenue among export commodities in India. The purpose of this study is to develop a computer vision based cashew nut grading system. Computer vision based cashew grading system is an alternative to the manual and mechanical method. Computer vision based method offers automated, high speed and cost effective solution for classification. The paper tried to build the classification model of cashew nuts and has analyzed the shape parameters of cashew nuts.Length (L), Width (W) and Thickness (T) of the cashew kernel plays vital role in deciding the grade of the cashew kernel.**

***Index Terms*— Cashew nuts, Shape parameters ,Cashew nut grading system, Classification.**

I. INTRODUCTION

Cashew nut is one of the world-famous nuts.India is the largest exporter & distributor of Cashew Nuts in the world.Cashew nuts is of the highest quality and has helped in gaining repute amongst all other nations in the international market. The grading operation is important, as it is the last opportunity for quality control on the Cashew kernels. With the exception of a few grading aids, all grading is being done manually and because of the special shape of cashew nuts and the special structure of the shell, manufacture of mature nuts sheller machine became more difficult to overcome the technical difficulties. In the present international market scenario,it is very much essential to keep our products well graded automatically to compete in the market place.

Today, various kinds of cashews are available in the market with different qualities. To ascertain the quality, grade standard have been designed by considering the texture,color and the size (weight) of the cashew kernel as important characteristic. Grading of cashew kernels is based on inspection of physical quality attributes such as colour, shape, and size.Several attempts have been made to mechanize the grading of the kernels, with limited success.Cashew classification is a very complicated process, and it is graded manually by skilled labor,employed only for grading,which not only waste a lot of manpower and material resources but also causes misclassification easily. Therefore Pattern recognition system has emerged as a 'grand challenge' for computer vision technology,to achieve cashew nut automatic classification.Computer vision system has good speed and accuracy which satisfies the ever-increasing quality requirements , hence aiding in the development of totally automated process. An intelligent classification system based on computer vision system can be developed for automated grading and sorting to speed up the classification of cashew kernels. This will solve the major problems of many of the cashew export industries and also gives justice to the cashew growing farmers in accurate grading. The objective of this study was to develop a computer vision based cashew nut grading system.Parameters like Length, Width and Thickness of cashew kernel are extracted to identify the particular grade of cashew kernel categories.To ascertain the quality and grade,a standard has been designed by considering the quality the cashew kernel as important characteristic..The proposed work also emphasis on the Bayesian classifier for classification of the cashew kernel samples into W-180,W-210,W-240,W-320,W-450 and W-500 classes. Bayesian classifier is a successful classifier based upon the principle of Maximum A Posteriori (MAP). Bayesian classification provides practical learning algorithms.The prior knowledge and observed data can be combined. Bayesian Classification provides a useful perspective for understanding and evaluating many learning algorithms. It calculates explicit probabilities for hypothesis and it is robust to noise in input data. The parameter obtained are used to train the Bayesian classifier.Once trained,the classifier tests with other cashew

kernel for desired results.All these programs are developed using MATLAB 7.8 version.

II. LITERATURE SURVEY

The literature survey was done for the development of the project.A number of challenges had to be overcome to enable the system to perform automatic recognition of the kind of fruit or vegetable using the images from the camera.. For example, Bananas range from being uniformly green, to yellow, to patchy and brown.[1] The computer vision strategies used to recognize a fruit rely on four basic features which characterize the object: intensity, color, shape and texture. This paper proposes an efficient method which can process, analyze and recognize fruits based on color and texture features. This paper proposes an efficient fusion of color and texture features for fruit recognition. Recently, different features of color, size, shape, and texture are combined together for their applications in the food industry. Normally, by increasing the features used, the performance of the methods proposed can be increased. Moreover, both surface information (color and texture) and geometry information (size and shape) of food products in images play a significant part in defect detection and class discrimination.

The process of color classification involves extraction of useful information concerning the spectral properties of object surfaces and discovering the best match from a set of known descriptions or class models to implement the recognition task [2]. Texture is one the most active topics in machine intelligence and pattern analysis since the 1950s which tries to discriminate different patterns of images by extracting the dependency of intensity between pixels and their neighboring pixels [3] or by obtaining the variance of intensity across pixels [4].[5]The paper tried to build the classification model of cashew nuts and had analyzed the shape parameters of cashew nuts, and the paper concluded that there was a clear linear relationship between the length and height of cashew nuts and there was not a clear linear relationship between the length and thickness of cashew nuts or between the height and thickness of cashew nuts.From the paper published by Zhang Lin[5],it is cleared that the relationship between length and height of cashew nuts is linear. This means that for the majority of cashew nuts ,longer the length of cashew nuts is, higher the height of cashew nuts is. Due to this we can use length as key parameter in cashew classification.It measured a variety of different sizes of cashew nuts,and It obtained large amounts of data about the length,thickness and height of different sizes cashew nuts. In order to find out the laws of the shape parameters of cashew nuts and the key parameters of classification of different sizes cashew nuts, and did the linear analysis of the length and thickness of cashew nuts, the length and height of cashew nuts and the thickness and height of cashew nuts by Origin data analysis and mapping software.[6]The usual method for classification processes of cashew-nut is manual and present some drawbacks like slowness,subjectivity, and inconsistency. The aim of this study is to investigate the performance of different multiclass classification techniques against whole cashew data set and to find the most appropriate technique for cashew grading system. The performance of various classification algorithms greatly depends on the characteristics of the data to be classified. There is no single classifier that works best on all given problems. The purpose of this study is to develop the computer vision based cashew grading system in conjunction with most accurate classification technique. This paper aims to investigate the performance of different multiclass classification techniques against whole cashew data set and to find the most appropriate technique for cashew grading system.

III. PROPOSED SYSTEM

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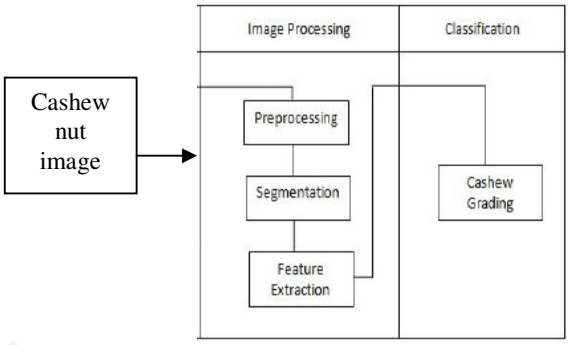


Fig 1: Schematic representation of cashew grading system

The system acquires images of the cashew kernel and this forms an input to the image-processing unit. For the image pre-processing task, the cashew kernel must be isolated from theBackground, thresholding is an important part of image segmentation. This results in a black and white(binary) image from the colour image, where background pixels are painted black and objects painted white. Image features of the cashew kernels were extracted to characterize the physical quality attributes of cashews. It extracts the necessary features of the cashew kernel like Length,Width,Thickness and texture. The features obtained are the inputs to the Bayesian classifier for cashew nut classification.

A. BAYESIAN CLASSIFIER

The classification is done by using Bayes algorithm. Bayesian classifier is a successful classifier based upon the principle of Maximum A Posteriori (MAP):

$$h_{MAP} = \arg\max_{h \in H} P(h|D)$$

Given a problem with D classes {D1, . . . ,DH} with so-called prior probabilities P(D1), . . . , P(DH), we can assign the class label c to an unknown example with features h = (h1, . . . , hN) such that c = argmaxcP(D = ckh1, . . . , hN), that is choose the class with the maximum a posterior probability given the

observed data. This aposterior probability can be formulated, using Bayes theorem, as follows: P(C = ckh1, . . . , hN) = P(C=c)P(h1,...,hNkD=c) P(h1,...,hN). As the denominator is the same for all classes, it can be dropped from the comparison.

Now, we should compute the so-called class conditional probabilities of the features given the available classes. This can be quite difficult taking into account the dependencies between features. The bayes approach is to assume class conditional independence i.e. a1, . . . , ai are independent given the class.Assuming the instances as conditionally independent,the approach becomes Naïve Bayes.This classifier can be now called as Naïve Bayes Classifier.

Naive Bayes assumption

$$P(a_1, a_2 \ldots a_n | v_j) = \prod_i P(a_i | v_j)$$

Which gives

$$\text{Naive Bayes classifier: } v_{NB} = \arg\max_{v_j \in V} P(v_j) \prod_i P(a_i | v_j)$$

This simplifies the numerator to be P(V =v)P(a1kV = v) . . . P(aikV = v), and then choosing the class c that maximizes this value over all the classes v = 1, . . . ,j.

Clearly this approach is naturally extensible to the case of having more than two classes, and was shown to perform well in spite of the underlying simplifying assumption of conditional independence

IV. MATERIALS AND METHODS

A.Experiment Samples

The samples included cashew kernels of W180,W210,W240,W320,W450,W500.Cashew inspectors manually classified the kernels. Table 1 shows the cashew kernels

Grade	Count per 454 gms	General Characteristic
W-180 W-210 W-240 W-320 W-450 W-500	170-180 200-210 220-240 300-320 400-450 450-500	Cashew kernels shall have been obtained through shelling and peeling cashew nuts. Shall have the characteristic shape; shall be white, pale ivory or light ash in colour;shall be whole or broken.

Table 1:Cashew kernels

B.Collection of Samples

A high-resolution (25-megapixel) Nikon digital colour camera (Model D10) was utilized. The captured images were obtained as JPEG image files.The cashew kernel samples were photographed at a particular position at specific lighting conditions. The images are likely to have a high resolution since it yields a better image processing result. An example of a sample jpeg image of a Cashew kernel is shown in fig 4

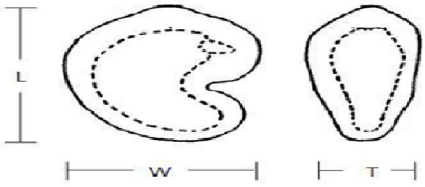
Fig 2:Sample of cashew image

C. Image Segmentation

Image segmentation refers to the process of delineating the regions or objects of interest in an image. For this work, the cashew kernel must be isolated from the background before they could be characterized. The first step in image analysis is to find objects. For this, object colour must be different from coloured foreground, based on a given colour threshold set by the user. Thresholding is an important part of image segmentation. The threshold value is generated according to the results of the histogram analysis. This results in a black and white (binary) image from the colour image, where background pixels are painted black and objects painted white. Due to the nature of the contrast between background and foreground, a thresholding technique has been applied in order to create a binary image: i.e. all nut pixels are represented as '1' and all background pixels are represented a '0'.

D. Feature Extration

To estimate the grade of the cashew kernel, Length, Width,Thickness of the cashew kernel are considered as important features. These Features are extracted using image analysis and image processing algorithms. Algorithms were developed in Windows environment using Matlab 7.8 programming tools to extract features of individual cashew kernel.



Length (L), Width (W) and Thickness (T) of the cashew kernel.

Fig 3:Feature extraction

IV. RESULTS

A.Image Segmentation

A typical segmented image of cashew kernel from the image background is shown in Fig below. The cashew kernels were of different colours but the background colour was fixed. Fig5 shows the segmented images. The results show that the segmentation algorithm could consistently segment the images. The ability to segment images of cashew kernels of different colours in the same background is important for practical implementation of this technology.

Practically, cashew kernel of different classes and colours are present in the same sample, and thus they must be imaged with the same background.Thus segmentation plays a major role in the classification process.

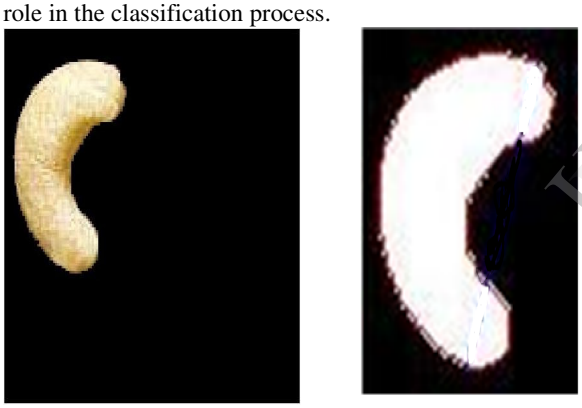


Fig 3: Segmented image

B.Feature Extraction

In [5] Zhang Lin, tried to build the classification model of cashew nuts and had analyzed the shape parameters of cashew nuts.The paper concluded that paper concluded that there was a clear linear relationship between the length and height of cashew nuts and there was not a clear linear relationship between the length and thickness of cashew nuts or between the height and thickness of cashew nuts.Due to this we can use length as key parameter in cashew classification.

No.	Features Extracted
1	Length
2	width
3	Thickness

Table 2:Extracted Features

Features are extracted using image analysis and image processing algorithms. Algorithms were developed in Windows environment using Matlab 7.8 programming tools to extract features of individual cashew kernel.

V. CONCLUSION

This paper proposes an automatic classification method based on computer vision, which can reduce the cost of manpower and material resources in the process of cashew nut classification. This method can also improve the quality and efficiency of the cashew nut classification. Thus the Length (L), Width (W) and Thickness (T) of the cashew kernel which plays a vital role in deciding the grade of the cashew kernel is measured. So the future work of this study is to also show that a properly trained Bayesian classifier can effectively classify cashew kernels. A computer vision–based system could be developed for automated grading and sorting using Bayesian classifier.

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REFERENCES

[1] Woo Chaw Seng and Seyed Hadi Mirisaee, "A New Method for Fruits Recognition System", *MNCC Transactions on ICT*, Vol. 1, No. 1, June 2009.
[2] Ferat Sahin, "A Radial Basis Function Approach to a Color Image Classification Problem in a Real Time Industrial Application", *Master's thesis*, Virginia polytechnic institute, Blacksburg, 1997.
[3] Kartikeyan,B and Sarkar,A, "An identification approach for 2-D autoregressive models in describing textures" *Graphical Models and Image Processing*, vol.53, pp.121-131, 1991.
[4] Haralick, R. M., Shanmugan, K. and Dinstein, I., "Textural features for image classification", *IEEE Transactions on Systems, Man, and Cybernetics*, vol.3, pp.610-621,1973.
[5].Zhang Lin,"Research and analysis of classification model based on the shape parameters of cashew nuts,IEEE-2011.
[6]. Mayur Thakkar,Malay Bhatt,C. K. Bhensdadia"Performance Evaluation of Classification Techniques for Computer Vision based Cashew Grading System",International Journal of Computer Applications (0975 – 8887)Volume 18– No.6, March 2011
[7]. P.Patel,M. Samvatsar,P. K. Bhanodia,"A Survey Paper On Cashew Kernels Classification Using Color Features & Computer Revelation System",International Journal Of Engineering Sciences & Research Technology,Aug-2012.
[8]. Rish, I., 2001. An empirical study of the naive bayes classifier", In IJCAI Workshop on Empirical Methods in Artificial Intelligence.
[9] Jain, A and Healey,G, "A multiscale representation including opponent color features for texture recognition", *IEEE Transactions on Image Processing* vol.7, No.1, pp. 124-128, 1998.

[10] Leemans, V. and Destain, M.-F, "A real-time grading method of apple based on features extracted from defects" *Journal of Food Engineering*, vol.61, pp.83-89,2004.
[11] Leemans, V., Magein, H. and Destain M.-F, "Defects segmentation on 'Golden Delicious' apples by using colour machine vision" *Computers and Electronics in Agriculture*, vol.20, pp.117-130,1999.
[12] Sarkar, N, and Wolfe, R. R, "Feature extraction techniques for sorting tomatoes by computer vision" *Transactions of the ASAE*, vol.28, pp.970-979, 1985.