Image Processing Techniques for Quality Checking in Food Industry

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Abstract— Computer vision system allows identifying physical characteristics and quality of product in a reliable form. Due to these advantages computer vision is widely accepted in agricultural and food industries. This paper proposes a computer vision based automatic and non-destructive grading of fruits according to their quality and maturity level. Different fruits used for this study are Apple, Mango and Banana. The proposed procedure is implemented through a digital colour image processing based on stages of preprocessing, segmentation, feature extraction and classification. The video image is taken from the wireless camera, Fuzzy C-mean (FCM) method is used for Segmentation, for feature extraction colour Moment, Color Auto-Correlogram, colour Moment features are extracted and Support Vector Machine (SVM) is used for the classification of fruits as good quality or bad quality.

Key words: Computer Vision, Image Processing, Segmentation, Feature Extraction, Classification

I. INTRODUCTION

Agricultural and Food industry needs to be efficient and provide assurance on safety and quality of its products which consumers could trust [5]. The manual grading by visual inspection poses problem in maintaining accuracy and consistency, this is also time consuming and labour intensive [9].This arises the need for replacement of human operators with the automated system. The automated system have advantage of lower labour cost, increased efficiency and can work in any weather conditions[8].Figure 1shows basic design of computer vision based system . Vision based system are different depending on the application but even they share some common features.

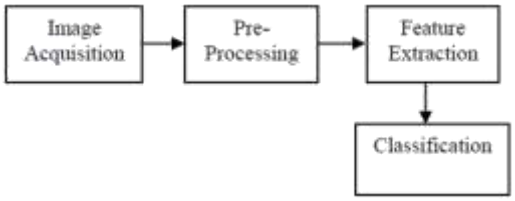

Fig. 1: Basic architecture of Computer Vision [8]

The basic model mainly consists of four steps: Firstly, a database of the fruit to be classified is created at image acquisition step. After that different image processing techniques are applied to improve image quality. Then features are extracted and dimensionality reduction is applied (if required) to give as input to the classifier. Finally, classification is performed using a classifier. The basic steps will remain same for all the models but the major difference is in using image processing techniques as well as classifier used [9].

II. RELATED WORK

Chandra Sekhar Nandi, Bipin Tudu, Chiraanjib Koley[1] proposed method for automatic grading of fruit according to their maturity level and quality, fruit used for study is Mango .A video image is captured by camera placed on the top of image capturing chamber. Gaussian Mixture Model(GMM) is used for the Prediction of maturity level quality is defined on size of fruit and surface defects present and fuzzy rule based algorithm is used for the grading of fruit.

Hamirul'Aini Hambali, Sharifah Lailee Syed Abdullah, Nursuriati Jamil, HazaruddinHarun[2] In computer vision the image segmentation is very important for classification and deciding for machine. Segmentation becomes difficult in different illuminations due to different intensity on object surface colour, which results in segmented images of low quality and reduces the classification quality. This paper proposes a TsNKM method which combines two algorithm first is improved thresholding and second is adaptive k-mean. The analysis Result shows that new method is producing segmented images with high accuracy rate.

V.pavithra, R.pounroja, Dr.B.Sathyabama [3] proposed method for grading cherry tomatoes on basis of quality and maturity. The proposed algorithm grades in two phases first phase describes the maturity and the second phase describes the quality of tomato. To extract features a new colour based segmentation on Euclidean distance is proposed. K-Nearest Neighbor based Support Vector machine classifier is used for classification in different classes.

L.Angel, S.Lizcano, J.Viola [4] this paper proposed method for checking the maturity level of the pineapple using computer vision techniques. Proposed method uses HSV as colour space model, otsu method is used for the segmentation, first-order moment of distributions of H and S planes as features, and the modified Basic Sequential Algorithm Scheme (MBSAS) as classifier for classifying different level of maturation.

Lu Wang,Xin Tian,Anyu Li,Hanxiao Li [5] proposed concept for checking quality of an Apple where colour histogram extracts the local image patches for the feature extraction, Linear Discriminant Analysis(LDA) is used for the dimensionality reduction which decreases the time and cost and Support Vector Machine (SVM) is used for classification.

III. FUZZY C-MEAN

FCM is an unsupervised clustering algorithm that is applied to wide range of problems connected with feature of analysis, clustering and classifier design. FCM is widely applied in agricultural engineering, astronomy, chemistry, geology, image analysis, medical diagnosis[9.]The clusters are formed according to the distance between data points and the cluster centers are formed for each cluster. The degree of membership of each data item to the cluster is calculated which decides the cluster to which that data item is supposed to belong [9].

The existence of a data item in more than one cluster depends on the fuzzification value (m) defined by the user in the range of [0, 1] which determines the degree of fuzziness in the cluster [9].

Thus, the items on the edge of a cluster may be in the cluster to a lesser degree than the items in the center of the cluster[9]. When m reaches the value of 1 the algorithm works like a crisp partitioning algorithm and for larger values of m the overlapping of clusters tends to be more[9].

The main objective of fuzzy clustering algorithm is to partition the data into clusters so that the similarity of data items within each cluster is maximized and the similarity of data items in different clusters is minimized. Moreover, it measures the quality of partitioning that divides a dataset into C clusters.[9]

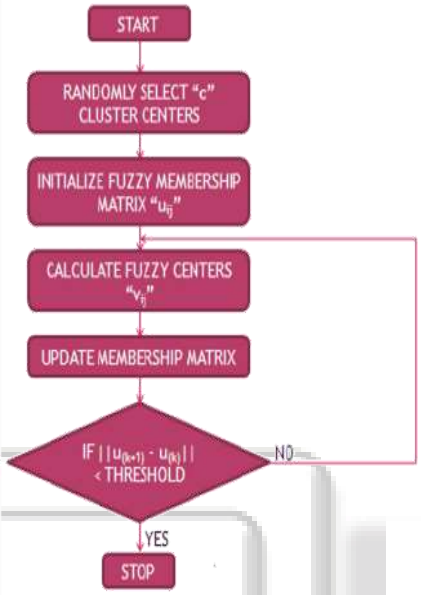

Fig. 2: Fuzzy c means algorithm[9]

IV. SVM

SVMs are set of related supervised learning methods used for classification and regression [10]. They belong to a family of generalized linear classification. A special property of SVM is, SVM simultaneously minimize the empirical classification error and maximize the geometric margin. So SVM called Maximum Margin Classifiers, SVM is based on the Structural risk Minimization (SRM) SVM map input vector to a higher dimensional space where a maximal separating hyperplane is constructed[10]. Two parallel hyper planes are constructed on each side of the hyperplane that separate the data. The separating hyperplane is the hyperplane that maximize the distance between the two parallel hyperplanes(called support vectors)[10].

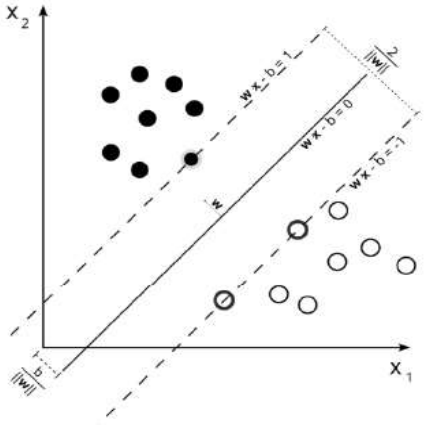

Fig. 3: An Example of SVM Classifier (Wikipedia, SVM)

V. PROPOSED WORK

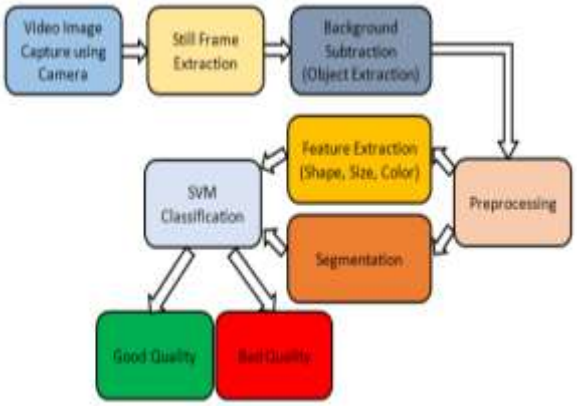

Fig. 4: Proposed flow Diagram

Figure 4 shows the proposed flow video image is captured from the wireless camera after capturing the image the background of the image is Subtracted, after that Pre Processing is done on image like removal of noise, resizing the image and then the feature of fruit like shape, size and color are extracted and then segmentation is performed on the video image. SVM classifier is used for the classifying the image as good quality or bad quality fruit.

VI. RESULT AND ANALYSIS

Table shows the performance analysis of good quality fruit and the bad quality fruit and the result is shown graphically in figure 5.

Class	Sr. No.	Accuracy	Precision (%)	Recall (%)
Good	1	88.42,92.73, 90.73	88.42	88.42
	2		93.76	91.43
	3		84.58	96.00
Bad	1	90.73,86.67, 94.71	93.44	86.67
	2		93.33	95.00
	3		89.60	91.43

Table 1: Performance Analysis

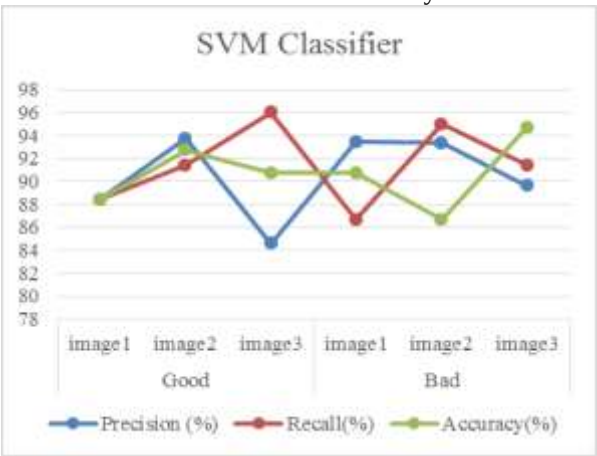

Fig. 5: Graphical representation of above Table

VII. CONCLUSION

According to literature survey number of methods and techniques are available for quality and grading of different food products and quality evaluation in food processing industries using computer vision systems. In the proposed using we have used modified Fuzzy-C Mean (FCM) for the

segmentation, SVM for the classification applied to different fruits for checking quality.

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