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Automatic Classification of South Indian Regional Fruits using Image Processing

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Abstract

Objectives: The main objective of proposed system is to classify different kinds of South Indian regional fruits. The fruits classified based on Extraction of morphological and Fourier features of a fruit image by applying DTNB classifier. **Methods/Statistical Analysis:** The proposed method is adapted to achieve fruit classification. The digital image of any fruits was given as an input to the system. Background elimination is the first step employed, is given based on the threshold technique. This helps in extracting only the interested pixel regions. Noise of the cropped image was removed; by applying mean filter.Statistical, morphological and Fourier features extracted from the image for the classification **Findings:** According to the literature survey conducted, most of the researchers used SVM (Support Vector Machine), neural network, KNN classifiers etc. for Automatic classification of fruits. Most of the authors extracted either spatial features or Fourier features for the classification. Very few researchers extracted both spatial and Fourier features to classify the fruit. The proposed method extracts both spatial and Fourier features of the fruits, which are commonly available in south Indian regions. The proposed system uses a hybrid combination of Decision table and Naïve Bayes classifier to obtain the accuracy of 88.08%. Mat Lab is used for extracting the features of fruit images. There is no sufficient work done on fruit image classification for south Indian image fruits. The results of the proposed work are above the average and found to be satisfactory in classifying the fruits. **Application/Improvements:** This proposed system further enhanced to recognize the sub categorization of a specific fruits. For example, mango further classified into Banganpalli, Alphonso, etc.

Keywords: Automatic, Classification, DTNB Classifier, Image Processing, MatLab, Regional Fruits, Weka

1. Introduction

Automatic Recognition of fruits has become very much important for various industrial and commercial applications. The proposed system used in business for different purposes like storage methods and Economic Order Quantity in warehouse through bulk classification etc. This proposed system applied during the production stage of the product in fruit based industries. This system also helps the business in deciding various operational processes of industries. This anticipated system can be modified and can be used in research work for grading the fruit, identifying the variety of a fruit, improving quality and hybridization of the fruit. In present information age, world is overloaded with a lot of information, so the anticipated system has many applications in image indexing.

When the visually impaired person wants to purchase the fruit, it is very difficult for them. So this project updated, according to their needs for recognizing the type of fruit. With the help of this, visually impaired person can get assistance at the time of purchasing the fruits.

In our country, Automatic recognition of fruits system is not using much when compared to the foreign countries. The suggested system recognizes commonly available Indian fruits such as apple, Mango, Melons and Clementine. Experiments performed on these four types of fruits that are available in south Indian region.

Identifying dissimilar types of vegetables and fruits is a hard-hitting job in hypermarkets. The practice of barcodes has predominantly terminated this problem for packed products but provided that utmost customers want to choose their products. The key is delivering codes for every fruit, but the memorization is tricky, leading to a pricing errors. The projected system is very much useful for these kinds of situations.

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To the best of our knowledge, fruit classification at the region based level for Indian regional fruits is not been reported in literature as compared to non-Indian regional fruits. It drives up a robust system for classification of local regional fruits, more specifically chosen from Karnataka region of some fruits and from southern parts of India. Fruit Detecting and Grading System Based on Image Processing whose work aimed to study different types of algorithms used for quality grading to developed an algorithm for detecting and sorting of fruit from the acquired image. The feature such as morphological and color feature is extracted to identify class of the fruit using neural network. Review paper of Automatic Fruit Classification. This paper depicts after many experiments that soft computing models have shown a very good results in terms of accuracy and speed in a fruit classification[1].

The author enhanced the portion occupied by fruit in images using a red chromaticity coefficient is adopted a circle detection method for classifying individual fruits to improve fruit visibility; they acquired multiple views from different viewing angles for a portion of a table canopy. Fruit visibility improved from 50% to about 90% by acquiring multiple views. Date palm fruits are popular in the Middle East and have a growing international presence. Sorting of dates can be a tedious job and a key process in the date palm industry[2].

A Veggie-Vision was an initial attempt to develop a produce recognition system for use in supermarkets. The system could analyze color , texture and density, and thus was able to obtain more information. Density calculated by dividing weight with the area of the fruit. The reported accuracy is approximately 95% by combining color and texture features[3] developed a methodology, which is associated with the numerous features and classifiers. Authors with the multi-class classification problem as a set of binary classification problem in such a way that one can accumulate altogether**.** They attained a classification accuracy of up to 99% for some fruits, but they merged three features[4], to be precise, Border-Interior Classification (BIC), color Coherence Vector (CCV), and Unser features and recognized the best binary rejoinders to accomplish them. Arivazhagan et al. collective color and texture features to classify fruits. They used minimum distance classifier and achieved 86% accuracy over their dataset with 15 different types of dataset.

They cropped and resized the image and then calculated the mean and range of hue and saturation channel of HSV image for extracting feature vector[5].

The author proposed a System for bulk classification of fruits. The maximal and minimal results around 94% and 92% using color and texture feature sets for Chikoo and Mango respectively. The outcomes from this study are very beneficial in a swift recognition and classification of bulk fruit by designing an elevator that moves a fruit across the camera. The outcome of the proposed system is a nearly matching with the manual recognition of bulk fruit types and it encompasses both image processing and pattern recognition techniques[6].

A structure for classifier fusion for the automatic recognition of produce in supermarkets was present in this work[7]. They joined low-cost classifiers trained for condensed classes of importance to increase recognition rate.

This paper obtained 95% classification accuracy over a dataset with eight types of different vegetables using texture measures in RGB color space. They used watershed segmentation to extract the region of interest as a pre-processing and decision table classifier for training and classification purposes[8].

In this paper, several techniques employed for extracting the shape of fruit. They carried out two kinds of methodologies of shape-based feature extraction and description that classified into contour-based and region based extraction[12].

The author anticipated a computer vision based automatic classification system for apple fruit. The region of interest of the fruit that is a focal point of an image parted from its background by using a threshold. The geometric features such as mean and standard deviation are also calculated. These features given as an input to the Nearest Neighbour (NN) superintended classifier for fruit classification. They obtained 94% of accuracy[9].

In the paper[10] recognized 10 different vegetables using color histogram and statistical texture features. They obtained a classification accuracy of up to 96.55% using neural network as a classifier.

The author proposed a method that can process, analyze, classify and identify fruits images that are in particular and directed to the system based on color, shape and size features of the fruit. The FCM algorithm is appropriate and operative classification algorithm applied in the Fruits Recognition System. In several circumstances, the most prominent information concealed in the frequency domain of the signal when compared with time domain. Hence, in a paper features based upon frequency combined with spatial domain

features extracted for classification. The classification of fruits done using a special hybrid combination of Decision table classifier and Naïve Bayes classifier. The particulars of the anticipated methods labeled in the following sections[14].

2. Method Description

2.1 Data Collection and Pre-processing

The images of various fruit samples acquired with a Nikon D3300 Digital camera. The black background was used to eliminate the time consuming process of segmentation of an image. The acquired images were 120 x 160 x 3 pixels in size i.e. 120 pixels Width, 160 pixels Height and 3 dimensions as shown in Figure 1. Images captured in NEF format. Through data cable, these images transferred and then stored in hard disk and different parameters of fruit extracted from image for further analysis.

The dataset consists of following some of the fruit images such as Mango, Apple, orange and Melons. The database generated by clicking the pictures of below mentioned fruits using a digital Nikon camera and the numbers of samples produced are depicted below in the Table 1. These images captured with a black background in .nef format in Figure 1. The object recognized by segmentation from the test sample.

Table 1. Dataset

Sl. No.	Name of the sample	Number of samples
1	Apple	44
2	Mango	44
3	Melons	42
4	Orange	40

Figure 1. Original image.

2.2 Feature Extraction

Feature extraction is the important processes to recognize the object from a given input image. In the proposed method total number of 26 features are extracted, out of which twelve shape features, twelve color features and two Fourier frequency related features.

As mentioned above, the background removed by using the threshold value. The sum of Red, Green and Blue pixels noted down as features. Mean Variance and standard deviation calculated separately for RGB pixels. Total of six, features extracted from the color image.

The image converted to grey scale for further feature extraction. The Fourier transform applied to grey scale image and calculated mean and standard deviation of transformed image. This forms two features. Later image is converted to binary image using Otsu's method and 14 features extracted. These 14 morphological features are bounding box, Area, Perimeter, Major axis, Minor axis, Eccentricity, Convex area, Centroid, Equivalent Diameter, Solidity and Euler number. A segmented object obtained as shown in the Figure 2. A detailed stepwise procedure of the proposed method is as mentioned.

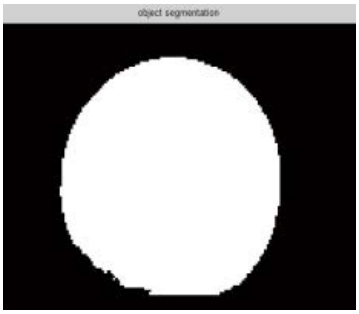

Figure 2. Object segmentation.

Algorithm 1

Input: Digital Image of fruit

Output: Feature Vector

- Remove the background based on threshold.
- Apply a mean filter to remove the noise.
- Summation of entire Red, Green and Blue pixel values of color image separately. This structures three features.
- Calculate the mean, variance and standard deviation of red, blue and green pixel value separately. This formulates nine features.
- Convert an image into gray scale image.
- Apply Fourier transform to the greyscale of the image.
- Calculate mean and standard deviation of transformed image. This forms two features.
- Convert the image into a binary image using Otsu's method.
- Estimate the bounding box of the object. This forms 4 features.

- Calculate the area and perimeter of segmented image. This forms two features.
- Calculate the major, minor axis and eccentricity of the object. This forms three features.
- Find the convex area, centroid, Equivalent Diameter, solidity and Euler number of the object. This forms five features.

3. Experimental Results

The outcome of the proposed fruit identification system evaluated on a dataset of 140 pre-processed images obtained as described under data collection in section II. The proposed system is set to 70% training set and 30% as testing set. Identification of test sample used Decision Table and Naïve Bayes classifier. The proposed method implemented using 6.1 software. The classification accuracy rate attained on the acquired dataset is 88.08%by applying a fusion of classifiers i.e. decision table classifier and naïve Bayes classifier. The carried out experiment clearly shows that the features extracted using Fourier transform adds a good weightage to obtained classification accuracy. To recognize the fruit in the given input image, the features of morphological and Fourier are extracted using MATLAB software version 6.1.

4. Conclusion

In this paper, feature extraction algorithms for fruit classification using Decision Table and Naïve Bayes classifier. Here it combined morphological and Fourier features to acquiring a better result. The images are processed and features are extracted using Mat lab 6.1 and Classification is done using Wekatool by applying both combined Decision Table and Naïve Bayes classifier to get accuracy of 88.08%, object segmentation of the given input image results as shown in *Figure 2*. The commercially available Apple, Mango, Melon and orange of south Indian regions common fruits considered for the experiment. In future, the system updated to identify other fruits and to increase the sample size of the accuracy. These concepts used to enhance the future scope in agricultural robotics, which could help in advancement of identifying the fruits to help in packing bulk fruits for export.

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