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Raisins Grade Detection Using Image Processing Technology

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Abstract: ***A number of methods for quality evaluation and sorting of agricultural products have been developed by different researchers over the past three decades. These methods are based on the detection of various physical properties which correlate well with certain quality factors of the agriculture products. Evaluation of agricultural products is done to understand to the quality of the product in addition to spew low quality of the products and even to expand product profitability. The product which can reviewed consequently includes grains, dry fruits etc. There is a need to build a computerized framework by using the images handling and to make evaluation of agriculture products much easier The frame work first analyses images from the document and after the image are passed for handling. Handling includes numerous paces like image pre-preparing, feature extraction, classification and grading. The frame work contrivance using Matlab. Classification of Raisins is accomplished by their color and size.***

Keywords: Automatic Programmed Grading, Raisins, Feature Extraction, Neural Network

1. Introduction

The history of Agriculture in India dates back to Indus Valley Civilization Era and even before that in some parts of Southern India. Today, India ranks second worldwide in farm output. Agriculture is demographically the broadest economic sector and plays a significant role in the overall socio-economic fabric of India.

India is the world's second or third largest producer of several dry fruits, agriculture-based textile raw materials, roots and tuber crops, pulses, production of raisins is in large scale. Classifying the grade of raisins for export uses traditional manual procedures and some machinery colander based on the size of raisins.

The cost of the machine is very high and these machineries are called sorting machines. For different fruits different sorting machines are used based on their size. Farmers feels it's better for hand picking of fruits. Manual grading of raisins includes more labors requirements, time consuming and inaccurate. The poor classification and sorting will lead to minimization of export quality. Because of these drawbacks in manual grading like inconsistency, tediousness, labor requirements and huge cost of machines, an automated grading system is to be developed which is affordable by small traders and farmers. Automatic grading system improves the quality of product, increases production, saves time and also reduces the dependency on manpower.

Grading of raisins involves sorting raisins by size, mainly for exports. To produce raisins, bunches of grapes are first brought from the vineyards to the raisin-manufacturing units, called 'sheds'. There they are processed according to the variety of raisins to be manufactured. The green colored raisin Hirwa and yellow colored raisin Pivla are two of the major grades manufactured in the region of Maharashtra. Hirwa grade is mainly manufactured for export and Pivla is for sale in the domestic market.

The manual sorting and grading has been replaced by machine vision system which has many advantages like high accuracy, uniformity and less time consuming.

1.1 Automatic programmed Grading

Color and size are the most important attributes for accurate grading of bulk raisins. Accordingly, a machine vision system for grading raisins by color and size features was designed and implemented.

Image processing has been proved to be effective tool for analysis in various fields and applications. Agriculture sector where the parameters like canopy, yield, quality of product were the important measures from the farmers' point of view. Many times expert advice may not be affordable, majority times the availability of expert and their services may consume time. Image processing along with availability of communication network can change the situation of getting the expert advice well within time and at affordable cost since image processing was the effective tool for analysis of parameters. This paper intends to focus on the survey of application of image processing in agriculture field such as imaging techniques, weed detection and fruit grading.

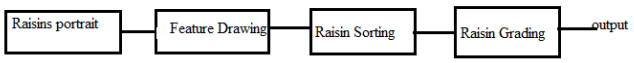

Figure 1.1: General working of Programmed grading system

The block diagram in Fig 1.1, describes the general working of programmed grading system which uses image processing. In first step the image can be captured by digital camera. This image is given to the system for grading. Grading here involves steps like feature extraction, classification and grading. Here image processing is used to extract the features of the image like color features and geometric features. Based on features extracted the fruit's class is determined using classifier technologies. Usually the system will be implemented using Matlab software.

1.2 Raisin and its varieties

A **raisin** is a dried grape. Raisins are produced in many regions of the world and may be eaten raw or used in cooking, baking, and brewing.

Raisin varieties depend on the type of grape used, and are made in a variety of sizes and colors including green, black, brown, blue, purple, and yellow. Seedless varieties include the sultana, Green Raisin, Golden Raisin, Green Raisin. Raisins are traditionally sun-dried, but may also be water-dipped and artificially dehydrated.

1.2.1 Green Raisins

Long green is the product prepared from the sound dried grapes of the varieties conforming to the characteristics of Pekami Iranian variety, processed in an appropriate manner into a form of marketable raisin with or without coating with suitable optional ingredients. Majority of cultivated grapes from which all types of raisins are produced belong to the Vitis Vinifera species, domesticated more than 5000 years ago in the Middle East. Long green raisins are sometimes sulphur treated for color enhancement.
Characteristics Color: Light Green
Appearance: Composed of berries with general appearance of the representative type .
Smell/Taste: Typical Raisins taste and smell / Sweet natural fruit flavor .
Consistency: Firm, non-sticky, free flowing

1.2.2 Golden Raisin

Golden Raisins is the product prepared from the sound dried grapes of the varieties conforming to the characteristics of Vitis Vinefera L.This product is then post processed with SO2 treating as a bleaching process to reach natural golden color. Grapes commonly used for drying are table grapes, which have a more tender skin, rich flavor and high sugar content. Sultana Raisins, Thompson Seedless Raisins and Golden Raisins are among the most commonly marketed varieties.
Characteristics Color: Light Amber.
Appearance: Composed of berries with general appearance of the representative type
Smell/Taste: Typical Raisins taste and smell / Sweet natural fruit flavor
Consistency: Firm, non-sticky, free flowing

1.2.3 Brown Raisins

Brown raisins are prepared through dipping in oil and drying in shade some are directly dried in sunlight. These are used in bakery, confectionery, ice-cream, medicinal and other culinary products. These are similar to American Thomson seedless raisins. There are two grades of Brown raisins such as Grade 1 and Grade 2.

1.2.4 Black Raisins

Black raisins are made from black grapes, these are long and round in shape. They are prepared by dipping in oil and dried in shade to get color and taste.

2. Problem Statement

Grading of agricultural products is very important to identify its quality. Because of these drawbacks in manual grading like inconsistency, tediousness, labor requirements and huge cost of machines, an automated grading system is to be developed which is affordable by small traders and farmers. Raisins are graded by its size and color. Existing systems sort either by color and size. There are some systems in which raisins are sorted by color and size but those systems grade raisins of same color into subcategories and these are not industrial standard grades. As the raisins available in the market will be available in different grades, so the raisins must be sorted and graded according to industry standards. So farmers and small dealers need a system which grades the raisins according to industries standard. So the previously developed systems cannot be used by farmers.

3. Proposed Methodology

The proposed methodology provides a method to allocate the raisins to industrial standard i.e. the first class is Brown Grade1; second class is Brown Grade2; third class is Super Sonaka Gold Grade1; fourth class is Super Sonaka Green; fifth class is Thomson Seedless Gold Grade1; sixth class is Thomson Seedless Gold Grade2 and seventh class is Thomson Seedless Green. The system captures the RGB color image. The image is pre-refined and segmented into sub parts i.e. each raisin from the image are taken. Then each raisin is handled for extracting features. The features extracted were color moments and geometric features. These features are gathered in vectors. Then for training and regulation probabilistic neural network is used. Once training is done, the image is passed to test the network. The image undergoes into pre-processing and features are extracted and stored in vector.

4. System design of Raisins Grade Detection System

The above figure describes the flow of the raisin grading system. In training part once image pre-processing is completed then segmentation and feature extraction is done. Above flowchart is utilized as a part of analyzing, planning, documenting with a procedure or program in different fields. Using the features obtained during training we will create knowledge base. The steps for training and testing are same until feature extraction. In testing the previous knowledge base created during training process is used for classification of raisins. Then the results are checked for accuracy by manually testing.

Procedure

1) First, image is captured for training process.
2) Image is pre-processed by removing back ground image.
3) The pre-processed image is converted to binary image and using connected component
4) labeling algorithm segmentation is done.
5) Then 19 features are extracted from the segmented image.
6) Then from all obtained features a classifier is trained and a knowledge base is created.
7) Now the system has to be tested for the accuracy of correct output. So a
8) Image is captured and selected randomly for testing.
9) Then it undergoes pre-processing, segmentation and feature extraction.
10) The extracted features are given as input for the classifier.
11) The classifier gives the output as the class to which the image belongs.
12) Then the accuracy of the system is tested by manually examining the output of the system.

Figure: Raisins Grading System Flow chart

5. Prototype model for Grade detection system

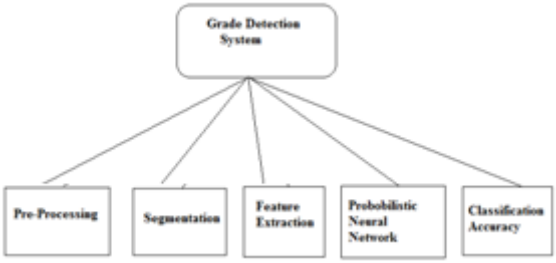

Figure 5.1: Prototype Model

5.1 Pre-Processing

The image captured is read into Matlab using *imread* function. The image read using imread is a RGB image. The selected is then transformed to gray image and then to binary image.

5.2 Segmentation

Next step is segmentation of the image to get single raisin present in the whole image. An image may contain minimum of 10 raisins. The idea behind segmentation is to group pixels of same region. The output of segmentation is a set of area that collectively covers the whole image. Using segmentation each raisin is extracted and subplot of each raisin is done. Segmentation is the way towards the dividing the image into numerous set of pixels (regions). The main purpose of segmentation is to streamline and change the representation of the image into other way that is more meaningful and easier to analyze. This is done typical to locate objects and locate boundaries present in the image. Segmentation is done using connected components labelling algorithm.

5.3 Feature Extraction

The most common visual features are color, texture and shape. This step has two different techniques namely color moments and geometric features to extract features of an image.

5.3.1 Color Histogram

Color histogram is a worldwide factual measure of an image. **color histogram** is a representation of the distribution of colors in an image. For digital images, a color histogram represents the number of pixels that have colors in each of a fixed list of color ranges, that span the image's color space, the set of all possible colors. Every image will have a signature connected with it. Signature of each image depends on its pixel values. The signature can be color, shape, surface or whatever other data through which two images could be thought about. In histogram based search there are two color spaces.

5.3.2 Geometric Features

Along with the color features geometric features are also extracted. To do so regionprops is used. And then area if found and using size major and minor axis are calculated.

```
S = regionprops(I,'Area');
Area = mean(cat(1,S.Area));
```

5.6 Classification

Classification uses feed forward probabilistic neural network (PNN) classifier for training and testing of images. PNN is derived from Kernel Fisher discriminate analysis algorithm and Bayesian network. PNN operates in multilayer passion. The layers are Input layer, Pattern/Summation layer, Hidden layer and finally Output layer. At the point when given input, first layer calculates the distance from input vector to the preparation vector. This layer gives the output as a vector whose components demonstrate how close the given input is to the preparation input. Next layer combines the contribution for each class of inputs and delivers net yields as vector of probabilities. Then a function on the output of the second layer picks the most extreme of these probabilities, and gives the output as 1 for the target class(positive recognition) and 0 for non-target class

(negative recognition). The experimentation is carried out using minimum of 30 images of each class.

Therefore using color moments a total of 15 features are extracted. And 4 geometric features are extracted. In total 19 features of each sub-image and extracted. Table 5.1 gives the brief list of all features extracted

Sl. No	Features Extracted
1,2,3	RGB Mean
4,5,6	RGB Variance
7,8,9	RGB Standard Deviation
10,11,12	RGB Moment
13	Area
14	Major Axis Length
15	Minor Axis Length
16	Aspect Ratio
17,18,19	HSI Mean

Figure 5.1: List of Raisins feature extracted

6. Conclusion

The programmed reviewing framework is executed for evaluating raisins into mechanical guidelines. The framework created is totally relying upon the shading highlights and geometric elements separated. These components are utilized for the distinguishing proof of raisin sorts. As the framework reviews the raisins into mechanical measures it can be utilized by little scale makes and merchants. Ranchers can likewise utilize the framework for evaluating raisins. The framework is executed for the desktop frameworks. The framework can be utilized to sort other sorts of farming items in view of shading and size. In future the framework can be made as an application for the cell phones so the clients can bring it alongside them wherever they go.

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