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Grading of Fruits Basis on Color Shape

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Abstract

Now a day, the classification and grading is performed based on observations and through expertise. The system utilizes image-processing techniques to classify and grade fruits. In the market there are many methods are available for grading but color is important parameter for grading. In this paper we are suggesting less complex method for fruit grading. Basically in this method we are using three dimensional color planes. Instead of using full color plane only respected color is used. Also size and shape grading is done by using moment of object region.

Keywords: Image processing, automatic color grading,color space conversion, fruit quality, Singular Value Decomposition,Shape identification,Region analysis.

Introduction

Agriculture is one amongst the most important economic sectors and it plays the key role in economic development of India. Classical method to review of fruits is performed by human consultants, that is taken into account to be time overwhelming and subjective. With the arrival of quick and high exactness machine vision technologies, automation of the grading method is predicted to cut back labor price conjointly rising the potency and accuracy of the method. A computer vision system processes pictures non-heritable from an electronic camera that is just like the human vision system wherever the brain processes pictures derived from the eyes. Computer vision has been used for quality review of fruits. Quality inspections of fruits have 2 completely different objectives: quality analysis and defect finding. In recent years, computer machine vision and image process techniques are found progressively helpful within the fruit trade, particularly for applications in quality review and form sorting.

Color and shape are two essential parameters for visual inspection and classification of fruits. A decisive autonomous system for fruit sorting shouldbe ready to adequately identify each parameter. Fruit's shape will simply be obtained from digital image exploitation classical techniques for image processing. However, though apparently immediate for humans, color identification involves several physical and psychological ideas, creating it tough to properly model and method color an image.Second order normalized second central moments of the region for shape grading.

Shape Identification

Shape is a crucial visual feature and it's one among the options of image content description. There are many methods are available which are difficult and takes more time for computation. Shape identification of similar object is very tedious job.

Most of the fruits are not circular in shape they are in elliptical shape. So identifying of fruit is done find out ellipse parameters. So following points are giving how to find out parameters of object using second order moment.Region based analysis method is more robust method. Region based analysis is carried by Moment-based shape descriptors.

Area

First find the binary image from captured image.The actual number of pixels within the region is calculated. For area calculation we have a tendency to be count number of ON pixels within the image.

Major and Minor axis calculation

Region-based analysis exploits both interior pixels and boundary of an object. R is denoting the set of pixels in a region. The simplest geometric properties are the region's centroid ($\bar{r}$,$\bar{c}$) and area A by considering ellipse shape.

Area:
The area is just a count of the pixels in the region R.

$$A \sum_{(r,c)\in R} 1$$

Centroid:
The centroid $(\bar{r},\bar{c})$is thus the average location of the pixels in the set R.

$$\bar{r} = \frac{1}{A}\sum_{(r,c)\in R} r$$

$$\bar{c} = \frac{1}{A} \sum_{(r,c)\in R} c$$

To describe region we are using spatial moment. First three second order moment used, which are given bellow.

Second-order row moment:

$$\mu_{rr} = \frac{1}{A} \sum_{(r,c)\in R} (r-\bar{r})^2 \qquad (1)$$

Second-order mixed moment:

$$\mu_{rc} = \frac{1}{A} \sum_{(r,c)\in R} (r-\bar{r})\,(c-\bar{c}) \qquad (2)$$

Second-order Column moment:

$$\mu_{cc} = \frac{1}{A} \sum_{(r,c)\in R} (c-\bar{c})^2$$

μ_{rr} −row variation from the row mean,
μ_{cc} −column variation from the column mean, and
μ_{rc} − row and column variation from the centroid.

To determine the lengths of the major and minor axes following equation are used:

$$Major\ axis\ length = 2\sqrt{2}\sqrt{\mu_{cc} + \mu_{rr} + \sqrt{(\mu_{cc} - \mu_{rr})^2 + 4\,{\mu_{rc}}^2}} \quad (3)$$

$$Minor\ axis\ length = 2\sqrt{2}\sqrt{\mu_{cc} + \mu_{rr} - \sqrt{(\mu_{cc} - \mu_{rr})^2 + 4\,{\mu_{rc}}^2}} \quad (4)$$

Color Grading

Color grading, is the primary method for determining product value in the food processing and agriculture industries. For color grading technique, here simplified method developed by the D. J. Lee, james K. Archibald and guangmingxiong which is called as Direct grading method. In that the three-dimensional RGB color space is converted into a small set of color indices unique to the application.

Color conversion

Fruits having a unique color present as per maturity stages. If consider RGB planes with representation of color in digital form; Assume 8 bits required for each

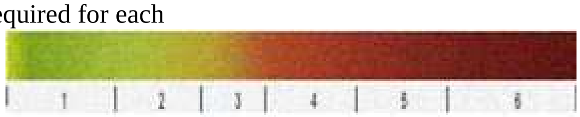

Figure 1. A color bar of colors of interest for tomato color grading.

color. 255 samples are present for each R, G and B planes. For every color representation need 24 bits. So, 16 million colors are present in this representation. But fruits are having less number of colors. Considering only that colors which are present in respected fruit and discard all other color. .And convert color it into unique indices.

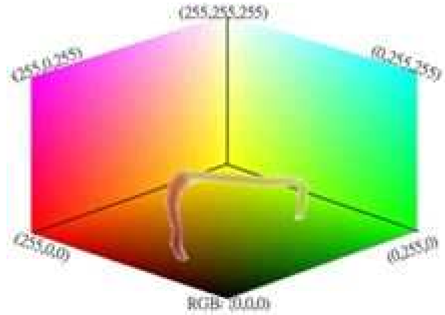

Figure2 Colors of interest in RGB space.

The formula for conversion is given bellow,

$$Color\ Index = c_1 \cdot RGB + c_2 \cdot R^2 + c_3 \cdot G^2 + c_4 B^2 + c_5 \cdot RG$$

There are a total 11 coefficients, 〖C〗_1, 〖C〗_2, C_3,…C_11 must be specified to use this formula. These coefficients are obtained through calibration using a selected set of colors of interest in RGB values and a set of desired linear color indices.

Figure.3 Converted color index values of Figure 1

Evaluation of coefficients

Evaluations of coefficients are carried out in preprocessing. In the preprocessing stage we are selecting at least 11 samples and which are chosen as per maturity stages. So using these 11 samples we are able to find out coefficient values.

Using equation 5 we find out coefficients. In the equation V1, V2….Vnare desired color indices values. Its values set by the user as per need of application or fruits. Its range for 8 bit representation of RGB planes is 0 to 255.

$$\begin{bmatrix} R_1G_1B_1 & {R_1}^2 & {G_1}^2 & {B_1}^2 & R_1G_1 & R_1B_1 & G_1B_1 & R_1 & G_1 & B_1 & 1 \\ R_2G_2B_2 & {R_2}^2 & {G_2}^2 & {B_2}^2 & R_2G_2 & R_2B_2 & G_2B_2 & R_2 & G_2 & B_2 & 1 \\ \vdots & \vdots & \vdots & \vdots & \vdots & \vdots & \vdots & \vdots & \vdots & \vdots & \vdots \\ R_nG_nB_n & {R_n}^2 & {G_n}^2 & {B_n}^2 & R_nG_n & R_nB_n & G_nB_n & R_n & G_n & B_n & 1 \end{bmatrix} \begin{bmatrix} C_1 \\ C_2 \\ \vdots \\ C_{11} \end{bmatrix} = \begin{bmatrix} v_1 \\ v_2 \\ \vdots \\ v_n \end{bmatrix} \qquad (5)$$

Conclusions and Future Work

This work presents a new technique for sorting and grading of fruits. This technique begins with capturing the fruits image using camera. The features are efficiently extracted from the query image. On the basis of color and size grade of fruit is determined. Direct color mapping concept is converting 3-D color spaces to 1-D color indices for automated color grading. Unlike other color grading techniques, this approach makes the selection and adjustment of color preferences much easier. The user can change color grade thresholds in a manner consistent with human color perception, simply sliding a cutoff point to include fruit that is slightly darker, a bit lighter green, or lighter red.

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