Color Sorting Technique - Image Processing

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Abstract. This paper discusses about sorting objects based on color threshold used for machine vision or image processing; This algorithm is used to count all the defect pixels appear on the object. So by using this algorithm we can sort-out the defect colored objects from the system. The defect pixel color can be defined by users as threshold value, so according to the threshold value fixed the defect pixels will be counted. This algorithm is designed to works on the RGB images, so if any RGB image is given as input to this algorithm it will count the defect pixels and give the counted defect pixels as output. The algorithm was coded using MATLAB-7.0 programming environment.

Keywords: defect pixel, image processing, machine vision, color sorting, defect color counting

I. Introduction

In the food processing industry, the removal of poor quality goods and extraneous matter from their produce is a necessity not only due to buyer demands but also due to Health and Safety regulations. Manual sorting can be very expensive, and therefore the use of automatic food sorting systems has become paramount in order to increase productivity and to improve profitability. In particular this paper discusses about the rice grain sorting algorithm using the aid of image processing, which is designed to meet the specific needs of rice grain industries. The machine vision algorithm sorts rice grains for the removal of foreign contaminants, discolored products using color sorting techniques.

Fig.1. Dark colored rice grain

Fig.2. Normal rice grain

The objective of this algorithm is to detect foreign bodies and defect objects, this paper aims at providing a sensitive scientific method for accurate inspection of rice grains with defect colors based on machine vision. For example in the below images we can notice the dark colored rice grains (Fig.1), our aim is to detect these kind of dark colored rice grains from normal grains (Fig.2). Machine Vision system (e.g. Color sorters) generally use camera-based systems to view processed rice grains. The sorting processes uses CCD camera technology, combined with fast, precise ejectors to reject as many defective products as possible, whilst minimizing the amount of good products ejected by pneumatic air jets from the produce stream.

II. RGB Images

An RGB image, sometimes referred to as a true-color image, is stored in MATLAB as an m-by-n-by-3 (Fig.3) data array that defines red, green, and blue color components for each individual pixel. RGB images do not use a palette. The color of each

pixel is determined by the combination of the red, green, and blue intensities stored in each color plane at the pixel's location. Graphics file formats store RGB images as 24-bit images, where the red, green, and blue components are 8 bits each. This yields a potential of 16 million colors. The precision with which a real-life image can be replicated has led to the commonly used term true-color image.

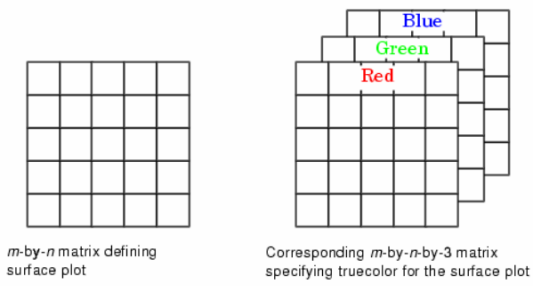

Fig.3. m-by-n-by-3 matrix

True color Surfaces Computer systems with 24-bit displays are capable of displaying over 16 million (224) colors, as opposed to the 256 colors available on 8-bit displays. You can take advantage of this capability by defining color data directly as RGB values and eliminating the step of mapping numerical values to locations in a color map. Specify true color using an m-by-n-by-3 array, where the size of the image is m-by-n.

III. The RGB Color Model

In the RGB model, each color appears in its primary spectral components of red, green, and blue. This model is based on a Cartesian coordinate system. The color subspace of interest is the cube shown in Fig.4, in which RGB values are at three corners; cyan, magenta, and yellow are at three other corners; black is at the origin; and white is at the corner farthest from the origin.

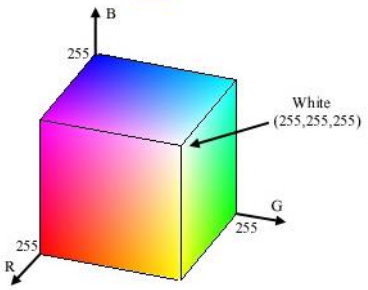

Fig.4. RGB color cube

The different colors in this model are points on or inside the cube, and are defined by vectors extending from the origin. Form the above Fig.4 we can clearly understand that the light colors lie farthest from the origin RGB (0, 0, 0). The darkest color regions were located near to the origin i.e. below (R = 200, G = 200, B=200).

IV. Algorithm pseudo code

```
% Defect Pixel Counting Algorithm
%Defect_Pixel: variable to count defect colors
% a: row; b: column; of the image
Defect_Pixel=0;
% Threshold values for defect pixels
Red_Range =0; Green_Range =0; Blue_Range =0;
For a=1to Image height
   For b=1to Image width
  If (((Image (a, b, Red_Channel) <Red_Range)  &
(Image (a, b, Greeen_Channel) < Green_Range) &
(Image (a, b, Bulu_Channel) < Blue_Range)))
        Defect_Pixel = Defect_Pixel +1;
     End
   End
End
```

The two ‘for’ loops will handle the image size (height and width). Red_Range, Green_Range, Blue_Range are the color range variable, using this variable user can set the color range to count the defect pixels. And the three coordinate’s pixel values were checked; If the value lie in between the specified color range means the Defect_Pixel variable will be increased to one(1). Finally the Defect_Pixel variable will contain the total amount of defect pixels. Then this Defect_Pixel variable value will be finally used to sort-out the rice grains.

IV. Result & Discussion

i. Input: Red_Range =200; Green_Range =200; Blue_Range =200; *(Color range values set to count dark colored pixels), Simulation performed under Matlab-7.0.*

Fig.5. Input - Dark colored rice grain

ii. Output

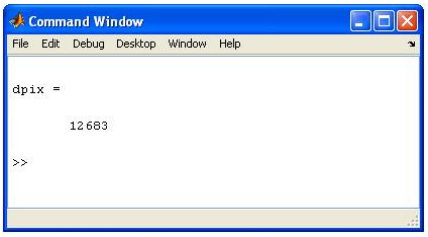

Fig.6. Amount of dark color present in grain

In the above Fig.6 we can clearly see the defect pixels (dpix = 12683) of the input image. So the variable (Defect_Pixel) value can be used as threshold limit to sort-out the rice.

V. Conclusion

Collation of all results and observations made during this project lead to the following conclusions, For any kind of rice grain the developed algorithms can be used. By using the color sorting algorithm the machine vision system can sort-out a bad rice grain from the system. The average of 0.2 seconds in a 128 MB RAM with ~1GHz Pentium III processor configuration. This time will be reduced in a higher configuration system, because nowadays processors speed were reached above 3 GHz.

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