Histogram Based Color Sorting Technique - Image Processing

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Abstract. This paper discusses about sorting objects based on color Histogram 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 colored object can be defined by users as threshold value, so according to the threshold value fixed the defect colored object will be ejected from the system. This algorithm is designed to works on the RGB images, so if any RGB image is given as input to this algorithm it will detect the defect colored object and produce the 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

The strategy of this approach originated from the strategy plan diagram shown in Fig.1. The plan has four steps labeled in numerical order. To begin with, step 1 was to find the red channel histogram of the RGB image; it can be easily calculated using a MATLAB built-in function *imhist()*. Similarly for step 2 and step 3 by using the histogram function the values are calculated and in the step 4 the values are summed and divided by 3 (three) to get the average value. The average value will be used as threshold value to sort-out the rice grains. The machine vision algorithm sorts rice grains for the removal of foreign contaminants, discolored products using color sorting techniques [1-44].

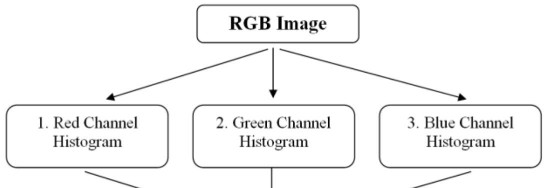

Fig.1. Histogram mean Value

The main goal of the histogram mean value algorithm is to classify the normal rice grains from the defect colored rice grains. 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.

Fig.2. Normal rice grain

II. Histogram

A color histogram of an image describes its color probability distribution. It is obtained firstly by choosing a discrete color space, which is defined by some color axes (e.g. red, green, blue), and then filled by counting the number of times each discrete color occurs in the selected image, each pixel in an image has a color which has been produced by some combination of the primary colors red, green, and blue (RGB). Each of these colors can have a brightness value ranging from 0 to 255 for a digital image with a bit depth of 8-bits.

A RGB histogram results when the computer scans through each of these RGB brightness values and counts how many are at each level from 0 through 255. Also to handle the range of values from 0 to 255, bins are defined so each color values can be put in separate bins. 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.

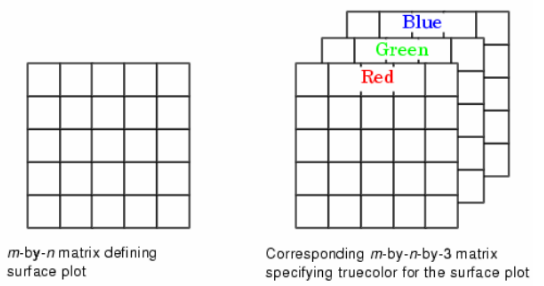

Fig.3. m-by-n-by-3 matrix

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.

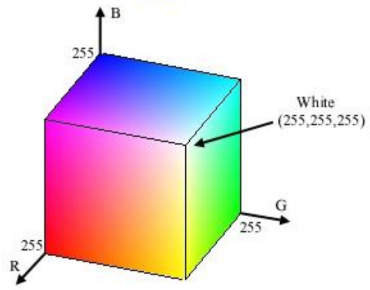

Fig.4. RGB color cube

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

% Histogram mean value algorithm
% nBins: variable to define number of bins
NBins = 256;
Red_Channel_H
= imhist (Image (:, :, Red), NBins);
Green_Channel_H
= imhist (Image (:, :, Green), NBins);
Blue_Channel_H
= imhist (Image (:, :, Blue), NBins);
Mean_Value
=round ((Red_Channel_H+
Green_Channel_H+
Blue_Channel_H)/3);
% to Display the histogram mean value
Disp (Mean_Value)

In the above algorithm *NBins* variable handles the number of bins should be in the histogram and by using the function *imhist()* each channel histograms are calculated separately and finally the average value has calculated and stored in the variable *Mean_Value*. This average value is used to sort-out the defect rice grain from the normal rice grains.

IV. Result & Discussion

Input: Normal rice grain (Fig.5)

Fig.5. Input – Normal rice grain

ii. Output

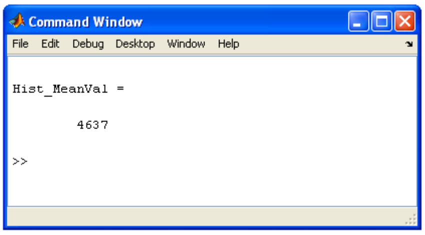

Fig.6. Output – Histogram mean value algorithm

In the above Fig.6 we can clearly see the histogram mean value *(Hist_MeanVal=4637)* of the input image. This algorithm will works only on the RGB images. The variable (Mean_value) value is used as threshold limit to sort-out the rice grain.

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 *Histogram Mean Value* 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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