International Journal of Engineering and Advanced Technology (IJEAT)
ISSN: 2249-8958 (Online), Volume-9 Issue-1, October, 2019

Color Image Segmentation without any Information Loss

Mohd. Junedul Haque, Rakesh Ahuja, Sachin Ahuja

Abstract*: *We can partition the background from foreground and locate the objects of interest using image segmentation techniques. In other words we can say image segmentation is the process of grouping adjacent pixels in to segments. In this research we proposed a model which can differentiate maximum and minimum frequencies for both color and grayscale images without any information loss. After getting the result of both images, we will check which (gray scale image or color image) gives better performance to the image segmentation techniques. So, here we will take the two techniques edge detection and threshold. This research gives better result of segmentation by using the relationship discontinuous and similar pixel values.

Keywords* : *image segmentation, color image, gray scale image, medical images.

I. INTRODUCTION

Digital images and digital videos are, respectively, pictures and movies that have been converted into a computer-readable binary format consisting of logical 0's and 1's. Usually, by an image we mean a still picture that does not change with time, whereas a video evolves with time and generally contains moving and/or changing objects [1]. One aspect of image processing that makes it such an interesting topic of study is the amazing diversity of applications that use image processing or analysis technique. Virtually every branch of science has sub disciplines that use recording devices or sensors to collect image data from the universe around us [1] Mathematically, an image is a two-dimensional light intensity function f (x, y), where f, is the brightness value or gray-level at a point (x, y). When both x, y and f are discredited, we get a digital image. The elements of the array are called pixels [2].

II. IMAGE ENHANCEMENT

The main objective of enhancement technique is to process an image so the result is more suitable than original image for a specific application. Spatial filter is typically done for noise removal or to perform some type of image enhancement. These operators are called spatial filters to distinguish them from frequency domain. The spatial filters are

Mean: Adds a "softer" look to an image.

Median: This median value is used to smoothen the noise with the background.

Enhancement: Highlight edges and details within the image [8].

Sharpening: the principal objective of sharpening is to highlight fine detail in an image or to enhance detail that has been blurred. Uses of image sharpening vary and include applications ranging from electronic printing and medical imaging to industrial checkup and independent management in military systems. Table1 shows the sharping masks that had been used in the research [5].

0	-1	0
-1	5	-1
0	-1	0

A

-1	-1	-1
-1	9	-1
-1	-1	-1

B

Table- 1 A and B the sharping masks

III. IMAGE SEGMENTATION

Image segmentation is an important aspect of digital image processing. It basically aims at dividing an image into sub parts based on certain feature. Features could be based on certain boundaries, contour, color, intensity or texture pattern, geometric shape or any other pattern. It provides an easier way to analyze and represent an image. In all segmentation is a process of assigning a label to pixels pertaining similar characteristics [2]. Segmentation also refers to the process of partitioning a digital image into multiple segments (sets of pixels, also known as super pixels). The goal of segmentation is to simplify and/or change the representation of an image into something that is more meaningful and easier to analyze. Image segmentation is typically used to locate objects and boundaries (lines, curves, etc.) in images. More precisely, image segmentation is the process of assigning a label to every pixel in an image such that pixels with the same label share certain visual characteristics [3]. Full segmentation: Individual objects are separated from the background and given individual ID numbers (labels). Partial segmentation: The amount of data is reduced (usually by separating objects from background) to speed up further processing, Image is divided into separate regions that are homogeneous with respect to a chosen property such as brightness, color, reflectivity, texture,…, etc. [11].

Revised Manuscript Received on October 30, 2019.

* Correspondence Author

Mohd. Junedul Haque*, CURIN, Chitkara University, Rajpura,Punjab,India. Email: junedul.haque@chitkara.edu.in

Rakesh Ahuja*, CURIN, Chitkara University, Rajpura,Punjab,India. Email:rakesh.ahuja@chitkara.edu.in

Sachin Ahuja, CURIN, Chitkara University, Rajpura,Punjab,India. Email:sachin.ahuja@chitkara.edu.in

Segmentation is often the most difficult problem to solve in image analysis. The result of image segmentation is a set of segments that collectively cover the entire image, or a set of contours extracted from the image.

Each of the pixels in a region are similar with respect to some characteristics or computed property, such as color, intensity, or texture. Adjacent regions are significantly different with respect to the same characteristic.[4][6]

IV. PRACTICAL ISSUES

The practical work is composed of six stages:

1. Image acquisition.
2. Read image data.
3. Preprocessing.
4. Segmentation.
5. Post processing.
6. Result.

In this research the working based on the properties of intensity values, which are

-Similarity: Thresholding, split and merge
(combine between threshold and split and merge)
-Discontinuity: Hough transform.

Project Over view:

As mentioned this research is consist of six steps .These steps will discussed in detail.

A. Image Acquisition:

Our project Work on Binary Bitmap images (BMP) because it's value is natural and easy in work, Then take the header of this image and put it in binary file to take the height and width of the image, its very efficient on work than scale
(width and height) of picture box specialty when the image smaller than the picture box. Figure 1 shows the original image that the work start with.

Original Image

Figure 1 BMP image

So here the width of this image is 204 and height is 276 but the picture scale width is 249 and scale height is 321 ,here we can see the difference between both by using image information we can work just on its width and its height.

B. Image Enhancement (Preprocessing):

B.1 Preprocessing On Image That Segmented By Using The Discontinuity Relation:

Sharping filter is used in discontinuity segmentation to produce the edges and remove the detail of image because image sharpening is working on high frequency of image, and the edge is the high frequency. Image discontinuity is working by edge deduction then edge linking so we have to produce the edges. Image enhancement is used as preprocessing and post processing. Figure 2 shows the image after applying Sharping filter. Sharping filter is used in discontinuity segmentation to produce the edges and remove the detail of image because image sharpening is working on high frequency of image, and the edge is the high frequency. Image discontinuity is working by edge deduction then edge linking so we have to produce the edges. Image enhancement is used as preprocessing and post processing. Figure 2 shows the image after applying Sharping filter [7].

Original Image Sharpening Image

Figure 2 Image after Applying Sharp Filter.

As we can see the difference between the original image sharp image with high frequencies pixels that found on edges. We need sharp because when we work on discontinuity relation between pixels because the first step to split the object is edge deduction and this process is work on edges so we have to produce the edges.

B.2 Preprocessing On Image That Segmented By Using The Similarity Relation:

Smoothing filter will used in this method because we want to work on the detail of the image not it's edges. So mean filter is used in this method to remove the edges and produce the detail. The details of an image are important in this method because we have to produce the brightness. Figure 3 shown an original image and the smoothen image, the difference between the original image and the smoothing image is that the smoothing image is blurred and more detail.

Original Image Smoothing Image

Figure 3 Image after applying Smooth filter

Smoothing filter will used in this method because we want to work on the detail of the image not it's edges. So mean filter is used in this method to remove the edges and produce the detail.

The details of an image are important in this method because we have to produce the brightness. Figure 4 shown an original image and the smoothen image, the difference between the original image and the smoothing image is that the smoothing image is blurred and more detail.

C. Image on Gray Scale:

on both method of segmentation(similarity and discontinuity), converting the image into Gray Scale Representation because the Gray image is easy to work on its pixels value and our project depend on brightness of the object, so it can be very clearly to work on gray images than color image.

D. Image segmentation :

In this step, implement two algorithms in our project the first one is Hough transform algorithm (use discontinuity relation), and the other is thresholding algorithm(use similarity relation).

D. 1 Segmentation By Hough Transform Algorithm:

In this algorithm, it is necessary to detect the edges then linking the edges. Edge detection is applied by using sobel equation the edges will be detected of the original image to split the object as we will see in Figure 4. edge linking is applied by Hough transform this algorithm is used to link the edges that results from sobel operator.

Original Image Segmented Image

Figure 4 shows the original image and the image segmented by Hough transform

D. 2 Segmentation By Using Thresholding Algorithm:

In this algorithm, first finding the threshold value and then segment the object depending on this value the result will be image that has the high or equal to brightness of the threshold value on this step we could draw the binary image resulting of threshold and also we could draw the gray pixel itself and then found each pixel, the color of it meaning that we draw the color brightness object, as shown in Figure 5.

Figure 5 shows the original image and the binary result image from the threshold algorithm then the gray pixel itself and the color image resulting from

We find that the threshold value of this image is 97 and it will change with another image depending on the brightness degree of this image. The binary resultant image produces parts of the object that will be more bright than others, this image called binary image because the pixel that has value is grater or equal to the threshold value, it will take the value (255) and the pixels that have less than the threshold value will be (0) mean that it produces the object that has more brightness, also do it on the third result gray image but with difference that the pixel that have grater or equal the threshold value will store in a matrix that contain the pixels of the object and that less than threshold value is stored in another array as the background pixels, and so on the color result image with different that we will draw the red, green and blue for brightness image[9].

E. Image Enhancement (Post Processing) :

In this step enhance the image resulting from segmentation know we ask our self how we will do that the answer is when the resulting image is contain only high frequencies so we will apply smooth enhance process on it and on the low frequencies image we will apply sharp on it. On the research when Hough transform segmentation is applied so the resulting image is high frequency image so we will apply smoothing enhance process by using mean filter, and on threshold segmentation the result image is low frequencies image so we will apply sharpening enhancement on the resulting image.

E.1 Post Processing On Resulting Image From Hough Transform Segmentation Algorithm:

In this step apply smoothing on the resulting image to remove the high frequencies and produce the detail of the image. the result image we can see that the image contain more detail.

E.2 Post Processing On Resulting Image From Thresholding Segmentation Algorithm:

In this step apply sharpening on the resulting image to remove the low frequencies pixels and produce the edges of the image. after applying sharp filter on the result image we can see that the image contain more edges, as shown in figure 6.

Figure 6 shows the resulting image after color thresholding and after post processing.

V. PROPOSED MODEL

For performing image segmentation using edge detection, an image has to convert into gray-scale image first as it can only be performed on those images where the intensity of image pixels is similar. For this method, image has to first convert into gray scale. Due to this reason applying edge detection methods directly to the color image is impossible.

So, in order to perform segmentation on color images, I have proposed a method, where a color image is first divided into its three color components i.e., R, G and B. After that, segmentation is performed on separate divided component images. On getting the segmentation result, we combine those three images, which would in turn give the final result of the image in segmented form.

For performing segmentation, we used the following algorithm which has following steps:

Steps to perform image segmentation on gray scale images

1. Open the color image.
2. Using Red, Green and Blue (RGB) components, convert the color image into Gray image.
3. Now use edge detection methods to get the edge gradient of the image.
4. Normalize edge value to the 0-255 range.
5. Now apply Threshold method to get the binary edge maps, at all threshold values (i.e., 0-255).
6. Now compare the result.

Similarly apply the same procedure for the color images:

1. Open the color image
2. First of all convert the image into its Red components.
3. Use edge detection methods to get the edge gradient of the image.
4. Normalize edge value to the 0-255 range.
5. Similarly repeat step 2 to step 4 for Green and Blue components.
6. Now, here we get three Segmented images of Red, Green, Blue components.
7. Combine these three images.
8. Now, Apply Threshold method to get the binary edge maps at all threshold values (i.e., 0-255) and we get the final result.
9. Now compare the result of gray-scale image with color images.

The manipulation process for gray images use one matrix of the image to accomplished the task. While, using the colored image in the manipulation process needs to manipulate 3 different matrices of the image which are red, green and blue.

For converting color image to gray scale image, we have to convert RGB image to R'G'I, because image processing technique uses only intensity I. Let's take an example to understand how to convert RGB into RGI.

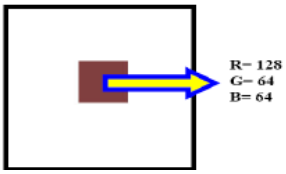

Figure 7 RGB value of Single Pixel

Let's take a pixel of image having R=128, G=64, B=64. To convert given color pixel into gray image pixel,we have to use following formula:

rd = (r * 256) ÷ (g +r + b)

gd = (g * 256) ÷ (g +r + b)

I = (g + r + b) ÷ 3

Now to perform inverse transform i.e. Gray scale image to color image we use following formula:

r1 = (rd *3 * i)÷256

g1 = (gd * 3 * i) ÷ 256

b1 = ((256 - rd - gd) * 3 * i) ÷ 256

By applying above formulas and previous values, we get following result:

Direct Conversion: rd = 128, gd = 64, i = 85

Inverse Conversion: r1 = 128, g1 = 64, b1 =64

Thus, we obtain the same pixel values, which mean that the conversion is correct.

VI. RESULT AND DISCUSSION

Finally, we can Say that the segmentation is part of image understanding, mean that the image is partitioned into objects and their background these objects can be split from their background depending on any segmentation base such as brightness, color, texture, or other segmentation base type. By using two different methods for segmentation, first is depend on discontinuity relation between neighbors' pixels and this method is split the edges of the object from its background then the result is objects that have high frequency pixels, we know that the background edges is less than its objects so Hough transform algorithm is split the objects from their background depending on the edges of the image, this is one method for segment [12]. The second method is to split the objects depending on the brightness of the image so The resulting image that segmented is the brightness parts of the images, this technique can be useful in medical devices such as the devices that connect to the MRI (Magnetic Resonance Imaging) scan that convert the signal into digital image the converting process is depending on segmentation process such as the brightness of the pixels, in medical each bright degree of pixel meaning something ,so here we can make to the image detection. Hence we can state that, these algorithms gives better result on color images than gray images. After using different types of images, we have found that, probability of better result on color images is more than the gray images [13].

VII. CONCLUSION

Image segmentation is a key step for transition to the image analysis as low level processing in digital image processing. For a long time, maximum image segmentation techniques were used only for gray scale images, but as the technology improved and use of color images increased, the color image segmentation are more and more concerned by the researchers. Color image segmentation is an improvement of the gray scale image segmentation method, but many of the gray scale images.

REFERENCES

1. Al bovik, 200, "Hand book of image and video processing", department of electrical and computer engineering the university of Texas at Austin. Austin, Texas.
2. Utkarsh Kumar Shah, Prof. A. Mukerjee Dept of Computer Science and Engineering IIT Kanpur 2010,"Image segmentation by region growing ", INDIA.
3. Chin-Ya Huang, Mon-Ju Wu ECE ,2006, Image Segmentation, Final Project, Fall 2006 ,University of Wisconsin- Madison University of Wisconsin- Madison.
4. Computer Assisted Image Analysis , Image segmentation2006, Lecture 5, Patrick Karlsson .

5. Basic Algorithms for Digital Image Analysis Dmitrij Csetverikov, image segment lectures ,lecture 10 Institute of Informatics,Eotvos Lorand University Budapest, Hungary, http://visual.ipan.sztaki.hu.
6. E.A.Zanaty , M.T.El-Melegy , M.R.Girgis, Walaa M.Abd-Elhafiez, Sohag ,2000," image analysis hand book Hybrid Image Segmentation Method Based on Seed Region Growing
and Edge Detection ",faculty of science, south valley university, Sohag, Egypt. Computer science department and math department,2000.
7. Bryan S. Morse, 2000, "Segmentation (Region Based)" lecture18, Brigham Young University.
8. Regions and Image Segmentation, METU EE 701 Lecture Notes by A.Aydin ALATAN 2008.
9. Xiaoheng Yang Nakajima Lab, October 29, 2004," Image Segmentation,",Titech
10. Wen-Xiong Kang, Qing-Qiang Yang, Run-Peng Liang, "The Comparative Research on Image Segmentation Algorithms", College of Automation Science and Engineering ,South China University of Technology Guangzhou, China.
11. Adam Hoover, Gillian Jean-Baptiste, Xiaoyi Jiang, Patrick J. Flynn, Horst Bunke, Dmitry B. Goldgof, Kevin Bowyer , David W. Eggert, Andrew Fitzgibbon, and Robert B. Fisher, 1996, "An Experimental Comparison of Range Image Segmentation algorithms", IEEE transactions on pattern an4lysis and machine intelligence, vol. 18,No.7.
12. Dmitrij Csetverikov, "Basic Algorithms for Digital Image Analysis", Institute of Informatics ,Eotvos Lorand University Budapest, Hungary, Image Segmentation Lecture 15, http://visual.ipan.sztaki.hu.
13. Mohd. Junedul Haque, Sultan H. Aljahdali, "An Approach for Reconstructed Color Image Segmentation using Edge Detection and Threshold Methods", International Journal of Computer Applications (0975 – 8887) Volume 68– No.11, April 2013

AUTHORS PROFILE

Dr. Mohd. Junedul Haque is Ph.D. in Computer Science and Engineering. He is having 8 years of experience in Academic, Research and Industries. at UG and PG levels of Computer Science & Engineering. His areas of interests are image processing, data warehousing, data mining and multimedia technology, computer networks. The author has published four books and many research papers in distinctive national/international journals, conferences.

Dr. Rakesh Ahuja is PhD in Computer Science & Engineering. He is having 24 years of experience in Academic, Research and Industries. His areas of expertise are Information Hiding, Digital Right Management, Multimedia Security and Pattern Recognition. His areas of interest include Database Management System, Real Time System, Distributed System, Software Engineering and Operating System. He has supervised several ME Scholars in the areas of Information Hiding.

Dr. Sachin Ahuja is current working as a Director (Research) in Chitkara University. He has over 15 years of experience in teaching and research at UG and PG levels of Computer Science & Engineering. His research interests include: Data Mining, Education Data Mining, Prediction using Fuzzy Logic and Fuzzy Time series..