Image Segmentation Using Marker-Controlled Watershed and Normalized Cut

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***Abstract*—Image segmentation is an important image processing technique which is used to analyze what is inside the image. Image segmentation is used to separate an image into several meaningful parts. It is an old research topic, which started around 1970, but there is still no robust solution toward it. There are two main reasons, the first is that the content variety of images is too large, and the second one is that there is no benchmark standard to judge the performance. In this project we develop a novel based approach to segment the image in a more better way.in this project we use the Ohta color model instead of RGB color model to get a better segmented image [1]. Graph cut algorithms are successfully applied to a wide range of problems in vision and graphics. Here we used this graph cut technique to solve the image segmentation problem. And we got successful results in partitioning an in image. In this project we use the normalized cut technique to do the segmentation of an image .in this method we use an efficient computational technique based on the eigenvalues and eigenvectors to get an optimized segmented image. We have applied this approach to segment the static images**

***Index Terms*—Color image segmentation,Marker-Controlled Watershed, graph partitioning,, normalized cut (Ncut).**

I. Introduction

We all know that every image is a set of pixels. And partitioning those pixels on the basis of the similar characteristics they have is called segmentation dividing an image into sub partitions on the basis of some similar characteristics like color, intensity and texture is called image segmentation. The goal of segmentation is to change the representation of an image into something more meaningful and easier to analyze. Image segmentation is normally used to locate objects and boundaries that is lines, curves, etc. in images. Segmentation can be done by detecting edges or points or line in the image. When we detect the points in an image then on the basis of similarities between any two points we can make them into separate regions. And in the case of the line detection technique we use to detect all the lines and the similarities in between those lines then on the basis of the dissimilarities between the lines or curves in the image we can divide the image into two regions. And in the case of edge detection we detect the edges in the image and after finding the edges in the image we can easily divide the image and here we can easily analyze what is inside the image and we can get a better segmented image. even it is the old technique to segment the image now a days these segmentation technique is used to segment the image. [2] In this project we use the graph cut technique to solve the segmentation problem. here we represent the image in the format of the graph that means it will contain the vertices and the edges like a graph .and here each vertices or a node can be taken as the pixels of the image and the color or intensity difference between any two pixels can be taken as the edge. And whenever there is a week edge in between the graph or the image then we cut that part. if the cutting the part of the graph is more than it is called maximum cut and we can call it minimum cut if the cut is small when compared to other cuts in the image. Here we use the minimum cut method to solve the segmentation problem and we didnt get the better segmented image. Because there are some of the discontinuities are there in the case of the minimum cut technique. Because it cuts all the pixels even if there are similarities in the image. So here we go for the normalized cut method in which we use the eigenvalues and the eigenvectors to solve the image segmentation problem. In this normalized cut method we use the eigenvector of the second smallest eigenvalue. And on the basis of the eigenvector we divide the image into two parts and if it is necessary we can cut the graph which divided into two parts by taking any part of the above divided image. we apply the same technique above applied and by this we can get a more segmented image. [3]

II. Marker-Controlled Watershed Segmentation

Marker-Controlled Watershed Segmentation is used to to separate touching objects in an image The watershed transform finds ”catchment basins” and ”watershed ridge lines” in an image by treating it as a surface where light pixels are high and dark pixels are low. . Marker-controlled watershed segmentation follows this basic procedure: Compute a segmentation function. This is an image whose dark regions are the objects you are trying to segment. 2. Compute foreground markers. These are connected blobs of pixels within each of the objects. 3. Compute background markers. These are pixels that are not part of any object. 4. Modify the segmentation function so that it only has minima at the foreground and background marker locations. 5. Compute the watershed transform of the modified segmentation function [4]

III. GRAPH CUT

In the graph cut technique we represent the image in the form of graphs. That means containing nodes and vertices like a graph. So here we represent the each pixel as a node and the distance between those nodes as the edges. We can calculate the distance between the nodes by using the attributes of the Ohta color model. The normalized cut method was proposed by J. Malik and J. Shi. In their view, the image segmentation problem can be seen as a graph theory problem. Graph theory is an interesting math topic which models math problems into edges and vertexes. Here we represent the each pixel as a vertex or node and the distance between those nodes as the edges. This model could be used for coloring problems (give each county a color, while connected county should have different colors. Each edge in the model could contain a value (weight), which could be used as flow or importance of it. This kind of graph is called weighted graph. In graph cut technique we cut the image where there are week similarities in between two pixels. [1] [**?**].

IV. FORMULA FOR FINDING NORMALIZED CUT

A graph G= (V, E) can be partitioned into two disjoint sets, A, B, A U B = V, A B =, by simply removing edges connecting the two parts. Weight of an edge can be calculated as the similarities between two nodes in a graph so, if there are no similarities in between two nodes then we can cut that edge this is called graph cut.

$$cut(A, B) = \Sigma_{u\epsilon A, v\epsilon B} w(u, v) \tag{1}$$

The normalized cut then could be defined as :

$$N_{cut}(A, B) = cut(A, B)/asso(A, V) + cut(A, B)/asso(B, V) \tag{2}$$

Here, Cut(A,B) Sum of all the edge weights associated with the cut assoc(A,B) sum of all the edge weights associated with the cut and all the points in the graph. Where asso(B, V)= uA,tV W(u, t) is the total connection from nodes in B to all nodes in the graph, and asso(A, V) is similarly defined. In the same way, we can define a value for the total normalized association within groups (a measure for similarities inside each group) for a given partition of the image.

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formula

V. WEIGHT MATRIX

We need to find the weight matrix to find out the eigenvalues and eigenvectors. We can find out the weight matrix by using the attributes of the ohta color model. That is we need to use the I1, I2, I3 values. Here is the formula for the weight function:

W(i,j) = $e^{\frac{-||x_i - x_j||_2^2}{\sigma_x^2}}$

Where Xi and Xj are the Ohta attributes of two pixels.

Where Xi and Xj are the Ohta attributes of two pixels. If I11, I12 ,I13 are the three attribute of the first pixel and I21, I22, I23 are the three attributes of the second pixel then we can find out the weight between by finding the norm of the Xi-Xj that is .. Xi-Xj=(I11-I21)2 +(I12-I22)2+(I13-I23)2 And we already know that we can find the norm of the x1 ,x2,x3 as sqrt(x12+x22+x32) Here, Is the scaling factor, that determines the sensitivity of the weight function After finding the weight matrices for all the edges in an image we need to represent all the weights of the image into a matrix. And that is called the weight matrix.

VI. DIAGONAL MATRIX

After find out the weight matrix we need to find the diagonal matrix. For that we need to add each row in the weight matrix and then by presenting them in a single column we can get the diagonal values. These values are presented in a diagonal form of a matrix with remaining all elements as zeros. Then we can get a diagonal matrix. The formula for this is

D(i) =$\Sigma_j w(i, j)$

Then by using matrices D and W we can find the eigenvalues and eigenvectors. By using the following formula we can find out those eigenvalues and eigenvectors (D-W)y = λDy

Then, after find out the eigenvectors we need to take the eigenvector of the second smallest eigenvalue to divide the region. On the basis of the eigenvectors based on the sign we can divide it into two regions. That means the pixels containing the same sign need to be in the same region and all the pixels with different signs (-ve) need to be in different region.

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VII. CONCLUSION

Here we used the Graph cut technique to segment the image. here we represent the image in the form of graph.

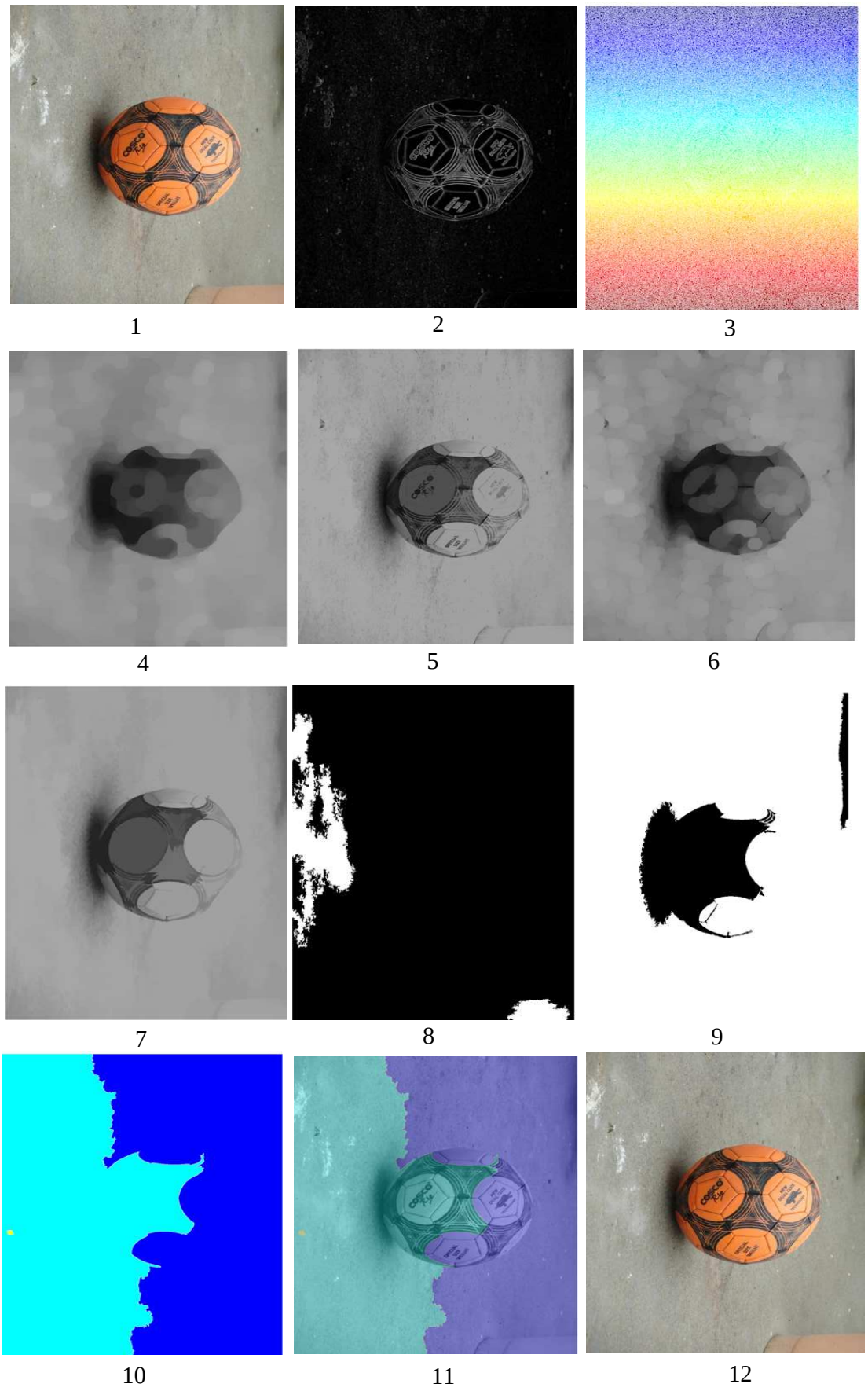

Fig. 1. Image segmentation different process

taking the advantage of the Ohta (I1,I2,I3) feature space we segmented the image using N cut method. Here, we overcome the correlation property of the image so, we got a better segmented image. [8]

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