Iterative Region Merging and Object Retrieval Method Using Mean shift segmentation and Flood fill algorihtm

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Abstract— **Nowadays image retrieval plays an important role in an extraordinary number of multimedia applications which serve human society. Since a generic graph based retrieval scheme working in every situation can be quite difficult to implement due to the presence of complex scene. In this paper we investigate to deal with such problems and focuses on how to extract the object from an image using topological models. It begins with the innovative concept of initial low level segmentation of input image, which are used to construct topological model on the basis of connected regions. Using this topological model we have design a new prototype known as Iteratively Region Merging and Object Retrieval (IRMOR).Using this prototype IRMOR we can extracted contour based descriptors on an object from an image which constituent the high level features.**

In addition we focus on how to apply a region labeling and flood fill method to extract object after formation of object contour, IRMOR have special application such an image matching, object recognition, content based image retrieval, object tracking etc.

Keywords- Mean shift segmentation, Bhattacharya coefficient, Flood fill method, watershed, super pixel, object contour.

I. INTRODUCTION

Image segmentation and object retrieval is very important area in image processing and it is also one of the fundamental problems in the computers vision. There has been a convincing quantity of research on image segmentation including clustering based methods [1], histogram based methods [2], adaptive threshold [3], level set methods [4], graph based methods [5,6] etc.

In this paper we have designed the prototype known as **Iterative Region Merging and Object Retrieval (IRMOR)**. This prototype based on initial segmentation of mean shift. Mean shift is low level segmentation method. Low level segmentation methods include mean shift [7, 8], watershed [9] and super pixel [10]. This low level method divides image into small regions (or segments). We use mean shift method in our prototype because it divides image into less segments in comparison to watershed and super pixel [11, 10]. Mean shift also present well edge information of the object.

With the help of IRMOR method we can calculate the similarity between the different segments of image and after it we iteratively merge large similar segments. At the ending of this iteratively large similarity merging process we get two types of segments. One is our desired object which is known as foreground and second one is background. With the help of this prototype IRMOR we get the object contour and extract the desired object from the image. The design prototype is very simple but it can extract the object from complex image.

In rest of the paper we consider following sections; section 2 presents the region merging process in IRMOR method, in section 3 we explain the analysis of IRMOR method and in last section 4 we explain conclusion and future work of the paper.

II. REGION MERGING PROCESS IN IRMOR

In our design prototype IRMOR we firstly apply the low level segmentation method for getting initial segmentation, this initial segmentation partition the image into homogeneous region for merging. For this we use any existing low level segmentation method which include watershed [9], super-pixel [10], mean-shift [7, 8] and level set [12]. We use mean shift method in our prototype because it divides image into less segments in comparison to other existing low level segmentation method and mean shift also present well edge information of the object.

(a.) Original Image (b.) Mean- Shift segmentation

Figure2. Initial Segmentation

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For obtaining initial segmentation of an image we use EDISON (Edge Detection and Image Segmentation) system [13], which is software of mean-shift segmentation. The initial segmentation map using EDISON software show in fig. 2

A. Similarity Measure of Regions

After initial segmentation using mean-shift segmentation method in IRMOR, we now have number of homogeneous segments. In our design prototype IRMOR we iteratively merge the most similarity region. For merging we first find out the similarity between segments. We can describe the region in many properties e.g. shape and size, texture [14] and color edge [15] of region. Color information of an image is very important as compared to other properties of an image because the same region having different shapes but high color similarity, so we use the color histogram. To generate color histogram for each region we will use RGB color space. After generating color histogram now we have problem that how we find out the similarity between the regions for merging on the basis of their color histogram. So here we need to use formula to measure the similarity between the regions. There are some existing methods like Euclidean metric, Bhattacharya coefficient and log-likelihood ratio statistic [16].

In our design prototype IRMOR we use the Bhattacharya coefficient [16, 17, 18, 19] formula to measure the similarity between the region for merging process. Let A and B are the two segmented regions of an image then according to the Bhattacharya coefficient:

$$P(A, B) = \sum_{u=1}^{4096} \sqrt{Hist_A{}^u \; Hist_B{}^u} \qquad (1)$$

In equation 1 $Hist_A$ and $Hist_B$ are the normalized histogram of region A and B, and u represent the u^{th} element of them.

$$\cos\theta = \left(\sqrt{Hist_A{}^1 \ldots Hist_A{}^{4096}}\right)^T \left(\sqrt{Hist_B{}^1 \ldots Hist_B{}^{4096}}\right)^T \qquad (2)$$

If two regions having same histogram then the Bhattacharya coefficient is very high between them and θ is very low. Bhattacharya coefficient is very efficient and simple method to compute the similarity between the region and it works well in our design prototype IRMOR.

B. Region Merging and Object Retrieval Process

We retrieve the object into two stages. In the first stage we merge the similar regions, this merging process is iteratively in fashion and at each iteration we will check where desired object contour achieve or not. We end the iterative region merging process after achieving the desired object contour. We also apply region labeling after achieving object contour in first step.

In the second stage we will apply the flood fill algorithms using 8-connectivity and retrieve the object.

Designed Algorithm for object retrieval

Input: We take an image as input and get its initial segmentation using the mean-shift segmentation method.

Output: Desired retrieval object from an input image.

Merge segments iteratively until the desired contour is achieved.

1. First we generate the initial segment of an image using the mean-shift segmentation.
2. We calculate the Bhattacharya coefficient of adjacent regions and merge them if they have higher Bhattacharya coefficient.
3. We iteratively apply the merging process (step 2) until we get the desired object contour and go to step 4.
4. After getting the object contour from step 3, we label regions of the image.

Region Labeling (I)

4.1 let N→2
4.2 for all image coordinate (u, v) we do
  4.2.1 If I (u, v) = 1 then
  4.2.2 Flood fill (I, u, v, m)
  4.2.3 n→n+1
4.3 return to the labeling image I

We apply flood fill algorithm using 8-connectivity after region labeling:

5. flood fill (I, u, v, label)
  5.1 Generate empty queue q
  5.2 ENQUEUE (q, (u, v))
  5.3 Until queue q is not empty do-
  5.4 (x, y) ← DEQUEUE (q)
  5.5 If (x, y) is inside the image and label of (x, y) = 1 then
  5.6 set I (x, y) label
  5.7 ENQUEU (q, (x-1, y+1))
  5.8 ENQUEU (q, (x, y+1))
  5.9 ENQUEU (q, (x+1, y+1))
  5.10 ENQUEU (q, (x-1, y))
  5.11 ENQUEU (q, (x+1, y))
  5.12 ENQUEU (q, (x-1, y-1))
  5.13 ENQUEU (q, (x, y-1))
  5.14 ENQUEU (q, (x+1, y-1))
  5.15 return

Above designed algorithm guarantee that it gives us the object contour after some iterative merging steps, for example let X and Y are the regions of an image and both having the higher similarity then according to design prototype IRMOR we merge X and Y i.e. $X = X \bigcup Y$. In IRMOR first stage merging process is repeated iteratively and number of regions in the image is reduced, because the numbers of regions in the image are finite so we obtain our desired object contour after certain finite iteration.

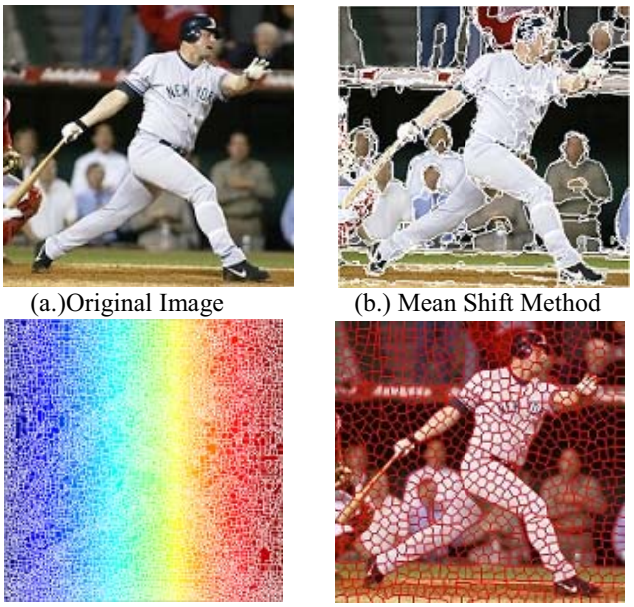
So IRMOR prototype obtains the desired object contour and label the every region of an image, label region is either background or object.

III. IRMOR ANALYSIS

In our design prototype IRMOR method we use mean-shift method for initial segmentation of input image, Bhattacharya coefficient for measuring the similarity between the two regions and flood fill algorithm for extracting the object contour from an image. In this section we will discuss that why IRMOR method is efficient and simple for of object retrieval.

A. Image Segmentationu

Usually we use low level image segmentation method such as mean shift, watershed and super pixel, which divides the image into small regions. Mean-shift segmentation method divides the image into less regions as compared to watershed and super pixel methods, while presenting well edge information of the object. In our design prototype IRMOR, we firstly divide the image into small regions and after it we iteratively merge similar regions for getting the desired object contour. If the number of region is less then time taken to merge the similar region is also less. Therefore time taken to obtain the desired object contour from the image which is segmented by mean shift segmentation method takes less time as compared to obtain desired object contour from an image which is segmented by the watershed and super-pixel segmentation method. Fig.3. show the watershed, mean-shift and super pixel segmented image.



(a.)Original Image (b.) Mean Shift Method

(C.) Watershed Method (d.) Super Pixel Method

Figure3. Low Level Segmentation Methods

By observing the image (a),(b) and (c) we can say that image (c) watershed segmented image having large number of regions and image (b) mean shift segmented image having small number of region. So when we use mean shift segmentation method in our design prototype IRMOR we get less number of initial segments and it decrease the object retrieval time which is advantage of our IRMOR method.

B. Object Contour Retrieval

Over design prototype IRMOR method is based on iterative similar region merging and flood fill method. In this section we compare over object retrieval method with Hybrid Graph Model (HGM) and Normalize Cut method. Graph model and normalize cut model are based on pixel, in our prototype we extend pixel based graph cut to region based graph cut. So nodes of the graph represent the mean shift segmented regions instead of pixels. Region based node of graph take less time as compared to the pixel based graph node to retrieve object. It is also one of the major advantages in our design prototype IRMOR

IV. CONLUSION AND FUTURE WORK

In our design prototype IRMOR method we use mean shift segmentation method to generate the initial segments of an input image and iteratively merge the similar region by comparing their Bhattacharya coefficient. When we obtain the desired object contour then we stop the region merging process and retrieve it. For retrieve the object we choose one seed point in the object contour and apply flood fill algorithm.

In our future work we will implement IRMOR method on images to retrieve the object. We also use RGB, YC_bC_r and HSV color images to retrieve the object and compare the efficiency of our IRMOR method. We will also compare our retrieved object quality with the watershed retrieved object quality.

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