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RESEARCH ARTICLE

A Study on Different Approaches on Image Segmentation

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Abstract -- Segmentation is the process to retrieve the feature or ROI from input image. The process is beneficial as the early preprocessing stage as well as application to identify the meaningful information from images. To obtain the meaningful information, more effective segmentation approach is required. In this work, a study is defined on the segmentation in image processing. The paper has discussed some of the common type of segmentation types applied on images.

Keywords – Image, Segmentation, Preprocessing, Edge Detection

I. INTRODUCTION

Image analysis and processing has great applications in clinical study, especially in non-invasive treatment. The retinal fundus images are widely used in detection of various eye ailments like glaucoma and diabetic retinopathy. Normally these images are manually examined by the trained ophthalmologist. It is very time consuming and resource intensive task. So, it would be of immense help to the ophthalmologists, If the retinal features can be localized and extracted automatically with help of computer aided system. Image processing facilitates this task[1]. Various image segmentation techniques are available to extract region of interest but the images are often corrupted by noise. This makes the segmentation task more difficult. As a result, some kind of preprocessing or post processing is required to get better and exact result.

Imaging is a technique for creating interior representation of body for analysis and intervention. Imaging differs in a large extent from other forms of image processing arising from non- data. In medicine the problem as well as the data stream is three-dimensional and the effort to solve the problem is mostly combination both human and machine [2] tasks can often be split into three areas:

- Image acquisition and performing operations like filtering, noise removal, and contrast and feature enhancement.
- Detection of conditions and events.
- Qualitative and quantitative analysis of the detected result.

Various steps involved in image processing can be divided into two basic categories:
- Filtering: these are the steps involved in the initial stage before making the image ready for registration or for segmentation. Most of the pre-processing steps fall under this category.
- Segmentation: This is the task of partitioning an image (2D or 3D image) into contiguous regions with cohesive properties.

In case of image processing, improving the quality of acquired image will effectively affect the quality of the resulting visualization. To create effective visualization tools it is necessary to understand the source of the image data, the technology and the physical principles involved in the acquisition of the image [3]. In this section different technologies that are available for image acquisition and feature extraction are briefly explained

A) Segmentation

The goal of image 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. Image Segmentation is the process of partitioning a digital image into multiple regions or sets of pixels .Actually, partitions are different objects in image which have the same texture or color. The result of image segmentation is a set of regions that collectively cover the entire image, or a set of contours extracted from the image. All of the pixels in a region are similar with respect to some characteristic or computed property, such as color, intensity, or texture. Adjacent regions are significantly different with respect to the same characteristics[4]. The goal of image segmentation is to cluster pixels into salient image regions, i.e., regions corresponding to individual surfaces, objects, or natural parts of objects. Segmentation could be used for object recognition, occlusion boundary estimation within motion or stereo systems, image compression, image editing, or image database look-up [2]. The concept of Watersheds is well known in topography. It is a morphological based method of image segmentation. Segmentation using the watershed transforms works well if you can identify, or "mark," foreground objects and background locations [3].

Segmentation of abdominal organs presents many challenges. Conventional methods of infection segmentation rely on large gray value contrast between infection area and surrounding tissues. These methods fail on scans with dense pathologies, and such scans occur frequently in clinical practice. Recent advances in informatics enabled access to most of the radiological exams to all clinicians through the electronic health record (EHR) and the picture archival and communication system (PACS).

II. LITERATURE SURVEY

Sardana H.K., Aggarwal Preeti, Vig R. (2010) [8] reviewed and suggested different methods that can be used for efficient visualization as well as automatically extracting the organ regions from abdominal CT (Computerized tomography) data especially from Glaucoma that can be further used in various diagnosis applications like CBMIR (Content-based image retrieval). Glaucoma Computer-Aided Diagnosis (CAD) is a potential method to accomplish a range of quantitative tasks such as early cancer and disease detection, analysis of disease progression. For identifying the Glaucoma diseases, computed tomography (CT) scan of the thorax is widely applied in diagnose. DICOM (Digital Imaging and Communications in Medicine) is used as a standard for imaging. They presented an interface for fully automatic method of visualizing and identifying the Glaucomas in three-dimensional (3-D) pulmonary X-ray CT images. Experimental results shows that the proposed method can improve the speed, robustness and accuracy of diagnosis as physician can judge a particular case in right time and with full information of pathology. Beucher (1991) proposed a method for image segmentation based on the mathematical morphology [9]. The process of image segmentation is divides into two approaches, boundary based and region based. Watershed segmentation is a region based approach and uses to detect the pixel and region similarities. Basic tools for the watershed transformation are given and watershed transformation is applied on the gray tone images by using flooding process. The problem of over segmentation is remedied by using marker controlled watershed segmentation. Another approach, called hierarchical segmentation, is proposed. This approach is particularly efficient for defining levels of

segmentation starting from a graph representation of the images based on the mosaic image transform. Kuang, Wei Hong Xu, Yan Hua Wang (2011) proposed an efficient algorithm in which first, the binary image is ultra-eroded by using a different structuring element to form different distance image[10]. Second, watershed image is obtained by using the watershed algorithm. Finally, the real watershed can be extracted. Compared with other watershed algorithms, the experiment results demonstrated that this method segmented out rice successfully in the touching rice image and improved the measurement accuracy, and also overcome over-segmentation effectively. Hamarneh and Li (2007) propose a method for image segmentation consist of watershed segmentation using prior shape and appearance knowledge [11]. Watershed segmentation is a common technique for image segmentation but has problems of over segmentation and sensitivity to noise. The proposed method has two stages, first is training stage and the other is segmentation stage. In training stage, a prior shape and appearance knowledge model is developed by using 'shape histogram' and image intensity statistics. The segmentation stage is an automatic iterative procedure and consists of four steps: classical watershed transformation, improved k-means clustering, shape alignment, and refinement. The issues of watershed are remedied by this method, as over segmentation problem is handled by clustering and noise effect can be removed by mean intensity of each segment. The limitation of k-mean clustering algorithm affects the proposed methods result and a failure case is reported. Other researchers also proposed different method to remedy the problem of watershed. Li, Elmoataz, Fadili and Ruan S. (2005) proposed an improved image segmentation approach based on level set and mathematical morphology [12]. The gradient magnitude of the smoothed image is input to the watershed transformation, the result of watershed is used for rough approximation of the desired contour in the image, and guide for the initial location of the seed points used in the following level set method. This method combines the advantages of both the methods and finds best contoured. Pham, Xu and Yan-Hua Wang (1998) presented an automated methods for the segmentation of anatomical images[13]. Current segmentation approaches are reviewed with an emphasis placed on revealing the advantages and disadvantages of these methods for imaging applications. The use of image segmentation in different imaging modalities is also described along with the difficulties encountered in each modality. They concluded with a discussion on the future of image segmentation methods in bio research.

Yun-Cai Zhou and Qi- Kun Huang and (2010) used the watershed algorithm definition by immersion, and modified it so as to achieve good results after applying it to core particles in image segmentation[14]. Experiments show that the method of watershed algorithm definition by immersion can meet the core particles image segmentation on both speed and effectiveness. Further, this technique can better extract the contour of moving objects. The watershed algorithm is the method of choice for image segmentation in the field of mathematical morphology, which is simple to implement and provides good performance. In year 2010, N. Nandha Gopal, Dr. M. Karnan defined a work on Glaucoma detection using C Means clustering algorithm[15]. In this paper an intelligent system is designed to diagnose Glaucoma through MRI using image processing clustering algorithms such as Fuzzy C Means along with intelligent optimization tools, such as Genetic Algorithm (GA), and Particle Swarm Optimization (PSO). The detection of infection is performed in two phases: Preprocessing and Enhancement in the first phase and segmentation and classification in the second phase.

III. SEGMENTATION APPROACHES

Segmentation subdivides an image into constituent regions or objects. The level to which that subdivision carried out is a problem specific. The simplest method among all segmentation methods is threshold-based method, whose volume uses either a manually or automated generated threshold values for segmentation. In this method first the histogram of the image is computed then a particular value of threshold (intensity) is selected to segment the region. However in this method the intensity values often suffer from non-uniformly distributed contrast values inside the vessels. So, in case of small structure vessel segmentation, global threshold based methods are not useful

A) Edge Detection

Edge detection [14] refers to the process of identifying and locating sharp discontinuities in an image. The discontinuities are abrupt changes in pixel intensity which characterize boundaries of objects in a scene. Classical methods of edge detection involve convolving the image with an operator (a 2-D filter), which is constructed to be sensitive to large gradients in the image while returning values of zero in uniform regions. There are extremely large numbers of edge detection operators available, each designed to be sensitive to certain types of edges.

B) Watershed Algorithm

The watershed transform is a popular segmentation method coming from the field of mathematical morphology [25]. The intuitive description of this transform is quite simple: if we consider the image as a topographic relief, where the height of each point is directly related to its gray level, and consider rain gradually falling on the terrain, then the watersheds are the lines that separate the "lakes" (actually called catchment basins) that form. Generally, the watershed transform is computed on the gradient of the original image, so that the catchment basin boundaries are located at high gradient points[13].
The watershed transform has been widely used in many fields of image processing, including image segmentation due to the number of advantages that it possesses: it is a simple, intuitive method, it is fast and can be parallelized and it produces a complete division of the image in separated regions even if the contrast is poor, thus avoiding the need for any kind of contour joining. Furthermore, several researchers have proposed techniques to embed the watershed transform in multiscale framework [11], thus providing the advantages of these representations.

C) Clustering

Clustering is used to partition an object in number of clusters based on some similarity measures. K-means clustering is an iterative procedure to partition an image into k clusters. K-Means clustering algorithm was invented in 1956. It is an unsupervised method.

K-means Clustering algorithm consists of following steps:

1. Pick k cluster centers. It can be selected randomly or based on some heuristics.
2. Assign each pixel in the image to the cluster with minimum squared distance between cluster center and pixel. Difference here means pixel color, intensity, location or weighted combination of any of these.
3. Re-compute the cluster centre by averaging all the pixels in a cluster.
4. Repeat step 3 and 4 until no cluster changes occur i.e no convergence obtained.

The major drawback of the algorithm is that it depends on initial choice of number of clusters. Poor selection of number of clusters results in inappropriate result

IV. CONCLUSION

In this paper, the exploration to image processing is defined under the segmentation process. The paper has discussed some of the effective segmentation approaches for image processing.

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