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A Fusion Technique of Image Enhancement and Segmentation using Fuzzy Rule and Graph Cut Method

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Abstract: We have proposed image enhancement and segmentation based on fuzzy rule and graph cut method. A graph is constructed from the image using its intensity, texture and color profiles concurrently. A fuzzy rule based system is developed depending on the nature of image in order to find the weight which is required to develop feature for the specific image. The resulted weighted average of various image features is further used to frame normalized graph cuts. Further, the graph is bi-partitioned iteratively through the normalized graph cuts algorithm. As a result, we get optimum partitions which are the required segments of an image. We used the standard Berkeley segmentation database to test our algorithm and segmentation results are evaluated through index rand probabilistic, global consistency error, sensitivity, Dice similarity coefficient and positive predictive value. It is revealed that the proposed segmentation technique provides efficient results for different types of general images.

Key words: Image, enhancement, segmentation, noise, fuzzy, fuzzy c-means, graph cut

INTRODUCTION

Image segmentation is one of the basic problems in computer vision (Basavaprasad and Hegadi, 2014). Even after many years of research, broader purpose of image segmentation still remains a very exigent task as it is intrinsically ill-posed. Amongst different segmentation techniques, graph theoretical ones have several high-quality features in practical applications. It unambiguously categorizes the image elements into mathematical structures which are very sound and makes the formulation of the problem flexible and more skillful. In this study, we have proposed image enhancement and segmentation based on fuzzy rule and graph cut method to get an efficient segmentation of general images which can be used in the applications like machine vision, Iris recognition traffic control systems, locate tumors and other pathologies (Ravindra *et al*., 2011; Hegadi, 2010), brake light detection, pedestrian detection, medical imaging (Hegadi and Goudannavar, 2011), content-based image retrieval, measure tissue volumes, study of anatomical structure, objects locations from the satellite images (forests, roads, crops, etc.) (Ravindra *et al*., 2011), fingerprint recognition, diagnosis, surgery planning, intra-surgery navigation, virtual surgery simulation, video surveillance, recognition tasks, object detection, face detection, face recognition and much more. The study is based on the analysis of optimized fuzzy logic based segmentation for general images. In this research, we have used a FCM (Fuzzy C-Means) algorithm that integrates spatial information into the association function for clustering. The advantage of this method is that it is less responsive to noise than the other methods. This research is focused in developing the application for the analysis of general images by segmenting the images. The results show that this technique is effective for the segmentation of general images that can be used for analysis purpose. Image segmentation and consequent extraction from a which is affected by noise has been remained a difficult task in the image processing field. Improvement of image quality is also required by increasing the contrast and eliminating the noise. The most important idea of image enhancement is to fetch the details that are hidden in an image or to boost contrast in a low contrast image. We have proposed a novel adaptive fuzzy contrast enhancement method based on the fuzzy entropy standard which is followed by segmentation different types of generic images using the techniques of graph cuts. Thereafter, the graph is constructed from the image using its texture, intensity and color profiles concurrently. A fuzzy rule based structure is developed based on the nature of image in order to find the weight which is required to construct feature for the specific image. The graph is obtained from the fuzzy based rule. The weighted average of various image features is further used to frame normalized graph cuts. Then, the graph

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