

Chapter 75

Improving the Efficiency of Color Image Segmentation Using an Enhanced Clustering Methodology

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ABSTRACT

The findings of image segmentation reflects its expansive applications and existence in the field of digital image processing, so it has been addressed by many researchers in numerous disciplines. It has a crucial impact on the overall performance of the intended scheme. The goal of image segmentation is to assign every image pixels into their respective sections that share a common visual characteristic. In this paper, the authors have evaluated the performances of three different clustering algorithms normally used in image segmentation – the typical K-Means, its modified K-Means++ and their proposed Enhanced Clustering method. The idea is to present a brief explanation of the fundamental working principles implicated in these methods. They have analyzed the performance criterion which affects the outcome of segmentation by considering two vital quality measures namely – Structural Content (SC) and Root Mean Square Error (RMSE) as suggested by Jaskirat et al., (2012). Experimental result shows that, the proposed method gives impressive result for the computed values of SC and RMSE as compared to K-Means and K-Means++. In addition to this, the output of segmentation using the Enhanced technique reduces the overall execution time as compared to the other two approaches irrespective of any image size.

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1. INTRODUCTION

Digital image processing refers to the processing of digital images by means of a digital computer. A digital image consists of a limited number of elements, and each element has a particular value and a location. These elements are referred to as pixels.

An image may be defined as a matrix in which the picture elements or the pixels are arranged in columns and rows. Mathematically, an image is a two dimensional function, $f(x, y)$, where x and y are spatial coordinates. The amplitude of f at any pair of plane coordinates (x, y) , which is the gray level or intensity of the image at that point.

Image processing is a simple method of conversion of an image to its digital form for the purpose of enhancing its visual appearance or extracting some useful information from it. The whole concept of image processing includes obtaining an *input image* by digital photography or video frame, *examining and maneuvering* the image in order to spot some patterns that are normally not visible to human eye, or sharpening the image for better viewing, or retrieving those portions of the image that are of interest, and finally *outputting* the resulting image based on some image analysis.

The aim of the segmentation in image processing consists of dividing an input image into several regions with similar characteristics like color, texture, intensity, etc. The pixels that share a certain amount of common visual characteristics are clustered into same regions as compared to the other pixels.

Today, image processing forms a core research area within engineering and computer science disciplines. A broad variety of computational vision problems could make good use of segmented images. For instance, after closely analyzing the segmented cancerous tissue it becomes more prominent to the naked eye from the non-cancerous ones. Similarly, radiologists work out the best path for applying radiation to a tumor while avoiding other critical structures of the body. To improve the diagnosis of heart diseases, image analysis techniques are employed to radiographic images. This image segmentation method reduces the time required for radiation treatment planning dramatically. Color image segmentation is also useful in many other applications. From the segmentation results, it is easily possible to identify the required region of interest.

There are primarily two approaches to carry out image segmentation; the first one is to find the pixels whose intensity rapidly changes. Those pixels are then connected to give the boundaries, which we generally term as *edge detection*. The second one is to locate the regions within the image whose intensity (color) is mostly stable, which we refer to as *region-based segmentation*. For this work, we have basically focused on the second approach. Our goal is to implement clustering approaches to image segmentation.

In this paper, we have compared the basic clustering methods for image segmentation and have introduced a new clustering algorithm for segmentation which is far more efficient than the classical K-Means algorithm (J. Mac Queen, 1967) and its modified K-Means++ algorithm (David Arthur and Sergei Vassilvitskii, 2007). We have implemented these algorithms on various standard images. The major downside of K-Means and K-Means++ are discussed, and in order to curtail such difficulties and improve the segmentation quality and efficiency, we have proposed a simple model known as Enhanced Clustering Algorithm. We have checked the relative performance of cluster based segmentation by using a few standard measures on the given algorithms and have also recorded the amount of computational time taken by each of them.

This paper is organized as follows: In Section 2 we briefly present the basic idea of relative performance of cluster based segmentation approaches. Section 3 presents the efficient and productive works done by several researchers in this relevant area. The K-Means and K-Mean++ clustering method is

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