Chapter 16
An Enhanced Clustering Method for Image Segmentation

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ABSTRACT

The findings of image segmentation reflect 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 chapter, the authors have evaluated the performances of three different clustering algorithms used in image segmentation: the classical k-means, its modified k-means++, and proposed enhanced clustering method. Brief explanations of the fundamental working principles implicated in these methods are presented. Thereafter, the performance which affects the outcome of segmentation are evaluated considering two vital quality measures, namely structural content (SC) and root mean square error (RMSE). 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.

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.

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*

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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.

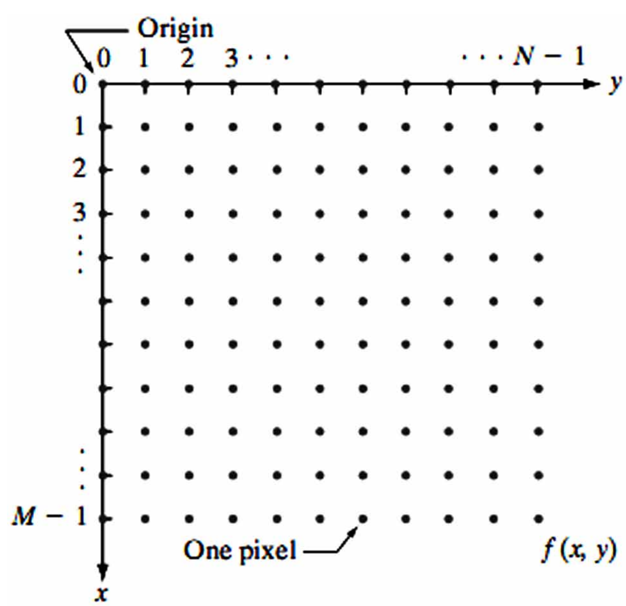
An image may be defined as a matrix in which the picture elements or the pixels are arranged in columns and rows. Mathematically, an image is a two dimensional function, $f(x, y)$, where x and y are spatial coordinates. The amplitude of f at any pair of plane coordinates (x, y), which is the gray level or intensity of the image at that point. We will employ two vital ways to represent digital images. Assume an image $f(x, y)$ has M rows and N columns. For convenience, we shall use integer values for x and y. Hence, the values of coordinates at origin are $(x, y) = (0, 0)$. The next values along the first row of the image are $(x, y) = (0, 1)$. Figure 1 show the coordinate convention used.

Thus, the total $M*N$ digital image can be represented in the following form:

$$f(x,y) = \begin{bmatrix} f(0,0) & f(0,1) & \cdots & f(0,N-1) \\ f(1,0) & f(1,1) & \cdots & f(1,N-1) \\ \vdots & \vdots & & \vdots \\ f(M-1,0) & f(M-1,1) & \cdots & f(M-1,N-1) \end{bmatrix} \tag{1}$$

The distribution of an image into meaningful compositions, formally referred as *image segmentation*, is often a crucial step in image analysis, object illustration, visualization, and several other image processing tasks. 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.

Figure 1. Representation of digital images using coordinates



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