Binary Image Deformation Algorithm

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Digital image processing is indispensable function of a computer and one of the key research area of computer science. Now most of image processing are digitalized. In these days, there are two types of Digital image, raster one and vector one. Raster one is used to almost all output devices. Raster image is a matrix of digital values, called picture elements or pixels. Digital value of each pixel means luminance value. The wider the luminance range is, the finer the tonal range is. And high resolution raster image is clear, thus raster type is used photograph and display device. Also, binary images are used to graphical processing, feature specification and analyses as they have simple data.

Nowadays, data size of the images we use is being larger, but, for example, memory capacity of image scanner or other input devices is poor compared to its reading precision. So input image data size is too large to reserve sufficient working space for image processing. Therefore, in case an input to a device is black-and-white, binary image processing is efficient on the memory efficiency.

The purpose of this research is to develop binary image deformation algorithms. If various binary image deformations without converting into grayscale are achieved, some embedded systems, image scanners, printers, and so on, will be reduced its computation load. Also, it may be impossible for real-time computer graphics to be used binary image instead of grayscale image to reduce load in some computer games.

In this research, the problem is morphing of binary images. Binary images consisting of pixels which have '0' or '1' is given as a input, we want to generate intermediate images between source image and target image which when put together with the original images represent the change from source image to target image. Image morphing is developed in 80s, and rapidly developed and then become one of major visual effect of movie, video game, and so on. There are many morphing algorithms for color or grayscale images. They make feature specification, warp generation and transition control. But these algorithms are inefficient to binary images. For instance, mesh warping uses linear interpolation, but binary images have no middle tone.

This paper presents algorithm which use two $n_x \times n_y$ binary image as a input. Simple implementation of thisalgorithm takes $O(n_x^2 n_y^2)$ time, but we describe a method that reduce to $O(n_x n_y)$ time. Also, we remark about a case of restricted working space.

Our algorithm for the morphing continues to swap a pixel of source image for a pixel of target image until source image become equal to target image. Pixel-swapping order is based on evaluated value.