Comparison of Error and Enhancement: Effect of Image Interpolation

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ABSTRACT

Image interpolation is a technique that pervades many an application. Interpolation is almost never the goal in itself, yet it affects both the desired results and the ways to obtain them. In this paper, we proposed a technique that is capable to find out the error when the common two methods (bilinear and nearest neighbor interpolation) are applied on an image for rotation. The proposed technique also includes the comparison results of bilinear interpolation and nearest neighbor interpolation. Among them nearest neighbor interpolation gives us a better result regarding to the enhancement and due to least error. The error is found by using Mean Square Error (MSE).

1. INTRODUCTION

Image interpolation is a technique that permeates many applications. Among biomedical applications where interpolation is quite relevant, the most obvious are those where the goal is to modify the sampling rate of pixels (picture elements) or voxels (volume elements) [1].

Image interpolation is the process of estimating the values of a continuous function from discrete samples. Image processing applications of interpolation includes image magnification or reduction, sub pixel image registration, to correct spatial distortions, and image decompression, as well as others. Of the many image interpolation techniques available, nearest neighbor, bilinear and cubic convolution are the most common [2].

Image interpolation methods are as old as computer graphics and image processing. In the early years, simple algorithms, such as nearest neighbor or linear interpolation, were used for re-sampling [3]. Standard interpolation methods are often based on attempts to generate continuous data from a set of discrete data samples through an interpolation function. These methods attempt to improve the ultimate appearance of re-sampled images and minimize the visual defects arising from the inevitable re-sampling error [4].

It has been recognized that taking edge information into account will improve the interpolated image's quality and it is known that the human visual system makes significant use of edges [4].

In this paper we used the two common methods bilinear interpolation and nearest neighbor interpolation, for image rotating and then compare them in-term of enhancement and error that is found by Mean Square Error (MSE).

The rest of the paper is organized as follows. Firstly, we already discussed some related work to this field. Then in the following two sections, we discuss the overview of our model for the object segmentation and some experimental results of the proposed model. Finally, we will provide concluding remarks about the precision of our method.

2. METHODOLOGY

Image interpolation is the process of estimating the values of a continuous function from discrete samples. In the proposed algorithm two common methods (bilinear and nearest neighbor interpolation) are used. These methods are applied upon an image for image rotation, and then when we re-rotate the image again, then the image lose some quality information. Due to which the error occurs. In the proposed algorithm there are comparison between bilinear and nearest neighbor interpolation.

Bilinear Interpolation: Bilinear Interpolation is used to determine the grey level value from the weighted average of the four closest pixels to the specific input coordinates, and assigns that value to the output coordinates.

Nearest Neighbor Interpolation: Nearest neighbor interpolation is the simplest that is used to determine the grey level values from the closest pixels to the specific input coordinates, and assigns that value to the output coordinates. Nearest neighbor interpolation just copies the existing values, it does not really interpolate the values.

The general form for an interpolation function is [2]:

$$g(x)=\sum_k C_k u(dist_k)$$

where *g()* is the interpolation function, *u()* is the interpolation kernel, $dist_k$ is the distance from the point under consideration, x, to a grid point, x_k and C_k are the interpolation coefficients [2].

When the image is rotated with a certain angle, and then re-rotates it again, then some error occurs that is finding out by using Mean Square Error (MSE).

The mean square error or MSE of an estimator is one of many ways to quantify the difference between an estimator and the true value of the quantity being estimated. It is to be noted that the MSE is not equivalent to the expected value of the absolute error. The general form of the MSE is given as:

$$MSE=\frac{1}{mn}\sum_{i=0}^{m-1}\sum_{j=0}^{n-1}\left[I(i,j)-K(i,j)\right]^2$$

where "I" is the original image and K is the estimated image (image after interpolation).

3. RESULTS AND DISCUSSIONS

Interpolation (sometimes called re-sampling) is an imaging method to increase (or decrease) the number of pixels in a digital image. Basically it is the recovery of a continuous intensity surface from discrete image data samples that is a link between the discrete world and the continuous one [4].

Interpolation is a technique that pervades many an application. Interpolation is almost never the goal in itself, yet it affects both the desired results and the ways to obtain them. Notwithstanding its nearly universal relevance, some authors give it less importance than it deserves, perhaps because considerations on interpolation are felt as being paltry when compared to the description of a more inspiring grand scheme of things of some algorithm or method. Due to this indifference, it appears as if the basic principles that underlie interpolation might be sometimes cast aside, or even misunderstood. In this paper we used two common methods bilinear interpolation and nearest neighbor interpolation, when the image is rotated with certain angle. In the proposed method, that is rotated by angle of 30 degree. When the image is rotated by 30 degree and then re-rotated again by -30, the image loses its information. The lost information has been found by the mean square error (MSE), which is an estimator that is used to quantify the difference between an estimator and the true value of the quantity being estimated. The estimated values of the two common methods are given as:

Original MSE value: 0.2067

Estimated MSE value by bilinear interpolation: 0.2308

Estimated MSE value by nearest neighbor interpolation: 0.2295.

So it is clear that the "Nearest-neighbor interpolation" gives us a better result regarding to the enhancement and due to least error. The results of the proposed method are given in Fig. 1 and 2.

4. CONCLUSION

Image interpolation is performed by computing the inverse transformation for every destination pixel. Output pixels are computed using bilinear interpolation. . In this paper, we proposed a technique that is capable to find out the error when the common two methods (bilinear and nearest neighbor interpolation) are applied on an image for rotation. The proposed technique also includes the comparison results of bilinear interpolation and nearest neighbor interpolation. Among them nearest neighbor interpolation gives us a better result regarding to the enhancement and due to least error. The error is found by using Mean Square Error (MSE).

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Original Image Rotated by angle 30 Rotated by angle -30

Fig. 1: Results of Bilinear Interpolation

Original Image Rotated by angle 30 Rotated by angle -30

Fig. 2: Results of Nearest Neighbor Interpolation