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COMPARISION OF NEAREST NEIGHBOR INTERPOLATION, BILINEAR INTERPPOLATION, BICUBIC INTERPOLATION

Aksheelia Sherin. I[1], Sushmitha. T[2]

[1,2]Student, Department of Computer Science, Fatima College, Madurai, Tamil Nadu, India

ABSTRACT

The purpose of this study is to evaluate the quality of Nearest Neighbor Interpolation, Bilinear Interpolation, and Bicubic Interpolation in Image Processing. The features of Nearest Neighbor Interpolation, Bilinear Interpolation, and Bicubic Interpolation were investigated using the Image Interpolation Algorithm. Their benefits and drawbacks were compared at the same time. The subjective and objective elements of these interpolation techniques were compared. The trial findings guide the user in selecting an appropriate method to attain the best outcomes for various applications.

Keywords: Interpolation, Image Processing, Nearest Neighbor, Bilinear, Bicubic.

1. INTRODUCTION

The process of interpolation is used in any image processing in digital computing, such as image enhancement and sharpness. Interpolation is the process of using known data to discover unknown pixels in an image. Image Interpolation works in two directions. To achieve a best approximation of pixel's color and intensity based on the values at surrounding pixels. Digital images are zoomed, shrunk, rotated, and geometrically corrected using interpolation. Interpolation can be done in a variety of ways. The quality of image magnification is directly affected by the Image Interpolation method. The features of Nearest Neighbor Interpolation, Bilinear Interpolation, and Bicubic Interpolation were evaluated in this research based on the interpolation approach used. Their benefits and drawbacks were compared at the same time.

2. METHODOLOGY

2.1 Nearest Neighbor Interpolation

Nearest Neighbor interpolation is the most basic sort of interpolation, involving very few calculations and hence being the fastest technique. However, it often produces the worst image quality. Because it only considers one pixel as the closest to the interpolated location, it takes the shortest time to process of all the interpolation algorithms.

Steps to take:

1. Instead of calculating an average value using weighting criteria or generating an intermediate value using sophisticated algorithms, this method simply finds the "nearest" adjoining pixel and assumes its intensity value.

2. Because it only considers one pixel as the closest to the interpolated point, it takes the shortest amount of time to process of all the interpolation methods.

3. This has the effect of merely increasing the size of each pixel. Images become blurred as a result of this.

Output:

Figure 1: Nearest Neighbor Interpolation of Image.

2.2 Bilinear Interpolation

Bilinear interpolation is a resampling method that estimates a new pixel value using a distance-weighted average. It's also known as Bilinear Texture Mapping or Bilinear Filtering. The interpolation is smoother than with the nearest neighbor method. Applying a linear interpolation in two directions is known as bilinear interpolation. The final image is noticeably smoother than the original.

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Steps to take:

1. To get the final interpolated value, bilinear interpolation uses a weighted average of four neighboring pixels. The final image is noticeably smoother than the original.

2. Calculates the closest 2x2 neighborhood of known pixel values to the unknown pixels.

3. Evaluates the final interpolated values by taking a weighted average of these four pixels. Produces images that are smoother than those in the nearest neighbor.

4. Requirements for additional processing time. When compared to Bicubic Interpolation, it takes less time to compute.

Output:

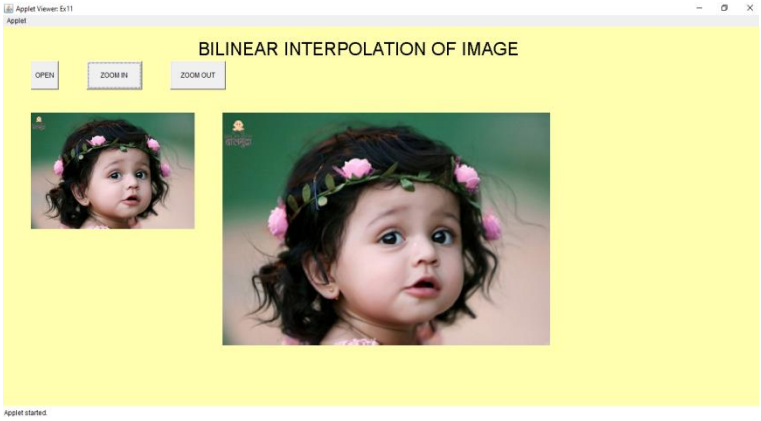

Figure 2: Bilinear Interpolation of Image.

2.3 Bicubic Interpolation

Among all non-adaptive approaches, bicubic interpolation is the best. Unlike Bilinear interpolation, which only considers four pixels (2x2), bicubic interpolation considers sixteen pixels (4x4).

Steps to take :

1. Consider the closest 4x4 neighborhood of known pixels for a total of 16 pixels, which is one step above bilinear.

2. The effect of an unknown pixel P in an image is stretched to its 16 adjacent pixels, and the colour value of P is estimated by these 16 pixels based on their distance from P.

3. The interpolated surface is smoother than equivalent surfaces created using methods such as bilinear interpolation and nearest neighbor interpolation.

4. Produces images that are sharper than the other two approaches.

5. A good balance of processing time and output quality.

Output:

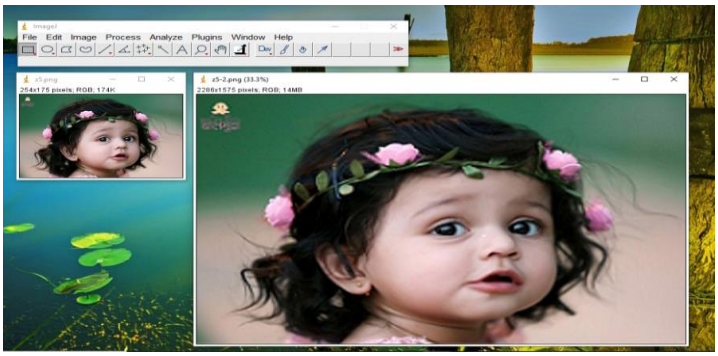

Figure 3: Bicubic Interpolation of Image.

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3. COMPARISION AND ANALYSIS

In comparison to Nearest Neighbor interpolation, Bilinear interpolation, the Bicubic interpolation algorithm uses advanced interpolation techniques and expands the influence with more points. In comparison to the other two photos, the Bicubic image produces a sharper image with more details. Bicubic interpolation takes less time to process (operation speed) than the other two methods. The Closest Neighbor Interpolation has a tendency to produce unwanted artifacts, such as extreme straight edge distortion. Bilinear interpolation has grey shades on output images, however Bicubic interpolation has no grey discontinuity faults on images where the Nearest Neighbor is. Bicubic interpolation is a more advanced approach than the previous two, resulting in smoother edges.

4. RESULTS

All three algorithms (nearest neighbor, bilinear and bicubic) are examined on a variety of images, that are frequent in image processing.

Nearest Neighbor Interpolation

Bilinear Interpolation

Bicubic Interpolation

5. CONCLUSION

It was clear from the examination of the interpolation approaches, particularly Nearest neighbor interpolation, Bilinear interpolation, and Bicubic interpolation, that when these techniques were applied to the given image, the image quality changed. The interpolation approach to be employed, however, is still determined by the image and the result we require. Bicubic interpolation is simpler than nearest neighbor and bilinear interpolation, although it requires more calculations. As a result, bicubic interpolation produces a superior visual impression than the Nearest Neighbor and Bilinear interpolation algorithms. As a result, we may deduce that Nearest Neighbor, Bilinear interpolation is fairly good, although also softens details. Simultaneously, the Bicubic interpolation method proves to be effective, resulting in smoother edges.

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