

Literature Survey on Image Interpolation

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Abstract— In digital access of diverse operations like image enhancement, compacting, decompression, all of them are done for transmission of images in an easier manner so that it is used easily in several applications. Interpolation is used in almost of the above approaches. Finding the unrevealed pixels in an image is the process of interpolation which is also used for enhancing the image quality. Other methods of interpolation includes linear, Bilinear, bicubic and nearest neighbor interpolation. Fast outcome can be seen in nearest neighbor interpolation technique with small distortion because of its simplicity. In Bicubic interpolation the interpolated picture has plane and high quality of picture.

Keywords: Pels, Interpolation, Linear, Bilinear, Bicubic, Nearest Neighbor

I. INTRODUCTION

Image is a depiction of pixels or pels. It is an optical representation of an entity. A digital picture is a binary description of 2D image. Image types can be of vector or raster depending on its resolution. A still image from camera or from a scanner is an example of raster image. Digital image consumes more time and occupies lot of space while moving from one to another place. Hence it is necessary to compress the digital image during transmission. The process of reducing the bits in the image is called as compression so it can be easily stored with less space and can be transmitted through band limited network. A reverse operation can be done on the receiver side to retrieve the image known as decompression. Compressed image will be small and using interpolation we can zoom it.

Interpolation is a method of finding some undetermined pels of picture using existing or given points or it is a procedure of finding unknown value from the neighboring values using lower and upper bounds.

A. Needs of interpolation:

Resolution plays an important role in an image in most of the applications. We need resolution due to the following facts:

- In order to refine denseness of faded pictures, numerous decision magnification methods are used
- Resolution is used to enhance the characteristics of a picture.
- More information is captured in a picture if resolution is high.
- If it is low the picture will be having fewer details and will be looking like spiky and downy.
- The clear size of pixels in an image is defined by resolution which is used in printing.

B. Challenges in image resolution enhancement

Images and pictures captured by satellite have low edges and hence we face difficulty in improving the quality of the images. Image enhancement methods are used in those

satellite pictures to improve the resolution. Higher frequency of sub-bands is provided by DWT. The estimation of sub bands is done through enhancement techniques. In these techniques input picture is divided into sub-bands. By the use of Inverse Discrete wavelet transform is a new resolution magnified image is obtained by pictures of high frequency sub-bands and input image of lower resolution can be evaluated. Using median phase sub-bands of higher frequencies are interpolated. SNR and Root mean square error shows that this technique is better from methods.

II. LITERATURE SURVEY

Image interpolation is used to generate latest interpolated image. The Interpolation ratio relates dimensions of current constructed image. Vacant positions in the source image are packed with suitable pel values. Important techniques are narrated below and their significance will be explained below:

The author [4] explains about the nearest neighbor technique where pel values in the nearest neighbor will pack up the vacant positions in the given images. This method provides greater speed, but bilinear interpolation technique provides better computational efficiency, quality of picture is good and also better cost.

A fast and very simple interpolation technique provided by the author [1] is the nearest neighbor interpolation. Due to stair case edges problem it is not so popular. In 3G graphics bicubic interpolation is used to get good outcome. Main facts of nearest neighbor method are the blurry pictures. Nearest neighbor technique is overcome by bilinear interpolation.

The author [5] explains a procedure to obtain good resolution image through demosaicing. Other colors can be found from its neighboring colors.

B-spline technique is used to find exponential B-Spline and this technique is very easier to use. The author [7] explains different interpolation techniques like cubic interpolation, nearest interpolation, bilinear interpolation which are expressed in frequency and time domains.

It is very difficult to zoom low resolution images. Ideal low pass filter can be used for zooming purposes in order to process CT scan images. Cubic B-spline, bilinear and nearest neighbor can be used for zooming but out of all these cubic B-spline will give better result. Low pass and pass band achievement is expressed according to logarithmic scale of frequency domain [6].

The authors [9] compare adaptive and non-adaptive techniques of interpolation. Visual perception is good in adaptive methods but consumes time for computation.

A new perceptive to cubic B-spline interpolation technique discussed by the authors [8], which are found to be on various parameters. Using this method, there is an enhancement in the quality of the reconstructed picture. The optimal parameters of various images are defined using

optimal parametric algorithm which also details the opportunity cost.

A fast and simple Median filter technique is proposed by the authors [3]. This technique computes the median value of four neighboring pels in order to speed up the filtering process. This technique is better compared to bilinear and bicubic filter methods.

In order to obtain good quality of an image low pass filter is used for resampling. Pass and stop zone defines the interpolation methods performance [2]. In pass zone nearest neighbor interpolation gives better performance.

III. METHODS OF INTERPOLATION

New set of data points can be constructed using interpolation method. Different types of interpolation are follows:

A. Bilinear Interpolation:

High resolution zooming cannot be done using nearest neighbor technique. To minimize the distortion in images bilinear interpolation can be utilized. This bilinear interpolation can be used in both row and column wise directions. The use of pels is found in the nearest four neighbors. A picture of size $m \times n$ is chosen in this technique. Zero elements of another matrix are also used. The net matrix will be zero if both the matrices are padded. Then find the weighted average of the four pels. To find weighted average of four neighboring pels bilinear interpolation can be used. This method is easier and faster to realize and its flowchart is given below.

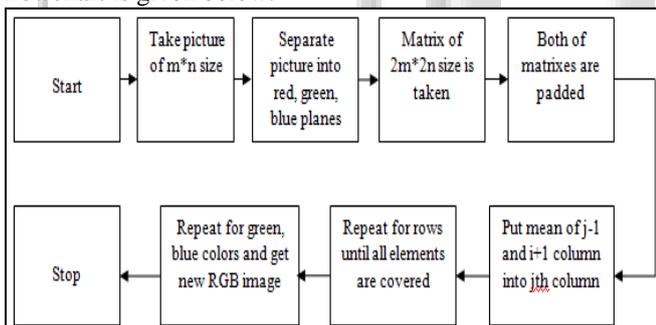


Fig. 1: Flow chart of Bilinear Interpolation.

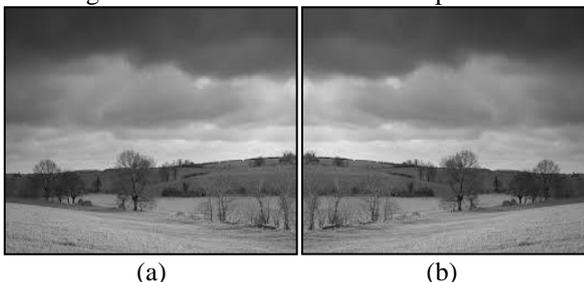


Fig. 2: Bilinear Interpolation: Processed image (a) Original (b) Final Image

B. Bicubic Interpolation:

This technique is found to be better than nearest neighbor and bilinear techniques. This method gives a smooth image. The produced image is closer to the primary image. The bicubic interpolation uses neighborhood of 16 pels as compared to nearest neighbor. Bicubic interpolation is used for scaling of images. The image features are preserved in

the bicubic interpolation. The image characteristics and processing time is also better and the flowchart is given below.

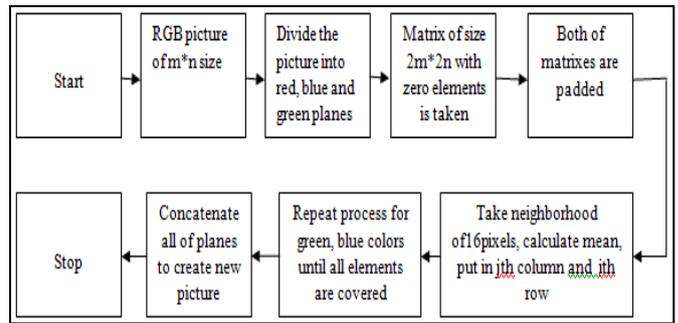


Fig. 3: Flowchart of Bicubic interpolation

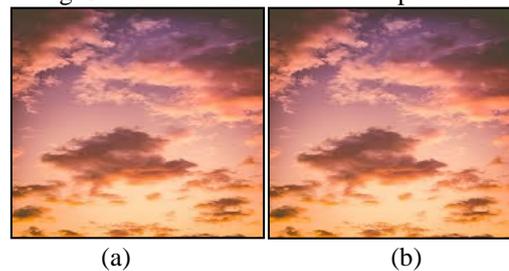


Fig. 4: Bicubic Interpolation: Processed Image (a) Original (b) Final Image

C. Nearest neighbor interpolation

This method is used for zooming of an image because it is simple and easy to execute. This method selects nearest value point. In order to enlarge an image it make use of two steps. Firstly new locations are created and for these new locations pixel values are assigned. The generated new pixel value gets assigned the nearest neighbor pixel value. The flow chart is given below.

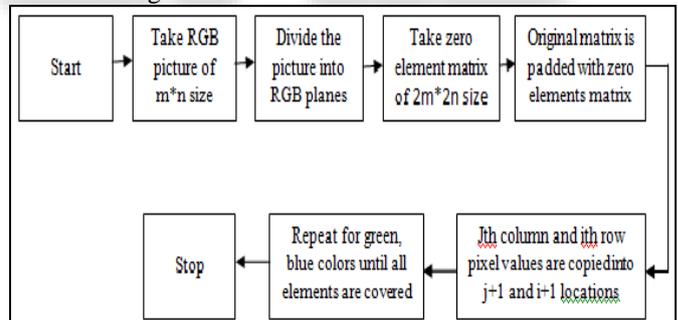


Fig. 5: Flowchart of Nearest neighbor Interpolation

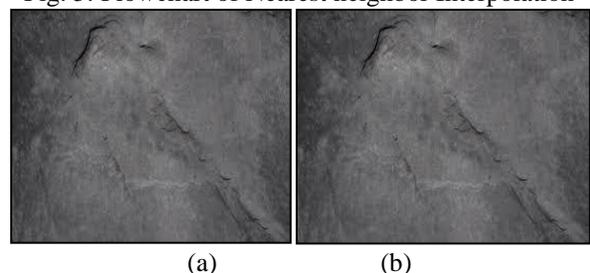


Fig. 6: Nearest Neighbor Interpolation: Processed Image (a) Original (b) Final Image

Interpolation method	Bilinear	Bicubic	Nearest neighbor
Pel values	weighted average of	weighted average of	values of nearest pels

	two pels is used	four pels are used	are used
Intuitive fondness	no sharpness, image Blur	Has Sharpness and fuzzy	Mosaic occurrence
picture clarity	spiky, unclear	greater than bilinear	unclear
performance	Average	Good	Below average
Time complexity	Average, but less compared to bicubic	high	Low
Speed	Slow	Fast	Simpler and faster

Table 1 Comparison of Interpolation methods

IV. CONCLUSIONS

Based on the above study we have seen various interpolation methods that are compared with parameters like performance, picture clarity, pel value, time complexity, speed. Bilinear interpolation technique makes use of neighborhood of 4 pels and generates spikes. Nearest neighbor technique uses nearest value of pels. On comparison with nearest neighbor and bilinear interpolation methods bicubic interpolation gives high quality image and is better than others.

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