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Up-Scaling of the Compressed Images using Adaptive Image Interpolation

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***Abstract*: In this paper, a method of image up scaling has been proposed. In many applications the display of electronic devices needs up scaling of images, but some time size of original image is small, so it may require synthetically increasing the size of the image. Interpolation is one of the solutions for that. In the presented method, a new up-scaled image has been achieved, which is upgraded based on the original image pixels present in small images. In the paper, its working is defined for the different directions of the image. The well-known image quality matrices have been considered to evaluate the performance of proposed method. The method has outperformed than the other standard methods and results have been shown in the paper.**

***Keywords* : About four key words or phrases in alphabetical order, separated by commas.**

I. INTRODUCTION

In today's time there are number of devices which are having digital displays. The size of the display is varying according to size of electronic device. In mobiles, tablets, laptops and TVs at every place the sizes of the displays are different. In order to see the same image its size should vary according to the display size. However, in some cases the original size of the image may be small so for the big displays size it should be increased. However for this, the device should have the processing capability. One of the solutions to these problems is the image up scaling based on interpolation. It includes the very simple processing and size of the image could be increased. Although there would be some loss in quality of image but the details could be maintained upto good extent. Image super resolution is the further advanced method of Image up scaling. Image interpolation includes the estimation of new pixels from the original pixels [9, 14, 18, 22]. In this paper images are up scaled with the help of simple interpolation.

A .Related work

In literature there are a number of methods which are based on basic principle that unknown pixel can be estimated based on the neighboring pixels [5,6,21]. Firstly the methods were based on simple interpolation [1,2], afterwards some methods were adaptive in nature [3,15-20].In some cases the methods were made advanced based edge detections [4,21]. The more advancements of these techniques leads to the term Super resolution which also up scaling and improving the quality of images [22]. In literature there are a number of methods under this category. However, these methods usually consumes time and some challenging to implement in practical situations but results in good quality of Image. In this paper section 2 is about image interpolation, section 3 is explaining the proposed method, section 4 is about the simulation results, and section 5 is presenting the conclusion.

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II. IMAGE INTERPOLATION

Image interpolation is one of the methods of image up scaling. It is a very practical method of image up gradation. This method based on estimation of unknown pixels from known pixels [21]. In these methods, neighboring pixels are used to give the estimation of target pixels. With reference to literature there are a number of methods which are used for image interpolation [21]. However, there are 3 basic methods of image interpolation, one is neatest neighbor interpolation, second is bilinear interpolation and third is cubic interpolation. These types of methods are always very practical and fast in comparison to other methods. However the results are not very accurate but still could be used in many applications. In the some methods, adaptive interpolation is also explained [10-14].

III. PROPOSED METHOD

In the proposed method, an interpolation based method has proposed to upgrade the small images. In this method " X 2" (double) up scaling have been presented .

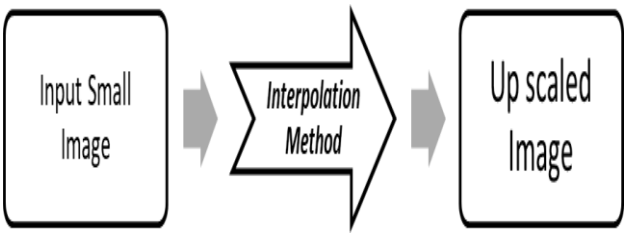


Fig. 1. Basic Block diagram of Method

In order to explain the proposed method, image matrix in Fig. 2 can be considered. In the Fig. 2 the shaded boxes indicates the original pixel values and indicated by small English letters a,b,c,..up to y. The target pixels are V,H and D ; vertical , horizontal and diagonal pixels respectively . In this method, firstly the horizontal pixel values shown in Fig. 2 by letter 'H' would be calculated, then vertical pixels 'V' and then diagonal 'D' pixels would be calculated.

a	H	B	H	c	H	d	H	e
V	D	V	D	V	D	V	D	V
f	H	G	H	h	H	i	H	j
V	D	V	D	V	D	V	D	V
k	H	L	H	m	H	n	H	o
V	D	V	D	V	D	V	D	V
p	H	Q	H	r	H	s	H	t
V	D	V	D	V	D	V	D	V
u	H	V	H	w	H	x	H	y

Fig. 2 The image matrix

In order to start the interpolation firstly horizontal pixels are estimated. In Fig. letter 'H' shows the target pixel. Parameter D is calculated in from original pixels as per equation (1), its results provide the information that weather the target pixel is near to plane area or edge.

$$D = |c - a| - |d - b| \qquad (1)$$

Based on equation (1) , ZZ is calculated as bias value which is useful in calculations of biasing of results.

$$ZZ = (1 - Z * D) \qquad (2)$$

Z is called as controlling vector which would decide the value of bias vector ZZ and ZZ', the value of Z may be varied depending upon the applications.

$$ZZ' = 1 - ZZ \qquad (3)$$

After calculation of ZZ and ZZ', the value of H (target pixel) will be calculated as per the below equation (4).

$$H = (ZZ * a) * \frac{1}{2} + (ZZ' * b) * \frac{1}{2} \qquad (4)$$

It is clear from equations (1-4) that the H will change its value with reference to the neighboring pixels a,b,c and d that indirectly calculated from ZZ and ZZ' ; The calculation is proceeded for next pixels and complete line of H pixels is calculated and then same process is repeated for the next line and so on for all H pixels of the image .

In the very similar way, same procedure is repeated for the vertical side, here the pixel chosen for the horizontal side are replaced with the vertical side and same process is repeated. Here a,b,c,d pixels from horizontal side are replaced by a,f,k,p from vertical side in reference image matrix (Fig. 2) and other procedure will remain same . In order to get the pixel values on diagonal points 'D' , the average of 4 surrounding pixels have been taken and line by line same procedure is repeated for all pixels in the image as per eq. (5) .

$$D = \frac{a+b+f+g}{4} \qquad (5)$$

IV. RESULTS AND SIMULATIONS

In order to check the performance of the proposed system, their result has been compared with standard methods. In the simulation results, the 'JPEG' compressed image has been considered. The considered image is then up scaled with 'X 2' with standard interpolation methods like nearest neighbor (NN), Bilinear and Cubic interpolation along with proposed method. The results have been shown in next Fig.s for different bit rates. It has been observed that the results of proposed methods are comparable to other methods.

Fig. 3 Test Image 256 x 256 (child)

(a) **(b)**

(c) **(d)**

(e)

Fig. 4. Up scaled images 512 x 512 (bit rate = 0.1874)(a) Nearest Neighbor Method (b) Bilinear Method (c) Bi-cubic method (d) Ref [11] (e) Proposed Method

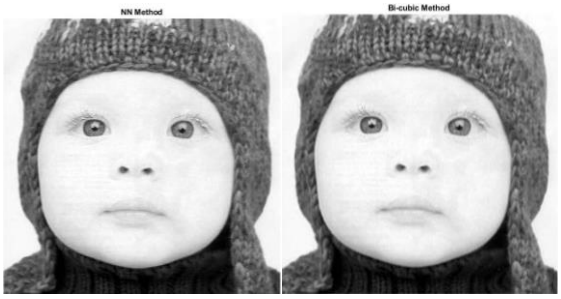
(a) **(b)**

(c) (d)

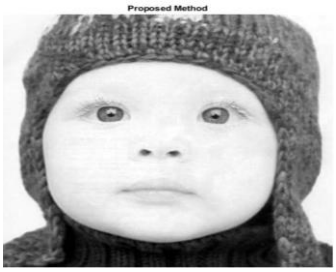
(e)

Fig. 5. Up scaled images 512 x 512 (bit rate = 0.2327)(a) Nearest Neighbor Method (b) Bilinear Method (c) Bi-cubic method (d) Ref [11] (e) Proposed Method

(a) (b)

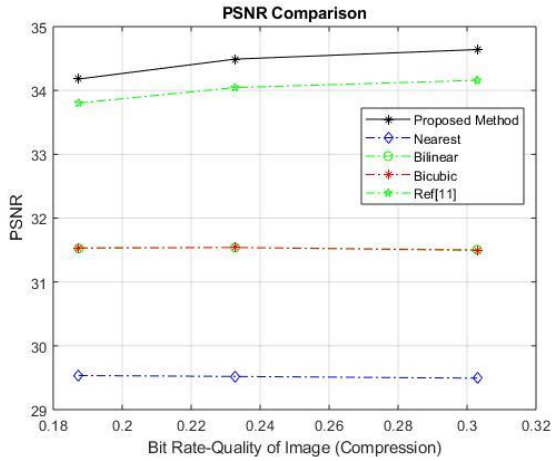


(c) (d)

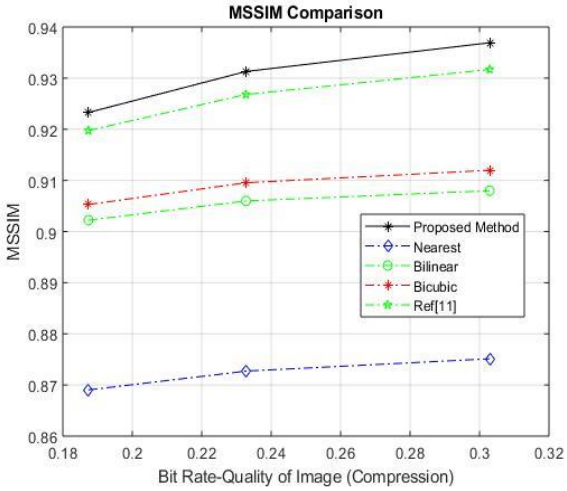


(e)

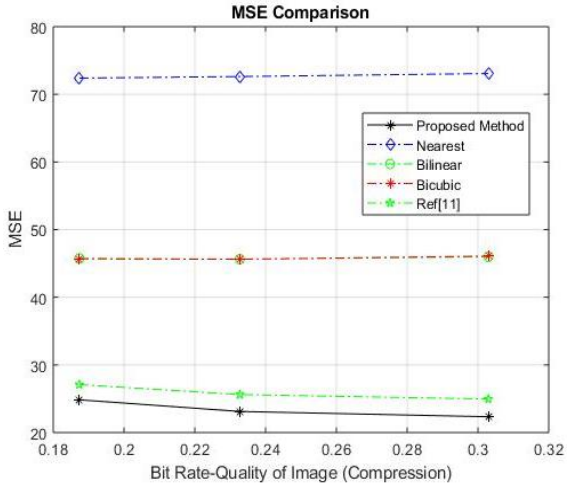
Fig. 6. Up scaled images 512 x 512 (bit rate = 0.3029)(a) Nearest Neighbor Method (b) Bilinear Method (c) Bi-cubic method (d) Ref [11] (e) Proposed Method



(a)



(b)



(c)

Fig. 7 .Comparison of up-scaling results (a) PSNR (b) MSSIM (c) MSE

Table 1. Comparison of Different quality matrices

	PSNR				
Bit Rate	**Proposed Method**	**NN**	**Bilinear**	**Bicubic**	**Ref[11]**
0.1874	34.1789	29.5337	31.5248	31.5346	33.8031
0.2327	34.4910	29.5197	31.5398	31.5393	34.0453
0.3029	34.6405	29.4930	31.5056	31.4950	34.1590
	MSE				
Bit Rate	**Proposed Method**	**NN**	**Bilinear**	**Bicubic**	**Ref[11]**
0.1874	24.8420	72.3949	45.7721	45.6694	27.0874
0.2327	23.1196	72.6289	45.6143	45.6194	25.6183
0.3029	22.3374	73.0772	45.9753	46.0870	24.9563
	MSSIM				
Bit Rate	**Proposed Method**	**NN**	**Bilinear**	**Bicubic**	**Ref[11]**
0.1874	0.9233	0.8690	0.9022	0.9053	0.9198
0.2327	0.9313	0.8727	0.9060	0.9095	0.9268
0.3029	0.9369	0.8751	0.9080	0.9120	0.9317

In the table results with different bit rates for 'JPEG' has been presented. Results have been shown with quality matrices like PSNR, MSE and MSSIM[17].

V. CONCLUSION

In this paper, image interpolation has been considered which is used for image up scaling and may be required for super resolution of images. In the proposed method, very simple but effective approach has been presented, which has performed comparable to standard methods. In terms of quality matrices the PSNR, MSSIM and MSE, the method has performed better than the other methods. It can be directly used in real time for image up scaling. The proposed method can be extended for color images and could be usable further to super resolve the images.

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