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Super Resolution Image Reconstruction for single image using Approximate BPTSRIRTD Algorithm

Dr. P. Ashok Babu
Professor, Dept. of Electronics and Communication Engineering, Institute of Aeronautical Engineering, Hyderabad, India
E-Mail: ashokbabup2@gmail.com

ABSTRACT
The goal of this manuscript is to attain a "super resolution image (picture)" from low resolution picture. The whole work is divided into 2 main segments as reconstruction and compression to attain "super resolution picture" for single picture. In reconstruction phase, to attain super resolution picture, an "Approximate Binary Plane Technique for Super Resolution Image Reconstruction in Transform Domain (ABPTSRIRTD) algorithm" is executed. The assessment metrics are SSIM, PSNR, blocking effect, MSE, and homogeneity is utilized in the evolution procedure.
In compression phase, the input picture will be decomposed utilizing "Integer Wavelet Transform". After that "threshold based binary plane method" will be connected to LL element of the picture. The "inverse integer wavelet transform (IIWT) and inverse binary plane technique (IBPT)" is utilized to obtain the compressed picture.
Key words: Low resolution picture, Super resolution picture, high resolution picture, ABPTSRIRTD algorithm.

1 Introduction

The "digital imaging framework" is not appropriate owing to its hardware boundaries. Achievements of pictures are mainly affected by diverse kinds of degradations. The color filtering and sensor noise are used to influence the confined images. Lastly, the frames confined by imaging framework are blurred, noisy, and decimated. The restrained pictures are recognized as "Low Resolution (LR) images". These dreadful situations have to be modeled fully or partially when "Low Resolution image" is analyzed.
The HR pictures provide the supplementary data for examination in numerous applications. Many segmentation and picture detection procedures do not work well with the noisy images. The eminence of digital image relay on environmental situations, resolution of the image sensors employed.
To acquire "single super resolution image", we need to deliberate as (i) reconstruction and (ii) compression. In concept of compression, the input picture will be decayed utilizing "integer wavelet transform [1] Then "threshold based binary plane technique" is connected to picture's LL factor. Compressed picture will be attained by inverse integer wavelet transform and inverse binary plane method.
In reconstruction phase an algorithm is executed "ABPTSRIRTD (binary plane technique for super resolution image reconstruction in transform domain) algorithm". In the method, a threshold based binary plane procedure will be connected to clean, noisy, and blur pictures and then "average fusion rule" will be connected on average of 2 LL values. After fusion procedure, "Inverse Binary Plane Technique and Inverse Integer Wavelet Transform" are utilized to acquire reconstructed super resolution image. Lastly, the B-spline algorithm [2] is utilized to develop the eminence of reconstructed super resolution picture.

2. PROPOSED METHOD

2.1 Bit Plane Technique

The bit plane strategy might be connected in both (i) lossy and (ii) lossless methods. The "lossy binary plane method" introduces little loss to attain much compression rate. The "lossless compression strategy" will be based on image's spatial domain of picture and these are appropriate for compression of medical pictures.
The binary plane approaches are worked for gray pictures and color pictures. In all these methods, the compressed document is usually maintained in 2 fragments, they are data table and bit plane. The data table contract with the important pixel qualities both parts are consolidated into one document [6]. The bit plane will be group of 0's and 1's to signify as if a pixel is repeated or not.
There are 2 codes to build the bit plane in the binary plane method demonstrated below:
Code 0 will be utilized to distinguish the existing pixel may be precisely be in the same as past pixel. It seeks to remove the existing pixel's storage.
Code 1 is utilized to represent the existing pixel is unique from past pixel. In this context, the existing pixel may be shifted to data table.

2.2 ABPTSRIRTD Algorithm

The compressed picture is suffered from blocking objects [3], and the particular picture might be deliberated as a blurred picture. Apply the subsequent steps to acquire the SR picture.

a. Read a "clean I1(x, y), Artifact image (Compressed Image) I2(x, y) and noise I3(x, y) Low Resolution pictures".
b. The "Integer Wavelet Transform" is applied to all the 3 LR pictures and attains the "low frequency components".
c. The "Lossy Binary Plane Technique" is applied to these "low frequency components" then stores the values in data table.
d. We have bit and data planes as an outcome of "Binary Plane Technique". In the 3 data planes select any 2 least values of

data planes and estimate the average among them [4].

e. The "Inverse BPT is applied to bit plane components of I1(x, y) along with the data table values" to obtain LL1 .
f. The "Inverse Integer Wavelet Transform is applied to LH, HL, HH elements" of clean picture along with LL1
g. Elements.
h. Finally, "B-Spline interpolation" is applied to acquire a "reconstructed Super Resolution image".

2.3 Parameters utilized for Evaluation

Specific "objective image quality measurement parameters" are utilized to estimate the presentation of "super resolution algorithm" are deliberated below:

Peak Signal to Noise ratio

$$PSNR = 10 \log_{10} | MSE$$

$$MSE = \sum \frac{[f(i,j) - F(I,J)]^1}{N^2}$$

Where

f (i, j) is represents the clean picture, and F(I,J) is represents the SR reconstructed picture, which consists N×N pixels.

2.4 Improved Signal to Noise ratio

$$ISNR = 10\log_{10} \frac{\sum_{i,j}[f(i,j) - y(i,j)]^2}{\sum_{i,j}[f(i,j) - g(i,j)]^2}$$

Where f(i,j) represents the clean picture, i,j are represents the total number of pixels in the vertical and horizontal dimensions of the picture, g(i,j) is the reconstructed and y(i,j) is the degraded SR pictures.

2.5 Blocking Effect

Zhou wang et.al suggested an efficient technique to estimate the blocking effect.

$$B_h = \frac{1}{(8-1)} \frac{8-1}{i=1} \frac{8-1}{j=1} \frac{N}{d_h} \qquad (i, 8j)$$

Where "i and j are the columns and rows of the block and 'd' is the block elements" [1].

3. IMPLEMENTATION

3.1 Analysis of ABPTSRIRTD Algorithm for Standard Database Images

Bicubic interpolation algorithm is estimated for diverse pictures using the performance metrics SSIM, PNR, Blocking effect, MSE, and Homogeneity and the outcomes are shown in below table 1.

Image	Bi cubic Interpolation approach				
	SSIM	PSNR (dB)	Blocking effect	MSE (dB)	Homogeneity
Chip	0.9918	27.229	0.015	126.12	0.02
Daffodil	0.9977	34.376	0.0132	24.189	0.0121
Woman	0.999	35.565	0.011	18.28	0.001
Tulip	0.9788	27.28	0.018	121.39	0.005
Croton	0.9983	31.336	0.0159	48.3	0.0185
Hibiscus	0.9993	32.429	0.0169	38.299	0.1745
Old man	0.9932	28.018	0.018	102.75	0.004
Leafs	0.8627	24.914	0.0198	209.76	0.0063
Lotus	0.998	32.3	0.0125	38.37	0.033
Daisy	0.9888	24.633	0.0246	223.94	0.0086
Rose	0.9967	27.702	0.0183	111.99	0.0153

Table1: Performance Evaluation of "Bicubic interpolation approach with ABPTSRIRTD Algorithm.

Yang technique is evaluated for diverse images utilizing the performance metrics SSIM, PNR, Blocking effect, MSE, and Homogeneity and the outcomes are shown in below table 2.

Image	Yang et al [4]				
	SSIM	**PSNR** (dB)	**Blocking Effect**	**MSE** (dB)	**Homogeneity**
Chip	0.986	29.94	0.022	65.79	0.019
Daffodil	0.998	36.286	0.0161	15.29	0.0129
Woman	0.9996	39.45	0.013	7.38	0.001
Tulip	0.9812	30.31	0.025	60.44	0.005
Croton	0.9993	33.589	0.0197	17.978	0.0198
Hibiscus	0.9999	39.411	0.0207	7.496	0.1753
Old man	0.9956	32.19	0.024	39.202	0.005
Leafs	0.9071	29.663	0.0298	70.31	0.0064
Lotus	0.999	34.18	0.017	24.8	0.033
Daisy	0.9923	28.43	0.0356	93.33	0.0088
Rose	0.9982	31.757	0.0249	43.556	0.0162

Table 2: Performance Evaluation of "Yang approach [4] with ABPTSRIRTD Algorithm"

The Fuzzy method is estimated for diverse pictures with the use of the performance metrics SSIM, PNR, Blocking effect, MSE, and Homogeneity and the outcomes are shown in below table 3.

Image	Fuzzy approach [5]				
	SSIM	PSNR (dB)	Blocking effect	MSE (dB)	Homogeneity
Chip	0.9994	39.98	0.0154	6.53	0.013
Daffodil	0.9998	43.592	0.0123	2.844	0.0086
Woman	0.999	45.016	0.011	2.04	0.0009
Tulip	0.9925	37.203	0.0163	12.38	0
Croton	0.9999	42.218	0.0161	3.904	0.0342
Hibiscus	1	42.535	0.0211	3.634	0.0916
Old man	0.9993	38.949	0.023	8.28	0.0026
Leafs	0.9372	36.256	0.0259	15.403	0.0031
Lotus	0.9999	43.23	0.0133	3.089	0.022
Daisy	0.9989	35.579	0.027	17.995	0.0026
Rose	0.9997	37.909	0.0216	10.557	0.0094

Table 3: Performance Evaluation of Fuzzy approach [5] with ABPTSRIRTD Algorithm

ABPTSRIRTD algorithm is evaluated for diverse images with the use of the performance metrics SSIM, PNR, Blocking effect, MSE, and Homogeneity and the outcomes are shown in below table 4

Image	**ABPTSRIRTD**				
	SSIM	PSNR (dB)	Blocking effect	MSE (dB)	Homogeneity
Chip	0.9998	43.7	0.011	3.02	0.01
Daffodil	0.9999	46.761	0.0111	1.3714	0.0067
Woman	0.9999	47.44	0.01	1.17	0.0008
Tulip	0.993	40.45	0.013	5.86	0.0002
Croton	0.9999	44.347	0.0132	2.399	0.0273
Hibiscus	1	41.899	0.0182	4.209	0.0716
Old man	0.9996	41.7	0.019	4.39	0.0022
Leafs	0.9026	36.445	0.0209	17.62	0.0028
Lotus	0.9995	47.031	0.01	1.288	0.017
Daisy	0.9995	38.463	0.023	9.412	0.0021
Rose	0.9998	40.194	0.0171	6.23	0.0079

Table 4: Analysis of ABPTSRIRTD Algorithm for standard data base Images

Here the outcomes of ABPTSRIRTD technique is compared with "Bicubic, Yang's and fuzzy based strategies" and outcomes are shown in above table. The recommended strategy (ABPTSRIRTD) will be compared against distinctive models such as "Bicubic, Yang and fuzzy" with diverse pictures. Whether compare thevalues of PSNR for "Bicubic, Yang, fuzzy and ABPTSRIRTD strategies" the values of PSNR increments from Bicubic technique to ABPTSRIRTD technique. The values of PSNR builds from 9 dB will 16 dB fordiverse pictures when compared to the further techniques. The "mean square error values" declines from Bicubic technique to approximate "ABPTSRIRTD technique". For better quality pictures the value of MSE must be as low as probable.

The SSIM will be a technique by which the comparison among two pictures might be calculated. SSIM value must be near to one for good quality pictures. Whether compare the 4 strategies in the recommended technique (ABPTSRIRTD) SSIM value will be very near to unity.

The Blocking effect expects during evaluating the presence of blocking artifacts in unique picture prior to compression for a provided compression method and bit rate.

From those tables 1, 2, 3 and 4 we might see that the blocking effect values attained for the suggested technique (ABPTSRIRTD) is much near to 0. Thus the suggested strategy might diminish blocking artifacts efficiently compared to different techniques.

Figure 1: a) LR picture b) Bicubic picture

Figure 2: c) Yang technique d) Fuzzy technique

Figure 3: ABPTSRIRTD technique

As in figures 1, 2 and 3 comparison of Hibiscus pictures for Bicubic, Yang, Fuzzy and ABPTSRIRTD Algorithms.

Figure 4: a) LR picture b) Fuzzy technique

Figure 5: ABPTSRIRTD technique

As in figures 4 and 5 Comparison of Old man pictures for "Bicubic, Yang, Fuzzy and ABPTSRIRTD Algorithms"

Figures 3 and 5 shows the comparison of Hibiscus and Old man for Bicubic, Yang, Fuzzy and ABPTSRIRTD algorithms. ABPTSRIRTD algorithm given better results visually compared to remaining algorithms.

The suggested system (ABPTSRIRTD) will be compared with few standard strategies such as Bicubic, Yang and fuzzy strategies utilizing the factors "PSNR, MSE, SSIM, blocking effect and homogeneity". PSNR for suggested technique will be expanded from 9.47 dB to 16.47 dB for diverse strategies. In conclusion, from the graphs PSNR for suggested technique will be high and the blocking effect for the suggested strategy will be low. Thus the recommended technique lessens the blocking artifacts successfully contrasted with different strategies.

Three methodologies "Bicubic interpolation, Yang approach, and fuzzy methodology" by Pukrait are examined and particular evaluation outcomes that were acquired with different pictures are tabulated. It provides for us both objective and subjective of method and also associates the present technique with previous research strategies. The technique will be tested and assessed for diverse pictures of2 data sets and compared with previous methodologies. The correlation is carried out on qualitative support by examining the techniques with diverse metrics.

4. CONCLUSION

In this paper, a "threshold based binary plane technique" will be executed for "super resolution picture". The executed strategy got sensibly better outcomes in performance assessment metrics and visual appearances of standard and natural database pictures.

The "ABPTSRIRTD approach" provided a remarkable execution when compared with yang, Bicubic, and fuzzy systems. Both qualitative and subjective analysis demonstrates that this methodology gives better outcomes that are appropriate for any real time applications.

5. FUTURE SCOPE

For the reason of upcoming survey, the author recommends the specialists to include more characteristics of assessment metrics are compression ratio and PSNR to examine their outcomes more effectively and proficiently. Moreover, the analysts might also take review of the most recent strategies in terms of the suggested procedure with the goal that they might attain a preferred super resolution picture.

The study can be extemporized further, toward subjecting the model to diverse color transformations for common pictures. This survey work might be taking dissimilar fusion algorithms with diverse color transformation strategies under consideration of object. This work could be prolonged for "medical imaging frameworks".

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