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Survey on Various Image Compression Techniques Used in Image Processing to Improve the Quality of Image

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Abstract:*This paper presents study of assorted lossy compression techniques. the 2 techniques are Wavelet Difference Reduction (WDR) based compression and Singular Value Decomposition (SVD) based compression and SVD based compression reduces the psycho visual redundancies present within the image through rank reduction technique. WDR may be a lossy compression technique. It gains compression by taking the discrete wavelet transform of the input image so encodes the transform values using difference compression method. Singular Value Decomposition (SVD) is one in every of the simplest compression techniques. SVD based compression technique gives better visual quality at higher singular values. Various compression parameters like PSNR, MSE and compression ratio are evaluated for the assorted techniques. during this survey, compare how SVD is applied to colour images, the technique of compression and maintain the standard of the image using SVD and also the algorithm to compress a picture using image processing tool MATLAB and compared the WDR SVD lossy compression techniques.*

Keywords: Lossy Compression, SVD, WDR, MATLAB, etc.

I. INTRODUCTION

Now a day, every people is keen on collecting the photos, images and videos on multimedia. Not only photos, peoples wish to capture all his memorable moments, that the rise of number of images, photos and videos on multimedia which needs the foremost space. it's obvious that a more amount of memory and quality of image is required to store of those images and videos. If these images are needed to be transmitted, it also requires large bandwidth and quality. So, for that it needs of compression techniques. These compression techniques reduce the disc space for storing occupied by the image with none loss to image quality [4]. Thus, the image size is reduced by selecting proper compression technique liable on the requirement of the user or application. Many of the image processing techniques were developed with application to medical imaging, beholding, face recognition, satellite Imagery, and photo enhancement [4].

The digital streamlining of even the normal day to day routines has caused the usage of multimedia to surge tremendously on a usual. The frequently used multimedia format during this regard is Image. on a daily basis we collect and store many images for various reasons and purposes. This activity finally ends up within the large storage of image files which take up the bulk the memory space of the pc disk. a good resolution for this problem is using compression techniques [1] to chop back the scale of the image. There are various compression techniques, which we are able to choose the acceptable technique supported the kind of image and also the required quality of the image output after compression [13].

1.1 Image Compression

Digital compression technique which compares the image which reduce disc space with maintaining the standard of the image. Basically, a picture compression technique is split into two classes:

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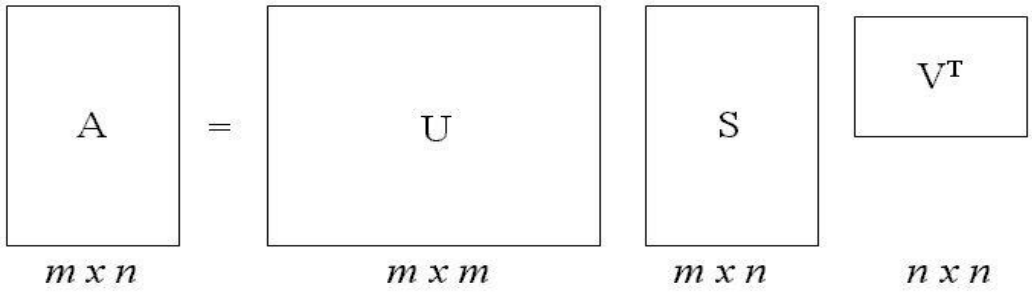
1. **Lossy Compression**
   In lossy compression, image is compressed with having some loss of knowledge. After applying decompression original image cannot reconstruct. SVD is that the lossy compression technique.
2. **Lossless Compression**
   In lossless compression it generates the compressed image without loss. Which is same because the original image.

1.2 Singular Value Decomposition

The technique in image processing domain Singular Value Decomposition (SVD) is alleged to be a big topic in algebra by many famous mathematicians. SVD has many practical and theoretical values; Special features of SVD are that it is performed on any input (m, n) matrix. we've got an input matrix A with m rows and n columns, withrank r with r ≤n ≤ m. Then the input matrix A will be factored into three diagonal matrices: A = T SVD Every image is represented by variety of pixel values. Pixels represent the intensity of the given image. These pixel values are arranged as a matrix form with rows and columns. The matrix representation of a picture is easily obtained using MATLAB. The key to working with SVD of any given matrix A is to think about AAT and ATA.



The columns of U, that is m by m, are eigenvectors of AA^T, the columns of V, that is n by n, are eigenvectors of A^TA. The singular values on the diagonal of matrix S, that is m by n, are the positive square roots of the nonzero eigenvalues of both AA^T and A^TA. Where A is the image matrix $A_{n\times m}$; Where A is the image matrix $A_{n\times m}$; Where Matrix U is a m × m orthogonal matrix U =[u1,u2.....ur...u_{r+1}.....$u_{m]}$

$$A = US^1V^T$$

$$A = \begin{bmatrix} u_1 & u_2 & \cdots & u_m \end{bmatrix} \begin{bmatrix} s_1 & 0 & \cdots & \cdots & \cdots & 0 \\ 0 & \ddots & & & & \vdots \\ \vdots & & s_r & & & \vdots \\ \vdots & & & 0 & & \vdots \\ \vdots & & & & \ddots & \vdots \\ 0 & \cdots & \cdots & \cdots & \cdots & 0 \end{bmatrix} \begin{bmatrix} v_1 \\ v_2 \\ \vdots \\ \\ \vdots \\ v_n \end{bmatrix}$$

Here, S is a $_{m\times n}$ diagonal matrix which is not orthogonal matrix with singular values (SV) on the diagonal. The matrix S can be shown in following fori = 1, 2, …, n, i s are called Singular Values (SV) of the matrix A. And matrix V is an n × n orthogonal matrix V= [v1,v2,.....v_{r+1} v_r.....v_n] column vectors i v for i = 1, 2, …, n, form an Orthogonal sets[14].

1. The matrices U and V are not Unique, however, the singular value 1,σ 2σ, nσ,… are unique.
2. Since $A^T A = VS^T SV^T$, so V diagonalize $A^T A$, it follows that the v^j s' are the eigenvector of $A^T A$.

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Algorithm

SVD algorithm for image Compression

Step-1 Read the image (input image). Step-2 Convert the input image (color image) into a gray scale image which is reduce in size.

Step-3 Decompose each component using Singular Value Decomposition i.e. SVD.

Step-4 Select k value and discard the diagonal value of S matrix that are not required. And Construct the image using the selected singular values. The k-value in the m-file represents the number of iterations taken on each layer used in the resulting disintegration. This Is really the rank of the SVD matrix. By increasing the rank we can increase clarity till an ideal image is got.

Step-5 Show the compressed image.

1.3 Wavelet Difference Reduction based Image Compression

The Wavelet Difference Reduction (WDR) is an encoding technique which relies on the difference reduction method. It gains compression by taking the discrete wavelet transform of the input image so encodes the transform values using difference reduction method. [3]

Discrete wavelet transforms divides image into four sub bands LL, LH, HL, HH. Wavelet Difference Reduction encoding uses four steps for encoding: Initialisation, Thresholding, Significant pass and refinement pass.

1. Initialisation: during this the scan order is about. The scan order goes through sub-bands from higher level to lower levels in zig-zag manner. A threshold T0 is chosen.
2. Update Threshold: Threshold is updated to Tk=Tk-1/2, for k=1,2…p and p'is the number of pixels during a picture.
3. Significance Pass: Here, values of wavelet transform are compared to a specific threshold value. a worth issignificant if it's greater than or adequate threshold value. If an index is found to be significant then it's removed from the scan order. Next, difference of these index values is taken and binary expansion of successive difference is completed. Since the MSB in these expansions is usually 1, we are able to ignore this bit and use the signs of the numerous transform values in its place within the symbol stream. The stream consists of 4 symbols that will be encoded using probabilistic model.
4. Refinement Pass: during this, standard bit plane quantization is applied to convey refinement bit. Refined value gives better approximation of transform value.
5. Repeat steps (2) to (4) until you get desired bit budget. To reconstruct the image, WDR decoding and inverse DWT is performed on compressed bit stream. [12] The property of WDR is that it gives perceptually better image at high compression ratio while retaining the desirable features[13].

II. LITERATURE SURVEY

Image signal comprises of an outsized dataset and hence it's hard to proceed with other image processing techniques. So, it's essential to compress the image dataset without compromising any important data from dataset. Zhang and Xiaofei [1] have discussed various compression techniques by learning to reducing the general error mechanisms. RGB and gray scale image component on MPQ-BTC is given in [2]. Gunjan Mathur et al. [3] have elaborated the importance of various lossy compression techniques. K Means clustering has various benefits over other techniques. This unsupervised method is discussed in [4] – [7]. Singular Value Decomposition technique has been proved to be one in every of the foremost frequently used compression methods. it's evidently stated in [8]. Mounika et al. [9] supports plenty in achieving good PSNR values using SVD. Thus, a sturdy background work has been carried to proceed with this paper.

In literature, Ozcelik and A. K. Katsaggelos [1] proposed a mean field annealing method for reducing objects. to chop back artifacts while keeping the required detail present within the primeval image. Proposed technique makes use of a priori information about the pristine image through a no stationary Gauss-Markov model. A maximum a posteriori (MAP) estimation is getting iteratively utilizing mean field annealing [1]. Bredies and Holler [3] proposed a whole variation decompression model for reducing artifacts. a fast primal dual algorithm is developed to unravel this model effectively; it's one of the energy minimization methods.

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The work [4][5] the K-SVD method developed to chop back the artifacts present within the image after decompression by improving PSNR. But this methodology (K-SVD algorithm) is kind of computationally demanding, especially when the dimensions of the dictionary rise or the number of coaching signals converts big [3]. Rowayda A. Sadek [5] proposed contribution in using unused SVD characteristics in novel approaches like an adaptive block-based compression, perceptual multiple watermarking, image capacity for thumping information, irregularity measure, etc., of those contributions were experimentally examined and gave talented results compared to established ones. the foremost contributions are a novel perceptual image forensic technique, a replacement potential visualization in using the SVD Properties, reviewing and experimental valuation of the developed SVD based application like compression, a replacement block-based roughness measure for application like perceptual liberal compression furthermore as perceptual progressive data hiding.

III. RESULTS

After applying various „k" singular values, generates the different image compression result.

a) Original Image b) Gray Scale image

c) Singular Value r=5 d) Singular Value r=80

e) Singular Value r=155 f) Singular Value r=280

Here highest singular value r=280 gives the better image quality.

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IV. CONCLUSION

The Above survey it can be accomplished that WDR based compression gives good quality compressed images with higher compression ratios and SVD based image compression gives better quality compressed images at higher singular values. For this above compression parameters, the results obtained by WDR based compression are superior than that of SVD based compression. If we amalgamate both these techniques then performance of WDR will get improved. We can get visually better compressed images with high amount of compression ratio if WDR is used along with SVD. This survey paper is for a practical survey of SVD characteristics in various developed image processing approaches for image compression.

This Survey in using unused SVD characteristics in new approaches such as an adaptive block-based compression, these contributions were experimentally checked and gave promising results compared to developed SVD. Singular Value Decomposition (SVD) is a very easy, robust and reliable technique. This SVD image compression technique provides a steady and effective compression method to divide the image matrix into a set of linearly independent matrices to get the different singular values so we can easily find out compressed image.

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