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Image Compression Techniques Comparative Analysis using SVD-WDR and SVD-WDR with Principal Component Analysis

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Abstract :- The image processing is the technique which can process the digital information stored in the form of pixels. The image compression is the technique which can reduce size of the image without compromising quality of the image. The image compression techniques can classified into lossy and loss-less. In this research work, the technique is proposed which is SVD-WDR with PCA for lossy image compression. The PCA algorithm is applied which will select the extracted pixels from the image. The simulation of proposed technique is done in MATLAB and it has been analyzed that it performs well in terms of various parameters. The proposed and existing algorithms are implemented in MATLAB and it is been analyzed that proposed technique performs well in term of PSNR, MSE, SSIM and compression rate.

In proposed technique the image is firstly compressed by WDR technique and then wavelet transform is applied on it. After extracting features with wavelet transform the patches are created and patches are sorted in order to perform compression by using decision tree. Decision tree sort the patches according to NRL order that means it define root node which maximum weight, left node which has less weight than root node and right node which has minimum weight. In this way the patches are sorted in descending order in terms of its weight (information). Now we can see the leaf nodes have the least amount of information (weight). In order to achieve compression of the image the leaf nodes which have least amount of information are discarded to reconstruct the image. Then inverse wavelet transform is applied to decompress the image. When the PCA technique is applied decision tree classifier the features which are not required are removed from the image in the efficient manner and increase compression ratio.

General Terms
Image Compression, Principal Component Analysis.

Keywords
SVD-WDR, Image Compression, PCA, lossy image compression.

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1. Introduction

Image Processing is a process to convert an image into digital form and perform some operations to get an enhanced image and extract useful information from it. It is a study of any algorithm that takes an image as input and returns an image as output. Image processing is referred to processing of a 2D picture by a computer. It is a form of signal privilege in which image is input similar to video frame or photograph and is image or characteristics associated with that image may be output. Image processing is used in a wide variety of applications to improve the visual appearance of images and to prepare images for measurement. Image processing usually refers digital Image processing but optical and analog image processing also are possible [1]. This article is about general techniques that apply to

all of them. The acquisition of images is referred to as imaging. Image processing is also known as digital image processing. The images should be available in digitized form is the most requirements for image processing of images, that is, arrays of finite length binary words. For digitization, first of all the given Image is sampled on a discrete grid and each sample or pixel is quantized using a finite number of bits. The digitized image is processed by a computer. To display a digital image, it is first converted into analog signal, which is scanned onto a display. Classification between the objects is simple task for humans yet it has turned out to be a complex problem for machines [2]. The raise of high-capacity computers, the availability of high quality and low-priced video cameras, and the increasing requirement for automatic video analysis has generated an interest in object classification algorithms. A simple classification system consists of a camera fixed high over the interested zone, where images are captured and thus processed. Classification includes image sensors, image preprocessing, object detection, object segmentation, feature extraction and object classification. Classification system consists of database that contains predefined patterns that compares with recognized object to classify into proper category [3]. Image classification is an important and challenging task in different application domains, including

biomedical imaging, biometry, video surveillance, vehicle navigation, industrial visual inspection, robot navigation, and remote sensing. The objective of image compression is to reduce irrelevance and redundancy of the image data keeping in mind the end goal to have the capacity to store or transmit data in an efficient form. Image compression is minimizing the size in bytes of a graphics file without degrading the quality of the image to an unacceptable level [4]. The reduction in file size permits more images to be stored in a given amount of disk or memory space. It likewise reduces the time required for images to be sent over the Internet or downloaded from Web pages. There are a few different ways in which image files can be compressed. For Internet utilize, the two most basic compressed graphic image formats are the JPEG format and the GIF format. The JPEG method is all the more regularly utilized for photographs, while the GIF method is ordinarily utilized for line art and different images in which geometric shapes are relatively simple [5]. Different methods for image compression incorporate the utilization of fractals and wavelets. These methods have not gained widespread acceptance for use on the Internet as of this writing. The JPEG has been the most common image format on the web for a long time. Standardized in 1994, it is capable of retaining high caliber with small file sizes. Its ability to pack so much visual information into a small file is to a great extent because of exploiting the capacities, or rather limitations, of the human eye. Linear algebra is the ideal form of math for registering. JPEG images are a collection of numbers in arrays corresponding to various color channels [6]. The data including a digital image resembles a matrix in that it has discrete values, and unlike calculus, which is continuous. Three steps are used in JPEG compression: a discrete cosine transformation, quantization, and entropy encoding (Huffman Coding).

2. REVIEW OF LITERATURE

Christian Rathgeb, et.al, (2016) investigated in this work [7], the influence of different cutting edge image compression principles on ear identification and ear recognition algorithms. Evaluations directed on an uncompressed ear database are considered regarding different stages in the handling chain of an ear recognition framework where compression might be connected, speaking to the most applicable forensic situations. Exploratory results are talked about in point of interest highlighting the potential and limitations of robotized ear recognition in nearness of image compression. Based on test comes about got for three different discovery algorithms and four feature extraction techniques it is presumed that, ear recognition may be feasible within the sight of serious image compression relying upon a few factors.

Mansour Nejati, et.al, (2016) exhibited in this paper a boosted dictionary learning structure to develop an ensemble of complementary particular dictionaries for sparse image representation [8]. The constituent dictionaries of the ensemble are gotten utilizing an intelligibility regularized dictionary learning model for which two novel dictionary optimization algorithms are proposed. These algorithms enhance the generalization properties of the trained dictionary contrasted with a few incoherent dictionary learning strategies. The calculation is assessed for compression of natural images. Trial comes about exhibit that the proposed calculation has better rate distortion execution as contrasted and a few contending compression strategies including explanatory and learned dictionary schemes.

Azam Karami, et.al, (2016) exhibited in this paper another lossy compression strategy for hyperspectral images that intends to optimally compress in both spatial and spectral domains and at the same time minimizes the impact of the compression on linear spectral unmixing execution [9]. A surmised strategy for quick estimation of the free parameters is presented also. It is important to say that the superiority of our strategy turns out to be more evident as the compression proportion develops. The proposed calculation achieves a superior execution (higher SNR variance and littler MSE) in comparison with two cutting edge compression algorithms, especially at high CRs. A quick rough strategy that fixes the center tensor measurements is presented also. In future work, the point is to decrease the computational complexity of the proposed calculation.

Jianquan Yang, et.al, (2015) proposed in this paper a hypothetical examination on the variety of local variance brought about by JPEG compression [10]. To start with, the desire of intensity variance of 8×8 non-covering blocks in a JPEG image is inferred. Second, some fascinating properties that portray the conduct of the local variance under different degrees of JPEG compression are talked about. Last, both simulation and tests are performed to check our derivation and examination. The hypothetical examination exhibited in this paper gives some new bits of knowledge into the conduct of local variance under JPEG compression. Besides, it can possibly be utilized as a part of a few ranges of image handling and examination, for example, image upgrade, image quality evaluation and image filtering.

R.O. Preda et.al, (2015) presented in this paper a watermarking-based image verification plan in the discrete cosine change (DCT) domain hearty to JPEG compression. The twofold validation code is created from a pseudorandom grouping based on a mystery key and a

block-dependent feature, securing the plan against cut-and-glue attacks. Test comes about demonstrate that the proposed method achieves great watermark impalpability and can recognize and find malicious attacks with great accuracy [11]. The plan achieves high image quality of around 45 dB and low false positive and false negative identification rates contrasted and other existing image verification procedures.

Amin Zehtabian, et.al, (2015) proposed in this paper [12], a Pixon-based image segmentation method, which profits by a preprocessing step based on halfway differential condition to extract more homogenous segments. In addition, a quick algorithm has been exhibited to adaptively tune the required parameters utilized as a part of the Pixon-based construction. The gained segments are then sustained into the support vector machine classifier, and the final thematic class maps are created. Experimental results on multi/hyperspectral data are encouraging to apply the proposed Pixons for classification.

3. BASIC THEORY

Image compression with principal component analysis (PCA) is a frequently occurring application of the dimension reduction technique. Recall from a previous post that employed singular value decomposition to compress an image, that an image is a matrix of pixels represented by RGB color values. Thus, principal component analysis can be used to reduce the dimensions of the matrix (image) and project those new dimensions to reform the image that retains its qualities but is smaller in k-weight. We will use PCA to compress the image. As the number of principal components used to project the new data increases, the quality and representation compared to the original image improve.

Principal component analysis is performed on each color value matrix. PCA is focused on image compression and not description or interpretation of the variables, the data does not require centering (subtracting the variable means from the respective observation vectors), and the center argument is set to FALSE. If the argument is not set to FALSE, the returned image will not have the right RGB values due to having their respective means subtracted from each pixel color vector.

Image compression with principal component analysis reduced the original image by 40% with little to no loss in image quality. Although there are more sophisticated algorithms for image compression, PCA can still provide good compression ratios for the cost of implementation.

Image compression with principal component analysis is a useful and relatively straightforward application of the technique by imaging an image as a $(n \times p)$or $(n \times n)$ matrix made of pixel color values. There are many other real-world applications of PCA, including face and handwriting recognition, and other situations when dealing with many variables such as gene expression experiments.

4. PROPOSED METHODOLOGY

In proposed technique the image is firstly compressed by WDR technique and then wavelet transform is applied on it. After extracting features with wavelet transform the patches are created and patches are sorted in order to perform compression by using decision tree. Decision tree sort the patches according to NRL order that means it define root node which maximum weight, left node which has less weight than root node and right node which has minimum weight. In this way the patches are sorted in descending order in terms of its weight (information). Now we can see the leaf nodes have the least amount of information (weight). In order to achieve compression of the image the leaf nodes which have least amount of information are discarded to reconstruct the image. Then inverse wavelet transform is applied to decompress the image. When the PCA technique is applied decision tree classifier the features which are not required are removed from the image in the efficient manner and increase compression ratio.

- First of all, we have started process by input the image which needs to be compress in which at initial stage we generated a histogram of original input image.
- When the histogram of original image is has been generated then Apply wavelet transformation technique to analyze color and textural features of the image.
- After applying wavelet transformation technique, then create various patches of the image and assign weight to each path on the similarity between the patches.
- Now we Sort the patched according to weights which are assigned to each patch
- After this process assign priority to each patch, and apply PCA.
- After applying the pca Construct the tree according to define conditions.
- Then, analyze all three colors component which is red, green and blue component.
- After this process we got a compressed image. And we generated a histogram of compressed image.
- At last calculated the parameters in terms of compression ratio, SSIM, PSNR and RMSE in

which we got results which shows betterment in image compression.

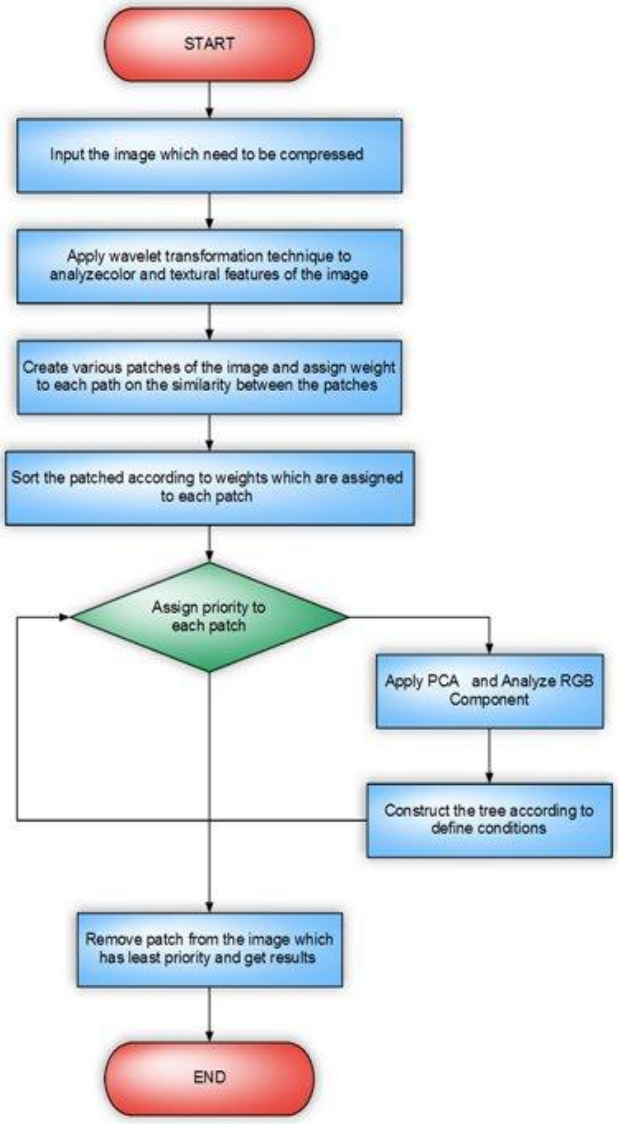

Figure 1: Proposed Flowchart

5. EXPERIMENTAL RESULTS

The various image are used for the research process and to find the results. The data for image were highly dimensional, but only 4 attributes has been finally considered on the basis of requirements. The image is loaded using MATLAB and processed it with existing algorithm and proposed algorithm one by one and compare the results of both algorithm.

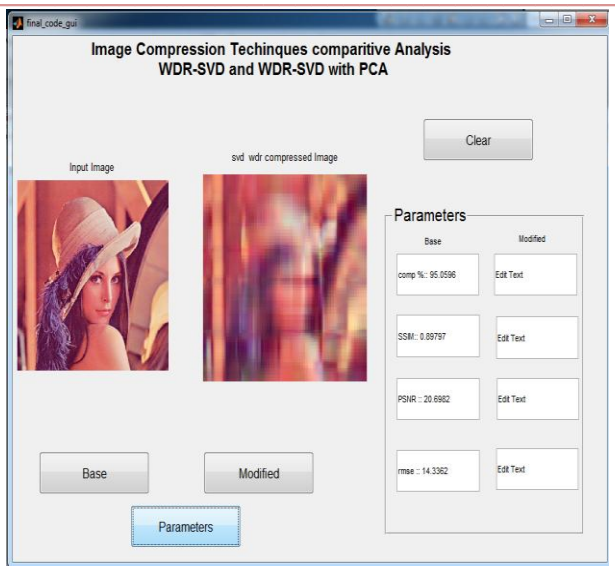

Figure 2 : Final output of SVD-WDR in GUI

As shown in figure 2 In This window we get a result of svd-wdr algorithm i.e showing input image, final compressed image and parameters in terms of Compression rate, SSIM, PSNR,and RMSE, Now we run the purposed algorithm with same image and compare the results.

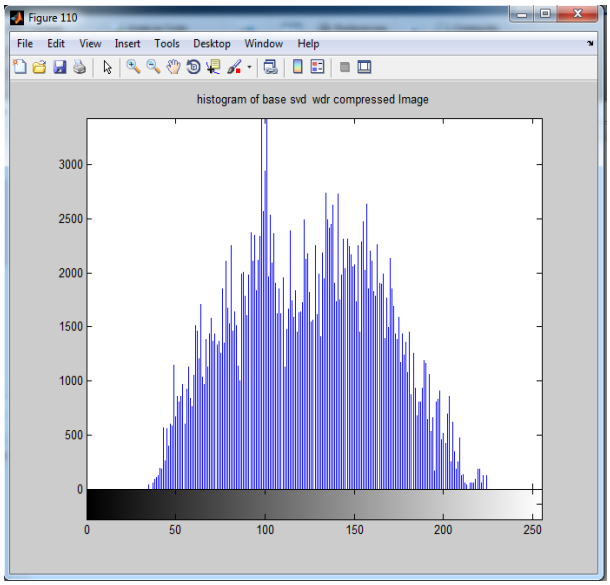

Figure 3 : Histogram of SVD-WDR compressed image.

As shown in figure 3, This window is showing the histogram of svd-wdr compressed image.

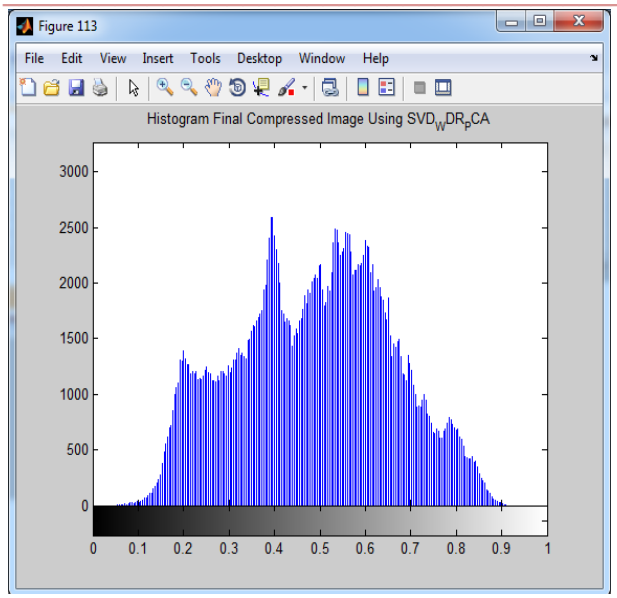

Figure 4 : Histogram of SVD-WDR compressed image.

As shown in figure 4, This is the window for showing the Histogram of Final Compressed Image by purposed work

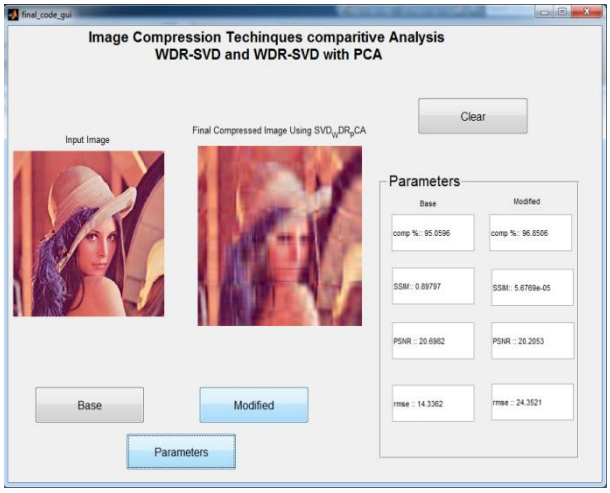

Figure 5: Final output of SVD-WDR with PCA in GUI

As shown in figure 5, In This window we get a result of svd-wdr algorithm i.e showing input image, final compressed image and parameters in terms of Compression rate, SSIM, PSNR,and RMSE, Now we run the purposed algorithm with same image and compare the results.

5.1 RESULT

In this work, it has been concluded that image compression is the technique which can reduce size of image without compromising image quality. In this research work, wavelet transformation technique is applied to extract textural features of the image. The PCA algorithm is applied to select extracted information. The proposed algorithm is tested in terms of various parameters and it has been analyzed that performs well as compared to existing techniques.

Table 5.1: Comparison with Existing Work

Parameters	SVD-WDR	SVD-WDR with PCA
Compression Rate	95.0596%	96.8506%
PSNR	20.6982	20.2053
RMSE	14.3362	24.3521
SSIM	0.689797	5.6769e^-05

6. CONCLUSION

As it can be seen in the table shown above that there is a big variation between all parameters compression rate, PSNR, RMSE, SSIM of existing work and proposed work. And with this proposed work the compression rate is increased and also improves the psnr, rmse and ssim values. So it can be said that the proposed modification in the existing SVD-WDR will give a huge improvement to the Image compression techniques. The problem of compression rate do not matter much, but when it comes to large size image when there are big variation, then it becomes enormously big problem.

In proposed technique the image is firstly compressed by WDR technique and then wavelet transform is applied on it. After extracting features with wavelet transform the patches are created and patches are sorted in order to perform compression by using decision tree. Decision tree sort the patches according to NRL order that means it define root node which maximum weight, left node which has less weight than root node and right node which has minimum weight. In this way the patches are sorted in descending order in terms of its weight (information). Now we can see the leaf nodes have the least amount of information (weight). In order to achieve compression of the image the leaf nodes which have least amount of information are discarded to reconstruct the image. Then inverse wavelet transform is applied to decompress the image. When the PCA technique is applied decision tree classifier the features which are not required are removed from the image in the efficient manner and increase compression ratio.

7. FUTURE SCOPE

Following are the various possibilities which can be done in future

1. In future proposed technique can be compared with the some other technique of loss-less image compression techniques.
2. In future, technique will be proposed which can analyze various both textural and color features of the image to generate final compressed image.

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