Reduction of Blocking Artifacts in JPEG Compressed Images

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Abstract- Image compression is a important issue for many applications in the area of multimedia communication, the objective being reduction of storage and transmission costs. Various types of techniques have been developed for various applications. Digital images are large in size and occupy large space. There large size deals with two types of problems, first is large bandwidth requirements and other is of more time required for uploading and downloading through internet. We can compress audio signals, video signal, text, fax and images. For medical images lossless compression is used and for other types lossy compression can be used. For compressing an image, use DCT (Discrete Cosine Transform) technique. During recovering original image from compressed image occurs various problems like blocking artifacts, ringing artifacts, blur artifacts or edge artifacts are observed. However quantification of these artifacts is a different task. In this paper discuss various conventional filters, which is used to reduce artifacts in compressed images. The experimental results are illustrating the performance of conventional filters on the basis of MSE and PSNR.

Keywords- Blocking Artifacts, DCT, Image Compression, Image Quality Measurement

1. Introduction

To meet growing demand for video communication, various efficient image compression methods and standardized have been developed for e.g. JPEG and MPEG [1]. The purpose of the data compression is to reduce storage and transmission costs while maintain image quality. Currently, most image compression standards use block based transform coding [2]. Various types of compression artifacts will occur in such block based transform coded images [3]. Blocking artifacts are one of the most annoying problems that degrade the perceived image quality. Digital image and video are mostly coded using Discrete Cosine Transform and Discrete Wavelet Transform. When we have to transfer the data at low bit rate these coding techniques have many visual distortions and imperfections called artifact occur. These are always some confusion between noise and artifacts.

A. Classification of Compression Algorithms

Data compression a method that takes an input data D and generates the data C (D) with the less number of bits as compared to input data. The reverse process is called decompression which takes the compressed data C (D) and reconstructs the data D' as shown in fig. 1.

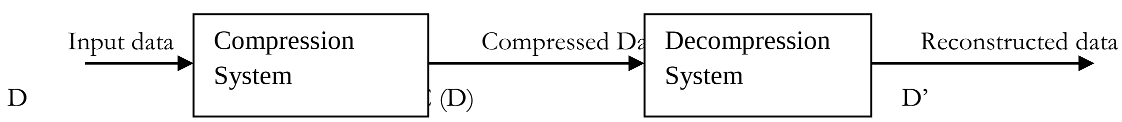

Fig. 1 Compression Algorithms

Compression algorithms are classified into two categories-lossless and lossy. Lossless data compression techniques are applied on text data or scientific data and preferred for artificial images such as technical drawings, icons or comics. This is because lossy compression methods, especially when used at low bit rates, introduce compression artifacts. Lossless compression methods may also be preferred for high value content, such as medical image scans made for archival purposes. Lossy methods are especially suitable for natural images such as photos in applications where minor loss of fidelity is acceptable to achieve a substantial reduction in bit rate. The lossy compression that produces imperceptible differences can be called visually lossless.

B. Compression Artifacts

A compression artifacts (or artifact) is the result of an aggressive data compression method applied to an image that discard information that may be too complex to store in the available data rate or may have been incorrectly determined by an algorithm to be of little subjective importance.

Some common artifacts are:-

1) Blocking Artifacts

Sometimes distortion appears in compressed image as abnormally large pixel blocks. It is also called "macro blocking". The blocking artifacts are filter divided into three various categories as:

- Staircase noise
- Grid noise
- Corner outliers

Staircase noise: - Stair noise case appears on the block edges, the edge is degraded such that the block bands like the edge.

Grid noise: - This is other form of artifacts which occurs by using the higher bit rate applications in the decompressed data.

Corner outliers: - This type of artifacts is visible at the corner points of blocks, where the corner point is either much larger or much smaller than neighboring pixels.

2) Ringing Artifacts

Ringing artifacts are appearing as spurious signals ("rings") near sharp transitions in a signal. Mostly they display as rings near edges of images. The main reason of ringing artifacts is due to a signal being band limited or passed through a low pass filter. It is also called Gibbs phenomenon.

3) Blurring Artifacts

Blurring means that the image is smoother than originally.

4) Color Distortion

Human eyes are not sensitive to color as to brightness much of the detailed color information is disposed, while luminance is retained. This concept is called 'Chroma' sub sampling. The brightness image is stored at the original resolution, whereas the two color images are stored at a lower resolution.

2. Literature Study

There are numbers of researches on image compression and blocking artifacts reductions. So defines various types of filtering techniques. An advanced Discrete Cosine Transform (DCT) based on image compression method that is combined with various advantages of several approaches. Image compression using Discrete Cosine Transform (DCT) is one of the simplest commonly used compression method. Blocking artifacts are artificial discontinuities along block-boundaries, they can be considered as high frequency artifacts. To eliminate these blocking artifacts, low pass filtering is a simple solution. A space- invariant filtering method was proposed by Reeve and Lim [4]. They introduced a symmetric; two dimensions 3×3 Gaussian spatial filtering method for the block boundary pixels which further caused image blurring due to its low pass nature. The nonlinear space variant filter proposed by Ramamuthi and Gersho [5] adapts to the varying shape of local signal spectrum and thus reduces only the locally out of band noise. To minimize the blocking artifacts, this algorithm employs a two dimensional (1-D) filter aligned parallel to edge for near edges. Hsu and Chen [6]. Proposed an adaptive separable median filter (ASMF), which is not only reduces the blocking artifacts, but also preserves the edges.

In the method proposed by Kuo and Hsieh [7], first blocks with visible blocking artifacts are detected then an edge map for these blocks is created and finally edge-sensitive filtering is performed by low pass filtering of the pixels only on one side of the edge without including the pixels on the edge. In the method proposed by Kim et al. [8], the filtering method has two modes, filtering for smooth regions and filtering for other regions. Mode decision is taken for each row of a vertical block boundary or each column of a horizontal block boundary by ratifying the flatness of this row or column by respectively. Filtering for smooth region is performed by using a nine tap one dimensional low pass filter. Filtering for other regions is performed by modifying only the pixels adjacent to the block boundary. The modification is based on a row-wise 4 point DCT analysis on the pixels across the vertical block boundary. Tai et al.[9] introduced a novel algorithm for reducing the blocking artifacts. The proposed algorithm is based on 1-d filtering of block boundaries. The masking effect of HVS is considered to improve visual quality. This work shows that using the three filtering modes promotes effective deblocking. The filtering in smooth regions is strong to remove noticeable blocking artifacts. An intermediate filtering mode is proposed to balance strong filtering in smooth regions and weak filtering in complex regions. This weak filter is applied in complex regions. Meier [10] proposed a method to remove blocking artifacts by first segmenting the degraded image in to regions by an MRF segmentation algorithm and then each region is enhanced separately using an MRF model. Vo et al. [11] design an adaptive fuzzy filter to fast remove blocking and ringing artifacts with consideration of edge and texture direction. Chatterjee and Milanfar [12] design a patch based wiener filter that exploits patch redundancy for image denoising. Buades and Coll [13] proposed a new algorithm the non local means (NL-means), based on a non local averaging of all pixels in the image. This filter can be applied to the image block and modify its pixels as the weighted sum of its neighborhood pixels, whose weighted parameters is determined by similarity of image block neighborhood

3. Problem Formation

The image compression is used to reduce the number of bits needed to represent an image without quality of image. When decompress the information, various unwanted blocking artifacts or blur are observed in image. To reduce these blocking artifacts, various filters give significant improvement between blocking noise, image features and effective reduction of image blurring

A. Steps for Research Work

1. To compress image using DCT technique.

2. To remove blocking artifacts using Mean filter, Median filter, Adaptive filter and Linear filter.

3. To decompress an image with above techniques and find the results on the basis of parameters such as MSE, PSNR.

4. Results And Disscussion

The observations by using MATLAB software have been shown in Table 1 and Table 2. Firstly take the original image then compress it using DCT compression. After that when image is decompressed for recovering the original image, it shows blocking artifacts in it. To remove these blocking artifacts use various filtering techniques like mean, median linear of adaptive filtering. Table 1and Table 2 show results with parameters like MSE (Mean Square Error) and PSNR (Peak Signal to Noise Ratio).

Table 1
PERFORMANCE OF THE CONVENTIONAL
METHODS IN TERMS OF MSE AND PSNR BY USING IMAGE QUALITY 5

Filtering techniques	Quality	MSE	PSNR
Mean Filtering	5	34.68	32.80
Median Filtering	5	34.00	32.92
Adaptive Filtering	5	31.50	34.82
Linear Filtering	5	38.84	32.54

Table 2
PERFORMANCE OF THE CONVENTIONAL
METHODS IN TERMS OF MSE AND PSNR BY USING IMAGE QUALITY 10

Filtering techniques	Quality	MSE	PSNR
Mean Filtering	10	34.60	32.75
Median Filtering	10	35.66	32.64
Adaptive Filtering	10	31.67	33.15
Linear Filtering	10	37.54	32.45

In Table 1 firstly used Mean filter with quality 5 and find the results with MSE 34.60 and PSNR 32.80. By use of Median filter it has been found MSE 34.00 and PSNR 32.90 and so on. In Table 2, when image compressed with quality 10, MSE is 34.60 and PSNR 32.75 by Mean filter. The Median filter shows MSE 35.66 and PSNR 32.64 and so on.

Fig. 2(a) shows Lena JPEG original image, 2 (b) image compressed with quality 5, 2 (c) image compressed with quality 10, 2 (d) image result with Median filter, 2(e) image result with Mean filter, 2 (f) image result with Adaptive filter and 2 (g) image result with Linear filter.

(a)

(b)

(c)

(d)

(e)

(f)

(g)

Fig. 2 Deblocking results for Lena (a) Original image (b) Compressed image,quality:5 (c) Compressed image, quality : 10 (d) Image recovered by Median filter (e) Image recovered by Adaptive filter (f) Image recovered by Mean filter (g) Image recovered by Linear filter.

5. CONCLUSION

Compression of digital image and video data play an important role in reading the transmission and storage cost for visual communication. However, when bit rates become very low, most compression algorithms yield visually annoying artifacts that highly degrade the quality image. In this paper, the review of conventional filter methods has been discussed. A discussion on compression artifacts was given first. Generally speaking, conventional filtering methods can be used to remove blocking artifacts, blur and ringing artifacts from decompressed images.

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