# A REVIEW AND ANALYSIS OF TECHNIQUES USED FOR REDUCTION IN BLOCKING ARTIFACTS AND EDGE DETECTION OF JPEG COMPRESSED IMAGES

*Parul Prakram Sharma, Kamaldeep Sharma*
Assistant Professor, Assistant Professor
*Department of ECE , Lovely Professional University*

***Abstract*— Due to rapid increase in digitization all over the world, storage capacity limit and data transmission bandwidth has grown significantly in recent years but various applications still require compression. A digital image of large size requires more storage, extensive transmission capacity and more duration for transmission. The objective of the concept of image compression is to limit the loading and transfer costs and also make sure to maintain the quality of the image . Due to its energy compaction property Block DCT is used for compression of still images. Improvement in image coding techniques has been a major research area for quite a while.Various image coding approaches are designed for diverse applications.Out of which the concept of "Joint Photographic Experts Group"s has been suggested for reduction of continuous tone still images. The pictures which are designed from JPEG results in annoying blocking artifacts near block boundaries, especially in highly compressed images. A more compression ratio can be designed if blocking effects which are used can be reduced. As a result of which there is alarming increase in the bandwidth to maintain good value images which is often very costly and also non affordable.Here we analyse a review of latest advances in post processing techniques both in spatial domain as well as frequency domain for reducing the blocking artifacts and edge detection. The need for an efficient image enhancement method for removal of these artifacts is therefore a challenge that continually initiate new kind of thoughts and applications in this area.**

***Keywords*— Blocking artifacts, edge detection, fuzzy logic, HVS, Fuzzy set Membership Function**

## I. INTRODUCTION

Low bit rate coding of still images has been an essential need for various multimedia applications due to narrow bandwidth of communication channels. At low bit rates, compression algorithms introduce visually irritating artifacts which degrades the quality of an image. The degradation results due to the fact that correlation between spatially adjacent blocks is ignored while coding an image. Increasing the bit rate or bandwidth to obtain better image quality is not feasible or is too costly [1].The source signal obtained from data source contains more information (motion and spatial details) and hence more bits are required for representation by the compression algorithm.An image is when compressed at same bit rates images with large d degrade more in comparison to those with fewer details. Another reason which affects the image quality is the coding bit rate. Hence lower the bit rate then there is more effect of blocking artifacts. Lastly, the type of compression algorithm used also defines the types of artifacts introduced such as ringing effects or blocking artifacts, blurring etc.[2]

In the Literature two most common strategies have been adopted for reducing these blocking artifacts. These can be categorized as pre-processing techniques and post processing techniques. Pre-processing techniques work at encoder end and these techniques do not assure or give confirmation to the system that is already their if compared with the existing coding standards such as JPEG and MPEG. Interleaved block transform, lapped transform and combined transform are some common pre-processing techniques [3]. Due to this advantage post processing techniques have been widely used for reducing the artifacts. Post Processing Filtering techniques can be further classified as spatial filtering, DCT- based filtering and hybrid filtering methods [5] . Spatial filtering focuses on removing the high frequency artifacts by application of a low pass filter around the block boundaries to remove these high frequency artifacts.. The hybrid method combines the spatial information and frequency information combined into one single algorithm with improved results. [6]

## II. Literature Review

Another methods are basically adopted for reducing these artifacts. In the first one, there is decrease of delaying artifacts which is implemented at the encrypting side since due to the given disadvantage. Some of these suggested schemes are enclosed block transform and combined transform and so on. post processing of the recreated picture is done in this methodology and as a result of which visual quality without any modification in the encoding or decoding side is improved

### II (a) Spatial domain Techniques:

The following concept suggested a symmetrical,2D 3x3 Gaussian spatial cleaning idea which includes the pixels which are along the block boundaries. But ,it lead to distortion in the image because of its low pass sieving nature.Another proposal which uses the adaptive separable median filter . The following concept separates not only reduced the obstructive objects but also conserved the edges.This following concept presented section based technique for improving the quality of picture reduced by

obstructing artifacts. Here, the corrupted picture is divided by a area growing algorithm and each area is then separated with the use of a low pass filter.

Another idea in which the algorithm is used to remove the obstructive objects in JPEG images once it is being subdivided into section area and intonation area based on the edge map which can then be obtained after thresholding the gradient absolute image. Many researchers have proposed iterative based methods such as theory of projection onto convex sets (POCS). The following concept, initially uses a closed convex check sets which respond to most of all the accessible values on the creative uncoded picture

**II (b) Frequency Domain Techniques**

**Another** new concept for decreasing the obstructive artifact in frequency domain. new index is used to analyse the obstructive effects. It shows that the expected value of MSDS rises after quantized DCT coefficients. The following concept eliminates the blocking effect by reducing the MSDS, while putting linear limitations equivalent to quantization bounds [10] This also reduced blocking artifacts which were on the idea of MSDS., This includes pixels which are neighboring diagonal pixels along with pixels which belongs to horizontal and vertical neighboring [6]. Human Vision System is an Another DCT-domain algorithm which will removes all the parameters required to detect the presence of blocking artifacts, with the help of (HVS) properties. Artifacts are then condensed by with the help of adaptive technique [11]. Hence , the reduction of edge information based on application of zero masking technique is noticeable [12].

Another technique which reduces the delaying artifacts in the the image where there are smooth regions. This connection in the values of intensity imposed where the visual insight can detect the blocking artifacts. Along with that the proposed work is to incorporate the human visual system (HVS).

**II (C) Fuzzy based Approaches**

While implementing compression of image, their is a need to preserve prominent visible edges or boundaries for human insight. the blocks of images with containing many pixel edge give a information which could be used as a result so that it could be decided when it should be less compressed. .Another system in which it is on quantization of fuzzy vector which determine optimal code vectors. This implementation makes use of precise belongings of rough fuzzy which is then used to rebuild the actual image [17].

**III Competitive Fuzzy Edge Detection (CFED):**

Boundaries or edges that are their in an image are outlines produced and due to unexpected or sudden alteration in the intensity of neighboring pixels points. These changes could be observed due to alteration in color, texture and shade which can further lead in estimating the orientation and size of an image.

Boundaries or Edges are one of the vital significant fragment of an image.While doing image compression, visually significant edges are requied to be well conserved for human . And It is also well aware that the image blocks which contains a collection of edge pixels points which contain more detail as a result of which their will be less compressed, And also image blocks which contain even regions are to be more compressed. Hence this Fuzzy transform based image firmness method reduces individual image block by analysing the value of edge detail contained in it [15]. When Boundaries or Edge detection has required submissions of the following fields which includes machine vision, and also pattern recognition along with biomedical imaging etc. Several false edges can also misinterpreted as real edges and can create ambiguity for any image processing task.

Edge detection is a process to capture the significant objects in an image without disturbing the important features of the image. The method required a large rule set for detection of edges in an image. Liang and Looney [23] proposed the concept of a feature vector calculation for each pixel and designed competitive rules edge for detecting the edges. Kaur et.al [24] proposed a fuzzy logic based edge detection method which uses a 2*2 pixel window and a GUI for loading the input image and displaying the results along with and added feature of noise removal. Verma et.al proposed a simple rule based fuzzy logic based edge detection algorithm [25] using a rule base of 30 rules around a 8*8 neighborhood using triangular membership function. Alshennawy et.al proposed a fuzzy based edge detection method using a 3*3 pixel window for segmenting the image [26]. Some Neural network based techniques as proposed by Looney [27] to train a neural network for detecting the edges have also been develop in recent times. Wang et.al proposed a hybrid technique using fuzzy logic and neural networks to detect the edges and this technique gives better results as compared with individual techniques [28].

Hence, gradient based techniques such as Canny edge detector or Sobel edge detectors yield poor results and thus fuzzy based edge detection approaches have been widely used in recent times.

**IV) Fuzzy Image Processing**

This image processing has three main cases: a) Fuzzification of an image b) Selecting Membership functions and calculating the degree of membership c) De-fuzzification of image as shown in figure 1.

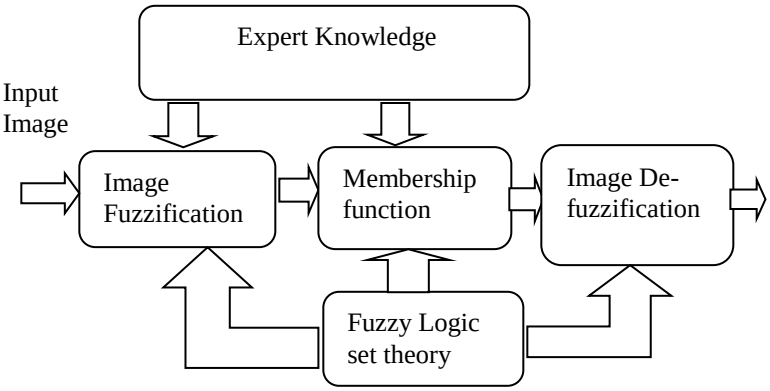


**Figure 1: Fuzzy Image Processing System**

The concept of fuzzy classifier has been utilized which accepts inputs in form of a feature vector. Fuzzy classifier detects the image pixels in various classes depending upon the variation in gray level intensities in various directions.

In the following figure there is 3*3 neighborhood around the center pixel $p_5$ along with the four directions in which edges may appear. The calculation of d1, d2, d3 and d4 is done as per following formula:

$d1 = |p_1 - p_5| + |p_9 - p_5|$ (direction 1) 1(a)

$d2 = |p_2 - p_5| + |p_8 - p_5|$ (direction 2) 1 (b)

$d3 = |p_3 - p_5| + |p_7 - p_5|$ (direction 3) 1 (c)

$d4 = |p_4 - p_5| + |p_6 - p_5|$ (direction 4)
1 (d)

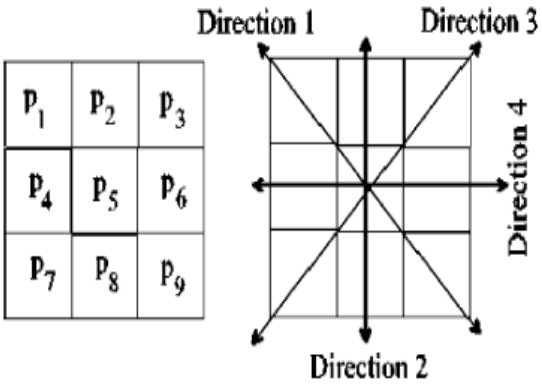


**Figure 2: Pixels and direction in a 3*3 nbhd**

The fuzzy classifier distinguishes the pixels into following classes, background class and a noisy edge pixel. . We construct six sample vectors (C0, C1, C2, C3, C4, and C5) to be the following centers of the respective six classes mentioned above i.e. 4 edge classes and one background class and one noisy edge class.

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Table 1
The classes and their prototype vectors

| | |
|---|---|
| Class 0 (background) | $c_0$ = (lo, lo, lo, lo) |
| Class 1 (edge) | $c_1$ = (lo, hi, hi, hi) |
| Class 2 (edge) | $c_2$ = (hi, lo, hi, hi) |
| Class 3 (edge) | $c_3$ = (hi, hi, lo, hi) |
| Class 4 (edge) | $c_4$ = (hi, hi, hi, lo) |
| Class 5 (speckle edge) | $c_5$ = (hi, hi, hi, hi) |

**Figure 3: Class and their prototype vectors**

Ideally, these low and high values must be defined by the user depending upon the type of the image. For example, for a gray scale image a gray level difference of 4 can be assigned as low and a value between 40 to 50 can be assigned as high.. The figure below shows the a) original Lena Image and b) Edge detection of Lena image


## V. Performance Indices/Metrics

Digital imaging rapid development along with assessment of image quality it is very important issue in various applications like image acquisition,compression and enhancement.

**a) PSNR**-This is the highest possible ratio power of a signal along with corrupting noise power which then affects the loyalty .When doing compression of image signals are considered as the image, and noise is taken as the error introduced by compression.

$$PSNR(X, Y) = 10\log_{10}(L^2/MSE)$$

**b) Mean Square Error:**

It is the Measurement of the average of the squares having errors or deviations. MSE is the measure of the quality of the estimator and it is always non-negative. The closeness of MSE value to zero is always better.

**c) Structure Similarity index measure:**

The index given in a system which can be used for the apparent quality calculation for the cinematic pictures and digital television and also with other types of digital images and also videos.It is used for measuring the common referencamong two images. It is to inhance on old-style methods that is its main purpose ,which includes techniques such as signal-to-noise ratio (PSNR) and mean squared error (MSE),

$$SSIM(X,Y) = \frac{(2\mu_x\mu_y + (K_1L)^2)(2\sigma_{xy} + (K_2L)^2)}{(\mu_x^2 + \mu_y^2 + (K_1L)^2)(\sigma_x^2 + \sigma_y^2 + (K_2L)^2)}$$

**d) Feature Similarity Index Measure:**

This technique allow assessment of the image from feature level to pixel level and is widely used as an index measure nowadays for image quality assessment.

## VI. Results and Discussion:

The figure below shows the original Lena Image (a) and the reconstructed Lena image with blocking artifacts (b).


The comparison of different techniques in terms of used methodology and their PSNR (dB) values is done in the table 1 below:

| Test Image | Gambhir (15) | Luo (13) | Kim (19) |
|---|---|---|---|
| Lena Image | 27.37 | 26.60 | 26.78 |
| Gold-hill | 26.44 | 25.42 | 26.09 |
| cabbage | 27.33 | 26.13 | 26.39 |
| Camera | 26.08 | 25.24 | 25.04 |
| House roof | 28.97 | 28.16 | 28.60 |
| plane | 26.22 | 24.09 | 25.20 |
| Trees | 22.80 | 20.9 | 21.60 |
| Boat | 22.44 | 22.29 | 22.33 |
| Bikes | 26.56 | 25.37 | 25.56 |
| Bark | 28.06 | 26.53 | 27.49 |
| Graffiti | 21.98 | 20.33 | 20.89 |

| | | | |
|---|---|---|---|
| Wall | 25.12 | 25.03 | 24.93 |

**Table 1: comparison of PSNR values (dB) using different approaches**

It is quite evident from the comparison table that fuzzy based approaches are more effective and powerful in removing blocking artifacts from highly compressed images at low bit rates due to improved PSNR.

Similarly, Table 2 below specifies the values of MSE for different approaches:

| Test Image | DCT compression | SAWS | Fuzzy |
|---|---|---|---|
| Lena Image | 91.85 | 60.54 | 51.17 |
| Gold hill | 104.73 | 77.11 | 71.62 |
| Peppers | 83.58 | 60.26 | 56.76 |
| Pirate | 115.10 | 85.07 | 80.92 |

Table 2: comparison of MSE using different approaches.

## VII. Conclusion and Future Scope:

In this review paper various existing techniques for reducing the blocking artifacts and edge detection has been analyzed and it has been shown that Fuzzy based approaches are more robust and flexible as compared to spatial and frequency domain based techniques. In future, a review on Neural network based fuzzy logic techniques can be analyzed so as hybrid methodology of neural networks and fuzzy logic can be applied to compressed images at low bit rates. Moreover, trained neural networks based techniques can also be explored with its benefits in field of image compression.

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