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A Novel Analysis of Noise and Filtering Mechanism for Image Enhancement - A Review

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ABSTRACT

Image processing is one of the thrust area and is used in almost every field of the study. Image processing is used in order to enhance, smoothening, filtering etc. the image. There are number of techniques which are suggested in order to enhance and smoothening the image. When images merged together then pixels may overlap with each other. This overlapping of image will cause redundancy within the image. In this paper we have surveyed and analyzed this redundancy problem. In order to determine the problem solving mechanism, large number of algorithms have been analyzed to check redundancy in the image and to find the solution which is optimal in nature.

Keywords : Noise, Overlapping , Redundancy, Filtering

I. INTRODUCTION

Today even the naïve user is using the computer. Naïve users do not now much command associated with the computers. So in order to make them understand the computer, Graphical User Interface is required. This interface will be provided with the help of applications of image processing[1]. So main application of image processing is in the field of interface designing. The interface is important as it will lead to the success or failure of the system. When interface is designed we may required in order merging multiple images together. When this happens pixels may overlap with each other. This overlapping of pixel will cause redundancy in the images[2]. Redundancy within the image will cause number of problems. The redundancy will cause extra space requirements. Hence when redundancy is present than extra cost will be encountered[3]. The redundancy can also be present due to compression technique which is used. The compression method can be lossy or lossless in nature. The redundancy problem is common in lossless compression.

A. Redundancy

The redundancy problem will cause image to blur. This blur portion of the image will cause the problem during the encryption as well as decryption process[4][5]. The clarity of the image will be reduced if the redundancy is present within the image. There are several techniques which are introduced in order to reduce the redundancy and to enhance the quality of the image. This can be accomplished with the help of buffering method. Within the buffer the pixel values which are already plotted are stored. When the new pixel is being plotted then it is compared with the old pixel which is plotted.

If the values matches than the new pixel is rejected. This method will cause the redundancy to be reduced from the image. Various types of redundancy which is present within the image are:

1) Psycho-visual Redundancy: It is a redundancy corresponding to different sensitivities to all image signals by human eyes. Therefore, eliminating some less relative important information in our visual processing may be acceptable.

2) Inter-pixel Redundancy: It is a redundancy corresponding to statistical dependencies among pixels, especially between neighboring pixels.

3) Coding Redundancy: The uncompressed image usually is coded with each pixel by a fixed length. For example, an image with 256 gray scales is represented by an array of 8-bit integers. Using some variable

length code schemes such as Huffman coding and arithmetic coding may produce compression Image compression is important for web designers who want to create faster loading web pages. Image compression also saves lots of unnecessary bandwidth by providing high quality image fraction of file size. Image compression is also important for those people who attach photos to email which will want to send the email more quickly. For this bandwidth cost is saved[6].

Image compression is more important by compression image for digital camera users and people who saves lots of photos their hard-drive, store more images on our hard disk thus saving the memory space. Images transmitted over the internet are an excellent example of why data compression is important. The image can be moved or transferred by converting the image into digital form by the use of 33.6kbps modem. If the image is not compressed, it will contain about 600 kilo bytes of data. Image compression coding is to store the image into bit stream as well as possible and to display the decoded image in the monitor as exact as possible.

B. Buffering

Buffering is used in order to store the pixel position values which are already plotted[3]. If the same pixel position again appear for plotting then that pixel position is rejected. Buffer in this case is also known as refreshing buffer. The refresh buffer will receive the pixel position from the CPU main memory. The pixel positions which are to plotted are inputted through the input device. The image entered through the input terminal is changed to bits and bytes and stored within the memory. The memory in this case is known as buffer. The size of the image which can be stored within the memory will depend upon size of the memory.

C. Image Compression Techniques

There are number of image compression techniques which are available to be used[7][8]. Each compression technique which is used is complex in nature. Huffman coding creates variable-area codes, each translated by a whole number of bits. Images with higher expectation get reduced code words. Huffman coding is the most ideal coding composition when code words are confined to whole number segment, and it isn't excessively unpredictable, making it impossible to execute [1]. It is in this way the entropy-coding pattern of world class in visit applications. The Huffman code tables typically required to be incorporated into the grouped record as side data. To maintain a strategic distance from this one could use a standard table determined for the important class of information, this is an alternative in the JPEG pressure mapping [4]. Another option is versatile Huffman coding as in [3]. While these instruments needn't bother with side data they use non-ideal codes and thus other than bits for the image code words. The proficiency of Huffman coding can regularly be fundamentally bettered by the use of hand crafted Huffman code tables. This probability is likewise incorporated into the JPEG pressure pattern [4]. The instruments used in this paper all use uniquely crafted Huffman code tables. Huffman coding is satisfactory when whole number codeword areas are prudent for the image grouping. For the most part, this is the situation when no images have high foresight, particularly no image ought to have likelihood more noteworthy than 0.5. On the off chance that the images reckoning are 0.5, 0.25, 0.125, 0.0625 or less than 0.05 then a construction utilizing whole number codeword segments will do great. Huffman codes don't misuse any conditions between the images, so when the images are measurably needy different instruments might be vastly improved. Compression techniques are divided into following categories:

1) Lossy Compression
2) Lossless Compression

1) Lossy Compression Technique

Transformation Coding:

In this technique Discrete Fourier transformation is used. In this technique the pixel in original image is changed to frequency domain. The overall energy of the entire pixels areconcentrated on the few necessary pixels. Only some significant pixels are selected and rest of the pixels are rejected.

Vector quantization:

In this case dictionary of code vectors are prepared. Code vector is the block of pixel values. The given image is then divided into parts. This is known as image vector. The image vector is than compared with the code vector in order to determine the code for the given image.

Fractal Coding:
The idea behind this encoding is to divide the image into parts. The image will be divided into parts on the basis of colors, edge detection etc. The technique is useful in case image contain redundancy.

Block Truncation Coding:
The picture for this situation is isolated into piece of non covering pixels. For each square limit and recreation esteems are resolved. The values of the block will then be compared against the threshold values. If the pixel values are greater than the threshold values than the pixel values will be rejected. This technique is not useful if the redundancy is presented within the images.

2) Lossless Compression Techniques
Run Length Encoding:
This is very simple form of encoding. In this case encoding the larger set of string is replaced with the smaller set of code. The Run Length Encoding is useful in a system where large number pixels repeat itself. In order to describe this system we will take following example of string
1122223344444444444443333333333333322222222255555555555
{1,2}, {2,4},{3,2},{4,13},{3,13},{2,10},{5,11}
In this type of encoding the frequency of each digit is included within the braces along with the digit itself.

Huffman Encoding:
Huffman Encoding is used to encode the given image into set of codes[10][11]. The codes can be represented in the form a tree. The reverse approach is followed in order to formulate a code. The code is generally represented in the form of a binary string.

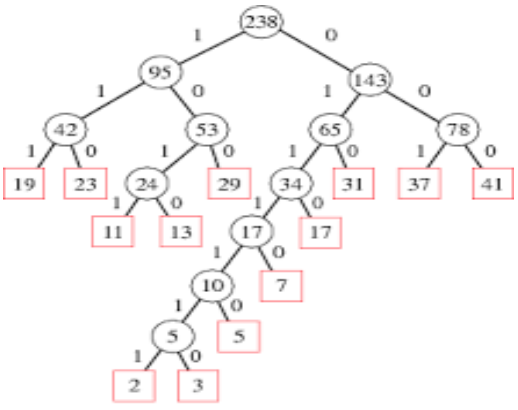

Figure 1. Huffman Encoding

The last two bits are extracted and then added together to achieve the value of the root node. This process continues until the root node is reached or tree terminated.

Here we think about three unique diagrams for pressure: forthright, JPEG- like, and recursive Huff- man coding. The two initial steps are indistinguishable for every one of the three components; we use DCT and uniform quantization with limit. The outcomes would then be able to be translated in a network where the lines are the frequencies and the sections are time. The sections are the quantized esteems; there are as continuous passages as there are tests in the flag. The upper left piece of this lattice might be

Table 1. Quantized values of the image

Block	1	2	3	4	5	6	7	8	..
LP(DC)	4	5	5	0	-4	-2	4	2	..
BP(AC)	1	0	3	0	0	-1	0	-2	..
	0	1	1	0	0	4	1	0	..
	0	0	0	0	5	0	0	-1	..
	0	0	0	0	0	0	0	0	..
HP(AC)	…	…	…	…	…	…	…	…	..

Since we have used a 16 focuses DCT, the network will have 16 lines (groups) and each square is 16 tests. The three unique systems used here all begin with this lattice of quantized bits, and use diverse approaches to shape the image plan. Candid Huffman Coding use just End of Block coding. The End of Block image, (0), and whatever remains of the images are shaped from the quantized esteems as per this table.

Table 2. End of Block Coding

Value	EOB	… -2 -1 0 1 2 …
Symbol	0	… 4 2 1 3 5 …

The symbol sequence after EOB coding for the example above will then be:
9, 3, 0, 11, 1, 3, 0, 11, 7, 3, 0, 0, 8, 1, 1, 11, 0, 4, 2, 9, 0, 9, 1, 3, 0, 5, 4, 1, 2, 0, · · ·.
We take note of that there will be as successive EOB images as there are sections in the framework, and that

the image arrangement will be non-negative whole numbers where the petite ones are other than likely than the bigger ones, use images translated by little whole numbers compare to little size of the quantized esteems.

JPEG-like Huffman Coding makes the images the clone path as JPEG does, every section of the grid compare to the crisscross examined succession of a 8 × 8 pixel picture obstruct in JPEG. The DC segment and the AC segments are coded independently. The DC part is DPCM coded and the images are represent by the accompanying table

Table 3. Structure of the tree through Huffman coding

Symbol	DPCM Difference	Additional Bits
0	0	0
1	-1,1	1
2	-3,-2,2,3	2
3	-7,…,-4,4,…,7	3
4	-15,…,-8,8,…,15	4
…	…	…

Every image is trailed by some supplementary bits to interestingly give the DPCM distinction. For the information case this gives (the two last lines are put away) For the AC part the zeros are run area coded. Every image comprises of two sections, the initial segment is the run that tells how visit zeros that go before the esteem (R), and the second part is the esteem image (S). The esteem images are the clone as the images used for the DPCM contrasts. To totally determine the esteem every image is prevailing by supplementary bits the clone path with respect to the DPCM contrasts. The joined image (translated as one whole number) is 16R + S. Image (0) is EOB. For the example data this gives

Table 4. Quantized Values with going before zeros

Quantized AC Value **Value Symbol (S)** **Preceding Zeros(R)**	1 EOB 1 EOB 3 … 1 0 1 0 2 … 0 0 1 0 0 …
Symbol (16R+S) **Additional Bits**	10 17 0 2 … 1 – 1 – 11 …

Recursive Huffman Coding uses the clone image grouping as direct Huffman coding. Typically these images are not autonomous, which practical that the genuine entropy (decreased utmost for conceivable piece rate) is less than zero-arrange entropy (lessened farthest point for bit rate for Huffman code). The proposed construction exploits a few conditions in the image succession and deeds this in the Huffman coding method. The following two segments of the paper clarify the points of interest of this instrument. Note that the instrument has a few constraints. In the event that the image arrangement is profoundly corresponded, it will most likely be smarter to endeavor to enhance the disintegration part as opposed to trust that this Huffman coding pattern will use the greater part of the related. Additionally, if number codeword areas are not fitting then different instruments might be greatly improved.

Coding through Lempel-Ziv – Welch

LZW (Lempel-Ziv – Welch) is basically a lexicon based coding[12]. The dictionary based coding can be either static or dynamic in nature[8]. The static word reference coding depicts lexicon as a settled amid the encoding and translating forms. The dynamic word reference coding portrays the lexicon as refreshed on fly. LZW is broadly utilized as a part of PC industry and is actualized as pack charge on UNIX.

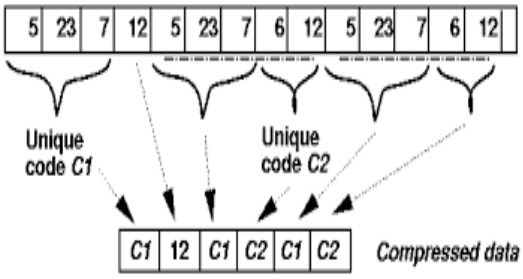

Figure 2. Image compression

Image compression gives rise to reduced size imaging but the problem of noise is introduced. The primary reason for introduction of noise is medium through which image is transferred. The sources of noise could be many and required to be tackled.

The greyscale images are used for better observing the problems present within the images. The greyscale images are converted back to original form by the use of database which is used in order to encode the coloured images. The image processing will require techniques in order to enhance the image for introducing clarity in the analysis process. During the analysis process pixel values are going to be analysed.

Pixel is phosphorus dot which will glow when the electron beam strikes on it. The pixel will have horizontal and vertical position associated with it. The intensity values will be disturbed when the noise is introduced within the image.

The intensity hike in the image will cause the distortion which will be handled by the use of histogram equivalence process. The implementation of the proposed system is done by use of tool known as MATLAB. The digital image processing tools are provided within the MATLAB for handling noise present within the image.

After noise handling mechanisms are successfully applied, compression comes into existence. The process is followed in order to compress the extracted images from the dataset. Compression is implemented to save the bandwidth and hence minimize the cost associated with transfer. It describes Huffman coding scheme for compression of presented data. Lossless compression scheme is proposed through this approach[13][4]. Discrete cosine transformation is another compression technique used to compress the data presented from source to destination[6][5].

Compression technique implementation once performed, data analysis process begins. Data analysis process check for the on road traffic by checking the position of vehicle received from the dataset. Image processing is a technique used in various fields like medical and education. Due to noise image may be corrupt. In order to remove the noise various techniques and filters are provided in the field of image processing. Image filtering also involves calculating the probability density function. This function leads to introduce the clarity within the image. Legion of techniques are present in order to enhance the image but review of only specific techniques which are optimal in nature are discussed.

D. Noise within the image

Noise is distortion introduced within the image. Distortion in images could be due to median through which data is transmitted. The image processing is the state of art mechanism used to enhance the image. Before enhancement the noise present within the image must be tackled. The noise can be tackled by the use of filters. The objective of this paper is to study the various filtering mechanism available in order to remove noise from it and then applying enhancement mechanism to make the image better for presentation.

Removing the noise from the image is known as denoising. Image denoising is the mechanism by which quality of the image is restored. Noise removal is the challenging task presented to the researchers[14]. Various type of noise is described in this section:

1) Salt and Pepper Noise

Salt and pepper noise cause the distortion in the image by introducing white dots within the image[15][1].The intensity of the pixel rises below or above threshold values[16][6]. Pixel intensity values lie between 0 to 255. If pixel intensity value exceed this limit salt and pepper noise occur within the image. This noise causes white spots within the image hence reducing contrast and clarity within the image.

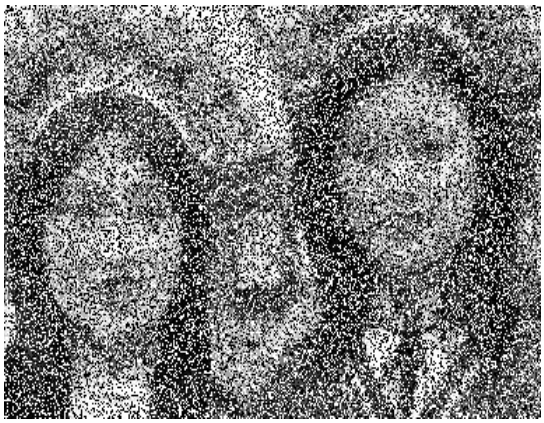

Figure 3. Salt and Pepper noise

2) Gaussian Noise

This noise is caused due to problems in frequency[17][7]. Frequency associated with the pixel is distorted as total of frequency and cumulative frequency values do not match. Clarity of image is completely lost. The contrast is enhanced or reduced from the region where it is not desired in this case.

Figure 4. Gaussian Noise

3) Shot Noise

Shot noise is also known as poissonnoise[18][3]. This is a electronic noise which occurs due to particle nature of light in optical medium. This noise commonly occurs during the transfer of data from source to destination.

Figure 5. Shot Noise

E. Noise handling mechanism

Noise causes distortion within the image. In order to handle the noise handling mechanism are required. This section describes various noises handling mechanism use to purify the image:

1) Median Filter

This filter is commonly used in order to handle salt and pepper noise[19][8]. In case of median filter, median of the neighbouring pixels are obtained. The median so obtained is replaced with the corrupted pixel. By the application of this filter mechanism white dots introduced within the image is reduced. Hence clarity is introduced. Gamma transformation is used in order to enhance the contrast within the image. Median filter along with gamma transformation help in reducing salt and pepper noise along with contrast enhancement.

Figure 6: Median Filter implication

2) Gaussian Filter

Adaptive Gaussian filter is used in order to rectify Gaussian noise[20][9]. Gaussian noise is introduced due to distortion in frequency. Cumulative frequency does not match with the total of frequency in the image. This distortion is removed by the use of Gaussian filtering mechanism.

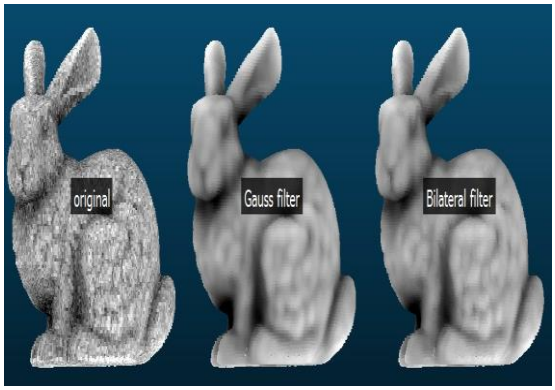

Figure 7. Gaussian Filter Implication

3) Low Pass Filter

Gaussian and Salt and Pepper noise can be handled using Low pass filter[21][10]. Low pass filter does not allow noise to pass through it and hence noise is reduced. Noise occupied higher region in the frequency domain. Low pass filter does not allow noise at higher frequency domain to pass hence image noise is substantially reduced.

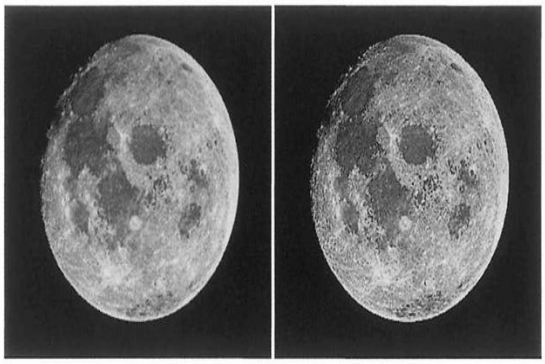

Figure 8. Low Pass filter implication

F. Contrast Enhancement

An Adaptive Histogram Equalization (AHE) is suggested in[3] to determine the image formation by adjusting histogram of the corresponding image. The image will be enhanced since components present within the image will be changed efficiently. It is used for improving near to refinement. The inevitable results

of AHE are typically superior to the GHE, yet this framework improves the segmentation process by decreasing the corrupted region within the image. The CLAHE[4] was used in order to update the image which is improved with adaptive histogram equalization[3].

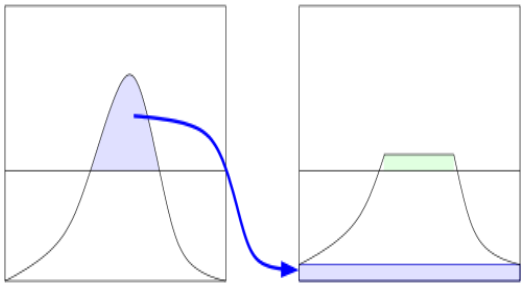

Figure 9. Contrast Limited Adaptive Histogram Equalization

A "Versatile Un-sharp Masking" is proposed in research paper by M. Mofarreh-bonab[5]. The complexity of an information picture is improved by utilizing un-sharp cover on the picture. A versatile channel is utilized because of which the smooth ranges are not or minimal honed though differentiate is upgraded more in territories with high subtle elements. The problem with the existing approach is low intensity images cannot be detected by the application of existing approach.

A framework Brightness Preserving Bi-Histogram Equalization (BBHE) is proposed in research paper by R. a.M, K. W.M, E. M. a, and W. Ahmed[6] in 1997,the mechanism was created for adjusting the histogram. The technique used for this purpose is known as BBHE. In light of the purposed methodology key segments from the image are extracted and enhancement is performed. The color image is converted into grey scale image and desired operation is performed. The pixels have the intensity from 0 to 255. The pixels will be brought into this category by adjusting the histogram[10][11]. A strategy known as sub image histogram equalization is purposed in[12]. It matches with BBHE which concerns with other techniques of HE. The purpose of enhancement is to increase the entropy[12][13]. The input image in this case is partitioned by using minimum mean brightness error as purposed in[14]. The considered procedure will be accumulation of pixels to form a common image. The image enhancement by balance HE is purposed by paper[7]. This paper remove the noise from within the image. The impulse noise is handled in this case. This paper[16] is enhancement of HE. The data histogram equalization can also be done by the use of technique suggested by[17]. The methodology restore the original image from scratch. The absolute mean brightness error can be tackled efficiently by the use of AHE. The technique is available for classification mechanism for MRI images whose pre processing phase incorporates AHE, BBHE and DHE.

Following are the points of interest and hindrances of the methods examined:

Table 5. Comparison of HE techniques

Technique	Classification	Pros	Cons
HE[2]	Global HE	Improve Contrast	Over Contrast upgrades and Information Loss.
AHE[3]	Local HE	Superior to anything HE	Enhance Noise and perception of points of interest ends up noticeably troublesome.
CLAHE[4]	Local HE	Eliminates negative aspect of AHE	Brilliance Loss in the procedure image
Adaptive Un-Sharp Masking[5]	Local HE	Enhanced than HE	Unable to intensify little contrast edge
BBHE[6]	Local HE	Clarity conservation	Improve noise and edges are not clearly experiential
DSIHE[12]	Local HE	Clarity is conserved, visual information is improved	Improve noise, involve superior degree of perpetuation
MMBEBHE[14]	Local HE	Intensity per petuation, removed noise, better enhancement, better conditions color preservation	Low contrast edges are complex to examine
DHE[16]	Local HE	Maintain image details, smooth enhancement and simple	-
BHENM[17]	Local HE	Glow maintenance with least computation time	-
MH-FIL[9]	Global HE	Enhanced Than HE and clarity preservation is considered	Difficult computations due to unlike method for brightness preservation

II. EARLIER WORK

There are number of papers which described the problem of redundancy in images. In order to build the base we analyze number of such papers. Some of the papers which we have studied will be described in this section. Redundancy will make certain portion of the image much brighter than the other portion of the images.

This paper consider the compression technique for jpeg images[6]. The jpeg images are common extension for the images which are being transferred. The transferred images will be compressed so that image should not take much space over the transmitted medium.

The transmission media will charge expenses if the data transferred are large[22]. So compression is required. Discrete cosine transform is used in this case to compress the image. If image is compressed properly than less bits per image is required to represent the image. Hence the mechanism of image compression will help in decreasing the cost associated with the image storage. In addition to the redundancy image processing also contains the problem of noise[23]. This considered paper considers the impact of noise on the image. The impact of noise will cause distorted image.

There are number of sorts of excess which are available inside the picture[11]. The pixels will have substantial spaces in the middle of the pixels. This is known as entomb pixel remove. Keeping in mind the end goal to diminish the separation pressure procedures are taken after. So as to proficiently pack the pictures pressure systems are utilized. Pressure method which is proposed in this paper incorporates lossless and lossy pressure. The redundancies which are considered are entomb pixel, coding and Psycho visual.

The picture pressure will be considered for this situation[24]. Picture pressure is required with the goal that the space necessities can be lessened. The picture pressure will be required to decrease the excess. The sort of excess which is considered for this situation will incorporate Psycho visual. This repetition demonstrates affectability to various pictures by human eye. So some superfluous data from the picture can be rejected.

Image pressure procedures are considered in paper[25]. The picture pressure will be utilized so generally less pixels ought to be utilized as a part of request to speaks to the picture. Once in a while picture does not contain any applicable information. All things considered that unimportant data must be wiped out. This is proficient with the assistance of pressure strategies.

The idea of restorative pictures is considered for this situation[3]. The MRI is a type of pictures which are utilized as a part of the zone of therapeutic field. Different sorts of redundancies are available inside the pictures. These redundancies are disposed of by the utilization of pressure methods. In this paper the zone of concern is therapeutic pictures.

The investigation of different picture pressure methods are considered for this situation[8]. Central Component Analysis procedure is considered for this situation. Picture f(x,y) is sustained into the encoder, which makes an arrangement of images frame the information and utilizations them to speak to the picture. In the event that we let n1 and n2 signify the quantity of data conveying units(for the most part bits) in the first and encoded pictures separately, the pressure that is accomplished can be measured numerically by means of the pressure proportion. The primary territory of concern is Huffman coding, LZW coding and so on.

PCA method proposed in this paper depends on two elements information decrease and elucidation[26]. The primary concentration of the considerable number of papers contemplated is information pressure and decreasing the repetition display inside the picture. The strategies which are recommended inside the papers are exceptionally mind boggling and tedious.

III. COMPARISON OF COMPRESSION TECHNIQUES, NOISE LEVELS AND FILTER USED IN IMAGE PROCESSING

Table 6. Comparison of Compression techniques

Compression Techniques	Type	Pros	Cons
LZW Compression[8]	Lossless	Data after compression and decompression is not lost	Complexity is linearly increased
Shannon Fone Coding[27]	Lossless	Simple and high performance	Lower code efficiency
Huffman Coding[28]	Lossless	High Performance under complex situations	Complex in nature
Arithmetic[29]	Lossless	Compression ratio is good	Compression speed is poor
Uniform Quantization[30]	Lossey	Complexity is reduced	Quantization error is

		through partitioning	high
Transform Coding[11]	Lossey	Accuracy along with compression ratio is high	Compression ratio in case of noise levels is reduced.
Discrete Cosine Transformation[7]	Lossey	Compression ratio is high	Slow in nature

Table 7. Performance comparison on Noise and its types

Noise	Type	Cause
Amplifier Noise or Gaussian Noise	Thermal Noise	Caused due to hike in temperature
Salt and Pepper Noise	Impulse Noise	Caused due to disturbance in Signal due to medium
Shot Noise	Statistical Noise	Caused due to statistical Quantum Fluctuations
Uniform Noise	Quantization	Noise introduced uniformly in smaller parts and collaborated together to form large noise
Film Grain	Photographic Noise	Grains if are uniformly distributed then this noise is caused
Non Isotropic Noise	Row or Column Noise	Scratches in film cause this noise

Table 8. Performance comparison of various filtering techniques

Filtering Mechanism	Type	Noise Handled	Pros	Cons
Smoothing Filter	Linear	Gaussian Noise	It is a low pass filter hence high levels of noise can be easily handled	It tend to blurr the image
Fuzzy Filter	Non Linear	High Noise	It easily handle high level of noise	High and low noise levels together can blurr the image
Weiner Filter	Linear	Low Noise	It can handle low noise levels and perform smoothening easily	High noise levels cannot be tackled
Median Filter	Non Linear	Salt and Pepper Noise	It can effectively eliminate high levels of salt and pepper noise	Image clarity is lost in case of high levels of noise

IV. RESEARCH GAP

Existing literature focuses on removing noise from within the image but space requirements are increased substantially. The reason for extra space utilization is maintenance of extra information for determination of original pixel definition. In order to preserve space along with noise cancellation further enhancement of work is required. The system can use buffer in order to tackle extra pixel elimination mechanism in which pixel which is already being plotted is discarded.

V. CONCLUSION AND FUTURE WORK

The study of various compression techniques has been analyzed in this paper. The compression techniques which are specified are lossy or lossless in nature. All the suggested techniques use complex mechanisms in order to reduce the redundancies. The applicative noise however is not tackled. Also adaptive median filter considered in most of the literatures used to tackle salt and pepper noise. Median filter can be further enhanced to form applicative adaptive median filter to tackle multiple noise in the presented image. In future, application noise tackling procedure along with adaptive median filter can be considered for future enhancement.

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