International Journal of Enhanced Research in Science Technology & Engineering, ISSN: 2319-7463
Vol. 3 Issue 6, June-2014, pp: (272-280), Impact Factor: 1.252, Available online at: www.erpublications.com

# Design and Implementation Image Compression and Enhancement Techniques

Baswanti[1], Shailesh Pathak[2]
[1]PG student, Department of ECE, JCDMCOE, Sirsa, India
[2]Asst. Professor, Department of ECE, JCDMCOE, Sirsa, India

**Abstract: This paper presents various image compression and enhancement techniques. The goal of image enhancement is to improve the interpretability or perception of information in images for human spectators, or to provide 'better' input for other automated image processing techniques. Image Compression addresses problem of reducing the amount of data required to represent the digital image. Compression is achieved by elimination of one or more of three basic data redundancies: (1) Coding redundancy, which is existing when less than optimal (i.e. the smallest length) code words are used; (2) Inter-pixel redundancy, which outcomes from correlations between the pixels of an image & (3) visual redundancy which is due to data that is ignored by the human visual system (i.e. nonessential information). Huffman codes contain the minimum possible number of code symbols (e.g., bits) per source symbol subject to constraint that the source symbols are coded one at a time. All implementation work has been done in MATLAB. Experimental results show that quality of image is improved.**

**Keywords: Image enhancement, Image Compression, Huffman Coding, Contrast Adjustment.**

## I. INTRODUCTION

**D**igital **I**mage **P**rocessing is a promising space of research in fields of electronics and communication, consumer and electronics, control and instrumentation, medical equipment, remote sensing and computer vision and computer aided manufacturing (CAM). Uncompressed multimedia (graphics, audio) data requires considerable storing capacity and transmission bandwidth. Despite quick progress in mass-storage density, processor speeds, and digital system presentation, demand for data storing capacity and data-transmission bandwidth continues to exceed capabilities of available technologies. The current development of data intensive multimedia-based web applications have not only sustained need for more effective ways to encode signals and images but have made compression of such signals central to storage and communication technology [1].

In computer science and electronic engineering image processing, image processing is any form of processing of signals for which input is an image, such as pictures or frames of video output of processing of images can be either an image or a set of characteristics or parameters related to the image [2]. Today there is almost no part of technical endeavour that is not impacted in some way by digital image processing. The area of application of digital image processing are so varied that some form of organization is desirable in attempting to capture the breadth of this field.

Research advances in wavelet coding theory have created a flow of interest in applications like image compression and enhancement. Image compression addresses problem of reducing amount of data required to signify a digital image .The underlying basis of the reduction process is elimination of redundant data. From a mathematical view, this amount to transforming a 2-D pixel array into a statistically uncorrelated data set .The transformation is applied proceeding to storage or transmission of the image. At some advanced time, the compressed image is decompressed to reconstruct original image or estimate of it.
Image enhancement processes consist of a collection of techniques that seek to improve the visual appearance of an image or to convert the image to a form better suited for analysis by a human or a machine. Enhancement of noisy data is a very challenging issue in many research and application areas. Image enhancement means getting a clearer image. Image enhancement can be treated as transforming one image to another so that the look and feel of an image can be improved or machine analysis or visual perception of human beings. The paper is ordered as follows. In section II, we discuss related work with the wavelength allocation scheme. In Section III, It describes different approaches to implement WDM networks. In Section IV, it describes the system architecture and components of system. Section V explains the design and implementation techniques of system. In section VI, it contains the all results of system. Finally, conclusion is given in Section VII.

## II. RELATED WORK

In literature, several propose a scheme for adaptive image contrast enhancement centred on a generalization of histogram equalization (HE). HE is a useful technique for improving image contrast, but its result is too severe for many purposes. However, dramatically different consequences can be obtained with relatively minor modifications. A concise description of adaptive Histogram is set out, and this framework is used in a discussion of past suggestions for dissimilarities on Histogram. A key feature of formalism is a "cumulation function," which is used to produce a grey level plotting from the local histogram. By selecting alternative forms of cumulation function one can achieve a wide variation of effects [3]. Authors proposed Image enhancement is one of the most important subjects in low-level image processing. Mainly, enhancement methods can be divided into two classes: global and local methods. In this paper, multi-peak generalized histogram equalization (multi-peak GHE) is proposed. In this method, the histogram equalization is better by using multi-peak histogram equalization combined with local information. In our experimentations, different local information is employed [4].

Another proposed that Contrast enhancement is often referred to as one of the most important issues in image processing. Histogram equalization (HE) is one of the shared methods used for improving contrast in digital images. Histogram equalization (HE) has proved to be a simple and effective image contrast enhancement technique. However, conventional histogram equalization methods usually results in excessive contrast enhancement, which causes unnatural look and visual artefacts of the processed image. This paper presents a evaluation of new forms of histogram for image contrast enhancement. The major modification among the methods in this family is criteria used to divide the input histogram. Brightness conserving Bi Histogram Equalization (BBHE) and Quantized Bi-Histogram Equalization (QBHE) use the average intensity value as their separating point [5].

Authors proposed an image enhancement method that uses piecewise linear transforms. The determination of this transformation is done using a new measure for mean dynamic range. Firstly method is defined for monochrome images and secondly is extended for colour ones. In this paper piecewise linear transformation is determined by using a new measure of the mean dynamic range. Firstly, there is presented the method for monochrome images and then the extension for colour images [6]. Some proposed that Fingerprints are the oldest and most widely used form of biometric identification. The performance of several fingerprint recognizers highly depends on the fingerprint image quality. Different types of noises in fingerprint images pose greater difficulty for recognizers. However, fingerprint images are hardly of perfect quality. They may be despoiled and corrupted due to variations in skin and impression conditions. Thus, image enhancement methods are employed prior to minutiae extraction to obtain a more consistent estimation of minutiae locations.

## III. IMAGE COMPRESSION TECHNIQUE

Compression is a process intended to yield a compact digital representation of a signal. In the literature survey, the terms source encoding and decoding, data compression, bandwidth compression, and signal compression are all used to denote to the process of compression. In cases where signal is defined as an image, a video stream, or an audio signal, generic problem of compression is to minimise the bit rate of their digital representation. There are several applications that benefit when image, video, and audio signals are accessible in compressed form.

Currently image compression is recognized as an "enabling technology". In addition to areas Just mentioned ,image compression is the natural technology for handling the increased spatial resolution of today's imaging sensors and evolving broadcast television standards. Furthermore image compression plays a major role in many important and diverse applications , including video-conferencing ,remote sensing(the use of satellite imagery for weather and other earth –resource applications), document and medical imaging ,facsimile transmission, and the control of remotely piloted vehicles in military , space and hazardous waste management applications.

- **Need of Compression**

There are many applications that benefit from data compression technology. Table-1 lists a representative set of such applications for image, video, and audio data, as well as data rates of the corresponding compressed bit streams. Typical data rates for uncompressed bit streams are also shown.

International Journal of Enhanced Research in Science Technology & Engineering, ISSN: 2319-7463
Vol. 3 Issue 6, June-2014, pp: (272-280), Impact Factor: 1.252, Available online at: www.erpublications.com

**Table 1: Image, Video, and Audio Compression Applications**

| Application | Data | Rate |
|---|---|---|
| | **Uncompressed** | **Compressed** |
| Voice 8 k samples/s, 8 bits/sample | 64 kbps | 2-4 kbps |
| Slow motion video (10fps) Frame size 176x120, 8bits/pixel | 5.07 Mbps | 8-16 kbps |
| Audio conference 8 k samples/s, 8 bits/sample | 64 kbps | 16-64 kbps |
| Video conference (15fps) Frame size 352x240, 8bits/pixel | 30.41 Mbps | 64-768 kbps |
| Digital audio 44.1 k samples/s, 16 bits/sample | 1.5 Mbps | 1.28-1.5 Mbps |
| Video file transfer (15fps) Frame size 352x240, 8bits/pixel | 30.41 Mbps | 384 kbps |
| Digital video on CD-ROM (30fps) Frame size 352x240, 8bits/pixel | 60.83 Mbps | 1.5-4 Mbps |
| Broadcast video (30fps) Frame size 720x480, 8bits/pixel | 248.83 Mbps | 3-8 Mbps |
| HDTV (59.94 fps) Frame size 1280x720, 8bits/pixel | 1.33 Gbps | • bps |

The examples above clearly illustrate the need for sufficient storage space, large bandwidth, and long transmission time for image, audio, and video data. At present state of technology, only solution is to compress multimedia data before its storage and transmission, and decompress it at receiver.

- **Image Compression and Reconstruction**

Three basic data redundancies can be considered in the image compression standard.

1. Spatial redundancy due to the correlation between neighboring pixels.
2. Spectral redundancy due to correlation between the color components.
3. Psycho-visual redundancy due to properties of the human visual system.

The spatial and spectral redundancies are present because certain spatial and spectral patterns between the pixels and the color components are common to each other, whereas psycho-visual redundancy originates from the fact that the human eye is insensitive to certain spatial frequencies. The principle of compression of images algorithms are (i) reducing the redundancy in the image data and (or) (ii) producing a reconstructed image from the original image with the introduction of error that is insignificant to the intended applications. The aim is to obtain an acceptable representation of digital image while preserving the essential information contained in that particular data set.

**Figure 1: Image Compression System**

The problem faced by image compression is very easy to define, as demonstrated in figure 1. First the original digital image is usually transformed into another domain, where it is de-correlated by using some transform. This de-correlation concentrates the important image information into a more compact form. The compressor then removes the redundancy in the transformed image and stores it into a compressed file or data stream. In the second stage, the quantization block reduces the accuracy of the transformed output in accordance with some pre- established criterion. The decompression reverses the compression process to produce the recovered image. The recovered image may have lost some information due to compression, and may have an error or distortion compared to the original image.

- **Image Compression Techniques**

The image compression techniques are broadly classified into two categories depending whether or not an exact replica of the original image could be reconstructed using the compressed output image. These are:

- **Lossless Compression Techniques**

In many applications, the decoder has to reconstruct without any loss the original data. For a lossless compression process, reconstructed data and the original data must be identical in value for each and every data sample. This is referred to as a reversible process. In lossless compression, for specific application, choice of a compression method involves a trade-off along the three dimensions, coding efficiency, coding difficulty, and coding delay.

- **Lossy Compression Techniques**

The majority of the applications in image or video data processing do not require that the reconstructed data and the original data are identical in value. Thus, some amount of loss is allowable in the reconstructed data. A compression process which results in an imperfect reconstruction is referred to as a lossy compression process. This data compression process is irreversible. In general, most irreversible compression processes degrade rapidly the signal quality when they are repeatedly applied on previously decompressed data.

## IV. IMAGE ENHANCEMENT TECHNIQUE

Image enhancement processes consist of a collection of techniques that seek to improve the visual appearance of an image or to convert the image to a form better suited for analysis by a human or a machine. The principle objective of image enhancement techniques is to process an image so that the result is more suitable than the original image for a specific application. It is used to increase contrast in images that are substantially dark or light. Image enhancement involves operations that improve the appearance to a human viewer, or processes to convert an image to a format better suited to machine processing. Image enhancement refers to those image processing operations that improve the quality of input image in order to overcome the weakness of the human visual system.

The principal objective of image enhancement is to modify attributes of an image to make it more suitable for a given task and a specific observer. During this process, one or more qualities of the image are modified. The choice of qualities and way they are modified are specific to a given task. Moreover, observer-specific issues, such as the human visual system and the observer's knowledge, will introduce a great deal of subjectivity into the choice of image enhancement methods. There exist many techniques that can improve a digital image without spoiling it. The enhancement methods can be divided in to the following two categories:

1. Spatial Domain Methods
2. Frequency Domain Methods

## V. DESIGN AND IMPLEMENTATION

In recent years, there have been significant advancements in algorithms and architectures for the processing of image, video, and audio signals. These progressions have proceeded along several directions.

- Image Compression by Huffman Coding

In 1952, D. A. Huffman developed a code construction method that can be used to perform lossless compression. The Huffman code construction procedure evolves along the following parts:

**1. Order the symbols according to their probabilities.**

For Huffman code construction, the frequency of occurrence of each symbol must be known a priori. In practice, frequency of occurrence can be estimated from a training set of data that is representative of the data to be compressed in a lossless manner. If, say, alphabet is composed of $N$ distinct symbols $s_1, s_2, s_3, K, s_N$ and the probabilities of occurrence are $p_1, p_2, p_3, K, p_N$, then the symbols are rearranged so that $p_1 \geq p_2 \geq p_3 K \geq p_N$.

**2. Apply a contraction process to the two symbols with the smallest probabilities.**

Suppose the two symbols are $s_{N-1}$ and $s_N$. We replace these two symbols by a theoretical symbol, say, $H_{N-1} = (s_{N-1}, s_N)$ that has a probability of occurrence $p_{N-1} + p_N$. Thus, the new set of symbols has $N-1$ members $s_1, s_2, s_3, K, s_{N-2}, H_{N-1}$.

**3. We repeat the previous part 2 until the final set has only one member.**

The recursive procedure in part 2 can be viewed as the construction of a binary tree, since at each step we are combining two symbols. At the end of the recursion process all the symbols $s_1, s_2, s_3, K, s_N$ will be leaf nodes of this tree. The code word for each symbol $s_i$ is obtained by traversing the binary tree from its root to the leaf node corresponding to $s_i$.

- **Image Compression by EZW Coding**

Embedded Zero-trees of Wavelet transforms (EZW) is an image compression algorithm. The EZW encoder is based on progressive encoding. Progressive encoding is also known as fixed encoding.

The EZW algorithm is centred on two observations:

- Natural images in general have a low pass spectrum. When an image is wavelet transformed, energy in the sub-bands decreases with the scale goes lower (low scale means high resolution), so wavelet coefficient will, on average, be smaller in lower levels than in the higher levels.

- Large wavelet coefficients are more significant than small wavelet coefficients.

- Image Enhancement by Contrast Adjust

Many images like medical images, satellite images, airborne images and even real life photographs suffer from poor contrast and noise. It is necessary to enhance contrast and remove the noise to increase image quality. One of the most important stages in medical images detection and analysis is Image Enhancement techniques which improves the quality (clarity) of images for human viewing, eliminating blurring and noise, increasing contrast, and revealing facts are examples of enhancement operations. Low contrast images occur often due to poor or non-uniform lighting conditions, or due to nonlinearity, or minor dynamic range of the imaging sensor. Contrast enhancement processes adjust the relative brightness and darkness of objects in the scene to improve their visibility.

**Algorithm: Image Enhancement by Contrast Adjustment**

- Read the input RGB/ Gray Scale Image.
- Set lower and upper limits
- Calculate size of the image.
- For k=1:r1
  - a = sort ( reshape ( img (:,:,k),1))
  - min(k) = a(ceil(low limit * row * col))
  - max(k) = a(ceil(upper limit * row*col))

  End
- if r1=3
  - Convert RGB to gray scale
- Find slope of image, multiply with 255 and we get enhanced image.
- Calculate Mean error and PSNR also.

## VI. RESULTS AND DISCUSSION

- Simulation Tool: MATLAB

MATLAB is a high-performance language for technical computing. It combines computation, visualization, and programming in an easy environment where problems and solutions are expressed in familiar mathematical notation. It is given by figure 2.

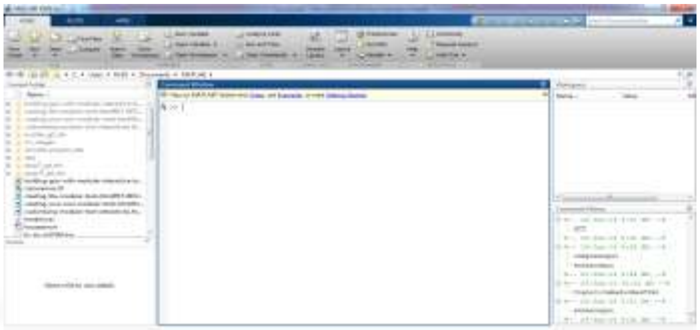

**Figure 2: MATLAB Tool**

- Graphical User Interface

In computing graphical user interface is a type of user interface that allows users to interact with electronic devices using images rather than text commands. A GUI represents information and actions available to a user through graphical icons and visual indicators such as secondary notation, as opposite to text-based interfaces, typed labels or text navigation. The actions are performed through direct manipulation of the graphical elements. The proposed GUI is given by figure 3.


**Figure 3: Proposed GUI**

- Compression by Huffman Coding

Huffman coding is a well-organized source coding algorithm for source symbols that are not equally probable. The algorithm is optimal in the sense that the average number of bits required to represent the source symbols is a minimum provided the prefix condition is met. The results are shown in fig 4.


**Figure 4: Compression by Huffman Coding**

- Compression by EZW Coding


**Figure 5: Compression by EZW Coding**

There are several ways wavelet transforms can decompose a signal into various sub-bands. These include uniform decomposition, band decomposition, and adaptive or wavelet-packet decomposition [12]. Out of these, EZW coding is the most widely used. The results are shown in fig 5.

- Enhancement by Contrast Technique


**Figure 6: Enhancement by Contrast Adjust**

- Contrast stretching separate the image in two parts the black and the white one, on the m value, and the transition between these parts is a slope that could be more or less smooth in the depends on the e value. It is also a fast algorithm. The results of contrast stretching are shown in figure 6. , the original image shows low contrast as compared to output images.

**Table 1: Comparison of All Techniques**

| Parameters | Huffman Coding | EZW Coding | Contrast Adjust |
|---|---|---|---|
| MSE | 39.6 | 74.98 | 40.1 |
| PSNR | 32.15 | 29.38 | 32.1 |

**Table 2: MSE and PSNR Comparisons of Multiple Images by Huffman Coding**

| Parameters | Size of Image | MSE | PSNR |
|---|---|---|---|
| Image1 | 960*540 | 56.67 | 30.59 |
| Image2 | 960*720 | 41.52 | 31.94 |
| Image3 | 960*768 | 51.37 | 31.02 |
| Image4 | 920*690 | 37.66 | 32.71 |
| Image5 | 560*480 | 57.72 | 30.51 |

**Table 3: MSE and PSNR Comparisons of Multiple Images by EZW Coding**

| Parameters | Size of Image | MSE | PSNR |
|---|---|---|---|
| Image1 | 960*540 | 100.41 | 28.11 |
| Image2 | 960*720 | 101.43 | 28.06 |
| Image3 | 960*768 | 97.63 | 28.23 |
| Image4 | 920*690 | 99.58 | 32.71 |
| Image5 | 560*480 | 102.36 | 28.02 |

## VII. CONCLUSION

Image compression is of prime importance in Real time applications like video conferencing where data are transmitted through a channel. Experiment was done on poor quality image initially and is compared to result proposed method and previous method. The proposed algorithm is implemented in MATLAB. This thesis presents various types of image compression and enhancement techniques. There are basically two types of compression techniques. One is Lossless Compression technique and other is Lossy Compression Technique. Comparing performance of compression technique is difficult unless identical data sets and performance measures are used. Some of techniques are obtained good for certain applications like security technologies. This algorithm is able to get good contrasted image which increases the brightness of the low contrasted images. This algorithm is tested on different type of images. The experimental outcome shows that the brightness is increased as compared to previous one.

## REFFERENCES

[1]. Gonzalez, R.C., Woods, R., "Digital Image Processing", 2nd Edition, Prentice-Hall, (2002).
[2]. Etienne E.Karre, Mike Nactegael "Fuzzy techniques in image processing". Frank Y. Shih" Image processing and mathematical morphology funda mentals and applications",
[3]. John C. Russ "The Image Processing Handbook", Third Edition CRC Press, LLC ISBN: 084935323 Pub Date: 07/01/98.
[4]. T. Jinshan, K. Jeonghoon, and E. Peli, "Image Enhancement in the JPEG Domain for People with Vision Impairment," IEEE Trans. Biomed. Eng., vol. 50, no. 11, pp. 2013 -2023, Nov 2004.
[5]. P. Soo-Chang, Z. Yi-Chong, and C. Ching-Hua, "Virtual Restoration of Ancient Chinese Paintings Using Color Contrast Enhancement and Lacuna Texture Synthesis," IEEE Trans. Image Process., vol. 14, no. 3, pp. 416-429, March 2004.
[6]. Z. Zhen you, and H. Li-Wei, "Whiteboard Scanning and Image Enhancement," Digital Signal Process., vol. 16, no. 2, pp. 414-432, March 2007.
[7]. P. Fridman, "Radio Astronomy Image Enhancement in the Presence of Phase Errors using Genetic Algorithms," in Int. Conf. on Image Process., Thessaloniki, Greece, Oct 2001, pp. 611-615.
[8]. D. Y. Tsai, L. Yongbum, M. Sekiya, S. Sakaguchi, and I. Yamada, "A Method of Medical Image Enhancement using Wavelet Analysis," in 6th Int. Conf. Signal Process., Beijing, China, Aug 2002, pp. 724-726.
[9]. K. Teddy, "Fingerprint Enhancement by Spectral Analysis Techniques," in 31st Applied Imagery Pattern Recognition Workshop, Washington DC,WA, Oct 2002, pp15.18.
[10]. D. W. Armitage, and J. P. Oakley, "Noise Levels in Colour Image Enhancement," in Visual Inform. Eng., London, UK, July 2003, pp. 104-108.
[11]. J.S. Kim, H.S. Cho and S.K. Kim "Fuzzy rule based enhancement algorithm for noisy image" IROS 91, Nov 2-5, 1991 IEEE Cat, No 91TH0375-6.T. Starr, J. M. Cioffi, and P. J. Silverman,1999, Understanding Digital Subscriber Line Technology. Englewood Cliffs, NJ: Prentice-Hall.
[12]. Kaijun Tang, Jaakko Astola, Member, IEEE , and Yrjo Neuvo , Fellow, IEEE "multichannel Edge Enhancement in Color Image Processing" Vol-4 No-5 October 1994.
[13]. Farzam Farbiz, Seyed Ahmad Motamedi, Mohammad Bagher Menhaj Electrical Engineering Department of Amirkabir University of Technology " An iterative method for image enhancement based on fuzzy logic"
[14]. I.Nedeljkovic, Zahumska Belgrade, Serbia and Montenegro "image classification based on fuzzy logic worked Fuzzy logic is relatively young theory".
[15]. Milindkumar V. Sarode, Dr. S.A. Ladhake, Dr. Prashant R. Deshmukh "Fuzzy system for color image enhancement ". World Academy of Science and Engineering Technology 48, 2008.
[16]. R. C. Gonzalez and R. E. Woods, "Digital Image Processing", Reading. MA: Addison Wesley, 2004.
[17]. David Salomon, Data Compression, The Complete Reference, 2nd Edition Springer-Verlag 1998.
[18]. A. K. Jain, Fundamentals of Digital Image Processing. Englewood Cliffs, NJ: Prentice-Hall, 1989.
[19]. W. K. Pratt, Digital Image Processing. New York: Wiley, 1978.D. J. Ketcham, R. Lowe, and W. Weber, "Seminar on image processing," in Real-Time Enhancement Techniques, 1976, pp. 1–6. Hughes Aircraft.
[20]. R. Hummel, "Image enhancement by histogram transformation," Comp. Graph. Image Process, vol. 6, pp. 184–195, 1977.