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Design & Implementation of image Enhancement & Compression Techniques

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Abstract- *Image Enhancement is one of the most important and difficult techniques in image research. The aim of image enhancement is to improve the visual appearance of an image, or to provide a "better transform representation for future automated image processing. Many images like medical images, satellite images, aerial images and even real life photographs suffer from poor contrast and noise. It is necessary to enhance the 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, removing blurring and noise, increasing contrast, and revealing details are examples of enhancement operations.*

Keywords- *Image Enhancement Technique, Image Compression Technique, Lossy Compression, Lossless Compression.*

1. INTRODUCTION

Digital Image Processing is a promising space of research in the fields of Computer Science and Engineering, Consumer and Electronics, Control and Instrumentation, Medical Instrumentation, 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 performance, demand for data storing capacity and data-transmission bandwidth continues to exceed the capabilities of available technologies. The current growth of data intensive multimedia-based web applications have not only sustained the need for more efficient ways to encode signals and images but have made compression of such signals central to storage and communication technology [2].

- Image enhancement can be treated as transforming one image to another so that the look and feel of an image can be improved.
- Image Compression addresses the problem of reducing the amount of data required to represent the digital image. The best image quality at a given bit-rate (or compression rate) is the main goal of image compression.

2. LITERATURE REVIEW

Image noise is generally regarded as an undesirable by-product of image capture because it causes distortions present in the image that can obscure the subject of the photograph. Although these unwanted fluctuations became known as "noise" by analogy with unwanted sound they are inaudible and can actually be beneficial in some requests, such as dithering.

An image signal gets corrupted with noise during acquisition, communication, storage and retrieval processes. Acquisition noise is mainly additive white Gaussian noise (AWGN)with very low variance. In various engineering applications, the acquisition noise is quite negligible. It is mostly due to very high quality sensors. In some applications like remote sensing, medical instrumentation, etc., the acquisition noise may be high enough. But in such a system, it is mostly due to the fact that the image acquisition system itself comprises of a transmission channel. So if such noise problems are measured as transmission noise, then it may be decided that acquisition noise is negligible. Therefore, the researchers are mainly concerned with the noise in a transmission system. Usually, the transmission channel is linear, but dispersive due to a limited bandwidth [5].

The image signal may be transmitted either in analog form or in digital form. If an analog image signal is transmitted through a linear dispersive channel, then the image edges (step-like or pulse like signal) get blurred and the image signal gets contaminated with AWGN since no practical channel is noise free. If the channel is so poor that the noise variance is high enough to make the signal excurse to very high positive or high negative value, then thresholding operation done at the front end of the receiver will contribute to saturated max and min values. Such

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noisy pixels will be seen as white and black spots. Therefore, this kind of noise is known as salt and pepper noise (SPN). In essence, if analog image signal is transmitted, then the signal gets corrupted with AWGN and SPN as well. Thus, there is result of mixed noise. If the image signal is transmitted in digital form through a linear dispersive channel, then inter symbol interference (ISI) takes place. In addition, the presence of AWGNin a practical channel can't be ignored. This makes situation worse. Due to ISI and AWGN, it may so happen that a '1' may be recognized as '0' and vice-versa. Under such circumstances, image pixel values have changed to some random values at random positions in image frame. Such type of noise is known as random-valued impulse noise (RVIN).

3. PROPOSED SCHEME

The main objective of the thesis work is to implement algorithms for image compression and enhancement technique. Image Compression addresses the problem of reducing the amount of data required to represent the digital image. Compression is achieved by the 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 results from correlations between pixels of an image; &/or (3) psycho visual redundancy which is due to data that is ignored by the human visual system (i.e. visually nonessential information).Huffman codes comprise smallest possible number of code symbols (e.g., bits) per source symbol (e.g., grey level value) subject to the constraint that the source symbols are coded one at a time. So, Huffman coding when joined with technique of reducing the image redundancies using Discrete Cosine Transform (DCT) helps in compressing the image data to a very good extent. Image enhancement techniques can be divided into three broad categories:

a) Spatial field methods, which operate directly on pixels.
b) Frequency domain approaches, which operate on the Fourier transform of an image.

1) A discussion on Fundamentals of image compression and enhancement, Different classes of their technique.
2) Image compression using Huffman Coding and EZW coding is proposed. The objective is to achieve a reasonable compression ratio as well as better quality of reproduction of image with a low power consumption.
3) Parameters associated with the compression process are analyzed & the conclusion is given.

4. IMAGE ENHANCEMENT

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 often used to increase the contrast in images that are substantially dark or light. Image enhancement entails operations that improve the appearance to a human viewer, or operations 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.[6][8].

Figure 1: Enhancement image

5. IMAGE ENHANCEMENT TECHNIQUE

5.1 spatial domain methods

Spatial domain methods which are operate directly on pixels. Spatial domain method pixel values may be modified according to rules that depend on the original pixel value (local or point processes). Alternatively, pixel values may be combined with or compared to others in their immediate neighborhood in a variety of ways [3].

5.2 frequency domain methods (dft)

Frequency domain which operate on the Fourier transform of an image [1].

1) Edges and sharp transitions (e.g., noise) in an image contribute significantly to high-frequency content of Fourier transform .
2) Low frequency contents in the Fourier transform are responsible to the general appearance of the image over smooth areas.

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6. IMAGE COMPRESSION

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 many applications that benefit when image, video, and audio signals are available in compressed form [26].

Figure 2: (a) Original image (b) compressed 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 image [4]. These are:

1. Lossless technique
2. Lossy technique

6.1 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 complexity, and coding delay [4][9][10].

6.2 lossy compression technique

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 [9-10].

6.3 image compression by huffman coding

- In 1952, D. A. Huffman developed a code construction method that can be used to perform lossless compression. As discussed earlier, the input data are partitioned into a sequence of symbols so as to facilitate the modeling process. In most image and video compression applications, the size of the alphabet composing these symbols is restricted to at most 64000 symbols. The Huffman code construction procedure evolves along the following parts:
- 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, the 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, the alphabet is composed of N distinct symbols $s_1, s_2, s_3, \ldots, s_N$ and the probabilities of occurrence are $p_1, p_2, p_3, \ldots, p_N$, then the symbols are rearranged so that $p_1 \geq p_2 \geq p_3 \ldots \geq p_N$.
- 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 hypothetical 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 $s_1, s_2, s_3, \ldots, s_{N-2}, H_{N-1}$.
- 3. We repeat the previous part 2 until the final set has only one member.

6.4 EZW Encoding

An EZW encoder is an encoder specially designed to use with wavelet transforms, which explains why it has the word wavelet in its name. The EZW encoder was originally designed to operate on images (2D-signals) but it can also be used on other dimensional signals. The EZW encoder is based on progressive encoding to compress an image into a bit stream with increasing accuracy. This means that when more bits are added to the stream, the decoded image will contain more detail, a property similar to JPEG encoded images. It is also similar to the representation of a number like π. Every digit we add increases the accuracy of the number, but we can stop at any accuracy we like. Progressive encoding is also known as embedded encoding. The EZW encoder is based on two important observations.

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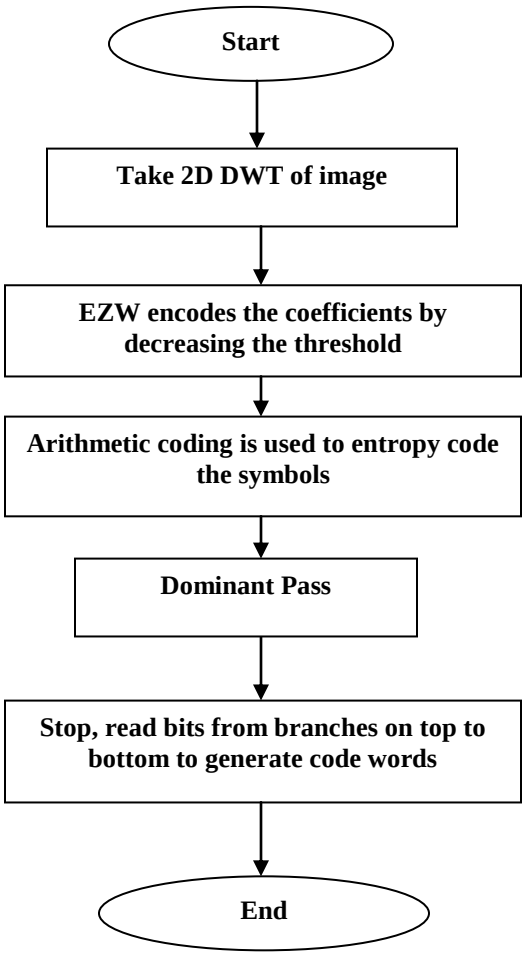

Figure 3: The Flowchart of EZW Algorithm

6.5 Image Enhancement By Contrast Adjust

Image Enhancement is one of the most important and difficult techniques in image research. The aim of image enhancement is to improve the visual appearance of an image, or to provide a "better transform representation for future automated image processing. Many images like medical images, satellite images, aerial images and even real life photographs suffer from poor contrast and noise. It is necessary to enhance the 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, removing blurring and noise, increasing contrast, and revealing details are examples of enhancement operations. Low contrast images occur often due to poor or non-uniform lighting conditions, or due to nonlinearity, or small dynamic range of the imaging sensor. Contrast enhancement processes adjust the relative brightness and darkness of objects in the scene to improve their visibility. The contrast and tone of the image can be changed by mapping the gray levels in the image to new values through a gray-level transform. A high-contrast image spans the full range of gray-level values; therefore, a low contrast image can be transformed into a high-contrast image by remapping or stretching the gray-level values such that the histogram spans the full range. The contrast stretch is often referred to as the dynamic range adjustment (DRA). [7]

7. Comparison of All Techniques

Table 1: MSE and PSNR Comparisons

Parameters	Compression by Huffman Coding	Compression by EZW Coding	Enhancement by Contrast Adjust	Enhancement by Optimal Technique
MSE	39.6	74.98	40.1	110
PSNR	32.15	29.38	32.1	27

8. APPLICATIONS

- Digital cameras generally include dedicated digital image processing chips to convert the raw data from the image sensor into a color-corrected image in a standard image file format. Images from digital cameras often receive further processing to improve their quality, a distinct advantage that digital cameras have over film cameras. The digital image processing typically is executed by special software programs that can manipulate the images in many ways.
- Many digital cameras also enable viewing of histograms of images, as an aid for the photographer to understand the rendered brightness range of each shot more readily.
- Digital image processing has wide applications in intelligent transportation systems, such as automatic number plate recognition and traffic sign recognition.

9. 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

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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. Some techniques perform fine for certain classes of data and poorly for others. This proposed algorithm is able to overcome the drawbacks of spatial domain methods like thresholding, histogram equalization and frequency domain methods. 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 result shows that the brightness is increased as compared to previous one.

REFERENCES

[1] 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.

[2] R. Gonzalez, R. Woods and S. Eddins "Digital Image Processing Using Matlab", 2004, Prentice Hall.

[3] Gonzalez, R.C., Woods, R., "Digital Image Processing", 2nd Edition, Prentice-Hall, (2002).

[4] S. N. Sivanandam, S. Sumathi and S. N. Deepa "Introduction to Fuzzy Logic using MATLAB Springer",-Verlag Berlin Heidelberg 2007.

[5] John C. Russ "The Image Processing Handbook", Third Edition CRC Press, LLC ISBN: 0849325323 Pub Date: 07/01/98.

[6] T. Jinshan, K. Jeonghoon, and E. Peli, "Image Enhancement in the JPEG Domain for People with Vision Impairment," IEEE Trans. Biomed. Eng., vol. 51, no. 11, pp. 2013 -2023, Nov 2004.

[7] 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. 13, no. 3, pp. 416-429, March 2004.

[8] Z. Zhengyou, and H. Li-Wei, "Whiteboard Scanning and Image Enhancement," Digital Signal Process., vol. 17, no. 2, pp. 414-432, March 2007.

[9] K. Sayood, "Introduction to Data Compression", 2nd edition, Academic Press, Morgan Kaufman Publishers, 2000.

[10] David Solomon, "Data Compression – The Complete Reference", 3rd edition, Springer.