Ear Biometric Compression using Huffman Coding

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Abstract- **An ear recognition framework depicts a potential tool in forensic applications. Even in the case the facial features of a pseudo is partly or fully covered an image of the outer ear may suffice to disclose a subject's identity. In forensic scenarios images may stem from surveillance cameras of atmospheres where image compression is general practice to conquer of limitations of storage and transmission capacities. Yet, the impact of an intensive image compression on ear recognition gas remained undocumented. In this paper, we investigate the impact of various cutting-edge image compression techniques on ear recognition and ear detection. Huffman coding compression technique is applying on ear images. Assessments directed on an uncompressed ear database are Considered as for various stages in the preparing chain of an ear recognition framework where compression might be connected, corresponding to the most pertinent forensic scenarios. Experimental results discuss the highlights of the proposing concept.**

Keywords: Ear images, image compression, Huffman coding, image processing and analysis.

1. INTRODUCTION

Digital image processing is the use of computer algorithm to perform image processing on the digital image. The digital image is a representation of a two-dimensional image as a finite set of digital value, called picture elements or pixels. Pixel value typically represents gray levels, colors, height, capacities etc. Focuses on the digital image processing is two major tasks. Such as Improvement of pictorial information for human interpretation and Processing of image data for storage, transmission, and representation of auto-mats machine perception.

Compression refers to decreasing the amount of information used to represent a document, picture or video content without too much lessening the nature of the source information. Image compression is the use of data compression on advanced images. As a result, the goal is to diminish the redundancy of the image information in order to be able to store or transmit information in a productive manner (Mamta Sharma, May 2010). Data compression has turned into a prerequisite for most applications in various zones, for example, software engineering, Information innovation, correspondences, and medicine and so on. In computer science, Data compression is characterized as the science or the specialty of representing data in a reduced frame (Sachin Dhawan, March 2011). It likewise diminishes the number of bits required to store and additionally transmit digital media. To compress something implies that you have a bit of information and you diminish its size. There are distinctive methods and they all have their own favorable circumstances and burdens. Huffman coding is a lossless image compression system. Huffman coding depends on the recurrence of event of an image items i.e. pixel in images. The strategy is to utilize a lower number of bits to encode the information into binary codes that happens all the more as often as possible. It is utilized as a part of BMP images. So this paper proposes a Huffman compression coding on ear biometric images which is retrieved from UCI repository. The image format is converted into BMP format then applied the proposed system.

The rest of the paper is organized as follows: section 2 discusses the related works of compression techniques applied on various images. Section 3 discusses methodology of the presented framework. section 4 discusses experiment and performance analysis of the proposed concept. Finally, described about the results and conclusion.

2. RELATED WORKS

There are various works have been discussed on different image compression techniques on images. S. Nirmal Raj et al proposed a set of Partitioning in hierarchical trees algorithm for image compression (S. NirmalRaj, 2015), SPIHT method provides a high-quality image with good PSNR value and it is the best method for progressive image transmission. In this work, SPIHT is compared with DCT, DWT algorithm. The various image is taken as input in terms of name, size, quality, the format is compared with PSNR and MSE values. For every image, the value is calculated before and after compression. It proves that SPIHT is effective and efficient than the existing algorithm which means that it can compress and reconstruct the original image without affecting the originality and quality of the input image. The future work is machine learning approach and artificial intelligence is used for image compression and compared with the SPIHT algorithm. Ranju Yadav et al reviewed the Image Compression Methods (Ranju Yadav and Prof. Anuj Bhargava , 2015), In this paper sample images is taken as input and then it is compared with image compression technique such as EZW, JPEG, VQ and Fractal methods. Hence the encoding and decoding time has been found by using PSNR. It had been estimated that four techniques produce a good result. But EZW produces very low bitrates i.e. 0.25bpp than other compression technique. So, EZW algorithm is effective and efficient. Gaurav Sharma et al proposed a novel image compression algorithm using modified filter bank (Gaurav Sharma and K.G.Kirar), This research work describe a novel image compression algorithm with modified wavelet filter-bank using Kaiser window and this technique is used with many test images. It provides high compression ration without affecting the quality of the image. From the experimental results proposed compression technique provides good performance when compared with the previous work. (Nagarajan et al W. Penebaker and J. Mitchell, 1993) Image compression is reducing the size in bytes of a graphics file without degrading the quality of the image to an unacceptable level. The reduction in file size allows more images to be stored in a given amount of disk drives or memory space. It also consumes the time required for images to be sent over the Internet or downloaded from Web pages. Data compression schemes give the optimized solution to transfer the data and store the data in secondary storage. This paper proposed the new idea about the enhanced version of run length encoding algorithm. The drawbacks of the run-length encoding scheme to provide an optimum compression. Thus, the forthcoming chapter discusses the methodology of the proposed concept.

3. METHODOLOGY

The ear biometric image will be of different size before taken input. The image color will be changed as RGB into Gray. The image size can be taken as 8*8, 16*16, 32*32 and 124*124 etc. the next process is assigning thresholding to the given input image with range define. The compression level will be chosen M*N and coefficient will find out. DCT is used for reshaping and applied run length encoding to compress that is Huffman encoder has been used and maximum variance algorithm is applied from the Huffman code dictionary. After this process, modulo conversion was accomplished. The compression process will be like Matrix and vector conversion in the reverse vector to matrix conversion as decompression. The input file is taken as .bmp file format and given shape as 8*8, grayscale as 8*8 and threshold as 8*8. The compressed file will be converted into fichier as a compressed file. Meanwhile, mean square error and PSNR has been applied for the ear biometric image. After completion of the compression process, the images have decompressed by using the reverse process of compression. Figure 1 shows the process of the proposed concept.

First, the whole image is loaded to the encoder side, then we do RGB to GRAY conversion after that whole image is divided into small NXN blocks (where N corresponds to 8) then working from left to right, top to bottom the DCT is applied to each block. Each blocks elements are compressed through Quantization means dividing by some specific 8X8 matrix called Q matrix and rounding to the nearest integer value as This Q matrix is decided by the user to keep in mind that it gives Quality levels ranging from 1 to 100, where 1 gives the poor image Quality and highest compression ratio while 100 gives the best Quality of decompressed image and lowest compression ratio.

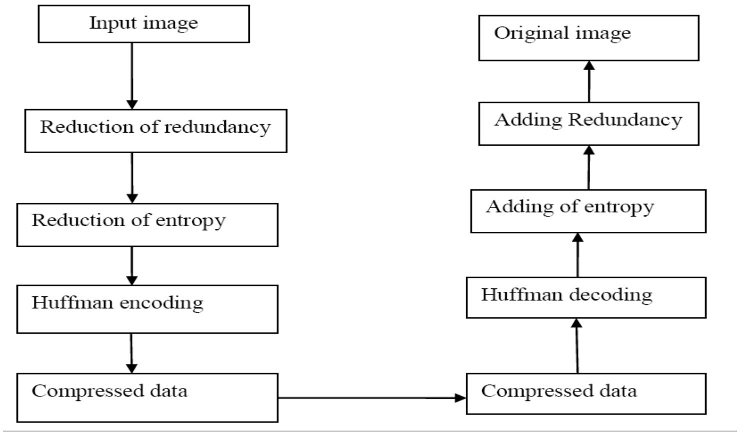

Figure 1. Process of compression of ear biometric image

3.1. Thresholding Assignment

Thresholding can be considered as a special case of image segmentation: it partitions the image pixels of a grayscale image into the foreground (typically "black") and background ("white") pixels, thereby transforming the grayscale image into a binary image. As it is both an essential and a possibly difficult preprocessing step in many image processing systems, in particular for document image recognition, many different thresholding techniques have been proposed in the literature. The thresholding algorithm itself is very simple: let f(x, y) be the grey value of the image at pixel position (x, y); then thresholding with threshold t transforms this image into a binary image f(x, y) as shown in the equation 1.

$$f(x,y) = \begin{cases} 1, if\ f(x,y) \leq t \\ 0, if\ f(x,y) > t \end{cases} \quad (1)$$

When the threshold is constant over the entire image, the thresholding is called global. When it depends on the position, i.e. t = t(x, y), the thresholding is called local. The different thresholding algorithms vary in their rules for determining the threshold t(x, y). An often deployed algorithm for global thresholding is Otsu‘s method.

The area of the contour in a number of pixels is identified by searching pixel values of CPP feature vector which show all the points along selected ear contour. The ear contour X-length found by selecting X-min and X-max and similarly Y-length found by picking Y-min and Y-max values.

M = X-min + X-max

N = Y-min + Y- max

AC = M*N in no. of pixels

Pixel-based ear biometrics system contains two phases

- Ear Biometric Enrollment
- Ear Biometric Verification

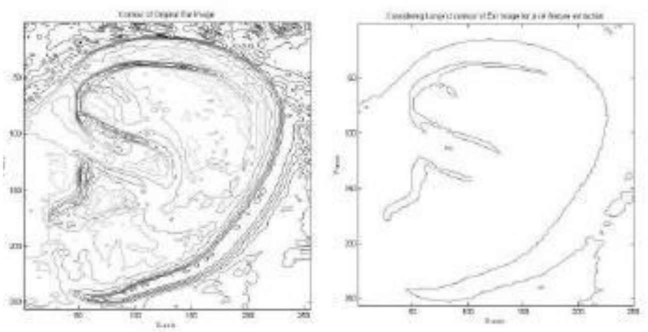

Figure 2. Pixel-based ear biometrics

Pixel-based image feature extraction contains the following steps

- Ear image acquisition
- Ear image enhancement

Resize of Ear image

- Convert ear image from .BMP format to grey scale.
- Construct image contour.
- Apply pixel-based feature extraction method
- Construct ear database.

3.2. Discrete Cosine Transform (DCT)

The discrete cosine transforms (DCT) helps separate the image into parts (or spectral sub-bands) of differing importance (with respect to the image's visual quality). The DCT is similar to the discrete Fourier transform: it transforms a signal or image from the spatial domain to the frequency domain. And it expresses a sequence of finitely many data points in terms of a sum of cosine functions oscillating at different frequencies. DCTs are important to numerous applications in science and engineering, from lossy compression of audio (e.g. MP3) and images (e.g. BMP, JPEG) (where small high-frequency components can be discarded), to spectral for the numerical solution of partial differential equations. Two related transforms are the discrete sine transforms (DST), which is equivalent to a DFT of real and odd functions, and the modified discrete cosine transforms (MDCT), which is based on a DCT of overlapping data.

3.3. Huffman Coding

The image compression techniques are classified into two main categories namely lossy compression and lossless compression technique.

3.3.1. Lossless compression

A technique is which the compressed image is reconstructed without any loss of data is called lossless compression. Lossless compression ratio gives good quality of compressed images, but yields only less compression.

3.3.2. Lossy compression

A technique in which the compressed image is reconstructed without any loss of data is called lossy compression. The lossy compression techniques lead to loss of data with higher compression ratio.

Huffman coding is a lossless technique with more attractive features in various applications such as medical survey and analysis, technical drawing etc. Huffman coding has better characteristics of image compression, as we know that Huffman coding algorithm is a step by step process and involves the variable length codes to input characters and it is helpful in finding the entropy probability of the state. It is very easy to calculate quality parameter in Huffman algorithm; original image can be reconstructed with the help of digital image restoration

Step 1: Input image
Step 2: Set thresholding and changing into gray level
Step 3: Apply DCT
Step 4: Applying Huffman coding
Step 5: Compressed image
Step 6: Decompression process
Step 7: Getting original image
Step 8: End

3.4. Analysis of Huffman Coding Algorithm

The matrix represents ear biometric image N*N. these matrix arrays given in matrix are the elements of image.

$$f(x,y) = \begin{matrix} b_{0,0} & b_{0,1} & b_{0,M-1} \\ b_{1,0} & b_{1,1} & b_{1,M-1} \\ b_{M-1,0} & b_{M-1,1} & b_{M-1,M-1} \end{matrix} \quad (2)$$

This ear biometric image $f(x,y)$ is break into set of non overlapping four sub images i.e two row and two column this can be represented as in equation 2, $f(x,y)$ which is an ear biometric image is divided into two small sub images as in equation 3. These small sub images are also called as non-overlapping sub images.

$$f(x,y) = [\, f_1(x,y)\ f_2(x,y)] \quad (3)$$

These $f_1(x,y)\ f_2(x,y)$ are the sub matrix of original ear image after applying Huffman coding on this sub-matrix they gives. $f_1(x,y)\ f_2(x,y)$ Respectively the compressed image can be obtained by adding these values.

3.5. Image Quality Parameters

There are four major significant parameter measures between uncompressed image and compressed image.
These are the following
Compression ratio: compression ratio is used to measure the original image and compressed image. As compression ratio increases the image quality increases. CR is equivalent to size of original image/size of compressed image
Bit rate: it is information (bits) stored per pixel of an image. The ratio of number of bits in the compressed image to total number of pixels in original image.

Number of bits per pixel needed by the compressed image
BR=(b/CR)
B=No. of bits per pixel

When bit rate is large it means large memory required to store an image. High bit rate indicate that image acquire more colors so bit rate should be less
The Mean Square Error (MSE): the difference between original image data and compressed image data is called mean square error (MSE). MSE is inversely proportional to PSNR, as MSE decreases the PSNR increases, PSNR indicate quality of image compression is lossless when MSE is zero. It's better to have less MSE

Peak Signal to noise Ration (PSNR): PSNR is the ration between maximum signals powers to noise appear in signal as in equation 4. PSNR is related to quality of image. For good quality of image the PSNR of image should be high. PSNR is depends upon the mean square error (MSE) of compressed is less the PSNR is high so eventually the quality of image is also high

$$PSNR = 10\log\frac{MAX^2}{MSE} \quad (4)$$

4. EXPERIMENTAL ANALYSIS AND RESULTS

4.1. Outcome of compressed and decompressed images

The ear biometric image given as an input into MATLAB code then there are three options set to give a input values like threshold, shape and etc as 8*8. The next process is file will convert into compression format. The compressed file will be name as ficher and it reduces to 100kb. The decompression process is in the reverse order that is compressed image will be selected as input and should be given thresholding values to decompress again. The original image will come finally.

Figure 3. Original image and Compressed image

we implement the coding of Huffman compression technique without the threshold value in MATLAB then we got the Peak signal to noise ratio is 39.4201 which is good but we got the encoding time very high that is 128.1167(approx. more than 2 min) and the decoding time is 17.052 sec which is quite low then encoding time. If we set the particular threshold value which is 1800 then we got the peak signal to noise ratio 25.9846 and encoding time is 27.529 sec which is very low as compare to previous scheme and the decoding time is 16.4702 sec which is little small then the previous scheme. Now further if we change the threshold value from 1800 to 1900 then we analyzes the major change again in encoding time. At this threshold value the encoding time obtained is very low i.e. 4.891 sec which is quite low. But there is no change in the PSNR value and decoding time is very near to the previous stage. So we can say that on the second value of threshold we obtain the best result if we concern only with encoding and decoding time. The below table 4.1 shows comparison of the schemes i.e. (existed and proposed one).

Table 1. Outcomes values

Scheme	**Threshold**	**PSNR**	**Compression ratio**	**Encoding (in sec)**	**Decoding time(in sec)**
Existing	No threshold	39.4201	89.15%	80	65
DCT	1800	25.9846	89.15%	60	59
Proposed Huffman	1900	25.9846	95.25%	60	59

The above table 1 depicts the compression ratio, encoding and decoding process and it's time along with threshold and PSNR values. As per the table the compression ratio of proposed Huffman achieved better accuracy of ear biometric images. The following figure 2 illustrates the compression ratio and difference between the existing compression techniques on ear biometric techniques.

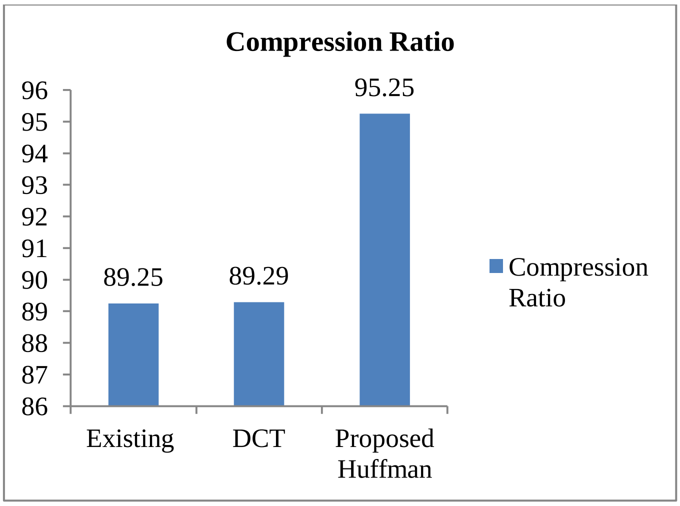

Figure 4. Compression Ratio

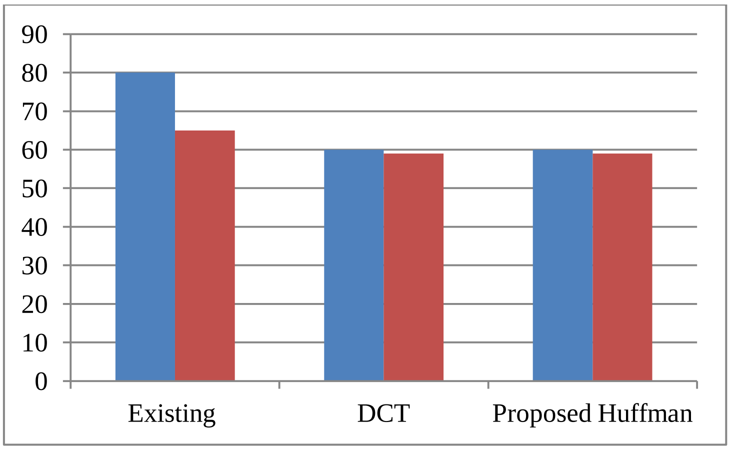

Figure 5. Execution time

The above figure 5 depicts the execution time when comparing to existing technique which have applied on biometric images. Huffman coding achieved efficiency in execution of short time and early better results.

5. CONCLUSION

In this work analysis of DCT and Huffman Image compression techniques for ear biometric images is done based on parameters, compression ratio (CR), mean square error (MSE), peak signal to noise ratio (PSNR). Our simulation results show that we achieved higher compression ratio using Huffman technique but loss of information is more. Huffman gives better compression ratio without losing more information of image. Pitfall of DCT is, it requires more processing power. DCT overcomes this disadvantage since it needs less processing power, but it gives less compression ratio. DCT based standard BMP uses blocks of image, but there are still correlation exits across blocks. Block boundaries are noticeable in some cases. Blocking artifacts can be seen at low bit rates. In wavelet, there is no need to divide the image. More robust under transmission errors. It facilitates progressive transmission of the image (scalability). This transform gives higher compression ratio but for getting that clarity of the image is partially trade off. It is more suitable for regular applications as it is having a good compression ratio along with preserving most of the information.

Thus the image compression plays important role in saving memory storage space and saving time while transmission images over the network. It increases transmission speed and capability. By using Huffman coding the image compressed by 40%. Huffman technique is easier because of its simpler mathematical calculation in order to find various parameters of image compression.

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