

# A Comparative Study on Multimodal Biometric System with Compression Techniques

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**Abstract**— Biometrics is a term that encompassed the application of modern statistical methods to the measurements of biological objects. The term biometrics usually refers to automatic technologies for measuring and analyzing biological and physiological characteristics such as fingerprint, eye retina, iris, voice, face, signature and etc. for individual identity. Later Multimodal biometric systems are introduced which are more efficient than uni-modal systems, in which single identification/verification done basis on multiple patterns. To improve the quality and speed of the multimodal systems equally need an improvement in preprocessing techniques too. Towards this issues a no of compression techniques are included as a preprocessing steps in both uni-modal and multimodal biometric systems. This paper mainly focuses on study of various compression techniques used in biometric systems.

**Keywords**—Multimodal Biometrics system, compression techniques, speed, disk space.

## I.INTRODUCTION

The most promising authentication system running over last few years is Biometric system in which identity approach is done basis on human physiological or behavioral characteristics which never to be lost or stolen. Today most of the survey's results multimodal biometrics techniques have more reliability and security than uni-modal biometrics. Moreover Biometric template protection is a major requirement throughout entire process.

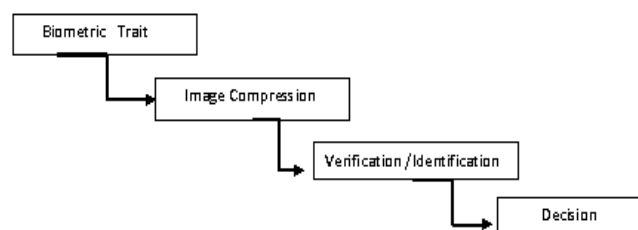


Fig. 1 Biometric data protection with compression technique

Image compression is the techniques which can give grate protection to the biometric data and also reduces the storage capacity. Already a great amount of work exists on using compression techniques in biometric systems. But lossy techniques are more significant as compared to lossless techniques especially for biometric data. However, in the case of lossy compression, need more investigation on accuracy aspect. In some cases of study JPEG and JPEG 2000 standards are well suited for lossy compression and whereas JPEG-LS is recommended for lossless and nearly lossless compression .The recent survey proposed that version JPEG 2000 only is included for lossy compression while the PNG is scheduled for lossless compressor. To recognize accuracy of finger and face JPEG, JPEG 2000 compression techniques are already started. Recently lossy fingerprint compression (e.g. [6, 10]), lossy compression of

face [2] and lossy iris compression [8] has been investigated.

## II. RELATED WORK

John Daugman and Cathryn Downing are using jpeg and jpeg2000 techniques on iris to reduced bandwidth and storage space of images [1]. Kresimir Delac, Sonja Grgic and Mislav Grgic are proposed JPEG, JPEG2000 techniques used to increasing processing speed and recognition accuracy [2]. Georg Weinhandel, Herbert Stogner and Andreas Uhl are using lossless techniques on different biometrics are explained and compared original image and compression image[3]. S. Anu H Nair, P.Aruna& M.Vadivukarassi are proposed an efficient algorithm for recognition of face and iris features extraction based on DWT and DCT method was used to reduce the dimension, to eliminate the noise, to save the space and to improve the efficiency using PCA method. These papers DWT are better compared to the DCT using PSNR[4]. Sheetal Choudhary, RajendarNath are introduced a multimodal biometric recognition system integrating palm print, fingerprint and face based on score level fusion. The feature vectors were extracted independently from the pre-processed images of palm print, fingerprint and face[5].Ms.Mansi Kambli and Ms.Shalini Bhatia are proposed A comparative study using discrete cosine transform based Joint Photographic Experts Group (JPEG) standard, wavelet based basic Set Partitioning in Hierarchical trees(SPIHT) and Modified SPIHT is done. The comparison shows that Modified SPIHT offers better compression than basic SPIHT and JPEG [6].Remigius onyszczak and abdou Youssef are developed a fingerprint compression specification called wavelet scalar Quantization (WSQ). In this paper mainly discoursed practical and theoretical difference of WSQ [7].G. Savithiri, A. Murugan is proposed Gaussian pyramid compression technique compressed eye used for the localization of the inner and outer boundaries of the iris region [8].

## III. COMPRESSION TECHNIQUES

Compression is a technique in which the size of a file is reduced without losing original information. Compression techniques are in general categorized into lossless and lossy. In lossless compression technique lossless data is decompressed and the resulting image is identical to the original. Where as in lossy compression algorithms result is in loss of data and the decompressed image is not exactly the same as the original.

### A. Lossless Compression Techniques

In this technique the original image can be perfectly retained from the compressed image. Some of the following compression methods under this category are listed:

- Run length encoding,
- Huffman encoding,
- LZW coding
- Area coding.

1) *Run length encoding*: The method in which compression approach is done depends on counting the number of adjacent pixels with the same gray level value. This count is called the run length and later it is coded and stored.

2) *Huffman encoding*: The method generates a code and it is almost close to the minimum bound, the entropy. As a result it produces variable length coding.

3) *LZW coding*: The only method which can produce code either in static or dynamic. In the case of static coding storage is fixed at both encoding and decoding processes .In dynamic coding storage is updated regularly.

4) *Area coding*: The method which is an extended version of run length coding.

### B. Lossy Compression

Lossy compression techniques are more over provided compression rate high than loss less compression. In this technique a file is reduced by eliminating redundant information. However, the final decompressed image is not exactly like original image. Some of the following compression methods under this category are listed:

- Vector Quantization
- Fractal Coding
- Block truncation coding
- Sub band coding
- Transformation Coding

1) *Vector Quantization*: The technique which contains storage of fixed size vectors and then vectors are to be encoded using entropy.

2) *Fractal Coding*: In this method the decomposition of image is done with various techniques like edge detection, colour separation, spectrum analysis and texture analysis. After that each segment is loaded into library called Fractal and it also contains IFS (Iteration Function System) codes of original images. Basis on code images are easily compressed and the result is closer to original one. These methods can provides effective compressing and also give best features like good regularity and self-similarity.

3) *Block truncation coding*: In this method first image is divided into no of blocks and then mean is calculated for every block later block is replaced with mean

value. However, bitmap block bitmap is formed by changing over all block values either zero or one depends on threshold value.

4) *Sub band coding*: In this method image is analyzed first and then bands are evaluated .later for each band quantization and coding is applied.

5) *Transformation Coding*: In this method the entire block of data is transformed at single shot and then quantized individually.

#### IV. IMAGE COMPRESSION

Image compression is one of the prominent compression techniques and it can reduce irrelevance and redundancy of the image data in order to store or transmit data in an efficient form. Image compression may be lossy or lossless. Lossless compression is preferred for archival purposes and often for medical imaging, and technical drawings. Lossy compression methods, especially when used at low bit rates, introduce compression artifacts. Lossy methods are especially suitable for natural images such as photographs in applications

#### V. TEXT COMPRESSION

Now Compression techniques reached to the digital era where it can working on compression towards digital documents like PDF, Word, email, SMS and Webpages. The text compression is done with lossless compression than lossy. As a result text is compressed and stored without any lost.

#### VI. AUDIO COMPRESSION

In this compression technique complex and rich set of Raw audio is taken and also it consumes more amount of memory .one of the most challenging task of audio compression is how to compress and how to save in suitable format But this is the only method which can compress raw sound easily and stored in a better way and also attempted for efficient transfer.

#### VII. MULTIMODAL BIOMETRIC SYSTEM WITH COMPRESSION

Multimodal biometric systems are limits the problems of uni-modal biometric systems and to produce high level recognition accuracy. To enhance level of accuracy more in multimodal biometrics many researchers are introduced compression techniques is the one of the preprocessing step. Towards this issue many proposed methods are introduced in this paper general methodology is introduced. How the process flow of recognition method done in

multimodal biometric system described in no of steps which are shown in Figure 2.

- Image Acquisition
- Image Compression
- Preprocessing
- Feature Extraction
- Fusion Method
- Matching
- Decision

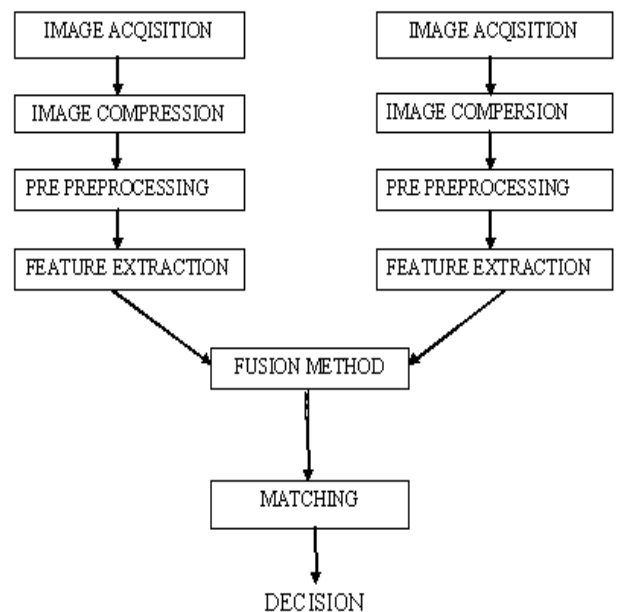


Fig. 2 Process flow of multimodal biometric system with compression

##### A. Image Acquisition

Image acquisition is the first stage of any vision system. In this step optical data is to be transmitted into an array of numerical data which can be manipulated by the system. Before attempting this step some of the preprocessing techniques are required to get the best quality of image those are like representation, transduction and digitization.

##### B. Image Compression

Image compression is a method in which the reduction of the storage space of images, videos take place there by storage capacity increased. The method which can also improves the performance of the transmission process without losing quality of image information.

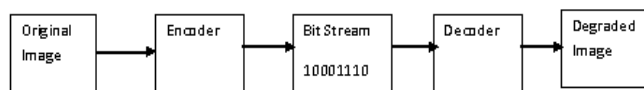


Fig. 3 Basic Flow of Image Compression

Image compression consists of a major component called encoder and decoder. The encoder converts series of binary data into bit-stream and the result is send to decoder .The general flow is shown in Figure 3.

### C. Pre Processing

In this stage processing both input and output results are images. However, image processing techniques are completely involved in any biometric technologies to enhance the quality of original image. In image processing the pictures are improved by using enhancement, restoration, segmentation and morphological techniques in spatial domain. At the end of this step images are produced with high quality.

1) *Image enhancement*: Basically, the idea behind enhancement techniques is to bring out detail that is obscured, or simply to highlight certain features of interest in an image.

2) *Image restoration*: It improves the appearance of an image. However, unlike enhancement, which is subjective, image restoration is objective, in the sense that restoration techniques tend to be based on mathematical or probabilistic models of image degradation.

3) *Image segmentation*: The method which can do partition an image into its constituent parts or objects. In general, the more accurate the segmentation, the more likely recognition is to succeed.

### D. Feature extraction

The step involved to extract the features of various biometrics with image processing techniques. According to the application and vendor feature set selection will be completely identical.

Some of the features related to some biometrics are listed below:

- Finger- ridge ending, Bifurcation and Cross over
- Iris- Ridges, Furrows, Freckles, Corona.
- Face-Eye socket, open ridge, Cheekbone area, Nose shape, Mouth points.
- Hand-Finger width, Finger height, Hand bone structure, Joints distance.

### E. Fusion

Multimodal biometric system improved level of accuracy in recognition process by introducing a new method called level of fusion. Fusion method can be done in a variety of scenarios some of the fusion approaches are listed below:

- Sensor level
- Feature level
- Decision level
- Matching score level.

1) *Sensor level*: In sensor level fusion, number of biometric traits are directly taken from either sensors/acquisition devices and combined as one composite trait.

2) *Feature level*: At the stage of feature level fusion, feature vectors of the all biometrics are collected and combined as one.

3) *Decision level*: In decision level fusion, every biometric classified independently and finally all it outputs are combined together.

4) *Matching score level*: In matching score level fusion, matching score of individual modalities generated and then single score is derived with fusion.

### F. Matching

In which the user's identity is established or a claimed identity is either accepted or rejected based on the matching score generated in the matching module. At end the result is send as decision to the external system.

## VIII. STUDY ON COMPRESSION TECHNIQUES WITH MULTIMODAL BIOMETRICS

To improve recognition system accuracy many of the researchers done excellent work .Some of the existing methodologies are studied and described in the following Table 1.

Author	Compression techniques	Biometrics
Georg Weinhandel, Herbert Stogner and Andreas Uhl.	JPEG2000,SPIHT,JPEG,GIF, PNG,RAR,ZIP,UHA,JPEG-LS, Huffman coding, 7z, BZ2, and GZ.	Finger print, iris, retina, face, and hand.
Ms.Mansi	Set Partitioning in Hierarchical	Finger

Kambli and Ms.Shalini Bhatia	trees (SPIHT) and Joint Photographic Experts Group(JPEG)	prints
Remigius Onyshczak and Abdou Youssef	Wavelet Scalar Quantization (WSQ)	Finger prints
Kresimir Delac, Sonja Grgic and Mislav Grgic	JPEG and JPEG2000	Face
G. Savithiri, A. Murugan	Gaussian pyramid compression	Iris
John Daugman and Cathryn Downing	JPEG and JPEG2000	Iris
Saad, M.NandKandi I, A.H.	Lossless and lossy	Hand
A. Loussert, A. Alfalou, R. ElSawda, A. Alkholidi	Non-destructive spectral fusion and JPEG	Hand

## IX. CONCLUSION

The authentication process in biometric will never be totally secure. Some of the factors which are like non-universality, noisy input, lack of invariant representation and non-distinctiveness are affected the accuracy of system. To enhance the level of accuracy and security to the system multiple traits processing is significantly required. However, to improve the performance speed of recognition method compression technique is included as a preprocessing to multimodal biometric system.

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