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Iris Images Compression Using JPEG 2000

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Abstract- Biometric recognition is a common and reliable way to authenticate the identity of the person. Many applications that require some degree of confidence concerning the personal identification are running away from use of paper or plastic identity cards or alpha-numeric passwords. These systems are too easy to defeat. Iris recognition is an automated method of biometric identification that uses mathematical pattern-recognition techniques on images of the irides of an individual's eyes, whose complex random patterns are unique. With the growing employment of the iris recognition systems and associated research to support this, the need for large databases of iris images is growing. If the required storage space is not adequate for these images, compression is an alternative. JPEG standard cannot fulfill the advanced requirements of today's digital imagery. Digital imaging has become an integral part of the Internet and JPEG 2000 is a powerful new tool that provides power capabilities for designers and users of networked image applications.

Index Terms- **Biometric recognition, Compression, Discrete Transform, Entropy Coding, and Quantization.**

I. INTRODUCTION

In a modern world, biometric recognition is a common and reliable way to authenticate the identity of the person. A physiological characteristic is relatively stable physical characteristic, such as fingerprints, iris pattern, retina scan etc. This kind of measurement is basically unchanging and unalterable during life time.[3] Biometric identification or verification of identity is currently a very active field of research. Many applications that require some degree of confidence concerning the personal identification of the people involved such as banking, computer network access or physical access to secure facility are moving away from use of paper or plastic identity cards or alpha-numeric passwords. These systems are too easy to defeat. A higher degree of confidence can be achieved by using unique physical characteristics to identify a person.

II. IRIS RECOGNITION

Iris recognition is an automated method of biometric identification that uses mathematical pattern-recognition techniques on video images of the irides of an individual's eyes, whose complex random patterns are unique and can be seen from some distance. The iris is a thin circular diaphragm, which lies between the cornea and the lens of the human eye. A front view of the iris is as shown in the figure 1. The function of iris is to control the amount of light entering through the pupil and this is done by the sphincter and the dilator muscles, which adjust the size of the pupil. The average diameter of the iris is 12 mm and the pupil size can vary from 10% to 80% of the iris diameter.[2] Formation of iris begins during the third month of embryonic life.[5] The unique pattern on the surface of the iris is formed during the first year of life and pigmentation of stroma takes place for first few years. The density of stromal pigmentation determines the colour of the iris. The externally visible surface of the multilayered iris contains two zones, which often differ in colour. An outer ciliary zone and the inner pupillary zone and these two zones are divided by the collarets which appears as a zigzag pattern. [2]

Fig 1.A Front View of Human Eye [2]

Formation of the unique pattern of the iris is random and not related to any genetic factors. The only characteristic that is independent of genetics is the pigmentation of the iris which determines its colour. Due to the epigenetic nature of the iris patterns, the two eyes of an individual contain completely independent iris patterns. A key advantage of iris recognition, besides its speed of matching and its extreme resistance to False Matches, is the stability of the iris as an internal, protected, yet externally visible organ of the eye.[2] Some other advantages of Iris Recognition

1) It is an internal organ that is well protected against damage and wear by a highly transparent and sensitive membrane (the cornea). This distinguishes it from fingerprints, which can be difficult to recognize after years of certain types of manual labor.

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2) The iris is mostly flat, and its geometric configuration is only controlled by two complementary muscles (the sphincter pupillae and dilator pupillae) that control the diameter of the pupil. This makes the iris shape far more predictable than, for instance, that of the face.[2]

3) Even genetically identical individuals have completely independent iris textures.

4) While there are some medical and surgical procedures that can affect the colour and overall shape of the iris, the fine texture remains remarkably stable over many decades. Some iris identifications have succeeded over a period of about 30 years.

III. NEED FOR COMPRESSION

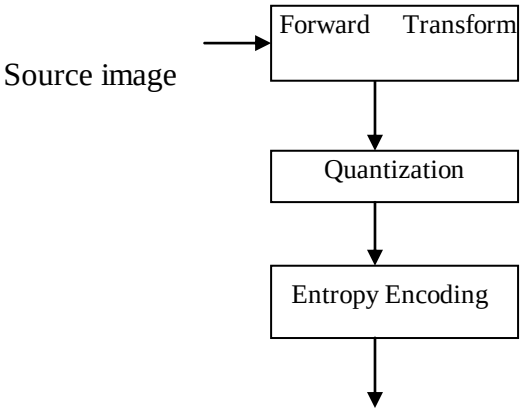
In order to use biometrics for identification, the biometric data must be collected by some means. This may be a costly and time consuming process and the data obtained is valuable and must be protected. Furthermore, data collections can create an inordinate amount of data that puts a strain on the available storage. With the growing employment of the iris recognition systems and associated research to support this, the need for large databases of iris images is growing. If the required storage space is not adequate for these images, compression is an alternative. It allows a reduction in the space needed to store these iris images. There are two types of compression schemes, lossless and loss compression deals with techniques for reducing the space required for storage of data. The main motive of image reduction process is to remove the redundant data. In a specific area of still image compression, there are many efficient compression techniques with considerably different features.

A. JPEG 2000

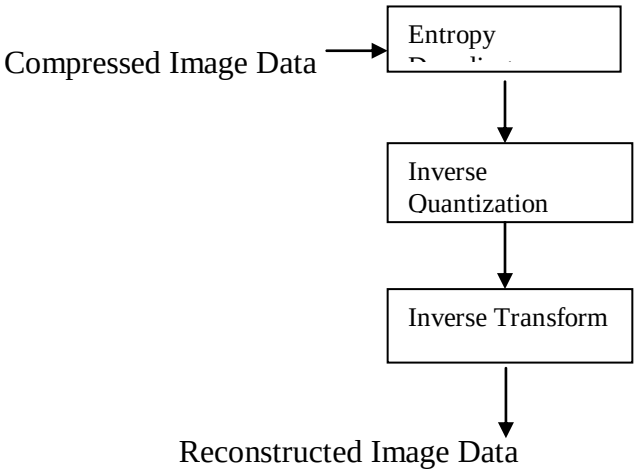
The JPEG standard has been in use for almost a decade now. It has proved a valuable tool during all these years, but it cannot fulfill the advanced requirements of today.[6] Today's digital imagery is extremely demanding, not only from the quality point of view, but also from the image size aspect. Current image size covers orders of magnitude, ranging from web logos of size of less than 100Kbits to high quality scanned images of approximate size of 40 Gbits.[1] Digital imaging has become an integral part of the Internet, and JPEG 2000 is a powerful new tool that provides power capabilities for designers and users of networked image applications[4] The JPEG 2000 standard provides a set of features that are of importance to many high-end and emerging applications by taking advantage of new technologies.[4] It addresses areas where current standards fail to produce the best quality or performance and provides capabilities to markets that currently do not use compression. Some of the features of JPEG 2000 are

1) Superior low bit-rate performance
2) Continuous-tone and bilevel compression
3) Progressive transmission by pixel accuracy and resolution
4) Region-of-interest (ROI) coding
5) Open architecture
6) Robustness to bit errors
7) Protective image security

At the encoder, the discrete transform is first applied on the source image data. The transform coefficients are then quantized and entropy coded before forming the output code stream (bit stream). The decoder is the reverse of the encoder. The code stream is first entropy decoded, dequantized, and inverse discrete transformed, thus resulting in the reconstructed image data.[4] Although this procedure looks like the one for the conventional JPEG, there are radical differences between them.



(a) JPEG 2000 Encoder



(b) JPEG 2000 Decoder

Fig 2. General Block Diagram of JPEG 2000

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IV. METHODOLOGY AND RESULT

The images used in this research come from Chinese Academy of Sciences (CASIA) iris database.[7] This is composed of images of 108 different eyes, with 7 images of each eye (totaling 756 iris images). These images are 320 × 280 8-bit bitmapped images (bmp), each occupying 92160 bytes on hard drive. Software used for compression of these images using JPEG 2000 algorithm is MATLAB. Different samples are taken from the database and various parameters are obtained like average bit rate, PSNR, RMSE and Compression Ratio. Results obtained are summarized in the TABLE 1.

Images	Average bit rate (bpp)	PSNR (dB)	RMSE (dB)	Comp. Ratio
Sample 1	0.33	35.7249	3.7969	0.2844
Sample 2	0.19	36.0816	3.6807	0.2724
Sample 3	0.25	36.2061	3.8120	0.2127
Sample 4	0.2	35.5982	4.1335	0.2621

V. CONCLUSION

JPEG 2000 is very powerful and efficient compression technique. Iris database could be reduced in size using this algorithm possibly by compression rate of 5 to 6 or even higher.

VI. FUTURE SCOPE

Further improved algorithms like SPIHT, modified SPIHT or Region Of Interest (ROI) algorithm can be used to obtain further compression of IRIS image. With these algorithms, storage space required will be definitely less as compared to that with JPEG 2000 algorithm.

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