International Journal of Science and Research (IJSR)
ISSN (Online): 2319-7064
Index Copernicus Value (2013): 6.14 | Impact Factor (2014): 5.611

Fingerprint Compression using Singular Value Decomposition

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Abstract: ***A Fingerprint compression technique is becoming more and more for security purpose required less space to store the data so I am processing new fingerprint compression technique using sparse representation obtains the complete dictionary from the set of fingerprint patches allows to represent sparse linear combination of dictionary atom.In the algorithm, we first collect the fingerprint patches and construct a dictionary for predefined fingerprint image patches It uses the l0-mimimization technique to represent the fingerprint patches according to the dictionary and then quantize and encode the representation. Those having the Coefficient less than given threshold treated as Zero and record the remaining coefficient and their locations. Then encode the atom number of each patch and find out the mean value of each patch. In this we also compare our method with other techniques such as JPEG JPEG2000 and Wavelet Scalar Quantization especially at high compression ratios. The experiments also illustrate that the proposed algorithm is robust to extract minutiae.***

Keywords: Fingerprint compression, sparse representation, Singular Value Decomposition, JPEG, JPEG2000, WSQ

1. Introduction

Fingerprints have been used for over a century and are the most widely used form of biometric identification. Fingerprint identification is commonly employed in forensic science to support criminal investigations, and in biometric systems such as civilian and commercial identification devices. Fingerprint identification methods are widely used by police agencies and customhouse to identify criminals or transit passengers since the late nineteenth century. ISO standardized the characteristics of the fingerprint files in 2004. However, with tens of thousands of persons being added into the repositories daily, the management of these data becomes a critical issue. Developing fine and delicate methods for fingerprint compression is necessary to both reduce the memory storage and identification time. Among many efforts, the compression technique is considered as one of the most effective solutions. The compression techniques make the database able to store more reference fingerprints, and also help to extract the effective features in improving the accuracy of fingerprint recognition. Because the fingerprint images are frequently sent between law agencies through internet, efficiently compressing the data before transmission is also desirable and necessary.

There are many image compression techniques available. JPEG, JPEG 2000, Wavelet Scalar Quantization (WSQ) are the existing image compression techniques. The JPEG, JPEG 2000 methods are for general image compression. Recognition technology in the society, because biometric identifiers can't be shared and they of persons by means of biometric characteristics is an important intrinsically represent the individual's bodily identity. Among many biometric recognition technologies, fingerprint recognition is very popular for personal identification due to the uniqueness, universality, collectability and invariance.

Large volumes of fingerprints are collected and stored every day in a wide range of applications, including forensics and access control. In 1995 , the size of the FBI fingerprint card archive contained over 200 million items and archive size was increasing at the rate of 30000 to 50000 new cards per day .Large volume of data consume the amount of memory. Fingerprint image compression is the key technique to solve the problem .generally compression technology can be classified into lossless and lossy.

1.1Lossless Compression

Lossless compression is a class of data compression algorithms that allows the original data to be perfectly reconstructed from the compressed data. By contrast, lossy compression permits reconstruction only of an approximation of the original data, though this usually improves compression rates (and therefore reduces file sizes).

Most lossless compression programs do two things in sequence: the first step generates a statistical model for the input data, and the second step uses this model to map input data to bit sequences in such a way that "probable" (e.g. frequently encountered) data will produce shorter output than "improbable" data. Lossless compression allows the exact original images to be reconstructed from the compressed data. Lossless compression technologies are used in cases where it is important that the original and the decompressed data are identical. Avoiding distortion limits their compression efficiency. When used in image compression where slight distortion is acceptable, lossless compression technologies are often employed in the output coefficients of lossy compression. Lossless data compression is used in many applications. For example, it is used in the ZIP file format and in the GNU tool gzip.

1.2 Lossy Compression

Lossy compression is the class of data encoding methods that uses inexact approximations (or partial data discarding) to represent the content. These techniques are used to reduce data size for storage, handling, and transmitting content. Different versions of the photo of the cat at the right show how higher degrees of approximation create coarser images as more details are removed. This is opposed to lossless data compression which does not degrade the image. The amount of data reduction possible using lossy compression is often much higher than through lossless techniques.

Lossy compression technologies usually transform an image into another domain, quantize and encode its coefficients. During the last three decades, transform based image compression technologies have been extensively researched and some standards have appeared. Two most common options of transformation are the Discrete Cosine Transform (DCT) and the Discrete Wavelet Transform (DWT) Lossy compression is most commonly used to compress multimedia data (audio, video, and images), especially in applications such as streaming media and internet telephony

In existing Fingerprint compression algorithms and to test the robustness of our algorithm to extract minutiae. Since existing fingerprint quality assessment algorithms are designed to examine if an image contains sufficient information (say, minutiae) for matching, they have limited capability in determining if an image is a natural fingerprint or an altered fingerprint. Obliterated fingerprints can evade fingerprint quality control software, depending on the area of the damage. If the affected finger area is small, the existing fingerprint quality assessment software may fail to detect it as a fingerprint.

The primary aim of this project is to implement techniques for fingerprint image enhancement and minutiae extraction. After the image enhancement construct a base matrix whose columns represent features of the fingerprint images, referring the matrix dictionary whose columns are called atoms, for a given whole fingerprint, divide it into small blocks called patches whose number of pixels are equal to the dimension of the atoms. Use the method of sparse representation to obtain the coefficients then, quantize the coefficients and encode the coefficients and other related information using lossless coding methods.

Well-designed lossy compression technology often reduces file sizes significantly before degradation is noticed by the end-user. Even when noticeable by the user, further data reduction may be desirable (e.g., for real-time communication, to reduce transmission times, or to reduce storage needs).

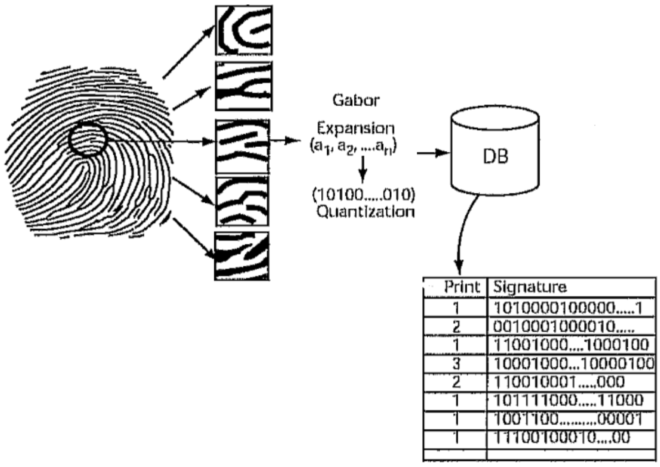

Figure: Gabor determination for each patch

2. Literature Survey

In last few years Fingerprint compression become more and more popular for hiding the important data to secure the data the primary goal of pattern recognition is supervised or unsupervised classification [1]. Among the various frameworks in which pattern recognition has been traditionally formulated, the statistical approach has been most intensively studied and used in practice. More recently, neural network techniques and methods imported from statistical learning theory have been receiving increasing attention. The design of a recognition system requires careful attention to the following issues: definition of pattern classes, sensing environment, pattern representation, feature extraction and selection, cluster analysis, classifier design and learning, selection of training and test samples, and performance evaluation. In spite of almost 50 years of research and development in this field, the general problem of recognizing complex patterns with arbitrary orientation, location, and scale remains unsolved. New and emerging applications, such as data mining, web searching, retrieval of multimedia data, face recognition, and cursive handwriting recognition, require robust and efficient pattern recognition techniques. The objective of this review paper is to summarize and compare some of the well-known methods used in various stages of a pattern recognition system and identify research topics and applications which are at the forefront of this exciting and challenging field.

Due to the increasing requirements for transmission of images in computer, mobile environments [2], the research in the field of image compression has increased significantly. Image compression plays a crucial role in digital image processing, it is also very important for efficient transmission and storage of images. When we compute the number of bits per image resulting from typical sampling compression is needed. Therefore development of efficient techniques for image compression has become necessary .This paper is a survey for lossy image compression using Discrete Cosine Transform, it covers JPEG compression algorithm which is used for full-colour still image applications and describes all the components of it. Image Compression addresses the problem of reducing the amount of data required to represent the digital image. We can achieve compression by removing of one or more of three basic data redundancies:

1) Spatial Redundancy or correlation between neighboring pixels.
2) Due to the correlation between different colour planes or spectral bands, the Spectral redundancy is founded.
3) Due to properties of the human visual system, the Psycho-visual redundancy is founded.

We find the spatial and spectral redundancies when certain spatial and spectral patterns between the pixels and the colour components are common to each other and the psycho-visual redundancy produces from the fact that the human eye is insensitive to certain spatial frequencies.

The time-frequency and time-scale communities have recently developed a large number of over complete waveform dictionaries—stationary wavelets, wavelet packets, cosine packets, chirp lets, and warp lets, to name a few[4]. Decomposition into over complete systems is not unique, and several methods for decomposition have been proposed, including the method of frames (MOF), matching pursuit (MP), and, for special dictionaries, the best orthogonal basis (BOB). Basis pursuit (BP) is a principle for decomposing a signal into an ―optimal" superposition of dictionary elements, where *optimal* means having the smallest *l*1 norm of coefficients among all such decompositions. We give examples exhibiting several advantages over MOF, MP, and BOB, including better sparsely and super resolution. BP has interesting relations to ideas in areas as diverse as ill-posed problems, abstract harmonic analysis, total variation denoising, and multiscale edge denoising. BP in highly over complete dictionaries leads to large-scale optimization problems. With signals of length 8192 and a wavelet packet dictionary, one gets an equivalent linear program of size 8192 by 212,992. Such problems can be attacked successfully only because of recent advances in linear and quadratic programming by interior-point methods. We obtain reasonable success with a primal-dual logarithmic barrier method and conjugate gradient solver.

Images, captured with digital imaging sensors, transmitted through various channels, often contain noise [3]. In literature, many image restoration techniques exists for the reduction of noise from degraded image, but they usually do not succeed when applied to diversified fields degraded images with Speckle, Poisson, Gaussian and Salt & Pepper noise. In this paper, we provide performance analysis of state of art image restoration techniques i.e. patch based image restoration technique for various combinations of noise and diversified field images, and also a new scheme for the removal of noise is proposed. The resulting restoration technique is shown to outperform alternative state-of-the-art restoration methods with synthetic noise to diversified field images both in terms of speed and restoration accuracy. Digital images play an important role in daily life application such as satellite television, imaging under water, magnetic resonance, computer tomography as well as in area of research and technology such as Medical, geographical information system and astronomy. Visual information is usually considered the most illustrative, informative, direct and comprehensive among all kinds of information perceived by human beings. Data sets collected by image sensors are generally contaminated by noise. Imperfect instrument, problem with the data acquisition process, and interfering natural phenomena can all degrade the data of interest. Image is greatly affected by capturing instruments, data transmission media, quantization and discrete sources of radiation. Furthermore, noise can be introduced by transmission errors and compression. Many diagnoses in Medical field are based on biomedical images derived from x–ray, computerized tomography (CT), ultra-sound, magnetic resonance imaging (MRI) and in geosciences scientists use remote sensing images to monitor planetary bodies, distant starts, and galaxies, so image must be without noise. Digital images are prone to a variety of types of noise. Noise is the result of errors in the image processing that result in pixel values that do not reflect the true intensities of the real scene.

3. Conclusions

Here I have given the paper on literature survey of fingerprint compression techniques. In proposed system we use the fingerprint compression using Singular Value Decomposition and also compare this technique with other techniques.

A new compression algorithm adapted to fingerprint images is introduced. Despite the simplicity of our proposed algorithms, they compare favourably with existing more sophisticated algorithms, especially at high compression ratios. Due to the block-by-block processing mechanism, however, the algorithm has higher complexities. The experiments show that the block effect of our algorithm is less serious than that of JPEG. We consider the effect of three different dictionaries on fingerprint compression. The experiments reflect that the dictionary obtained by the K-SVD algorithm works best. Moreover, the larger the number of the training set is, the better the compression result is. One of the main difficulties in developing compression algorithms for fingerprints resides in the need for preserving the minutiae which are used in the identification. The experiments show that our algorithm can hold most of the minutiae robustly during the compression and reconstruction. There are many intriguing questions that future work should consider. First, the features and the methods for constructing dictionaries should be thought over. Secondly, the training samples should include fingerprints with different quality (―good", ―bad", ―ugly"). Thirdly, the optimization algorithms for solving the sparse representation need to be investigated. Fourthly, optimize the code to reduce complexity of our proposed method.

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