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Compression of Fingerprint Using SVD in Sparse Respresentation

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Abstract

Compression is known as reducing the memory size of an image. In the process of compression, there will be a loss of data then this type of compression is called lossy compression. If there is no loss of data, then this type of compression is called lossless compression. This new fingerprint compression algorithm is based on Singular Value Decomposition in sparse representation. In the algorithm, firstly the uploaded image is divided into patches then secondly dictionary is created for each fingerprint image patch. These patches are compressed using SVD in sparse representation. Then the image is reconstructed. This is a Lossless compression. The experiment demonstrates that our algorithm is efficient compared with several competing compression techniques (JPEG, JPEG 2000, and WSQ), especially at high compression ratios.

Conclusions: Sparse representation is used for compression. JPEG has bad performance at low-bi rates and this is the more sophisticated algorithm. It provides a high Peak Signal to Noise Ratio and a high compression ratio. In this paper, a Fingerprint image is compressed using Singular Value Decomposition(SVD) in Sparse representation. The uploaded image occupies more storage size and requires more bandwidth and time to transfer. In this algorithm, Upload a fingerprint image from system memory into the application. This image is divided into patches. Dictionary is created for each patch of the image. SVD is used for the compression of the image. Reconstruction of the compressed image takes place. The resultant image after compression will have less storage size with the same quality. Bandwidth and time taken for the image transfer are less now. A graph is represented comparing the storage size of the uploaded image and the compressed image.

Keywords: Fingerprint Compression, Singular Value Decomposition (SVD), Sparse Representation, JPEG, JPEG 2000, WSQ

1. Introduction

The latest security system used now is biometric identification. Biometrics are like fingerprint, retina, face, voice or signature, etc. Fingerprints are used in applications like security systems, security locks, identity recognition, attendance system, secure financial services, health care, electronic commerce, telecommunication, government, etc. Biometric security software automatically recognizes people based on their behavioral or biological characteristics. Security systems used knowledge-based methods like passwords, pins, and token-based methods. Driver licenses, passports, and ID cards were likely to threaten or fraud because passwords or PIN numbers may be forgotten. The tokens may be stolen, missing, or copied. Sometimes they are hacked too. So a biometric system is required for robust, reliable, and guarantee personal identification, and authentication systems. Biometric data can't be stolen or guessed. Each individual has unique biometric traits so this can be used to avoid fraud or theft.

A fingerprint refers to the flow of ridge patterns on the tip of the finger. **Bifurcations** is known as the division of something into two branches or parts. Short ridges are ridges that are shorter than the average ridge length. Minutia is very important in the analysis of fingerprints.

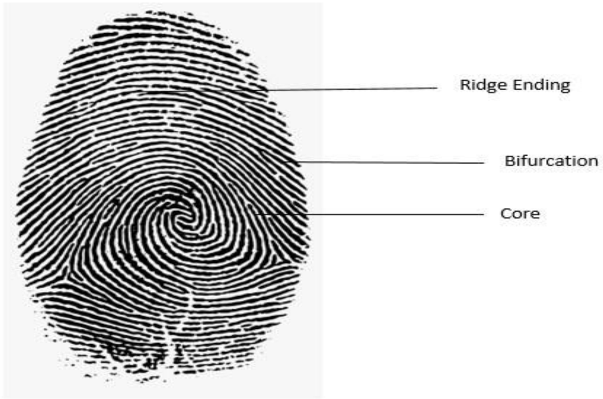

Fig.1 Biometric features of fingerprint image.

Forensically, a fingerprint **Core** is simply defined as, the central area of the fingerprint. The core point is found in the middle of the spiral. While the fingerprint delta is defined as a place where two lines run side-by-side and then diverge to form a triangle. However, fingerprints are not distinguished by their ridges and furrows, but by minutiae, which are some abnormal points on the ridges, or **Minutiae** refer to certain small features of a fingerprint image. These are the two minutiae types that are most significant and in heavy usage: one is called termination (which is the immediate ending of a ridge) the other is called bifurcation. There are two main minutiae: ridge ending and ridge bifurcation. The point where a ridge ends abruptly is known as **Ridge ending**. The point where a ridge forks or diverges into branch ridges is known as **Ridge bifurcation**.

2. Related Work

1. JPEG:

JPEG stands for Joint Photographic Specialist Groups.JPEG standard has been established by ISO (International Standards Organization) and IEC (International Electro-Technical Commission). JPEG has undertaken the goal of developing a general-purpose compression standard. This is used to meet the needs of almost all continuous-tone still-image applications. The JPEG compression scheme has many advantages such as portability, compatibility, vibrant, simplicity, universality and availability. JPEG has a bad performance at low bit-rates. For this reason, the JPEG committee began to develop a new wavelet-based compression standard for still images, which is called as JPEG 2000. The JPEG customary specifies 3 modes specifically progressive, serial, and hierarchic. These modes are used for lossy secret writing, and one mode of lossless secret writing. It works well on photographic pictures. It is a lossy technique.

2. JPEG 2000:

In March 1997 brand new concern contributions were launched for the event of a brand new commonplace for the compression of still pictures, the JPEG 2000 commonplace. This aims to provide a broad range of features in a single compressed bit stream for numerous applications. JPEG-2000 is the only standard compression scheme used for both lossless and lossy compression. In JPEG 2000, the DCT of JPEG is replaced with DWT (Discrete Wavelet Transform).

3. WSQ:

The WSQ compression technique was developed by the FBI. Alternative entities were designed to compress supply fingerprint pictures between ratios of ten to one and twenty to one. WSQ is targeted at fingerprint images. This contains special compression algorithms. The most common is Wavelet Scalar Quantization(WSQ). The technique is designed to delete data that is not necessary for the reconstruction of a fingerprint image.

3. Problem Statement

Data (like audio, video, and Uncompressed graphics) require considerably more storage capacity and transmission bandwidth. In spite of rapid progress in mass storage density, processor speeds, and digital communication system performance demand for data storage capacity and data transmission bandwidth continues to exceed the capabilities of the available technologies. Dealing with such a huge amount of information can often present difficulties. Digital information must be stored and retrieved efficiently.

Usually, television image generates data rates exceeding 10 million bytes/sec. Data require a large capacity and bandwidth for storage and transmission, which could be expensive. The reduction of the number of bits is concerned with the image data compression technique.

4. Proposed System

In this, fingerprint images are compressed using the SVD algorithm. As the image size will be huge and require more bandwidth and time to transfer through the internet so we need an efficient way to compress such images to transfer faster. The uploaded image is divided into patches. Dictionary is build for each patch in the image. SVD algorithm will scan each pixel of the image and then replace high intensity pixels with low intensity pixels to reduce storage size. SVD algorithm will maintain a dictionary of pixels and while compressing it will scan that dictionary to replace low intensity pixels with high intensity. The image is reconstructed. The resultant image after compression will have the same quality of image with less storage size.

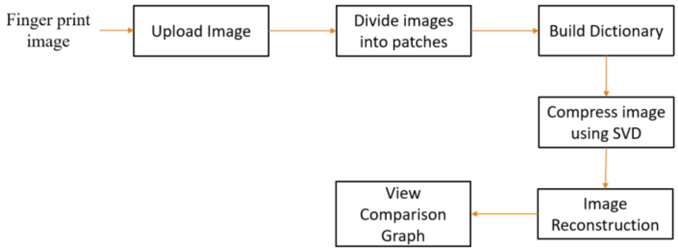

Fig. 2 System design of Fingerprint compression using SVD in Sparse Representation

5. Implementation

These are the three modules which are listed in the following.

1. Upload the Input Image
2. Compression using SVD
3. Graph Analysis

1.Upload the Input Image:

The image (JPEG format) is uploaded to the application. This image is uploaded from the system memory. The filename is given as the unique identification of the user. The uploaded image has high intensity pixels. The storage size of the uploaded image is high. So it takes more bandwidth and time to transfer.

2.Compression using SVD:

Image is compressed using SVD (Singular Value Decomposition). Uploaded Image is divided into patches. Dictionary is created for each patch. SVD algorithm will scan each pixel of the image. This algorithm replaces high intensity pixels with low intensity pixels to reduce storage size. Pixel intensity value is known as the primary information stored within pixels. SVD maintain dictionaries of the patch, it will scan that dictionary to replace low intensity pixels with high intensity. The resultant image is reconstructed. After compression, Image will have the same quality of the image with less storage size. This is lossless compression.

3.Graph Analysis:

After compression, uploaded image is compared with the compressed image. The size of the image is displayed at the top of the image. A graph is compared between the uploaded image and the Compressed image. Bar graph shows the comparison between the Normal File Size and the Compressed File Size.

Algorithm 1: Fingerprint compression using SVD in Sparse Representation

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1. Upload the image of the fingerprint.
2. Image of the uploaded fingerprint is divided into patches.
3. Construct a dictionary for fingerprint image patches.
4. Compress the uploaded image using SVD Algorithm.
5. Comparison graph is displayed between the original and compressed fingerprint images.

6. Results

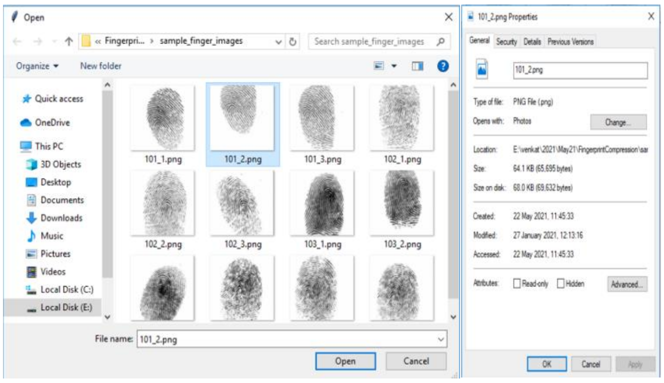

Fig. 3 Compression of the Uploded Image.

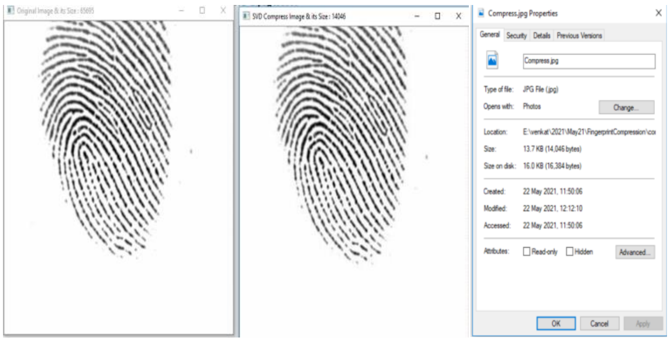

Fig. 4 Comparision between Uploded and Compressed Image.

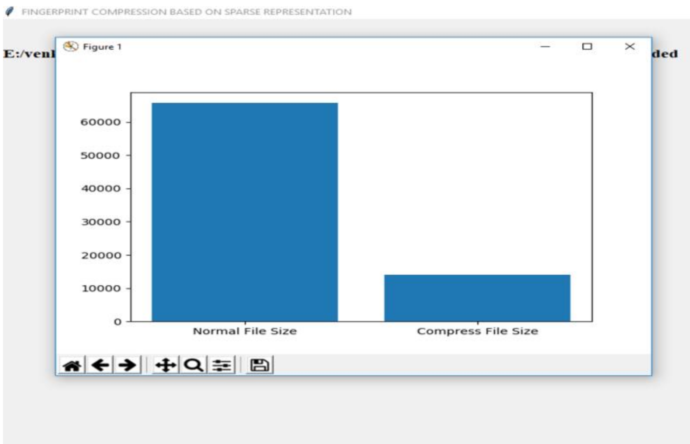

Fig. 5 Comparision Graph.

From Fig. 3 The image size is 64.1 KB and sees the same image size in compress folder after compression.

After compression(From Fig. 4) the same image size is reduced to 13.7 KB. Similarly, you can upload other images and test and now click on ‘Comparison Graph’ button to get below graph.

In above graph (Fig. 5) x-axis represents technique name and y-axis represents image size and in above screen we can see after compression images size is reduced.

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