An Efficient Fingerprint Compression Algorithm Using Sparse Coding

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***Abstract*— here a new technique of fingerprint compression is introduced. Fingerprint compression is a challenging task in storage and communication media because more amount of image has to stored, processed and transformed in many applications. Here the dictionary is obtained from the preprocessed fingerprint patches which are represented as linear combination of sparse method. After the dictionary is formed L-norm minimization is done to find similar blocks and Huffman encoding for effective compression. This proposed method can increase the performance in terms of quality as well as compression. The output is compared with the existing techniques such as JPEG compression method and K-SVD compression method. Finally result analysis is made based on performance parameters such as PSNR and MSE.**

Keywords*—(compression,huffman encoding,DCT,PSNR,MSE*)

I. Introduction

Every day enormous amount of information is stored, processed and transmitted digitally since the most information are graphical or pictorial in nature the storage and communication requirement are immense. Methods of compressing data prior to storage or transmission are required

Image compression addresses the problem of reducing the amount of data required to represent image hence the underlying principle of reduction process is the removal of redundant data. Generally, compression technologies can be classed into lossless and lossy. Lossless compression is a type of image compression algorithms that allows the original data to be perfectly reconstructed from the compressed data. Typical image file formats of lossless compression are like PNG or GIF; it is also often used as a component within lossy data compression technologies. Lossless compression is used where it is essential that the original and the decompressed data be identical, or where deviations from the original data could be deleterious. Lossless compression methods may be classified according to the type of data they are designed to compress.

Lossy compression technologies usually transform an image into another domain, quantize and encode its coefficients. lossy compression is the type of image encoding methods that uses inexact approximations to represent the content. These methods are used to reduce data size for storage, handling, and transmit content. The amount of data reduction achievable using lossy compression is often much higher than through lossless techniques. In lossy transform codes, samples of image are taken, chopped into small segments, transformed into a new basis space, and quantized. The resulting quantized values are then encoded using entropy coding. There are transform-based image compression methods have been implicitly researched and some principles have appeared. Two most common options of transformation are the Discrete Cosine Transform (DCT) and the Discrete Wavelet Transform (DWT)

Fingerprint recognition is very popular for personal identification due to the uniqueness, universality, collectability and invariance. Large volumes of data consume the amount of memory. The main aim of the project is to develop algorithm based on sparse representation for the efficient compression of finger prints. Obtaining an overcomplete dictionary from a set of fingerprint patches, they are represented as a sparse linear combination of dictionary atoms. Hence the new fingerprint images are represented as patches according to the dictionary by computing Norm-minimization and then quantize and encode the representation using discrete cosine transform and Huffman encoding technique

II. Proposed Method

The sparse representation to compress fingerprint images includes construction of the dictionary, compression of a given fingerprint, quantization and coding.

A. Construction of the Dictionary

First, we construct a training set. Then, the dictionary is obtained from the set. Choose the whole fingerprint images, cut them into fixed-size square patches. Given these patches after the initial screening, construct the training samples.

a. The first patch is added to the dictionary, which is initially empty.
b. Then we check whether the next patch is sufficiently similar to all patches in the dictionary. If yes, the next patch is tested; otherwise, the patch is added into the dictionary.

c. Repeat the second step until all patches have been tested.

Before the dictionary is constructed, the fingerprint image is divided into 8*8 samples and the mean value of each patch is calculated and subtracted from the corresponding patch.

Construction: it is a training method called K-SVD. The dictionary is obtained by iteratively solving an optimization problem. *Y* is consisted of the training patches, *A* is the dictionary, *X* are the coefficients and *Xi* is the *i th* column of *X*. In the sparse solving stage, we compute the coefficients matrix *X* using MP method, which guarantees that the coefficient vector *Xi* has no more than *T* non-zero elements. Then, update each dictionary element based on the singular value decomposition (SVD).

B. Compression of a Given Fingerprint

Given a new fingerprint, slice it into square patches which have the same size with the training patches. The size of the patches has a direct impact on the compression efficiency. The algorithm becomes more efficient as the size increases. However, the computation complexity and the size of the dictionary also increase rapidly

The proper size should be chosen. In addition, to make the patches fit the dictionary better, the mean of each patch needs to be calculated and subtracted from the patch. After that, compute the sparse representation for each patch by solving the *l*0 problem. Those coefficients whose absolute values are less than a given threshold are treated as zero.

C. Huffman Encoding

Huffman coding was developed by David A. Huffman in a 1952.This method attracted an overwhelming amount of research and it is used in many applications such as fax machines and data compression techniques, especially image compression, which is the main contribution of this work. The two important properties of Huffman coding they are used usefully in this work are: unique prefix property, where no Huffman code is prefix of any other Huffman code, and optimality, where the Huffman code is minimum-redundancy code. Then the data obtained is a compressed binary output.

III. AGORITHM DESCRIPTION

1. Reading Fingerprint Image.
2. Converting into blocks.
3. Subtracting Mean with All elements of blocks.
4. Creating an Empty Dictionary. Select the first block as reference block and other blocks as test blocks
5. Match all the blocks using SVD and Norm Minimization
6. Store Mean value, Matched block, and index into dictionary. Repeat as step 5 till the last block.
7. Perform DCT based compression for Matched blocks in the dictionary.
8. Perform Huffman coding and Store Compresses value.

The figure shows the flowchart for the above algorithm.

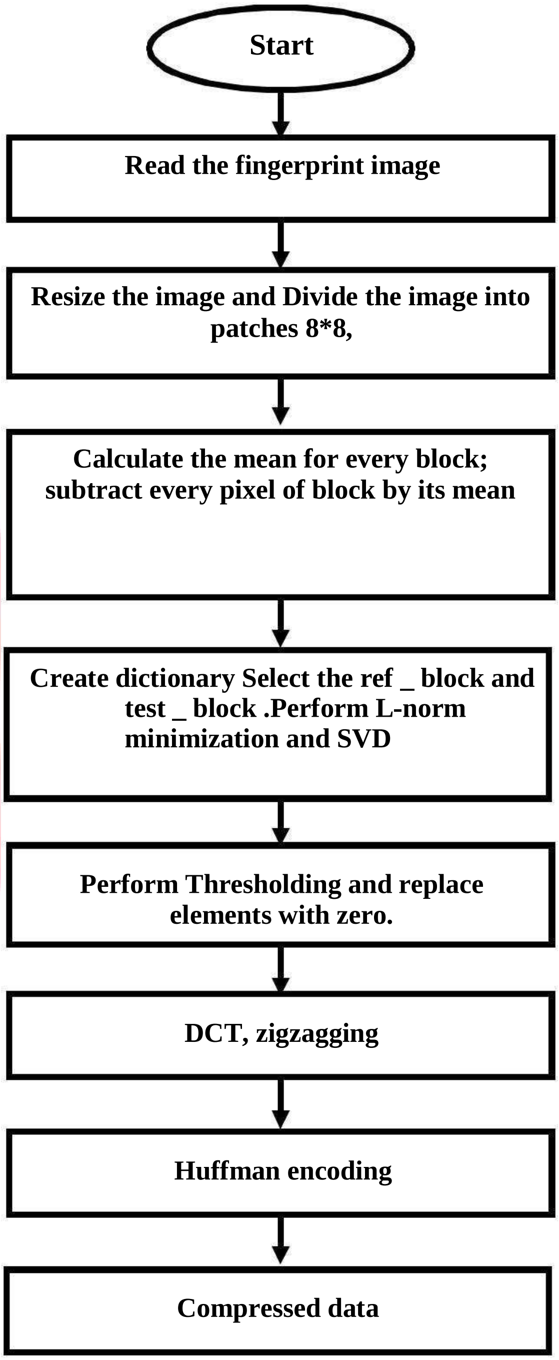

Figure 1: Flowchart for fingerprint image compression

IV RESULTS

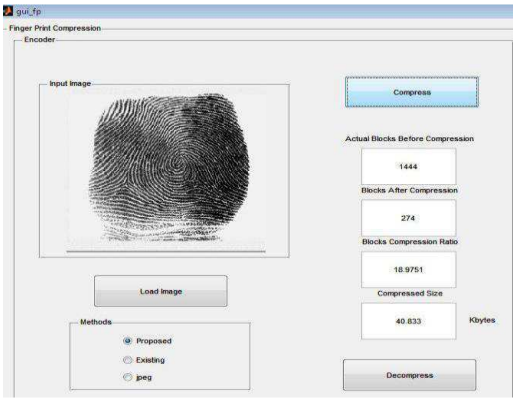

Figure 2: Huffman compressed image output

The above figure shows the compressed size of the fingerprint image using a DCT and Huffman Encoding (proposed method). The compressed image is decompressed to reconstruct the original fingerprint image and PSNR, MSE values are displayed below.

Figure 3: Huffman decompressed image output

The comparison is d one by consider three different fingerprint image samples, which is shown in the below figure.

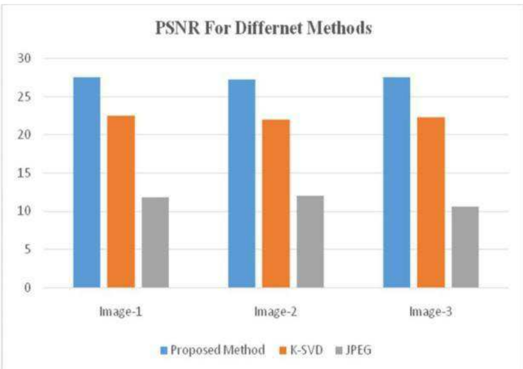

Figure 4: PSNR for comparison for different methods

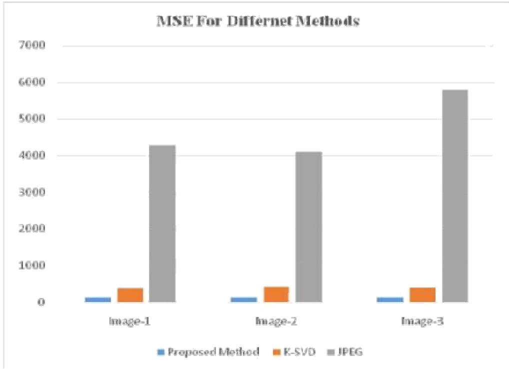

Figure 5: MSE comparison for different methods

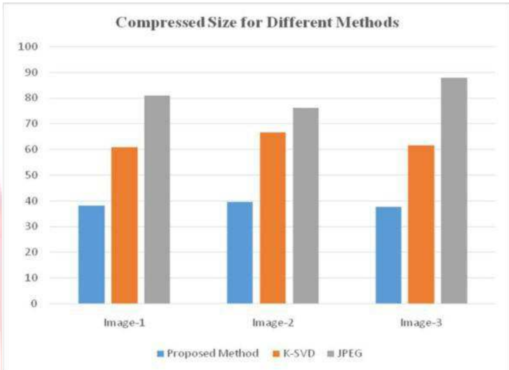

Figure 6: Compressed size comparison for different methods

	Compressed size(Kbytes)	***PSNR***	***MSE***
PROPOSED METHOD	40.833	29.8745	66.9322
K-SVD	55.2454	25.0038	205.4484
JPEG	77.111	13.4959	2907.316

Table 1: PSNR, MSE and Compressed size comparison

V CONCLUSION

This paper introduced a novel direct fingerprint image compression method based on sparse representation the different compression techniques adapted to compress the fingerprint images are reviewed and their Performance are compared

On the other side, our result analysis shows the comparison in term which is of PSNR and MSE obtained using mathematical method and MATLAB. PSNR and MSE comparison are done based on three sets of database consisting of few samples of fingerprint images. So we conclude that the fingerprint images in terms of PSNR, compressed size and MSE show that the fingerprint images are well compressed using our proposed method in comparison to K-SVD compression method and JPEG standard compression method.

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