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A NEW CODING METHOD IN PATTERN RECOGNITION FINGERPRINT IMAGE USING VECTOR QUANTIZATION

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Abstract— **Fingerprints are imprints formed by friction ridges of the skin and thumbs. They have long been used for identification because of their immutability and individuality. Immutability refers to the permanent and unchanging character of the pattern on each finger. Individuality refers to the uniqueness of ridge details across individuals; the probability that two fingerprints are alike is about 1 in 1.9x1015. In despite of this improvement which is adopted by the Federal Bureau of Investigation (FBI), the fact still is "The larger the fingerprint files became, the harder it was to identify somebody from their fingerprints alone. Moreover, the fingerprint requires one of the largest data templates in the biometric field". The finger data template can range anywhere from several hundred bytes to over 1,000 bytes depending upon the level of security that is required and the method that is used to scan one's fingerprint. For these reasons this work is motivated to present another way to tackle the problem that is relies on the properties of Vector Quantization coding algorithm.**

Key words— **Vector Quantization, Fingerprint, Vector Quantization coding algorithm**

I. INTRODUCTION

Nowadays, fingerprint recognition is one of the most important biometric technologies based on fingerprint distinctiveness, persistence and ease of acquisition. Although there are many real applications using this technology, its problems are still not fully solved, especially in poor quality fingerprint images and when low-cost acquisition devices with a small area are adopted.

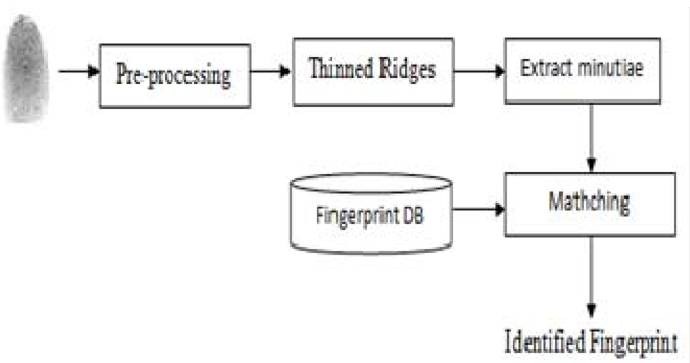

Fig.1 Fingerprint Recognition process

In fingerprint recognition process, the important step which affects on system accuracy is matching between template and query fingerprint. Many solutions are designed to increase this step's accuracy ([1], [2], [3], [4], [5], [6]). Fingerprint imaging technology looks to capture or read the unique pattern of lines on the tip of one's finger. These unique patterns of lines can either be in a loop, whorl, or arch pattern [7]. There are several methods in accomplishing the process of identifying one's fingerprint [8]. The two major applications of fingerprint recognition are

fingerprint verification and fingerprint identification. Verification is known as one-to-one fingerprint matching, whereas, fingerprint identification is known as one-to-many

matching. Verification is used for access applications and identification is used for investigation purposes. Many successful approaches have been presented for verification applications, where the identification field is still open challenging area because of many problems. The main common problem that the verification faces is the huge database. This problem can be classified into two categories: first is

establishing identify based on single print i.e. comparing a latent print from the scene of a crime with prints from a file. Second is establishing identify based on a set of ten fingerprint records i.e. record [9]. After arrest or employment are requirements. For reasons discussed in [10], the problem of the first category is extremely difficult, whereas the second one has greater quantity of information available from ten-print file searching. The traditional systems have sequential structure which suffers from a problem that the error propagates and information is blocked which means that the second stage can not use the information available at the first stage but it may suffer from the errors caused by the first stage. Moreover, conventionally, the matching process may use the following features: ridges or valleys (or both), minutia i.e. its type, location and direction, and global matching. Common Features are shown in Table 1 and Figure 1 respectively.

Table 1. Common Features for Matching Process

Ridges	Various patterns across fingerprint
Valleys	Spaces between ridges
Minutia	Type (ending, bifurcation)Location (x,y) Direction
Global Patterns	Arch LoopWhorl

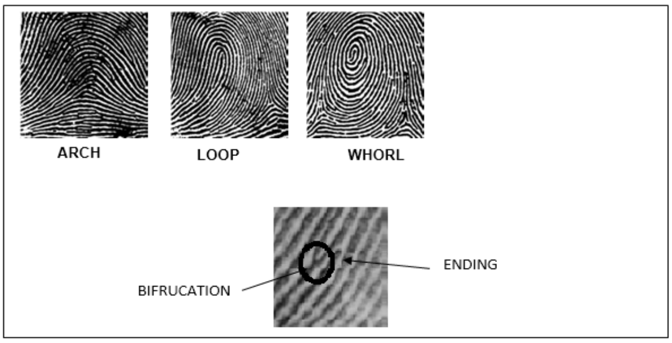

Figure 2. Common global Patterns (above), common Minutia

This work proposes new feature that can be used for matching. The proposed feature is a vector generated after the fingerprint image is compressed by Vector Quantization Coding approach. This vector is uniquely representing the entire image. Thus, it can

be effectively used for matching purposes. The proposed algorithm is illustrated in section 3 and tested in section 4. Section 5 concludes this work and gives some recommendations. Before all, brief introduction to Vector Quantization coding is given in next section.

2. Vector Quantization Coding Algorithm:

It uses a codebook that contains the pixel patterns with the corresponding index on each of them. The main idea of VQ in image coding is then to represent arrays of pixels by an index in the codebook. In this way, compression is achieved since the size of the index is usually a small fraction of that of the block of pixels [11].

3. PROPOSED APPROCH:

A. Mechanism Of The proposed system :

In Figure 3. depicts the general mechanism of the proposed system. After the fingerprint image is fed to the system, it will be converted to binary image as a preprocessing stage. Then the binary image is compressed using Vector Quantization coding approach. The first stage in image vector quantization is the image formation. The image data are first partitioned into a set of vectors. A large number of vectors from various images are then used to form a training set. The training set is used to generate a codebook, normally using an iterative clustering algorithm. The quantization or coding step involves searching each input vector for the closest codeword in the codebook. Then the corresponding index of the selected codeword is coded and transmitted to the decoder. At the decoder, the index is decoded and converted to the corresponding vector with the same codebook as at the encoder by look-up table. Thus, the design decisions in implementing image vector quantization include [12]:

1. vector formation;
2. training set generation;
3. code book generation; and
4. quantization.

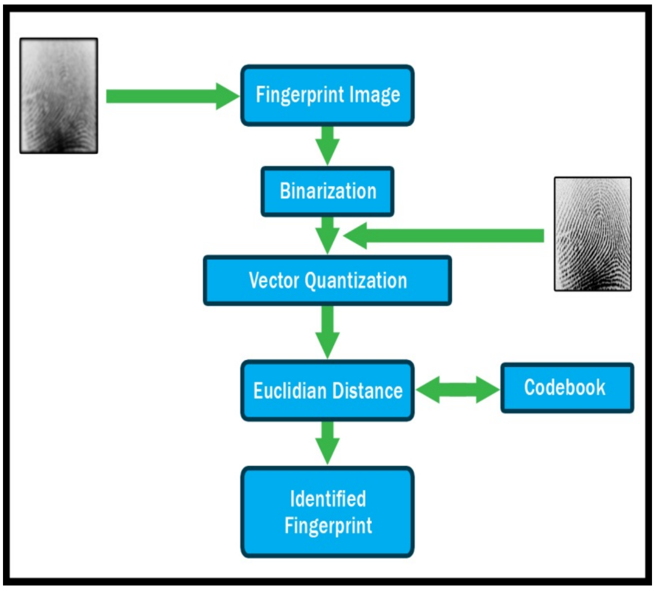

Figure 3. Flowchart for the proposed algorithm

the distance between the entire vector and the corresponding vector in codebook is equal to zero, but because of the entire image has not always the exact appearance to the image that captured during the stage of building the codebook, the distance may be greater. However, the shortest distance can be used to point to the corresponding vector and then fingerprint is identified.

Procedure Of Applying Proposed System:

The two important components for the system shown above are the Vector Quantization coding compression stage and the codebook. At compression stage the entire image which is binary matrix is compressed using Vector Quantization coding algorithm to produce a vector of almost 1/16 image size. For instance, for the fingerprint image of size 256x256 or 65536 which uses 65536 bytes, the generated vector length is 4096 that is using 8192 bytes. Therefore, the memory size is decreased by 1/8, from 65536bytes for original image to 8192bytes for corresponding vector. To build the codebook, same procedure can be followed, by converting the database (fingerprint images) to code vectors and assigning each one to its corresponding owner. Thus the codebook contains vectors rather than images. For instance, if we have 1 million finger images for 1 million persons, this database is traditionally using 256x256x1000000 = 655360000000 bytes ~ = 154

Gigabytes, their corresponding vectors use only 20720x1000000 bytes ~= 19 Gigabytes. These simple calculations lead to conclude that the identification rate has gained many benefits such as high speed as well as low False Acceptance Rate (FAR) / False Rejection Rate (FRR).

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