International Journal of Trend in Scientific Research and Development (IJTSRD)
Volume 3 Issue 5, August 2019 Available Online: www.ijtsrd.com e-ISSN: 2456 – 6470

Identification of Persons by Fingerprint using Huffman Coding Algorithm

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How to cite this paper: Nwe Ni Kyaw | Kyaw Kyaw Naing | Myat Myo Nwe Wai "Identification of Persons by Fingerprint using Huffman Coding Algorithm" Published in International Journal of Trend in Scientific Research and Development (ijtsrd), ISSN: 2456-6470, Volume-3 | Issue-5, August 2019, pp.1208-1211, **https://doi.org/10.31142/ijtsrd26600**

IJTSRD26600

ABSTRACT

Fingerprint system is one of the most common biometric features used for personal identification and verification. There are many techniques used for finding the features of fingerprint when it matches the other images of fingerprint. This system must input the fingerprint for the corresponding profile. It converts the binary image. This image will convert the Huffman code approach and to generate codes for input fingerprint. The system has the profile information along with their associated fingerprints. When the system identified the fingerprint, the system will display the associated profile information for the corresponding image. Huffman compression technique was the most accurate technique for compression of fingerprint image.

KEYWORDS: *Biometrics, Automated Fingerprint Identification System, Huffman Code*

1. INTRODUCTION

Biometrics are automated methods of recognizing a person based on a physiological or behavioral characteristic. Among the features measured are face, fingerprints, hand geometry, handwriting, iris, retinal, vein, and voice. Biometric data are separate and distinct from personal information. Biometric templates cannot be reverse-engineered to recreate personal information and they cannot be stolen and used to access personal information [1].

Fingerprint identification is the method of identification based on the different patterns of human fingers, which is actually unique among each person.

Figure 2: (a) Plain Arch (b) Loops (c) Whorls

It is the most popular way of acquiring details of any person and is the easiest and convenient way of identifying a person [4]. These unique patterns of lines can either be in a loop, whorl, or arch pattern [5]. In figure 1, shows the fingerprint patterns. Finger patterns can be divided into three groups as show below figure 2. **Arches**: Ridges enter and exit on same sides. Loops: Ridges enter on one side and exit on different side. Whorls: It consists of circles or mixture of pattern types [4].

Figure1: Fingerprint pattern

The two major applications of fingerprint recognition are Fingerprint verification and fingerprint identification. Fingerprint Verification; also known one-to-one fingerprint matching or Fingerprint Authentication is the process of confirming that a user is who they claim to be. In fingerprint Verification a user usually provides some kind of identification, for example a user ID or username or a card before placing his finger on the fingerprint scanner. It takes the user ID and tries to match the new fingerprint with the fingerprints associated with this user ID.

Fingerprint Identification, also known as one-to-many matching fingerprint matching, is the process of comparing a fingerprint against all the fingerprints in the database to see if a match is found.

Fingerprint identification system is a part of a project to design and implement a national standard for collecting, encoding, storing and retrieving digitized fingerprints images.

2. RELATED WORKS

Aburas et al. (2008) has been presented the fingerprint patterns recognition system by using Huffman Coding algorithm. Firstly, the fingerprint image is fed in the system. Secondly, it converts the binary image as the pre-processing stage. And then, the binary image is compressed by using Huffman coding approach. The obtained results are considerably promising since very low FAR i.e. 0.733%, FRR i.e. 2.6% and high accuracy i.e. approximately 97%. The weakness of the system comes from the point of different captured environments for the images [2].

Kanbar et al. (2016) proposed the fingerprint identification and verification system for crime scene investigation. the paper presents an overview of the different steps involved in the development of fingerprint based person identification and verification using minutiae based system [3].

Kambli et al. (2010) presented for compressing the fingerprint images by comparing the different methods. This research used 50 images of 512 x 512 bmp format. The result showed Modified SPIHT offers better compression than basic SPIHT and JPEG [7].

McMahon et al. (2003) published Huffman Coding Algorithm for implementation of Character Recognition System. They used this algorithm to produce approximate character. Alternatively, Huffman Coding Algorithm is used to implement current fingerprint identification system [8].

3. Automated Fingerprint Identification System

Automated Fingerprint Identification Systems (AFIS) arc used inlawcnforccmcnt and security applications to identify individuals based on their fingerprints. A pattern matching algorithm is typically at the heart of these systems. Pattern matching is used to compare two different fingerprint images to determine if they represent fingerprint impressions from the same individual.

4. Huffman Code

In computer science and information theory, Huffman coding is an entropy encoding algorithm used for lossless data compression. The term refers to the use of a variable-length code table for encoding a source symbol (such as a character in a file) where the variable-length code table is derived in a particular way based on the estimated probability of occurrence for each possible value of the source symbol [9].

The technique works by creating a binary tree of nodes. These can be stored in a regular array, the size of which depends on the number of symbols, *n*. A node can be either a leaf node or an internal node.

Initially, all nodes are leaf nodes, which contain the symbol itself, the weight (frequency of appearance) of the symbol and optionally, a link to a parent node which makes it easy to read the code (in reverse) starting from a leaf node. Internal nodes contain symbol weight, links to two child nodes and the optional link to a parent node. As a common convention, bit '0' represents following the left child and bit '1' represents following the right child. A finished tree has up to *n* leaf nodes and (n – 1) internal nodes. A Huffman tree that omits unused symbols is produced the most optimal code lengths [10].Huffman coding uses a specific method for choosing the representation for each symbol.

The process essentially begins with the leaf nodes containing the probabilities of the symbol they represent, and then a new node whose children are the 2 nodes with smallest probability is created, such that the new node's probability is equal to the sum of the children's probability. With the previous 2 nodes merged into one node (thus not considering them anymore), and with the new node being now considered, the procedure is repeated until only one node remains, the Huffman tree. Fingerprints are encoded 8-bits grayscale images.

Huffman coding algorithm is an entropy encoding algorithm used for lossless data compression in image processing and information theory.

The simplest construction algorithm uses a priority queue where the node with lowest probability is given highest priority:

1. Create a leaf node for each symbol and add it to the priority queue.
2. While there is more than one node in the queue:
   A. Remove the two nodes of highest priority (lowest probability) from queue:
   B. Create a new internal node with these two nodes as children and with probability equal to the sum of the two node probabilities.
   C. Add the new node to the queue.
3. The remaining node is the root node and the tree is complete.

If the symbols are sorted by probability, there is a linear-time (O(n)) method to create Huffman tree using two queues, the first one containing the initial weights (along with pointers to the associated leaves), and combined weights being put in the back of the second queue. This assures that the lowest weight is always kept at the front of one of the two queues:

A. Starts with a many leaves as there are symbols.

B. Enqueue all leaf nodes into the first queue (by probability in increasing order so that the last likely item is in the head of the queue).

C. While there is more than one node in the queues:

1. Dequeue the two nodes with the lowest weight by examine the front of both queues.
2. Create a new nodes, with the two just removed nodes as children (either node can be either child) and the sum of their weights as the new weight.
3. Enqueue the new node into the rear of the second queue.

D. The remaining node is the root node; the tree has now been generated.

5. Proposed System

In the following system design; the system displays the associated profile information for the corresponding fingerprint.

A. Algorithm Flowchart

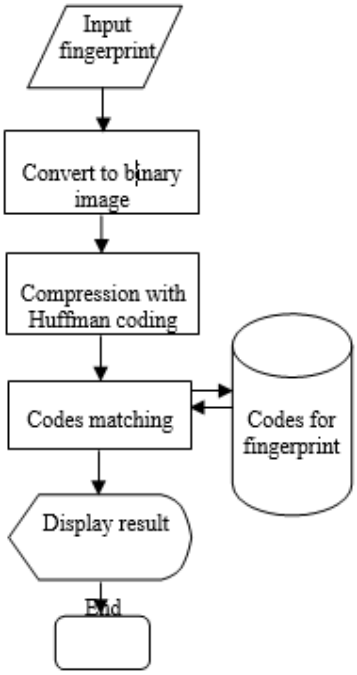

Figure3: System Flow Diagram

In Figure 3. depicts the general mechanism of the proposed system The system has two main tasks, profile information acquisition and fingerprint identification. In profile information acquisition process; user can input the profile information to the system. Also, user must input the fingerprint image for the corresponding profile. This image will be converted into Huffman code and store in database for the identification process. In the fingerprint identification process; the user must input the fingerprint image to the system. Then, the input fingerprint image is also converted into Huffman codes stored in the database. When the system identified the fingerprint, the system will display the associated profile information for the corresponding fingerprint.

6. Experimental Results

After the fingerprint image process is finished, user select match image to start fingerprint recognition process to find the associated person.

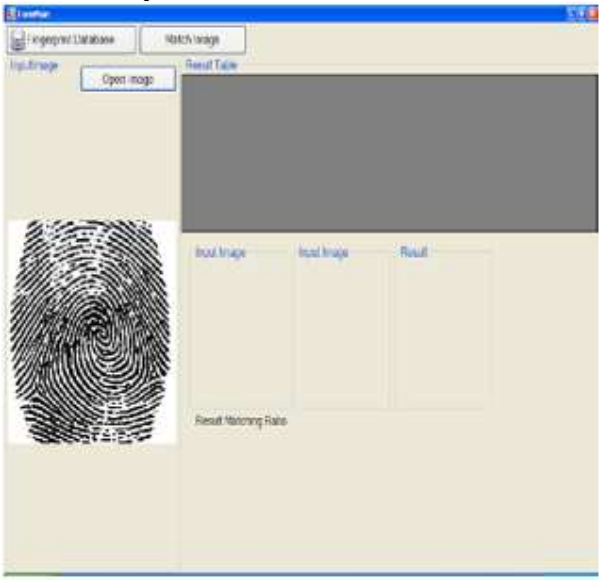

Figure4: .Fingerprint database

In the figure 4, , user can see the stored personal profile information. "Add New" button represents the process for adding new personal information.

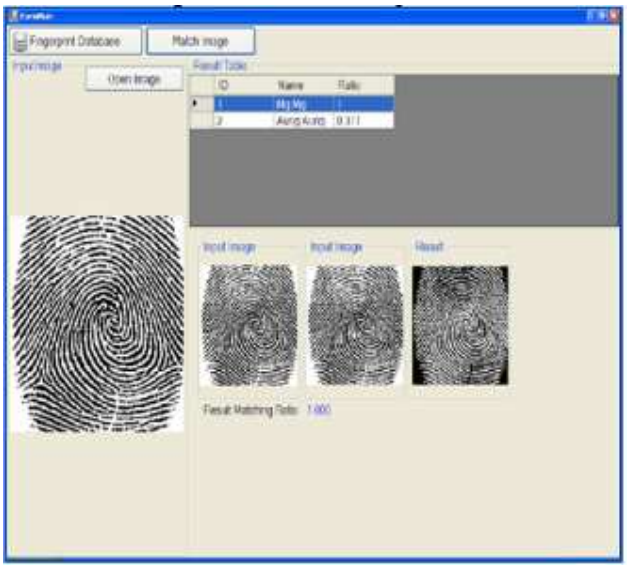

Figure5: Form main window

According to the result table, "Open Image" button represents the process to input the fingerprint for recognition process. When user clicks the “Open Image” button, the following Select Image window will appear to choose input fingerprint. At this window, user can rotate the fingerprint to be in appropriate orientation. "OK" button represent the process to finish fingerprint input process. After the fingerprint image process is finished, user can start fingerprint identification process to find the associated person.

When the fingerprint recognition process is completed, the result information will be displayed in the Result Table. The associated person is the one who has the maximum similarity ratio. In the example, user can be determined that the associated person for the input fingerprint is “Mg Mg”.

7. CONCLUSION AND FUTURE WORK

The system uses Huffman coding Algorithm to compress the fingerprint image for storing it into the personal profile information database to save space and gets response time faster. Also, Huffman coding is used to match the input fingerprint against with the stored fingerprints from the personal profile information. Because the system can reduce space effectively, it is appropriate to store the large amount of fingerprints. Fingerprints are encoded 8-bits grayscale image. The system used C#.net programming language. The system can extend other programming language.

ACKNOWLEDGMENT

The authors would like to thank the anonymous reviewers and the editor for their valuable comments and suggestions, which improvement the quality of this paper.

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