A New Algorithm for Fingerprint Recognition

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Abstract

This study describes method for Automatic fingerprint Recognition(AFR). It presents a computer algorithm and mathematical model for (AFR). This identification algorithm involves several steps, including: image processing, modified chain coding to analyse marker lines to determine the model parameters, and the identification procedure to recognize the input frame image. To validate our work, several experiments are executed on number of real fingerprints images. Taken from AL-Nassiriah city for 30 university students.

Keywords: Fingerprint, Recognition, Image Processing, Chain

1.History

The first year of the first known systematic use of finger print identification began in the united states in 1902. The New York civil service commission established the practice of fingerprinting applications to prevent them from having better qualified persons take their tests for them. The New York state prison system began to use fingerprint for the identification of criminals in 1903. In 1904 the fingerprint system accelerated when the United States Penitentiary at Leavenworth , Kansas, and St. Louis, Missouri, Police Department both established fingerprint systems. The growing need and demand by police officials for a national repository and clearinghouse for fingerprint records led to an Act of Congress on July 1,1921, establishing the Identification Division of the FBI. In 1924 Identification Division of the FBI was established to provide one central repository of fingerprints. When the

Identification Division was established its purpose was to provide a central repository of criminal identification data for law enforcement agencies throughout the nation. However, in 1933 the United States Civil Service Commission (now known as the Office of Personnel Management) turned the fingerprints of more than 140000 government employees and applicants over to the FBI. Therefore, a Civil Identification section was established. These innovations marked the initiation of the FBI's Civil File which was destined to dwarf the criminal files in size. In 1992 the Identification Division was re-established as the Criminal Justice Information Services Division(CJIS). In the last years many algorithms for this purpose were applied.

2.Introduction

Fingerprint identification is the method of identification using the impressions made by the minute ridge formations or patterns formed on the fingertips. No two persons have exactly the same arrangement of ridge patterns, and the pattern of any one individual remain unchanged through life[1], other personal characteristics

may change, but fingerprint does not. The probability that two fingerprints are a like is 1 in 1.9*10^15[1].

Fingerprint can be recorded on special devices used for this purpose, these devices are worked digitally. So that it has a good a accuracy and sensitivity. The fingertips of any person generated from these devices has the same finger position and same rotation angle. Fingerprints have been in use for biometric recognition since long because of their high acceptability, immutability and individuality. Biometric recognition systems offer grater security and convenience that tradition methods of personal recognition. Along with the rapid growing of this emerging technology, the system performance, such as accuracy and speed, is continuously improved. At the same time, the security of the biometric system itself is become more and more important [2]. The most important branch of individual identification is fingerprint identification the AFR is a real life problem, which needs to be solved using different methods of information technologies such as serial chain coding method.

The world generate an increasing amount of information in the various forms with different degrees of complexity. The need for improved information systems has become more conspicuous, since information is an essential element in decision making. The applications of AFR are very important such as security access systems, credit card verification, Hug shots searching and criminal identification.

This paper introduces a new technique for fingerprint identification based on chain coding method. This technique has same characteristics comparing with other fingerprint identification method.

3.Image condition

All images used in this paper are taken to 30 persons from Iraqi society (student in Thi-Qar university) for one finger (thumb) with same conditions, the images has some properties such as:-

1. The image size is fixed.
2. The images are taken under one light source.
3. They have the same accuracy and resolution.
4. All the images taken with same finger direction and with out any deformation.

All images are copied to be processed in the computer using one scanner and then enhanced using ACDsee version 5program[3].

4.The proposed recognition system

4.1.The modified chain coding algorithm

At first, this algorithm converts the two dimensions matrix which represents the two dimensions input image to one dimensions vector(v), this vector consists of important features information of an input finger print image. Then the finger print image is translated into its edges features. The processing of edge extraction depending on 8-neigherhood window [4]. In our proposed algorithm the coordinate (x,y) of any edge is not recorded; because we don't need to decode the result vector. The edge direction is recorded only which refers to the next edge point in the chain. That reduces the processity time and the data base size.

4.2.The proposed algorithm

In the eight connectivity encoding scheme introduced by Freeman a link represents the direction between two points(pixels). These directions are numbered 0-to-7. In order to digitally represent these directions, three bits are needed for each direction[4,5,6]. Transition takes value between(0-7) each coding boundary (number of each points are represented by x and y coordinate of the starting of transition value each coding point must be valued(e.g.1 byte)). The proposed representation taken because in the above algorithm they use 0 to separate the edges. In our proposed algorithm we don't need to do that. Before chaining the boundaries in the binary edge detected image.

The categorization of these points can be described in terms of two characteristics of a given edge point(p). The first, N(p),is the number of 8-neighboors of the edge point. The second, T(p) is the number of edge to background or background to edge transitions[6]. The categorization illustrated in the table shown bellow.

Edge type	N(p)	T(p)
Isolated 'I'	0	0
End point'E'	Less or equal to 2	Equal to 2
Internal point'V'	Equal to 2	Equal to 4
Attractant multiway 'M'	-	Greater than or equal to 6
Potential multiway 'W'	Greater than 2	Equal to 4

Table (1): categorization of the used points.

The proposed algorithm can be described as bellow:-

1. Search for the edge point categorized as end point 'E' starting from the upper left corner of the image in to low right corner.
2. Join adjacent edge pixels starting from the detected end point.
3. Stopping at 'E','M' or 'W' with a priority given to 'M' over 'W' then chain this point to nearest attractant point.
4. If no categorized end point 'E' is found, search for any closed contour of 'V' point and broken it at point and chained as one.
5. Terminate the chain process when no edge detected or only Isolated point .

However, any encoded boundary can not be coded again since the encoding process deletes each encountered points. For each chained segment of boundary, the encoded data consists of the sequence of moves from boundary point to neighboring boundary point.

4.3.Matching process

Instead of storing the original biometric of template finger print images, the vector of important information of that fingerprint image is stored. This vector is represent the important features information. To identify the input figure image is existed in the stored database or not the following matching process is applied. The process consists of two stages:

The first stage we compare the number and type of input image edges with the numbers and types of all images stored in the database. The positions of these edge and the image maintain are not used.

The second step may be performed or not, that is depending on the result of first step. If there is a matched vector then the matching between the vector of input image and the detected vector in the edge positions, series lengths, and the angles direction of each edge which are stored

and recorded in the vector.

5.Experiments

We take two fingerprint images for thirty persons from Thi-Qar university using canon scanner device. The scanner device is used to record the image in some government foundations such as Hospitals, Police stations and search centers.

The proposed algorithm is applied on these 60 fingerprint images which are stored as a data base file. Then we choose any fingerprint image randomly from database file to recognize it and the reorganization system succeeds. The recognition system will reach the correct answer identification in short time (some few minute). The percentage success is 100% to all experiments taken. The undefined input image is matched will all fingerprint images stored in the database file except itself because they are 100% matching. The difference between any two fingerprint images(the 1'st one is the test image and the second one is read it from database file) is computed. The image which has least difference is the fingerprint image of required parson. The following figure shows a samples of fingerprint images used in our experiments.

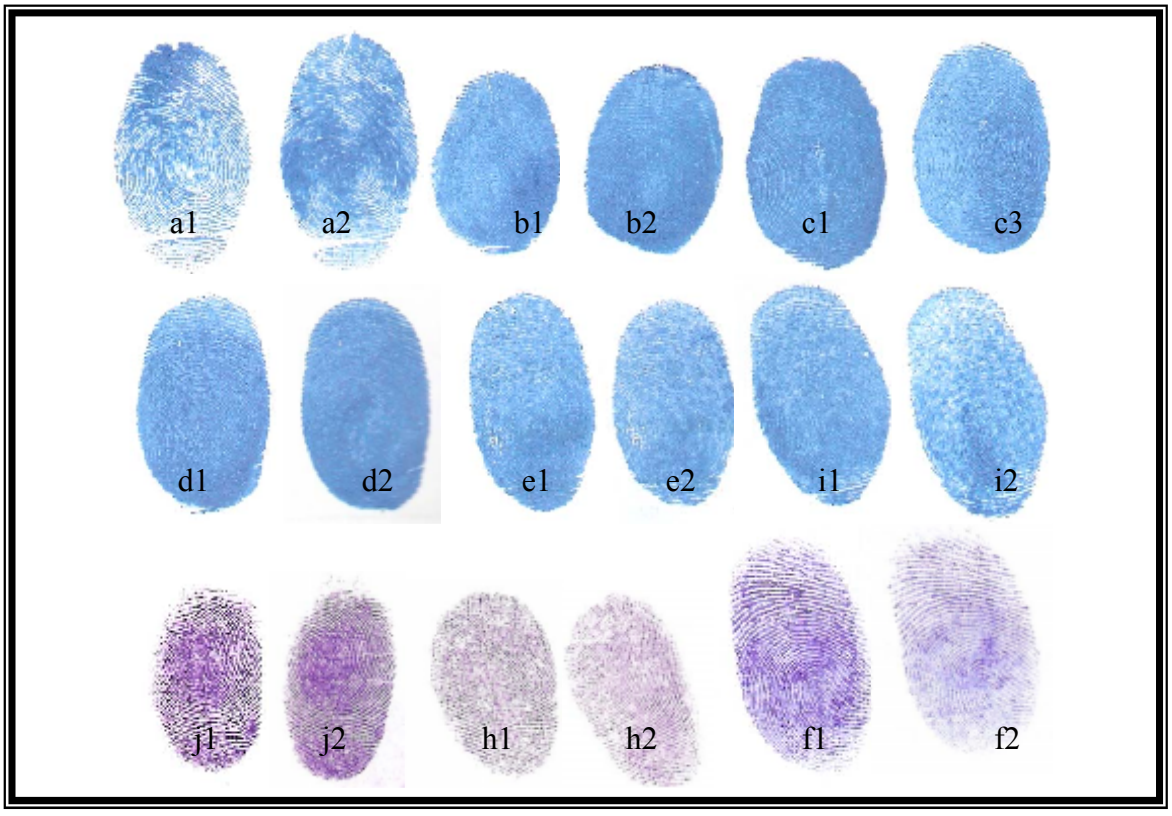


Figure (1) :sample of the fingerprint images

Results and Conclusions:

The following table (2) shows the difference between any input fingerprint image and other images stored in the image database except the input image itself, because the difference is zero.From the obtained results we conclude that there is 100%

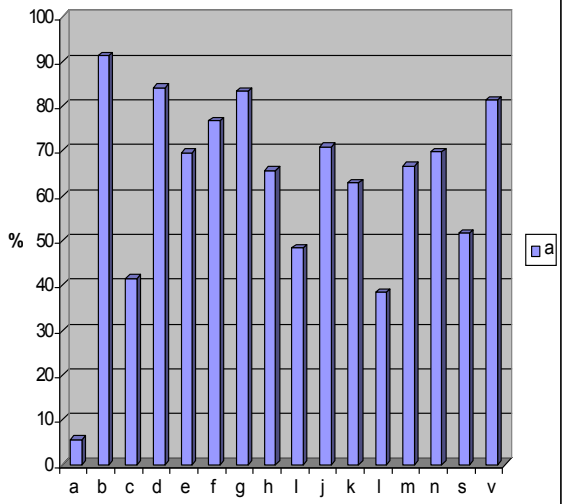
matching with the expected results. This mean that the proposed algorithm is better than the previous algorithms in this field, because those methods often give a percentage of error.

A sample of the obtained results was represented by a histogram as shown in fig.(2,3,4,5,6,7,8,9). This histogram helps the user to detect the required image belonging to the same person because it has always a minimum value (the lowest column in the histogram).

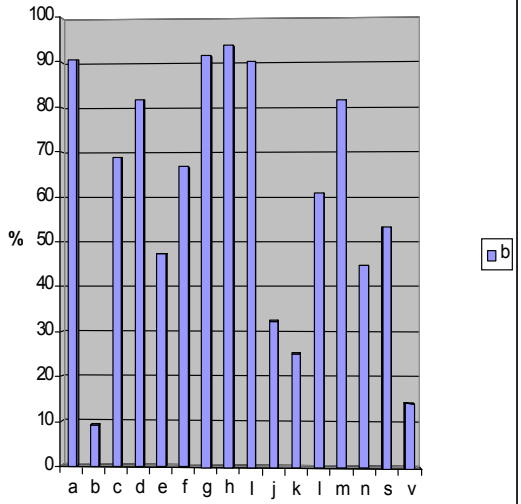
E3	A	B	C	D	E	F	G	H	I	J	K	L	M	N	S	V
A	5.7	91.25	41.54	84.11	69.63	76.69	83.28	65.6	48.44	70.93	62.82	38.39	66.65	69.85	51.63	81.26
B	90.6	9.35	68.73	81.67	47.41	66.59	91.19	93.44	89.76	32.47	25.23	60.8	81.46	44.88	53.26	14.38
C	71.06	85.04	2.3	72.83	48.04	60	71.4	41.16	12	50.28	36.41	15.39	42.95	48.42	17.26	67.94
D	29.67	44.95	68.08	7.86	91.22	46.73	15.23	16.56	24.61	83	34.05	87.94	19.96	89.83	20.53	18
E	77.56	71.21	92.5	47.7	7	23.26	44.96	13.24	69.75	40.29	22.4	98.53	11.8	38.21	59.25	38.29
F	29.11	62.48	50.84	31.85	30.31	0.88	28.28	47.58	20.22	24.71	59.5	64.37	43.09	29.36	10.5	19.58
G	98.33	47.69	49.76	14.97	81.7	39.43	9.51	15.77	97.45	73.89	68.89	68.63	99.5	80.38	89.37	12.12
H	90.7	74.58	69.96	53.82	11.7	32.24	51.4	9.2	49.89	15.49	18.07	79.13	30.25	12.49	40.62	45.51
I	93.97	83.04	13.39	69.19	41.09	54.79	67.53	33.28	9.22	43.62	27.89	19.5	35.31	41.52	16.18	63.64
J	44.07	69.92	11.13	45.25	14.49	19.81	42.49	18.33	77.38	9.78	27	11.98	14.73	13.73	66.4	35.51
K	69.02	76.5	57.26	57.27	18.3	37.3	55.03	12	38.69	21.8	1.8	65.74	11	18.9	30.11	49.58
L	62.31	85.81	15.11	79.22	50.7	62.17	72.87	44.17	16.32	52.82	39.66	6.89	45.87	51.06	21.5	69.58
M	98.88	73.78	75.3	52.37	18.9	30.19	49.87	13.38	54.6	12.84	11.47	84.76	4.34	10.54	45.03	43.8
N	31.7	71	93.9	47.32	73.32	22.7	44.56	14.08	71	35.95	23.29	10.36	10.6	9.22	60.42	37.83
S	16.78	81.92	20.86	67.16	37.2	51.81	65.44	28.88	16.59	39.9	23.14	27.39	31.05	37.66	9.96	61.25
V	33.61	53.35	11.93	15.25	62.05	24.35	10.81	83.51	75.09	55.08	98.35	28.76	77.93	60.87	58.07	9.42

table(2) represent the variation percentage between each image with the other

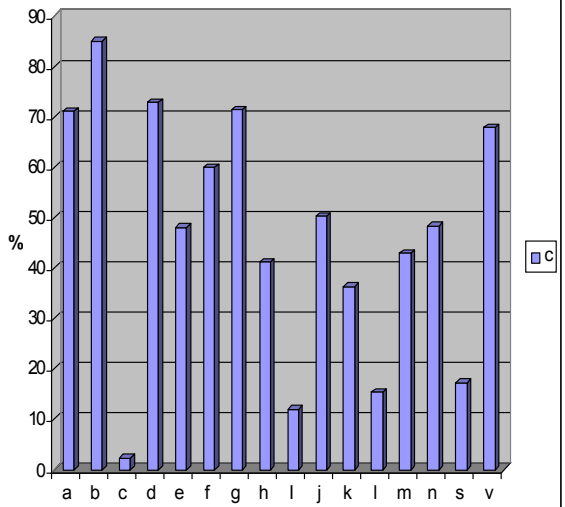
Figure(2)represent the variation percentage between the image a with the other images



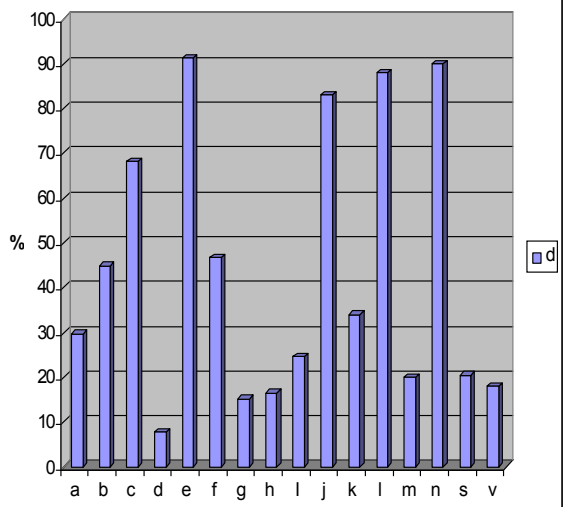
Figure(3)represent the variation percentage between the image b with the other images



Figure(4)represent the variation percentage between the image c with the other images

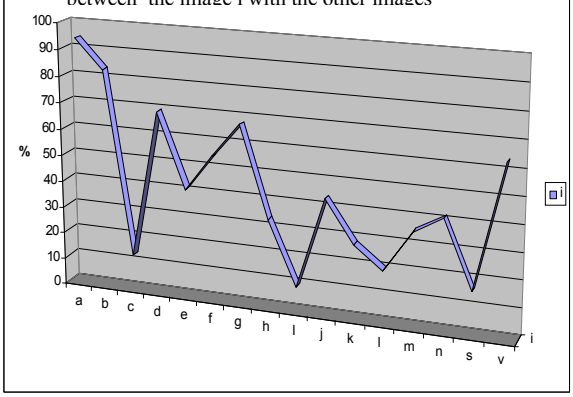


Figure(5)represent the variation percentage between the image d with the other images

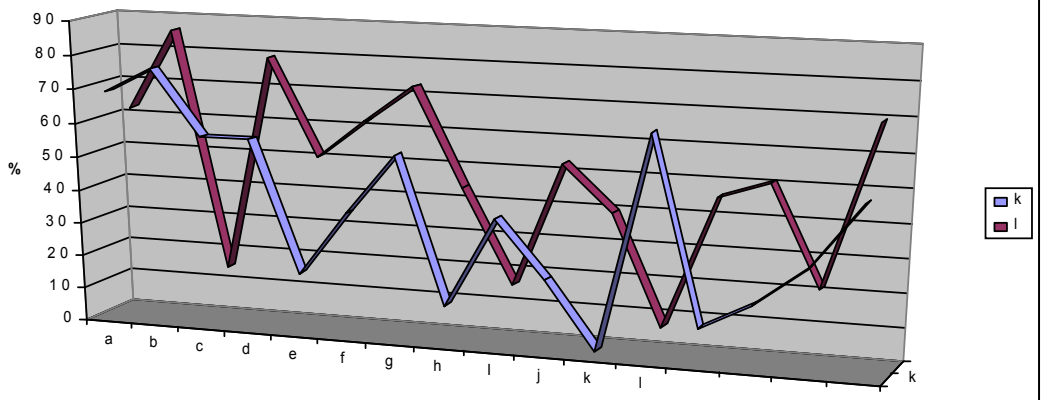


Figure(6)represent the variation percentage between the image j with the other images

Figure(7)represent the variation percentage between the image i with the other images



Figure(8)represent the variation percentage between the image i,k with the other images



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