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Fingerprint Pattern of Matching Family with GLCM Feature

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Abstract

In this research, fingerprint pattern matching is done to find out whether there is the similarity between parent and child fingerprint pattern. An important step in fingerprint matching is the fingerprint pattern search and matching. Fingerprint data is used by 11 families from various families. The method used in fingerprint feature extraction is GLCM. The GLCM angle used is 0^o, and the features used are contrast, homogeneity, correlation, and energy. For fingerprint pattern matching use minutiae score. From the results obtained GLCM has been widely used in fingerprint texture analysis. This study proves that the proposed method for matching fingerprints on parents and children gets the most dominant pattern is the loop pattern.

Keywords*: Fingerprint, GLCM, Pattern, Texture, Analysis*

1. Introduction

Fingerprint is categorized as one of the best identification tools for its uniqueness [1-2]. Many researchers about combination development [3], feature extraction is well done [4]. Fingerprint matching is an essential and difficult predicament in fingerprint recognition. Still, even if so many different methods are there, it has been erudite from studies that a improved feature extraction technique may leads to especially good outcome [5]. Even though so many different methods are there, it has been learned from studies that a better feature extraction technique may leads to very good results. Co-occurrence matrices can be used to extract features from the fingerprint image because they are composed of regular texture patterns [6].

Fingerprints are the most widely used parameter for personal identification amongst all biometrics. Fingerprint identification is commonly employed in forensic science to aid criminal investigations etc. A fingerprint is a unique pattern of ridges and valleys on the surface of a finger of an individual [7]. In addition, the fingerprint is used for genetics [8], the relationship between the child's fingerprint has a correlation relationship with the parent's fingerprint [9]. Parents with a particular fingerprint pattern have a relative high tendency to produce children with the same pattern [10].

Several previous studies have examined fingerprint matching using the GLCM method. As for the concentration conducted in this study is, fingerprint matching is done on family fingerprint between parents and children. The data used in this study were 11 different family fingerprints. The GLCM method is used to extract parent and child fingerprints. Minutiae score is done to match the fingerprint pattern.

2. Related Work

Fingerprint matching is performed based on finding the normalized Euclidean distance between the input and the template feature vectors. Experimental results validate the effectiveness of the proposed method in extracting fingerprint features and achieving good performance [6].

This work uses vector which is generated from Huffman coding compression process. Therefore, the matching process is done between code (vector) and codes (vectors) and the database is sharply decreased. 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% [11]. Finger print recognition and matching algorithm is explained and results give remarkable performance.

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Images are cropped and features are extracted, then matching is done using Euclidean distance [5].

3. Research Method

In this study, we determined the classification of the fingerprints of parents and children in accordance with Reviews their respective families. Fingerprint Data taken using a digital fingerprint persona u are u 4500 SDK. Then the application used is C# based applications. Before the stage classification will be done first pre-processing of the fingerprint of data, the size of the original fingerprint 254x292.At the stage of pre-processing will be Carried outcropping of the fingerprint of data to the size of 154x192. After the pre-processing stage will be Carried out later on fingerprint feature extraction parents and children to get its value, then it will be done after the pattern matching. The method of feature extraction proposed in this research is gray level co-occurrence matrix (GLCM) method. GLCM features used in this research are correlation, contrast, homogeneity, and energy.

$$\text{Correlation} \qquad f1 = \frac{\sum_i \sum_j (i-\mu_x).(j-\mu_y).p(i,j)}{\sqrt{\sigma_x \sigma_y}} \qquad (1)$$

Where:

i=row
j=columns
p=glcm matrix

$$\text{Contrast} \qquad f2 = \sum_i \sum_j (i-j)^2 . p(i,j) \qquad (2)$$

Measuring the spatial frequency of the image and the difference GLCM moment. The difference is meant a difference of its high and low pixel. Contrast will be 0 if the pixel neighborhoods have the same value.

$$\text{Homogeneity} \qquad f3 = \sum_i \sum_j \frac{p(i,j)}{1+(i-j)^2} \qquad (3)$$

The value was very sensitive to the value around the main diagonal. It will has a high value when all the pixels have the same value. The opposite of contrast will have a great value if it has the same pixel value at the time of valuable energy.

$$\text{Energy} \qquad f4 = \sum_i \sum_j p(i-j)^2 \qquad (4)$$

Energy will have a high value when the pixel values are similar to one another would otherwise be of little value indicates the value of GLCM normalization is heterogeneous. The maximum value of the energy was 1, which means the distribution of pixels in a state of constant or in the form (not random). The main steps of proposed method are:

1. Data collection fingerprint
2. Image resampling to 254 x 292 number of pixel size.
3. Pre-processing the input image (154 x 192).
4. Region-of-interest
5. Feature extraction GLCM
6. Determination of fingerprint pattern using minutiae score.

4. Results and Analysis

4.1. Data Collection Fingerprint

Data were taken from 11 different families in the Lombok region. The fingerprints were taken our children's fingerprints and parental fingerprints. The total fingerprint used in this study was 33 fingerprints.

4.2. Image Resampling

In this study, using the original fingerprint image with a size of 254x292 pixels as shown in Figure 1.

Figure 1. Fingerprint original (a) father (b) mother (c) child

4.3. Preprocessing

In the preprocessing stage will be cropping on the original fingerprint image into a 154x192 pixels to reduce the computing process, 154x192 cropping results can be seen in Figure 2.

Figure 2. Cropping fingerprint (a) father (b) mother (c) child

4.4. Region of Interest

At this stage we will look for the ROI of fingerprints father, mother and children to speed up the process of classification, the results of fingerprint ROI as Figure 3.

Figure 3. Region of interest

4.5. Feature Extraction GLCM

Feature extraction to obtain fingerprint features, parent, and child. Angles used are 0^o and features used are energy, contrast, correlation, and homogeneity. The results of fingerprint feature extraction for parents and children such as in Table 1.

Table 1. GLCM

No	Name	Contrast	Homogenity	Correlation	Energy
Family 1	Father	9347.3	0.3497	0.5049	0.0978
	Mother	8402.3	0.4321	0.5654	0.1470
	Child	6903.3	0.5202	0.5558	0.2478
Family 2	Father	8160.2	0.4209	0.5438	0.1447
	Mother	8402.3	0.4321	0.5654	0.1470
	Child	9723.9	0.4101	0.4918	0.1290
Family 3	Father	8160.2	0.4209	0.5438	0.1447
	Mother	8402.3	0.4321	0.5654	0.1470
	Child	9181.6	0.4057	0.4507	0.1353
Family 4	Father	8498.5	0.4670	0.5289	0.1748
	Mother	9611.9	0.4768	0.4967	0.1921
	Child	7957.9	0.5112	0.4334	0.2466
Family 5	Father	7525.4	0.4553	0.5487	0.1678
	Mother	6659.4	0.3669	0.5919	0.1864
	Child	6530.0	0.5060	0.4868	0.2437
Family 6	Father	8751.3	0.3846	0.4845	0.1183
	Mother	10448	0.3229	0.4082	0.0840
	Child	9710.9	0.3355	0.4619	0.0924
Family 7	Father	8751.3	0.3846	0.4845	0.1183
	Mother	10448	0.3229	0.4082	0.0840
	Child	9034.0	0.3607	0.4371	0.1048
Family 8	Father	8751.3	0.3846	0.4845	0.1183
	Mother	10448	0.3229	0.4082	0.0840
	Child	7490.3	0.4672	0.5134	0.1905
Family 9	Father	7313.2	0.3799	0.6170	0.1137
	Mother	8470.9	0.4875	0.4898	0.2128
	Child	8254.4	0.4921	0.5397	0.2132
Family 10	Father	9801.7	0.3452	0.4565	0.0967
	Mother	9053.9	0.3411	0.5282	0.0909
	Child	12617	0.3764	0.3793	0.1144
Family 11	Father	10374	0.3227	0.4117	0.0829
	Mother	7852.2	0.4341	0.5754	0.1518
	Child	5918.9	0.4604	0.6899	0.1691

4.6. Fingerprint Pattern

Pattern matching to facilitate the classification of each fingerprint pattern after pattern recognition is done according to each family. Fingerprint matching is done using minutiae score by counting the minutiae detected later in comparison with minutiae on other fingerprints. Example minutiae detected in Figure 4, to view the results of Table 2.

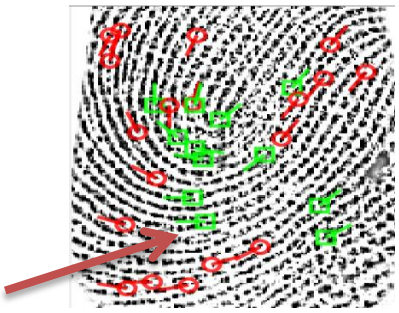

Figure 4. Minutiae detection

This study uses 11 family fingerprint data consisting of father's fingerprint, mother's fingerprint, and child's fingerprint, the total number of fingerprints used is 33 fingerprints. Gray level co-occurrence matrix (GLCM) method is used to obtain the extraction result on fingerprint,

the angle used in this research is angle 0^o. Minutiae score is used to calculate the number of detected minutiae so that it can be matched with every minutia of the father's fingerprint, mother's fingerprint, and child's fingerprint.

Table 2. GLCM and Fingerprint pattern using minutiae score

No	Name	Contrast	Homogenity	Correlation	Energy	Minutiae	Pattern
Family 1	Father	9347.3	0.3497	0.5049	0.0978	30	Loop
	Mother	8402.3	0.4321	0.5654	0.1470	32	Loop
	Child	6903.3	0.5202	0.5558	0.2478	30	Loop
Family 2	Father	8160.2	0.4209	0.5438	0.1447	35	Loop
	Mother	8402.3	0.4321	0.5654	0.1470	32	Loop
	Child	9723.9	0.4101	0.4918	0.1290	36	Loop
Family 3	Father	8160.2	0.4209	0.5438	0.1447	35	Loop
	Mother	8402.3	0.4321	0.5654	0.1470	32	Loop
	Child	9181.6	0.4057	0.4507	0.1353	39	Loop
Family 4	Father	8498.5	0.4670	0.5289	0.1748	31	Loop
	Mother	9611.9	0.4768	0.4967	0.1921	33	Loop
	Child	7957.9	0.5112	0.4334	0.2466	17	Whorl
Family 5	Father	7525.4	0.4553	0.5487	0.1678	28	Whorl
	Mother	6659.4	0.3669	0.5919	0.1864	35	Loop
	Child	6530.0	0.5060	0.4868	0.2437	20	Whorl
Family 6	Father	8751.3	0.3846	0.4845	0.1183	32	Loop
	Mother	10448	0.3229	0.4082	0.0840	39	Loop
	Child	9710.9	0.3355	0.4619	0.0924	38	Loop
Family 7	Father	8751.3	0.3846	0.4845	0.1183	32	Loop
	Mother	10448	0.3229	0.4082	0.0840	39	Loop
	Child	9034.0	0.3607	0.4371	0.1048	45	Whorl
Family 8	Father	8751.3	0.3846	0.4845	0.1183	32	Loop
	Mother	10448	0.3229	0.4082	0.0840	39	Loop
	Child	7490.3	0.4672	0.5134	0.1905	53	Whorl
Family 9	Father	7313.2	0.3799	0.6170	0.1137	31	Loop
	Mother	8470.9	0.4875	0.4898	0.2128	30	Loop
	Child	8254.4	0.4921	0.5397	0.2132	39	Loop
Family 10	Father	9801.7	0.3452	0.4565	0.0967	52	Loop
	Mother	9053.9	0.3411	0.5282	0.0909	51	Loop
	Child	12617	0.3764	0.3793	0.1144	52	Loop
Family 11	Father	10374	0.3227	0.4117	0.0829	41	Loop
	Mother	7852.2	0.4341	0.5754	0.1518	41	Loop
	Child	5918.9	0.4604	0.6899	0.1691	42	Loop

5. Conclusion

In this study presents two methods of fingerprint classification of parents and children. There are two major contributions to research. The first is fingerprint extraction using GLCM to get the value of a feature. The second is the use of the minutiae score method for matching fingerprint patterns. GLCM is also used to perform fingerprint analysis. The data used are 11 family fingerprints consisting of child fingerprint, father's fingerprint, mother's fingerprint. The most dominant pattern is the loop pattern. The success rate of the minutiae extraction process depends heavily on the quality of the fingerprint image. Image obtained with low image quality can result in minutiae process is not maximal so minutiae cannot be found.

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