

Comparative study of finger knuckle prints-pilot study

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Abstract

Biometric traits are now highly explored by the researchers to establish a system which can be used to identify a person accurately. The finger knuckle prints refers to the inherent patterns of skin that are formed at the joints in the finger back surface. This paper presents the comparative study of the finger knuckle prints, its individuality on the basis of which the prints are different from each other.

Keywords

Biometrics• Fingure Knuckle Print• Ridge Ending• Ridge Bifurcation• Individuality

Introduction

Biometric is being referred as an automatic identification or verification of an individual or a claimed identity by using certain physiological or behavioral traits associated with the prints such as knuckle- prints, hand geometry, iris, retina, face, hand vein, thermo grams, voiceprints, signatures and others. Knuckle print identification is now being one of the most important biometric technologies which has drawn a substantial amount of attention substantially [1].

The uniqueness of a knuckle print is determined by the local ridge characteristics and their relationships. The minutia has two local ridges which are being classified as the, ridge ending and ridge bifurcation. The ridge ending is the point where a ridge ends abruptly whereas the ridge bifurcation is the point where a ridge divides or diverges into a branched ridge. Comparison of the knuckle prints depends upon these local ridge characteristics and their relationship to make a personal identification.

Finger Knuckle Anatomy

Each finger has three joints. There are three bones in each and every finger known as the proximal phalanges, central phalanges and distal phalanges. It is shown in Figure 1.

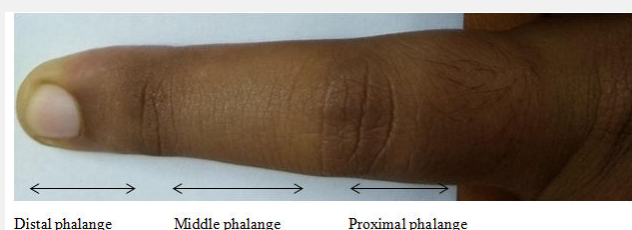


Figure 1. The names of three bones of a finger.

And this skin pattern has capability to discriminate completely different people and this pattern of knuckle print is unique and might be getting online or offline for authentication [2].

Aim

Comparative study of finger knuckle prints to identify the difference between male and female knuckle prints and to know the uniqueness in the prints.

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Materials and Methods

Sample collection

Sample size: 30 samples were collected where 15 samples of males and 15 samples of females. The samples were collected by photographing the knuckle prints against a white background. The image resolution was 4032 x 3024 and image size was 3.3 MB.

Sample analysis

The samples collected were converted into gray scale by using ImageJ software, after converting into gray scale a normalized image was obtained. The region of interest was obtained and the analyses of ridges were done. The spacing between the ridges was measured by using a Vernier Caliper. The ridges were marked as A, B, C and D. The spacing between the ridges, the number of ridge endings and the number of ridge bifurcations were observed in both the male and female finger Knuckle prints [3].

Equipment used

Vernier caliper was used for measuring the spacing between the ridges.

Image J software was used to convert the original image into gray scale image and then to an enhanced image (normalized image) [4].

Observations

SAMPLE (FEMAL ES)	DISTANCE BETWEEN THE LINES		RIDGE ENDING		RIDGE BIFURCATION	
	LEFT	RIGHT	LEFT	RIGHT	LEFT	RIGHT
S1	A to B 3.5 mm	A to B 4.4 mm	8	6	7	6
	B to C 4.1 mm	B to C 2.7 mm				
	C to D 3.5 mm	C to D 2.7 mm				
S2	A to B 2.4 mm	A to B 3.0 mm	4	5	8	10
	B to C 2.5 mm	B to C 2.3 mm				
	C to D 2.8 mm	C to D 2.6 mm				
S3	A to B 2.5 mm	A to B 3.3 mm	6	7	6	7
	B to C 3.2 mm	B to C 3.5 mm				
S4	A to B 2.7 mm	A to B 5.2 mm	6	6	8	7
	B to C 2.3 mm	B to C 2.5 mm				
	C to D 3.5 mm	C to D 2.0 mm				

S5	A to B 3.5 mm	A to B 2.1 mm	4	5	5	4
	B to C 5.0 mm	B to C 2.1 mm				
	C to D 2.6 mm	C to D 2.4 mm				
S6	A to B 1.9 mm	A to B 3.4 mm	6	7	6	7
	B to C 1.9 mm	B to C 2.8 mm				
	C to D 2.1 mm	C to D 1.9 mm				
S7	A to B 4.1 mm	A to B 2.7 mm	5	6	6	5
	B to C 3.7 mm	B to C 1.8 mm				
	C to D 3.0 mm	C to D 2.5 mm				
S8	A to B 4.6 mm	A to B 2.4 mm	8	9	7	8
	B to C 2.9 mm	B to C 3.0 mm				
	C to D 2.4 mm	C to D 2.4 mm				
S9	A to B 3.1 mm	A to B 4.3 mm	6	7	7	5
	B to C 4.1 mm	B to C 3.5 mm				
	C to D 3.2 mm	C to D 2.0 mm				
S10	A to B 4.2 mm	A to B 4.2 mm	5	6	4	5
	B to C 2.5 mm	B to C 3.5 mm				
	C to D 2.4 mm	C to D 2.1 mm				
S11	A to B 2.9 mm	A to B 2.8 mm	4	6	5	6
	B to C 2.0 mm	B to C 2.3 mm				
	C to D 2.0 mm	C to D 2.7 mm				
S12	A to B 2.7 mm	A to B 3.5 mm	4	4	4	3
	B to C 2.8 mm	B to C 3.3 mm				
	C to D 2.8 mm	C to D 3.2 mm				
S13	A to B 2.8 mm	A to B 3.7 mm	5	5	4	3
	B to C 3.7 mm	B to C 2.6 mm				
S14	A to B 3.8 mm	A to B 4.3 mm	5	6	4	5

S15	B to C 2.8 mm	B to C 2.4 mm	4	4	1	2
	C to D 2.9 mm					
	A to B 3.1 mm	A to B 1.9 mm				
	B to C 1.7 mm	B to C 2.3 mm				
	C to D 1.6 mm					

Table 1. Observation of ridge ending and ridge bifurcation is case of female fingers.

SAMPLE (MALES)	DISTANCE BETWEEN THE		RIDGE ENDING	RIDGE BIFURCATION		
	LINES					
	LEFT	RIGHT		LEFT	RIGHT	LEFT
S1	A to B 5.5 mm	A to B 3.9 mm	6	5	4	5
	B to C 1.9 mm	B to C 5.9 mm				
	C to D 4.7 mm	C to D 3.5 mm				
S2	A to B 3.4 mm	A to B 4.5 mm	5	5	4	3
	B to C 3.2 mm	B to C 2.6 mm				
	C to D 2.3 mm	C to D 1.6 mm				
S3	A to B 3.2 mm	A to B 5.5 mm	4	5	5	5
	B to C 1.7 mm	B to C 4.8 mm				
	C to D 5.2 mm					
S4	A to B 3.1 mm	A to B 5.6 mm	6	7	5	6
	B to C 2.3 mm	B to C 2.8 mm				
	C to D 5.6 mm	C to D 4.6 mm				
S5	A to B 2.8 mm	A to B 4.3 mm	5	6	4	6
	B to C 4.3 mm	B to C 4.1 mm				
	C to D 4.3 mm	C to D 2.0 mm				
S6	A to B 4.4 mm	A to B 2.7 mm	4	7	4	5
	B to C 4.4 mm	B to C 2.4 mm				
	C to D 2.7 mm	C to D 5.6 mm				

S7	A to B 2.8 mm	A to B 4.0 mm	6	8	4	4
	B to C 2.4 mm	B to C 4.0 mm				
	C to D 2.4 mm	C to D 1.5 mm				
S8	A to B 3.7 mm	A to B 2.5 mm	5	7	3	4
	B to C 1.8 mm	B to C 2.8 mm				
	C to D 2.2 mm	C to D 2.0 mm				
S9	A to B 4.0 mm	A to B 4.0 mm	5	5	8	6
	B to C 3.0 mm	B to C 2.9 mm				
	C to D 3.4 mm	C to D 2.9 mm				
S10	A to B 2.8 mm	A to B 2.9 mm	5	6	3	3
	B to C 2.5 mm	B to C 3.2 mm				
	C to D 1.5 mm					
S11	A to B 1.7 mm	A to B 3.4 mm	5	4	4	3
	B to C 1.8 mm	B to C 1.9 mm				
	C to D 1.9 mm					
S12	A to B 3.6 mm	A to B 5.0 mm	5	6	1	2
	B to C 3.6 mm	B to C 5.5 mm				
	C to D 5.6 mm	C to D 5.3 mm				
S13	A to B 4.9 mm	A to B 4.1 mm	6	7	5	6
	B to C 3.9 mm	B to C 3.2 mm				
	C to D 6.8 mm	C to D 3.4 mm				
S14	A to B 2.1 mm	A to B 4.8 mm	5	4	5	7
	B to C 2.6 mm	B to C 3.8 mm				
	C to D 3.2 mm					
S15	A to B 4.8 mm	A to B 3.9 mm	5	4	6	5

B to C	B to C
3.9 mm	4.0 mm

Table 2: Observation of ridge ending and ridge bifurcation is case of female fingers.

Result and Discussions

After the analysis of the Knuckle prints it was observed that, each and every print is individual and unique. The spacing between the ridge lines and the ridge endings and the ridge bifurcations were analyzed and differences were observed [5]. The spacing between the ridge lines were measured by using Vernier Caliper. In males the spacing between the ridge lines were observed higher as compared to that of females i.e., 6.8mm and 5.0mm respectively. In some prints only "3" ridge lines were observed where as in some prints "4" ridge lines were observed. The number of ridge bifurcations and the number of ridge endings were different in all the prints. The number of bifurcation minutiae was found to be minimum of 1 while maximum of 8 for males, where minimum of 1 and maximum of 10 for females [6].

Conclusion

The comparative study has been done to know the differences between the knuckle prints of females and males, and to know the different characteristics of finger knuckle prints on the basis of which its uniqueness is determined. So, differences were found in each and every finger knuckle prints and due to which it is individual to each and every person, and because of its uniqueness it is being used for biometric identification.

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