

Determination of Sex from the Latent Palm Prints Present on Documents

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Abstract

In the field of forensic science, to determine the sex of suspect from latent prints found at crime scene is often suspicious. Identification of an individual's sex is being possible from the latent palm prints present on documents. To determine the sex from the latent palm print can be done with minutiae details of developed prints from the documents, which will be helping for the investigators in nabbing the suspects. For this study, 60 samples including male and female from villages of Uttar Pradesh, India were taken for the determination of sex of an individual through the development of latent palm prints present on documents. The Obtained 12 parameters (radius of curvatures, Angle of curvature from line of writing, Inter distance between centre of curvatures, and Distance of centre of curvatures from line of writing), their mean values and standard deviations from this study not only gives the significant of sex at 95% confidence level of difference but also considered statistically significant (p<0.05). On behalf of which determination of sex can be done. It also can increase the evidential value of such lateral palm prints. These evidences can be helpful for reducing the pool of potential suspects in investigations, and also can be placed.

Keywords: Latent palm prints; Determination of sex; Documents; Statistically significant

Introduction

Patterns (Finger and Palm) which are genotypically determined [1] and Being unique and permanent by nature, these are considered one of the best mean of absolute identification of an individual [2]. The palm prints which are highly Individualistic [3] and encountered at crime scene and on questioned documents also. A few works has been carried out to determine the writer, but not to determination of gender of an individual. In forensic Science, to estimate the sex of suspect from latent palm prints is challenging [4] and no work has been carried out yet related to this. Identification of individual through palm prints is infallible [5], and if the determination of gender could be done from latent palm prints then it will be helping for forensic experts and Investigator's to nab a suspect [5].

It must be remembered that while writing or preparing the works of art, etc. one cannot help touching or holding the surface, part of the hand (Palm and Finger) resting on the writing surface to give support and facilitating the movement of the hand. Since the finger/Palm has raised lines and furrows having sweat pores which keeps the ridges moist, and hence as it touches the writing surface, it is expected to leave their impression (prints) in latent form on the writing surface or papers. Especially when we signed, the lower part of the palm (Hypothenar area) comes in the contact of the surface. Since sweat is apparently a colorless fluid, the prints so left behind are not visible to the naked eye; the visibility of the prints [5] are enhanced by various methods.

In this work, the inherent relation of the signatures with the lateral palm prints is leading the determination of sex of the suspect, and also increasing the reliability of questioned documents examination. By carefully examination of the developed palm prints and obtained parameters (Radius of curvature, Distance of curvature from line of writing, Angle of centre of curvature from line of writing, and interdistance of curvatures) of minutiae details gives the statistically significant values (P<0.05). These results indicate that the determination of sex is possible [6].

Material and Methods

Samples

For this study, 60 samples including 30 male and 30 female were considered from the villages Ramala, Kirthal, Barout, Sarurpur, Kishanpur Baral, Baoli, Bijwara, of Districts Baghpat and Meerut of Uttar Pradesh, North part of India in March 2013. The selection of the subjects was done randomly. After taking the consent of subjects, the subjects were asked to put their signature on white paper sheet of good quality (bond paper) with ball pen. For the development of fresh latent prints, Black powder was used, which is usually considered best developer for fresh samples.

Methods

All the subjects were selected randomly, and the consent was taken. The primary information about the subjects such as Age, sex, Address, occupation and their educational qualification were noticed. The subjects were asked to sit on the chair at ease. After giving a blank white paper sheet and blue ball pen to the individuals, were asked to sit on chair and to put the paper on a table which was up to the height of elbow. The subjects were spoke to put their signatures on the sheet at calm and congenial atmosphere [6].

When the individual was asked to stop to writing, according to the "Mutual Exchange principle" [7] the print in latent form was also transferred on papers and below to the signature. By carefully handling, the sheets were put at the room temperature for 5-6 hours.

Development of latent prints

Black powder: The powder, which reacts with the lipid materials present in the prints (finger and palm) residue and enhance the visibility of latent prints. All the samples were put at room temperature for 6 hours. All the samples containing sheets were treated with Black Powder, which is considered the best developer for fresh Samples on papers. It was seen that latent prints were successfully developed on all the sheets. The developed prints shown in Figure 1(a-d) were clear and having enough information about the identification of an individual.



Statistical Analysis

The purpose of the study is to determine the sex of an individual from the obtained aggregate information of developed palm prints [8]. Firstly, we have to allocate three centers of curvatures in the developed palm prints and to correlate them with the line of writing, where signatures were put on. It is expected that the latent image of palm prints [9] will come below that signature or in the line of writing.

For the centre of curvatures, First of all two tangentional lines [10] were drawn, where the lines intersects each other in developed print from that point a corresponding line is also drown. Now from the corresponding line up to the deepest point A, it will be the radius of centre of curvatures A. Thus all three centers (A, B, C) and the radius of respective centers were allocated. Now a straight line along with the signature (baseline) was drawn, which will correlate the palm prints with the signatures. For all of three centers A, B, C and their radius, ra, rb, rc, were measured, the angle of the centre of curvature from the

line of writing oa, ob, and oc were taken. The inter-distance of three centers AB, BC, CA was measured, and the normal distance from the line of writing of the centers of curvatures la, lb, lc was determined [6]. The correlation of these points (Wu Xiagqian et al.) with respect of writing's line is cumulative and was measurable. It was seen that all the parameters for each individual were unique. The position of latent palm print was below the signature. It is considered that all the obtained parameter's details Ra, Rb, Rc (radius of curvatures), La, Lb, Lc (Normal distance of centre of curvature from line of writing) and AB, BC, CA (Inter-distance between centre of curvatures) were having enough information for the determination of sex of an individual.

The identification of individual [11] with absolute certainty has become a necessity. Palm prints, undoubtedly are most reliable and accepted evidence in court of law. The present work was carried out to determine the sex [12] of an individual from latent palm prints on documents. It's very rare that the latent palm prints are not occurring on documents and very hard to believe that when we are writing, our hand/part of or palm do not rest on paper. No occurrence of latent prints on papers can be because of wearing gloves in hands. Once the signatures or any material have written on a document, then along with the writing the individual also left their identity in form of latent palm print. The results of this study conclusively differentiate the gender. By studying the developed palm prints shown in Figure 2(a-d) and their inherent relation with the signatures are leading to determination of the sex of suspect [13].



After application of T-test, during the observation of parameters of minutiae details, it is noted that the variation in the parameters of both (Male and Female) are clear. If the suspect is male, then the angle of centre of curvature from line of writing (Θa , Θb , Θc), are higher than female parameters which lies up to (± 60).

After the application of t-test the obtained Standard deviation for angle of centre of curvature from line of writing (0a) is (male 5.82, female 12.75) gives P-Value (0.0254), which is statistically significant (P<0.05). The standard error is (2.599). For Θ b the S.D. (male 6.37, female 11.93) gives P-Value (0.048), which is considered statistically significant (P<0.05).

The standard error is (2.469), And for oc the S.D. (Male 6.85, Female 10.24) and the P-Value is (0.0382) which indicates the significance (P<0.05). The standard error is (2.249). In observation of male, the radius of curvature ra, rb, and rc are too higher than the comparison of female.

The observations of radius of Curvature Ra, standard deviation (Male 0.39, female 0.34) and the P-Value (0.0180), which is statistically significant that (P<0.05). The standard error is (0.094). For observation standard deviation of Rb (male 0.38, female0.53) and the P-Value (0.2794), which is not statistically significant (P>0.05) and standard error is (0.199) In observation of Rc (Male0.19, female 0.43) and the P-Value (0.0308), which is statistically significant (P<0.05). The standard error is (0.086)

Now, in the normal distance of centre of curvature (la, lb, lc,), the observations of male suspects also differ from the female. For Normal distance of curvature from line of writing (la), the standard deviation (Male 0.91, female 1.06) and the P-Value is (0.0182), which is statistically significant (P<0.05) and standard error is (0.255). Now for lb the S.D. (Male 1.42, Female 1.55) and the P-Value are (0.0045), which is considered statistically significant (P<0.05) and standard error is (0.384). For the lc, the S.D. (Male 1.05, female 1.42) and the P-Value is (0.0160), which is significant (P<0.05). The standard error is (0.322)

In parameters of inter distance between centre of curvatures AB, BC and CA that it also gives the significant difference between the genders. Now for the inter distance of centre of curvatures (AB), the standard deviation (Male 0.48, female 0.67) and the P-Value (0.0101), which is considered statistically significant (P<0.05) and S.E. is (0.50).

At centre of curvatures the inter distance (BC), the standard deviation (male 0.27, female 0.26) and the p-Value is (0.0159), which indicates the statistically significant (P<0.05) and S.E. is (0.068). And for the CA the standard deviation (Male 0.77, female 0.48) and the P-Value is (0.0119), which is considered strongly significant (P<0.05). The Standard error is (0.166).

These variations in the minutiae details between male and female are the significant of sexing [14] which in term allows the conclusive determination of sex of an individual. The graph between the details of male and female sex determination significantly shows variations-

In the given Figures 3-6 the difference between genders can be easily seen. The error in the measured distance is within the limits of $(\pm 0.2 \text{ cm})$, and in the angles it is up to the limits of (± 20) which can be attributed to the instrumental error/constant error and are due to natural variation.



Ra, Rb, Rc,

Rb



Figure 3: The difference between male and female on basis of angle.









Determination of sex also provides an important clue about the suspect during investigation, which decrease the decision time and its identical role. From the results of the study it is seen, that it can be utilized in order to minimize suspects list by getting similar values for suspects sex.

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