

Original Research Paper

A Biometric Approach for Personal Identification Using 2-D Lip Images of Brahmin & Baniya Communities

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Abstract

Personal identification is an important fact in Forensic investigation. Identification through biometric systems is motivated by real life criminal and Forensic applications. Present study was to determine any differences in lip patterns and lip measurements between two communities and to ascertain whether this beheld the potential for determination of sex of an individual. A total of 80 subjects of both Brahmin and Baniya community of Bundelkhand region of 20-40 years were taken. Lip measurements were taken along with the lip images and classified according to Tsuchihashi's classification. Statistical analysis indicated that there were significant differences between sexes of both communities. There is correlation of photographic length and width ratio to actual dimension of lips in both the sexes. The overall accuracy for sex determination in **Brahmin** community is found to be **47.1875 %**, whereas in **Baniya** community it was **38.125%**. Hence, the percentage of determining the differences in lip images of males and females in both communities was **42.65%**. This study can provide a preliminary idea about the use of lip images and measurements along with lip pattern as a biometric system in sex determination among both communities.

Key Words: Cheiloscropy, Lip images, Lip pattern, Sex determination

Introduction:

Human identification leads to mutual trust that is essential for the proper functioning of society. We have been identifying fellow humans based on their voice, appearance, or gait for thousands of years. However, a systematic and scientific basis for human identification started in 19th century when Alphonse Bertillon introduced the use of a number of anthropomorphic measurements to identify habitual criminals. "**Biometric**" recognition is based on two fundamental premises about body traits; **distinctiveness & permanence**.

The applicability and identification accuracy of a specific biometric trait essentially depends to what extent these two premises hold true for the population at hand.

Identification the biometric system searches a database for a reference matching a submitted biometric sample and if found, returns a corresponding identity. A biometric is collected and compared to all the references in a database. [3]

Cheiloscropy is a Forensic investigation technique that deals with identification of humans based on lips traces. [4] The use of lip prints were first recommended as early as in 1932 by **Edmond Locard (1877-1966)**, one of France's greatest criminologists. Perhaps the greatest research of Cheiloscropy completed has been from Japanese doctors **Suzuki** and **Tsuchihashi** in 1970 and 1974 wherein lip prints were obtained from 280 and 1,364 Japanese citizens (respectively). [1]

During the studies, lip prints were classified into five main types. Type I represents a lip possessing full vertical grooves. Type II (Pronounced "one-dash") has partial grooves running vertically on the lip. Type II represents branched grooves while Type III represents intersected (diamond) grooves that look similar to crosses. Type IV represents the reticular (rectangular) (pattern similar to wire mesh or boxes). [5]

Very few people know that just like fingerprints, even lip prints can be instrumental in identifying a person positively. Lip prints are normal lines, fissures in the form of wrinkles and

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grooves present in the zone of transition of human lip between the inner labial mucosa and outer skin. [2] The appearances of lip prints, like finger prints, vary from person to person. The use of lip prints is not so popular but exists as a methodology in forensic science. Studying in depth and establishing further facts and truth in lip print will certainly help us, as useful evidence in Forensic science. [3]

With the ever-increasing demands placed upon law enforcement to provide sufficient physical evidence linking a perpetrator to a crime, it makes sense to utilize any type of physical characteristic to identify a suspect of an offense. Lip prints and their patterns have unique markings that can be entered into a specific classification. Results of this project identified a legitimate need to actively pursue lip images along with pattern analysis and comparison within the law enforcement and legal system. [6]

Hence, the objective of the present study was to determine whether there are any differences in lip patterns & lip measurements (using lip images) between two different communities, and to ascertain whether this behold the potential for determination of sex of an individual from the configuration, to access correlation between length and width ratio with actual dimension of lips respectively.

Material and Methodology:

The materials used in the present study are as follows:

- Digital camera
- Two rulers of 30 cm
- Vernier calliper

This study consisted of 80 subjects who include 40 Brahmins (20 males and 20 females) and 40 Baniyas (20 males and 20 females). All the subjects belong to both "Brahmin" and "Baniya" community of Bundelkhand Region of India, in the age group of 20-40 years.

Procedure:

The subjects were made to sit in a relaxed position and after cleaning the lips the subject was asked to keep the mouth as well as his/her face stationary. After that original (actual) dimension of lips were taken with the help of Vernier calliper. The actual dimension of the subject was noted down. Width of oral opening was measured from right cheilion to left cheilion.

Height of the upper lips was taken from labrale superior to stomion and height of the lower lips was taken from stomion to labrale inferior.

Then the photograph of the subjects were taken from three distances i.e. 10cm,

15cm, & 20cm respectively, with the help of digital camera in **VGA size (640x480) pixels**. During this the subject was asked to keep his/her face stationary. After taking the photograph of all the subjects the photograph was made to crop to **(440x280) pixels**.

The color printouts of all the photographs were taken & then we measure the dimension of lips at 10cm distance, 15cm distance, and 20cm distance. Along with this the recording was done by noting the combinations of groove types found in each lip image.

Because most lips contain more than one type of pattern, the lips were divided into two compartments as lower lip & upper lip. Both upper and lower compartment is studied and the combination of groove patterns for both was recorded. The lip patterns were classified based on the classification of Tsuchihashi. [1]

Statistical Methodology:

This study was done by using Software Package for Social Services (SPSS). The frequency of each lip print type was calculated. The Chi square (X^2) test was applied to determine whether there were significant differences in lip prints & images between sexes or community. Independent **t-test** was performed to determine the differences in each lip measurement between sexes. $p < 0.01$ is significant and $p > 0.01$ is not significant.

Result and Discussion:

Here we observed through Wilk's lambda among **Baniya males & females** that Actual lip length of male & female (0.6001), photographic lip length of male and female at 10 cm (0.5615), photographic lip width of male and female at 10 cm (0.4388), photographic lip length of male and female at 15 cm (0.5145), & photographic lip length of male and female at 20 cm (0.4708).

Value are highly differentiable, i.e. we can differentiate the gender on the basis of above lip dimension of male & female as corresponding values are near to one, which determine the differences between male and females of Brahmin community. (Fig. 1)

In our study we also observed through Wilk's lambda among **Brahmin males & females** that Actual lip width of male & female value is highly differentiable, (0.6379) i.e. we can differentiate the gender on the basis of actual lip width of male & female as value suggest that there is no relationship between them. (Fig. 2)

In this study we found that there is correlation of photographic length and width ratio to actual dimension of lips however the percentage of accuracy was not so high. The

percentage of accuracy in determining females was not high as in males.

Our study showed that the overall accuracy for sex determination in **Brahmin** community is **47.1875%**, whereas in **Baniya** community the overall accuracy is **38.125%**.

Therefore, the percentage of determining the differences in lip images of males and females & on the basis of community correctly was **42.65%**.

Table 1 and 2 shows overall lip pattern type i.e. I, I', III, IV and II respectively for both male and females of both community.

Hence, it is concluded that in both the communities type I lip pattern is preferably found in both males and females.

Conclusion:

In the present study an attempt has been made to determine the whether there are any differences in lip patterns & lip measurements (using lip images) between two different communities, and determination of sex of an individual from the configuration.

We also try to find out whether basics of lip biometric can be used for person identification and frequency of occurring of lip patterns within community as well as between male and females. Hence, on the basis of the observation and result obtained it was clearly and conclusively demonstrated that lip patterns & lip measurements (using lip images) can be used to determine the sex or community of a person however, the percentage of accuracy generated for each measurement was not high.

There is somewhat correlation between photographic length and width ratio with actual dimension of lips. The percentage of accuracy in determining females was not as high as in males. Further work on the subject and

maximize the number of subject involves in the study can help to make cheiloscopy a practical reality at the ground level of the Forensic identification process.

In our study, we have researched on the lip biometrics using lip images and there is no such relevant research available as of now. Many research scientists have worked on the lip prints but no one had researched on the 'lip images' regarding biometrics. Hence, our research is a pioneer in this field.

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Table 1: Frequency of Lip Pattern Types of Brahmin Community

S.N.	Lip Pattern Type	Frequency		Total (%)
		UL	LL	
1	Type I	16	17	33(41.25)
2	Type I'	6	13	19(23.75)
3	Type II	3	2	5(6.25)
4	Type III	11	3	14(17.5)
5	Type IV	4	5	9(11.25)

Table 2: Frequency of Lip Pattern Types of Baniya Community

S.N.	Lip Pattern Type	Frequency		Total
		UL	LL	
1	Type I	11	18	29(36.25)
2	Type I'	8	13	21(26.25)
3	Type II	4	0	4(5.00)
4	Type III	11	4	15(18.75)
5	Type IV	6	5	11(13.75)

Fig. 1: Sex Validation through Lip Dimension of Actual and Photographic Length and Width of Male and Female among Brahmin Community (Mean Difference)

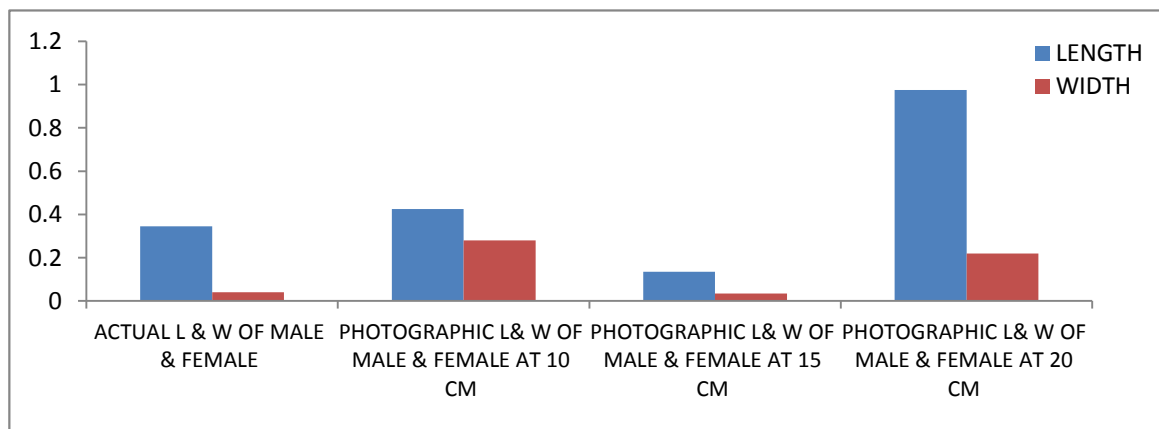
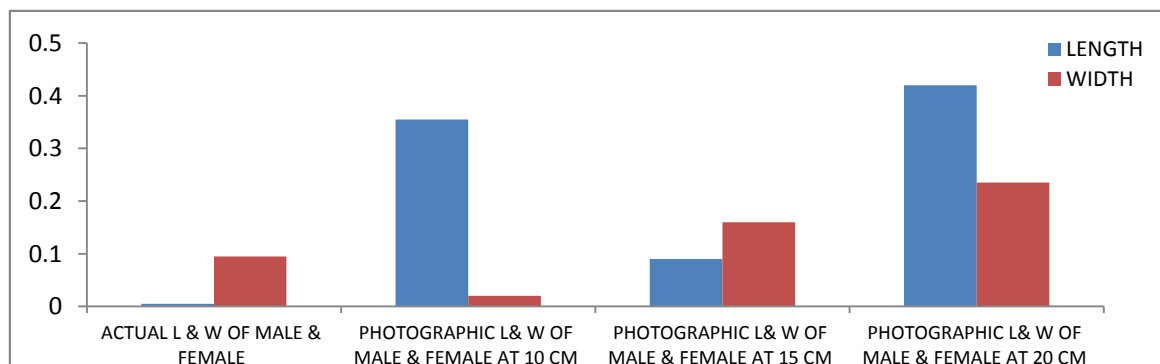


Fig. 2
Sex Validation through Lip Dimension of Actual and Photographic Length and Width of Male and Female among Baniya Community



How much more shall I wait?

I waited for someone to help.

But even he, who had laughed with me last, left me alone.

I waited for an ambulance to come

But, of that, I could imagine the sound only.

I waited for someone who could attend to me.

But, hardly could I see one,

in that "dreamy" state.

And now, even when, I am no more,

should I wait further for my MLC to the fore?

Then in the cold room, I could have "chilled",

but here too, it was already more than "filled".

If now, are the inquest papers ready or should I have left little bit late?

Am I supposed to further wait, or shall I calm down for the final take?

Don't scare me now, if you are "merely" thinking about my viscera.

Yes, you might be planning for my viscera for the sake.

But now you can 'keep' it.

As of now 'I' am 'one' no more.

A stomach can wait for the results....

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