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Analysis of Age and Gender Using Lip Impression

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Abstract: ***Lip prints are acquiring popularity in forensic science because they are unique, stable, and capable of providing personal identification. Human identification is on the rise in this new millennium because of rising crime, natural disasters, and terrorist attacks. Lip prints are a unique pattern comprising the sulci labiorum, or wrinkles and grooves on the labial mucus. I agree that lip prints have uniqueness just like fingerprint and as such study of lip prints known as Cheiloscopy. Cheiloscopy is the study of the exterior portion of the lip, which includes a multitude of ridges and indentations that can create a distinctive pattern known as a lip print. Each individual is like a fingerprint, with its own unique features. This study examines the validity of lip prints in determining their age and gender considering a sample of 300 individuals, divided equally within the jurisdiction of two age groups and both sexes. The analysis of lip print patterns was performed in quadrants using Suzuki and Tsuchihashi classification, and chi-square, Pearson's correlation and regression analysis were applied to verify the results. A statistical analysis showed significant gender-related distributions, reporting significantly more Type I lip prints in women and more Type II and Type IV lip prints in men (p=0.043). Age effects included: patterns of change among young and old***
Keywords: Lip prints, Cheiloscopy, Gender identification, Forensic Science, Forensic Odontology

I. INTRODUCTION

Human identity is necessary for social, legal, and personal reasons. Lip prints are a unique pattern made up of the sulci labiorum, or wrinkles and grooves on the labial mucous. The study of lip prints is known as Cheiloscopy.[1] Cheiloscopy is the continuous study of the exterior of the lip, consisting of many ridges and indentations that form unique patterns called lip prints. Just like fingerprints, every person has distinct characteristics.[3]

The identification of humans is increasing in this new millennium due to escalating crime, natural disasters, and terrorist threats. With a combination of information acquired from oral soft tissues and dental hard tissues found within antemortem and postmortem records, experts are now identifying individuals using dental methods.Our goal in this study is to assess the reliability of lip prints as a forensic method. Compared values are patterns from both sexes at all ages to establish the inter- and intraobserver bias in recording lip print data. Registered indirectly with objects, the lip prints compared to directly registered patterns evaluate changes in the patterns overtime.[2]

The system, developed by Suzuki and Tsuchihashi, has categorized lip prints into numerous categories. These include reticular patterns, branched grooves, intersected grooves, and vertical grooves. The classifications help to identify and associate the individuality of lip print patterns to gender differences in forensic investigation. [4]

Lipstick smears are known as lip prints are often left as trace evidence which can link the suspect to the scene of murder. If the suspect does not wear lipstick, or if the lip prints are obtained using smudge-proof lipstick (protective lipstick, also known as permanent or long-lasting cosmetics that do not leave any visible marks) it is possible to retrieve,[5]

These prints of lip are providing key evidences in homicide, rape cases, and other criminal practices. The dependability of the lip prints as the biometric identifier is enhanced when considering such research that claims this lip print is independent upon age, environmental, as well as minor injuries.[4]

Lip prints are created when the material on the lips, such as sweat, oil, lipstick, or blood, is transferred to the surface by the lip grooves or ridges as it comes into contact with it. Photographs may show easily recognised lip prints. If they are indeed readily visible at the crime scene, they can be photographed, magnified, and overlay tracings of the grooves collected. Latent lip prints, on the other hand, are hidden or masked and need to be developed in order to photograph them. The surface on which the lip print has been left, dictates the methods used to identify and develop latent prints. [5]

II. MATERIALS AND METHODS

A. Study Design

A cross-sectional observation, the kind of study which was conducted by observing a group of people and by collecting specific data all at once in a short period of time. This study was conducted to analyze the relationship between factors such as gender, age, and kinds of lip prints. Data was collected at one point in time.

B. Study population

A total of 300 samples were collected. 150 samples were males and 150 were females. From the population of the 15–70 age range, they were further divided into two groups:
Group 1: Subjects within the 15 to 25 age range.
Group 2: Between 26 years and 70 years old.

C. Selection criteria

Inclusion Criteria: Only healthy subjects with normal anatomy of lips were included in the study. Only those participants who were willing to give written consent were selected.
Exclusion Criteria: Only participants without disorders affecting the anatomy of their lips injuries, or deformities were selected for the study.

D. Materials required

The following materials were used to collect and analyze lip prints:
Lipstick: Non-glossy, smear-proof lipstick was chosen so that clean impressions were obtained.
Cellophane Tape: The lip impression was imprinted with the help of an adhesive, transparent tape.
White Paper: A white paper sheet was used as a mounting and storing area for the samples of lip prints.
Pen and Notebook: The information about participants including gender and age was written on a notebook.
SPSS Software: Statistical studies, such as group comparisons, regression, and correlation, were performed using SPSS software.

E. Methodology

The participant's lip impression was collected using a dark color lip stick, no shine with low moisture. All the participants were given tissue to remove whatever was remaining in the mouth and lips, such as moisture or makeup. The participant's lips were covered with a thin, uniform layer of lipstick. The lipstick was applied evenly to the lip using a swab. After applying the lipstick give a minute to settle. After that, the tape was carefully taken off, leaving a distinct impression of the ridges and grooves of the lips.[4]
A white paper containing the age and gender of the participant along with their ID number was used to facilitate the attaching of the lip print imprint. The lip imprint patterns were studied with a magnifying lens for each quadrant.

The classification system devised by Suzuki and Tsuchihashi was utilized to classify the lip print patterns. Classification of lip prints is done according to Suzuki and Tsuchihashi classification of 1970.
Type I- A clear-cut groove running vertically across the lip
Type I′- Partial-length groove of Type I
Type II- A branched groove
Type III- An intersected groove
Type IV- A reticular pattern [6]

By examining the lip impressions, the four quadrants representing the upper and lower lips were further subdivided into three sections: the lateral (L), mid-lateral (ML), and middle (M) portions. classification of gathered lip prints was observed and by using a basic magnifying glass the pattern of lip prints found in each quadrant was recorded. The lip prints that displayed patterns in each of the four quadrants were categorized as good prints, while the remaining prints were thought to be random.[7]
The statistical analysis for this study was carried out using IBM SPSS Each sort of lip print was counted frequently, and the percentage of each type was determined. All the data was analyzed statistically and $P < 0.05$ was considered to be statistically significant. The data was generated and examined using various tests.[7]
Descriptive statistics: Frequency and percentages of lip print types distributed by age and gender. Chi-Square Test: To study the correlation between lip print types and gender.
Pearson's Correlation- Determine whether there is a relationship between lip print types and age. Independent t-test: It is used to compare the types of lip prints of men and women.

III. RESULT

The analysis of lip print pattern shows distinct characteristics for each lip print pattern. No two lip prints show similarities, establishing the uniqueness of the lip prints from the study conducted the most common type of lip type was found to be Type I from both the age groups, followed by Type II, Type III, Type IV and Type V.

The study conducted for all the 300 samples with different age group and gender.

150 samples of male and 150 samples of Female were divided into two age groups from 0-70 years.

- Group 1 having 0-25 years showed 37.3% most common in Type I
- Group 2 having 26-70 years showed 51.3% most common in Type I

GROUP 1 (0-25 Years)

TABLE I
Descriptive Analysis of Group 1 Between the Age 0-25 Years

LIP TYPE	MALE	FEMALE	FREQUENCY	PERCENTAGE
TYPE 1	27	29	56	37.3%
TYPE 2	19	20	39	26.0%
TYPE 3	17	9	26	17.3%
TYPE 4	8	12	20	13.3%
TYPE 5	4	5	9	6.0%
TOTAL	75	75	150	100%

In group 1: Type I was the most common lip type found in the samples collected in group 1, from which 56samples out of 150 samples were identifies as Type I (37.3%). In males 27 (36.0%) was Type I, 19 (25.3%) was Type II, 17 (22.7%) was Type III, 8 (10.7%) was Type IV and 4 (5.3%) was Type V.

In females 29 (38.3%) was Type I, 20 (26.7%) was Type II, 9 (12.0%) was Type III, 12 (16.0%) was Type IV and 5 (6.7%) was Type V.

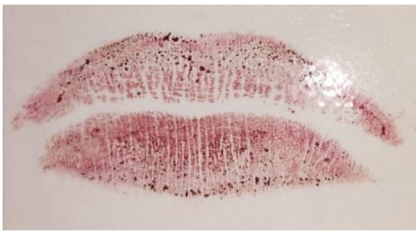

Fig.1 Type I lip print in female under the age group of 15-25

Fig. 2 Type I lip print in male under the age group of 15-25

Fig. 3 Type II lip print in female under the age group of 15-25

Fig. 1 Type II lip print in male under the age group of 15-25

Fig. 2 Type III lip print in female under the age group of 15-25

Fig. 3 Type III lip print in male under the age group of 15-25

Fig. 4 Type IV lip print in female under the age group of 15-25

Fig. 5 Type IV lip print in male under the age group of 15-25

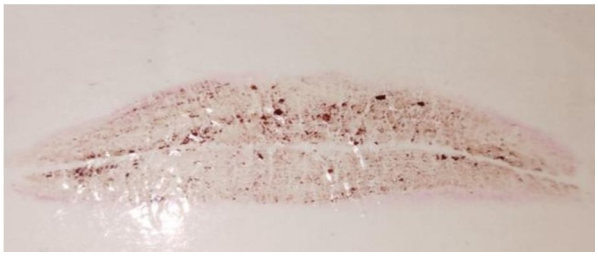

Fig. 6 Type V lip print in female under the age group of 15-25

Fig. 7 Type V lip print in male under the age group of 15-25

In group 1 analysis type I was most common lip print type in both male and female 56out of 150 samples (37.3%) type II 39 out of 150 (26.0%) type III 26 out of 150 (17.3%) type 4 20 out of 150 (13.3%) and type V 9 out of 150 (6.0%)

GROUP 2 (26-70 years)

TABLE II

Descriptive Analysis of Group 1 Between the Age 0-25 Years

LIP TYPE	MALE	FEMALE	FREQUENCY	PERCENTAGE
TYPE 1	42	35	77	51.3%
TYPE 2	15	21	36	24.0%
TYPE 3	9	12	21	14.0%
TYPE 4	4	7	11	7.3%
TYPE 5	5	0	5	3.3%
TOTAL	75	75	150	100%

In group 2

Type I was the most common lip type out of 77 out of 150 samples were identifies as Type I (51.3%). In males 42 (28.0%) was Type I , 15 (10.0%) was Type II, 9 (6.0%) was Type III, 4 (2.7%) was Type IV and 5 (3.3%) was Type V.

In females 35 (23.3%) was Type I, 21 (14.0%) was Type II, 12 (8.0%) was Type III, 7 (4.7%) was Type IV and 0 (0.0%) was Type V.

In group 2 analysis type I was most common lip print type in both male and female 77 out of 150 samples (51.3%) type II 36 out of 150 (24.0%) type III 21 out of 150 (14.0%) type IV 11 out of 150 (7.3%) and type V 5 out of 150 (3.3%)

Fig. 8 Type I lip print in female under the age group of 26-70

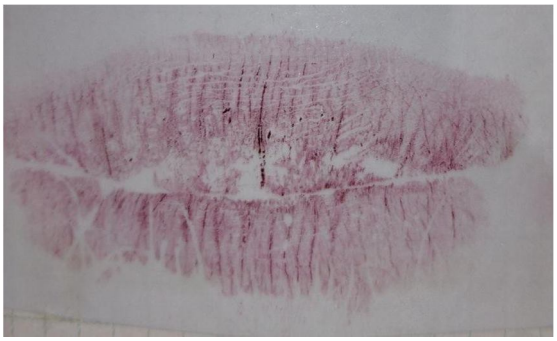

Fig. 9 Type I lip print in male under the age group of 26-70

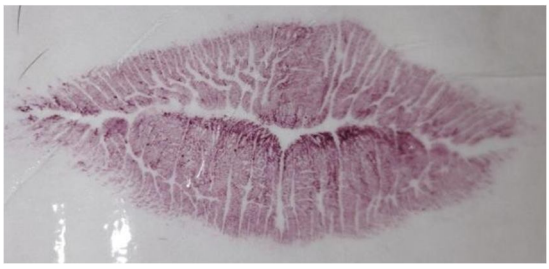

Fig. 10 Type II lip print in female under the age group of 26-70

Fig. 11 Type II lip print in male under the age group of 26-70

Fig. 12 Type III lip print in female under the age group of 26-70

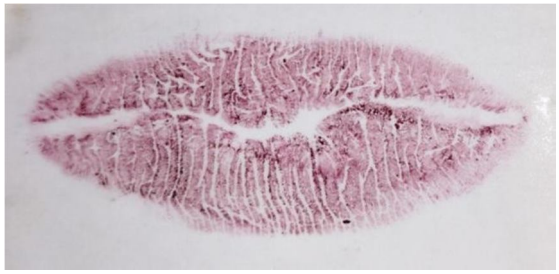

Fig. 13 Type III lip print in male under the age group of 26-70

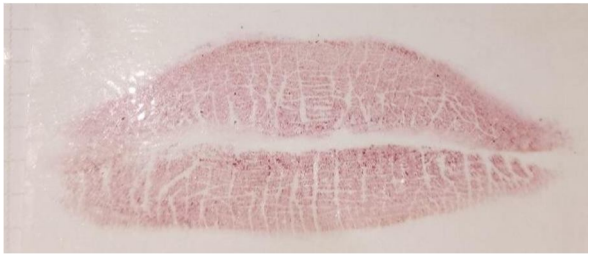

Fig. 14 Type IV lip print in female under the age group of 26-70

Fig. 15 Type IV lip print in male under the age group of 26-70

Fig. 16 Type V lip print in female under the age group of 26-70

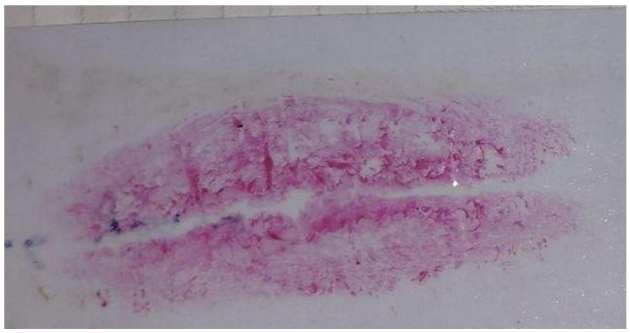

Fig. 17 Type V lip print in male under the age group of 26-70

An Independent T test was conducted for both the groups (group 1 and group 2) to compare the lip type between males and females. In group 1 the mean lip type of female and male were compared. In Females (samples 75) the mean was seen to be 2.252 with the standard deviation of 1.3058 and standard error mean of 0.15079, this lip score was compared with male (samples 75) where mean was seen to be 2.2400 with the standard deviation of 1.20629 and standard error mean of 0.13929.
The independent sample T test indicated no statistically significant differences in the lip type between male and female where t-value was found to be 0.65 and p-value was 0.948. Since p-value is greater than 0.05, equal variance is assumed.

The independent test shows no significance gender wise difference in mean lip type value (0.948). Both male and female lip type have almost identical distribution.
In group 1 the mean lip type of female and male were compared. In Females (samples 75) the mean was seen to be 1.8800 with the standard deviation of 0.99946 and standard error mean of 0.11541, this lip score was compared with male (samples 75) where mean was seen to be 1.8667 with the standard deviation of 1.2229 and standard error mean of 0.14121.
A similar variability is observed in standard deviation
The independent sample T test indicated no statistically significant differences in the lip type between male and female where t-value was found to be 0.073 and p-value was
0.942, Since p-value is greater than 0.05, equal variance is assumed.
The independent test shows no significance gender wise difference in mean lip type value (0.942). the mean and confidence level shows minimal variation between male and female distribution
For gender identification chi-square test was conducted
Group 1

TABLE III
Distribution of Lip Print Types Among Male and Female Participants with Chi-square Values in group 1

LIP TYPE	MALE	FEMALE	TOTAL	CHI-SQUARE VALUE	P-VALUE
TYPE 1	27	29	56	3.516	0.475
TYPE 2	19	20	39		
TYPE 3	17	9	26		
TYPE 4	8	12	20		
TYPE 5	4	5	9		
TOTAL	75	75	150		

Results of the Chi-Square Test:
The most common lip print type is Type 1.
P-Value: 0.475; Chi-Square Value: 3.516
The p-value 0.475 is bigger than the significance level =0.05 α=0.05.
Applying the Chi-Square test of independence, the association between gender and lip print types is shown. There was no statistically significant association for Type 1., $\chi 2$(type I = 56) =3.516, p=0.475, Similarly, the test showed that there was no significant association for the overall distribution of lip print types across genders,
$\chi 2(4,N=150)=7.883,p=0.096$. This finding suggests that lip print types was equally distributed among male and female participants.

Group 2

TABLE IV

Distribution of Lip Print Types Among Male and Female Participants with Chi-square Values in group 2

LIP TYPE	MALE	FEMALE	TOTAL	CHI-SQUARE VALUE	P-VALUE
TYPE 1	42	35	77	9.832	0.043
TYPE 2	15	21	36		
TYPE 3	9	12	21		
TYPE 4	4	7	11		
TYPE 5	5	0	5		
TOTAL	75	75	150		

Results of the Chi-Square Test:
The most common lip print type is Type 1.
P-Value: 0.043; Chi-Square Value: 9.832
The p-value 0.043 is less than the significance level =0.05. this suggests that the relationship between age and lip type is statistically significant.
Applying the Chi-Square test of independence, the association between gender and lip print types is shown. There was statistically significant association for Type 1., $\chi 2$(type I = 7) =9.832, p=0.043, The test showed that there was significant association for the overall distribution of lip print types across genders.

Correlation test conducted for the understanding of lip type and age
Group 1- Pearson Correlation Coefficient (r):
The relationship between lip type and age is -0.115 which is weak negative correlation The p-value is 0.159, which is greater than the standard significance level of 0.05. This suggests that there is no statistically significant correlation between lip type and age.
Group 2- Pearson Correlation Coefficient (r):
The correlation between age and lip type is -0.167, which is weak negative correlation.
Significance (Sig. 2-tailed):
The p-value is 0.042, which is less than the significance level of 0.05.
This suggests that the relationship between age and lip type is statistically significant.

IV. CONCLUSION

This study has drastically pertained the domain of forensic cheiloscopy to lineate lip print patterns with age and sex to an extent that is statistically significant. It was statistically verified (regression analysis and chi-square tests) how much lip prints could be used for the identification of someone, especially when other biometric data are not available. The study also addresses the challenges posed by environmental factors, as well as calls for standardization in lip print collection and analysis. These findings are instructive and help advance the study, providing a baseline for future studies and stimulating development of globally applicable, well-established methodologies. The results further indicate that future integration of digital technologies, such as AI and machine learning, may enhance the accuracy and efficiency of lip print analysis. This study supports the continued applicability of conventional biometric instruments, such as lip prints, as forensic science advances, providing an affordable option in environments with limited resources and broadening the range of forensic identification techniques. In a nutshell, the study shows how cheiloscopy can revolutionize the field of forensic science by linking theoretical knowledge with real-world applications.

V. ACKNOWLEDGMENT

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In the end, I wish to put on record my appreciation to all the participants who willingly provided their lip impressions along with the demographic details that enabled the completion of this research.

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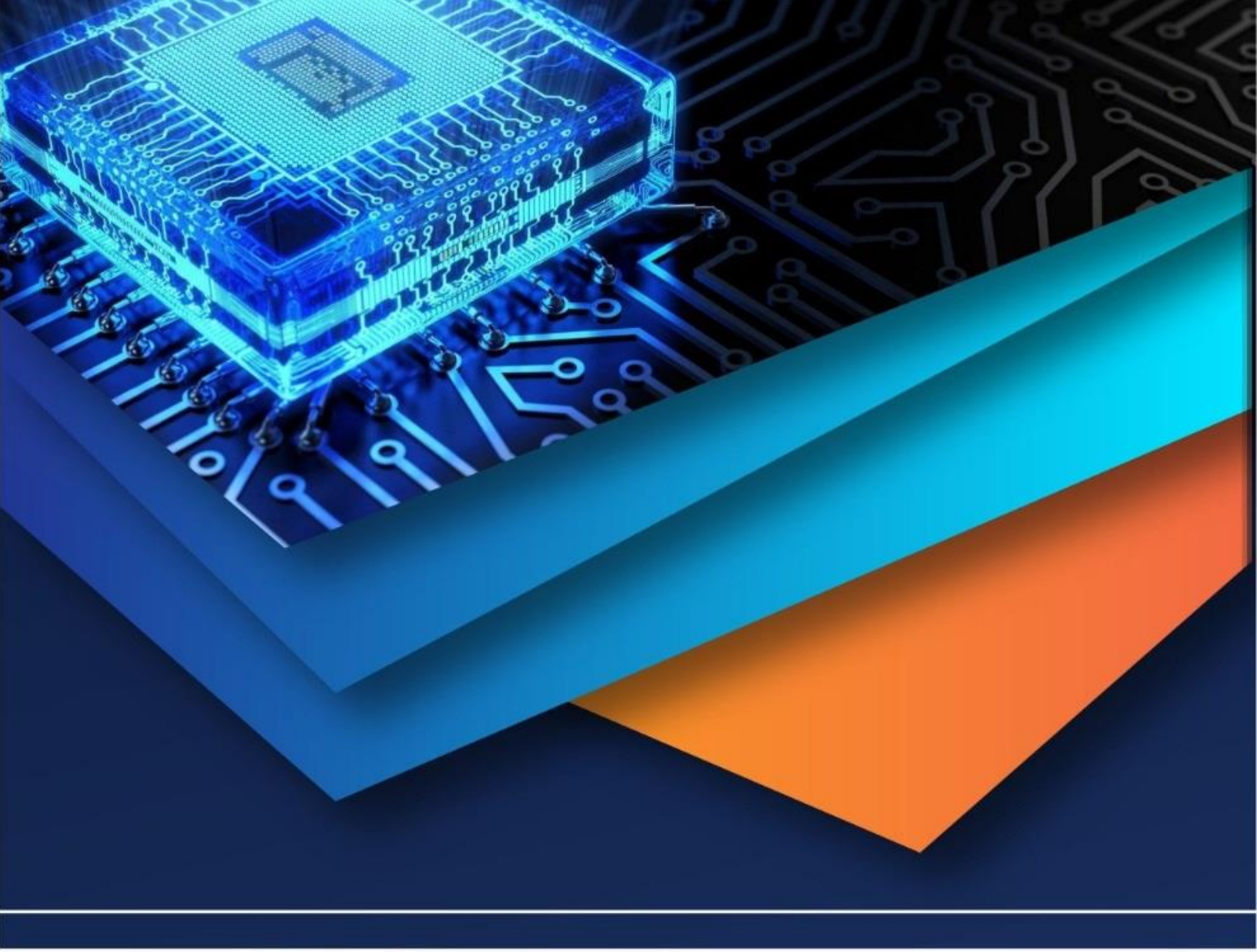

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