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VARIATION IN HANDWRITINGS UNDER DIFFERENT WRITING CONDITIONS

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Abstract: Handwriting requires the concerted effort of the brain, muscles, and nerves. Natural variations are the essential characteristics of a person's handwriting because the human brain is not a computer; it cannot reproduce the same thing repeatedly in the same fashion. It always imposes a challenge for document experts to distinguish between intra and inter writer variations in handwriting. The expert is always questioned whether the variations in an individual's handwriting are occurring naturally or deliberately. This study has been undertaken to investigate the range of variations occurring in the handwritings of individuals under different writing conditions and the possibility of determining the authorship of the writer under such circumstances.

Key words **- Variations, Characteristics, Writing conditions, Size, Skill, Slant, Alignment, Intra and Inter writer variations**

I. INTRODUCTION

Every time we write, our writing is slightly different. It can be a little larger, a bit smaller, more angular, sometimes faster, sometimes slower and on and on. Thus these variations must be closely and carefully studied by the examiner to identify whether the writer of two different contents is the same or not. Natural variation refers to the variations in an individual's handwriting in ideal condition, which occurs unconsciously as the writer proceeds with his/ her handwriting because of the habits ingrained in an individual.

Accidental variations in handwriting occur when the writer deviates from his comfortable writing conditions or writes in unideal conditions like on different surfaces (soft, rough, lap), moving condition, different writing instruments, etc.

Natural variations are the essence of any individual's writing, and they are very likely to appear in one's handwriting, but these variations lies within a specific limit. As a forensic document examiner, one should be able to differentiate between these variations and attempted deviation from normal characteristics for disguise [1].

Thus, one should know the extent of variation in handwriting characteristics under particular conditions to frame a proper opinion about the writer. The examiner should know the reliable features that can aid to identify the authorship, even where exhibits are written in different writing conditions. The proper methodology to approach such examinations is first to examine the general or class characteristics such as speed, skill, movement, pen pressure, etc., and then moving on to individual characteristics and stylistic features. [2, 3,]. Some handwriting characteristics may change with the condition, some may vary with age [4], posture [6], and some characteristics remain robust to any change in condition. One can determine the authorship even in block writings if the principles of handwriting examination are applied carefully [5]. Therefore by following the principles of handwriting identification, one can fix the authorship. The examiner can also opine about the possible condition under which the writer wrote the content based on some surface or condition-specific characteristics.

II. RESEARCH METHODOLOGY :

SAMPLE PROCUREMENT -

For conducting the study, 80 samples were collected from 10 different individuals, i.e., eight handwriting samples from each writer. Each writer was requested to write a given paragraph of text on an A4 sized plain paper eight times under eight different writing conditions that include:

1. S1: Writing written on normal hard surface (taken as standard)
2. B1: Soft Surface
3. B2: Rough Surface
4. B3: Polished Wall
5. B4: Lap
6. B5: Moving Vehicle
7. B6: Writing while Walking
8. B7: Writing without wearing spectacles

The writings written by each of the ten writers on the normal writing surface (hard surface) were taken as their standard writings. First, the samples were examined based on the class characteristics of the writer. The variation in class characteristics was observed in comparison to the class characteristics of standard handwriting of each individual writer. The class characteristics that were considered are as follows:

1. Size : Small, Medium and Large
2. Slant : Vertical, Forward and Backward
3. Speed : Slow, Fast, and Normal
4. Spacing: between characters, between words, and between lines
5. Skill : Low, Medium and High
6. Alignment : Ascending, Descending, Horizontal and Varying
7. Line quality: Defective, Poor and Good
8. Pen pressure: Light, Medium and Heavy

Then individual characteristics of the writer in standard and other different conditions (B1 to B7) were observed. Few common characteristics were observed in most of the handwriting of different individuals, i.e., these features were seen only under one condition in most of the writer's handwriting. These features are condition-specific characteristics such as glitches, extension of vertical staff etc.

The Quantitative interpretation of some characteristics was performed based on statistical parameters like correlation, chi-square value, and p-value. The significance of the results as checked at alpha= 0.05 and 0.01, to determine the effectiveness of various writing characteristics in personal identification.

Materials used:

1. Scale
2. Compass
3. Magnifying lens
4. Stereomicroscope

Each writer's handwriting was examined individually to find the class and individual writing characteristics to determine the extent of the deviation under different writing conditions, from the standard handwriting. Individual characteristics were taken into account to eliminate the writer's natural variations to focus on the changes that occur in characteristics that arise due to different writing conditions.

All the handwriting samples' class characteristics were noted, for each and every writer, in a tabular form. Following table is an example :

Table 1.1 : Representation of class characteristics for writer

Characteristics	**S_1**	**B1**	**B_2**	**B3**	**B4**	**B5**	**B6**	**B7**
1.Size	medium	medium	medium	medium	medium	medium	medium	large
2. Spacing :								
i. b/w characters	medium	> medium	> medium	> medium	> medium	medium	>medium	wide
ii. b/w words	medium	medium	medium	medium	medium	< medium	medium	medium
iii. b/w lines	medium	wide	wide	wide	wide	wide	wide	wide
3. Slant	forward	forward	forward	varying	varying	varying	varying	forward
4. Speed	medium	medium	slow	medium	medium	slow	slow	medium
5. Skill	medium	medium	low	medium	medium	low	low	medium
6. Movement	wrist	wrist	finger	wrist	wrist	finger	finger	wrist
7. Line quality	uniform	uniform	poor	poor	uniform	poor	poor	uniform
8. Alignment	descending	varying	descending	descending	varying	ascending	ascending	varying
9. Pen pressure	light	medium	medium	light	medium	light	medium	light

Characteristics	**S_1**	**B_1**	**B_2**	**B_3**	**B_4**	**B_5**	**B_6**	**B_7**
1.Size	medium	medium	medium	medium	medium	large	medium	medium
2. Spacing :								
i. b/w characters	medium	medium	medium	medium	medium	medium	medium	medium
ii. b/w words	varying	varying	varying	varying	varying	varying	varying	varying
iii. b/w lines	wide	wide	wide	wide	wide	medium	wide	varying
3. Slant	forward	vertical	varying	varying	vertical	varying	vertical	vertical
4. Speed	medium	medium	slow	medium	medium	medium	medium	medium
5. Skill	medium	medium	low	medium	medium	medium	medium	medium
6. Movement	wrist	wrist	finger	wrist	wrist	wrist	wrist	wrist
7. Line quality	uniform	uniform	poor	uniform	uniform	poor	uniform	uniform
8. Alignment	varying	descending	ascending	descending	descending	varying	descending	varying
9. Pen pressure	light	heavy	heavy	light	heavy	medium	heavy	medium

Pen pressure on a surface was observed based on the intensity or depth of indentation marks obtained on the paper's backside with respect to the pen pressure found on the standard writing sample. If the pen pressure was more than that of the standard (or to the extent where paper damage could be seen), it was taken as heavy, if less than standard, it was taken as light.

Later on, surface-specific individual characteristics, which occurred only in a few particular conditions, were evaluated. These characteristics include Glitches, Paper damage, Improper ink deposition, Tremors (due to irregular rough surface), Overwritings etc. Individual characteristics such as the extension of vertical staff, missing t- bars, missing i-dots, incomplete loops, the extension of endings were also examined to check the effect of different conditions on these writing parameters.

Also, few general characteristics such as size, line quality, alignment, pen pressure, and slant were analyzed statistically to check whether they show any significant changes in the condition.

III. Results and Discussions

Through the study and examination of samples, it was observed that it is possible to determine authorship despite different writing conditions.

In this study, the examination of handwriting samples of 10 individuals in six different writing conditions was done in terms of their general and individual characteristics to determine whether the examiner can identify the writer based on the characteristics that do not change depending upon the writing condition. Class characteristics like size, slant, alignment, pen pressure, and line quality do not necessarily change with different writing conditions.

Also, individual characteristics such as missing i-dots, missing t-bars, incomplete loops, extension of vertical staff and extended endings do not show any significant changes i.e. despite the various writing conditions same individual characteristics were observed for each and every individual. Thus, one can determine authorship based on these individual characteristics.

Figure 1 : Data for missing t-bars in handwriting of 10 writers under different writing conditions

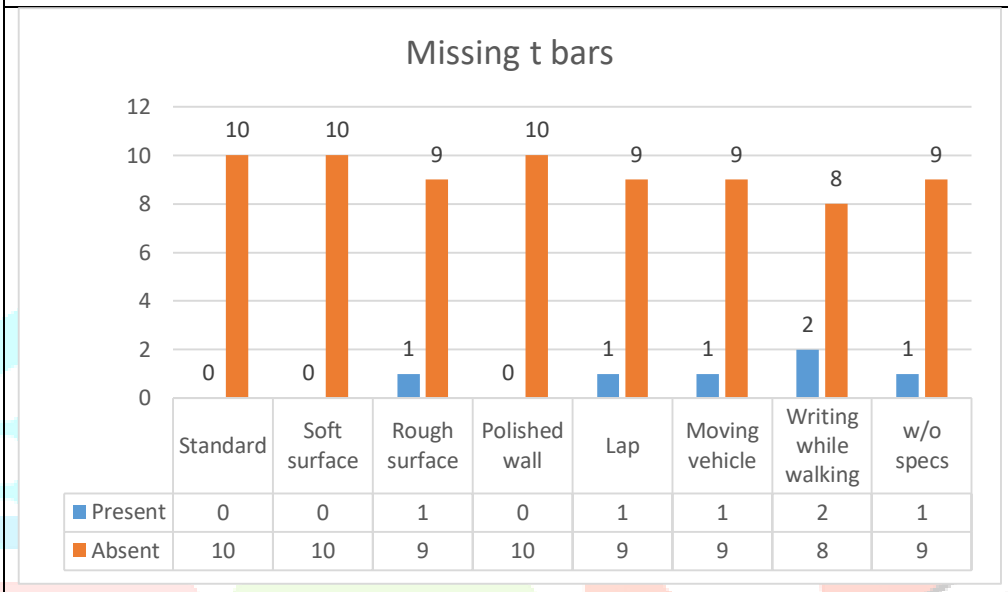


Figure 2. Data for incomplete loops in handwriting of 10 writers under different writing conditions

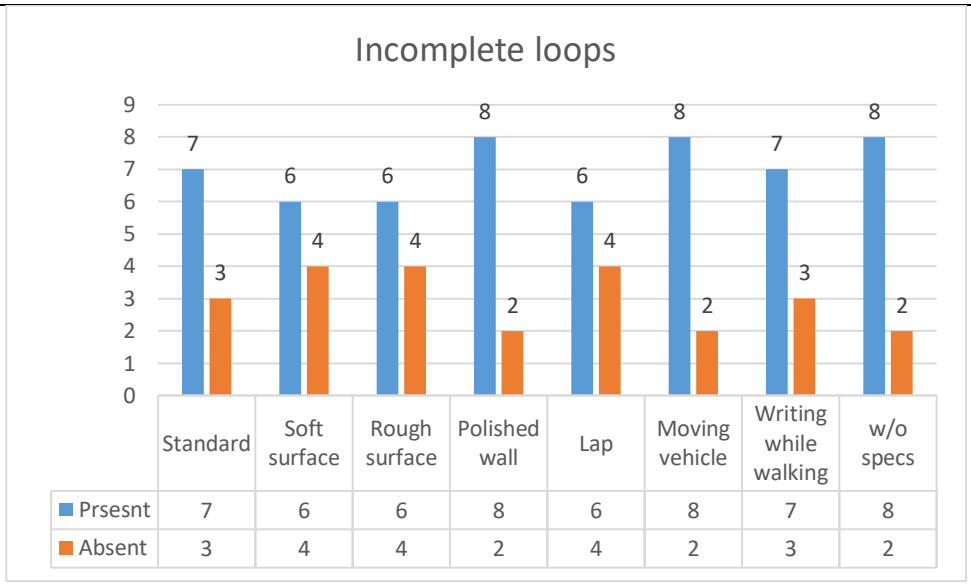


Figure 3 Data for extension of endings in handwriting of 10 writers under different writing conditions

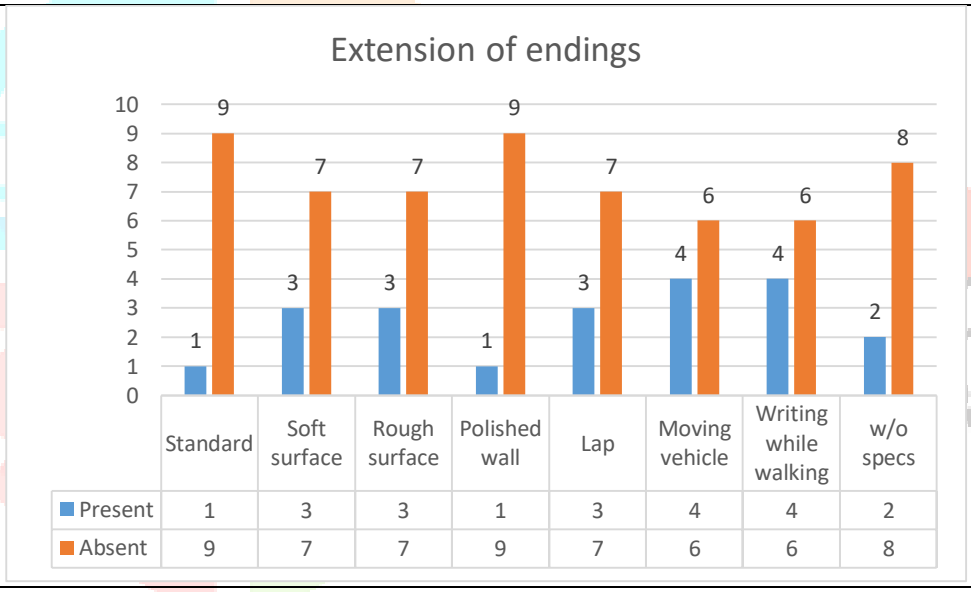
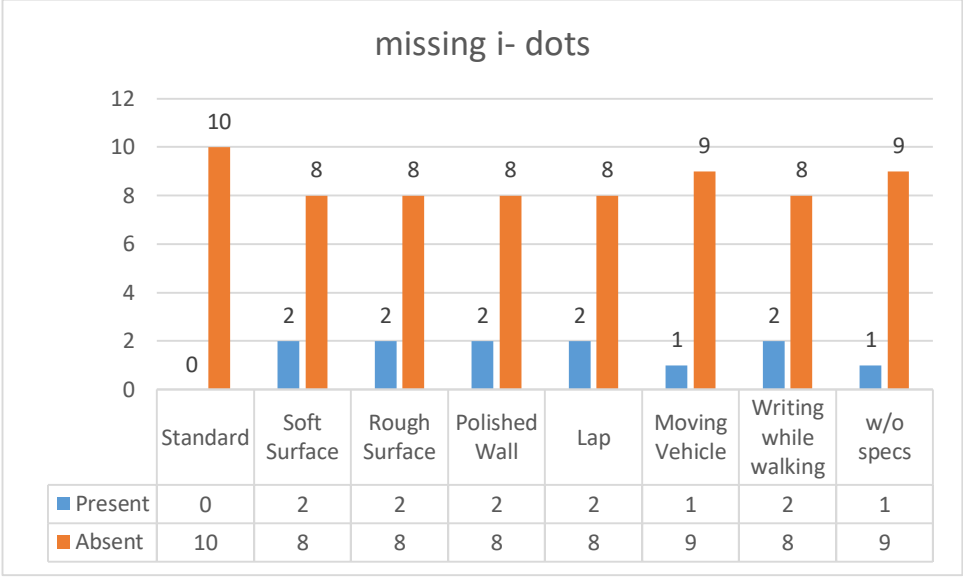


Figure 4 Data for missing i-dots in handwriting of 10 writers under different writing conditions



Therefore from above data, we can infer that individual characteristics do not show huge variation under different writing conditions.

Class characteristics which showed variation with different writing conditions such as size, line quality, alignment, pen pressure, and slant were analysed statistically to check whether they show any significant changes under different writing conditions.

Table : 3.1 Descriptive stats for variation seen in size under different writing conditions

Hypothesis	Writing Conditions	Correlation	chi sq. value	p - value	Conclusion
Null hypothesis (H0): Size does not show significant variation with surface type Alternate hypothesis (H1) : Size shows significant variation with surface type	Soft Surface	0.87	3.6	0.165	Null hypothesis is accepted
	Rough surface	0.660	4.076	0.130	Null hypothesis is accepted
	Polished wall	0.684	2	0.367	Null hypothesis is accepted
	Lap	0.986	1.091	0.779	Null hypothesis is accepted
	Moving Vehicle	0.433	4.8	0.090	Null hypothesis is accepted
	Writing while walking	0.769	4.410	0.220	Null hypothesis is accepted
	Writing without specs	0.723	3.090	0.378	Null hypothesis is accepted

Table : 3.2 Descriptive stats for variation seen in line quality under different writing conditions					
Hypothesis	Writing Conditions	Correlation	chi sq. value	p - value	Conclusion
Null hypothesis (H0): Line Quality does not show significant variation with surface type Alternate hypothesis (H1) : Line Quality shows significant variation with surface type	Soft Surface	1	2.222	0.136	Null hypothesis is accepted
	Rough surface	-1	20	<.000	Null hypothesis is rejected
	Polished wall	1	5	0.025	Null hypothesis is rejected
	Lap	1	6.666	0.009	Null hypothesis is rejected
	Moving Vehicle	-1	20	<.000	Null hypothesis is rejected
	Writing while walking	-1	13.333	0.000	Null hypothesis is rejected
	Writing without specs	1	1.053	0.304	Null hypothesis is accepted

Table : 3.3 Descriptive stats for variation seen in alignment under different writing conditions					
Hypothesis	Writing Conditions	Correlation	chi sq. value	p - value	Conclusion
Null hypothesis (H0): Alignment does not show significant variation with surface type Alternate hypothesis (H1) : Alignment shows significant variation with surface type	Soft Surface	0.970	0.444	0.800	Null hypothesis is accepted
	Rough surface	1	0	1	Null hypothesis is accepted
	Polished wall	0.755	0.254	0.880	Null hypothesis is accepted
	Lap	0.803	0.8762	0.645	Null hypothesis is accepted
	Moving Vehicle	0.5	0.343	0.842	Null hypothesis is accepted
	Writing while walking	0.870	1.486	0.685	Null hypothesis is accepted
	Writing without specs	0.359	5.397	0.067	Null hypothesis is accepted

Table : 3.4 Descriptive stats for variation seen in pen pressure under different writing conditions

Hypothesis	Writing Conditions	Correlation	chi sq. value	p - value	Conclusion
Null hypothesis (H0): Pen Pressure does not show significant variation with surface type Alternate hypothesis (H1) : Pen Pressure shows significant variation with surface type	Soft Surface	0.359	2.619	0.270	Null hypothesis is accepted
	Rough surface	-0.886	8.271	0.015	Null hypothesis is rejected
	Polished wall	0.996	1.066	0.586	Null hypothesis is accepted
	Lap	-0.268	5.504	0.063	Null hypothesis is accepted
	Moving Vehicle	0.339	3.818	0.148	Null hypothesis is accepted
	Writing while walking	0.124	3.818	0.148	Null hypothesis is accepted
	Writing without specs	0.959	1.02	0.548	Null hypothesis is accepted

Table : 3.5 Descriptive stats for observed paper damage under different writing conditions

Hypothesis	Writing Conditions	Correlation	chi sq. value	p - value	Conclusion
Null hypothesis (H0): Paper Damage does not depend on surface type Alternate hypothesis (H1) : Paper Damage depend on surface type	Soft Surface	1	4	0.025	Null hypothesis is rejected
	Rough surface	-1	8.571	0.003	Null hypothesis is rejected
	Polished wall	1	1.052	0.305	Null hypothesis is accepted
	Lap	-1	8.571	0.003	Null hypothesis is rejected
	Moving Vehicle	1	1.052	0.305	Null hypothesis is accepted
	Writing while walking	1	1.052	0.305	Null hypothesis is accepted
	Writing without specs	1	1.052	0.305	Null hypothesis is accepted

Table : 3.6 Descriptive stats for glitches observed under different writing conditions

Hypothesis	Writing Conditions	Correlation	chi sq. value	p - value	Conclusion
Null hypothesis (H0): Glitches and surface type are independent Alternate hypothesis (H1) : Glitches and surface type are dependent	Soft Surface	1	1.053	0.305	Null hypothesis is accepted
	Rough surface	-1	8.571	0.003	Null hypothesis is rejected
	Polished wall	1	2.222	0.136	Null hypothesis is accepted
	Lap	1	1.053	0.305	Null hypothesis is accepted
	Moving Vehicle	-1	16.366	0.000	Null hypothesis is rejected
	Writing while walking	1	3.529	0.060	Null hypothesis is accepted
	Writing without specs	1	1.05	0.305	Null hypothesis is accepted

Table : 3.7 Descriptive stats for improper ink deposition under different writing conditions

Hypothesis	Writing Conditions	Correlation	chi sq. value	p - value	Conclusion

Null hypothesis (H0): Improper Ink deposition and surface type are independent Alternate hypothesis (H1) : Improper ink deposition and surface type are dependent	Soft Surface	1	1.053	0.305	Null hypothesis is accepted
	Rough surface	-1	10.769	0.001	Null hypothesis is rejected
	Polished wall	1	4	0.025	Null hypothesis is rejected
	Lap	1	4	0.025	Null hypothesis is rejected
	Moving Vehicle	1	1.053	0.305	Null hypothesis is accepted
	Writing while walking	1	1.053	0.305	Null hypothesis is accepted
	Writing without specs	1	1.053	0.305	Null hypothesis is accepted

Table : 3.8 Descriptive stats for extension of vertical staff of characters under different writing conditions

Hypothesis	Writing Conditions	Correlation	chi sq. value	p - value	Conclusion
Null hypothesis (H0): Extension of vertical staff of characters and surface type are independent Alternate hypothesis (H1) : Extension of vertical staff of characters and surface type are dependent	Soft Surface	1	0	1	Null hypothesis is accepted
	Rough surface	-1	5.494	0.019	Null hypothesis is rejected
	Polished wall	1	1.25	0.263	Null hypothesis is accepted
	Lap	1	0392	0.531	Null hypothesis is accepted
	Moving Vehicle	-1	5.494	0.019	Null hypothesis is rejected
	Writing while walking	1	2.4	0.121	Null hypothesis is accepted
	Writing without specs	1	0	1	Null hypothesis is accepted

IV. CONCLUSION:

After examining the handwriting samples of writers under different writing conditions, it can be concluded that if the examiner follows the basic principles of handwriting identification, one can determine the authorship.

General characteristics did not show significant changes in different writing conditions; for example, alignment changed only when the writer who wore high power spectacles tried to write without spectacles. During the course of study, it was seen that class and more importantly, individual characteristics play a vital role in determining the authorship as individual characteristics are very robust to any change in the writing condition. For example, if the writer is in the habit of writing 'i' without i dot, then whatever may be the writing condition, 'i' dot will remain missing in the handwriting written under different writing conditions as these are the habits that are ingrained in the habit of the writer.

Also, other characteristics such as paper damage, improper ink deposition, glitches, and tremors were observed; these characteristics are surface-specific characteristics. Paper damage was observed in handwriting samples written with a rough surface, soft surface and lap as a writing surface. The irregularity and softness of these surfaces cannot endure the pressure exerted by the writing instrument.

Improper ink deposition was observed only in rough walk and polished wall. The writer has to hold the pen slightly horizontal or with the rear end facing downward; while doing so, the flow of ink to the nib of the writing instrument becomes irregular. Glitches were very prominent in writing samples in moving vehicle conditions and rough surfaces due to the vehicle's movement and irregularity of surface, respectively.

As per the study, changes in size, slant, and spacing are not condition-dependent, i.e., these characteristics do show some changes, but these changes are not that significant and one can still identify the writer. Although every writer shows natural variation, these variations will be similar in standard writing conditions and different writing conditions.

Additionally, for accurate determination of authorship examiner can also look for the individual characteristics such as commencement of letters, hook endings and start, movement of strokes, pen operation used to form characters etc.

REFERENCES :

[1] Katherine M. Koppenhaver, (2007) Forensic Document Examination: principles and practice, Humana Press Inc., New Jersey,
[2] Ordway Hilton, Scientific Examination of Questioned documents, CRC Press, New York
[3] Albert Osborn, Questioned documents, Boyd printing company. New York, U.S.A Huber R. A., Headrick A. M., Handwriting identification: facts and fundamentals, CRC Press, New York 1999.
[4] Kapoor T. S. , Kapoor M., Sharma G. P., Study of the form and extent of natural variation in genuine writings with age, Journal of the Forensic Science Society 1985, vol. 25, pp. 371.375.
[5] Surbhi Mathur, Sumit Kumar Choudhary, Examination of block capital writings with the view to fix authorship and expert opinion thereon, Journal of International Academic Research For Multidisciplinary, Volume 2, Issue 5, June 2014
[6] Celine Equity, MS; Raymond Marquis, MS; and Williams D. Mazella, MS ; " Influence of writing posture on the dimension of signatures" in the Journal of the American Society of Questioned Document Examiners (Volume 10, Number 2)