A Study of Consistent Similarities Between Complete, Partial, And Initial Signatures of An Individual for Author Identification In Forensic investigation

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Abstract: A signature is a written document in an individual's handwriting that depicts his/her personal identity. It could be in any style of handwriting that includes embellishments, various letter formations, and writing strokes that are generated out of the habit of writer. Signatures are scrutinized for genuineness in effect and consistent repeating options that back up the author's allegations practice pattern and help in the identification of the author in the event of a legal conflict. The structure and formation of the characters, distance between the letters and words, pen-lifts, pen-pauses, inclination, beginning and ending strokes, as well as pen pressure are some of the most commonly utilized features for signature analysis by handwriting specialists. In certain crucial circumstances, it becomes difficult for forensic analyst and handwriting experts to compare disputed initials signatures with full admitted or specimen signatures and vice versa. The current research focuses on extracting scientific connections between a person's initial, partial and complete signatures in order to help the investigators in their personal identification. In cases when initials have been employed deliberately or inadvertently, this study may aid in identifying the alleged author.

Keywords: Document, Signatures, Initial Signatures, Partial Signatures, Complete Signatures, Handwriting Characteristics, Author Identification

1. Introduction

Something typed or written, printed, imprinted, or represented in order to provide significant information to receiver is considered as document. Whenever, there is a question of its authenticity, it befalls into the category of Disputed or Questioned Document. On the other hand, a person's handwriting is typically his handwritten writing; it may include alphabets, words, a signature, or initials, numbers or figures that have been written in script or without script. It might include labels, icons, lines, and other elements as well. Because it involves a brain-coordinated neuromuscular activity, handwriting is officially referred to as "Brain Writing" [1]. From the time they enter puberty until they are influenced by outside factors, everyone has a unique writing habit that they keep throughout their lives.

A signature is a formal representation of someone's complete name, surname, or an alphabet that has been used only once as an indicator of their identification on any requested document [2]. It is a unique type of handwriting that incorporates flourishes and peculiar letters that are formed by habit repeatedly [3]. When attempting to fake a signature, the forger does not follow the writer's psychological habit, as everyone has their own unique writing style and "Brain Patterns" that does not alter until the individual suffers a significant injury or illness [4]. Systems for signature authentication and authorization can be categorised in to 'offline and online', according to Y. M. Al-Omari [5].

The offline method is gathering signatures on a sheet of paper as well as scanning them into a computer to visualize them and to use them further on any desired place. Whereas, in an online method, the signature is usually placed on a keypad, or pen-tablet or any other such device to make the signatures digitally [5].

Previously, in one of the studies, handwriting analyses was performed with the help of GRAPHJ, a tool that uses algorithms to automatically detect quantitative measurements of factors like letter size, location of 'i' dots, stroke shape, word and letter dimensions, and spacing [6].

Another study looked at the similarities and differences between two distinct sets of handwriting by two notable individuals. The researcher compared speed, skill, angle, orientation, dimension, shade, pen force, and pen placement as criteria. They came to the conclusion that the signatures of individuals had coincidental similarities, which might lead to a better knowledge of brains in the same way that neurotransmitters are understood [7].

In 2014, Liwicki et al. investigated the use of a signature-signing machine for evaluation and validation with the use of skilled FHE's in identifying forgeries that were altered or imitated from authentic signatures. They discovered that the simulated system gave significant outcomes, and that the automated system's efficiency is comparable to that of human choices [8].

Initial signatures are defined as brief signatures that convey the entire name of an individual in short and are accepted in documents just as the complete signatures [9]. Initial signature is usually the few letters of a person's name, or it may be in any style as adopted by the writer.

Because they have a long name, many people make initial signatures on papers. Individuals use an initial signature for a variety of reasons. One of the most common is to save time and to use the provided space efficiently. Signatures are often checked for genuineness in execution and repeated possibilities that corroborate the author's established habit. The questioned signature is then examined to ensure that the writing is genuine.

Alignments, ornamentation, pen moves, pen stops, distance between letters and words, angle, the crossing of 't', location of dot of 'i', starting & ending strokes, and pen pressure are some of the most often studied signature characteristics as identification factors [9,10].

2. Materials and Methods

The study was intended with major objectives to:

1. Find consistent similarities among an individual's complete, partial, and initial signatures in respect to their class, individual, and microscopic characteristic traits.
2. Compare a person's initial, partial, and complete signatures based on their class, individual, and microscopic features.
3. To identify the authorship of an individual on the basics of the consistent similarities in his/her initial, partial, and complete signatures.

Sample collection: A total 750 signature samples were randomly obtained from 50 distinct adult male and female individuals from SGT University Gurugram, Haryana, India. With the use of a ballpoint pen, the participants were requested to produce signature samples comprising five full signature, five partial, and five initial signatures on a given sample recording paper.

Sample Analysis: The gathered samples were then examined for characteristics such as letter formation, embellishments, base line, letter slant, size of the letter, starting and ending strokes, incomplete letter formation, loop formation, diacritic placement, retracing, pen stops, pen stretches, and linking strokes; pen hesitations, that may have been present. A stereomicroscope and a magnifying glass were used to examine the samples to observe minute features. Individual and class traits are compared manually using the identification criteria stated in Roy A. Huber and A.M. Headrick's "Handwriting Identification: Facts and Fundamentals".

3. Observations and Results

As mentioned above, all of the collected samples (complete, partial and initial signature) were examined for distinct handwriting characteristics. The handwriting features have been determined and identified during the examination by utilizing a magnifying glass and stereomicroscope. All the samples were properly codified for the purpose of identification. The characteristics were also thoroughly identified, examined, and compared manually using the sophisticated tools. Few of the samples have been listed here to summaries the observations as shown in illustrated case examples below:

3.1.1 Analysis of Sample No. 29:

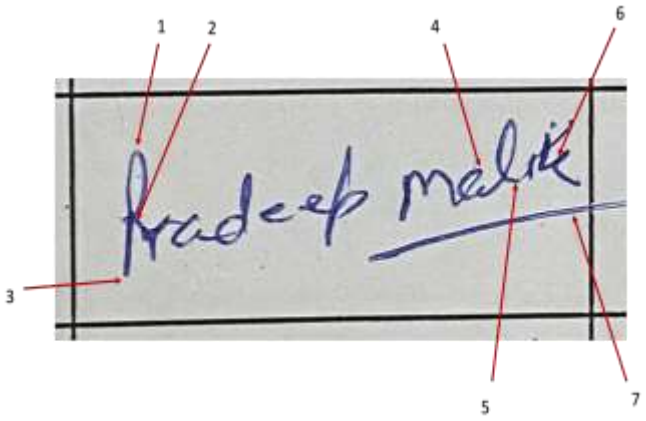

Figure:1

An enlarged image of one of the specimens out of five full signatures of the subject (sample no. 29) showing the markings of highly individual characteristic features that were compared with partial and initial signatures of the subject.

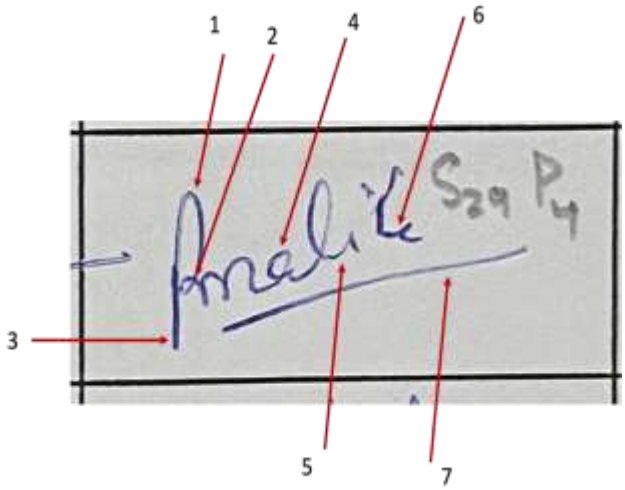

Figure:2

An enlarged image of one of the specimens out of five of partial signatures of the subject (sample no. 29) showing the markings of highly individual characteristic features that were compared with full and initial signatures of the subject.

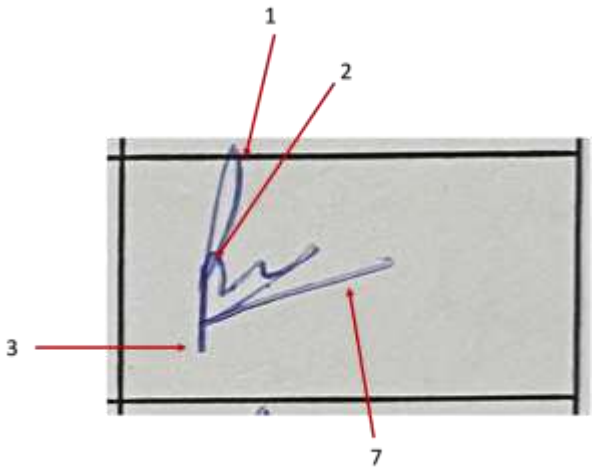

Figure:3

An enlarged image of one of the specimens out of five of initial signatures of the subject (sample no. 29) showing the markings of highly individual characteristic features that were compared with full and partial signatures of the subject.

Comparative Similar Findings in All Three Samples (full, partial, and initials):

1. The formation of vertex (characteristic no. 1) and its angle at the top of letter P is similar in all three (full, partial, and initials) with minute natural variations within the range of identification.
2. Formation and flow of connecting strokes (characteristic no. 2) between letter P and r is similar in all three (full, partial, and initials) with minute natural variations within the range of identification.
3. Retracing is seen at the base arm of letter P (characteristic no. 3) in all three (full, partial, and initials).
4. The formation and placing of baseline (characteristic no. 7) is similar in all three samples (full, partial, and initials)

3.1.2 Analysis of Sample No. 22:

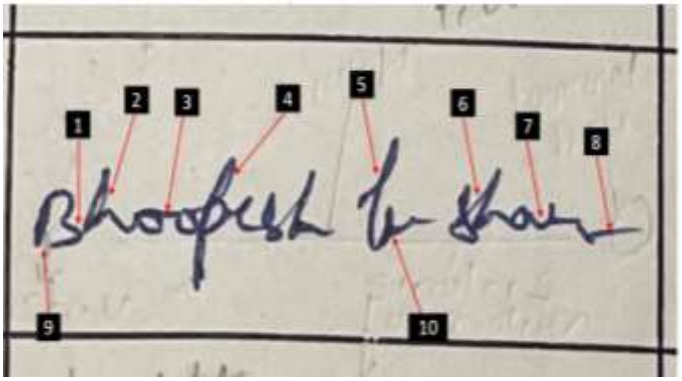

Figure:4

An enlarged image of one of the specimens out of five of full signatures of the subject (sample no. 22) showing the markings of highly individual characteristic features that were compared with partial and initial signatures of the subject.

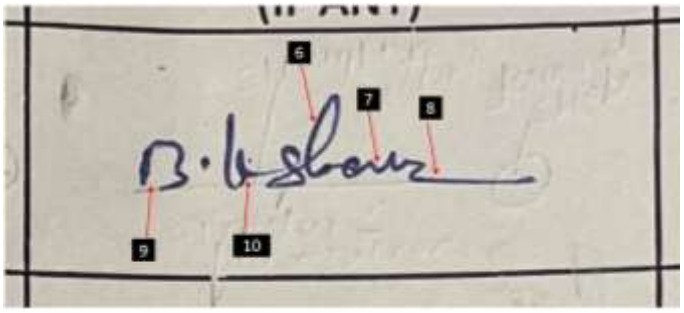

Figure:5

An enlarged image of one of the specimens out of five of partial signatures of the subject (sample no. 22) showing the markings of highly individual characteristic features that were compared with full and initial signatures of the subject.

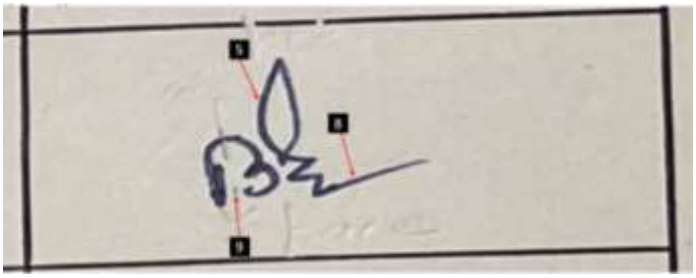

Figure:6

An enlarged image of one of the specimens out of five of initial

signatures of the subject (sample no. 22) showing the markings of highly individual characteristic features that were compared with full and partial signatures of the subject.

Comparative Similar Findings in All Three Samples (full, partial, and initials):

1. Formation of letter 'B' in all the aspects including retraced arm, upper and lower half (characteristic no. 9) is observed as similar in all three samples (full, partial, and initial) with minute natural variations within the range of identification. Also, as an individual characteristic feature open counter in letter B were observed in all three samples (full, partial, and initial).
2. Presence of temple like loop in the formation of letter 'K' (characteristic no. 5) was observed as a habitual characteristic feature of the writer in all three samples (full, partial, and initial).
3. Wavy last terminal stroke (characteristic no. 8) once again proves the penmanship of the same writer in all three samples (full, partial, and initial)

3.1.3 Analysis of Sample No. 30:

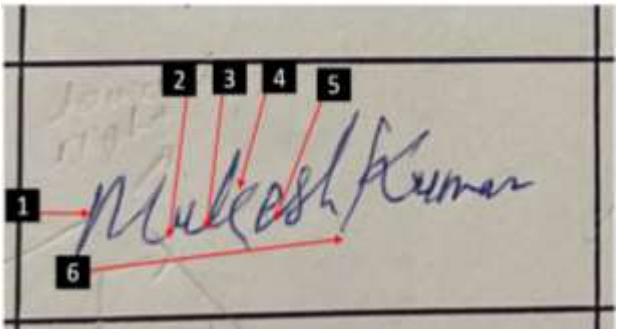

Figure:7

An enlarged image of one of the specimens out of five of full signatures of the subject (sample no. 30) showing the markings of highly individual characteristic features that were compared with partial and initial signatures of the subject.

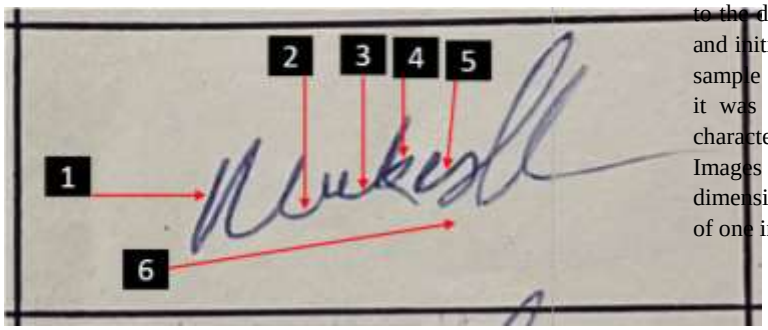

Figure:8

An enlarged image of one of the specimens out of five of partial signatures of the subject (sample no. 30) showing the markings of highly individual characteristic features that were compared with full and initial signatures of the subject.

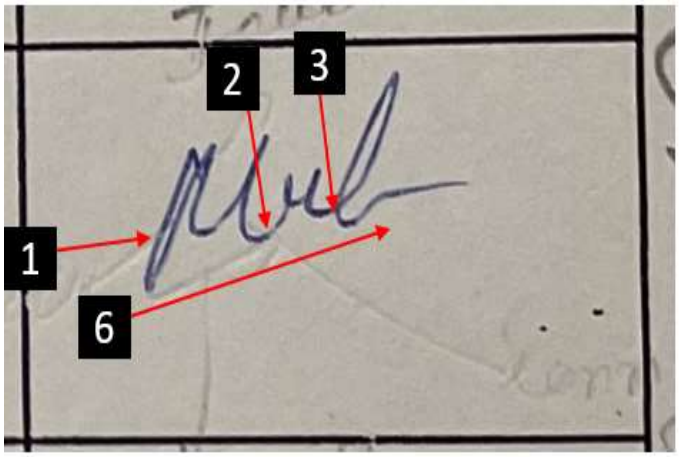

Figure:9

An enlarged image of one of the specimens out of five of initial signatures of the subject (sample no. 30) showing the markings of highly individual characteristic features that were compared with full and partial signatures of the subject.

Comparative Similar Findings in All Three Samples (full, partial, and initials):

1. Formation and flow of connecting strokes (characteristic no. 2) between letter M and u is similar in all three (full, partial, and initials) with minute natural variations within the range of identification.
2. Formation and flow of connecting strokes (characteristic no. 3) between letter u and k is similar in all three (full, partial, and initials) with minute natural variations within the range of identification.
3. The formation and placing of baseline (characteristic no. 6) is similar in all three samples (full, partial, and initials).

3.2. Sample Analysis by Digital Method-A Novel Approach

It was found that using a digital app like a "Measure" on Apple iphone iOS 16.3.1, it is possible to identify similarities in respect to the dimensions and proportional size among complete, partial, and initial signatures of an individual. The measurements of each sample signature were taken by the same mobile application, and it was observed that there were countable similarities in the characteristics of each of the signatures of the same individual. Images below shows the comparison of digitally measured dimensions in respect to complete, partial, and initial signatures of one individual.

Figure:10

Images above showing the comparison of dimensions of the full, partial, and initial signatures as measured with the iOS Mobile Application “Measure”

According to the observations, sample no. 22's entire signatures ranged in length from 5 to 10 distinguishable distinguishing features, with an average of 5 cm.

Similarly, the length of partial signatures in all samples reduced to 3 cm with a reduction in the number of distinguishable characteristics to 5, and eventually the length of beginning signatures was consistently measured at 1 cm with a reduction in the number of distinguishable characteristics to 3.

By utilising a digital tool to assess the signature's size and proportion, it is able to compare the questioned samples of writing materials to the control samples and identify patterns that are useful for forensic investigations. Also, a correlation between the length of the signature and the number of distinguishable traits was found. This study offers a helpful perspective on the utility of physical examination of a person's full, partial, and initial signatures along with the assistance of digital apps like "Measure" for signature analysis, and it can serve as a springboard for further investigation into the use of artificial intelligence (AI) in the examination of questioned documents.

4. Discussion

An individual's signature is his or her own identity. Every day, we use our signatures for a variety official and unofficial purposes. Many incidences of signature forgery are recorded every day across the world, with the majority of them occurring in money transfers.

People frequently sign proxy signatures for someone else. In addition, the vast majority of people utilize three signature styles in their day-to-day activities: full or complete signatures representing their full or complete names and partial & initial signatures (short form). When initial signatures are challenged, it’s tough for a questioned document examiner and signature expert to compare and contrast partial signatures to whole signatures and make conclusive conclusions.

Initials should be compared to initials, partial to partial and complete signatures in comparison to full signatures as a general rule of analysis.

However, when there are no full specimen signatures or reported written samples, the expert must attempt to compare complete signatures with partial or initials.

The goal of this research was to look at the little differences between people's complete, partial and initial signatures in order to identify who wrote them. During the research, it was discovered that some of the individual handwriting characteristics are replicated in complete, partial and initial signatures including proportional dimensions.

Characteristics such as the starting letter's formation, linking Letter proportional size in respect to others, base orientation, individual embellishments, and writing inclination, writing strokes, spurs, loops, and the construction of peculiar shade and unshaded loops. All of these characteristics may be used to identify the author in its entirety.

However, if the act of concealment has been actively inculcated, this may be even more difficult.

5. Conclusion

Based on the findings, it can be inferred that an individual's complete, partial, and initial signatures share a number of characteristics that can provide a successful match during careful examination. In complete, partial and initial signatures, orientation, pace, angle, and the individual's natural pattern, especially in the formation of the person's letters, pen moves and pen halts in certain words or letters, distance among individual letters, dotting after a signature, beginning, ending, and connective strokes are all common similarities. The notion that no two signatures are exactly same is linked to the notion that each author has a unique variation.

This was observed in the current study as well. However, if two separate sets of signatures (complete, partial and initial) are written by the same person, close inspection of individual writing features can be used to compare them to some extent. Handwriting specialists, on the other hand, analyse signature patterns to determine a writer's range of variation; the pattern must be used to establish the several test samples.

It can be concluded that employing a digital app to gauge a signature's size and proportion can be a helpful forensic tool for spotting similarities between a sample under scrutiny and a control sample.

The study also discovered a correlation between the amount of distinguishable qualities and the duration of the signature, which could be useful when examining signatures in forensic investigations.

According to the study's findings, physical inspection of full, incomplete, and initial signatures as well as the use of digital tools like "Measure" can be a useful technique for signature analysis in forensic investigations.

As a potential future topic of study, the potential of AI in the investigation of contested documents is also proposed. Overall, this study offers insightful information about the use of digital tools in forensic investigations and emphasizes the significance of signature analysis in spotting possible fraud.

In addition, this work was found to have several demerits, but also a possible future area of work. The most important considerations constraints was that if the forensic handwriting expert cannot locate his or her competence in language from the exemplars obtained, the forensic handwriting expert finds it difficult to compare the written features of full, partial and initial signatures. When the person has employed totally distinct writing characters in the whole, partial and initial sign, however, it becomes more challenging for the specialist to identify a connection to verify or deny the signatures' validity.

6. Acknowledgment

We thank our colleagues from S.G.T. University, Gurugram, Haryana who provided insight and expertise that greatly assisted the research. We would also thanks to Dr. Jagjeet Singh, Forensic Science Laboratory, Rohini, Delhi, for his immense guidance

Conflicts of interest

None

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