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Forensic Handwriting Analysis: Validating the Doc-Scale Approach

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ABSTRACT

This study examines the effectiveness of the innovative 'Forensic Doc-Scale' in addressing the limitations of conventional forensic handwriting analysis methods. Handwriting features like slant, alignment, spacing, and dimensions were analyzed in disputed signature cases. Conventional methods often lack precision and are prone to subjectivity, relying on inconsistent tools. The 'Forensic Doc-Scale' introduces standardized features, including proportional grids and alignment markers, to enhance accuracy and objectivity. A comparison with conventional methods using prepared and real forensic cases demonstrated improved precision, reduced subjectivity, and higher reproducibility. Adaptable to various document types, the 'Forensic Doc-Scale' offers significant advantages and is recommended as a standard tool for reliable forensic handwriting analysis.

Keywords: *Handwriting Analysis, Handwriting Characteristics, Forensic Doc-Scale, Signature Comparison, Conventional Method.*

1. INTRODUCTION

In Forensic Science, handwriting analysis is an essential tool, particularly when handling contested signatures and questioned documents[1]. In order to prove authenticity and spot forgeries, it entails analysing the distinctive features of handwriting. This technique revolves around parameters like slant, alignment, spacing, dimensions, size, proportion, and placement because they represent the unique neuromuscular patterns of each person's handwriting[2]. These characteristics are useful indicators for forensic comparison since they are frequently impacted by subconscious tendencies. However, the instruments and techniques used have a big impact on how well handwriting analysis works. Conventional methods of handwriting analysis depend mostly on experienced observations along with simple measurement devices such as protractors, grids, or rulers[3]. These techniques have been around for decades, but they have disadvantages. Due to the need for exact measurements and physical alignment checks, the procedure is frequently time-consuming and labour-intensive. Furthermore, because human analysis is subjective, there is a chance that various experts will measure and evaluate handwriting characteristics in different ways. Because of this heterogeneity, it can be difficult to provide reliable and repeatable results, which is crucial in forensic and legal proceedings[4].

The need for innovative instruments that might improve accuracy and dependability is highlighted by the absence of standardization in conventional handwriting analysis methods[5]. The "Forensic Doc-Scale" was created as a specific tool for forensic handwriting analysis in order to address this gap. This multipurpose, transparent scale has features including dimension indicators, angle markers, appropriate grids, and accurate alignment instructions. By facilitating the process of measuring handwriting characteristics, the technology will enable forensic specialists to more easily spot minute variations or similarities between reference and questioned signatures[6]. Standards for handwriting analysis have advanced significantly with the introduction of the 'Forensic Doc-Scale'. It improves the objectivity of forensic examinations and reduces the possibility of human error by offering a clear and uniform framework. Because of its design, it may be applied to a variety

of document types, including ones with overlapping or obscured text a problem that frequently arises in actual forensic cases. Furthermore, the tool's flexibility provides that it may be used in a variety of handwriting circumstances, that include single characters to complete phrases, providing more flexibility than conventional techniques. This study seeks to validate the practical utility of the 'Forensic Doc-Scale' by comparing its performance against conventional handwriting analysis techniques. Disputed signature cases, both Prepared and Real, are analysed to evaluate the tool's effectiveness in identifying key handwriting characteristics. The comparative analysis focuses on accuracy, reliability, efficiency, and ease of use. By examining these factors, the study aims to establish the 'Forensic Doc-Scale' as a valuable innovation in forensic handwriting analysis, paving the way for its adoption as a standard tool in forensic laboratories and legal proceedings. Through this research, it is anticipated that the 'Forensic Doc-Scale' will demonstrate measurable advantages over Conventional methods, including improved accuracy and consistency in analysis, reduced subjectivity, and greater efficiency. These benefits have the potential to transform the field of forensic handwriting analysis, contributing to more reliable and credible evidence in cases involving questioned documents. The findings of this study are expected to underscore the importance of innovation in forensic science, reinforcing the need for tools that combine precision, adaptability, and standardization.

2. MATERIALS AND METHODS

The primary objectives of the study was to examine specific handwriting characteristics, including slant, alignment, spacing, dimensions, size, proportion, and placement, in both Prepared and Real forensic cases of disputed signatures using conventional analytical methods. Additionally, the study aimed to develop an innovative transparent tool, the "Forensic Doc-Scale," designed to enhance the accuracy and efficiency of handwriting analysis for these parameters.

A total of 200 samples were obtained, comprising 100 from real cases and 100 from prepared cases for the study. The collected disputed and specimen signatures were analyzed for specific characteristics such as slant, alignment, dimensions, and proportional size. These features were examined, identified, and compared using the AACE method (Analysis of Known, Analysis of Unknown, Evaluation, and Comparison). Both class and individual characteristics of the handwriting were studied in detail.The "Forensic Doc-Scale" was employed to measure various features, including angle, slant, spacing, and alignment, by placing it directly over the signature samples. Additional tools, such as foldable rulers with millimetre, centimetre, and inch markings, as well as protractors, were used to simultaneously measure these parameters.

3. RESULT

The samples were analysed using the innovative design of Forensic Doc-Scale patented as “PROTRACTOR” (Design Patent No. 408390-001) to study various characteristic features like slant, alignment, angle of writing, proportional size, and aspect ratio etc. Analysis of few of the sample are shown below in Fig. 1 to Fig. 4. Similarly, all the 200 samples were analysed using this specially designed Forensic-Doc Scale.

Example of Sample No. 1:

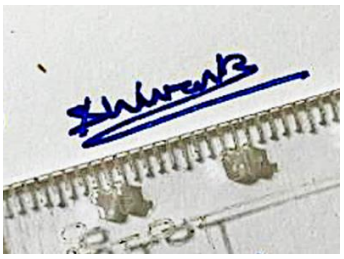

Figure 1

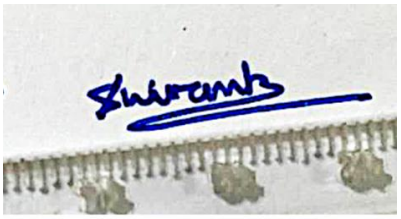

Figure 2

Figure 1 & 2: Showing the conventional measurement (using ruler) of the admitted and the disputed signatures.

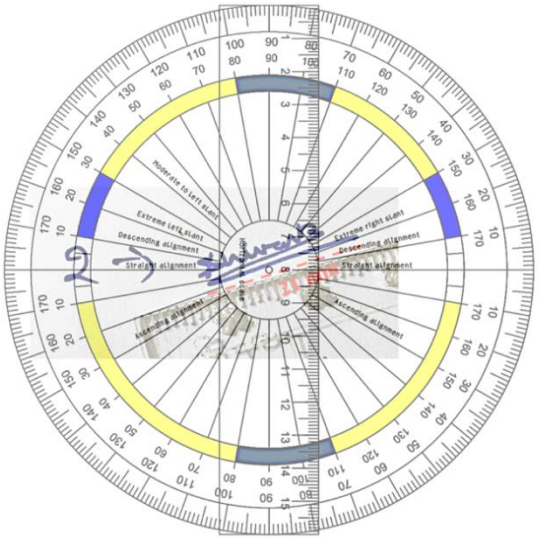

Figure 3

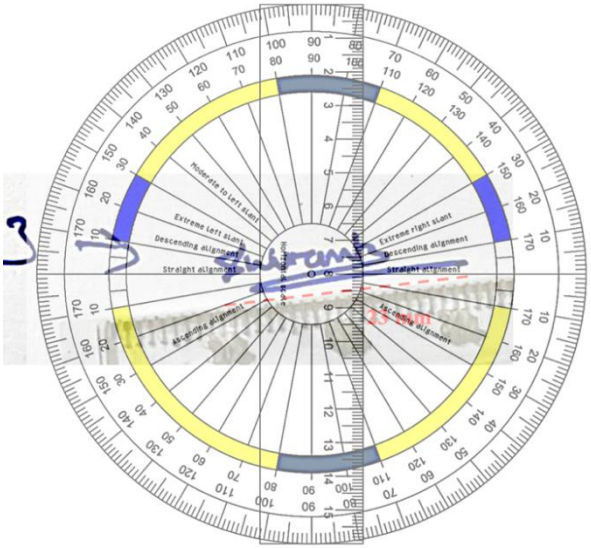

Figure 4

Figure 3 & 4: Showing the innovative approach of "Forensic Doc-Scale" measurement of the admitted and the disputed signatures.

As clear from the images above that by using "Forensic Doc-Scale" the parameters like alignment, slant, angle of writing, proportional size, and ratio can be measured more effectively in comparison to the conventional ruler method. The measurement in the above case example shows uphill Alignment in both admitted and disputed signature, the slant is moderate to left in both the sets with 950-1000 writing angle, and the proportional size is he sets of the signature 5mm length with a width of 21mm admitted signature and 5mm length with a width of 23mm for disputed signature which is almost similar. Also, the ratio of admitted signature is 4.2mm whereas in disputed the ratio is 4.6mm.

Similarly in another sample example, the class and individual characteristics remains same in disputed as well as specimen signatures with slight natural variations within the range of genuine handwriting. Also, the measurements and the aspect ratio shows the variation of less than 0.5 which further falls within the range of identification of same writer. As shown in figure 5 – figure 8.

Example of Sample No. 2:

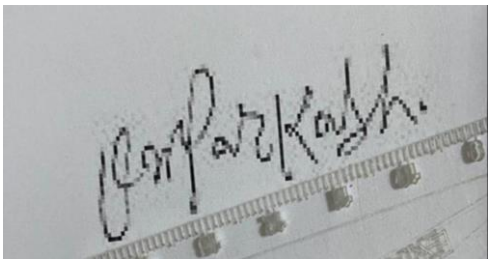

Figure 5

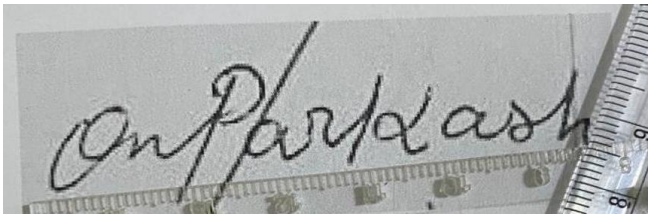

Figure 6

Figure 5 & 6: Showing the conventional measurement (using ruler) of the admitted and the disputed signatures.

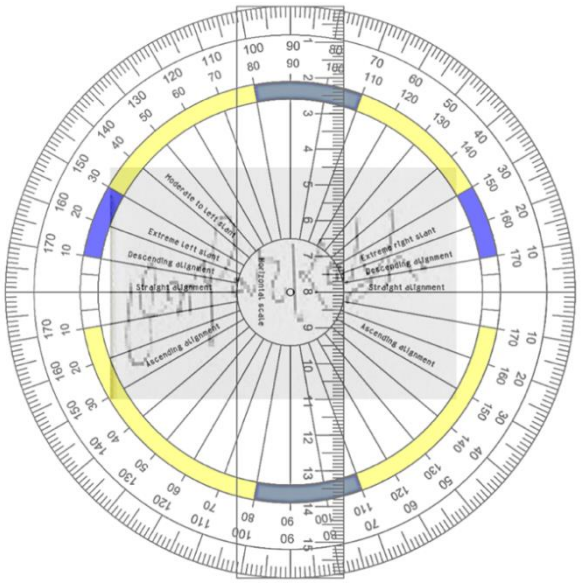

Figure 7

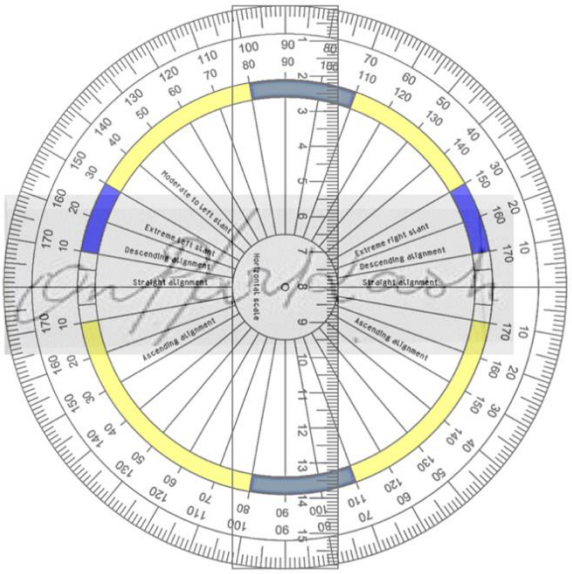

Figure 8

Figure 7 & 8: Showing the innovative approach of "Forensic Doc-Scale" measurement of the admitted and the disputed signatures.

In the above case example, the signatures when measured with the aid of "Forensic Doc-Scale" shows uphill alignment in admitted signature whereas in disputed signature the alignment is horizontal, the slant is vertical in admitted signature whereas in disputed it is moderate to right. The angle of writing varies between 900-1000 in admitted signature whereas in disputed signature angle is 700-800. The length is 18mm with a width of 52mm for admitted signature, whereas the length of 21mm with width of 71mm is observed in disputed signature. The ratio varies greatly for admitted and disputed signatures with a reading of 2.28mm and 3.38mm respectively on Forensic Doc-Scale.

In the mentioned case example, the individual characteristics deviate largely from the range of natural variations of the genuine handwriting along with the dimensional aspect ratio more than 0.5mm. Hence, indicating it as a case of forgery.

4. DISCUSSION

Forensic handwriting analysis plays a crucial role in the authentication of signatures and identification of forgery, particularly in legal and investigative contexts[7]. Conventional methods of handwriting examination, while established and widely practiced, have inherent limitations[8]. These include subjective interpretation, lack of standardization, and reliance on basic measuring tools, which can lead to inconsistencies in analysis[9]. The development of the "Forensic Doc-Scale" addresses these challenges by introducing a transparent, multi-functional tool designed to enhance the precision, consistency, and objectivity of handwriting analysis.

The comparative analysis of the "Forensic Doc-Scale" and Conventional methods revealed several key advantages of the innovative tool. Conventional methods often involve separate instruments for measuring different parameters, such as rulers for spacing and protractors for angles. This fragmented approach is time-consuming and increases the likelihood of errors. In contrast, the "Forensic Doc-Scale" integrates multiple functions into a single tool, enabling simultaneous measurement of slant, alignment, spacing, dimensions, and proportional size. This significantly reduces analysis time and improves accuracy.

Another limitation of Conventional methods is their dependency on subjective visual assessments, which can lead to variability in results between examiners[10]. The "Forensic Doc-Scale" offers a standardized framework for analysing handwriting characteristics, reducing subjectivity and enhancing reproducibility. This is particularly important in disputed signature cases, where consistent and reliable results are essential for legal proceedings.

The study evaluated the tool's performance across both Prepared and Real forensic cases of disputed handwriting. In both scenarios, the "Forensic Doc-Scale" demonstrated superior precision in identifying and measuring key handwriting characteristics. Prepared cases, which are often artificially created, tend to exhibit uniform patterns, making Conventional methods more prone to oversight. The "Forensic Doc-Scale" effectively highlighted subtle variations in slant, spacing, and alignment, providing a higher level of detail for comparison.

In Real forensic cases, where natural handwriting exhibits inconsistencies due to factors such as fatigue, mood, or writing conditions, the tool's adaptability proved invaluable. Its ability to measure dimensions on various substrates, including paper,

boards, and other surfaces, ensures its practical utility in diverse forensic contexts.

The AACE (Analysis of Known, Analysis of Unknown, Evaluation, and Comparison) method, applied in this study, benefitted greatly from the "Forensic Doc-Scale." The tool enhanced the identification of class characteristics, such as general alignment and slant, as well as individual traits, such as unique pressure patterns and spacing habits. The precise measurements provided by the "Forensic Doc-Scale" allowed for more detailed comparisons, facilitating a clearer distinction between genuine and forged signatures.

The "Forensic Doc-Scale" offers significant potential for standardizing handwriting analysis practices. Its transparent design, portability, and multi-functionality make it a practical tool for fieldwork and laboratory analysis. Moreover, its ease of use makes it an ideal training tool for forensic science students, helping to bridge the gap between theoretical knowledge and practical application. While the tool demonstrated considerable advantages, further research is recommended to explore its integration with advanced technologies, such as hyperspectral imaging and machine learning. Combining the "Forensic Doc-Scale" with digital tools could enhance its functionality, enabling automated analysis and further reducing examiner bias.

CONCLUSION

The development and application of the "Forensic Doc-Scale" represent a significant advancement in forensic handwriting analysis. By providing a standardized, transparent tool for measuring key handwriting characteristics such as slant, alignment, spacing, dimensions, size, proportion, and placement, the "Forensic Doc-Scale" enhances both the precision and consistency of handwriting analysis. This innovation addresses the limitations of traditional methods, which often rely on subjective interpretation and fragmented measuring tools.

Through its comparative evaluation with conventional techniques, the "Forensic Doc-Scale" demonstrated its ability to simplify and expedite the analysis process while improving the accuracy of disputed signature comparisons. Its versatility, portability, and ease of use make it an invaluable tool for forensic experts, students, and Questioned Document Examiners (QDEs) alike. Furthermore, its practical applications across diverse substrates and measurement parameters make it a comprehensive solution for forensic handwriting examinations.

In conclusion, the "Forensic Doc-Scale" has the potential to revolutionize the field of forensic handwriting analysis, offering a reliable, efficient, and standardized approach to examining disputed signatures. By enhancing the objectivity and accuracy of forensic document examination, this tool can significantly improve outcomes in legal and investigative contexts, paving the way for more robust and credible forensic practices worldwide.

CONFLICT OF INTEREST

The authors have no conflicts of interest regarding this study**.**

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