

## Automated Measuring Tool for Handwriting Examination

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**Abstract:** Handwriting examination is always been a challenge for document expert in court of law. The expert has to form his opinion on the perceptions and observation, however, the need of mathematical or definite calculation is required for a precise and scientific opinion. Automated tool for handwriting examination have always been an area of scientific research in the field of Forensic Document Examination, several models have been reported by many researchers for Optical Character Recognition and few on signature verification but all are very lengthy and need extensive sample size to train the model. However the tool proposed here is developed to measure the pixel distance and compute to calculate angle, and distance which in turn is used to identify the handwriting characteristics.

**Keywords:** Holographic Document, Automated Tool, Forensic Document,

### Introduction

Huber (1999) defined Handwriting as a complex motor skill which is a combination of sensory, neurological and physiological impulses. Factors such as visual perception and acuity, comprehension of form, central nervous system pathways, and the anatomy and physiology of the bones and muscles of the hand and arm all combine to produce the desired output [1].

Automated handwriting identification has always been the area of interest for questioned document examiner in last few decades it has gained much attention. The examination of handwritten signature or text involves comparison of a questioned document with a standard item of established origin associated with the matter under investigation.

The Comparisons are based on the principle that no two persons write the same way, while considering the fact that the writing of each person has its own variability. The conventional methods has several judicial issues regarding the questioned document examination that need study and research it includes Establishment of individuality that is whether the handwriting of every Individual is distinct or not, Validation of procedures; whether the procedures used by QD examiners are repeatable or not and The problem of Uncertainty; whether the inevitable uncertainty

in individualization/exclusion can be quantified [2].

Computational methods of signature examination offer the promise of resolving each of these problems. They can be used to perform statistical tests on representative populations to address the individuality problem. By formalizing human procedures they can be used to validate existing methods as being repeatable. They can also be used to compute various probabilities of interest in quantifying uncertainty in the opinion. The development of such methods also could not only help resolve the legal issues of Document evidence, but be eventually useful as tools for the QD examiner [3].

### Experimental Setup

A document examiner needs his skill along with measuring instruments and light source for comparing the questioned and specimen handwritten documents. However, several instruments are available for the printed and security documents, it is the expertise of the examiner which fixes the authorship of the handwritten text or signature.

The automated tool discussed in this paper for handwriting examination is based on Matlab a high level programming software developed by the Math works and it require a workstation with minimal requirement for running Matlab and a scanner of high resolution to digitize the

handwritten data. The proposed methodology includes the following steps

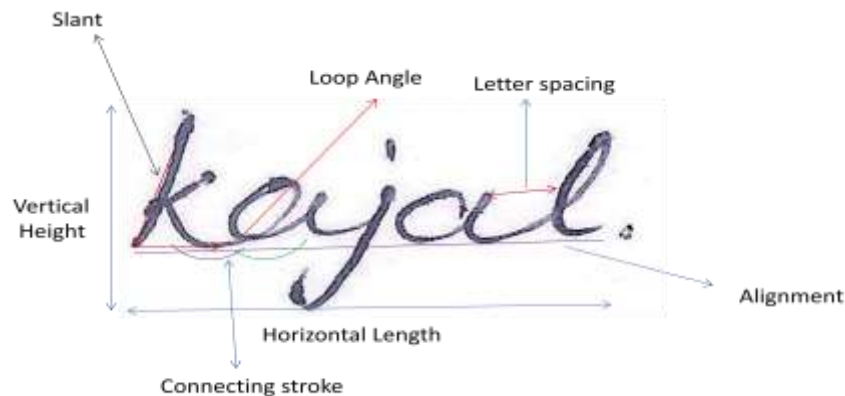
*A. Image Acquisition-* Samples of handwriting were digitized using hp Scanjet 2400 Series scanner and a dataset of 50 handwritings is prepared by compiling the scanned handwritten images and storing in memory of the computer.

*B. Noise Removal-* The noise appeared during image acquisition resulting from a number of factors, which affect the intensity of actual image, is removed using Gaussian filters [4].

*C. Image segmentation-* Noise free image is subjected to Otsu method for the segmentation of the preprocessed image which chooses the

threshold to minimize the intra class variance of black and white pixels.

*D. Feature Selection-* The image is further segmented to extract the desired features as mentioned in Table 1 the segmented images are then assembled to make a dataset which is converted and saved in a uniform format. Further for every specimen, number of strokes and their x,y coordinates were extracted using the command `impixelinfo` of matlab, the coordinates for every sample were carefully checked for any errors and labeled. The coordinates thus obtained were computed to calculate the values for the parameters selected for this study using their respective formula as shown in Table 1.



**Figure 1: Features of Handwriting selected for development of automated tool**

**Table 1: Formulae employed for Selected Features and their classification**

Sr. No	Handwriting Features	Mathematical Formula Employed for Measurement	Features Classified as
1	Slant	$\Theta = (y_1 - y_2) / (x_1 - x_2)$	Forward Slant if $\Theta > 90$ Backward Slant if $\Theta < 90$ Vertical Slant if $\Theta = 90$
2	Size of letters	$Size = \sqrt{(x_1 - x_2)^2 + (y_1 - y_2)^2}$ Average Vertical distance of letter on x,y plane calculated by distance formula	Small Medium Large (Based on number of Pixel)
3	Alignment	$\tan \Theta = \text{Base} / \text{Hypotenuse}$ The angle between a line and the x-axis is measured counterclockwise from the part of the x-axis to the	Horizontal if $\Theta = 180^\circ$ Uphill if $\Theta < 180^\circ$ Down Hill if $\Theta > 180^\circ$

		right of the line.	
4	Spacing	Average Horizontal Distance between letters, words and lines on x,y plane calculated by $Space = \sqrt{(x_1 - x_2)^2 + (y_1 - y_2)^2}$	Moderate Narrow Wide (Based on number of Pixel)
5	Angle of Strokes	$\Theta = \tan^{-1}(m_2 - m_1) / 1 + (m_2 * m_1)$	Acute if $\Theta < 90$ Obtuse if $\Theta > 90$ Right Angled if $\Theta = 90$
6	Aspect Ratio of Signature	Aspect ratio=Width (W) /Height (L)	Tall (L >W) Wide (W >L)

### Development of GUI Measure tool

The proposed graphical user interface tool is intended for precise measurements. This tool is easy to use and give accurate measurement if proper selections is made by the user, the tool computes the distance and angle for a desired selection and also counts the number of pixel within a defined area, these parameters are accordingly computed as per the mathematical

formula mentioned in table 1. These parameters are computed easily by the user by just making few selections on the selected image and the desired calculations is computed automatically by the tool and the observations are saved to a text file which can be used for further use.



**Figure.2 Screenshot of the proposed tool**

### Conclusion:

The Computational method developed for handwriting examination is easy to use as it is a simple graphical user interface tool developed using matlab. The tool is employed for measuring pixel values of handwritten documents and computed on formulae of simple coordinate

geometry and are highly significant when accurately computed, the proposed tool can be used by questioned document examiner to overcome the problem of repeatability, individuality and uncertainty and will certainly assist them to fix authorship and will have more legal admissibility.

## References

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