

# Review Part 1: Handwriting Analysis, Forgery and Counterfeiting

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**Abstract-** Handwriting is a distinctive characteristic of individuals, and has been used for a long time to identify individuals and continues to evolve. This study reviewed the characteristics of handwriting in terms of its advantages, characteristics, and factors influencing writing, including clarity, shape, and drawing, while taking into account the individual characteristics of individuals. Through handwriting characteristics, these characteristics were discussed in order to identify forgery and counterfeiting, which can occur intentionally or unintentionally. The study also included a review of writing characteristics and a comparison with samples diagnosed as forged or altered, with varying degrees of accuracy. The study demonstrated that there are several factors that control the persistence of the same writing style as a distinctive form for individuals. These factors include time and the health status of individuals, which may lead to a forced change in handwriting style.

**Keywords-** Handwriting, Forgery, Personal Properties, counterfeiting, Analysis

## I. INTRODUCTION

The method used by individuals of different affiliations and cultures to express various activities through the use of the hand as a means of recording, which varies from one language to another and from one person to another. Individuals' handwriting proficiency for people influences with many parameters which are: (1) The approach the individual followed when learning to write, and (2) The handwriting the writer adopted in his or her plan. (3) The presence of natural anomalies or defects resulting from illness or injury, and (4) The presence of some external influences on writing. From the above, and as scientifically proven, the form, type, style and characteristics of writing are considered a distinctive characteristic of the individual, so they can be used as a method for identifying identity [1].

One of the methods or applications used to recognize handwriting is the ability to identify forgery and counterfeiting that can occur in documents of various types, such as forging signatures, or fingerprints, and changing the details of a document. As we reported in our previous works, the process of analysis required determining the part that has been changed may require the use of materials such as exhibits or special detection methods [2-4]. Similarly, in the process of detecting change or forgery, we need to use special methods. Forgery or a written lie refers to the substitution of an incorrect matter in the correct place, such as changing the truth about a person or what is written in real documents, or fabricating documents and falsely attributing them to a person or group of people. It is clear from the two phrases forgery and counterfeiting: The first is used to strike at the private interest of a person or group of people,

while the second most likely includes a large segment of society, if not the entire society. However, in both cases, this does not prevent the material impact or damage from being very great [5].

Many reported works aimed to identify all the processes that lead to the forgery, counterfeiting or alteration of the recognized nature of an official document, whether a passport, document, paper currency or any printed matter within these terms, by imitating the characteristics of the printed matter, seal, signature [6]. This work deals with the forgery and counterfeiting that accrued by handwriting, thus first examining the primary mechanism through which the alteration process can occur, intentionally or unintentionally, by the use of hand, represented by handwriting. As reported by much of literature, forgery occurs manually, requiring the addition of a specific phrase, letter, symbol, or even the falsification of a personal signature. The effectiveness of the alteration or imitation varies depending on the person performing the process [7].

Therefore, we will first identify handwriting as a term and delve into some of its characteristics that relate to the subject of forgery, as it includes many details and characteristics.

### **1. Handwriting**

Handwriting is the act of forming letters and words on a page using a writing tool, such as a pen or pencil. It allows us to communicate through writing in a way that other people can interpret. Handwriting has many forms of word identifications, such as the shapes of letters, their slant, angles, connections, and curves; the quality of the line, or the thickness of the line. The arrangement identifications of handwriting require the skim for distribution of the drawing words in a specific order such as spacing, alignment, formatting, and unique punctuation marks, as well as legal with logical requirements such as spelling, wording, punctuation, and grammar [8].

### **Forgery of Handwriting**

There are three reasons that made handwriting important and critical parameters for identifying the identities and those responsible for determining forgery. The first is that "handwriting" has become more or less restricted to mean a person's own form of writing. However, before the introduction of the typewriter into general use, when handwriting had more utilitarian value, schools focused on teaching handwriting [9]. The second is: Studies have shown that the pressure on the pen holder (grip pressure) as well as the pressure of the pen point on the paper (point pressure) vary continuously during writing, thus writing speed is not uniform but depends on the type of writing being done [10].

The direction of the stroke, the turns and loops, the complexity of the stroke, and the type of stroke preceding it will all change the speed of a specific writing stroke. Speed is also affected by the length of the letter elements, as drawing long strokes typically takes longer than drawing short strokes. By comparing the handwriting movements of good and limited-ability writers, researchers found that these two groups differed in handwriting position, speed, and the types of finger and hand movements. In these sections there should be mentioned the influence of the hand, which is responsible for drawing writing if right or left and that influence directly on the properties of writing [11].

### **2. Qualities of Drawing Letters**

A significant correlation was found between changes in speed and letter shape, and good writers showed greater consistency in the speed at which they formed similar strokes. Later, experts who experimented with manuscript and printed text confirmed that the latter type of handwriting is learned and executed more quickly because it more closely resembles printed writing. Used tools did not prevent the forensic sciences from starting with any property which may be class characteristics or individual characteristics or mark to distinguish the identifying details of the writing.

Handwritten evidence is admissible in court, provided scientifically accepted guidelines are followed. Scientific analysis of handwriting has now become an important tool for forensic document examiners. Many relevant law enforcement agencies use handwriting analysis to solve important cases. According to the information above, the work will start with features properties of handwriting before highlighting with forgery.

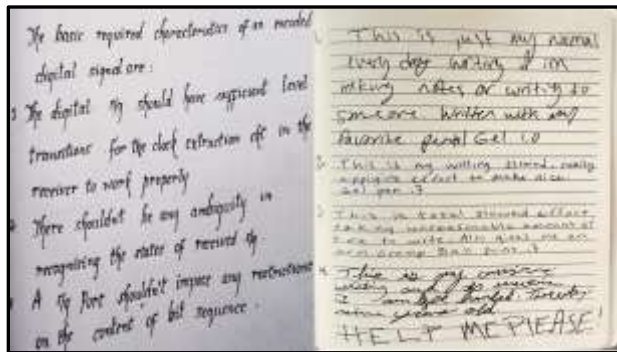


Figure 1: skim for two documents wrote with good skills at the left and bad skills at the right.

### 3. Personal Properties of Handwriting

The handwriting characterized by specific properties, such as pen pressure, cursive and printed letters, Letters complete, connecting letters, Continuous, Size consistency, Spacing and Font quality [12]. According to figure 1, the beauty and nature of drawing the letters, handwriting can be classified into three types: the first is Good Handwriting: which identified by (1) legible: easily recognized the letters, (2) uniform size of Letters, with a consistent slant, baseline, and joining, (3) adequate spacing exists between letters and words, (4) writing is recognized with start and end letters which means presentable and easy to follow.

The second type is handwriting with bad quality, that could be related to neurological or developmental issues. However, it is characterized by: (1) letters are illegible, difficult to decipher or recognize, (2) variance in size and slant and connecting between letters, (3) irregular space between letters and words, (4) some of the letters was not distinguished thus difficult to read. Average handwriting: commonly exists among people, with abilities to modify with time and after

practice. However, general identification of this type is: (1) readable, (2) can recognize the letters in all conditions. (3) small variance in letter size, slant, or spacing.

Figure 2 reports examining the characteristics of each category. It is possible to scientifically predict the differences between the original document and the document that has been altered or forged. Therefore, the process of discrimination requires first classifying the required handwriting proficiency analytically, followed by observing the differences between the original and the suspected document.

Working with the distinction between forgery and counterfeiting requires the ability to distinguish between exceptional and distinctive characteristics of individuals, which must be identified by forensic workers and that two sections standard handwriting exemplar and standard non-request handwriting exemplar. According to the definition of standard handwriting exemplar, which is handwritten sample of known writing that was written during the normal course of business, social, or personal affairs by any given individual. The second term which is standard Non-request handwriting exemplar, include copy book forms, with Letters that are behaved similar in design to the letters in the copy books used to teach or drawing handwriting. The last description takes care of the variance between the letters in a word are joined together or written with one graphic motor sequence, which is known as cursive type or written with separated skim.

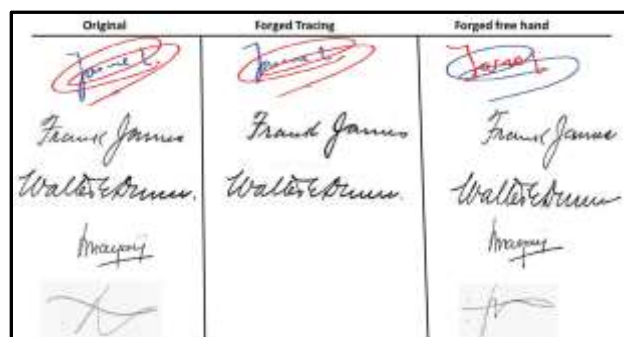


Figure 2: Skim of compare between original, forged tracing and forged free hand for different handwriting samples

#### 4. Specific Properties of Handwriting

In many cases involving a signature, an opinion to solve, signature was either genuine, or falsified it did a perfect imitation because it may have looked like the other signatures and with high quality. On examination, sometimes it could be seen what appeared to be an unusual pen lift in an abnormal place in the questioned signature. Forensically, an unusual location which leaves a break in the line of writing in the questioned signature or word is known as a pen lift, could be forming basic for genuineness, or inverse. An optical microscope with direct viewing can identify facts, reality, and a reliable basis to make a final and strong opinion. Mostly forensic scientists may face the questioned signature bore a resemblance to the group of exemplar signatures, none of which had a similar pen lift [13].

All of that required from forensic scientists able to identify air Strokes, alignment, blobs, and Characteristic which can be seen in figure 3. The first section required identifying an invisible part of the stroke that bridges the gap between the point where the pen is raised off the paper to the point it returns to the paper. The second refers to the organization of margins, lines, words, and letters, line spacing, and various line indentations. The third part refers to the accumulation of ink which mostly indicates starting to write the words or some sections of signature and sometimes gives indicators of writer impairment [14].

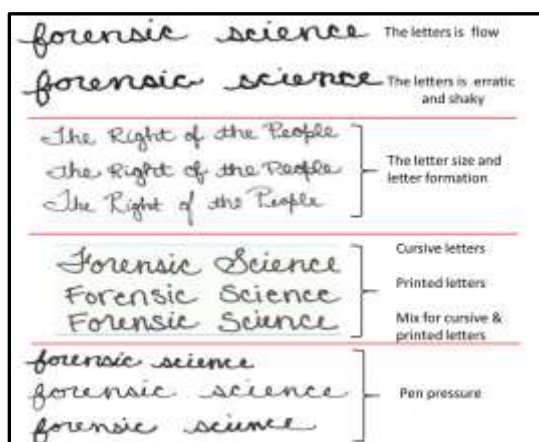


Figure 3: skim for different cases of handwriting to Imitating the writing style intentionally or unintentionally, or even for the purpose of forgery

## II. TYPES OF COUNTERFEITING

Forgery includes several types that are listed in the following diagram, which gives an illustrative idea with a comparison of each one. As shown in figure 4, above, the physical forgery is more easily to apply in two ways: the easily represents by partial change while the other requires total change, which required more efforts to make it.

It should be taken to identify two cases that are "deliberately written by a writer in a way to attempt to hide identity", which is Disguised writing, the other cases "do not appear to reflect normal writing habits, either from a deliberate attempt to disguise or from unusual writing conditions" which is Distorted writing [15].

As shown in the figure, each type has a distinguishing feature in the method of implementation and procedure. For example: Photography could be applied by regular photography, copiers and scanners. The behavior of applying method also changed with the aims such copy methods could have made Direct: with a light-transmitting glass panel with a light underneath, and a document with the forged paper attached. The traces are visible and can be taken with any writing instrument, usually leaving a print. While the other indirect forgery can be accomplished by using a tool such as printing paper on a sheet of paper and applying pressure to the signature sites, leaving a pen tip mark. However, what distinguishes this method is that it is more precise and better in performance than direct forgery [16-17].

Partial, forgery occurs in part of the document or document to which the change is requested. This is done in the following ways: The first is addition. Here, the document is altered so that the paper used for writing and the text on it has no connection to the original document. This is done by adding a word, sentence, paragraph, text, or number to the altered document.

The second is insertion. In this case, a word, paragraph, or sentence is inserted into an available space on the surface of the document to be

changed. The third is assembly. Words or phrases are assembled, then photographed and inserted into the document. The fourth is deletion. In this method, a paragraph, word, or part of a word is deleted or crossed out from the document. This is done using razor blades, staples, or special chemicals. The final type involves shredding, in which a part of the document is deleted or cut out, rendering it completely inaccessible.

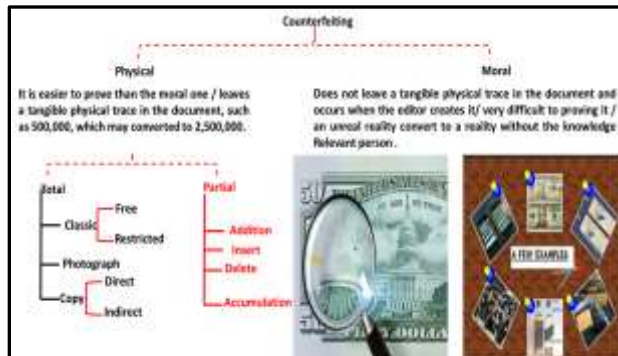


Figure 4: Skim for classification counterfeiting.

One of the basic factors that cause a change in writing proficiency is time, as shown in figure 5, which related to the abilities of muscles to perform this activity. The change in writing form can also occur after changes which are not transitory, such as sudden and permanent, such as a debilitating stroke, drugs and alcohol, and that mostly cannot change to the usual form [18].

Signatures and handwriting have long played a role in day-to-day activities and the identification process is used as a means of comparison and discrimination, which can be based on evaluation of the significance of their similarities and dissimilarities.

The number of significant similarities and dissimilarities will be the cue in concluding whether the handwriting belonged to a particular person or not in cases like forgery and fraud. This is all done by comparing the document under analysis with a document from the same period, to eliminate the time factor and health factors, if there is a physical impact.



Figure 5: Skim for the change in style of signatures with age (43-88) years

### III. CONCLUSION

Many sources, as well as this research, have shown that handwriting is a distinctive characteristic of individuals and can be used to identify documents that have been altered, such as forgery. The research also demonstrated that individual writing characteristics can be used to distinguish between authentic and forged handwriting. According to the reported work, understanding the properties of writing with the ability to examine it using specific apparatus can identify the real or non-real documents. A handwriting analyst must be familiar with the basics of analyzing these characteristics to be able to perform the analysis. The study demonstrated that handwriting analysis requires a very important factor, namely the age of the writing. This requires using a comparison sample that matches the age of the document being analyzed.

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