Forensic Examination of Obliteration and Alteration in Handwriting Using Digital Image Processing

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ABSTRACT: The most frequent type of problem in forensic question document examination is obliteration and alteration which is always a challenging task for document experts. In this research paper a novel approach has been used to decipher the obliterated by using commercially available image processing software Adobe Photoshop Version 7.0 instead of any spectral comparator or conventional method. In our first study where graphite pencil handwriting were obliterated with ballpoint pen which cannot be discerned visually are taken for experimental purpose and in second study a case of addition and alteration in handwriting is discussed in the paper. The technique like tonal adjustment using curves; brightness/contrast and threshold mode was applied to decipher the hidden and altered content. The latest edition of tool has tremendous potential for document examination and results obtain after examinations are highly appreciable and better than any spectral comparator. The application of the tool are non destructive in nature and support to almost all type of image file formats. The results obtain by tool are visually very effective for court presentation as well as for interpretation.

Keywords: forensic examination obliterated writing, addition, Adobe Photoshop, digital image processing.

Introduction

The obliteration in handwriting is often found intentionally where the culprit wants to hide the original content by using different ways like overwriting, crossing or coloured with pen or pencil and in case of addition in handwriting the forger generally tries to manipulate the handwriting by adding of few numbers or handwriting without influencing the original content while in case of alteration the handwriting is manipulated by introducing some additional strokes to the existing handwriting. The forensic questioned document community has encountered difficulty visualizing obliterated and altered handwriting using conventional methods. Conventional methods for visualization of obliterated writings do not adequately visualize writing when obliteration is made with the same class of color ink, or when graphite pencil writings are obliterated by ink [1]. A number of methods have been suggested for analysis of obliterated writing in literatures. To obliterate means to blot out so as not be readily or clearly readable. Writing may be intentionally obliterated to render them indecipherable by covering or obscuring with marking, overwriting, blots of ink or rubbing with pencil or carbon paper etc. which are examined by their spectral features because each ink has unique spectral feature.

Image processing is a physical process used to convert an image signal into a physical image. The image signal can be either digital or analog. The actual output itself can be an actual physical image or the characteristics of an image. In addition to photography, there are a wide range of other image processing operations. The field of digital imaging has created a whole range of new applications and tools that were previously impossible. Face recognition software, medical image processing and remote sensing are all possible due to the development of digital image processing. Specialized computer programs are used to enhance and correct images. These programs apply algorithms to the actual data and are able to reduce signal distortion, clarify fuzzy images and add light to an underexposed image. Many computer software programs are beneficial to Forensic Document Examiners [3]. A simple computer approach was discussed for decipherment of obliterated writing with application computer digital image processing tool box [2].

Over the past thirty years there has been a limited amount of research into using computers to enhance and automate the analysis performed by forensic document examiners [5-7]. The computer imaging also has potential for abuse in creation of fraudulent documents [4].

In this paper an attempt has been made to decipher two different type of case where the graphite pencil handwriting obliterated by ball pen and determination of addition and alteration in handwriting with the help of computer application software Adobe Photoshop (Version 7.0.). The Adobe Photoshop is widely available commercial

software having a variety of applications in image processing and image correction.

Materials and Methods

The exhibits taken for the purpose of experimental works are first scan by using high resolution scanner (resolution 600 X 600 (dpi) dots per inch) and save in .JPEG file format.

For installation of Photoshop and Image Ready from the Adobe Photoshop Compact Disc (CD) onto your hard drive please double click on setup file of the application and follow the screen installation instructions, because you cannot run the program directly from the Compact Disc.

Minimum Installation Requirements

When installing Photoshop to a hard drive other than your system or boot drive (usually C :), you will still need to have at least 65-70MB free on your system drive to proceed with installation, regardless of how much space is on your installation drive. (Please note that Photoshop 7.0 does not support Windows 3.1.x or Windows 95.)

System Configuration of the Host Computer

a) Specifications: System Model: T12Rg-H, BIOS Version: American Megatrends Inc. 205 HCL Infosystems.
b) Operating System: Microsoft Windows XP Professional, V: 5.1.2600 Service Pack: 2.0
c) Memory (RAM): Capacity: 512 MB.
d) Processor: Genuine Intel(R) CPU T2080 @ 1.73GHz, Version: x86 Family 6 Model 14 Stepping 12, Speed: 1729 MHz.

The scan file is then open with Adobe Photoshop window and processes it with the techniques like brightness and contrast, tonal adjustment sing curves and threshold mode.

Brightness and Contrast

The Brightness/Contrast command lets you make simple adjustments to the tonal range of an image. Unlike Curves and Levels, this command makes the same adjustment to every pixel in the image. The Brightness/Contrast command does not work with individual channels and is not recommended for high-end output, because it can result in a loss of detail in the image.

Tonal Adjustment Using Curves

Like the Levels dialog box, the Curves dialog box lets you adjust the entire tonal range of an image. But instead of making adjustments using only three variables (highlights, shadows, mid tones), with Curves you can adjust any point along a 0-255 scale while keeping up to 15 other values constant. You can also use Curves to make precise adjustments to individual color channels in an image

Using the Threshold Command

The Threshold command converts grayscale or color images to high-contrast, black-and-white images. You can specify a certain level as a threshold. All pixels lighter than the threshold are converted to white; all pixels darker are converted to black. The threshold command is useful for determining the lightest and darkest areas of an image.

Results and Discussions

The results of the tool shows that the tool has tremendous potential for forensic document examination very efficiently, as show in (**Fig.1**) the first case where graphite pencil handwriting is obliterated by ballpoint pen was revealed as "YPYM" after Brightness & Contrast command and tonal adjustment of each pixel using curves command.

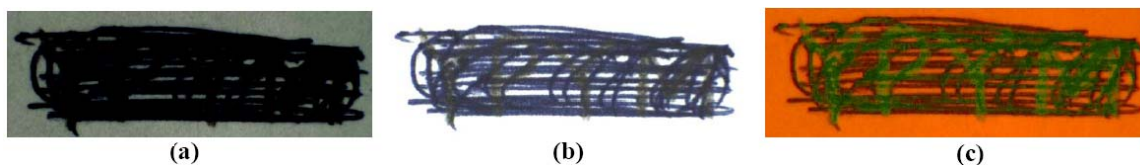| (a) | (b) | (c) |

Fig. 1: Original scan image of graphite pencil handwriting obliterated with ball pen (a), after tonal adjustment using curves (b) and after brightness and contrast adjustment (c)
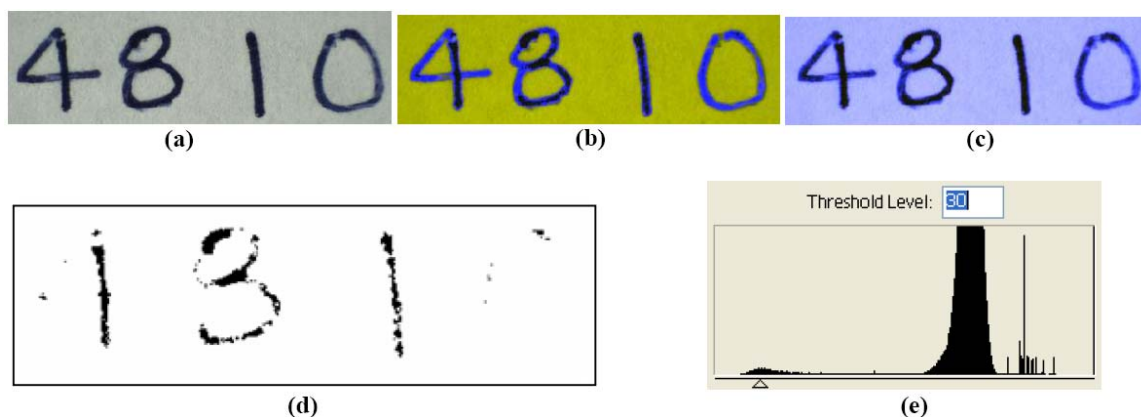
Fig. 2: Original scan image of alteration and addition in ball pen handwriting with ball pen (a), after tonal adjustment using curves RGB and blue channel (b) & (c) and after threshold mode and its dialogue box (d) and (e) respectively

The alteration and addition in handwriting was determined by the use of tonal adjustment of the every point by curves and threshold mode. The actual handwriting was "131″ which was converted as "4810″ after alteration and addition (**Fig.2**). With the increase in brightness and contrast at different level and tonal adjustment in RGB and CMYK mode are better for the decipherment.

The obliterated, altered and addition of handwriting was processed with different channel and found good results in blue channel where as the threshold mode show very appreciable result when we minimize the threshold values in between 28 to 32.

Conclusion

The digital image processing tool box Adobe Photoshop has incredible utilization in field of forensic document examination to resolve the problem like obliteration, alteration and addition in handwritings with high accuracy. It is a non invasive, less time consumption for examination and very cost effective tool box. The future research in this field will explore its other potential in different field of forensic science and prove the validity of its results.

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