# Questioned Documents Analysis for Decipherment of Obliterated Writing

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Abstract: Obliteration with the application of erasure is made with intent to cheat someone. Documents are changed in numerous ways, and every method requires separate technique for detection and decipherment of the original writing. It is very challenging task for document examiners, hence new detection methods should be developed to detect obliterated writing written with similar ink, which cannot be detected by the conventional method. In the present study 20 different types of documents were collected and then reconstructed samples were prepared for the study. Out of which 10 samples were prepared by using physical erasure and 10 samples were prepared using chemical erasures on different types of Papers. For the document reconstruction purpose we use 16 different types of writing materials with four erasures. In this research we investigate the use of Multispectral imaging on Visual Spectral Comparator (VSC-6000 HS, Foster & Freeman Co Ltd England) for decipherment of writing with similar ink. The experimental results demonstrate that obliterated writing with same color ink, which cannot be detected by the conventional method, can be detected by Multispectral imaging.

Keywords: obliterated writing, questioned document, Multispectral Imaging and VSC 6000.

#### 1. Introduction

The obliterated writing is writing that has been obscured or removed by deliberately overwritten or masked using different colored writing instruments of varying ink. The decipherment of such obliterated writing is an important and difficult task for forensic document examiners. The use of visible and near infrared spectroscopy imaging is the conventional method for decipherment of obliterated writing. If various writing instrument were used to reconstruct document with obliterated writing on varying nature of papers, certain obliterated writing cannot be detected by the conventional methods. Commonly obliterated writing is detected using spectroscopic image in which light transmits through the obliterated writing and is absorbed by the overwritten or masked writing. In certain condition the obliterating ink absorbs in the 400-1000 nm region or even when the obliterating ink transmits light in a certain wavelength band, the writing ink transmits the light of the same wavelength band and also neither the obliterating ink nor the writing ink fluoresces. In this condition, the obliterated writing sometimes very difficult to visualize using the conventional method; therefore it is necessary to find alternate method to address this issue. In this research, I experimentally demonstrate that Hyperspectral Imaging feature of VSC 6000 is capable of deciphering erased and obliterated writing, which can not detected by conventional method.

#### 2. Method

The obliterated writing used in this study was prepared as follows: First, old document of various nature were collected from different sources. Randomly selected writing area from collected documents was then erased by using ink erasures Milkado<sup>TM</sup>. The obliteration was made using different writing instruments (Table I), selected based on the original writing ink color on document. If the original writing is with blue/black color then rewriting or alteration were made using blue/black color ink. After completion of document reconstruction process the marking were done on suspected obliterated area. This marked areas of document then analyzed under Visual Spectral Comparator (VSC-6000 HS, Foster & Freeman Co Ltd England) for decipherment of actual obliterated writing text. For that we examined reconstructed document by visible, near infrared multispectral imaging and Middle-infrared hyperspectral imaging along with luminescent photography. The spectra measurement region ranging from 4000 to 700 nm was selected for decipherment of writing.

Table I: Black, blue	, and red	writing	inks	used	in	the
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experiments				
		Туре	Colour	Trade Name
Writing Ink	Sample 1	Writing pen	Blue	Unknown
	Sample 2	Printer Ink	Black	HP laser get P 1108
	Sample 3	Printer Ink	Black	HP laser get
	Sample 4	Printer Ink	Black	HP laser get
	Sample 5	Writing Pen	Blue	Unknown
	Sample 6	Printer Ink	Red	Unknown
Obliteration Ink	Sample 1	Writing Pen	Blue	Reynolds
	Sample 2	Writing Pen	Black	Luxor
	Sample 3	Writing Ink	Black	Flair
	Sample 4	Writing Ink	Blue	Montex
	Sample 5	Writing Pen	Blue	Roritoflymax
	Sample 6	Writing Ink	Red	Rechno

#### 3. Result and Discussion

Sample I

Volume 9 Issue 1, January 2020 www.ijsr.net

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#### DOI: 10.21275/ART20204054

#### International Journal of Science and Research (IJSR) ISSN: 2319-7064 ResearchGate Impact Factor (2018): 0.28 | SJIF (2018): 7.426



Figure 1: Results of obliterated-writing detection for sample 1, second 1-c sample using the multispectral Imaging method. The analysis conditions of the MSI are listed in Tables 1 and 2, respectively.



Figure 2: Results of obliterated-writing detection for sample 2, second II-c sample using the multispectral Imaging method. The analysis conditions of the MSI are listed in Tables 1 and 2, respectively

Sample III **Examination** Committee **Examination** Committee **Examination** Committee Neeti Kapoor Neeti Kapoor Neeti Kapoor Rahul Melkundeka Rahul Melkundekar Rahul Melkundeka Shrikant Korke Shrikant Korke Shrikant Sorke

II-f

II-d II-e Figure 3: Results of obliterated-writing detection for sample 2, second II-f sample using the multispectral Imaging method. The analysis conditions of the MSI are listed in Tables 1 and 2, respectively



Volume 9 Issue 1, January 2020 www.ijsr.net

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#### DOI: 10.21275/ART20204054

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Figure 4: Results of obliterated-writing detection for sample 3, second III-f sample using the multispectral Imaging method. The analysis conditions of the MSI are listed in Tables 1 and 2, respectively.





Figure 5: Results of obliterated-writing detection for sample 4, second IV-c sample using the multispectral Imaging method. The analysis conditions of the MSI are listed in Tables 1 and 2, respectively



Figure 6: Results of obliterated-writing detection for sample 5, second V-c sample using the multispectral Imaging method. The analysis conditions of the MSI are listed in Tables 1 and 2, respectively.



Figure 7: Results of obliterated-writing detection for sample 6, second VI-b sample using the multispectral Imaging method. The analysis conditions of the MSI are listed in Tables 1 and 2, respectively

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**Table 2.** Analysis condition for decipherment by Multispectral Imaging

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Writing Ink Number	Ink Colour	Figure annotation	Image Name	Reflection/ Transmission	Incident Light	Filter between sample and camera
1	Dlue	La	Spot Light Image	Transmission	200-1000nm	Long pass filter
I DI	Diue	Blue I-C	Spot Light mage		wavelength light	Cut on wavelength of 695 nm
4 Black	Black	Black II-c	Near Infrared Reflection	Transmission Spot	200-1000nm	Long pass filter
	DIACK				wavelength light	Cut on wavelength of 645 nm
12 Black II	Πf	Near Infrared Deflection	n Transmission Flood	200-1000nm	Long pass filter	
	DIACK	DIACK II-I	inear minared Kenection	Transmission Flood	wavelength light	Cut on wavelength of 570 nm
13 Black	Black	Black III-c	Near Infrared Reflection	Transmission Flood	200-1000nm	Long pass filter
	DIACK				wavelength light	Cut on wavelength of 610 nm
2 Blue	luo IV c	Spot Light Image	Transmission	200-1000nm	Long pass filter	
	Diue	Diue IV-C	Spot Light mage	Transmission	wavelength light	Cut on wavelength of 850 nm
9	Blue	V-c	Spot Light Image	Transmission	200-1000nm	Long pass filter
					wavelength light	Cut on wavelength of 725 nm
13	Red	VI-b	Spot Light Image	Transmission	200-1000nm	Long pass filter
				1141151111551011	wavelength light	Cut on wavelength of 645 nm

## 4. Conclusion

In figures 1-7, pre- and post-obliteration images of the samples 1-6 are shown. The results of Multispectral imaging are displayed in III-c, II-c, II-f, III-c, IV-c, V-c and VI-b. The analysis conditions for the decipherment by Multispectral Imaging are listed in Table 2. Although the multispectral imaging was performed at 15 different analysis conditions, only six representative results are shown, owing to a lack of space. In all the cases, obliterated writing was successfully detected by Multi-spectral imaging. If the writing ink is completely erased by erasures and under the same color obliteration ink, the multispectral imaging features of VSC 6000 could be able to detect original writing along with alteration. In all samples the reflection or absorption of light showed on different wavelength. The obliteration with all kind of ink, papers and erasures types can be deciphered through Multispectral Imaging. It is a technique. Nondestructive Traditional obliteration examination and detection techniques such as Electrostatic Detection device, a microscope, photography, UV radiation or IR luminescence may decipher obliteration in some extent and can cause harm to the documents or sometimes unable to detect. The obliteration with certain black or blue gel pen inks may not deciphered through this technique. The Hyperspetral analysis mode of VSC with Near Infrared Multispectral imaging, Reflection and transmission analysis along with luminescent photography is a great tool for decipherment of obliteration with same color ball point ink and capturing the image. Further study will need to focus on obliteration decipherment of Gel pen ink.

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## Volume 9 Issue 1, January 2020

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