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Enhancement of Handwritings on Selected Charred Documents using Video Spectral Comparator (VSC)

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Abstract

Questioned documents are documents whose authenticity is disputed. Documents are destroyed by fires and other means to conceal criminal activities. Charred or burnt documents are a type of questioned document that are likely to contain vital information. These documents are mainly linked to ransoms, forgery, fraud, suicide and other white collar offences. This study aimed to evaluate the ability of a Video Spectral Comparator (VSC-6000) for the enhancement of writings on charred documents and to determine the effectiveness of flood light and white spot beam in VSC on charred documents.

A passage was written by different types of writing instruments on different types of writing paper available in Malaysia. Then the handwritten documents were burned until the writings became invisible. The charred documents were viewed under flood light and

Keywords: Forensic Science, Charred/Burnt Document, Handwritings Enhancement, Video Spectral Comparator.

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the white beam by adjusting the wavelengths.

Results showed that the writings on the charred document exhibited appreciable enhancement suitable for forensic investigation. The writings were comparatively more visible under the white spot beam than the flood light beam. These findings were recorded through photography.

The present study provides a promising method and an effective alternative way to enhance writings on charred documents.

تحسين استظهار الكتابات المحرقة بخط اليد على الأوراق المحترقة باستخدام تقنية فيديو الطيف المقارن (VSC)

المستخلص

إن الوثائق محل التحقيق هي الوثائق المشكوك في صحتها، والتي يتم إجراء تغييرات على أصلها أو تدميرها بالحرق أو بغيره من الوسائل وذلك لإخفاء الأنشطة الإجرامية، وتعد المستندات والوثائق المتفحمة أو المحترقة محل الشك من الوثائق التي من المحتمل أن تحتوي على معلومات حيوية، وغالباً ما ترتبط هذه الوثائق بعمليات طلب فدية أو تزوير واحتيال، أو انتحار وغيرها من جرائم ذوي الياقات البيضاء.

هدفت هذه الدراسة إلى تقييم قدرة جهاز فيديو طيف المقارن (VSC-6000) على تحسين استظهار الكتابات الموجودة على الوثائق المحترقة وتحديد فعالية الضوء في الجهاز على الوثائق المتفحمة. وقد تمت الدراسة بكتابة فقرة بخط اليد بأنواع مختلفة من أدوات الكتابة على أنواع مختلفة من ورق الكتابة المتاحة في ماليزيا. ثم تم حرق تلك الوثائق المكتوبة بخط اليد حتى أصبحت الكتابات غير مرئية. ثم شوهدت الوثائق المحترقة تحت ضوء الفم

المشبع و تحديد إعدادات الأشعة البيضاء عن طريق ضبط الأطوال الموجية.

وأظهرت النتائج التي تم التوصل إليها أن الكتابات على الوثيقة المتفحمة حدث لها تحسين ملموس مناسب للتحقيقات الجنائية. حيث ظهرت الكتابات بوضوح أكثر تحت أشعة البقعة البيضاء من أشعة الضوء الغمر المشبع، وقد سجلت هذه النتائج من خلال التصوير الفوتوغرافي. وتقدم الدراسة وسيلة واعدة ووسيلة بديلة فعالة لتحسين استظهار الكتابات على الوثائق المتفحمة التي يمكن استخدامها في سيناريوهات الجريمة الحقيقية.

الكلمات المفتاحية: الأدلة الجنائية، الوثائق المحروقة، كتابة خط اليد، تحسين الاستظهار، تقنية فيديو الطيف المقارن

1. Introduction

A document may be defined as a piece of written, printed, or electronic matter that provides information and forms a record. Documents have marks, signs, or symbols to make it understandable [1]. Forensic document examination involves the analysis and comparison of questioned documents in order to obtain information that can be used to serve the justice system based on scientific explanations [2]. In general, documents have handwritings, signatures, machine printed or altered matters [3].

The analysis of handwriting has a long history, perhaps dating to the origins of handwriting itself. Handwritten signatures occupy a very special place in this wide set of biometric traits. Signatures are generally accepted by governments and financial institutions as a legal means of verifying identity [4]. Crime involving documents ranges from fraud and anonymous letters to armed robbery, suicide and murder. The handwritings and signatures are valuable pieces of evidence in white collar crimes during forensic document investigation [5].

Questioned documents are documents whose authenticity is disputed. Questioned documents portray a noteworthy role in conviction and vindication in a court of law [6]. A charred or burnt document is any document that has become darkened and brittle through exposure to fire. Burning documents to conceal a crime is fairly common; most people believe that once evidence of their crime has turned

into ash, they will not be discovered. However, with special equipment, an experienced document examiner can often still read what is on a burned or charred document [7].

The handling and decipherment of charred documents is one of the perplexing problems in the field of questioned document examination and arson investigation. A burnt document is extremely fragile and requires great care in handling and processing. In addition, its blackened, carbonized state renders ordinary restorative processes ineffective. An entirely new approach to a unique problem is required [8].

Forensic document examiners apply an array of techniques and make use of state of the art equipment to conduct a variety of examinations on items of evidence. A Video Spectral Comparator (VSC) imaging device allows a document examiner to analyze inks, visualize hidden security features, and reveal alterations in a document [9]. It allows for the non-destructive visualization of security elements and the acquisition of reflectance measurements in both visible and shortwave near infrared region at focused areas in the document [10].

The present study aimed to study the ability of a VSC for enhancement of handwritings on burnt documents and to determine the effectiveness of flood light and white spot beams under suitable wavelengths.

2. Materials and Methods

The research was conducted at the Royal Malaysia Police College Forensic Laboratory, Cheras, Selangor state, Malaysia. In this study, four types of writing papers (10.5 x 14.5 cm) commonly available in Malaysia were used: white paper (70 gsm), yellow paper (80 gsm), blue paper (70 gsm) and cardstock paper (140 gsm). A known passage was written in these papers by using six different types of writing instruments (pens) available in Malaysia: a blue ballpoint pen (Paper Mate; 0.6), a black ballpoint pen (Paper Mate; 0.5), a blue gel pen (M&G; 0.7), a black gel pen (Pilot G-2; 0.5), a black pentel marker and a red sharpie marker. The text on the paper was written by the same person since different



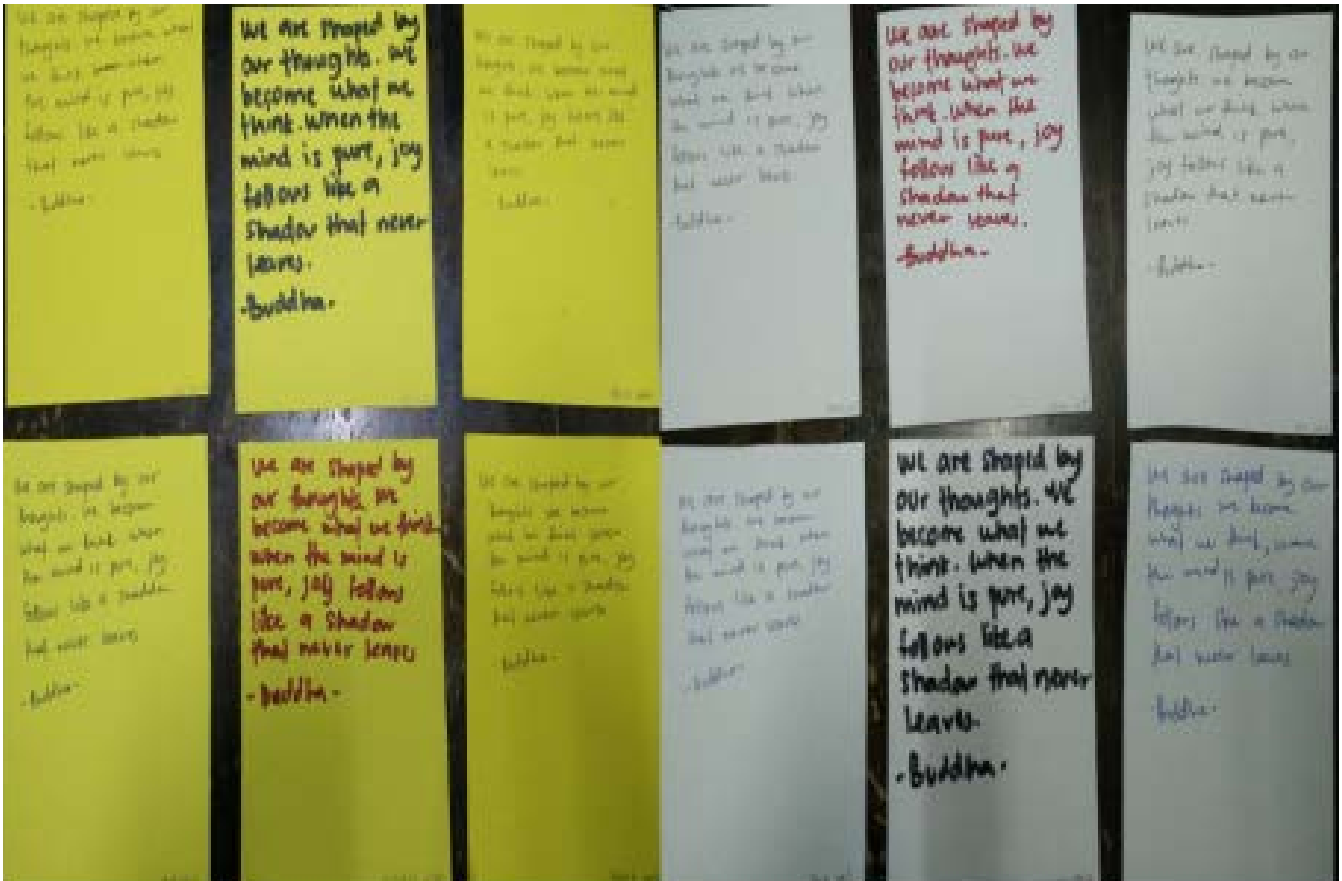


Figure 1- Illustrative example of images showing two different types of papers (yellow and cardstock) with similar passage written with six different types of pens.



Figure 2- Malaysian made lighter (showing both sides) used to burn the documents

persons apply different pressure which would have affected the results.

All the fire-burnt documents were coded with sample ID for anonymity. The burnt samples were photographed with different light beam settings at different incident angles. An

illustrative example of images showing two different types of paper (yellow and cardstock) with a similar passage written with six different types of pen is shown in Figure-1.

The sample size consists of 24 handwritten document sheets and the samples were subsequently burned using a lighter flame as in real crime scenarios. Previous researchers used a muffle furnace to char the documents [11]. But in this study, the documents were burned using a Malaysian made, commonly available smoker's lighter (Figure-2). The paper was ignited starting from the middle of the paper until all the writings disappeared.

The paper was kept at a distance of about 1.5 cm from the lighter and the paper was burned slowly without damaging the paper (Figure-3). The burned sample was then preserved for analysis.

The burning process was conducted under similar laboratory conditions under the supervision of the forensic lab-

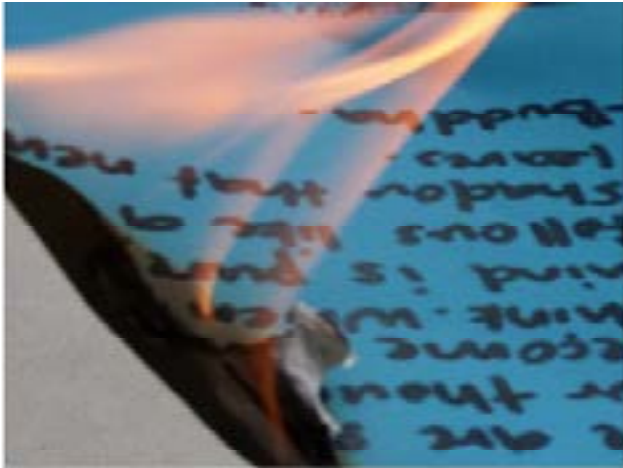


Figure 3- Illustrative example of burning of a passage written on a blue colored paper.

oratory technician. The charred documents were initially viewed under a hand magnifier and then examined with a VSC 6000 using floodlight beam and white spot beam setting. The wavelengths were adjusted until clear visibility was achieved. Some documents showed minimal visibility of the handwriting. The wavelengths used in the present study were 645, 725 and 780 nm. The handwritings viewed under the above mentioned wavelengths were photographed and recorded.

3. Results and Discussion

In attempting to decipher charred documents, it is impor-

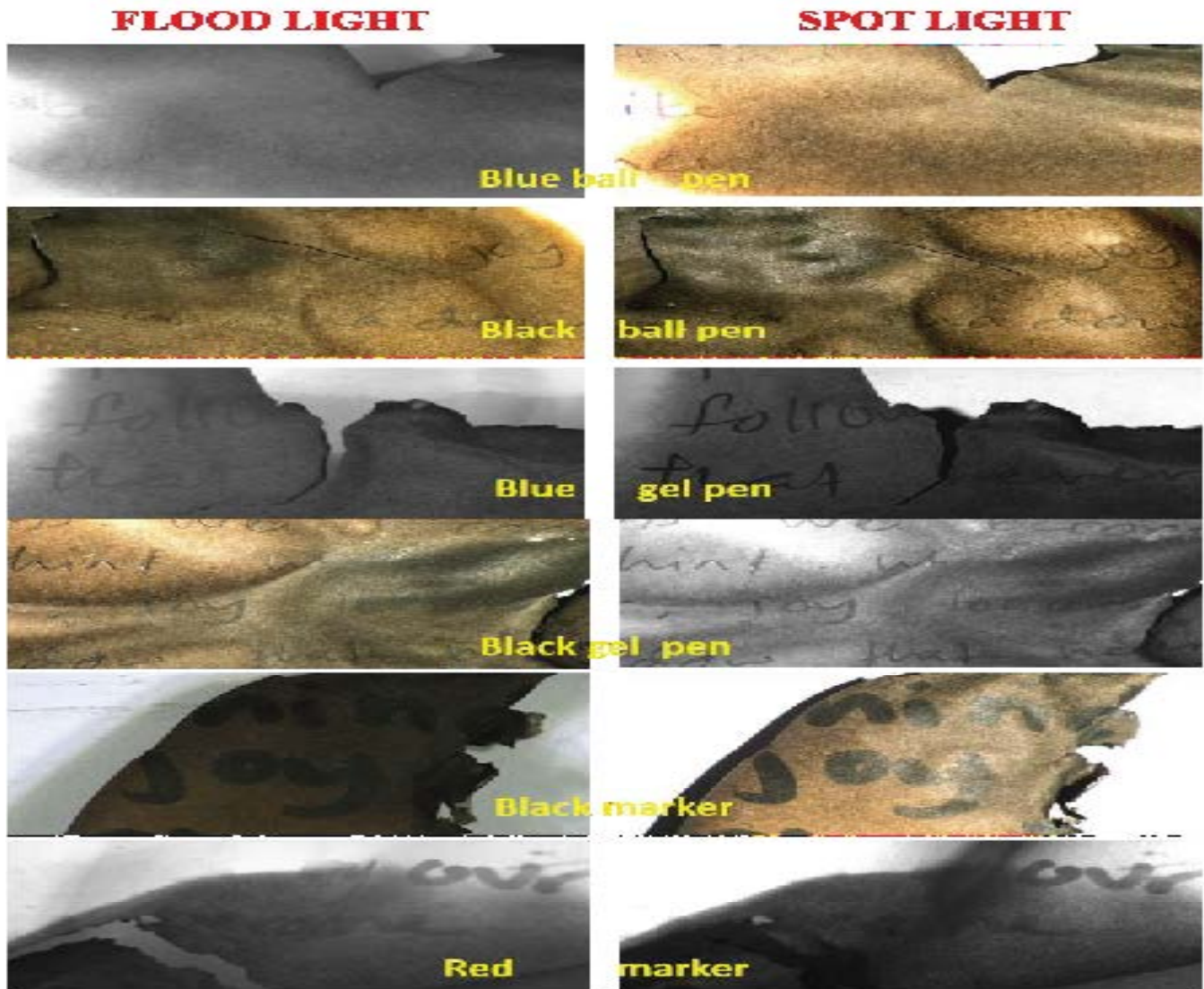


Figure 4- Illustrative examples of images showing the enhancement of handwritings on burnt white papers written by various writing instruments.

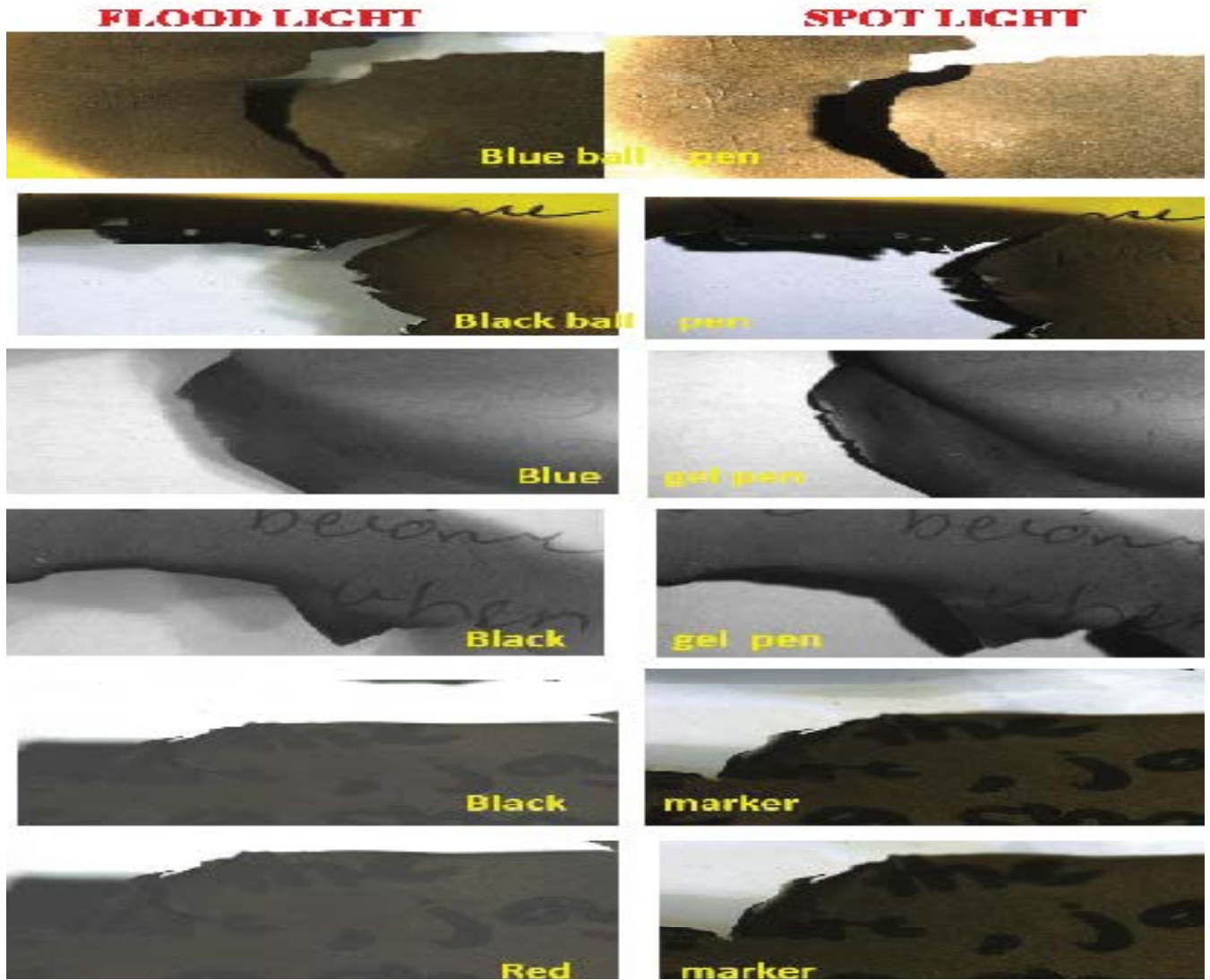


Figure 5- Illustrative examples of images showing the enhancement of handwritings on burnt yellow papers written by various writing instruments.

tant to bear in mind the fact that such documents may vary considerably in their physical and chemical composition, depending upon the type of paper and ink and also upon the conditions under which they were burned [12]. Thus, the results of the investigation depended on the basis of the weight of paper (gsm) and types of ink used in the writing instruments.

The current study details an attempt to decipher charred documents using various types of VSC's light settings. The charred documents were visually inspected but no decision could be arrived at. Then the charred documents were examined under a VSC with flood light and spot light beam

by adjusting the wavelengths. Considerable care was exercised in handling the charred documents and in placing them in the VSC to examine them under different light beams followed by appropriate photographic recording. The examination of fire-charred documents with a view toward deciphering the writing thereon constitutes an interesting though somewhat difficult problem.

Figures-4, 5, 6 & 7 are the illustrative examples showing four types of charred papers written by six types of writing instruments and the type of enhancements used to visualize the writings. Figure-8 shows a charred document that did not show any marks or writings.

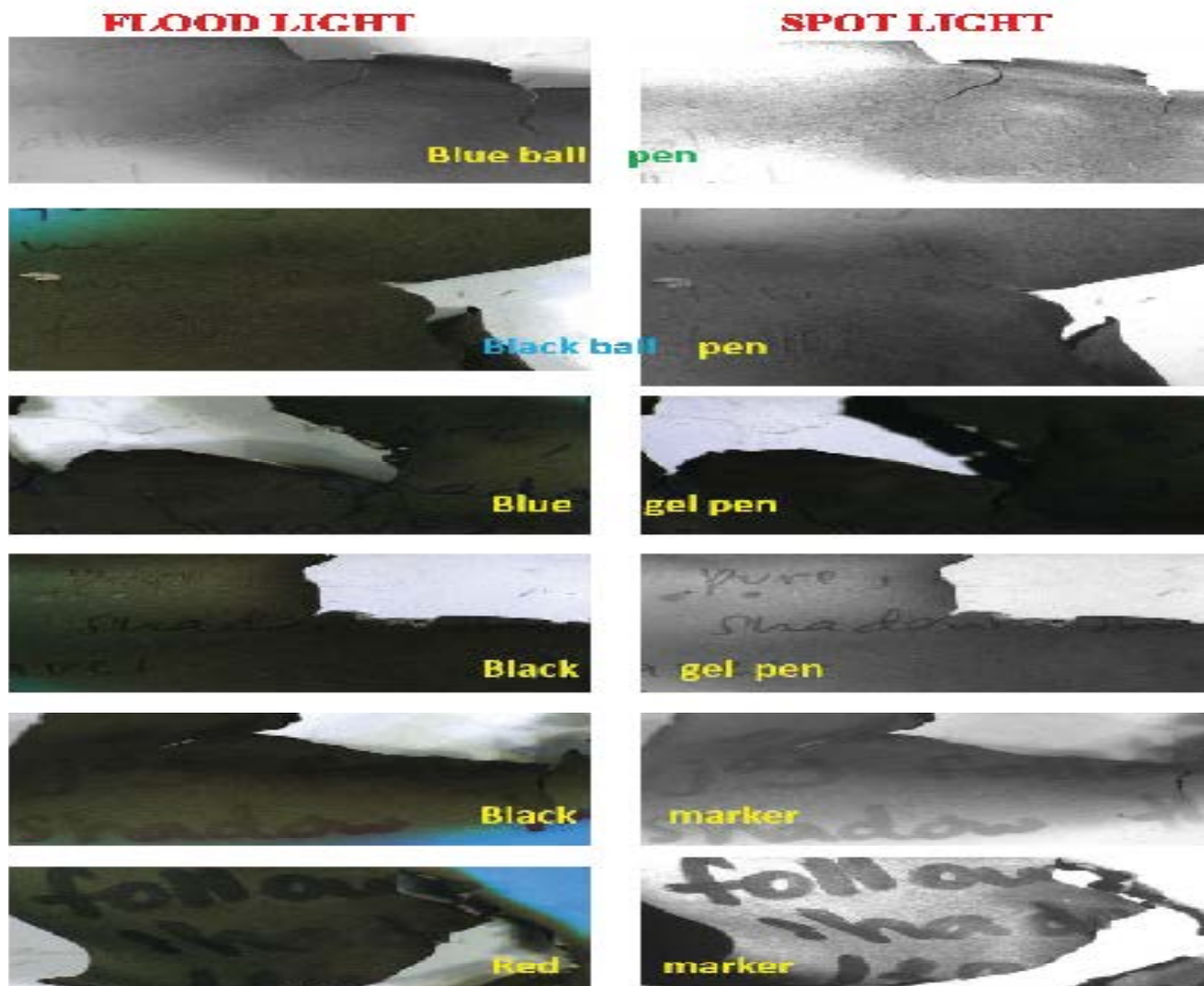


Figure 6- Illustrative examples of images showing the enhancement of handwritings on burnt blue papers written by various writing instruments.

The results of the investigation usually depend upon the type of paper and types of ink used in the writing instruments. Accordingly, the present study used different types of color, thickness of paper and colored inks with varying density. The enhancement of handwritings observed on charred documents using VSC with spot light and flood light with adjusted wavelengths are shown in figure-4 & 7. Results showed that the visibility of pen pressure (indented impression) was comparatively more prominent in ballpoint pens under spot light, irrespective of color and thickness of paper and the type of pen.

It was interesting to note that the gel pens caused less

prominent enhancement in the burnt documents compared to ballpoint pens. This is because of the formation of deep furrows formed on papers through the pointed edge of ballpoint pens. The black and red marker writings showed clear enhancement in spot light compared to flood light. The black marker was found to be more prominent in white paper than yellow paper. Also, blue gel and red gel marks showed better enhancement in white papers than yellow papers and hence this technique can be utilized very effectively in real crime scenarios.

The wavelengths 645, 725 and 780 nm were found to be suitable to cause contrast on the writing papers and increase

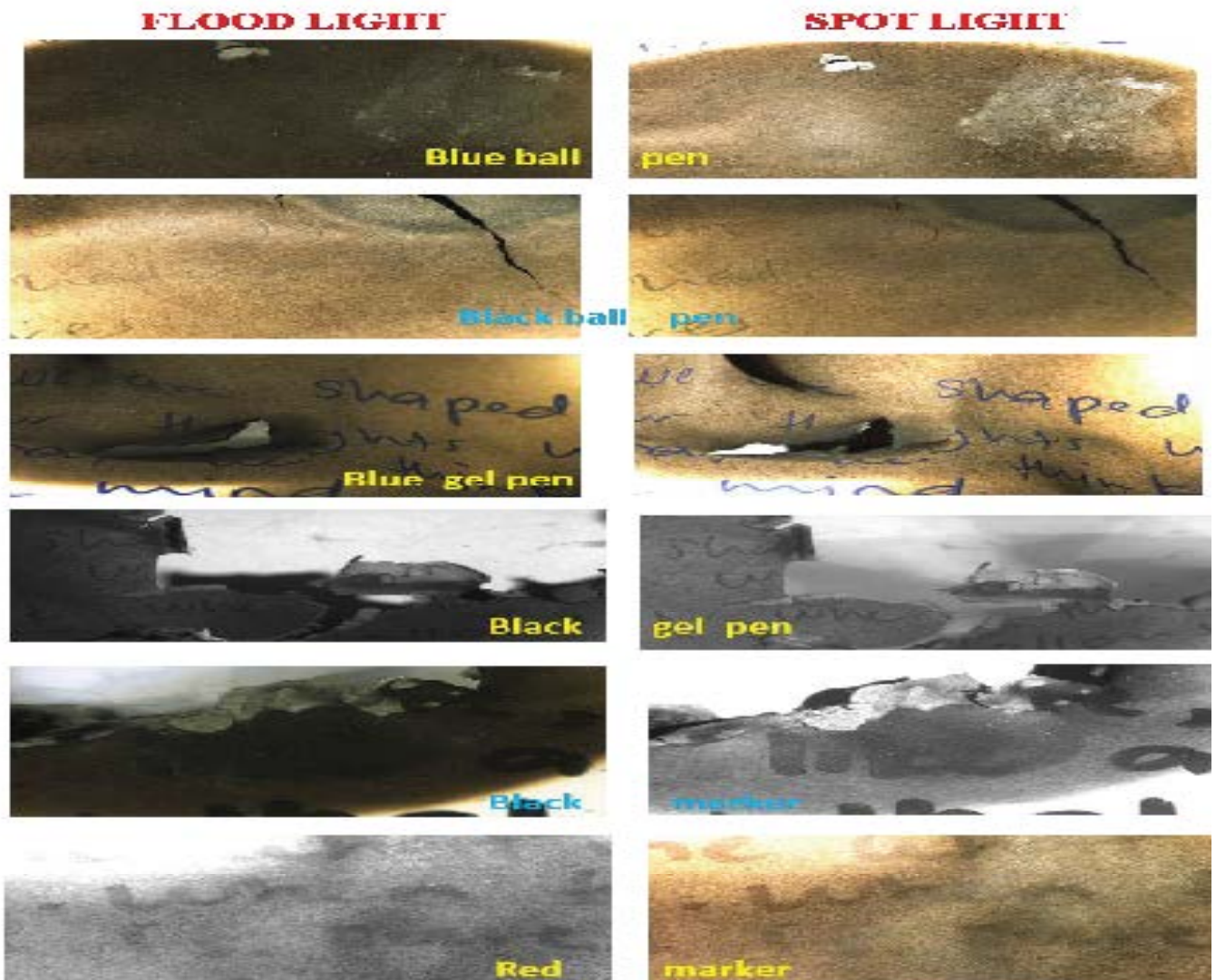


Figure 7- Illustrative examples of images showing the enhancement of handwritings on burnt cardstock papers written by various writing instruments.



Figure 8- Illustrative example showing invisible marks on the charred document

the visibility of the writings on the burnt document. The use of 780 nm provided good enhancement of writings on certain burnt documents.

The authors are encouraged to continue the research by using other different types of writing instruments and paper.

4. Conclusion

The present study concludes that the flood light and white spot settings of a VSC can be used to enhance the writings on charred documents. Better enhancement was shown under the white spot beam compared to the flood

light beam. The adjustment of the wavelengths of the beams enhanced certain writings that were not clearly visible under the standard flood light and white spot setting. Pen pressure was found to be prominent in the charred documents, irrespective of paper colour. Marker pens also showed satisfactory enhancement of handwriting in the charred documents under suitable wavelengths. The application of a VSC on charred documents revealed appreciable contrast between the writings and the burnt background. In conclusion, the use of a VSC may provide a reliable alternative tool to enhance the writings on charred/burnt documents.

Conflict of interest:

The authors have no conflict of interest to declare. The authors did not receive any specific funding for this research.

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