Detection of Writing and Fingerprints on Burnt Documents Using the Video Spectral Comparator

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Abstract: Both writing and latent fingerprints on burnt papers were visualized with the help of different light sources available in the Video Spectral Comparator. The extent to which these were visible was found to be dependent on the pen type, and it was found that each pen type could be visualized using this machine.

Keywords: alternative light sources, burnt, charred, documents, fingerprints, infrared, paper, ultra-violet, Video Spectral Comparator, VSC, writing

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Introduction

Often, in the case of arson or other fires, documents made from ink written on paper will be heavily damaged through burning. What was written on these documents may have some value to whoever wrote on them. In the case of documents being purposefully burnt, it is possible that the document may have even had something incriminating written on it, or possibly even something else of legal importance\textsuperscript{1}. While often paper that is set on fire will completely burn to ashes, there is still the chance that any other number of factors will come around during the burning and prevent the entire document from being entirely burnt to ashes. It is possible for paper to be burnt to the point of being burnt black; making the writing that is on it unreadable to someone looking at it with the unaided eye. Even tightly packed books can become damaged and rendered unable to be read by smoke and soot from a fire\textsuperscript{2}. This is the purpose of the paper to attempt to find a way to use alternative light sources to recover the contents of written documents that have been burnt to the point of making them unable to be read. If even a small portion of the document can be visualized with alternative light sources, it is possible that the contents of the rest of the document may also be determined or confirmed.

A topic of great importance in any crime scene investigation is the recovery of fingerprints, from whichever medium is available to give them\textsuperscript{3}. Because of this it is important to consider the possibility of using alternative light sources to recover clear photographs of latent fingerprints. While there are currently methods available to recover fingerprints from paper, they are chemical and may cause damage to the burnt documents\textsuperscript{4}. It would be of great benefit to any investigator to be able to recover an accurate visualization of the fingerprint without damaging the burnt evidence itself.

This research focused on two common inks used in many documents, including most legal documents. These would be the inks of black and blue ballpoint pens. Inks found in pens are commonly used to write down notes, even on printed documents, and are also used for writing signatures, which can be of great legal importance. It can be of great use to a forensic investigation to prove to the courts that a specific document did, in fact, have the signature of someone who signed said document.

Some research that has been conducted in the past suggests that alternative light sources, such as those found in the infrared and ultraviolet wavelengths of light, can be used to visualize what has been written on paper\textsuperscript{5}, even after that paper has been burnt to the point of its contents being rendered unable to be read\textsuperscript{6}. Using a piece of equipment that is somewhat new to the field of forensics, the Video Spectral Comparator (VSC), to show that alternative light sources can be used for these purposes. The VSC, is commonly used today for document examination and ink examination. It makes use of a high-quality camera as well as alternative light sources. Agencies such as the FBI and various border
control organizations across the globe have been using it for more than a decade now. This technology will allow for a quick and thorough analysis of the documents burnt during research, and can potentially be used for the examination of burnt documents collected as evidence without causing any harm to the documents themselves.

Materials

- Oven
- Printer Paper
- Cue cards
- Blue Ballpoint Pen
- Black Ballpoint Pen
- Video Spectral Comparator (VSC)

Methods

To begin, both paper types were covered in writing from one of the two ink types. This produced four samples, each with a specific short three-letter word repeated across the surface of the paper, such as “FOU”. It was decided that short three-letter sequences of letters would be best because they take up only a small amount of the document and the entirety of the “word” can be found when focusing on a relatively small area using the VSC. There should be minimal empty area left on each sample, as the burning of the sample isn’t always reliable. Each sample had its picture taken using the Video Spectral Comparator (VSC), to give a before and after comparison.

Other samples with only latent fingerprints were also made. The latent prints were placed evenly across the paper, and special attention was given to make sure that the prints did not overlap. There were no pictures of these samples taken before burning because the prints were not visible in any way to someone observing the documents prior to burning.

Each sample was burnt using an oven, and then removed and placed in a box for safekeeping. The samples were then brought over to the VSC for examination using Alternative Light Sources (ALS). In the VSC, each sample was viewed under every available wavelength of infrared and ultra-violet (UV) light (300-900 nm), as well as other lighting options, such as co-axial lighting. Pictures were taken of the burnt samples, under normal lighting, infrared lighting, UV lighting, and co-axial lighting. Notes were made as to which light sources best showed results for each ink and paper combination, as well as for which light was best for viewing the fingerprints.

Results
The two samples using blue ballpoint pen were labelled “ONE” and “THR” to represent the numbers one and three respectively. The writing on “ONE” was simply the word “one” written in all capital letters repeatedly across a piece of printer paper. The writing on “THR” was the letters “thr”, written in all capital letters repeatedly across a cue card. Both two samples gave the same results. When viewed under normal lighting, the writing on each sample could not be seen (Figure 1). However, by using infrared light sources, the writing on each of these two samples became clearly observable (Figure 2). Co-axial lighting could also be used in order to make it possible to read what was written on the paper after it had been burnt. UV lighting was of no assistance in reading anything on the burnt document.

Figure 1. The blue ballpoint pen used to write on this burnt paper is not visible
Figure 2. An example of infrared lighting being used to visualize blue ballpoint pen on burnt paper.

The two samples using black ballpoint pen were labelled “TWO” and “FOU” to represent the numbers two and four respectively. The writing on “TWO” was the word “two” written in all capital letters repeatedly across a piece of printer paper. The writing on “FOU” was the letters “fou”, written in all capital letters repeatedly across a cue card. Just like the blue ballpoint pen samples, these two samples gave the same results. When viewed under normal lighting, the writing on each sample could not be seen (Figure 3). However, by using co-axial lighting, the writing on each sample could be made clearly visible (Figure 4). Unlike the blue ballpoint pen samples, infrared light sources could not be used to view the writing on the burnt pieces of paper. UV lighting was once again of no assistance for viewing the contents of the burnt documents.
(Figure 3, the writing in black ballpoint pen cannot be seen)

(Figure 4, an example of co-axial lighting being used to visualize black ballpoint pen on burnt paper.)

On the fingerprint samples, the fingerprints showed themselves once the paper began to burn. When the paper started to approach a brown colour, the latent fingerprints showed themselves as black on the paper (Figure 5). By using the VSC, the prints could be shown even clearer by using
infrared light (Figure 6). The infrared light source allowed for the fingerprints to be shown in
detail, important for the forensic examination of any print found in an investigation.

Figure 5. The fingerprints reveal themselves with a black colouring on the paper that is burnt
brown.

Figure 6. Fingerprints being more clearly visualized using infrared light, showing fine detail.

Discussion
It was successfully proven that ALS could be used to view the written contents of burnt documents. It cannot be said for certain that it is possible for all ink types or paper types, but it certainly true for the ink and paper types that could be properly burnt and viewed using the VSC. It is also possible to better visualize prints found on burnt paper using this machine.

Both the black and blue ballpoint pen types were used to make samples on printer paper and cue card paper. For the most part, the results for both ink types were the same. Co-axial lighting could be used to view the contents of the burnt paper with either color of ballpoint pen. Co-axial lighting is basically light that is shot only from the side of the VSC, and is useful for showing the fine detail of the indentations made when a writing utensil is pressed into a sheet of paper leaving dents in the document. Because of this, when it is used to view burnt paper it is possible to see the grooves made by the pen on the paper. Another similarity between the samples made with either color of pen was that UV rays could not be used to view the contents of either of them.

The biggest difference between the two ink types was that infrared light could be used to enhance the view of writing in blue ballpoint pen on burnt paper, while it could not be used to do the same with writing in black ballpoint pen. Further research should be done to determine if this is because of the color of the pens, or just the brand used. Infrared lighting was also able to be used to better visualize the fingerprints found on burnt documents.

The paper type used didn’t seem to have much effect on the results of this experiment. Both printer paper and cue card paper were consistently burnt to the point of making the writing on them unreadable. Further research should be done using other brands of printer paper and cue cards; it is possible that they may react differently to heating with the ink types used in this experiment.

**Conclusion**

It can now be known that alternative light sources can be used to properly examine what has been written on a burnt document. Writing on cue cards and printer paper, using both black and blue ballpoint pens, were successfully examined using the VSC. With the blue ballpoint pen, infrared and co-axial lighting were used to clearly interpret the message written on a piece of paper that had been burnt. With the black ballpoint pen, co-axial lighting was used to the same result. UV lighting could not be used to examine the contents of either. Infrared lighting was successfully used to better visualize latent fingerprints left on the paper prior to burning. It can be said that the VSC provides a safe option that will provide little harm to burnt documents, which is important because the handling of burnt documents has proven problematic in the past7.
With the limited sample size used in this research, further research on the topic should be carried out. Other ink and paper combinations may yield differing results than the ones obtained in this experiment.

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References:


