Evaluation of Techniques for the Visualization of Latent Fingerprints on Canadian Polymer Banknotes

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Abstract:

Three techniques were tested for the visualization of latent fingerprints laid on different regions of Canadian polymer banknotes. BVDA Gel-lifters, AccuTrans Casting Silicone Material and Natural IR fluorescent powder were tested to visualize fresh fingerprints on the banknotes of different denominations. All the techniques were found to show remarkable ridge details with clear visibility of minutiae in fresh fingerprints in the three regions of these bank notes which have different printing qualities. However, in the aged fingerprints the quality of ridge details was dependent on the technique used and the region of the bank notes. The Gel lifter and Natural IR powder showed promising results in all the three areas of different complexities.

Keywords: Fingerprint, Polymer banknotes, Natural IR, Gel-lifters, AccuTrans

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Introduction

Fingerprints on the banknotes are important evidence in the investigations of robberies, ransoms, and drug dealing. The Canadian polymer bank notes are in circulation for the last few years and with many other countries likely to start similar bank notes there is a need for the quick and reliable latent fingerprint visualization techniques. These new banknotes are produced from a thin and transparent flexible film of polypropylene which is non-porous. Non-porous surfaces do not hold dirt and oils very well like the porous surfaces. This poses a challenge for investigators to develop more efficient enhancement strategies on the polymer banknote. The multi-colored surface of the banknotes makes it more difficult to enhance and visualize the latent fingerprints. The striation pattern running through the banknotes appears like the ridges of fingerprints. Many security features are visible under infrared light which interferes with certain fluorescent powders.

There are only a few studies on the latent fingerprint visualization on polymer banknotes. The technique proposed in these studies used sequential development with cyanoacrylate fuming, vacuum metal deposition, and fluorescent dye staining. These time-consuming methods are tedious and are not universally accessible to smaller forensic investigative units. Crime scenes have the possibility of analyzing more than one item with potential fingerprint evidence. Therefore, quick, and easy processing techniques play an important role in the case processing.

AccuTrans Casting Silicone Material is ideal for textured surfaces as they fill in the textured areas and the whole print can be lifted. The extractor gun expels the material without touching the fingerprint and preserves the integrity of the powdered print. Transparent casting material is an excellent choice for multi-coloured surfaces and allows for direct fingerprint comparison. Casting materials are the means to preserve the fingerprints in a manner that will not smear or alter the print. It lifts excellent ridge details on several difficult surfaces that prove to be a problem for investigators. Natural 1 IR is a fluorescent fingerprint powder from Foster + Freeman. This powder is claimed to suppress any background interference by displaying a high contrast print. Natural 1IR powder fluoresces in the infrared region by red or blue illumination. Fluorescent powders are ideal for surfaces that are multi-coloured or textured. Currently, there is no research on the effectiveness of this powder on Canadian polymer bank notes which are both multi-coloured and textured.

Gel-lifters are a common fingerprint lifting technique for surfaces that cannot be chemically treated or as a non-destructive method. Nonporous smooth surfaces are ideal for gel lifters and gave high scores for lifted latent prints. Gel-lifters can be used on heavily contaminated items which is why they are of interest on the polymer banknotes.

These three techniques are quick and require minimum preparations for the fingerprints visualization. Therefore, in this study we have compared the effectiveness of these three techniques to visualize fingerprints on the different regions of the Canadian polymer bank notes.
Methods and Methods

Each banknote was cleaned with isopropyl alcohol to remove any previous fingerprints, oils, and contaminants present. The donors washed their hands with soap prior to fingerprint deposition. The sebaceous fingerprints were deposited in the three regions A, B, and C of banknote as shown in Figure 1. Banknotes of $5, $10, $20, $50, and $100 denominations were tested.

After fingerprint deposition, the banknotes were left at the room temperature of 20°C for about 30 minutes for stabilization of the fingerprints. After 30 minutes these banknotes were divided into three sets and different techniques were applied. In another group the banknotes with laid fingerprints were left in a box at room temperature 20°C for three weeks to see the effectiveness of these techniques on the aged fingerprints. The black BVDA Gel-lifters made by Sirchie were cut into small pieces and used to lift the fingerprints directly from each region of the banknote without any treatment. The end of the Gel-lifter was placed at the 45° angle to the area to be lifted. The ending of the Gel-lifter was slowly pushed down, one section at a time, with the length of a finger in a rolling motion. After the entire Gel-lifter was placed, it was lightly smoothed down to ensure all ridge details were lifted. Next, the end of the Gel-lifter was gently pulled backwards until the entire piece was lifted. This method was applied for all 3 areas of each of the banknote. The fingerprints were visualized and photographed using the Video Spectral Comparator (VSC) 40HD with coaxial light with the following settings: Integration 20ms/40ms, Iris 100% and Brightness 50-78% (Figures 2-3).

In the second set of fingerprints the deposition region was dusted with black granular fingerprint powder with a fiberglass brush. After visualization of the fingerprint in each area, AccuTrans casting silicone material purchased from Tritech Forensics was applied. The extruder trigger was depressed and an even flow of the AccuTrans casting silicone material was released into the spreader tip. The casting material was evenly and slowly flowed over the entire fingerprint and ten minutes was allowed for setting time. After the casting material hardened, it was slowly lifted and placed onto a labeled fingerprint card for storage. The VSC40HD was used to take the photographs of each lifted fingerprint under flood light with the following settings: Integration 20ms, Iris 70%, and Brightness 50% (Figures 4 and 5b).

Natural1 IR powder was taken with a fiberglass brush and transferred to each banknote. The powder was spread by gently shaking the banknote from side to side until the fingerprint was visualized. The VSC 40HD was used to visualize the fingerprint under infrared wavelength of range of 600-645nm. The following settings were used to take the photographs of the fingerprints: Integration 40ms, Iris 100% and Brightness 50% seen in (Figures 3, 8)

Results
Figure 1a: Areas of sebaceous fresh prints deposited on each Canadian polymer banknote.

Figure 1b: Known Standard Fingerprint with Fingerprint ink.

Figure 2: Fingerprints from the Canadian $50 banknote in deposited in the region A (2a) and region C (2b) lifted with BVDA Gel-lifter and visualized with coaxial light.

Figure 3: Fingerprints from the Canadian $50 banknote deposited in the region A (3a) and region C (3b) visualized with Natural 1IR under Infrared light.
Figure 4: Fingerprints from the Canadian $50 bank note deposited in the region A (4a) and region C (4b) lifted with AccuTrans casting material and photographed under flood light.
Figure 6: Fingerprints from the Canadian $20 bank note deposited in the region A (6a) and region C (6b) lifted with BVDA Gel lifter and visualized with coaxial light.

Figure 7: Fingerprints from the Canadian $20 bank note deposited in the region A (7a) and region C (7b) lifted with AccuTrans casting material and photographed under flood light.

Figure 8: Fingerprints from the Canadian $50 bank note deposited in the region A (8a) and region C (8b) visualized with Natural IIR under Infrared light.
Figure 9: Three weeks old fingerprints deposited on the region A of Canadian bank note $5 (9a & 9b). In figure 9b color is inverted.

Figure 10: Three-week-old fingerprints deposited on the region A of Canadian bank note $5, lifted with BVDA Gel lifter, and visualized with coaxial light (10a) and lifted with AccuTrans casting material and photographed under flood light (10b).
Figure11: Three weeks old fingerprints deposited on the region B of Canadian bank note $50, and lifted with lifted with BVDA Gel lifter and visualized with coaxial light (11a); lifted with BVDA Gel lifter and visualized with coaxial light (11b) and visualized with Natural 1IR under Infrared light (11c).

Discussion

The Canadian banknotes have relatively transparent surface in A and C regions but the surface in B region is textured and the striations running across the surface mimic the appearance of fingerprint ridges (Figure 1). The striations in the B region can be misinterpreted for fingerprint ridges while analysing the developed fingerprints. Therefore, there must be a clear distinction between the surface and the fingerprints lifted or developed and visualized by any technique.

The fresh fingerprints lifted with AccuTrans silicone material and BVDA gel lifters displayed clear distinguishable ridge details in all the three regions (Figures 2 and Figures 4-7). The ridges were better visualized after the AccuTrans was applied and lifted on a white fingerprint card. The AccuTrans casting silicone material revealed exceptional ridge details with the black granular powder and fiberglass brush in fresh fingerprints (Figures 2 and 7). The casting material preserves the fingerprint indefinitely and does not smear or smudge the print. The fresh fingerprints lifted with the BVDA Gel –lifters also showed good quality of fingerprint ridges, however, the coaxial lighting had to be manipulated to get the best details. The fresh fingerprints developed and visualized with the fluorescent powder Natural 1 IR in the all the three regions were of very good quality and all the ridge retails were clear and comparable to the known standard. (Figures 1b, 3, 5c and 8). The results show that the Natural 1IR powder can be used as preferred techniques for the visualization of fresh latent fingerprints on the polymer banknotes because it is simple, fast, and easy method. The powder was found to be very sensitive to the latent fingerprints. In the other
techniques, there are chances of contaminants being lifted along with the fingerprints also these methods had some extra steps unlike the Natural 1 IR fluorescent powder.

The quality of ridge details in the three weeks old fingerprints lifted and visualized with the AccuTrans from the regions A and C were of relatively good quality (Figure 10b). But the fingerprints lifted with AccuTrans from the region B were not quite good and the ridges were not distinguishable from the striations of the banknote (Figure 11b). The continuity of the ridges was disrupted in these fingerprints. The results show that the Gel-lifters worked well on the three weeks old fingerprints deposited in all the regions particularly (Figures 10a and 11a). Several fingerprint ridges were seen in the fingerprints lifted with Gel-lifters on the aged prints (Figure 11a). The visualization of three weeks old fingerprints with the Natural 1IR fluorescent powder was very clear in all the regions and the ridge details can be clearer when seen by colour inversion (Figures 9 and 11c). In some cases, the intensity of the fluorescence produced by the Natural 1IR powder was not very good and needed some manipulations to see the complete fingerprints.

Conclusion

The results show that BVDA Gel-lifters and Natural 1 IR fluorescent powder can be used for the quick and easy visualization of fingerprints on the complex surface like polymer banknotes. The natural 1 IR fluorescent powder can be preferred over other techniques with some manipulations for the visualization of fingerprints on the polymer banknotes as it is nontoxic and easy to use if one has access to the infrared light sources.

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References


