Evaluation of the Capabilities and Limitations of the FARO Freestyle 3D Handheld Scanner

Mike MacPhee\textsuperscript{1} BFS, Pardeep Jasra\textsuperscript{1} PhD

Abstract:

FARO 3D handheld Laser scanner has been recently introduced to document the crime scenes, or different structures and objects in more detail. It produces point cloud representations of objects and areas, which have been scanned. This study was done to test the capabilities and limitations of the FARO Freestyle 3D handheld scanner. Mock crime scenes were created and scanned with this 3D scanner to test its effectiveness in scanning the whole crime scene as well as various pieces of evidence. Blood stain patterns, fingerprints, broken glass, 2D and 3D footwear impressions, and written documents were all scanned for the study. Scans were also done in the dark to determine how effective the scanner is in dealing with the low light situations. It was found that the scanner could detect blood stain patterns, fingerprints, footwear impressions and writing on documents, however, the clarity of the images created decreased proportionally with the size of the evidence being scanned. The scanner could not detect glass in color scanning model, but it could detect objects on the glass such as fingerprints, substrates and labels. The scanner also had a difficult time detecting very dark coloured objects but could detect them with added time.

Scanning glass and dark objects in infrared could potentially recreate opaque images, making scanning in both colour and infrared beneficial to investigators. The measuring tool in the FARO software was incredibly useful and could measure distances to one-tenth of a millimetre. This information is beneficial when using the Faro Freestyle in a forensic setting.

Keywords: FARO Scanner, Crime Scene, Evidence, Documentation, and SCENE Process

1 Forensic Sciences, Faculty of Science, University of Windsor, 401 Sunset Avenue, Windsor, Ontario
email: macpheeem@uwindsor.ca

Communicating Author Contact: Pardeep Jasra, email: Pardeep.Jasra@uwindsor.ca
Introduction

FARO scanners are incredibly useful tools to preserve and document the crime scenes in greater details. It is possible to create point cloud representations of objects and areas and exported to different software. These point clouds can then be used by investigators to review and further process the scene, create sketches, replace the gruesome pictures with dummies, or make further measurements days after the crime. The FARO Freestyle 3D scanner is one such scanner, which uses laser technology to recreate images onto the FARO Scene software. It is a handheld lightweight scanner, which allows for added mobility and utility when scanning scenes. The scanner creates point clouds of objects and areas that are scanned and stores them onto a micro SD card. The micro SD can then be transferred to a workstation with the FARO SCENE Process for further processing. This software also allows the user to place multiple scans together to fully recreate an accurate representation of a scene as well as take measurements of the scene. Such scanners are commonly used in construction and mining industries but their use in crime scene investigations is novel and data in this field is nearly nonexistent. This study was undertaken to test the capabilities and limitations of this scanner in crime scene investigations.

FARO Freestyle Handheld Scanner

Methods

Mock crime scenes were created and various pieces of evidence were placed within each crime scene. A 3D footwear impression, written note, glass bottle with fingerprints, large paper with blood stain patterns, broken glass, hammer, and a 2D footwear impression made from dirt were all used as evidence and placed throughout the scene.
The entire scene was then scanned in colour with the FARO Freestyle handheld scanner. The scans were then uploaded to the FARO Scene Process software and placed together to recreate the scene on the software. Measurements were taken and compared to traditional measuring techniques such as laser measuring and tape measuring. Scans were also performed in a dark room to test the scanner in a low-light situation.

**Results**

*Figures 1a and 1b: Camera Photo (a) and Scan (b) of 3D & 2D Footwear Impression.*

*Figures 2a and 2b: Camera Photo (a) and Scan (b) of Forensic Evidence*
Figures 3a and 3b: Photo (a) and scan (b) of bloodstain patterns

Figures 4a and 4b: Camera Photo (a) and scan (b) of glass bottle with fingerprint evidence as well as written document.

Figures 5a and 5b: Camera Photo (a) and Scan (b) of scene displaying dark colour object (lining).
Discussion

It was found that the finer details of objects could not be determined using the FARO Freestyle Scanner, but the general shape of objects could be determined. The 3D footwear impression’s shape was clearly visible and some fine detail of the impression could be observed (Figure 1). The 2D footwear impression could only faintly be seen. This was most likely due to lack of sufficient contrast between the substrate and surface. Increasing the contrast may be helpful in such evidence. The fingerprint on the glass bottle could be seen but the details of the print could not be determined so the scanner is able to indicate their location but can not be used for the detailed analysis (Figure 4). It was possible to see the blood stains in the scans and even the general shape of the larger blood stain patterns was visible, however, it was not possible to use it for bloodstain pattern analysis because many smaller stains were not picked up by the scanner (Figure 3). Glass objects did not show up on the scans such as the broken glass or glass bottle. It is possible that scanning in infrared would produce images for glass objects; however, these images are likely to be opaque representations, leaving the investigator with an inaccurate representation of these objects. Therefore, it would be beneficial to an investigator to produce scans using both the colour and infrared features of the 3D scanner. The writing on the note could be seen on the scan and was somewhat legible depending on the font size. Measurements were precise to one-tenth of a millimetre but accuracy was difficult to pinpoint due to the nature of the Faro software. The scanner had little to no difficulties in low light situations as it used a flash to illuminate the scene. The scanning of dark coloured objects needed added time to provide images of acceptable quality (Figure 5).

Conclusion

The FARO Freestyle scanner is a useful tool for the forensic investigations. It can be used to provide precise measurements and accurate recreation of a crime scene. It does, however, have some limitations in that colour scans cannot recreate images of glass. The scanner takes a long time for scanning dark coloured objects. These limitations can possibly be overcome to some degree by using the scanner's infrared feature. It also cannot be used to display fine details of different evidence, which may be found at a scene but is useful in displaying the location of evidence in a scene. The ability to export the point cloud files to the software such as FARO Reality is very useful to recreate the crime scene and using dummies and other features of Reality software. Further work is being done to explore the further utilities of this scanner and Reality software after processing in SCENE.
Acknowledgements

We thank Dr. Shashi Kiran Jasra, Forensic Sciences Programs Chair for help and encouragement. Thanks are also due to Mr. John Johnston for help in initial set up.

References