Xournals

Academic Journal of Forensic Sciences

ISSN: 2581-4273 | Volume 06 | Issue 02 | October -2023

The Power Of DCS5 For The Detection, Capture And Enhancement Of Latent Fingerprints In Forensic Science

Yakubu Magaji Yuguda[1]

Available online at: www.xournals.com

Received 23rd September 2023 | Revised 27th September 2023 | Accepted 11th October 2023

Abstract:

Latent fingerprints, which are frequently undetectable to the human naked eye, can yield incredibly useful information for criminal investigations. This paper introduces a novel approach to latent fingerprint development in the field of forensic sciences. Currently, conventional developing techniques like chemical methods, powder dusting, cyanoacrylate fuming, and small particle reagent method have all been gradually compromised due to their emerging drawbacks, which include high toxicity, low contrast, sensitivity, and selectivity, as well as the use of fluorescent nanomaterials, which have their own drawbacks. The discipline of forensic science has undergone a revolution because of the advancements in imaging technology, especially in the area of latent fingerprint identification. When compared to latent fingerprint development using conventional techniques, the DCS5 Imaging System is a particularly effective instrument for capturing and analyzing latent fingerprints among these cutting-edge systems. This article explores the capabilities of the DCS5 system and its significant impact in development, detection, capture and enhancement of latent fingerprint on any surface, highlighting its impact on forensic investigations.

Keywords: *DCS5, Latent fingerprint, Forensic science, Fingerprint analysis.*

Authors:

1. *Department of Science Laboratory Technology, Federal Polytechnic, Kaltungo, Gombe State, Nigeria.*

Introduction

In criminal investigations, forensic science is essential since it helps with evidence analysis and identification. The recovery and examination of fingerprints is an essential component of forensic investigations. Since fingerprints are distinctive to each person, they may be an important piece of evidence used to connect suspects to crime scenes. In police forensic work, recovering latent fingermarks from paper is a regular duty, nevertheless the developed marks are sometimes very faint, or their quality prevents identification. The most frequent method of visualization is to utilize chemical reagents that react with some of the chemical components of sweat to generate a color or luminescence, which makes the latent traces apparent. Since the amount of sweat in the latent markings may be minuscule and contain only very little amino acids which are common targeted components for chemical enhancement on paper making a significant fraction of the latent marks remain undetected **(Kanjan *et al.*, 2017).** The term " Reversed " fingerprint development refers to a process where latent fingerprints are enhanced in a reversed manner, that is the response occurs not on the ridges themselves, but outside and between them. The fingermark substance acts as a mask throughout this procedure and is not involved in the chemical reaction. Perhaps the best known example of such a process is the VMD (Vacuum Metal Deposition) technique, for development of fingermarks on polymeric materials, which is considered the most sensitive fingerprinting technique for e.g. plastic bags **(Shenawi et al., 2013).**

The complicated pattern of elevated papillary ridges and depressed furrows characterizes the corrugated skin at the terminal portion of human fingers. Papillary ridge patterns vary not just across individuals but also between fingers, and they are topologically constant from the time of birth. Fingertip contact with an item can transfer and deposit watery ectocrines, like sweat, and oily substances, like sebum onto its surface, creating a fingerprint as a result, fingerprints are the skin's raised papillary ridge's contact impression. In the field of forensic sciences, papillary ridge fingerprints are still regarded as the most reliable source of information for personal identification because of their intricate, distinct, and stable patterns. Since the first use of fingerprints for personal identification suggested in the late 19th century, fingerprints have become a well-established signature for criminal investigation and personal identification **(Wang et al., 2017).**

In general, impression, visible, and latent fingerprints are the three forms of fingerprint evidence that are frequently found at crime scenes. Latent fingerprints, which are those that are not readily apparent to the unaided eye, are the most prevalent kind found at crime scenes **(Khare and Singla, 2022).** Nevertheless, by using specific development methods, the latent fingerprints can be revealed. The fingerprint can be created if a clear contrast is produced between the fingerprint remnants and the substrate underneath. Numerous methods for generating fingerprints have been investigated over the past century, including optical, physical, and chemical techniques. It will be challenging to do accurate fingerprint analysis and identification if a latent fingerprint left at a crime scene cannot be clearly developed using a reliable technique. Therefore, latent fingerprint development is crucial to identifying individuals in forensic sciences **(Almog et al., 2000).**

Latent fingerprints which are frequently undetectable to the human eye, can yield incredibly useful information for criminal investigations. The discipline of forensic science has undergone a revolution because to advancements in imaging technology, especially in the area of latent fingerprint identification **(Yamashita *et al.*, 2011).** The DCS5 Imaging System is one of these cutting-edge devices that is particularly effective in detecting and interpreting latent fingerprints. DCS5 is an all-inclusive imaging system that can identify, capture, and enhance any kind of fingerprint on any surface or background. In addition to producing images of extraordinary quality, the DCS 5 high resolution, 36.3MP camera equipped with application-specific macro lenses also allows for advanced digital processing that when used simply maximizes print detail to increase the value of evidence. Precise wavebands of illumination from UV through the visible to IR are provided to improve the visualization of every type of fingerprint whether it be latent, contaminated or chemically treated **(https://fosterfreeman.com/dcs-5/)**. This article explores the capabilities of the DCS5 system and its significant impact in development, detection, capture and enhancement of fingerprint on any surface, highlighting its impact on forensic investigations with the aim of providing a reference for future research and application of DCS 5 in forensic science.

Issues with Conventional Latent Fingerprint Development Techniques

- **Poor Resolution and Image Quality**

Similar to the notion of signal-to-noise ratio, contrast in fingerprint development refers to the difference between the fingerprints and the substrate background. Improving the signal and lowering the background (noise) are the two primary approaches to enhance the growing contrast. Fluorescence enhancement is the most commonly used method to increase the signal. The two most successful methods for reducing the noise are minimizing background fluorescence interference and avoiding background colour distraction. The colour of the substrate severely restricts the use of nonfluorescent fingerprint powders, such as metallic and ordinary powders, for the powder dusting process. When applied to white or certain light-colored surfaces, the fumed fingerprints with white coating produced by the cyanoacrylate fuming process have a low developing contrast.

- **Poor Clarity and Visibility**

The concept of visibility and clearness of the ridge details described by sensitivity. Contrast in fingerprint development refers to the distinction between the fingerprints and the substrate background, much as the concept of signal-to-noise ratio. The two main strategies to increase the increasing contrast are to improve the signal and reduce the background (noise). Increasing the signal most often involves fluorescence intensification. Reducing background fluorescence interference and avoiding background colour distraction are the two most effective ways to lower the noise. The usage of nonfluorescent fingerprint powders, such metallic and regular powders, for the powder dusting procedure is severely limited by the substrate's colour. The fumed fingerprints with white coating created by the cyanoacrylate fuming technique have a low growing contrast when applied to white or certain light-colored surfaces.

- **Poor Selectivity**

In fingerprint development, the term "selectivity" describes the ability of developing materials (such as chemical reagents, powders, etc.) to only adhere to or react with the papillary ridges in latent fingerprints, not with the furrows on substrates. Because of the comparatively poor selective physical adhesion of fingerprint powder particles to latent fingerprint residues, the developing selectivity in the powder dusting approach is typically not very high. Due to the fingerprint powder's high adhesion to damp surfaces, developing selectivity will be quite poor, especially when applied to humid substrates. When used properly, the cyanoacrylate fuming method's development selectivity is usually high because of the very selective polymerization reactions that occur between the fingerprint residues and the cyanoacrylate ester monomers. Chemical techniques such as the DFO, ninhydrin, and silver nitrate procedures can readily stain the furrows on the substrates because of the spontaneous or incorrect diffusion of active components, including amino acids and chloride ions, on some substrates that infiltrate.

- **Elevated Toxicity**

Toxicology in fingerprint development relates to damage to DNA in fingerprint residues as well as the toxicity of the producing materials and related equipment to people. DNA extraction and detection for personal identification is becoming increasingly successful these days due to the quick advancement of the procedure. Two effective methods for identifying a person are fingerprint and DNA detection techniques. The two methods mentioned above, nevertheless, don't appear to work together. If DNA extraction is done first, latent fingerprint development cannot be completed, and if latent fingerprint development is tried before extraction, DNA extraction is very impossible to complete. Thus, suggesting a better or novel approach for latent fingerprint creation without causing harm to DNA seems acceptable, despite being challenging.

Components of DCS5

- **Camera**

Custom-modified digital SLR camera order to achieve excellent image quality, the DCS 5 has been built around a pro-grade DSLR camera customized by Foster + Freeman for UV-Vis-IR imaging applications. The Nikon D810, which has set new benchmarks for image quality, combines a potent image processing engine with a revolutionary large format image sensor to create exceptionally clear photographs.

- **Lenses**

With the use of different lenses in capture and development of latent fingerprints, more control over the image that the camera capture is possible with a selection of specialized lenses.

  - **105 mm Vis-IR Macro Lens**

  In terms of generic imaging at all distances, photos maintain their sharpness when focused up to 1:1 life size in both auto and manual focus settings.

  - **60 mm UV Transmitting Lens**

  For reflected UV imaging This quartz/fluorite lens, is essential for Reflected UV Imaging but also provides excellent results in the visible and IR.

➢ **85 mm Vis-IR Tilt/Shift Lens**

For depth of field control with a revolving capability of + or - 90 degrees this high-performance lens enables selective focusing of images across different focal planes in the visible and IR wavelengths.

- **Copy stand and accessories**

For precise, consistent image alignment a 1.2m column and transmitted light base are included in a professional photographic copy stand. Variable friction light sources mounts and camera lenses bellows are examples of the accessories.

➢ **Multi-wavelength Ring Light**

For visible and fluorescent image analyses, the Crime-lite 8x4Mk2 offers powerful white, UV, violet, blue, blue/green, green, orange, and red narrow waveband light.

➢ **Package for Halogen Light Sources**

For general contrast imaging, a powerful 150W light source with five colored filters is provided. To be utilized with the fiber optic light guides to provide focused illumination on any kind of surface.

➢ **Forensic Light Source (FLS)**

To increase contrast imaging and eliminate distracting backgrounds, a continuous 400–1000 nm narrowband light source is utilized in combination with fiber optic light guides to deliver precise light wavelengths.

➢ **IR Imaging Crime-lite 8x4Mk3**

For producing infrared fluorescence from specialized dusting powders like fpNatural 1, LED ring lamp with strong blue and red light is used. Infrared light as well, is used for examining reflected infrared images for fingerprints in blood or on materials treated with powders or physical developers.

➢ **UV Light Source**

The Crime-lite 82S fitted with 16 UV LEDs produce fluorescence from processed fingerprint images and reflected UV images more strong UV at 365 nm.

➢ **Fibre Optic Light Guides**

Any sort of evidence for examination may be illuminated using flexible directed light guides.

Imaging Techniques for DCS5

- **Fluorescence Imaging**

Numerous latent fingerprint treatments exhibit fluorescence at certain wavelengths of light, including Ardrox, DFO, BY40, and fluorescent powders. An operator can choose the ideal wavelength to produce the highest fluorescence intensity for each type of therapy by using the DCS 5 multi-wavelength ring light.

- **Infrared Imaging**

When using chemical treatments like Physical Developer and certain powders, which absorb infrared light and look black, interfering backgrounds can be suppressed and seem white because they reflect infrared light. Foster + Freeman's new fingerprint dusting powder 'fpNatural 1' fluoresces brightly in the infrared when illuminated with red light. Its application has the advantage of eliminating interference from most backgrounds which rarely fluoresce at this wavelength.

- **Reflected longwave UV Imaging**

Many materials, including plastics and glass, absorb UV light and turn black, making latent prints which frequently reflect UV light more visible, whether they are treated or not. The DCS5 software can be used to greatly improve images.

- **Flexible directional lighting**

A high intensity halogen or interference light source fitted with a range of fibre optic light guides provide backlight, coaxial and oblique lighting for the examination of fingerprints on difficult surfaces such as reflective, curved or dusty surfaces or as 3-D impressions in soft materials.

Benefits of the DCS5 Latent Fingerprint Development System

- **Enhanced Image Quality and Resolution**

The DCS5 Fingermark Imaging System incorporates state-of-the-art technology to capture highly detailed images of fingermarks. By utilizing advanced optics and high-resolution sensors, the system produces sharp and clear images, allowing forensic experts to extract crucial ridge details with precision. The enhanced image quality provided by the DCS5 system significantly improves the accuracy and reliability of fingerprint analysis.

- **Multiple Light Sources**

The DCS5 system is equipped with multiple light sources, including ultraviolet (UV), visible, and infrared (IR) lights. This versatile lighting capability enables forensic investigators to visualize fingermarks under various conditions, such as different surface types or substances. UV lighting is effective in detecting latent fingerprints on porous surfaces, while IR lighting aids in capturing prints on reflective surfaces. By offering a wide range of lighting options, the DCS5 system maximizes the chances of successful fingermark recovery across diverse crime scene scenarios.

- **Advanced Image Processing Algorithms**

The DCS5 Imaging System is equipped with advanced image processing algorithms specifically designed for latent fingerprint analysis. These algorithms enhance the visibility of latent prints, even in challenging conditions. The system's software provides powerful tools for image enhancement, noise reduction, and contrast adjustment, ensuring that latent fingerprints are brought to the forefront for examination. By leveraging these advanced algorithms, forensic experts can extract crucial information from latent prints that may have otherwise remained undetected.

- **Rapid workflow and Processing**

Forensic investigations sometimes need a tight timeline. The DCS5 Fingermark Imaging System streamlines the fingermark capture and processing workflow, enabling investigators to work efficiently. The system boasts fast image acquisition, reducing the time required for each fingermark capture. Additionally, the DCS5's integrated software provides intuitive tools for image enhancement and comparison, accelerating the analysis process and enhancing overall productivity.

- **Advanced Software Capabilities**

Complementing its hardware capabilities, the DCS5 system offers powerful software features designed to assist forensic experts in analyzing and comparing fingermarks. The software includes sophisticated algorithms for automated fingerprint recognition and matching, reducing the manual effort required for identification. Furthermore, the system's database management functionality allows for efficient storage and retrieval of fingerprint records, supporting cross-referencing against existing databases for potential matches.

- **Compatibility and Integration**

Compatibility and integration are two key design considerations for the DCS5 Fingermark Imaging System. Because of its smooth integration with current forensic laboratory tools and procedures, adopting this cutting-edge technology is made easier without upsetting long-standing routines. By connecting to computer networks, the technology allows forensic specialists to collaborate and share data. This compatibility guarantees a seamless transition and raises forensic operations general effectiveness.

- **Database Integration and Comparison**

The DCS5 system makes it easy to integrate fingerprint databases, which makes it easier to compare and identify latent prints. To find possible matches, forensic investigators can swiftly examine and cross-reference latent prints against current databases. The advanced software of the system optimizes the process of comparison, minimizing human error and enhancing the precision and velocity of fingerprint recognition. By integrating databases, the forensic skills are greatly improved and cases are resolved more successfully.

Conclusion

A new method for developing latent fingerprints on any surface is desperately needed to improve latent fingerprint development, detection, capture, and efficiency for forensic applications. While there are several image processing methods that may be used to create a latent fingerprint, each has significant drawbacks. Many of the shortcomings of the earlier traditional methods for the development, detection, capture, and enhancement of fingerprints on any surface have been addressed by the recent discovery of the DCS5 technique for latent fingerprint development. This paper presents various advantages of DCS5 technique to provide several benefits of latent fingerprinting enhancement, development, detection, and capture on any surface.

Compliance With Ethical Standards

Disclosure of conflict of interest

The author reports no conflicts of interest. The author alone is responsible for the content and writing of the paper.

Statement of ethical approval

The present research work does not involve any ethical approval.

Statement of informed consent

The present research work does not involve any inform consent.

References:

Almog, Joseph, et al. "Reagents for the Chemical Development of Latent Fingerprints: Scope and Limitations of Benzo[F]Ninhydrin in Comparison to Ninhydrin." Journal of Forensic Sciences, vol. 45, no. 3, Wiley-Blackwell, May 2000, p. 14726J. https://doi.org/10.1520/jfs14726j.

Foster+Freeman. Advanced fingerprint capture and enhancement. https://fosterfreeman.com/dcs-5/

Kanjan, Neelima, et al. "A Comparative Study of Fingerprint Matching Algorithms." International Research Journal of Engineering and Technology (IRJET), vol. 04, no. 11, Nov. 2017.

Khare, V. P., and Anu Singla. "A Review on the Advancements in Chemical Examination of Composition of Latent Fingerprint Residues." Egyptian Journal of Forensic Sciences, vol. 12, no. 1, Springer Nature, Jan. 2022, https://doi.org/10.1186/s41935-021-00262-2.

Shenawi, Sanaa, et al. "A Novel Approach to Fingerprint Visualization on Paper Using Nanotechnology: Reversing the Appearance by Tailoring the Gold Nanoparticles' Capping Ligands." Chemical Communications, vol. 49, no. 35, Royal Society of Chemistry, Jan. 2013, p. 3688. https://doi.org/10.1039/c3cc41610k.

Wang, Meng, et al. "Fluorescent Nanomaterials for the Development of Latent Fingerprints in Forensic Sciences." Advanced Functional Materials, vol. 27, no. 14, Wiley-Blackwell, Feb. 2017, p. 1606243. https://doi.org/10.1002/adfm.201606243.

Yamashita, B., French, M., Bleay, S., Cantu, A., Inlow, V., and Ramotowski, R. (2011). Latent print development. The fingerprint sourcebook, 1, 155-222.