

# **Techniques Involved in Forensic Evidence Collections: A Short Communication**

**Raida Said Salim Al Abaidani <sup>1</sup>, Faizal Hajamohideen <sup>2\*</sup>**

Assistant Professor<sup>1,2</sup>, Department of Information Technology<sup>1,2</sup>,  
University of Technology and Applied Sciences, Sultanate of Oman<sup>1,2</sup>.  
faizalh.soh@cas.edu.om<sup>1\*</sup>

## **ABSTRACT**

Forensic evidence collection is a significant aspect of criminal investigations and plays an important role in determining the outcome of a case. This paper outlines the various techniques involved in forensic evidence collection, including photography, fingerprint analysis, DNA analysis, impression evidence, ballistics, trace evidence, document examination, digital forensics, toxicology, and arson and explosion investigation. These techniques provide valuable information to support or refute a suspect's involvement in a crime. By combining these methods, forensic experts can build a comprehensive picture of the evidence at a crime scene and present it in a court of law.

### **Keywords:**

Forensic, Digital forensics, DNA Analysis, Toxicology.

## **1 INTRODUCTION**

Forensic evidence plays a critical role in criminal investigations, providing crucial information that helps solve crimes and bring justice to victims. Collecting forensic evidence is complex and scientific, involving a range of techniques to gather and analyze evidence from crime scenes. The results of these investigations can have far-reaching consequences, serving as the cornerstone of legal proceedings and influencing the outcome of a case. In this paper, we will examine the various techniques involved in forensic evidence collection and how they are used to support criminal investigations. These techniques include photography, fingerprint analysis, DNA analysis, impression evidence, ballistics, trace evidence, document examination, digital forensics, toxicology, and arson and explosion investigation. Understanding the role of these techniques in forensic evidence collection is essential for anyone interested in the criminal justice system and the pursuit of justice.

## **2 BACKGROUND**

Forensic evidence techniques are an integral part of the criminal investigation process, providing valuable information about a crime's circumstances. These techniques are used to collect and analyze physical evidence, such as blood, fingerprints, DNA, hair, fibers, soil, and digital devices, to determine the events at the crime scene. The goal of forensic evidence techniques is to provide objective and scientifically valid information that can be used to support a criminal investigation and help solve crimes.

Forensic evidence technique has a prolonged past from the 19th century when scientists initially started to use scientific methods to analyze evidence in criminal investigations. Since then, forensic science has stretched to include a wide spectrum of disciplines, including forensic biology, chemistry, and digital forensics.

The recovery of evidence from mobile devices in digital forensics is a complex and challenging task, due to the established principles of forensic evidence [1,2]. The memory of these devices is usually integrated, making it difficult to isolate before attempting recovery. Additionally, various file systems and formats have been adopted by manufacturers, further complicating the process of decoding and presenting the evidence [3]. Some studies on the DNA typing-based genetic and molecular structures describe the two main genetic systems used in forensic DNA typing. Both systems utilize the high molecular variation within the human population, making it highly unlikely for two unrelated individuals to have identical DNA structures [4]. Forensic evidence techniques play a critical role in criminal investigation by providing objective information about the crime scene and the events. This information can be used to reconstruct events, identify potential suspects, and provide a scientific basis for prosecuting criminal cases.

The interpretation of forensic evidence requires a comprehensive understanding of the scientific methods used and the legal system and the rules of evidence. Additionally, the results of forensic examinations must be presented clearly and convincingly, making it essential for forensic scientists to have strong communication and presentation skills.

### **2.1 Forensic evidence collection techniques: Photography**

Photography is a fundamental technique in forensic evidence collection. It is used to document crime scenes and capture images of physical evidence, such as fingerprints, footprints, tire tracks, and other impressions. Crime scene photographers use specialized cameras and lighting equipment to capture high-quality images that can be used as evidence in court. Digital photography has become an increasingly important tool in forensic evidence collection, allowing images to be easily shared and stored for later analysis. Using photography in forensic evidence collection helps preserve a visual record of the crime scene. It provides an accurate record of the evidence, which is

crucial in legal proceedings. The proper techniques of forensic photography are essential in ensuring that the images captured are accurate and reliable, and they are an essential aspect of forensic evidence collection.

## **2.2 Forensic evidence collection techniques: Fingerprint analysis**

Fingerprint analysis is a crucial technique in forensic evidence collection. It involves the examination of fingerprints left behind at a crime scene, which can be used to identify suspects and link them to the crime. Fingerprint analysis is based on the unique patterns and ridges found on the fingertips, which remain unchanged throughout a person's life. The evolution of fingerprints has been the subject of research. In order to calculate the average ridge clarity, a two-dimensional Fourier analysis was performed on a contrast-enhanced image that had been pre-processed. Yoon et al. focused their research specifically on latent impressions, but the quality algorithm still needed to be designed to predict the performance of AFIS (Automated Fingerprint Identification Systems). This means that the algorithm was not necessarily geared towards the attributes that are considered during human examinations [7], [8]. In forensic evidence collection, fingerprints are often collected from different surfaces, including glass, metal, paper, and wood. To make the fingerprints visible, various techniques are employed, such as powder dusting, chemical reagents, or laser techniques. Once the fingerprints are developed, they are compared with known fingerprints in databases, such as the FBI's Integrated Automated Fingerprint Identification System (IAFIS), to establish if there is a match. Fingerprint analysis is a powerful tool in forensic evidence collection, as it provides a strong link between a suspect and a crime scene. When used in combination with other forensic techniques, it can provide crucial evidence in support of a criminal investigation.

## **2.3 Forensic evidence collection techniques: DNA analysis**

DNA analysis is a widely used technique in forensic evidence collection. It involves the examination of DNA samples collected from a crime scene, such as blood, saliva, semen, or skin cells, to identify suspects and link them to a crime. According to one study, the process of cell division sometimes experiences errors. This can result in cells having an abnormal number of chromosomes, either too high or too low. Additionally, a few different tissues, such as the liver, may contain cells with a different frequency of chromosomes [5]. In forensic DNA analysis, the collected samples are subjected to a series of tests to isolate and amplify the DNA, creating multiple copies that can be analyzed. The amplified DNA is then compared to reference samples, such as a sample taken from a suspect or stored in a DNA database, to determine if a match exists.

DNA analysis is a powerful tool in forensic evidence collection, as it provides high accuracy and precision in identifying individuals. DNA evidence can also exclude individuals who could not have been involved in a crime. Combined with other forensic

techniques, DNA analysis can provide strong evidence to support a criminal investigation. However, it is essential to note that proper handling and preservation of DNA samples are crucial to ensure the validity of the results.

#### **2.4 Forensic evidence collection techniques: Impression evidence (e.g., tire tracks, footprints)**

Impression evidence refers to physical marks left behind at a crime scene, such as tire tracks, footprints, or tool marks. This type of evidence can provide valuable information about the suspects and their movements at the crime scene.

In forensic evidence collection, impression evidence is typically collected using photography, casting, or molding techniques. The impressions are then compared to reference samples, such as shoe or tire samples, to determine if a match exists. The performance of the fingerprinting impression was evaluated using a range of datasets. These datasets were designed to simulate real-life cases, and some were even directly derived from actual casework situations under operational conditions [6]. Impression evidence can be crucial in linking a suspect to a crime scene, and it can provide important information about the movements and actions of the suspect. When combined with other forensic techniques, impression evidence can provide strong evidence to support a criminal investigation. However, it is essential to note that impression evidence can be easily contaminated or destroyed, making proper collection and preservation techniques crucial to ensure the validity of the results.

#### **2.5 Forensic evidence collection techniques: Ballistics (e.g., firearm and ammunition examination)**

Ballistics is a forensic science division examining firearms, ammunition, and bullets. This evidence can provide valuable information about the weapons used in a crime and the suspect's actions.

In forensic evidence collection, ballistics involves the examination of firearms, ammunition, and bullets to determine their characteristics, such as make and model, caliber, and any unique markings. This information can then be compared to reference samples, such as test-fired bullets or cartridges, to determine if a match exists.

Ballistics is a crucial tool in forensic evidence collection, as it can provide important information about the weapons used in a crime and link a suspect to a crime scene. Ballistics can provide strong evidence to support a criminal investigation when combined with other forensic techniques. However, it is essential to note that proper handling and preservation of ballistic evidence are crucial to ensure the validity of the results.

## **2.6 Forensic evidence collection techniques: Trace evidence (e.g., hair, fibers, and soil)**

Ballistics is an area of forensic science that examines firearms, ammunition, and bullets. This evidence can provide valuable information about the weapons used in a crime and the suspect's actions.

In forensic evidence collection, ballistics involves the examination of firearms, ammunition, and bullets to determine their characteristics, such as make and model, caliber, and any unique markings. This information can then be compared to reference samples, such as test-fired bullets or cartridges, to determine if a match exists.

Ballistics is a crucial tool in forensic evidence collection, as it can provide important information about the weapons used in a crime and link a suspect to a crime scene. Ballistics can provide strong evidence to support a criminal investigation when combined with other forensic techniques. However, it is essential to note that proper handling and preservation of ballistic evidence are crucial to ensure the validity of the results.

## **2.7 Forensic evidence collection techniques: Document examination (e.g., handwriting and typewriting analysis)**

Document examination is a forensic science branch that examines written and printed materials, such as handwriting and typewriting. This type of evidence can provide valuable information about the authorship, authenticity, and content of documents related to a crime.

In forensic evidence collection, document examination involves the comparison of questioned documents to known standards, such as samples of handwriting or typewriting, to determine if a match exists. This examination may include a visual comparison and more technical examinations, such as spectral analysis or digital image processing.

Document examination can be crucial in investigations that involve fraudulent documents or handwriting, such as forgeries, altered documents, or anonymous letters. Document examination can provide vital evidence to support a criminal investigation when combined with other forensic techniques. However, it is essential to note that proper handling and preservation of documentary evidence are crucial to ensure the validity of the results.

## **2.8 Forensic evidence collection techniques: Digital forensics (e.g., computer, mobile device analysis)**

Digital forensics is a field within forensic science that deals with the examination of electronic devices such as computers, mobile phones, and other digital devices. Its aim is to gather, preserve, analyze, and present digital evidence that can provide insight into the actions of individuals who used the devices and the content of the devices. Reith, Carr, and Gunsch (2002) conducted a study on various published models and frameworks for digital forensics. The foundation of these models is based on traditional physical forensic evidence collection strategies as practiced by law enforcement agencies, such as the FBI [9]. In forensic evidence collection, digital forensics involves

the examination of digital devices, such as computers and mobile phones, to identify and preserve digital evidence related to a crime. This examination may include the recovery of deleted or hidden data, the analysis of files and systems, or the examination of communication logs.

Digital forensics is crucial in investigations involving electronic devices, as it can provide important information about the actions of individuals using these devices. When combined with other forensic techniques, digital forensics can provide strong evidence to support a criminal investigation. However, it is essential to note that proper handling and preservation of digital evidence are crucial to ensure the validity of the results.

### **2.9 Forensic evidence collection techniques: Toxicology (e.g., drug and poison analysis)**

Toxicology is a branch of forensic science that studies poisons and drugs and their effects on living organisms. This type of evidence can provide valuable information about the presence of drugs or poisons in a person's body and the manner and cause of death.

In forensic evidence collection, toxicology involves the analysis of biological specimens, such as blood, urine, or tissues, to determine the presence and concentration of drugs or poisons. This examination may include a range of laboratory techniques, such as chromatography or mass spectrometry, to identify and quantify the substances in the specimens.

Toxicology is crucial in investigations that involve poisoning or drug-related crimes, as it can provide important information about the presence of drugs or poisons in a person's body and the manner and cause of death. When combined with other forensic techniques, toxicology can provide strong evidence to support a criminal investigation. However, it is essential to note that proper collection and preservation of toxicology evidence are crucial to ensure the validity of the results.

### **2.10 Forensic evidence collection techniques: Arson and explosion investigations.**

Arson and explosion investigation is a branch of forensic science that examines fires and explosions to determine the origin and cause. This type of evidence can provide valuable information about the circumstances surrounding a fire or explosion and the responsible party.

In forensic evidence collection, arson and explosion investigation involve the examination of the fire or explosion scene to identify and preserve physical evidence related to the origin and cause of the incident. This examination may include the collection of burn patterns, fragments of exploded materials, and samples of accelerants.

Arson and explosion investigation is crucial in investigations that involve fires or explosions, as it can provide important information about the circumstances surrounding the incident and the responsible party. When combined with other forensic techniques, arson, and explosion investigation can provide strong evidence to support a criminal investigation. However, it is essential to note that proper handling and preservation of physical evidence are crucial to ensure the validity of the results.

### **3 INTERPRET BETWEEN FORENSIC EVIDENCE TECHNIQUES**

Forensic evidence techniques are methods used in forensic science to collect, analyze, and present evidence related to a crime. The interpretation of forensic evidence involves the examination of the actual evidence and correlating the results with other pieces of evidence, as well as with the circumstances surrounding the crime.

The different forensic evidence techniques each have a specific purpose and provide unique information. For example, fingerprint analysis provides information about the identification of individuals, while DNA analysis provides information about the genetic identity of individuals. Impression evidence, such as tire tracks and footprints, provides information about the movements of individuals, while ballistics provides information about the firearms and ammunition used in a crime. Trace evidence, such as hair, fibers, and soil, provides information about the location and movements of individuals, while document examination provides information about the authenticity and source of written materials. Digital forensics provides information about electronic devices and the activities of individuals who use them, while toxicology provides information about the presence of drugs or poisons in a person's body. Arson and explosion investigation provides information about the origin and cause of fires and explosions.

The interpretation of forensic evidence requires a comprehensive understanding of the scientific methods used to collect and analyze the evidence and the limitations of each technique. It also requires an understanding of the legal system and the rules of evidence and the ability to present the results clearly and convincingly. Ultimately, interpreting forensic evidence is a critical step in criminal investigation and can provide vital information to support a criminal investigation.

### **4 CONCLUSION**

Forensic evidence techniques are essential in criminal investigation, providing valuable information about the circumstances surrounding a crime. These techniques include photography, fingerprint analysis, DNA analysis, impression evidence, ballistics, trace evidence, document examination, digital forensics, toxicology, and arson and explosion investigation. Each technique provides unique information, and when used together, they can provide a comprehensive understanding of the crime and support a criminal investigation.

Proper collection and preservation of evidence are crucial to ensure the validity of the results, and the interpretation of the evidence demands a comprehension of the scientific methods and the limitations of each technique. The interpretation of the evidence also requires an understanding of the legal system and the rules of evidence. The results are clearly and convincingly presented with interpreted pieces of evidence.

In conclusion, using forensic evidence techniques plays a critical role in the criminal investigation process, providing valuable information that can support a criminal investigation and help solve crimes.

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