

A Systematic Literature Review on the Usage of Digital Photography at Crime Scene Investigation Process

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Abstract

The use of digital photography medium is dominantly used in the process of investigating criminal cases. Digital photography used in the investigation process is also known as crime scene photography, where photographic images are produced to collect evidence, documenting the scene, and subsequently, be used as a reference for criminal case investigation and prosecution process. Using systematic literature review (SLR), this study identifies the current practice of digital use of photography in the process of investigating criminal cases. Searches via electronic databases of indexed journals, namely, Scopus, Science Direct, Web of Science and Springer were conducted. Data is limited to these journals was produced within the years 2017 until 2021 as the latest research information. The findings consist of 28 papers that had met the criteria by which this study touched on digital photography technology such as DSLR Camera, Drone Photography, and CCTV.

Keywords: Digital photography, crime scene, investigation, Systematic Literature Review.

I. INTRODUCTION

Photographs contain a thousand words and could indicate as proof for crime investigation [1]. Photography also is one of the most influential and significant mediums in helping to assist in the analysis of criminal cases. Due to their quickness and ease of understanding, digital photographs also present a practical and beneficial medium for communication [2]. The information contained in the digital evidence proved to be very helpful in documenting the crime scene and was used to reconstruct crimes for investigation [3]. This statement was reinforced by [4], who described digital photography as representing the gold standard in documenting forensic evidence. On that basis, the photographic medium is used to gather evidence and relevant information to assist in investigating cases. But according to [5], the advancement of forensic science technologies makes digital photography increasingly lagging behind time to be used as a documentation medium because it requires accurate measurements. However, digital photography cannot be completely rejected as the digital photograph is seen as helping the jury to see and examine digital photographs closely in the trial process at court [6].

Challenges in the increasingly complex world of criminal case investigation and the durability of evidence are temporary, non-permanent, or easily lost. The sophistication of digital mediums such as DSLR Cameras [7], CCTV [8], Drone [9], Mobile phones [10] that are becoming more and more accessible and easy to use makes image recording increasingly crucial for the criminal investigation. Digital photography has become essential in various fields, primarily in criminal investigations [2], to collect images and video [11].

Digital photography is the basis of the documentation process of a crime scene. Therefore, the role of this medium should be clearly understood so that it can help facilitate and maximize its use in any investigation process. Using data obtained through the online journals, this study only focuses on the medium of digital photography to take an in-depth look at the implementation and use of digital photography in the current practice of the investigation process. The results of this study can explain the importance of digital photography in current methods used in the criminal investigation process to collect evidence and crime scene documentation. The study will also discuss the features of digital photographs for use in a criminal investigation.

II. LITERATURE REVIEW

A. Review Stage Digital photography in investigation

Digital photography in the investigation process is widely used in forensic analysis, cyber-crime or fraud [1], medical examination [12], forensic medical [13], crime scene investigation [6] and so on. According to [3], it has been around two decades since digital photography has been used in forensic investigation.

There are four levels of investigation process consisting of collection of evidence, examination of the evidence collected, analysis and preparing the report [14]. In crime scene investigation, documenting the scene is the most crucial part of collecting evidence [15]. Among the common documenting methods in investigating a crime scene utilizes transcription, photography, video or audio recordings, and scene sketch [15].

The rapid development of digital technology has changed the pattern of criminal investigations worldwide. More advanced technologies are being created and used in the process of criminal investigations [16], such as DSLR Cameras [7], CCTV [17], [18], [8], Drone [9], 360-degree camera [19]. The diversity of forms of digital technology has changed the methods, techniques, and scope of criminal investigation [20]. It was reported that the courts are more receptive of digital evidence without insisting on scientific verification, methodologies or digital forensic tools [20]. According to [21] digital proof has become more important than eyewitnesses.

Digital photography is a method of producing images using light. Each sensor comprises light-sensitive diodes called photosites that convert photons that strike it into an electric charge proportional to the light's power [22]. Each sensor records data for a single image component or pixel in the image. The combination of three primary colors (red, green, and blue) will produce a variety of colors in an image [22]. The following variables must be considered in order to create acceptable photograph quality: white balance, exposure, angle, and, most importantly, the sharpness of the image [5].

[16] described photographs as a digital component containing information that can be used to identify the perpetrator and the victim and relate to the incident that occurred during the investigation process. In digital photography, three coherent, recorded, validated, and inter-connect knowledge components form the knowledge chain in each investigation stage: methods and tools [2]. In medical, digital images are used to describe clinical findings, operational measures, or postoperative outcomes for medical education and record-keeping [12].

B. Digital photography method of experiment

Digital photographs are not only limited to the process of investigation but also work as a method of experiment. [23] has used photography to capture fingermarks and assist with the experiment. In their study, Accioly used the digital camera SONY@DSC-HX1 to photograph natural fingermarks on a shiny surface. Digital photography is very significant in assisting the investigation as a medium of visual documentation for analysis purposes. A method experiment [24] described digital images as an important documentation source. Its study also used 2D color digital photographs to evaluate the decomposition of exposed human analogs in taphonomy forensic investigations. For crime investigation purposes, the camera modification into an infrared version is to capture non-visible light. Research from [7] proves that the modification of digital cameras can help collect evidence documentation evidence. Infrared photography has potential applications in forensic science and medicine since it shows ordinarily unseen facts to the human eye [7].

C. Digital Photographs as a tool of documentation and evidence

The crime scene investigation aims to protect the integrity of physical evidence, assist the investigator in reaching conclusions, and submit evidence and reports of good facts to the court [15]. For example, an American court accepts a photograph as factual evidence, regardless of whether it was taken as part of a police investigation at a crime scene or as evidence of a demonstration in a court case [25]. In criminal trials, photographs are effective in relaying information and proving a case because text cannot represent itself as well as an image can [21]. [12] describe the power of a picture piece has the potential to solve a case, and a picture can give an idea of the scene even if we are not in the place. However, according to [2], photos, are only tools in investigation which still requires other corroborative evidence for identification. Geradts's opinion does not represent the overall thinking of researchers when [1] defending the importance of photographs serve to clarify the scene of a crime and present the visual evidence in investigations and to a jury during court proceedings.

Offences which are committed through online or technology platforms inevitably requires digital witness devices . However, investigation of offences committed physically also relies on digital devices such as information in relation to the crime captured by the device [26]. Cases involving personal injuries resulting from accidents or crimes commonly rely on photographs as evidence on how the accident or crimes occurred. [5].

D. Characteristic of Digital photography for investigation

The study [12] proposed using photographic forensics to investigate sexual violence cases highlighted the Rule of 4s and 5s, where pictures should be taken in three different ranges of wide, medium photographs range and close up. Three elements make up the objectivity of digital evidence, such as photographs of on-site information recording: recording time, recording location, and recording person. [15]. [26] digital tools come up with elements of description or memory to present the data of the commission of the offence. Digital images can be descriptive information for the long-term memory in recalling and retrieving the information about a person or event [2]. According to [26], digital Images also act as a digital witness supporting an investigation because they contain descriptive elements that describe the incident at the scene during the investigation process. [25] described decoding the crime scene in the investigation as a way to understand the content of the picture through viewing and re-enactments.

E. Relevancy Digital photography for investigation purpose

Evolution photography started with a camera pinhole, and now the camera's digital technology is gaining glory with the existence of DSLRs and mirrorless in the digital world market. The impact of the advancement of digital technology has also contributed to the increasingly sophisticated and dangerous crime scene. With advances in forensic science technology, digital photography has become obsolete for certain documents requiring precise measurements [5]. So to make sure photography stays relevant [1] emphasizes that photography must adapt to remain relevant in a world where criminals are growing increasingly intelligent and crime categories, such as fraud, are becoming increasingly complex.

Crime scene photographs during the investigation process will be selected and included in the investigation papers for the prosecution process. However, according to [6], the traditional printing method still has a gap, often losing clarity and details, making it more challenging to interpret what they are seeing. Further, [6] suggested that the court must be better equipped with technology which could present the digital evidence during trial because although high end photography technologies were used by the crime scene officers in collecting the evidence, they were hindered from satisfactorily displaying the evidence due to lack of technology in court. Therefore, usage of digital photography at the crime scene investigation would be futile if the courts lack the technology to benefit from the digital evidence captured.

III. METHODOLOGY

This study implements a systematic literature review (SLR) to see the use of crime scene photography as documentation and evidence in the investigation process. Systematic Literature Review was developed from the need to certify that decisions impacting the lives of the people are founded on the recent and comprehensive understanding of the available research [27]. A systematic literature review is a specific process that creates a whole article based on a review of the literature rather than empirical data collection [28]. According to [29], a systematic literature review methodology is suggested as to get accurate and transparent data in the review process. To conduct this study [30] suggest seven key particulars of SLR, which are (1) the development and validation of the review protocol or publication standard or reporting standard or guidelines, (2) the formulation of research questions, (3) systematic searching strategies, (4) quality appraisal, (5) data extraction, (6) data synthesis, and (7) data demonstration.

To perform a literature study using four main phases and a document-based qualitative methodology, we used the following methods: Plan the review, execute the search, analyze the research choices, and present the results [28]. Studies on literature selected from the last five years ranging from 2017 to 2021 were conducted to obtain the latest information about photography in crime scenes as documentation and evidence in the investigation process. The selection keywords were selected based on the objective that had been decided.

The suitable keywords for the search procedure were chosen based on each objective. This study employed comprehensive search on four selected major databases: Web of Science, Springer, Scopus, and Science Direct search. Specific keywords and

phrases were used in their advanced keyword search to find relevant articles. Using the phrase searching function and the Boolean operator, the keywords used were (Crime OR offence) AND (Crime scene OR crime investigation) AND (Digital forensic OR digital evidence OR digital proof) AND (photography OR photographic OR visual OR photograph)

The current study aimed to examine the recent findings of research with regards to usage of digital photography in the investigation process at the crime scene. To conduct this research, the researcher sets two objectives: RO1: Identifying the current practice of using crime scene photography in the investigation process, and RO2: Discussing the significance of crime scene photography in the investigation process. What is the current practice of digital photography in the criminal investigation process? This is the main research question to be answered in this study. The second question is about the significance of digital photography in crime scene investigation.

IV. DISCUSSION AND FINDING

Table I Summary of The Research Result

Items	Data Summary		
	Electronic Data Base	Search Result	Relevant Paper
1	Scopus	35	6
2	Science direct	115	9
3	Springer	83	7
4	Wos	29	6

Table 1 shows the selected electronic databases, Scopus, Science Direct, Springer, and Wos. A search was carried out in September 2021. In ensuring quality, only peer-reviewed articles of concluded empirical research on digital photography published between 2017 and 2021 were selected. The search produced a total of 262 papers. The abstracts were scrutinised to determine the relevance of the articles to the research questions. The articles must present current findings on digital photography used in the investigation process at the crime scene digital photography's and discuss the significance of digital photography in the investigation process. Upon eliminating irrelevant articles, 28 papers which met the requirements were selected. Table 2 summarizes the papers that met the criteria. The papers were synthesized to examine the objectives, methodology and evaluation method and data capture.

Table II Summary of The Review Paper Included

Items	Summary Data			
	Authors	Objective	Design & Development Methodology	Evaluation Method and Data Capture
1	[31]	This study examined crime scene look and camera shots of television drama	Case study	Content analysis Screen shot image from drama episode CSI
2	[32]	This article introduced professionals to new forensic photography technologies, methodologies and digital tools/software, and photography guidelines.	Literature review	Literature review from online database
3	[16]	The study identified the validity and authority of digital or electronic evidence in criminal trials. The study was conducted by looking at the latest legal trends and identifying what legal experts are doing in determining the authenticity	Descriptive and Analytical Approach	Using a comparative perspective, compare the laws of the United Arab Emirates (UAE). Public sources, books, legal

Summary Data				
Items	Authors	Objective	Design & Development Methodology	Evaluation Method and Data Capture
		of electronic evidence for cybercrimes.		literature and online database
4	[17]	This study expanded current understanding of how CCTV aids criminal investigations, with an emphasis on homicide investigations.	Ethnographic Study	Using quantitative and qualitative data collected over the course of a four-year ethnographic study of 44 homicide investigations in the United Kingdom
5	[21]	This paper analyzed digital evidence security and suggested that digital evidence collection, analysis, auditing, and safeguards modal be carried out.		
6	[22]	This paper provides a comprehensive evaluation of the advancements and challenges in computerized image crime scene investigation to develop apprentices' understanding, identifying the requirements, and identifying the exploration holes in this field.	Experimental	Computerized picture crime scene investigation
7	[26]	The aim of the study is to identify and focus on investigative capabilities using digital evidence at the crime scene	Case Study	Focus group Examination to respondent on the crime scene investigation
8	[23]	This paper aimed to experiment with a chemical treatment to dissolve the technical problem such as overlapping lines, low contrast, and reflection in taking a digital photograph of fingerprints on reflective surfaces.	Experimental	Using fingerprints of Volunteer participants
9	[15]	This work presented a set of trustworthy processing algorithms for data records based on Chinese cryptography standards, which ensure the records' credibility based on time, space, and persons associated with the data.	Experimental Study	Prototype development
10	[33]	This paper is on multi-user of variety models virtual collaboration platform for the collection and analysis of evidence for trial.	Design Concept	The outcome was DIOGENES which was a design concept for a multi-user, multimodal virtual platform.
11	[20]	This paper identifies incorrect and inconsistent use of technology, outdated procedural guarantees that are not fitted to contemporary digital evidence procedures and services, and a lack of reliable testing in digital forensics practice.	Literature Review Paper	Published journal in online database

Summary Data				
Items	Authors	Objective	Design & Development Methodology	Evaluation Method and Data Capture
12	[25]	To demonstrate the principles of seeing and narrating in crime scene photo analysis by decoding photographs of a gangster's death in 1936.	Exploratory Experiment	Content analysis Arthur 'Weegee Fellig's Crime scene photographs of gangster's death in 1936
13	[2]	Reviewing papers in general fields of competence (1) image manipulation detection (2) biometric comparison (face, gait and other bio- metrics) Identifying the camera's	Systematic Literature Review	Review relevant paper focus on photographs and video in forensic perspective starting 2016 to 2019
14	[11]	This paper examined combining different kinds of video and image data into a 3D reconstruction simulation.	Case Study	Experimental case study by develop 3D crime scene reconstruction algorithms
15	[34]	This study used a fusion feature to extract, detect, and hierarchical clustering method for forgery detection.	Experimental	Comparative analysis from image analysis Image forgery detection method via extensive survey
16	[6]	The goal of this research was to examine usage of digital technology from different types in courts and in the gathering of digital evidence presented by the police officers in court.	Qualitative Phenomenological Research Study	Using a semi- structured, open-ended questionnaire, the researchers recruited respondents through snowball sampling of 21 police officers from England and Wales, as well as Australia.
17	[35]	This research offered a new methodology to help forensic investigators detect object positioning changes caused by crime scene tampering.	Experimental	Image analysis The test dataset consists of four groups of photos simulated from an indoor crime scene.
18	[1]	A major focus of this essay is the developments in photography, as well as how imaging-science approaches might be applied to fraud investigations.	Systematic Literature Review	There were numerous sources used in the research, including scholarly publications on criminology, imaging science, and the history of forensic photography
19	[36]	This experiment investigated the use of reflected infrared photography for the purpose of detecting hidden bloodstain evidence using a modified digital single-lens reflex (SLR) camera.	Experimental	Visual examination and image analysis All the photos were taken using both reflected infrared and visible light cameras.
20	[24]	This study examined the suitability of 2D color digital images in analyzing decomposition of human counterparts in	Experimental	Fixed lens digital camera with Fujifilm FinePix HS-20EXR were used to capture

Summary Data				
Items	Authors	Objective	Design & Development Methodology	Evaluation Method and Data Capture
		a tropical savanna setting, and whether or not they were effective		photographs of decomposition of pig carcasses.
21	[37]	The purpose of this study is to introduce the Forensic Field Map (FFM), a two-dimensional forensic framework that is straightforward to understand.	Experimental	The forensic casework being done at the Netherlands Forensic Institute inspired the examples offered in this study.
22	[3]	This article describes a revolutionary computer-aided forensic toolbox that includes tools for analyzing, documenting, annotating, and visualizing forensic cases involving complex digital data.	Experimental	Visual analysis Case analysis and documentation. The majority of these cases have been recreated postmortem, but others have been presented during court proceedings.
23	[5]	This paper aimed to look at how well and accurately a 3D model made with the Botscan could be used to record and measure things. Wound size measurements were obtained using the gold standard of forensic photo documentation.	Experimental	Forensic photographs of Model victims with crime injuries were taken using a Nikon D700, Nikon AF-S Micro-Nikkor 105 mm f/2.8G IF-ED VR (Nikon Corporation, Japan).
24	[4]	The paper aims to examine the capabilities of drone-based aerial photography as equipment for recording crime scenes and to test the abilities of 3D models in a forensic context.	Experimental	Mock scene and on-site documentation using drone photography and photogrammetry processing Drones can record high-quality aerial photography of crime scenes, which can aid in the criminal investigation process.
25	[38]	The goal of this research was to compare the measurement functions for measuring crime scenes, namely using a tape measure and a 360-degree digital camera equipped with photogrammetry software.	Experimental & Comparative Study	A Spheron SceneCam and the SceneCam were used in various locations in a bedroom.
26	[39]	The goal of this research is to describe how prior laboratory-based work was extended to field-based trials using a rescue dummy as a victim.	Experimental	Simulation was done to photograph victim's body after relocation and before removal of clothing to record soil patterns.
27	[19]	This study proposed technology for the simultaneous detection and visualization of semen and saliva using a SceneCam 360° camera (Spheron VR AG)	Experimental	Ten participants; 4male and 6 females, aged Ten participants; 4male and 6 females.

Summary Data				
Items	Authors	Objective	Design & Development Methodology	Evaluation Method and Data Capture
				The photographs of human semen and saliva were recorded using a SceneCam 360°.
28	[7]	This study aimed to explain how to set up a specific camera modification to IR photography and show how it worked in a forensic setting. It also showed examples of trace evidence and both external and internal findings.	Experimental	Forensic evidence included gunshot traces and automobile part impressions on the victim's black trousers. The victim's tattoo and bruises were also used as forensic samples.

V. CONCLUSION

Through this SLR study, it is clear that photographic digital mediums are significant in investigating a criminal case. The diverse forms of crime will change the pattern of the digital use of photography, but the goal of its use remains the same: to record evidence at the scene before the evidence is disposed of. Digital photography is also used as an experimental method in investigating a criminal case to understand and analyze a phenomenon that occurs scientifically. The various methods of proof of digital technology that exist today, such as CCTV, 360 cameras, drones, and so on, show that the digital technology of photography will continue to evolve in line with current developments. However, the use of images produced using digital photography is still relevant and should be practiced in the field of investigation.

REFERENCES

- [1] P. M. Gilmour, "The application of photography in investigating fraud," *Imaging Sci. J.*, vol. 67, no. 4, pp. 215–223, 2019, doi: 10.1080/13682199.2019.1600254.
- [2] Z. Geradts, N. Filius, and A. Ruifrok, "Interpol review of imaging and video 2016–2019," *Forensic Sci. Int. Synerg.*, vol. 2, pp. 540–562, 2020, doi: 10.1016/j.fsisy.2020.01.017.
- [3] A. Bornik et al., "Integrated computer-aided forensic case analysis, presentation, and documentation based on multimodal 3D data," *Forensic Sci. Int.*, vol. 287, pp. 12–24, 2018, doi: 10.1016/j.forsciint.2018.03.031.
- [4] P. Urbanová, M. Jurda, T. Vojtišek, and J. Krajsa, "Using drone-mounted cameras for on-site body documentation: 3D mapping and active survey," *Forensic Sci. Int.*, vol. 281, pp. 52–62, 2017, doi: 10.1016/j.forsciint.2017.10.027.
- [5] R. Michienzi, S. Meier, L. C. Ebert, R. M. Martinez, and T. Sieberth, "Comparison of forensic photo-documentation to a photogrammetric solution using the multi-camera system 'Botscan,'" *Forensic Sci. Int.*, vol. 288, pp. 46–52, 2018, doi: 10.1016/j.forsciint.2018.04.012.
- [6] K. Sheppard, S. J. Fieldhouse, and J. P. Cassella, "Experiences of evidence presentation in court: an insight into the practice of crime scene examiners in England, Wales and Australia," *Egypt. J. Forensic Sci.*, vol. 10, no. 1, 2020, doi: 10.1186/s41935-020-00184-5.
- [7] T. Rost, N. Kalberer, and E. Scheurer, "A user-friendly technical set-up for infrared photography of forensic findings," *Forensic Sci. Int.*, vol. 278, pp. 148–155, 2017, doi: 10.1016/j.forsciint.2017.07.001.
- [8] M. P. J. Ashby, "The Value of CCTV Surveillance Cameras as an Investigative Tool: An Empirical Analysis," *Eur. J. Crim. Policy Res.*, vol. 23, no. 3, pp. 441–459, 2017, doi: 10.1007/s10610-017-9341-6.
- [9] A. Renduchintala, F. Jahan, R. Khanna, and A. Y. Javaid, "A comprehensive micro unmanned aerial vehicle (UAV/Drone) forensic framework," *Digit. Investig.*, vol. 30, no. 2019, pp. 52–72, 2019, doi: 10.1016/j.diin.2019.07.002.
- [10] Jessica camaho, *Forensic Analysis on Mobile Devices*, vol. 2. Springer International Publishing, 2019.
- [11] M. Kraus et al., "Toward mass video data analysis: Interactive and immersive 4d scene reconstruction," *Sensors (Switzerland)*, vol. 20, no. 18, pp. 1–38, 2020, doi: 10.3390/s20185426.
- [12] R. Yesodharan, V. Renjith, A. Kumar, and V. C. Nayak, "Forensic clinical photography: A game changer in medicolegal investigation and forensic science," *Indian J. Forensic Med. Toxicol.*, vol. 12, no. 2, pp. 262–266, 2018, doi: 10.5958/0973-9130.2018.00113.5.
- [13] M. Luseti, L. Salsi, and X. A. Wang, "A blockchain based solution for the custody of digital files in forensic medicine," *Forensic Sci. Int. Digit. Investig.*, vol. 35, p. 301017, 2020, doi: 10.1016/j.fsidi.2020.301017.
- [14] F. Böhm, L. Englbrecht, and G. Pernul, "Designing a decision-support visualization for live digital forensic investigations," *Lect. Notes Comput. Sci. (including Subser. Lect. Notes Artif. Intell. Lect. Notes Bioinformatics)*, vol. 12122 LNCS, pp. 223–240, 2020, doi: 10.1007/978-3-030-49669-2_13.
- [15] Y. Yang, Y. Wu, and X. A. Wang, "Trusted Records Scheme in Scene Investigation," *Adv. Intell. Syst. Comput.*, vol. 1264 AISC, pp. 303–308, 2021, doi: 10.1007/978-3-030-57811-4_28.
- [16] A. F. Moussa, "Electronic evidence and its authenticity in forensic evidence," *Egypt. J. Forensic Sci.*, vol. 11, no. 1, 2021, doi: 10.1186/s41935-021-

- [17] F. Brookman and H. Jones, "Capturing killers: the construction of CCTV evidence during homicide investigations," *Polic. Soc.*, vol. 0, no. 0, pp. 1–20, 2021, doi: 10.1080/10439463.2021.1879075.
- [18] D. Seckiner, X. Mallett, C. Roux, D. Meuwly, and P. Maynard, "Forensic image analysis – CCTV distortion and artefacts," *Forensic Sci. Int.*, vol. 285, pp. 77–85, 2018, doi: 10.1016/j.forsciint.2018.01.024.
- [19] K. Sheppard, J. P. Cassella, S. Fieldhouse, and R. King, "The adaptation of a 360° camera utilising an alternate light source (ALS) for the detection of biological fluids at crime scenes," *Sci. Justice*, vol. 57, no. 4, pp. 239–249, 2017, doi: 10.1016/j.scijus.2017.04.004.
- [20] R. Stoykova, "Digital evidence: Unaddressed threats to fairness and the presumption of innocence," *Comput. Law Secur. Rev.*, vol. 42, no. November 1950, p. 105575, 2021, doi: 10.1016/j.clsr.2021.105575.
- [21] P. Senthil and S. Selvakumar, "Digital Proof Collective Model Using Integrated Fusion Data Modelling," *Wirel. Pers. Commun.*, no. 0123456789, 2021, doi: 10.1007/s11277-021-08713-8.
- [22] T. Jain and S. K. Shandilya, *Evaluation of Digital Image Forensics*, vol. 166. Springer Singapore, 2021.
- [23] R. J. Accioly, "A low-cost chemical and optical approach to develop latent fingerprints on silver mirror surfaces," *Forensic Sci. Int.*, vol. 327, p. 110988, 2021, doi: 10.1016/j.forsciint.2021.110988.
- [24] A. Ribéreau-Gayon, C. Rando, R. M. Morgan, and D. O. Carter, "The suitability of visual taphonomic methods for digital photographs: An experimental approach with pig carcasses in a tropical climate," *Sci. Justice*, vol. 58, no. 3, pp. 167–176, 2018, doi: 10.1016/j.scijus.2017.12.001.
- [25] A. Lam, "Decoding the Crime Scene Photograph: Seeing and Narrating the Death of a Gangster," *Int. J. Semiot. Law*, vol. 34, no. 1, pp. 173–190, 2021, doi: 10.1007/s11196-019-09676-7.
- [26] G. Horsman, "Digital evidence and the crime scene," *Sci. Justice*, vol. 61, no. 6, pp. 761–770, 2021, doi: 10.1016/j.scijus.2021.10.003.
- [27] J. P. T. Higgins et al., *Cochrane handbook for systematic reviews of interventions*. 2019.
- [28] S. Kraus, M. Breier, and S. Dasí-Rodríguez, "The art of crafting a systematic literature review in entrepreneurship research," *Int. Entrep. Manag. J.*, vol. 16, no. 3, pp. 1023–1042, 2020, doi: 10.1007/s11365-020-00635-4.
- [29] C. Okoli and K. Schabram, "Working Papers on Information Systems A Guide to Conducting a Systematic Literature Review of Information Systems Research," *Work. Pap. Inf. Syst.*, vol. 10, no. 2010, 2010, doi: 10.2139/ssrn.1954824.
- [30] H. A. Mohamed Shaffril, S. F. Samsuddin, and A. Abu Samah, "The ABC of systematic literature review: the basic methodological guidance for beginners," *Qual. Quant.*, vol. 55, no. 4, pp. 1319–1346, 2021, doi: 10.1007/s11135-020-01059-6.
- [31] N. Elyamany, "Theorizing the forensic gaze and the CSI shot in the multimodal ensemble of CSI: Crime Scene Investigation (2002–2015)," *Convergence*, no. Clc, pp. 1–22, 2021, doi: 10.1177/13548565211005755.
- [32] R. Yesodharan, T. T. Jose, M. Nirmal Krishnan, S. Anitha, and V. C. Nayak, "Looking through the lens of a sexual assault examiner: novel trends and approaches in forensic photography," *Egypt. J. Forensic Sci.*, vol. 11, no. 1, 2021, doi: 10.1186/s41935-021-00241-7.
- [33] U. Erra et al., *Collaborative Visual Environments for Evidence Taking in Digital Justice: A Design Concept*, vol. 1, no. 1. Association for Computing Machinery, 2021.
- [34] K. Sunitha and A. N. Krishna, "Efficient Keypoint based Copy Move Forgery Detection Method using Hybrid Feature Extraction," *2nd Int. Conf. Innov. Mech. Ind. Appl. ICIMIA 2020 - Conf. Proc.*, no. Icimia, pp. 670–675, 2020, doi: 10.1109/ICIMIA48430.2020.9074951.
- [35] M. Petty, S. W. Teng, and M. Murshed, "Improved Image Analysis Methodology for Detecting Changes in Evidence Positioning at Crime Scenes," *2019 Digit. Image Comput. Tech. Appl. DICTA 2019*, pp. 1–8, 2019, doi: 10.1109/DICTA47822.2019.8945934.
- [36] B. Bastide, G. Porter, and A. Renshaw, "Detection of latent bloodstains at fire scenes using reflected infrared photography," *Forensic Sci. Int.*, vol. 302, p. 109874, 2019, doi: 10.1016/j.forsciint.2019.109874.
- [37] H. van Beek, "A forensic visual aid: Traces versus knowledge," *Sci. Justice*, vol. 58, no. 6, pp. 425–432, 2018, doi: 10.1016/j.scijus.2018.08.006.
- [38] K. Sheppard, J. P. Cassella, and S. Fieldhouse, "A comparative study of photogrammetric methods using panoramic photography in a forensic context," *Forensic Sci. Int.*, vol. 273, pp. 29–38, 2017, doi: 10.1016/j.forsciint.2017.01.026.
- [39] K. R. Murray, R. W. Fitzpatrick, R. Bottrill, and H. Kobus, "Patterns produced when soil is transferred to bras by placing and dragging actions: The application of digital photography and image processing to support visible observations," *Forensic Sci. Int.*, vol. 276, pp. 24–40, 2017, doi: 10.1016/j.forsciint.2017.03.026.