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Forensic identification from remote digital sources: a systematic review of fingerprint recovery and reliability

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Abstract

Background: Fingerprint (FP) biometrics have benefited from high-resolution smartphone image sensors, allowing remote acquisition of papillary patterns without physical contact [1]. Beyond traditional scanners, social media images may contain latent biometric data recoverable for forensic investigation. Case reports confirm successful identification of suspects through FP in photographs [1, 2]. Furthermore, digital FP from uncontrolled environments or video frames can be effective for Automated Fingerprint Identification Systems (AFIS) [3]. Deep learning models further enable ridge reconstruction from low-quality samples [4]. The rising exposure of these images requires a systematic evaluation of current evidence. **Objective:** To review the literature and forensic case reports in order to assess the technical feasibility and reliability of human identification using FP from unconventional digital sources. **Methods:** This review followed the PICO framework and PRISMA guidelines. An exploratory search was conducted in PubMed, ScienceDirect, Scopus, and IEEE Xplore using the keywords: "fingerprints", "photographs", "identification", and "AFIS". Inclusion criteria were peer-reviewed forensic case reports and studies on remote capture, minutiae extraction, and AFIS integration, written in English and available in full text. Non-peer-reviewed documents, editorials, reviews, duplicates, and other biometric modalities were excluded. Analysis focused on image processing and ridge reconstruction. **Results:** Forensic case reports confirm identification via unconventional sources, such as photos of handheld objects [1] and mobile images [2], providing sufficient quality for high-confidence AFIS hits [3]. Success depends on frame selection and digital filters to preserve papillary structure despite lighting and perspective challenges [1, 5]. Advanced processing and Convolutional Neural Networks (CNNs) transform photographic fragments into valid evidence meeting law enforcement standards [3, 4]. **Conclusions:** Forensic practice is evolving with FP increasingly accessible through public digital records [1, 3]. Advances in reconstruction allow accuracy levels compatible with forensic standards [3, 5]. This highlights the need for standardized guidelines for handling biometric data from uncontrolled sources and increased awareness of privacy risks.

Keywords: biometric identification; fingerprint reconstruction; remote fingerprint capture

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