

A multi-factor knuckle and nailbed verification tool for forensic imagery analysis

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When engaging in child sexual grooming, offenders often send pornographic selfies to minors. They hide their faces, but their sexts often include hand, knuckle, and nail bed imagery. We present a novel biometric hand verification tool designed to identify offenders and abusers from images or videos based on biometric/forensic features extracted by hand regions. The tool harnesses the unique characteristics of an individual's hand, focusing on the region of interest of the knuckle fingerprint and the nail bed area. By employing advanced image processing and machine learning techniques, the system can match and authenticate hand component imagery against a constrained custody suite reference of a known subject.

The proposed biometric hand verification tool works on both static images and videos, in the latter case selecting the best frame (in terms of resolution and orientation of the hand). The tool is embedded with selectable authentication models trained on a variety available datasets (both individually and in combination). To explore the performance and reliability of the biometric verification models, we considered several parameters, including hand orientation, distance from the camera, single or multiple fingers, architecture of the models and performance loss functions. Results showed best performance for pictures sampled from the same database and with the same image capture conditions, which combined with nail and knuckle score fusion reached high levels of reliability with error rates lower than 1%.

We highlight the strength of the system and the current limitations. The authors conclude the biometric hand verification tool offers a robust solution that will operationally impact law enforcement by allowing agencies to investigate and identify offenders and abusers online more effectively.