Development of an Intelligent Shoeprint Retrieval System

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Abstract

Shoeprints collected at crime scenes are key evidence to catch suspects and recreate the crime scene. However, current shoeprint retrieval systems rely on investigators looking at patterns with their own eyes. This manual method causes errors based on personal judgment and takes too much time when searching large databases. Therefore, this study proposes an intelligent shoeprint retrieval system that automates the whole process from start to finish using the latest deep learning technology. Our proposed system: (1) Effectively removes poor lighting and noise using a hybrid pre-processing algorithm combining Retinex and wavelet transform. (2) Extracts visual and semantic features using a multimodal model for pattern classification and a token-based model for image search. (3) Performs fast and accurate retrieval in large databases using a hybrid search strategy. Experimental results show that the system achieved a Top-10 accuracy of 51.43%. It trained on 26,000 reference data and was tested on 145 real crime scene shoeprints. This is a 4.29% accuracy improvement over the traditional manual method. Furthermore, it reduced the analysis time by about 76% and successfully detected tiny patterns that the old method missed.

Keywords

Shoeprint Retrieval, Image Preprocessing, Deep Learning, Feature Extraction.