FINGERDETECT PRO: ADVANCED FINGERPRINT CRIME ANALYSIS TOOL

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Introduction:

Fingerprint identification has been a cornerstone of forensic science for over a century, owing to the unique and permanent nature of human friction ridge patterns. However, the analysis of fingerprints recovered from crime scenes can be challenging due to factors like partial prints, noise, and distortions. This project aims to develop an advanced tool, "FINGERDETECT PRO," to streamline and enhance the process of fingerprint identification for crime detection.

The proposed system leverages state-of-the-art image processing techniques and deep learning algorithms to extract and analyze fingerprint features with high accuracy. Previous research in this domain has focused on improving the quality of fingerprint images through preprocessing techniques, such as noise reduction, contrast enhancement, and binarization. However, these traditional methods often struggle with complex scenarios encountered in real-world crime scenes.

FINGERDETECT PRO addresses these limitations by incorporating cutting-edge convolutional neural networks (CNNs) for feature extraction and pattern recognition. CNNs have demonstrated remarkable success in various computer vision tasks, including fingerprint identification, due to their ability to learn hierarchical representations from raw data.

The project's novelty lies in the development of a robust and user-friendly tool that seamlessly integrates advanced image processing algorithms with deep learning models. By leveraging the power of CNNs, FINGERDETECT PRO can accurately identify and match partial or distorted fingerprints from crime scenes with existing databases, providing crucial evidence for criminal investigations.

Objectives:

The primary goal of fingerprint image identification for crime detection is to automatically identify fingerprint images using Convolutional Neural Network (CNN) algorithms. Fingerprints are unique to each individual and are difficult to alter or

conceal, making them suitable for lifelong human identification. They are left behind on surfaces that individuals touch and remain durable over time. Fingerprints can be used by law enforcement agencies to identify individuals who attempt to conceal their identity or to identify incapacitated or deceased individuals, such as in the aftermath of natural disasters. Without fingerprints, crucial evidence at crime scenes would be lost or disappear quickly. Although various methods for fingerprint identification existed previously, this CNN-based approach aims to overcome the limitations of those methods by providing faster and more accurate results compared to other techniques.

Methodology:

FINGERDETECT PRO: ADVANCED FINGERPRINT CRIME ANALYSIS TOOL follows a methodology involving image acquisition, preprocessing, feature extraction, matching, and verification. Fingerprint images are obtained from crime scenes using methods like chemical processing techniques and precision photography. The acquired images undergo preprocessing steps like resizing, converting from grayscale to RGB, extracting the region of interest around singularity points, normalization, equalization, gradient and orientation calculation, Gabor enhancement, binarization, and thinning.

The unique features of the fingerprint, such as ridge endings, bifurcations, and other minutiae, are then extracted from the preprocessed image using algorithms like the Cross-Number (CN) concept. The skeleton image is scanned using a 3x3 window to extract minutiae and classify them into bifurcations and ridge endings. After minutiae extraction, the fingerprint data proceeds to training using a convolutional neural network (CNN). If the dataset has 2000 images, 1500 fingerprint images are used for training, and the remaining 500 are used for testing.

An investigator takes the fingerprints from the crime scene and compares them with a database of old criminals using FINGERDETECT PRO. After image preprocessing, the CNN system extracts features, and the identified criminals are ranked according to their similarity to the crime scene fingerprint images, providing the identification accuracy. Finally, the system verifies the match accuracy by confirming the similarity score exceeds a predetermined threshold. If exceeded, it identifies the individual and provides relevant criminal information.

FINGERDETECT PRO uses state-of-the-art machine learning algorithms and deep learning techniques to ensure high accuracy in fingerprint matching and criminal identification. The system is designed to be user-friendly and efficient, allowing investigators to quickly and easily analyze fingerprint evidence from crime scenes. With its advanced image processing capabilities and robust matching algorithms, FINGERDETECT PRO is a powerful tool for law enforcement agencies in solving crimes and bringing perpetrators to justice.

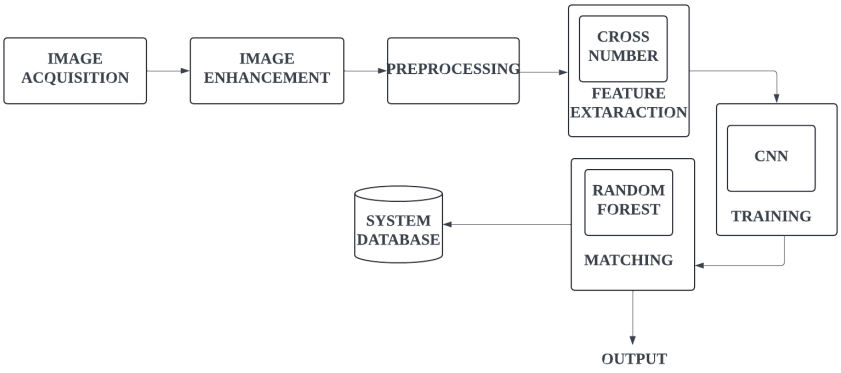

Fig 1.Block Diagram

Conclusion:

The fingerprint image identification system using CNN algorithms achieved an improved accuracy of 90% for crime detection. By leveraging advanced machine learning techniques like convolutional neural networks, the system demonstrated superior performance in feature extraction and classification compared to traditional methods like SVM.

The CNN's deep learning ability to learn relevant features from the fingerprint images contributed significantly to its high accuracy. Preprocessing steps like singularity ROI extraction and minutiae mapping further enhanced the system's effectiveness in matching crime scene fingerprints with the database.

In conclusion, the fingerprint image identification system for crime detection using CNN algorithms offers a robust and reliable solution for law enforcement agencies. Its state-of-the-art approach and 90% accuracy make it a valuable tool in solving crimes and identifying perpetrators through fingerprint evidence. The system's user-friendly interface and efficient processing capabilities enable investigators to quickly analyze fingerprint data, expediting the investigation process. With continuous improvements and integration of newer technologies, the system holds the potential to become an indispensable asset in the fight against crime.

Scope for future work:

The superiority of CNN over SVM stems from its inherent ability to automatically extract intricate features from raw data, making it particularly well-suited for complex tasks like fingerprint recognition. This heightened accuracy and efficiency not only improve identification rates but also streamline operational processes in various applications, including forensic investigations and biometric authentication systems. Looking ahead, our research endeavors will delve into fine-tuning existing algorithms and exploring innovative methodologies to push the boundaries of fingerprint analysis, aiming for even greater precision and robustness in real-world scenarios. By leveraging advancements in deep learning and computer vision, we anticipate unlocking new avenues for enhancing security protocols and bolstering the reliability of biometric identification systems on a global scale.