Multimodal Biometrics for Human Identification using RCNN Method

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Abstract

Multimodal biometrics using Region-based Convolutional Neural Networks (RCNN) is an advanced approach for human identification that leverages multiple biometric traits, such as face, fingerprint, iris, or voice, to improve accuracy and robustness. Here's an outline of the concept: Introduction to Multimodal Biometrics: Definition: Combines multiple biometric modalities to enhance recognition accuracy and reliability. Advantages: Improved resistance to spoofing or fraudulent attacks. Higher accuracy by leveraging complementary information from multiple sources. Robustness to missing or low-quality biometric data. Role of RCNN in Biometrics RCNN Overview: A type of neural network that excels in object detection by proposing regions of interest (ROIs) and classifying them. Suitable for localizing and identifying features in biometric data, such as facial landmarks, iris patterns, or fingerprint minutiae.

Why RCNN for Biometrics: Precision in identifying key regions in complex biometric inputs. Ability to handle variability in pose, lighting, and occlusions. System Architecture Input Data: Multimodal inputs (e.g., face image, fingerprint scan, and iris scan). Preprocessing for normalization and noise reduction. Feature Extraction: RCNN detects and extracts features from each biometric modality. Region Proposal Network (RPN) identifies regions of interest in the data. Feature Fusion: Combines features from different modalities using techniques like concatenation, weighted averaging, or attention mechanisms. Ensures complementary information is utilized for robust recognition. Classification Fully connected layers classify the combined features to identify individuals. The output includes identity and confidence scores. Challenges and Solutions

Challenges: Computational cost of processing multimodal data. Data alignment and synchronization for different modalities. Handling missing or incomplete data. Solutions: Optimize RCNN architecture to reduce complexity. Use imputation techniques for incomplete modalities. Implement parallel processing and GPU acceleration for efficiency. Applications Security: Access control in secure areas, surveillance systems. Healthcare: Patient identification in medical systems. Banking: Authentication for financial transactions.

I. Introduction

Traditional access control frameworks utilized today require different recognizable proof devices, for example, character reports, passwords, attractive cards. Assuming these devices are in the possession of others without the consent of the individual, it can cause material and moral misfortunes. Conventional frameworks in regions like public safety, electronic business and banking, where individual recognizable proof is critical, can't give adequate certainty. For this large number of reasons, biometric frameworks have progressively begun to substitute the customary frameworks utilized for individual distinguishing proof cycles [7].

Biometrics is a logical discipline that requires mechanized techniques in view of the conduct and physiological highlights of people. Biometric highlights based individual ID processes are becoming well known step by step, as they have numerous applications and are more solid than customary techniques [134]. Biometric frameworks are fundamentally founded on the rule of remembering at least one physical or conduct qualities that only one's own, which can't be changed by others or himself that demonstrates that the individual is himself that recognizes the individual from others. The way that biometric frameworks comprise of physical or conduct highlights guarantees that biometric highlights are not lost, can't be utilized by another person, can't be neglected and can't be imitated [8]. The motivation behind biometric frameworks is to empower individuals to utilize their own highlights, which are difficult to mirror, without retaining data like passwords and conveying anything with them to demonstrate their character. In this way, the utilization of these frameworks guarantees the most elevated level of safety.

II. Human Identification using RCNN

Biometric frameworks are really an example acknowledgment framework comprising of the means of taking biometric information from individuals, getting a bunch of elements from this data set, and coordinating this list of capabilities with the model set in the data set. Biometric information comprises of conduct elements, for example, step, voice, console use, signature elements, and actual highlights, for example, unique finger impression, face shape and math, iris, DNA, vein structure, palm print, finger knuckle prints. The suggested one among these highlights is the finger knuckle surface. The articular surface of the finger knuckle is an intrinsic skin example and communicates a type of the joints on the intra-toe surface. This biometric is wealthy in tissue data. This lavishness empowers the finger knuckle surface to be utilized in distinguishing proof cycles even within the sight of low goal gadgets.

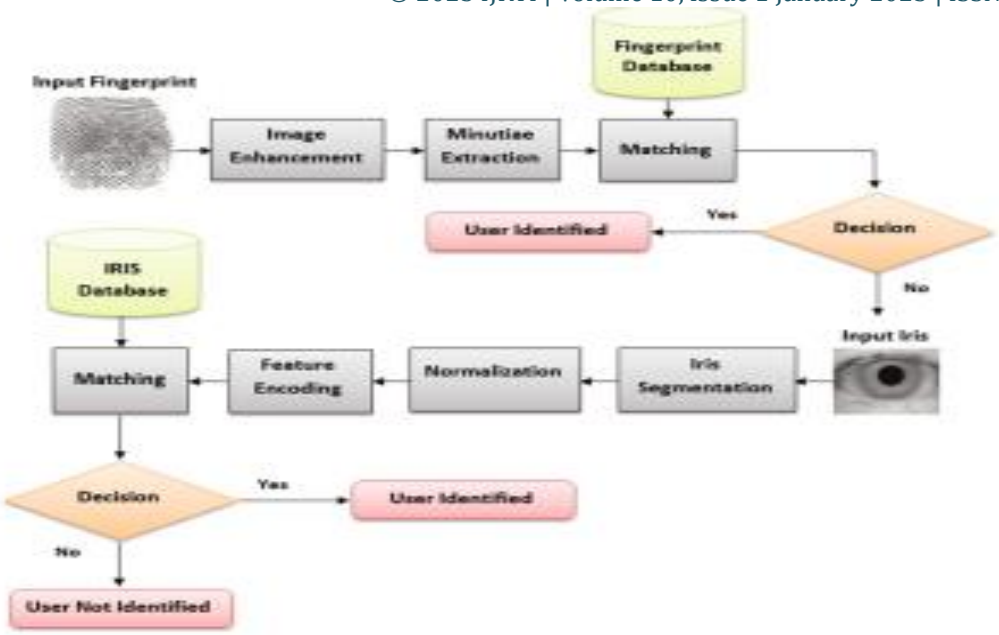

Figure 1. Architecture of the proposed RCNN cascade multimodal biometric system

Systems created using a single biometric such as the finger knuckle surface are reliable, not universal, etc. They face many problems such as due to the necessity of removing these problems, the idea of multimodal-biometric system was put forward using Region-based Convolutional Neural Network (RCNN). Multimodal biometric systems are systems that are formed by the combination of biometrics obtained from the same sensor or from different sensors. In order to avoid the problems encountered in systems based on single biometric data, multiple biometric recognition and verification consisting of finger knuckle surface and fingerprint was performed in this research work.

III. Conclusion

The purpose is to develop a hybrid features based multimodal biometric identification system using deep convolutional neural networks. The second part presents the proposed methodology, and the third presents the simulation results. This article presents multimodal biometric identification using GLCM and wavelet moments features extraction, followed by hybrid feature classification based on convolutional neural networks with a random forest classifier.

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