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Multimodal Biometrics for Human Identification using Artificial Intelligence

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Abstract- Multimodal biometric systems combine multiple biometric modalities to enhance the accuracy and security of human identification. Instead of relying on a single biometric trait (such as fingerprint or face), these systems use a combination of different biometric characteristics to provide a more robust and reliable identification process. The key idea behind multimodal biometrics is that the fusion of diverse biometric data can overcome the limitations of individual modalities, resulting in higher accuracy and lower error rates.

Keyword: Artificial Intelligence, Human Identification

I. INTRODUCTION

The most common biometric modalities used in multimodal systems include: Fingerprint: Analysis of unique patterns on the fingertips, Face recognition: Identifying individuals based on facial features. Iris recognition: Scanning and analysing the uniquepatterns in the iris of the eye. Voice recognition: Identifying individuals based on their uniquevoice characteristics. Palmprint recognition: Analysing the patterns on the palm of the hand. Retina recognition: Scanning and analysing the unique patterns of the retina. Hand geometry:Measuring the physical characteristics of the hand. Signature recognition: Analysing thedynamic features of a person's signature.

II. METHODOLOGY

A. Advantages of Multimodal Biometrics

Increased accuracy: Combining multiple biometric modalities reduces the risk of false positives and false negatives, resulting in higher accuracy rates. Robustness: Even if one biometric modality fails due to factors such as injury or poor image quality, other modalities can still beused for identification. Improved security: Multimodal systems provide stronger authentication and make it harder for impostors to bypass the system. User convenience: By using multiple biometric modalities, the system can adapt to different users and situations, making it more user-friendly.

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B. Challenges of Multimodal Biometrics

Data acquisition: Collecting and storing multiple biometric data can be challenging, as differentsensors and technologies may be required for each modality. Computational complexity: The fusion of multiple modalities often requires more processing power and storage resources. Privacy concerns: Collecting and storing various biometric data may raise privacy concerns if not handled properly. Cost: Implementing multimodal biometric systems can be expensive dueto the need for multiple sensors and advanced processing capabilities.

III. RESULT

Despite the challenges, multimodal biometric systems have the potential to greatly enhancethe security and reliability of human identification in various applications, including access control, border security, financial transactions, and law enforcement. As technology advances and the adoption of biometrics increases, multimodal systems are likely to play an increasingly important role in ensuring secure and accurate identification.

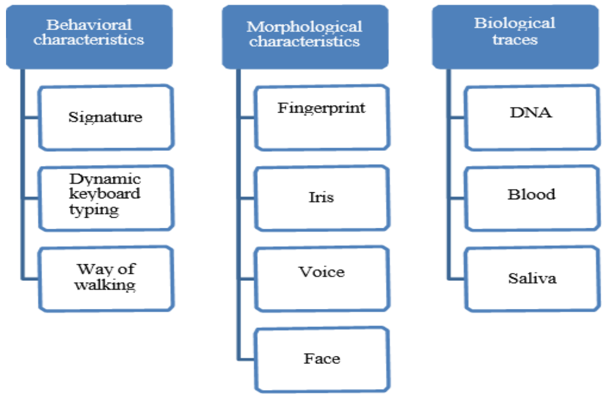

Fig. 1 - Different facets of Biometrics: Behavioural, Morphological and Biological Biometrics with Some Examples

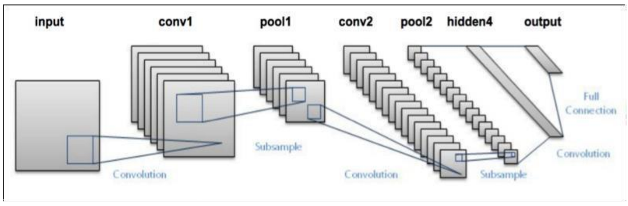

Fig. 2 - Typical Deep Convolutional Neural Network Architecture

Figure 2 indicates the typical convolutional neural network architecture with multimodalarchitecture.

IV. CONCLUSION

The idea of multiple biometrics, which was introduced due to the problems encountered insingle-biometric systems, is another suggested approach. This study allowed to validate the feasibility of a multimodal biometric system by concatenating four biometric modalities: fingerprint, finger knuckle, face, and iris. The use of SVM classifier mainly amounts to selecting a good family of kernel functions and adjusting the parameters of these functions. In the preprocessing part, normalization was performed in order to ensure that the images have unit variance and zero mean, and the side effects of light conditions were saved. This research work demonstrated that the approach adopted provided excellent results in terms of the accuracy and precision, and that it is able to manage delicate situations, in particular when unimodal systems do not allow good recognition to be carried out, thus justifying the need to merge several biometric modalities. The methodology presented in first phase of chapter threeshows an accuracy of 97.63% with AdaBoost classifier and 99.13% with random forest classifier. It has been observed that convolutional neural networks as feature extractor is a verypowerful alternative. Hybrid features are obtained using GLCM, wavelet moments and deep features. For the classification stage, random forest classifier is used. The important thing is to choose well a specific training dataset for the data environment with which you later want to test. The proposed approach of second phase has been tested in the experimental studies carriedout. When the three different feature extraction methods are considered, it is seen that successful results are achieved with an accuracy of 99.33%. The feature selection has done its job very well in third phase and the maximum accuracy achieved by utilizing FCM and random forest classifier is 99.33%. It has been demonstrated that the proposed multimodal-biometric identification system is more successfulthan single-biometric structures.

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Authors Contributions	All authors have equal participation in this article.

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