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MULTIMODAL BIOMETRIC RECOGNITION USING EDHO BASED DEEP MAX-OUT NETWORK AND ADAM OPTIMIZATION

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ABSTRACT

The field of biometrics, which is still relatively young in the world of technology, has been instrumental in addressing a number of issues that relate to conventional verification techniques. There are certain physical or behavioural characteristics that are connected with a person, and these characteristics can be used to automatically recognize that individual automatically. Multimodal biometric recognition using EDHO (Embedding-based Deep Hashing Optimization) based deep max-out network and Adam optimization is the primary objective of this study, which aims to undertake research on the subject. For the purpose of personal identification, an efficient multimodal recognition strategy that is referred to as an EDHO-based hybrid fusion technique is provided here. The Elephant Herding Optimization (EHO) method and the Deer Hunting Optimization (DHOA) method are combined to create the EDHO algorithm. This algorithm is the outcome of the combination of these two methods. The purpose of this research is to extract the relevant properties of a person identification model into neural networks. Additionally, optimization approaches are utilized in order to guarantee that the neural networks are trained in the suitable manner.
Keywords:*Multimodal Biometric Recognition, Adam Optimization, Deep Max-Out Network, EDHO, Biometrics.*

INTRODUCTION

Due to the fact that it has the potential to improve both security and accuracy, multimodal biometric recognition, which involves utilizing various physiological or behavioural features for the purpose of identifying, has gained a significant amount of attention today (Dhameliya& Chaudhari, 2013; Hezil&Boukrouche, 2017). Taking into consideration the aforementioned circumstances, the incorporation of EDHO-based Deep Max-out Network and ADAM optimization constitutes an innovative strategy for addressing the difficulties of multimodal biometric systems. The EDHO framework provides a comprehensive mechanism for feature extraction and representation. This mechanism is able to capture complicated patterns across a variety of biometric modalities, including fingerprints, facial photos, and iris scans, among others (Oloyede & Hancke, 2016; Kumar& Kumar, 2016). This integrated model, when combined with the ADAM optimization method, which is well-known for its effectiveness in optimizing deep neural networks, shows promise for better convergence speed and generalization performance (Alay & Al-Baity, 2019; Bari & Gavrilova, 2019). This research intends to accelerate multimodal biometric identification systems to new heights of accuracy and robustness by combining the strengths of EDHO-based feature learning and ADAM's optimization prowess. In addition, this research has the potential to have applications that range from safe access management to border protection and beyond.

LITERATURE REVIEW

The table that follows provides examples of a variety of alternative literatures that are associated with the models that are utilized for multimodal biometric recognition.

Table 1: Related Works

AUTHORS AND YEARS	METHODOLOGY	FINDINGS
Lumini and Nanni (2017)	This experiment compared numerous score-level matcher fusion methods. The comparison used three independent score benchmark datasets. This study was a biometric matcher combination case study. The fusion of scores shows that techniques that integrate multiple methods yield the best results.	After analysing the pros and cons of several biometric matcher combination methods and experimentally testing some of them, we reached our conclusion and suggested some future research directions.
Singh, Singh, and Ross (2019)	A multibiometric system can overcome some of the limits of a non-biometric system by methodically combining information from multiple sources. Using several sources enhances system reliability and recognition. Multiple-source information is less unique to an individual than single-source information.	Information fusion for presentation attack detection and multibiometric cryptosystems is also explored.
Gui et al., (2019)	The purpose of this essay is to review brain biometric system studies and analyse the literature. This article covers the latest brainwave signal capture, collecting, processing, and analysis advances, as well as public databases, feature extraction and selection, and classifiers.	It clarifies several developing brain biometrics research gaps. Issues include multimodality, security, permanence, and stability.

Research Gap: Multimodal biometric identification systems have advanced, but EDHO-based Deep Max-out Networks with ADAM optimization are still understudied. EDHO and ADAM have showed potential in feature extraction and optimization, but their combined use in multimodal biometrics is underexplored. Research relies on classic feature extraction and optimization methods, ignoring the

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benefits of deep learning architectures and contemporary optimization algorithms. Bridging this gap is essential for multimodal biometric systems to reach their full potential, as EDHO and ADAM could improve recognition accuracy, resilience, and scalability across multiple biometric modalities. These components' synergies and interactions should be investigated to improve multimodal biometric recognition in real-world applications.

METHODOLOGY

Effective multimodal recognition strategy EDHO-based hybrid fusion for personal identification is described. EDHO was created by combining DHOA with EHO. This procedure identifies people using electromyography (EMG), dorsal hand vein, and finger vein testing. For added security, a hybrid feature fusion model is used. Weight coefficients incorporate features in this model. To forecast weight factors, an optimization approach is created. To increase identification, use ideal weight values, which suggest the best answer. However, the fitness function determines the ideal value. Start by analysing each biometric and retrieving the ROI. Add BiComp masks to the surface. The features obtained after these operations are fused or linked to create a feature vector. A Deep MaxoutNetwork identifies individuals using this feature vector. Only analysis-based input combinations are considered during feature fusion.

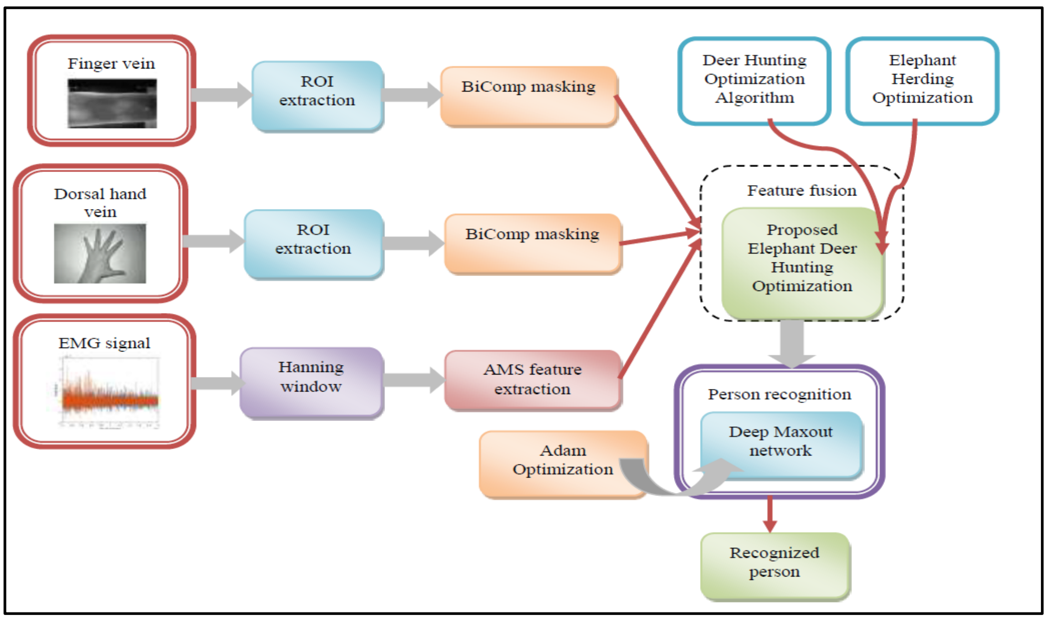

Figure 1: **Block diagram of proposed EDHO-based hybrid fusion approach for person recognition**

RESULTS AND DISCUSSIONS

The finger vein database (SDUMLA-HMT Finger database 2017), the dorsal hand vein database (Bogazici University - Hand Database 2020), and the electromyography database (EMG dataset 2020) are employed throughout the testing phase. By using the three datasets described earlier, we can assess the performance of this biometric model based on its sensitivity, accuracy, and specificity metrics.

The SDUMLA-HMT database contains “facial photos, finger vein images, gait movies, view angles, iris images, and fingerprint images”. Furthermore, the database includes videos of individuals' walking patterns. The database contains genuine multimodal data contributed by 106 distinct individuals. When conducting finger vein analysis, it is imperative to adjust the training data ratio from 50% to 90% and consider the variations in population sizes. The study considers a population size ranging from twenty to eighty, using a scale of 20. The accuracy is 95.10% when 90% of the training data is utilized, and the population size is 80. Similarly, the specificity has a value of 95.38%, while the sensitivity has a value of 94.28%.

Table 2: Performance of the proposed EDHO-based hybrid fusion model on SDUMLA-HMT dataset

SDUMLA HMT DATASET	Training percentage =90% and Population size=80			
	IMAGE SIZE	Accuracy (%)	Sensitivity (%)	Specificity (%)
	(128 X 128)	95.10	95.38	94.28

The table above presents the results of the proposed hybrid fusion model, which is based on EDHO, on the SDUMLA-HMT dataset. To train the classifier, a meta-heuristic strategy inspired by nature is employed, which enhances the accuracy of individual recognition. In the proposed study, the deep maxout classifier is used in combination with an optimization method called EDHO, which effectively determines the best possible solution. In our previous study, we successfully trained the MSVNN model using the GwPeSOA approach. Later, to enhance the model's efficiency, it was improved by combining the MSVNN-based algorithm and the DBN-based model. However, in this specific case, the feature fusion model is used in combination with the EDHO-based model. When using Deep Max out Network for classification, it is important to consider biometric information from internal organs, such as electromyography (EMG) and dorsal hand veins, in addition to finger veins. The BiComp masking approach is applied to extract the features from the pictures using the recovered finger vein. Finger vein detection is achieved when the user is in motion, thanks to the improved user convenience and greater efficiency of the system's recognition program. Previously, deep learning methods utilizing recurrent neural networks (RNN) and convolutional neural networks (CNN) successfully captured the unique features of vein patterns and achieved exceptional performance in recognition. Nevertheless, when contrasted with the suggested model, these methodologies exhibited merely a marginal degree of precision.

CONCLUSION

The development of a hybrid fusion model for the processing of a person recognition system using optimization techniques. The purpose of this model is to facilitate system processing. Consideration is given to three modalities: finger vein, dorsal hand vein, and EMG signal. The ROI is extracted using both the finger vein image and the dorsal hand vein image. Following this, the ROI is subjected to the BiComp masking technique. Following the application of windowing to the EMG signal, the AMS feature is extracted from the processed signal. For person recognition, the EDHO method is utilized for feature fusion, whereas the Deep Maxout network generates the recognized output. As a result, the classifier is trained utilizing the Adam optimization algorithm in accordance with the prescribed methodology. A model for person recognition extracts and integrates the pertinent properties into neural networks. Following this, optimization techniques are utilized to ensure that the neural networks are trained effectively.

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