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Assignment Report: Human Gait Recognition Using Deep Learning

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Human Gait Recognition Using Deep Learning

Summary research papers

Paper1 : Researchers have carried out a lot of work on human gait recognition (HGR) to address different factors affecting the recognition technique's performance.

The authors presented a new method based on a two-stream network. The technique is comprised of five steps such as frames acquisition from video data, conversion of frames into Grayscale, designing of a two-stream network for feature extraction, feature fusion obtained from both streams, and classification using machine learning algorithms. A 55-layer CNN model is designed from scratch to design both streams. The optical flow is obtained using the Horn and Schunk algorithm, and temporal features are obtained using the CNN model in stream-1. While the frames are directly passed to the CNN model for feature extraction in the stream-2. The method is validated using CASIA-B and more than 90% accuracy is obtained on each angle. The gives good outcomes on the CASIA-B dataset but shows degraded performance on the CIFAR-100 dataset on which it was originally trained [1].

Paper2 : A method based on deep learning feature extraction is proposed to overcome the recognition problem in HGR. The method is comprised of several steps such as the processing of input data, the region of interest segmentation, feature extraction using the VGG model, and classification. The input image of 128×128 is given as input to the model and features are obtained using the transfer learning technique. The model has different layers and can be divided into five distinct groups such as a group having two convolution layers and the second type of group is based on three convolution layers. The feature extraction is performed using convolution layers and classification is performed using a fully connected or dense layer. The method is evaluated with the help of a publicly available dataset called

CASIA-A and a maximum accuracy of 97.80% is obtained. The method performed well on the CASIA-A dataset but the generalisability is not validated [2].

Paper3 : The assurance of correctness and safety is carried out by introducing an HGR method using the CNN model. The method includes several steps such as video-to-frame conversion, GEI's extraction by applying to preprocess, and ROI identification such as the knee, hip, angle of the knee, etc, feature extraction using original and ROI data, feature vector fusion, and classification of data. The data of 150×150 is taken as input and preprocessing is applied using Grayscale conversion and background removing. After preprocessing, the model-based and appearance-based feature extraction is carried out. In the next step, the Fused Gait Feature Representation (FGFR) model is designed to concatenate both extracted feature vectors. In the last step, the classification of the data is carried out. The model is tested using CASIA-A-A and CASIA-B datasets and accuracy of 99.60% and 99.80% is obtained. The model performed very well by aggregation of the features by is computationally intensive due to the fusion of features. Moreover, the model-based approach is also dependent on the data and may fail if the RIO is not correct [3].

Paper4 : To overcome the angle, view, and clothing variations problem in HGR, a new method is proposed based on four steps. The features are obtained with the help of two pre-trained models such as AlexNet and VGG19. In the next step, features fusion is carried out selecting higher index values. Moreover, entropy and skewness-based techniques are employed during the feature optimization and the best subset of the feature vector is selected. In the last step, various machine learning algorithms are utilized to classify the data. The method is assessed with the help of CASIA-A, B, C, and AVAMVG gait, and the accuracy of 99.70%, 93.30%, 92.20%, and 99.80%. The performance of the method is good on the gait data but the feature extraction process is complex and there may be a loss of features during the feature selection process [4].

Paper5 : The variation problem of human gait is addressed using a CNN model. The method is based on the hybrid technique of feature extraction and selection. This method includes four steps such as frame acquisition from input videos, feature extraction using a pre-trained model such as VGG-16, Kurtosis and Principal Score approach-based feature selection, serial feature fusion, and classification using an SVM classifier. The method is validated using six CASIA-B angles and obtained an accuracy of 95.80% on the 00 angle, 96.0% on the 18 angle, 95.90% on the 36 angle, 96.20% on the 54 angle, 95.60% on 72 angle, and 95.50% on 90 angle [5].

Paper6 : A HGR approach is presented to handle huge data tasks based on a deep learning approach. The method is designed to overcome variations of gait data problems such as clothes, view, and carrying conditions. The method includes preprocessing using data augmentation with the help of a three-flip operation, feature extraction Inception-NASNet Mobile and ResNet-V2, feature optimization using a whale optimization, feature fusion using serial fusion based on modified mean absolute deviation, and clarification using machine learning algorithms. The proposed method is validated with the help of the CASIA-B dataset and an average accuracy of 89.0% is obtained. The proposed method is efficient and effective but is less flexible as compared to multi-stream techniques [6].

Critical Analysis:

In the literature, various HGR methods are proposed by authors based on different feature extraction techniques and feature selection/optimization methods. The method worked well on the gait data for human recognition on different datasets. The accuracy of the models is promising but includes additional overhead due to feature fusion and feature selection process. Moreover, some models are not assessed to validate the generalizability by conducting experiments on different datasets.

Connections:

Following are some connections among different HGR methods discussed above.

Feature Extraction for Gait Recognition: All HGR techniques consider the feature extraction step as an important task. Different deep learning models are used to obtain relevant features such as AlexNet, VGG, etc.

Dataset-Specific Performance: These methods used famous gait datasets such as CASIA-A, B, and C and showed improved results. While the generalizability problem is still a gap.

Multi-Stream and Hybrid Approaches: Various HGR methods are based on a hybrid of multi-stream techniques and obtain the spatiotemporal features from the gait data. These methods address the problem of variation in gait data such as carrying, clothing, and walking variations.

Feature Fusion and Optimization: Most of the methods utilize the feature optimization techniques such as nature-inspired algorithms, entropy, and kurtosis-based methods. The methods are comprised of a combination of feature extraction and optimization which offers good results.

Resource Efficiency and Complexity: Various HGR methods tried to address the computation problem due to its application in the real world. They aim to develop such a method that is lightweight and has fewer parameters.

Conflict among Methods:

Following are some conflicts among the different HGR methods discussed above.

Model Complexity vs. Resource Constraints: Some methods focus on higher computational costs by designing complex gait models while others focus on developing lightweight methods to address the computational problem. This shows that the trade-off between accuracy and computational cost is important.

Single vs. Multi-Model Feature Extraction: Some methods use a single CNN model for feature extraction while others use more than one model such as AlexNet and VGG19. The method based on multiple models is good at the extraction of robust features but may be complex to some extent.

Rule-Based vs. Machine Learning-Based Classification:

Some methods are based on machine learning classification while some use rule-based methods and use different deep learning models for feature extraction. The selection is based on the data type and results.

Generalization vs. Dataset-Specific Optimization:

Some HGR method uses only one data to test the models and have a lack of generalizability while some method uses more than one gait dataset to make a generalized model.

Feature Selection vs. Comprehensive Fusion:

There are various methods that focus on the feature optimization process to obtain relevant features and eliminate redundancy. Some method uses the fusion method to take all features as input for classification to eliminate the feature loss problem. The literature review summary is also given in Table 1.

Table 1: Summary of Literature Review of Recent HGR Methods

Ref#	Year	Research Design	Key Findings/Results	Methodology	Limitations
Mehmood et al. [1]	2024	Experimental	Method obtained more than 90% accuracy	Frame Acquisitions, RGB to Gray Scale conversion, spatiotemporal feature extraction, feature optimization, classification	The accuracy of CIFAR-100 is not promising
Rani et al. [2]	2024	Experimental	The method was tested using the CASIA-A dataset and achieved an accuracy of 97.8%	Preprocessing, image segmentation, feature extraction, and classification	The method is tested on a small dataset which does not reflect the generalizability
Yousef et al. [3]	2023	Experimental	The model is tested using CASIA-A and B and achieved	Video-to-frame conversion, GEI's extraction by applying to preprocess,	The model-based approach is dependent on the data and may fail

			99.60% and 99.80% accuracy	and ROI identification, feature extraction, fusion, and classification of data.	if the RIO is not correct.
Arshad et al. [4]	2020	Experimental	The method obtained 99.70%, accuracy on CASIA-A, 93.30% accuracy on CASIA-B, 92.20% accuracy on CASIA-C, and 99.80% accuracy on AVAMVG gait	Features using AlexNet and VGG19, feature fusion, entropy, and skewness-based feature optimization, machine-learning classification	The feature extraction process is complex and there may be a loss of features during the feature selection
Mehmood et al. [5]	2022	Experimental	The HGR method is tested using six CASIA-B angles and obtained an accuracy of 95.80% on the 00 angle, 96.0% on	Frames acquisition, feature extraction, selection, serial fusion, and classification.	The method is accurate and robust but may be dependent on data quality and also computationally intensive due to

			the 18 angle, 95.90% on the 36 angle, 96.20% on the 54 angle, 95.60% on 72 angle, and 95.50% on 90 angle.		the feature selection process
Saleem et al. [6]	2021	Experiment al	The method is evaluated on CASIA-B dataset and obtained an average accuracy of 89.0%	Preprocessing, feature extraction, feature optimization, fusion, and classification	The method is less flexible as compared to multi-stream techniques

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