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Person Re-Identification System Using Facial Recognition: A Literature Survey

Harshit S[1], CyrillVictor[2], Pravin M[3], Ashwin Kumar[4]
Puducherry Technological University, India

Abstract: Person re-identification (ReID) is a critical task in surveillance, security, and access control systems, aiming to consistently recognize individuals across time and varying environments. While deep learning and face-based methods dominate recent advancements, they often face limitations related to computational complexity, dependence on high-quality data, and vulnerability to occlusions, lighting variations, and appearance changes. This literature survey critically evaluates key ReID methodologies, including deep learning-based, face-centric, hybrid, etc. The review highlights the potential of combining landmark-based modeling with real-time vectorization to overcome the scalability and robustness issues of conventional techniques. Future directions include improving landmark detection accuracy, optimizing anthropometric measurement extraction, and validating these methods in diverse real-world scenarios. This survey positions anthropometry as a promising foundation for next-generation, sustainable person re-identification systems.

I. INTRODUCTION

Person re-identification (ReID) refers to the process of recognizing individuals across multiple observations in time and space, often under challenging real-world conditions such as occlusion, pose variations, lighting changes, and evolving appearance. ReID plays a critical role in surveillance systems, public safety, and access control, where consistency and reliability are paramount.

Most modern ReID research focuses on deep learning techniques, particularly convolutional neural networks (CNNs), attention mechanisms, and face-based recognition systems. These approaches remain dependent on high-quality data, intensive computation, and large-scale annotation.

This literature review critically examines existing ReID methods, focusing particularly on deep learning-based techniques, hybrid models, and other systems, while introducing, anthropometry-based person re-identification using vector graphics. Anthropometry, which involves measuring and modeling human body proportions, offers potential advantages such as interpretability, low sensitivity to environmental factors, and enhanced privacy. While existing literature on anthropometry in ReID is limited, this paper positions it as a novel approach for future systems, particularly in long-term, low-cost, and sustainable identification scenarios.

Table 1: Limitations of Current Person Re-Identification Approaches

Category	Approach	Limitations
Deep Learning-Based	CNNs, Transformers, Triplet Loss, etc.	- High computational cost - Requires large labeled datasets - Poor robustness to occlusion and lighting changes
Face-Centric Recognition	FaceNet, ArcFace, Custom CNNs	- Sensitive to resolution and lighting - Performance drops under pose variations and occlusion - Privacy concerns
Multi-Modal Fusion	RGB-Thermal Fusion, Visible-Infrared Matching	- Requires high-quality, multi-modal sensors - Computationally expensive - Fails when modalities are missing
Hybrid &	Combination of	- Complexity increases system overhead

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Multi-Stream Systems	body parts, head, and gait	- Label noise from pseudo-labeling - Not suitable for real-time systems
Biometric-Based (Fingerprint, Iris)	Hardware/biometric fusion	- Requires physical proximity or high-resolution sensors - Security and storage concerns - Limited scalability

II. EXISTING APPROACHES TO PERSON RE-IDENTIFICATION

The literature can be categorized into the following themes:

A. Deep Learning-Based Re-Identification Approaches

1) Applying deep learning image enhancement methods to improve person re-identification

- Description: This paper explores enhancing person re-identification in low-light environments through deep learning-based image enhancement.
- Methodology: Combines the AlignedReID++ architecture with image enhancement techniques such as pre-processing for illumination correction and post-processing for noise reduction. Utilizes domain-specific datasets (TGC20ReId and TGC20lime) and a ResNet50 backbone for feature extraction.
- Limitations: Depends on paired low-light and normal-light images, which are challenging to acquire in real-world settings. Enhancement techniques can introduce visual artifacts, and the domain-specific focus may reduce generalizability.
- Improvement: Employ unsupervised enhancement approaches like Zero-DCE to eliminate the need for paired datasets. Retrain with broader datasets and utilize advanced post-processing tools such as NAFNet. Integrate adaptive quality assessment and domain adaptation techniques.

2) Deep learning-based person re-identification methods: A survey and outlook of recent works

- Description: This survey reviews the evolution of deep learning-based pedestrian re-identification techniques, focusing on trends and challenges in the field.
- Methodology: Categorizes ReID methods into supervised, semi-supervised, and unsupervised learning. Analyzes datasets and performance metrics to evaluate strengths and weaknesses across approaches.
- Limitations: Strong dependence on large-scale annotated datasets. Struggles with occlusion, lighting variability, and limited generalization across real-world environments.
- Improvement: Promote unsupervised and semi-supervised learning approaches to reduce reliance on labeled data. Integrate multi-modal and domain adaptation techniques to improve real-world performance and robustness.

3) Learning discriminative deep features for person re-identification

- Description: This study introduces a deep feature learning framework that enhances ReID performance through discriminative representation.
- Methodology: Uses a multi-branch CNN with a combination of softmax and triplet loss functions to learn identity-specific features. Incorporates multi-scale feature extraction for improved surveillance robustness.
- Limitations: Requires large, labeled datasets and is computationally intensive. Performance drops in extreme viewpoint shifts and occlusion scenarios.
- Improvement: Develop lightweight architectures to minimize resource usage. Introduce self-supervised learning and enhance cross-modal ReID techniques to improve generalizability and efficiency.

4) Low-Rank Multi-Scale Multi-Modal Fusion for Person Re-Identification

- Description: This paper proposes a low-rank multi-scale, multi-modal fusion strategy to enhance person re-identification using different imaging modalities.

- Methodology: Fuses RGB, near-infrared (NI), and thermal infrared (TI) data using deep learning and low-rank constraints to improve feature representation and reduce redundancy.
- Limitations: High computational demand and dependence on high-quality multi-modal datasets. Performance may degrade under extreme illumination or missing modalities.
- Improvement: Explore lightweight fusion methods, employ domain adaptation to enhance generalization, and integrate self-supervised techniques for cases with limited multi-modal data.

5) DSAF: Dual Space Alignment Framework for Visible-Infrared Person Re-Identification

- Description: Introduces the Dual Space Alignment Framework (DSAF) to address modality discrepancies in visible-infrared person re-identification.
- Methodology: Utilizes dual-stream CNNs and a shared feature space to align visible and infrared modalities. Employs cross-space alignment loss and feature distillation for effective learning.
- Limitations: Computationally expensive and sensitive to low-resolution or occluded images. Requires large datasets for training.
- Improvement: Optimize the model for efficiency, improve occlusion robustness, and implement self-supervised learning to reduce dataset dependence.

6) PersonNet: Person Re-Identification with Deep Convolutional Neural Networks

- Description: Presents PersonNet, a deep convolutional network designed for robust end-to-end person re-identification.
- Methodology: Uses a 10-layer CNN to extract features and measure similarity using a metric-learning approach. Incorporates neighborhood difference layers and RMSProp optimization.
- Limitations: Suffers from high training costs and poor performance under occlusion and clutter. Needs extensive labeled datasets for learning.
- Improvement: Reduce complexity through lightweight models, strengthen generalization via data augmentation, and adopt self-supervised learning strategies.

B. Face-Centric and Multi-Biometric Identification

1) Personal identification based on deep learning technique using facial images for intelligent surveillance systems

- Description: This study presents a deep learning-based face recognition system tailored for surveillance using low-resolution images.
- Methodology: Implements a 25-layer CNN architecture for feature extraction and classification. Applies data augmentation techniques such as rotation, flipping, and normalization to enhance performance.
- Limitations: Faces challenges in recognition accuracy due to low-resolution surveillance images and limited dataset size. Pre-trained models are unsuitable, requiring custom architectures.
- Improvement: Increase dataset diversity, optimize for real-time inference, and explore alternative deep models to improve accuracy under varying conditions.

2) Face Recognition and Identification using Deep Learning Approach

- Description: Develops a face recognition and identification system using deep learning for secure authentication applications.
- Methodology: Uses Haar Cascades for face detection and CNNs within a TensorFlow environment for classification. Performance is validated through confusion matrices and real-time tests.
- Limitations: Struggles with low-light accuracy, requires long training durations, and has limited profile-face detection capability.
- Improvement: Improve recognition under low-light by augmenting the dataset, accelerate training time, and extend the system to handle multi-angle face recognition.

3) Arc2Face: A foundation model for ID-consistent human faces

- Description:Proposes Arc2Face, an identity-conditioned face synthesis model preserving ID consistency using facial embeddings.
- Methodology: Utilizes ArcFace embeddings and fine-tunes a Stable Diffusion model on high-resolution facial data for image generation. Identity verification benchmarks assess model fidelity.
- Limitations: Subject to training data bias, high computational demand, and poor performance under extreme pose variation and occlusion.
- Improvement: Expand training diversity, improve computational efficiency, and incorporate augmentation to handle extreme visual scenarios.

4) Enhancing Face Recognition with Latent Space Data Augmentation and Facial Posture Reconstruction

- Description: Introduces Face Representation Augmentation (FRA) to simulate pose variation while preserving identity and emotion.
- Methodology: Uses autoencoders for landmark extraction and latent embeddings, then refines features with Vision Transformers and a multi-task loss.
- Limitations: Relies heavily on high-quality embeddings, is computationally intensive, and may lose subtle facial details during transformation.
- Improvement: Optimize Transformer models for efficiency, adopt self-supervised learning to reduce dependence on labels, and test across more diverse datasets.

5) Personal identification system based on multi-biometric depending on cuckoo search algorithm

- Description: Designs a multi-biometric identification system using facial components and evolutionary algorithms for optimization.
- Methodology: Applies Viola-Jones for face detection, HOG for feature extraction, and a customized Cuckoo Search Algorithm (DCSA) for biometric matching. Utilizes parallel processing to improve performance.
- Limitations: Sensitive to image quality, motion, and facial accessories like glasses. Computational requirements are high.
- Improvement: Improve lighting and occlusion resilience, include more biometric traits, and optimize parallel processing for real-time deployment.

6) Hardware security against IP piracy using secure fingerprint encrypted fused amino-acid biometric with facial anthropometric signature

- Description: Proposes a secure hardware-level authentication scheme using fused amino-acid biometric and facial anthropometry.
- Methodology: Combines fingerprint-encrypted amino-acid signatures and facial landmarks within an AES-based encryption framework. High-level synthesis embeds the system into IP hardware cores.
- Limitations: Computationally heavy due to multi-layer fusion. Requires secure fingerprint storage and lacks defenses against reverse engineering.
- Improvement: Extend encryption to additional biometrics (e.g., iris), improve tamper-proof storage, and integrate hardware obfuscation for piracy protection.

C. Hybrid and Multi-Stream Recognition Systems

1) Enhancing long-term person re-identification using global, local body part, and head streams

- Description: Proposes a long-term person re-identification model that handles appearance changes such as clothing variations by extracting features from multiple body regions.
- Methodology: Implements a three-stream architecture capturing global, local body part, and head features. Uses pseudo-labels for segmentation and integrates multiple loss functions including adversarial and pair-based loss.
- Limitations: Computationally expensive due to the multi-stream setup. Pseudo-labeling can introduce noise, and the head detection pipeline lacks efficiency.

- Improvement: Optimize head detection for real-time use, refine pseudo-labeling strategies to reduce noise, and explore more efficient architectures without sacrificing accuracy.

2) Context-aware person re-identification in the wild via fusion of gait and anthropometric features

- Description: Introduces a context-aware fusion framework using anthropometric and gait features for long-term person re-identification in wild surveillance settings.
- Methodology: Collects Kinect-based data and applies Sequential Forward Selection for optimal feature sets. A fusion strategy combines soft-biometric traits in a context-dependent manner.
- Limitations: Dependent on the quality and availability of Kinect sensors. Computationally demanding and potentially limited in generalizability due to small dataset size.
- Improvement: Increase dataset diversity, improve the computational efficiency of the framework, and explore additional soft-biometric inputs to enhance accuracy.

3) Pose-invariant embedding for deep person re-identification

- Description: Presents a pose-invariant feature embedding system to improve robustness in deep person re-identification tasks.
- Methodology: Uses a multi-branch CNN along with a human pose estimation module to align features across varying poses.
- Applies metric learning for stronger identity discrimination.
- Limitations: High computational load due to the multi-branch architecture and large dataset requirements. Performance still affected by extreme pose and partial occlusion.
- Improvement: Introduce lighter-weight models to reduce complexity, enhance pose-alignment mechanisms, and incorporate self-supervised training methods to limit dependence on annotations.

D. Anthropometry-Based and Ergonomic ReID Research

1) Anthropometric Vision System for Measuring the Windlass Mechanism During the Gait Cycle

- Description: Proposes an Anthropometric Vision System (AVS) for measuring foot biomechanics, specifically the Windlass mechanism, during the gait cycle.
- Methodology: Uses a dot product-based landmark detection algorithm and high-speed cameras to measure the Medial Longitudinal Arch (MLA) and Metatarsophalangeal Joint Angle (MJA) in real-time. Validates results against Kinovea software and ground-truth measurements.
- Limitations: System performance is impacted by lighting variability, calibration errors, and camera resolution, which affects frame rate and accuracy.
- Improvement: Enhance lighting adaptation and calibration robustness, utilize high-frame-rate cameras, and apply machine learning for more reliable landmark tracking.

2) A comparative anthropometric analysis of U.S. female firefighters versus the general female population

- Description: Analyzes anthropometric differences between female firefighters and the general female population to assess fit and ergonomics of protective gear.
- Methodology: Combines 3D body scanning with traditional anthropometric measurements and applies PCA to identify key differences. Compares results to NHANES population data.
- Limitations: Limited to U.S.-based subjects, which may reduce generalizability. No in-field validation of gear fit. Fitness level variability may skew measurements.
- Improvement: Expand sampling to include diverse regions and populations, design adjustable gear based on findings, and conduct real-world usability testing.

3) *Validation of a 3D whole-body scanning system to collect anthropometric data from a working-age population for ergonomic design*
- Description: Validates the Vitus Bodyscan 3D whole-body scanner for anthropometric data collection in working-age adults for ergonomic design applications.
- Methodology: Compares scan-based measurements with manual measurements per ISO 20685-1. Uses color landmarking and statistical analysis (Bland-Altman) to evaluate accuracy.
- Limitations: Posture inconsistencies, lighting issues, and scanner resolution can influence accuracy. The Anthroscan algorithm is a proprietary black box, limiting transparency.
- Improvement: Develop posture correction algorithms, adopt machine learning-based landmarking, and expand testing across more varied demographic groups.

E. Forensic and Descriptive ReID Techniques

1) *Forensic facial reconstruction: an anthropometric study of the ear*
- Description: Conducts an anthropometric study of the ear to improve forensic facial reconstruction (FFR) through accurate estimation of ear size, position, and inclination.
- Methodology: Uses both manual and photographic measurements from 99 Brazilian participants. Establishes 18 anatomical correlations between ear dimensions and cranial landmarks for FFR use.
- Limitations: The dataset is population-specific, which may limit generalizability. Variability in ear morphology across ethnicities and photographic distortion can affect accuracy.
- Improvement: Expand the dataset to include global population samples, develop automated ear recognition models, and enhance 3D modeling for more realistic reconstructions.

2) *Appearance descriptors for person re-identification: A comprehensive review*
- Description: Offers a comprehensive review of appearance-based descriptors in person re-identification, especially in video surveillance systems.
- Methodology: Surveys descriptor types including part-based models, local/global features, and fusion techniques. Discusses metric learning and body modeling approaches for ReID.
- Limitations: Appearance descriptors struggle with illumination, pose, and occlusion variability. Clothing-based features are limited for long-term identification due to frequent changes.
- Improvement: Integrate appearance descriptors with gait or anthropometric features for higher stability. Develop adaptive models that handle extreme variations in viewpoint and occlusion.

III. CONCLUSION

The review reveals that while deep learning and face-based identification dominate current ReID literature, they often face challenges in scalability, privacy, and robustness to real-world variation. Hybrid models improve accuracy by combining multiple feature streams, yet they introduce computational overhead and label noise. Studies exploring anthropometry and soft-biometrics represent a promising direction for long-term, low-cost, and privacy-respecting person re-identification.

Anthropometric modelling, particularly when combined with vector graphics and landmark detection, offers a stable and interpretable alternative to conventional methods. Future research should focus on refining anthropometric measurements, improving landmark detection, and validating these systems across diverse populations and conditions. Integrating these with real-time vectorization and motion-aware analytics can form the backbone of sustainable ReID systems.

REFERENCES

[1] Ackermann, A., Wischniewski, S., Bonin, D., Gaida, A.-K., & Jaitner, T. (2025). Validation of a 3D whole-body scanning system to collect anthropometric data from a working-age population for ergonomic design. International Journal of Industrial Ergonomics, 105, 103698.
[2] Fugiwara, F. V. G., Vassallo, F. N. S., Moritsugui, D. S., Mazzilli, L. E. N., & Melani, R. F. H. (2025). Forensic facial reconstruction: an anthropometric study of the ear. Australian Journal of Forensic Sciences, 57(1), 142–153. https://doi.org/10.1080/00450618.2024.2306679
[3] Hashemifar, S., Marefat, A., Hassannataj Joloudari, J., & Hassanpour, H. (2024). Enhancing Face Recognition with Latent Space Data Augmentation and Facial Posture Reconstruction. Journal of Computer Vision and Artificial Intelligence, 15(2), 112–128.
[4] Jiang, L., Wu, A., Ouyang, W., Xu, J., & Zheng, W.-S. (2023). Low-Rank Multi-Scale Multi-Modal Fusion for Person Re-Identification. Pattern Recognition, 144, 109020.

[5] Jiang, L., Wu, A., Xu, J., & Zheng, W.-S. (2023). DSAF: Dual Space Alignment Framework for Visible-Infrared Person Re-Identification. IEEE Transactions on Image Processing, 32, 1234–1248.

[6] Ming, Z., Zhu, M., Wang, X., Zhu, J., Cheng, J., Gao, C., Yang, Y., & Wei, X. (2022). Deep learning-based person re-identification methods: A survey and outlook of recent works. Image and Vision Computing, 119, 104394.

[7] Nambiar, A., Bernardino, A., Nascimento, J. C., & Fred, A. (2017). Context-aware person re-identification in the wild via fusion of gait and anthropometric features.Proceedings of the IEEE International Conference on Computer Vision Theory and Applications (VISAPP), Porto, Portugal.

[8] Papantoniou, F. P., Lattas, A., Moschoglou, S., Deng, J., Kainz, B., & Zafeiriou, S. (2024). Arc2Face: A foundation model for ID-consistent human faces.arXiv preprint arXiv:2403.11641.

[9] Park, J., Kino, S., & Hsiao-Wecksler, E. T. (2023). A comparative anthropometric analysis of U.S. female firefighters versus the general female population.Applied Ergonomics, 110, 103664.

[10] Pham, V.-H., Tran, D.-P., & Hoang, V.-D. (2020). Personal identification based on deep learning technique using facial images for intelligent surveillance systems. International Journal of Machine Learning and Computing, 9(4), 465–470. https://doi.org/10.18178/ijmlc.2020.9.4.827

[11] Rodríguez-Quiñonez, J. C., Trujillo-Hernández, G., Flores-Fuentes, W., Castro-Toscano, M. J., Sergiyenko, O., Hernández-Balbuena, D., & Murrieta-Rico, F. N. (2025). Anthropometric Vision System for Measuring the Windlass Mechanism During the Gait Cycle. Biomedical Signal Processing and Control, 103, 107405.

[12] Santana, O. J., Lorenzo-Navarro, J., Freire-Obregón, D., Hernández-Sosa, D., & Castrillón-Santana, M. (2024). Applying deep learning image enhancement methods to improve person re-identification.Neurocomputing, 598, 128011.

[13] Sarfraz, M. S., Schumann, A., Eberle, A., & Stiefelhagen, R. (2018). Pose-invariant embedding for deep person re-identification.IEEE Transactions on Image Processing, 27(1), 303–312.

[14] Satta, R. (2013). Appearance descriptors for person re-identification: A comprehensive review.arXiv preprint arXiv:1307.5748.

[15] Sengupta, A., Anshul, A., & Singh, A. K. (2024). Hardware security against IP piracy using secure fingerprint encrypted fused amino-acid biometric with facial anthropometric signature.Microprocessors and Microsystems, 112, 105131.

[16] Teoh, K. H., Ismail, R. C., Naziri, S. Z. M., Hussin, R., Isa, M. N. M., & Basir, M. S. S. M. (2021). Face Recognition and Identification using Deep Learning Approach.Journal of Physics: Conference Series, 1755(1), 012006. https://doi.org/10.1088/1742-6596/1755/1/012006

[17] Thanh, D. T., Lee, Y., & Kang, B. (2024). Enhancing long-term person re-identification using global, local body part, and head streams. Neurocomputing, 580, 127480.

[18] Wu, L., Shen, C., & van den Hengel, A. (2016). PersonNet: Person Re-Identification with Deep Convolutional Neural Networks. arXiv preprint arXiv:1601.07255.

[19] Younis, A. N. (2021). Personal identification system based on multi-biometric depending on cuckoo search algorithm. Journal of Physics: Conference Series, 1879(1), 022080.

[20] Zhao, L., Xie, F., Xing, J., Wu, X., Yan, J., & Tian, Q. (2017). Learning discriminative deep features for person re-identification.IEEE Transactions on Pattern Analysis and Machine Intelligence, 39(3), 365–379.