Deep Learning-Based Gait Recognition Using Smartphones in the Wild

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Introduction

- **Description:** The proposed method collects inertial gait data under unconstrained conditions without knowing when, where, and how the user walks
- **Primary objective:** To obtain good person identification and authentication performance using deep-learning techniques that learn and model the gait biometrics based on walking data
- **Possible further applications (significance & impact):** Health Sciences - to detect early-stages of motor-neuron diseases, Sports industry, Security - intoxication detection

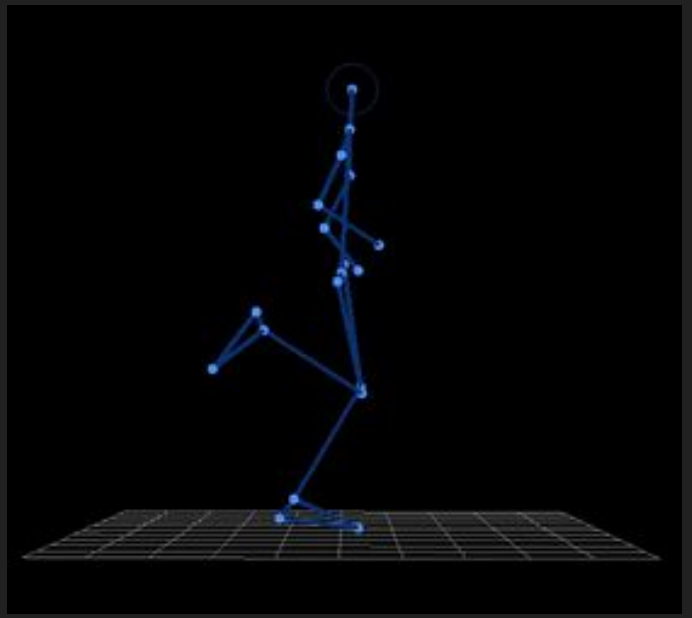

Fig. 1: Gait Modeling

Specific References

1. The original paper was presented in the IEEE Transactions On Information Forensics And Security, Vol. 15, 2020

2. Datasets: This project comprises of 8 sets of data. Datasets 1 to 6 are used for Person Identification and Authentication, and datasets 7 and 8 are for Gait data segmentation. The dataset is available for download on github.

3. System Requirements: Data Collection - Android Smartphone, Training Network - PyTorch 0.4.0, Python 3.6, CUDA 8.0, Intel Core Xeon E5-2630@2.3GHz, 64GB RAM and two GeForce GTX TITAN-X GPUs.

4. Code: The code is mostly written in python. The gait data extraction is done using tensorflow.

Solution Approach

1. Inputs: Inertial Measurement Unit data from smartphone (gyroscope and accelerometer)
2. Outputs: Gait classification
3. Deep Networks: LSTM based (SL-LSTM, Bi-LSTM, DL-LSTM), CNN based, and CNN+LSTM based network structures.
4. Optimizers: Adam optimizer using a learning rate of 0.0025
5. Performance measures:
    a. Performance of Traditional Methods: The classification results of Fourier, Wavelet, and EigenGait are shown. Fourier-transform method works best with an accuracy of 81.55% and 93.64%
    b. Performance on Deep Learning Methods: Seven deep learning methods were used for the task and their accuracy was compared to show that CNN+LSTM network works best on all datasets

Solution Approach

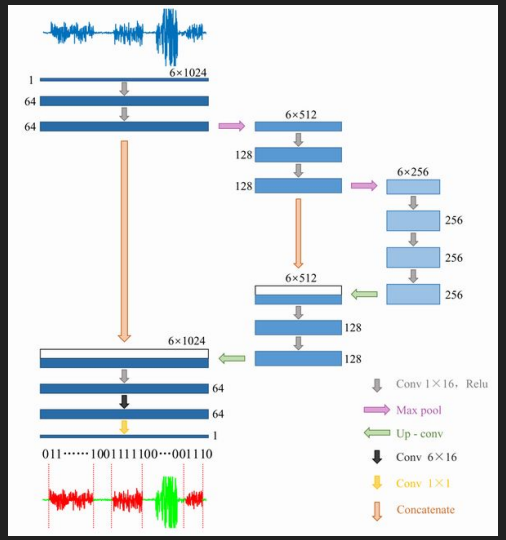

Fig.2: Gait data Extraction

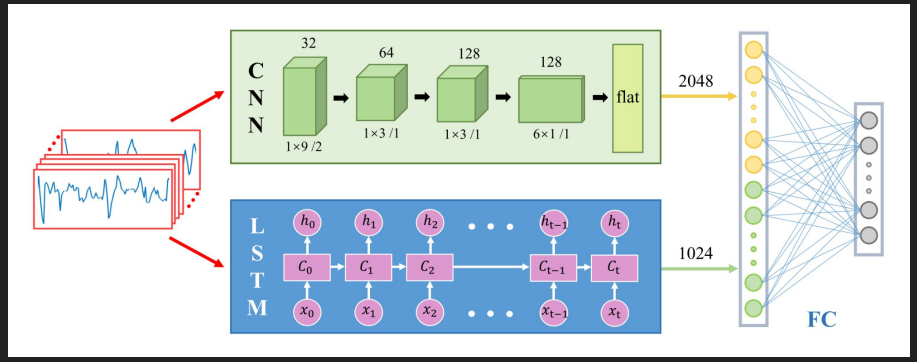

Fig. 3: Gait Identification

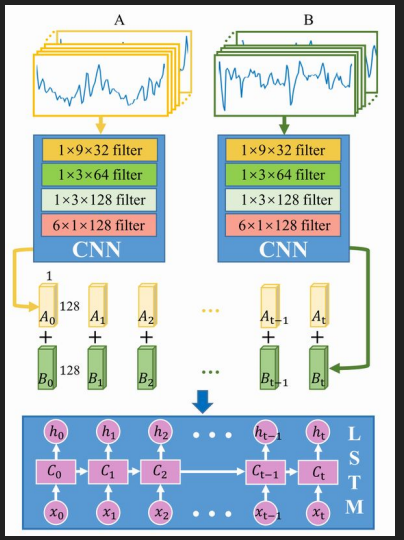

Fig. 4: Gait Data Authentication

Results

1. Gait-Extraction:

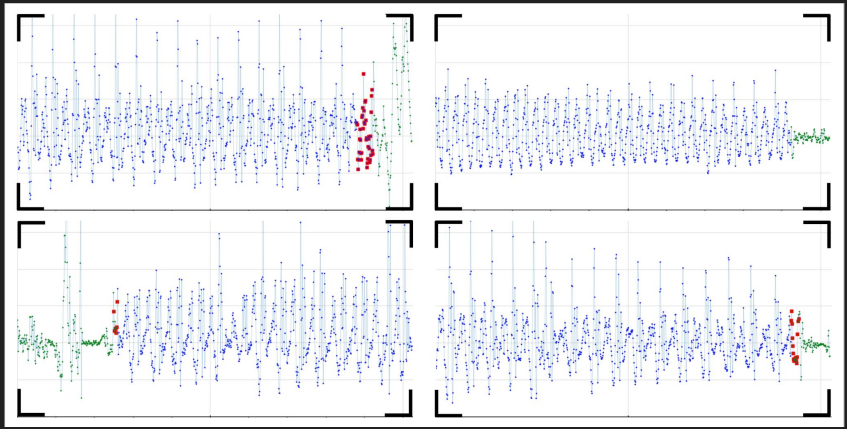

Fig. 5: Examples of walking data extraction

2. Gait-Identification:

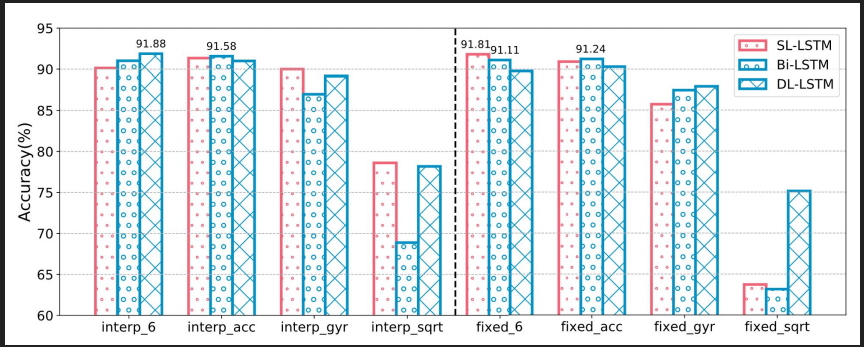

Fig. 6: Performance of different LSTM networks

Results

3. Gait-Authentication:

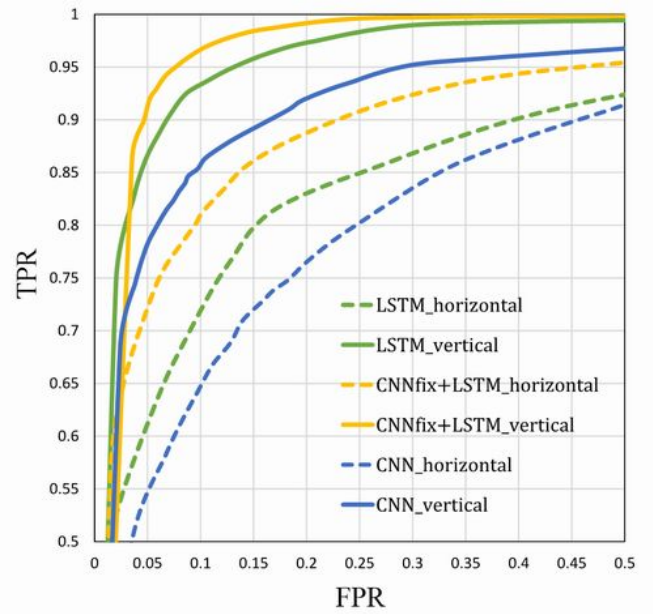

Fig. 7: ROC curves of six deep-learning-based authentication methods

Justification for chosen Reference

- Venue of Publication: This paper was published in the IEEE Transactions on Information Forensics and Security, Vol. 15, in 2020.

- The work for this project involves the literature review of papers published in the International Joint Conference on Biometrics, IEEE Transactions on Systems, Man, and Cybernetics, European Conference on Computer Vision and Pattern Recognition, etc.

- Comprehensive results and discussions: The model effectively performed segmentation between walking and non-walking data with an accuracy of 90.22%. The CNN+LSTM deep learning network performs classification and authentication with the highest accuracy on all datasets.

Questions?

Thank You!