Human Activity Recognition Using Neural Networks

Overview

- Objective
- Dataset
- Data Analysis
- Modeling Approach
- Results
- Recommendations
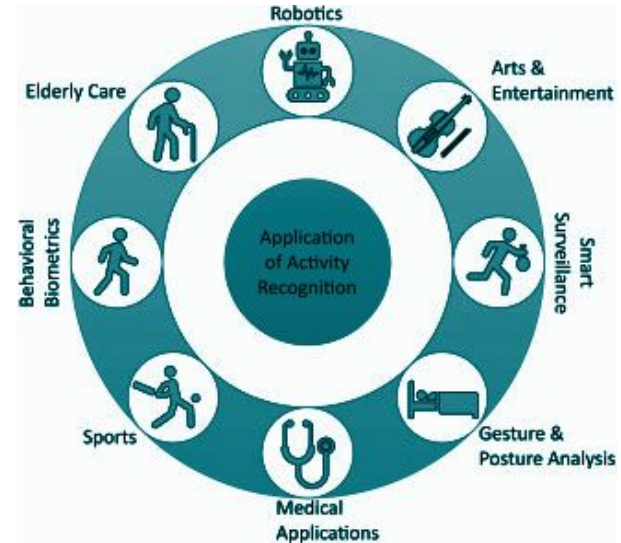- Limitations

Objective

What is Human Activity Recognition?

A technology that uses sensors and machine learning to identify and categorize human actions.

Focus of this work

Develop a neural networks model that can use raw time-series data from accelerometers to classify activities.
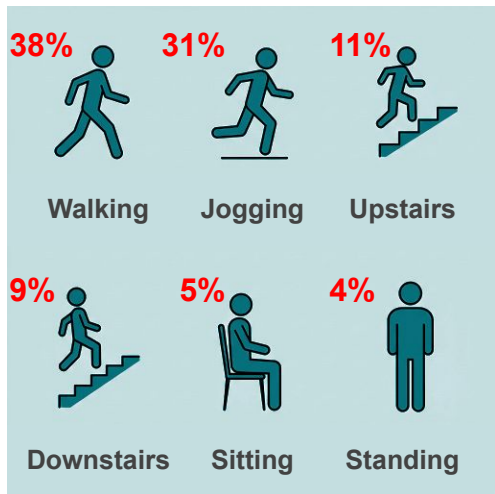

Yadav et al., 2021

Dataset

- **Reference:** *Jennifer R. Kwapisz, Gary M. Weiss and Samuel A. Moore (2010). Activity Recognition using Cell Phone Accelerometers. -*
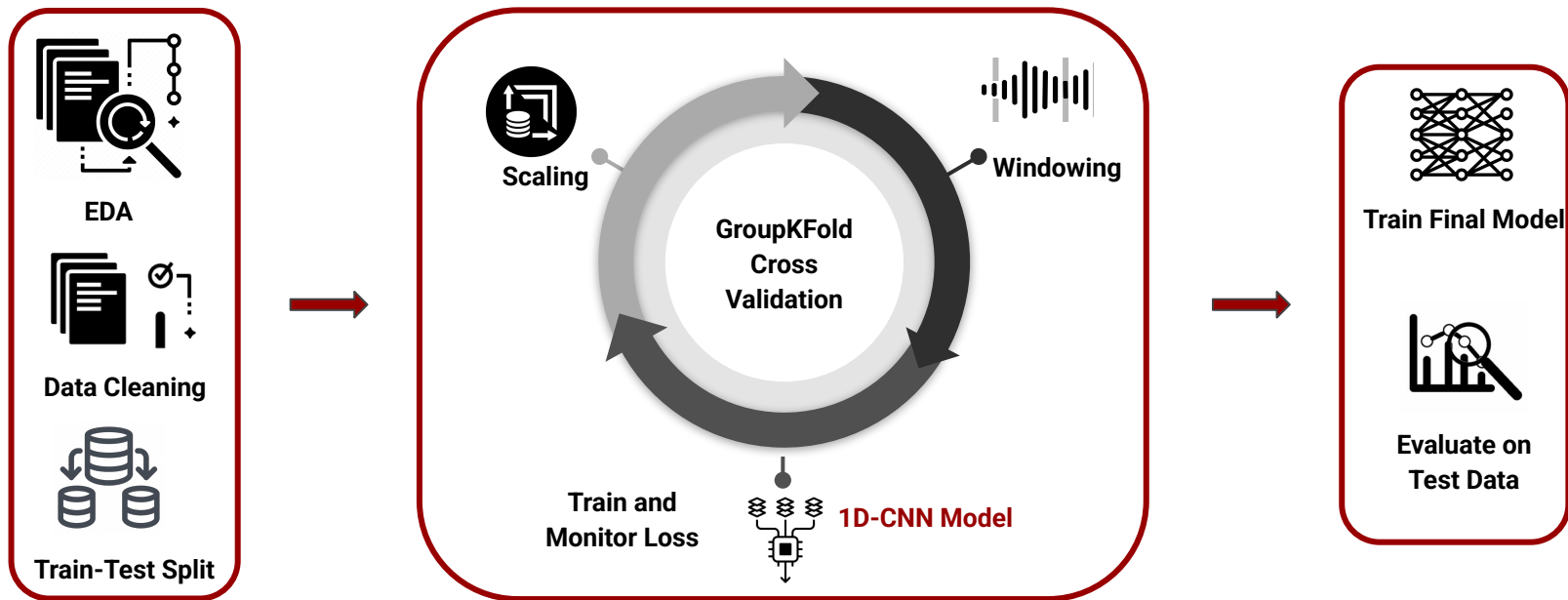
38% Walking
31% Jogging
11% Upstairs
9% Downstairs
5% Sitting
4% Standing

Created by Gemini 2.0
%s are not exact.

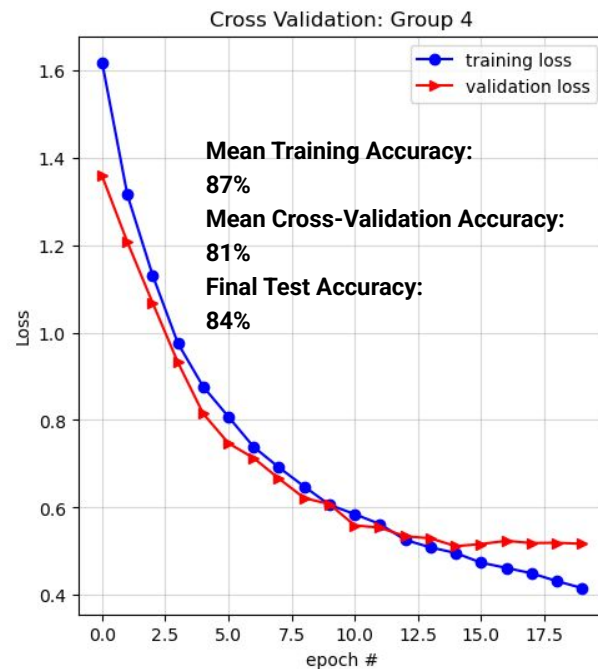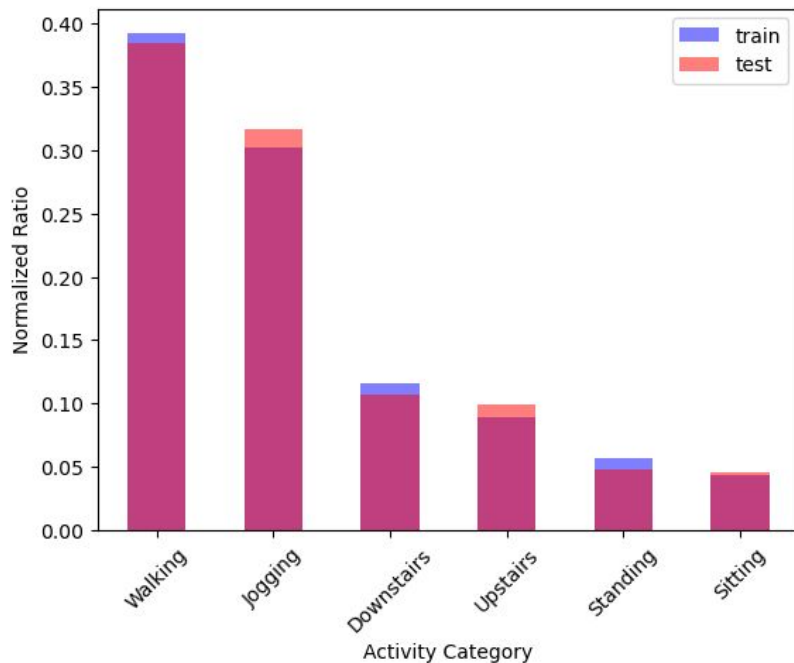|	**Raw Time Series**	**Transformed**
# of Entries	1098208	5000
# of Features	3	43

Modeling Approach

- The transformed data was used to train a **baseline logistic regression** model (considering *class imbalance*) that serves as a baseline model. Weighted average F1 score: **70%.**
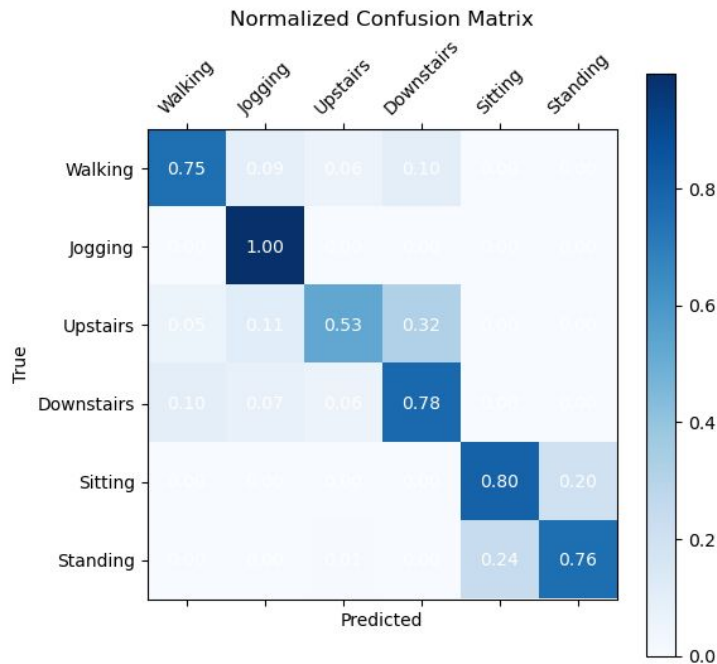

EDA

Data Cleaning

Train-Test Split

Scaling

Windowing

GroupKFold Cross Validation

Train and Monitor Loss

1D-CNN Model

Train Final Model

Evaluate on Test Data

Modeling Approach - Cont'd

Mean Training Accuracy:
87%
Mean Cross-Validation Accuracy:
81%
Final Test Accuracy:
84%

Results

Normalized Confusion Matrix

- Average weighted F1-score: 83%
- Improvement wrt. baseline model: +13%
- Upstairs often misclassified as downstairs but not the other way round (directional asymmetry)
- Average cross-validation time: ~10 minutes
- Average final train time: ~4 minutes
- Average inference time: ~0.2 ms

Limitations & Next Steps

- Combining similar classes to increase performance (sitting & standing, upstairs & downstairs)
- More systematic hyperparameter tuning
- Personalization