Accenture Student Research Project

Smartphone-Based Gait Recognition

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Outline

General Idea

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Application

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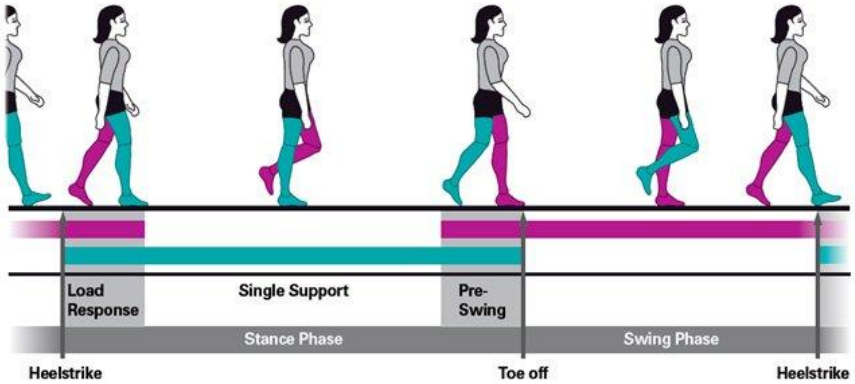
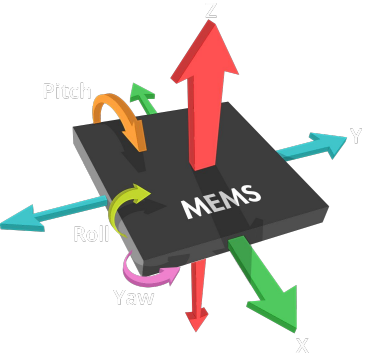
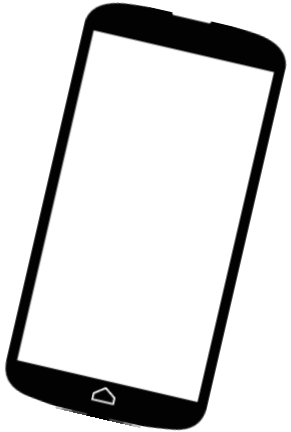


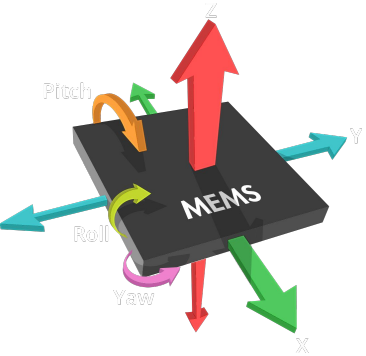


General Idea



Approaches

- Camera/Video-based
- Floor-sensor based
- **Inertial Sensors based**



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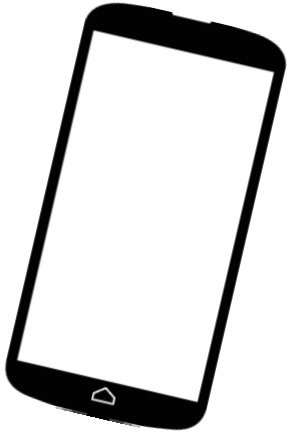

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Usage

- Healthcare
- Sports
- **Security - access control system**

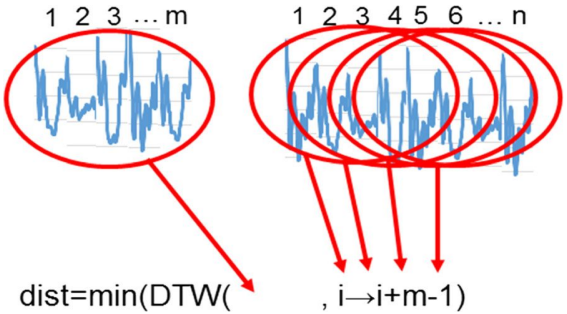
Objectives

- Access Control System
  - Feature extraction library
  - Machine learning algorithm
  - Data collection - Android application

Related Works

MARSICO - 2017 (Univ. Sapienza, Rome)

- Dynamic Time Warping
- 8,9% EER(ZJU-GaitAcc)



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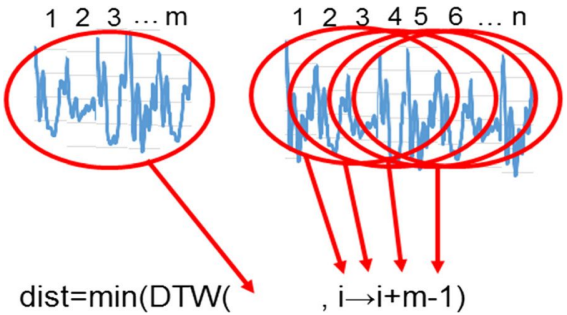
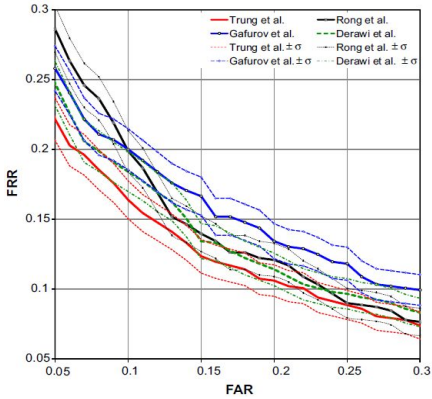
- period detection
- accelerometer > gyroscope





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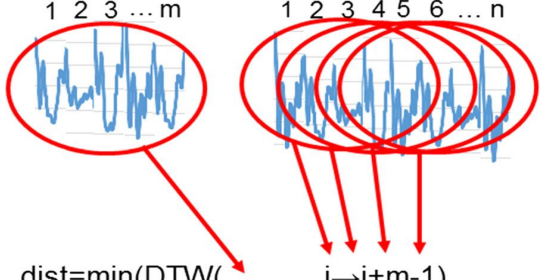
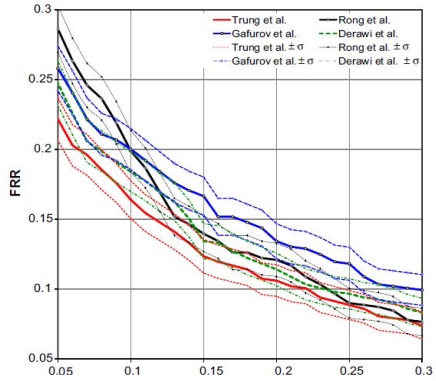
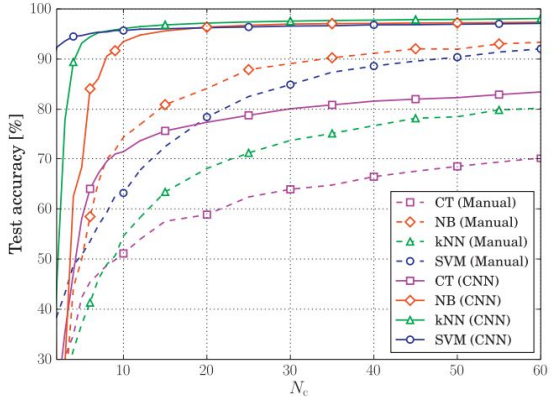
GADALETA - 2018 (Univ. Padova)

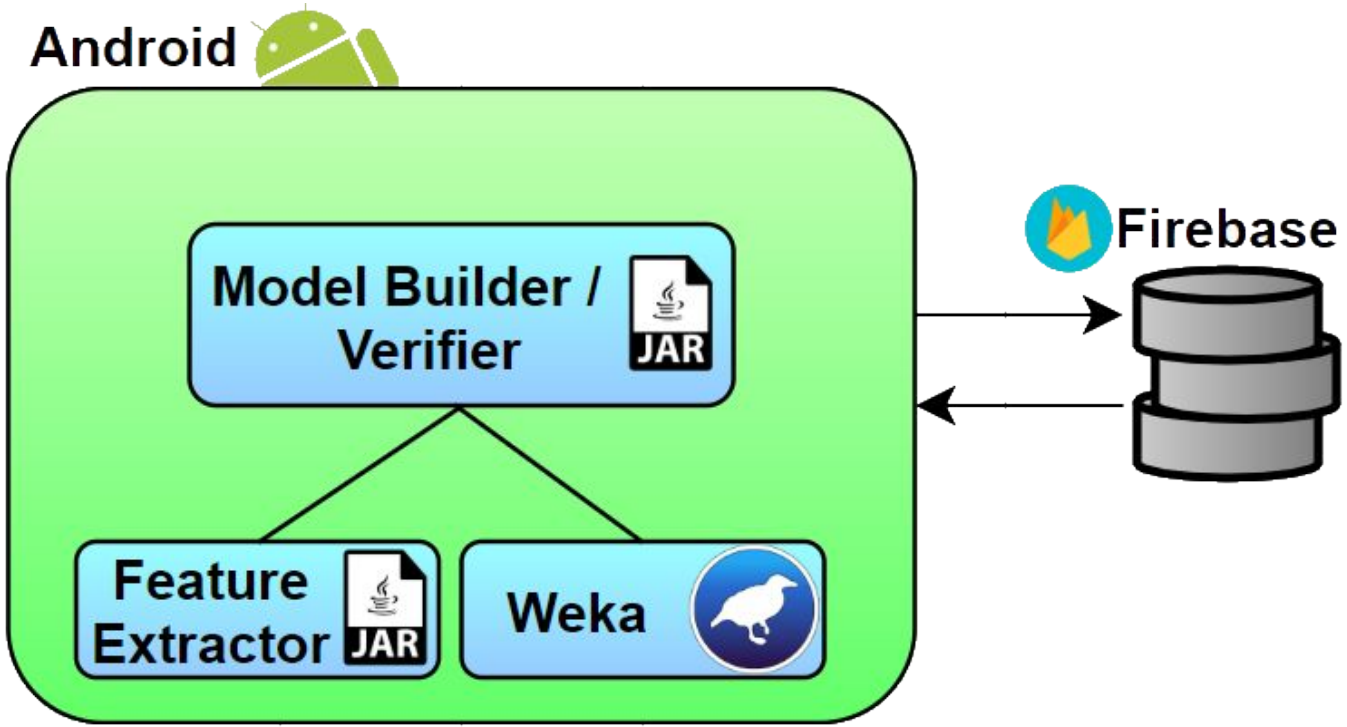
- feature extraction
- **IDNet** dataset





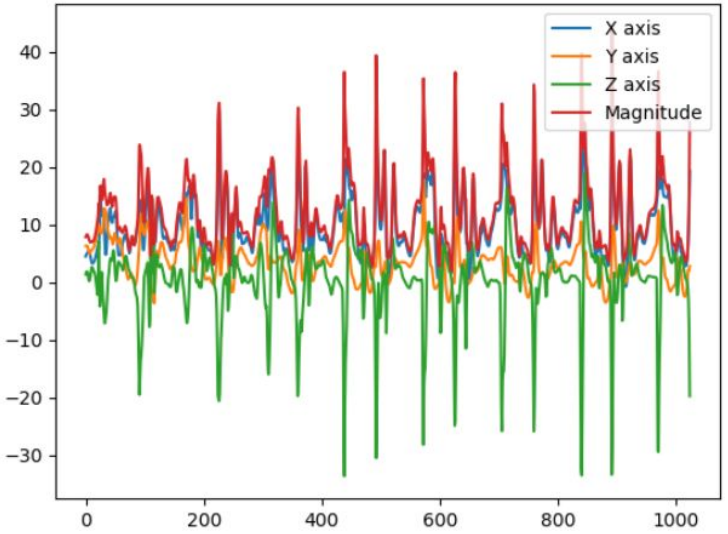


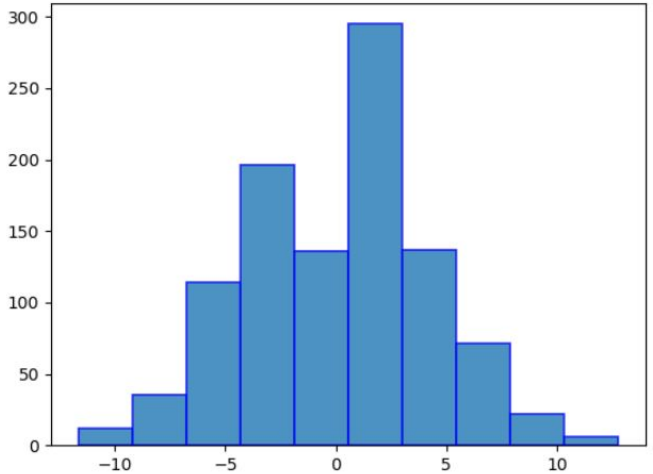
Application



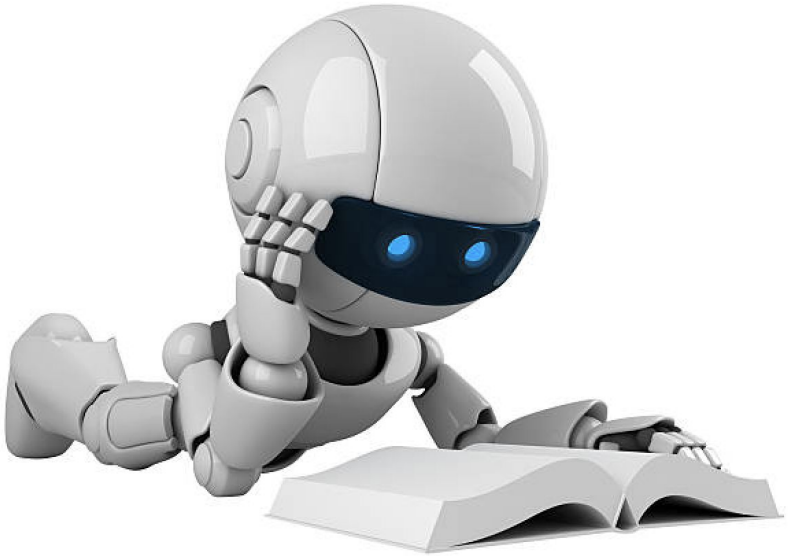
I. Feature Extraction

- minimum points
- mean values
- standard deviations
- mean absolute differences
- zero crossing rates
- histograms





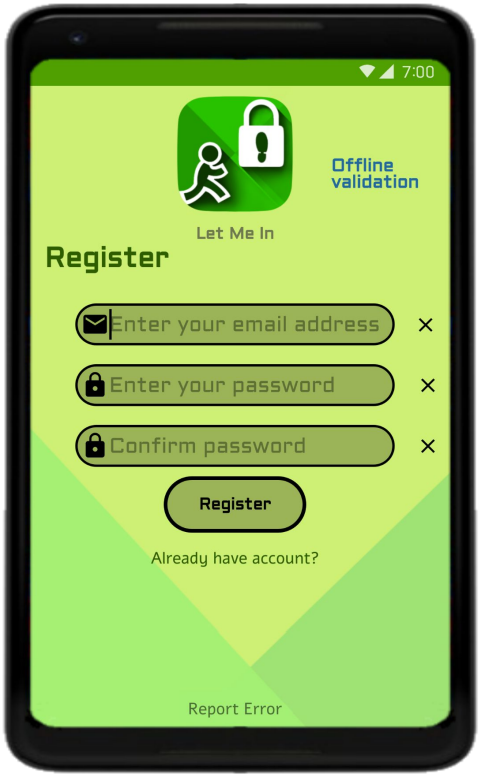
II. Machine-Learning



- Weka library
- Binary classifier
- Model creation
- Validation

III. Android application

- App with friendly UI
- User registration and login
- Raw data collecting
- Model generation
- User validation
- Storing data in Firebase



RESULTS

1. GAIT CHANGES OVER TIME

ML Alg.	Training	Testing	Prec.	AUC	EER
KNN	S1	S1	0,93	0,96	0,06
KNN	S1	S2	0,80	0,86	0,16
RF	S1	S1	0,94	0,98	0,04
RF	S1	S2	0,71	0,87	0,15

Dataset:
- ZJU-GaitAccel
- **153** users, 2 sessions
  - **S1**: session1
  - **S2**: session2
- Fs = 100 Hz

Binary classifiers:
- balanced training data

Validation:
- one step cycle

RESULTS

2. STEP CYCLES VS. FIXED-LENGTH FRAMES

Unit	Training	Testing	Prec.	AUC	EER
Cycle	**S1**	**S1**	0.94	0.98	0.04
128 samples	**S1**	**S1**	0.94	0.98	0.05
Cycle	**S1**	**S2**	0.71	0.87	0.15
128 samples	**S1**	**S2**	0.74	0.87	0.16

Random Forest classifier

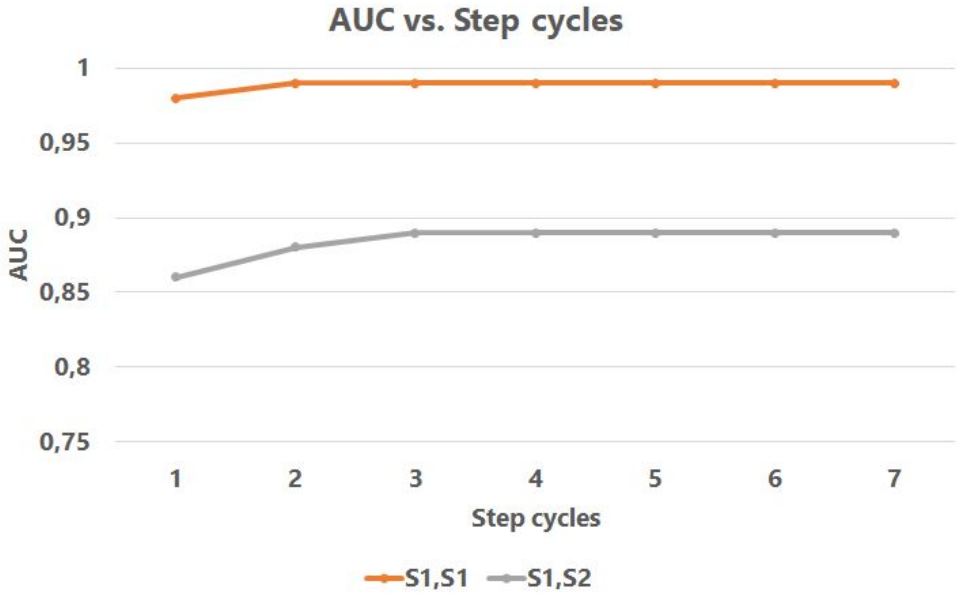
- balanced

Verification - 1 unit:

- one step cycle
- 1 frame (128 samples)

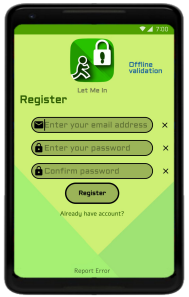
RESULTS

3. Required number of step cycles for validation



Random Forest Classifier

- balanced training data
- validation: 1 - 7 step cycles

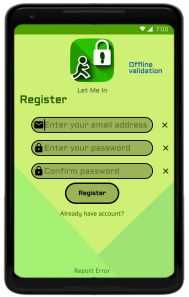


Summary

1. **Cross-session** evaluation:
   precision decreases with 10 - 20%

2. Using frames ≈ Using step cycles

3. Minimum **5 step cycles** for reliable result



Summary

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- Students' Scientific Conference, **April 13-14, 2018**, Târgu Mureş (3rd place)
- SZAMOKT XXVIII., **October 11-14, 2018**, Băile Tuşnad, Romania, pp. 118-123.

THANK YOU accenture FOR SUPPORT!