

Tremplin Recherche 2025/2026 – Project Proposal

Project title

Smartphone Sensors for Floor-Change Detection and Prediction Using Machine Learning

Laboratory / Institution

AME- GEOLOC Laboratory – Université Gustave Eiffel (Nantes campus)

Supervisor (name and email)

Dr. Pavel PASCACIO DE LOS SANTOS – pavel.pascacio-de-los-santos@univ-eiffel.fr

Targeted students

Level: E4 (M1)

Specializations:

Artificial Intelligence & Cybersecurity

Data Science & Artificial Intelligence

General presentation of the topic

Accurately recognizing and predicting subtle floor-change activities—such as stair climbing, elevator use, or escalator riding—is crucial for multi-level pedestrian navigation, particularly in Global Navigation Satellite System-denied environments [1]. Smartphones, equipped with inertial sensors and magnetometers, offer a practical platform for detecting these transitions using machine learning [2]. However, floor changes are brief and produce noisy signals, making reliable classification challenging. Variability in smartphone placement, individual movement patterns, and environmental factors further complicate recognition [3]. Additionally, collecting and labeling datasets for these fast transitions is resource-intensive, and real-time user labeling can disrupt natural movement.

This project addresses these challenges by collecting real-world floor-change data with a smartphone app, pre-processing and extracting features, and training machine learning models for robust recognition and prediction of subtle transitions in multi-level pedestrian navigation.

Project objectives

- **Collect real-world floor-level activity data** (stairs, elevators, escalators) through a dedicated smartphone application.
- **Implement data analysis and preprocessing pipelines** to extract meaningful features from inertial, magnetic, and barometric sensors.
- **Develop and train machine learning/AI models** to enhance the robustness of floor-change activity classification.
- **Extend the models to predict upcoming floor-change activities**, enabling proactive updates in multi-level pedestrian navigation systems.

Expected learning outcomes:

- **Learn how to collect and manage real-world sensor data** (floor-change activities) using a smartphone app.
- **Gain experience in data cleaning, preprocessing, and feature extraction** for activity recognition tasks.
- **Develop skills in training and evaluating machine learning models** for classification and prediction.
- Understand challenges of subtle activity transitions and **how to improve model robustness**.
- Acquire knowledge on **applying predictive models to pedestrian navigation systems**.

Bibliography

- [1] Pascacio, Pavel, Thomas Bonis, and Valerie Renaudin. "Anticipating Pedestrian Movements: Future Activity Prediction for Floor-Change Scenarios." 2025 IEEE/ION Position, Location and Navigation Symposium (PLANS). IEEE, 2025.
- [2] Wang, Qu, et al. "Recent advances in pedestrian navigation activity recognition: A review." IEEE Sensors Journal 22.8 (2022): 7499-7518.
- [3] Chen, Yufei, and Chao Shen. "Performance analysis of smartphone-sensor behavior for human activity recognition." IEEE Access 5 (2017): 3095-3110.