Fraunhofer
PORTUGAL

SMARTRANS

SMARTPHONE-BASED TRANSPORT MODE DETECTION FOR ELDERLY

Objectives

The project aim is to detect the most common transport mode of elderly people including whether an individual is inactive, walking, in bus, in car, in train or in metro by using the accelerometer sensor signals as the main data source and also using Wi-Fi access points available in public transports to improve the system performance.

In addition, the device used to obtain the transport mode can't be obstructive and big, as it would bring demotivation to its usage. So, it is necessary that this detection is done by a small, practical and convenient device with capabilities to send the information obtained to the caregivers.

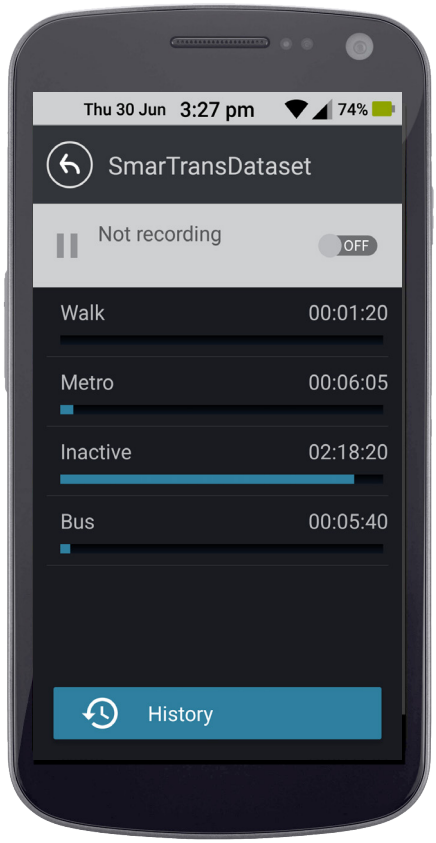

Fig1. Android application's UI.

Motivation

The main motivation behind this project is the implementation of a system capable of Human Activity Recognition (HAR), allowing the caregiver, a kin or a medic, to assist the elderly people by checking their daily activities and learning the person's daily activity habits. Detecting the transport mode is an important HAR tool, as it allows the caregivers to perceive the elder health condition, possible advances or deterioration over time.

Both, Google and Intel, developed an activity recognition Application Programming Interface (API) to facilitate the development of context-aware applications, with 80,33% and 48,74% accuracies respectively. These API's don't differentiate between different types of vehicles and detect other activities, such as running and biking. Due to the low accuracy rate of these implementations it is necessary to build a more robust system.

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Features

- Integration with Smart Companion
- Integration with MoverLib
- Detection of the transport mode
- Update data to server in real time
- Track the elder activities from the Android app and the website

MoverLib integration

- Accelerometer data and feature calculation obtained from this Lib
- Usage of the inactive classification
- Using the stance classification to distinguish between sitting and standing

Results

Several classifiers were evaluated and the decision tree, with 95,6% accuracy, outperforms both Naïve Bayes and Support Vector Machine classifiers with 92,4% and 61,9% accuracy, respectively.

Future Work

- Detecting the initial acceleration of each transport mode to improve overall classification
- Test the system performance with a group of users

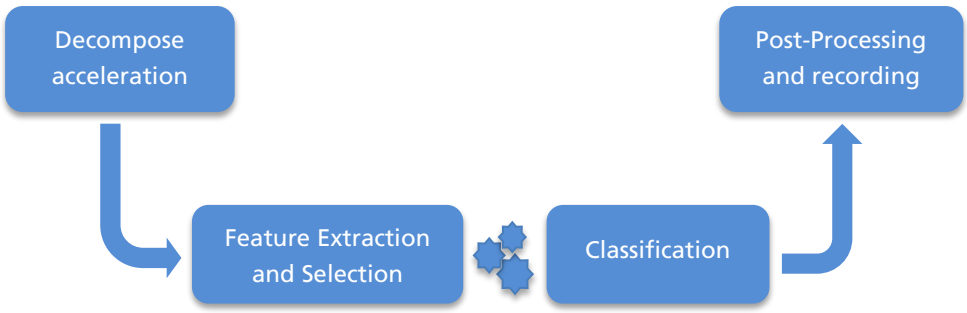

Fig2. Overall system pipeline.

System Architecture

Smartphones are everywhere, and they are a very attractive platform to perform unobtrusive monitoring of users. In this project, common features of modern smartphones are used to build an HAR system for elderly care.

The dataset created for testing and evaluation was obtained from the accelerometer sensor using over 24 hours of transportation data from a group of 15 individuals. The data was collected with a frequency of 33,33Hz and was divided in segments of 5 seconds. For each segment, a total of 357 features were calculated and then, with the help of the Weka tool, selected the most relevant attributes, decreasing the number of features from 357 to 40.

The output obtained from Weka result was implemented in the Android application. The MoverLib developed by Fraunhofer Portugal AICOS is also used in the system to prevent the detection of transport activities while the user is inactive and to detect if the user is standing or sitting within the transport.

The calculated predictions obtained from the classifier are then post-processed in order to avoid false classifications. The Access Points located in some public transports, such as in buses and in trains can also be used to improve the classification by inferring that is highly possible that the user is using that transport. The last minute of classifications and Wi-Fi detection is saved and some post-processing is performed avoiding miss classifications. A weight is given to both the classified transport and the Wi-Fi Access points detected in order to determine the user mode of transport.

Conclusions

Relying on the power and ubiquity of modern smartphones for HAR purposes is a very attractive proposition that previous researchers have explored. In this project, is presented the development of a classifier for transport mode detection that uses the smartphone accelerometer sensor and wireless communication capabilities. The final goal is to embed the classifier in an application for elderly care, that can be used by care givers and alike to learn about the daily activity patterns of elderly people.