Fraunhofer
PORTUGAL

mActivityClassify

MOBILE REAL-TIME CLASSIFICATION OF ACTIVITIES OF DAILY LIVING IN POST-STROKE PATIENTS

Introduction

A stroke or a cerebrovascular accident consists of a blockage or rupture of the blood flow to the brain and it is nowadays the third largest cause of death in Europe, Japan and the USA. Per year, more than 750.000 people have a stroke and, from those, 200.000 do not survive. In most cases, stroke survivors are forced to live the rest of their lives with serious impairments in one or more parts of the body. In order to decrease the impact of these physical impairments, stroke rehabilitation must be conducted as soon as possible. In this kind of rehabilitation there is a special focus on stroke patients relearning physical and cognitive skills that were lost due to the stroke.

The stroke rehabilitation is conducted according to the therapist's practical experience. Therefore, we may conclude it would be useful to have an extra source of information, preferably quantitative data, about patients' daily activity, gathered outside the health facility.

Fig1. Overview of the mActivityClassify system and devices used.

Monitoring System

For this project, following a reunion with a stroke therapist, two activities of daily living were identified as being useful for detection by the algorithm: sitting/standing and eating. The objective of this system is to detect and monitor these activities. A dataset was collected comprising 26 individuals.

Contact

Rua Alfredo Allen, 455
4200-135 Porto, Portugal

+351 220 430 300
info@fraunhofer.pt
www.fraunhofer.pt

Dataset

For this project, data from a dataset of 26 individuals was collected. This dataset had 18 elderly people.

Computed Metrics

- Total time standing
- Total time sitting
- Number of sit/stand transitions
- Total time active
- Total time inactive
- Number of eating movements

Future Work

- Use only the smartwatch
- Explore other activities
- Collect dataset in unsupervised ambient
- Develop mobile app for the stroke therapist

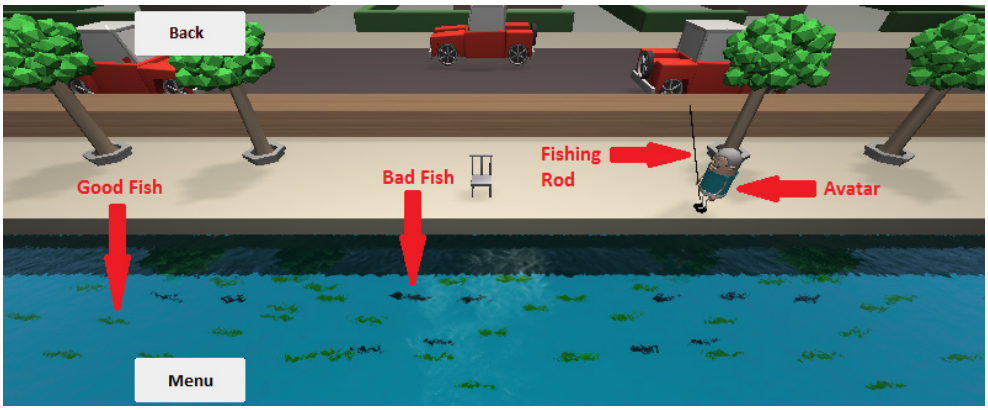

Fig2. Example of the exergame graphical interface.

Each individual performed a total of 6 sitting/standing transitions and 20 eating movements (10 correctly performed and 10 incorrectly performed).

The sitting/standing activity used the smartphone in the front pocket and was able to detect the movement using only the accelerometer, by means of a threshold-based method. The algorithm used the absolute value of the Y-axis accelerometer data to detect these activities, which enabled the smartphone to be used in 8 different positions inside the pocket. The sitting threshold was defined at under 2 m/s^2, the standing threshold at over 8 m/s^2 and between these thresholds, the user was considered in transition. The algorithm computed several useful metrics and had an overall mean relative error of 6.84%.

The eating activity was detected using a smartwatch on the wrist and required the use of the accelerometer, gyroscope and magnetometer. The algorithm implemented a Decision Tree using 5 features, which were computationally selected from a set of 459 generated features. Several useful metrics were also computed and the movement was detected with an accuracy of 92.99% and detection error of 7.01%.

Exergame

The developed activity detection algorithm was applied into the design of a stroke rehabilitation exergame. The objective of this game is to promote physical activity of the upper limb, specifically for the eating movement. This exergame is part of 'ExerGames', a full gaming solution for Rehabilitation and Fall Prevention, which is in development at Fraunhofer Portugal.

In this exergame, the avatar had to catch good fish and avoid catching bad fish, when those jump off. The fish catching movement mimicked the eating movement. The game finishes when a score of 10 is reached or when the countdown timer ends.

In the final score, the game matched the player's in-game performance with the International Classification of Functioning, Disability and Health (ICF) scale, which can be useful for a stroke therapist to more accurately know the patient status. Besides this, the exergame is also able to present the computed metrics, which can also be useful for a stroke therapist.

ON.2 O NOVO NORTE PROGRAMA OPERACIONAL REGIONAL DO NORTE
QREN QUADRO DE REFERÊNCIA ESTRATÉGICO NACIONAL
UNIÃO EUROPEIA Fundo Europeu de Desenvolvimento Regional