Master Thesis Defense Bhargavi Mahesh

Date: Monday 27.05.2019
Time: 12:00 h
Room: C175

Title:
On Using Convolutional Neural Networks for Human Activity Recognition with Accelerometer Data

Abstract:

Enabling wearable devices to recognize daily activities in the real world is a vital yet challenging task, primarily due to the variations in how the activities are performed. The activity classification task has been majorly addressed by traditional machine learning algorithms that receive extracted or selected features as input. However, the performance of such algorithms is often limited by the feature extraction process which relies on human expertise. Additionally, the widely accepted traditional approach for activity recognition, i.e., random forest, does not leverage the time-related information such as periodic patterns among activities. The supervised feature learning approach of convolutional neural network (CNN) has not been extensively adopted for activity recognition; a primary reason for which is the shift in the input domain from image to time-series.

This study presents a systematic approach towards the classification of activities in a controlled setting and a free-living environment using CNN. The CNN was built to recognize activities such as sitting, walking, stair-climbing, running, and cycling. Acceleration data obtained from wrist-worn and chest-worn wearables was used. The data belonged to two environments, namely, controlled and free-living. The activities in a controlled environment abided by a protocol. However, activities in free-living were less restricted, thereby challenging the CNN. Therefore, an analysis of the data was done to measure the shift between the two datasets, and the capability of CNN to extract features from time-series data was showcased. Based on the observations, a transfer learning approach, along with dataset balancing techniques, was used to classify activities in free-living.

Classification of seven categories of activities in a controlled environment using the CNN resulted in an F1 score of 0.955, with an improvement of 3.7% from a benchmark study [1], whereas, the classification of thirteen classes of activities resulted in 0.917, with an improvement of 8.9%. In free-living, five activities were classified with a maximum F1 score of 0.883. This study demonstrated that CNN could capture fundamental and intuitive patterns from the time-series data. The study also highlighted the need for specific measures that have to be adopted while recognizing the free-living activities.

Reference:
[1] Kostas Konsolakis. Master’s thesis - Physical Activity Recognition Using Wearable Accelerometers in Controlled and Free-Living Environments. 2018.