R&D project defense Ganesamanian Kolappan

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Title: Feature Extraction for Motion Data

Abstract:
Motion data is the readings from the sensors used to detect movement. These sensor readings are time-series data. Time-series data is discrete values ordered sequentially according to the time; one example of this, the stock price of Amazon. Smartphones and smartwatches used everyday consist of sensors such as accelerometers and gyroscopes to detect movement. The time-series data from these sensors collectively called motion data and is used for Human Activity Recognition or Classification (HAR/HAC).

Motion data is challenging to interpret due to its higher dimensions and complexity. Extracting features from the motion data, then utilizing these features for HAR/HAC overcomes the challenges. Current State-Of-The-Art (SOTA) methods defined in the literature either transform the time-series data to images or a different domain. Besides, some methods are neither reusable nor time-efficient as regards processing extensive data. Motion data can be broken down into many small data series, and the features from those small series can be independently extracted. This research work uses a sliding window for the disintegration process and autoencoders for feature extraction. Additionally, feature-based methods from SOTA are separately implemented to validate the autoencoders'
performance. The feature-based methods consist of a Fast Fourier Transform (FFT) and several statistical features. The extracted features from autoencoders and feature-based methods are individually provided as input to the Support Vector Machine (SVM) for HAC. The SVMs' accuracy indicates the significance of the method used to extract features from motion data.

This proposed method has experimented with three annotated HAC datasets, namely Motionsense (not the sensor manufacturer), Wireless Sensor Data Mining (WISDM), and Wireless Sensor Data Mining version 1.1 (WISDM v 1.1) datasets. The accuracy of the feature-based methods on the Motionsense dataset is 99.38%, the WISDM dataset is 99.65%, and the WISDM v 1.1 is 85.50%. The autoencoders' accuracy is 98.64%, 99.99%, and 70.46%, respectively. The autoencoders' performance is competitive with feature-based methods. Thus, this research has proven that autoencoders can extract features from motion data without transforming the raw data. In addition to this, the autoencoders have the further advantage of supporting code reusability and processing the extensive datasets.