Real-Time Monitoring of Physical Activity Using Accelerometer Data

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Physical activity monitoring is very useful in understanding personal health condition and developing recovery plan of patients. It has been of great interest in using accelerometer data to classify the type of activities and estimate energy expenditure with machine learning techniques. However, these techniques are computational expensive in model training and have poor adaptivity when new data or new classes need to be added to the algorithm. The goal of this project is to develop real-time physical activity monitoring strategy using an advanced machine learning algorithm, called extreme learning machine (ELM), to make improvements to reduce computational cost in model training such that fast and accurate monitoring can be achieved in critical conditions (e.g., fall detection). The hypothesis is that the ELM can provide comparable accuracy with existing techniques but significantly reduce computing time. The proposed algorithms using ELM and its kernel variation (KELM) were implemented in MATLAB using a public dataset. The adaptive learning capability of ELM was also investigated. The same model was simply modified for both classification of activities and regression for energy expenditure estimation. Based on the result of the experiment, ELM and KELM provide much faster training and testing with the accuracy comparable to state-of-the-arts. They also allow online refinement and update based on incoming data stream, offering a great potential to be adopted in smartphone application development by utilizing smartphone accelerometer data, which can conveniently provide more detailed information about physical activity with higher temporal resolution.

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