Privacy-Preserving Ubiquitous Activity Recognition with Wearable Sensors

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This project develops a wearable wireless sensor system and artificial-intelligence-based algorithms to automatically recognize specific daily activities performed by a human subject. The specific activities that are recognized and monitored include eating, sleeping, climbing, falling (fall detection) and the occurrence of hand tremors. The developed system can be helpful in monitoring the health and well-being of an elderly person in his/her home. The wearable sensor system avoids the use of cameras and fully preserves the privacy of the elderly person. The sensor system consists of a 3-axis accelerometer and a 3-axis gyroscope integrated with a wireless transceiver, an amplifier, and a battery on a sensor board. The wearable device obtains continuous inertial motion measurements using the on-board sensors and wirelessly transmits the data to a laptop in the home. Training an artificial intelligence or deep learning algorithm to recognize specific activities among hundreds of different types of actions performed in daily life by a person is a difficult challenge. It requires tremendous quantities of real-life data with which the learning algorithms can be trained. This project addresses the challenge by utilizing physical intuition on expected relations between particular accelerometer and gyroscope signals for the specific activities under consideration. The number of real-time signals needed for activity recognition and the amount of data needed for training are thereby highly reduced. Experimental results show that the developed system works well and can accurately recognize activities in new untrained data.