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A Smartphone-Based Real-Time Activity Recognition and Fall Detection System

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Abstract : Fall is the most serious accident leading to increased unintentional injuries and mortality. Falls are not only the cause of suffering and functional impairments to the individuals, but also the cause of increasing medical cost and days away from work. The early detection of falls could be an advantage to reduce fall-related injuries and consequences of falls. Smartphones, embedded accelerometer, have become a common device in everyday life due to decreasing technology cost. This paper explores a physical activity monitoring and fall detection application in smartphones which is a non-invasive biomedical device to determine physical activities and fall event. The combination of application and sensors could perform as a biomedical sensor to monitor physical activities and recognize a fall. We have chosen Android-based smartphone in this study since android operating system is an open-source and no cost. Moreover, android phone users become a majority of Thai's smartphone users. We developed Thai 3 Axis (TH3AX) as a physical activities and fall detection application which included command, manual, results in Thai language. The smartphone was attached to right hip of 10 young, healthy adult subjects (5 males, 5 females; aged< 35y) to collect accelerometer and gyroscope data during performing physical activities (e.g., walking, running, sitting, and lying down) and falling to determine threshold for each activity. Dependent variables are including accelerometer data (acceleration, peak acceleration, average resultant acceleration, and time between peak acceleration). A repeated measures ANOVA was performed to test whether there are any differences between DVs' means. Statistical analyses were considered significant at $p<0.05$. After finding threshold, the results were used as training data for a predictive model of activity recognition. In the future, accuracies of activity recognition will be performed to assess the overall performance of the classifier. Moreover, to help improve the quality of life, our system will be implemented with patients and elderly people who need intensive care in hospitals and nursing homes in Thailand.

Keywords : activity recognition, accelerometer, fall, gyroscope, smartphone
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