A Body Position Detection Method by Fusing Heterogeneous Information of Surface ECG

Tsu-Wang Shen*, Fang-Chih Liu, Ya-Ting Tsao and Yi-Ling Ou

Medical Informatics, Tzu Chi University, Hualien, Taiwan

Objectives: The fall among seniors is a serious problem. The Center for Disease Control and Prevention (CDC) reported that one in four seniors, who fall and sustain hip fractures, will die within one year. Alarmingly, hip fractures are expected to exceed 500,000 by 2040. The issue is not just altruistic legislation but it addresses major economic implications. CDC also estimates that the direct costs to medical care will exceed $32 billion in 2020. Hence, determination of body position is a very important issue in both biomedical and healthcare fields, and it can be applied on various medical applications. Methods: Current fall detection systems used external signals to detect falls, such as accelerometer-based, vision-based, and wireless sensor array detectors. Instead of external signals, this proposed system is applied the heart as body internal sensor to detect body positions, including standing, sitting, and lying. Our experiment data contains 23 subjects with the similar range of ages. After signal pre-processing, the heart axis, heart rate viability (HRV), QRS areas, PR intervals, and PCA components are extracted and compared to evaluate the best factors for position detection. Finally, a soft sensor was also used to fuse those heterogeneous features for distinguishing different body positions. Results & Conclusions: Our results indicate that the heart axis is more accurate than HRV and PR intervals for posture detection. In addition, for standing and lying classification only, 99.93% training and 66.67% testing accuracy can be achieved for system performance. However, if a subjects identity is known in advance by using ECG biometrics, the performance may be further improved. Overall, ECG is potentially able to combine with other external signals to provide more reliable fall detection on homecare systems for prevention of false alarm.