World Academy of Science, Engineering and Technology
International Journal of Computer and Information Engineering
Vol:17, No:06, 2023

Improving Activity Recognition Classification of Repetitious Beginner Swimming Using a 2-Step Peak/Valley Segmentation Method with Smoothing and Resampling for Machine Learning

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Abstract : Human activity recognition (HAR) systems have shown positive performance when recognizing repetitive activities like walking, running, and sleeping. Water-based activities are a reasonably new area for activity recognition. However, water-based activity recognition has largely focused on supporting the elite and competitive swimming population, which already has amazing coordination and proper form. Beginner swimmers are not perfect, and activity recognition needs to support the individual motions to help beginners. Activity recognition algorithms are traditionally built around short segments of timed sensor data. Using a time window input can cause performance issues in the machine learning model. The window's size can be too small or large, requiring careful tuning and precise data segmentation. In this work, we present a method that uses a time window as the initial segmentation, then separates the data based on the change in the sensor value. Our system uses a multi-phase segmentation method that pulls all peaks and valleys for each axis of an accelerometer placed on the swimmer's lower back. This results in high recognition performance using leave-one-subject-out validation on our study with 20 beginner swimmers, with our model optimized from our final dataset resulting in an F-Score of 0.95.

Keywords : time window, peak/valley segmentation, feature extraction, beginner swimming, activity recognition
Conference Title : ICMLA 2023 : International Conference on Machine Learning and Applications
Conference Location : Copenhagen, Denmark
Conference Dates : June 15-16, 2023