Swim Smart, Swim Fast: Development and Application of a Fitbit App for Swim Technique Study

Li, Rockwell (School: Ocean Lakes High School)

Swimming is a highly technical sport. Knowing what stroke technique to use and to what extent it should be used is crucial for swimmers to achieve optimal performance. Videos provide some visual feedback, but many details are missing. Unlike some professional equipment, a Fitbit is affordable for most swimmers. In this project, a Fitbit app is developed in Javascript to collect sensor data to study swim technique. I used this app to collect data during my swim practice. Accelerometer and heart rate data are collected and analyzed. All four strokes are studied: freestyle, backstroke, breaststroke, and butterfly. This study shows that 1D convolutional neural network can classify the four stroke patterns represented by accelerometer data with high accuracy. The Fitbit accelerometer is even sensitive enough to detect the subtle differences in stroke technique such as butterfly hand and wrist rotation with relatively high accuracy. How swim technique affects the performance is also investigated. Results support that the higher stroke rate increases the speed for butterfly and that the higher stroke rate does not always increase the speed for breaststroke. There is an optimal glide time (0.4s~0.6s per stroke) for me to achieve optimal speed in breaststroke. The results support that the greater magnitude of a strike does not always give a faster time. Hip driven freestyle is observed to have better endurance than shoulder driven freestyle. This project provides an approach for swimmers to monitor and analyze their swimming techniques quantitatively. It helps swimmers improve their strokes and swim faster. This technology can be further extended to fields such as Navy sailor training and physiotherapy to help track the patient's progression to redeveloping their motor skills.

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