ABSTRACT

Monitoring cycling intensity can provide insight and feedback to cyclists to optimize their cycling routines and intensity to improve cycling effectiveness. However, existing cycling applications can still be extended to provide more information, such as cycling pose monitoring and cycling pose targets, that can help inform cyclists during training. This study aims to utilize long short-term memory (LSTM)--based human activity recognition (HAR) to develop a cycling intensity monitoring application and implement the synthetic minority over-sampling technique (SMOTE) to overcome the imbalance problems.

First, we obtained the HAR Trondheim (HARTH) dataset from the UC Irvine Machine Learning Repository. The next step was to prepare data and train the LSTM. We benchmarked the LSTM with recurrent neural networks (RNN) and principal component analysis with adaptive boosting (PCA-AdaBoost).

Then, we compared SMOTE with several other methods: K-means-SMOTE and adaptive synthetic (ADASYN). We then developed a modified Karvonan formula to calculate the cycling pose target and designed a cycling pose monitoring application. The test results show that LSTM has the best accuracy, precision, recall, and f1-score compared to RNN and PCA+AdaBoost, with values of 0.96, 0.90, 0.98, and 0.94, respectively.

Then LSTM+SMOTE also has the best average recall compared to LSTM+K-Means-SMOTE, LSTM+original dataset, and LSTM+ADASYN, with values of 0.98, 0.94, 0.92, and 0.91, respectively. We have also designed an application to monitor the cycling pose and determine the target pose using the modified Karvonen formula.

Keywords*: synthetic minority oversampling technique, long short-term memory, cycling, human activity recognition, Karvonen formula*