

Determination of Distinctive HRV Features of E-Sports Players Playing Exergames

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In this study, the most effective and distinctive features were tried to be determined in the classification of heart rate variability (HRV) data recorded in exercise game and e-sports sessions of different groups. At the same time, tried to determine successful classifier models for relevant data. With this aim, HRV data of 3 groups played two different types of exergames pre and post e-sport sessions and did not play exergame were used. One group played an exergame that worked the lower extremities, the other played another exergame that worked the upper extremities, and the last group only played e-sports. HRV features such as RMSSD (Root Mean Square Difference of RR intervals), SDNN (Standard Deviation of RR intervals), SD1/SD2, Poincare ellipse area (S), Stress index (SI) and LF/HF calculated and tried to classifying groups.

Heart rate data from 45 healthy person with ages between 19 – 39 ($24,44 \pm 4,36$) in 3 different groups of 15 person each, were used in this study. Heart rate data in the bpm (Beats Per Minute) format and were recorded with the Fitbit Sense 2 wristband worn on the participants' right wrists.

In this study participants played 2 types of exergame pre and post e-sport sessions. Participants are divided into 3 different groups according to exergame type and playing status. All groups played the same e-sport game (Brawl Stars). The first group played e-sport and the 1st type exergame (Hot Squat) which allows to work out lower extremity muscle groups. The second group played e-sport and the 2nd type exergame (Beat Saber) that helps to work out upper extremity muscle groups. And the third group only played e-sport game.

The obtained results showed that the effective features that put difference between two different exergame played and non-exergame played groups can be determined with the proposed approach. The k-fold cross-validation value was set to 5 for the generation of training and testing data in the classifiers.

This study showed that RMSSD may be a key feature in classifying e-sports sessions across various groups. For the classification of group 1 and group 2, RMSSD achieved 80.00% success rate. When classifying 3 group e-sports sessions using two-feature combinations, RMSSD combinations produced the highest accuracy. The RMSSD-LF/HF pair reached 88.89% success with Medium and Wide Neural Network models, while the RMSSD-Ellipse Area pair achieved the same rate with Wide and Bilayered Neural Networks. For Group 1 and Group 2 sessions, the

RMSSD-SDNN pair had a 93.33% success rate with the Weighted KNN model, and RMSSD-Ellipse Area also reached 93.33% using Fine Gaussian SVM.

In the classification of exergame sessions between Group 1 and Group 2, SD1/SD2 was the best-performing single feature, with an 80.11% success rate across multiple models. However, two-feature combinations yielded perfect classification results, with 100% success in various models, including Quadratic Discriminant, Cubic KNN, and Neural Networks. Feature pairs such as RR mean-LF/HF, RMSSD-SDNN, and RMSSD-SD1/SD2 proved particularly effective, further underscoring the value of feature combinations for improving classification accuracy.

Keywords: Classification, E-sport, Exergame, HRV

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