Hardware Implementation for Lower Limb Surface EMG Measurement and Analysis Using Explainable AI for Activity Recognition

Publisher: IEEE

Ankit Vijayvargiya ; Puneet Singh ; Rajesh Kumar ; Nilanjan Dey **All Authors**

Abstract: Electromyography (EMG) signals are gaining popularity for several biomedical applications, including pattern recognition, disease detection, human–machine interfaces, med... **View more**

Metadata

Abstract:

Electromyography (EMG) signals are gaining popularity for several biomedical applications, including pattern recognition, disease detection, human–machine interfaces, medical image processing, and robotic limb or exoskeleton fabrication. In this study, a two-channel data acquisition system for measuring EMG signals is proposed for human lower limb activity recognition. Five leg activities have been accomplished to measure EMG signals from two lower limb muscles to validate the developed hardware. Five subjects (three males and two females) were chosen to acquire EMG signals during these activities. The raw EMG signal was first denoised using a hybrid of Wavelet Decomposition with Ensemble Empirical Mode Decomposition (WD-EEMD) approach to classify the recorded EMG dataset. Then, eight time-domain (TD) features were extracted using the overlapping windowing technique. An investigation into the comparative effectiveness of several classifiers is presented, although it was hard to distinguish how the classifiers predicted the activities. Having a trustworthy explanation for the outcomes of these classifiers would be quite beneficial overall. An approach known as explainable artificial intelligence (XAI) was introduced to produce trustworthy predictive modeling results and applied the XAI technique known as local interpretable model-agnostic explanations (LIME) to a straightforward human interpretation. LIME investigates how extracted features are anticipated and which features are most responsible for each action. The accuracy of the extra tree classifier gives the highest accuracy of the other studied algorithms for identifying different human lower limb activities from sEMG signals.

Published in: IEEE Transactions on Instrumentation and Measurement (Volume: 71)