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Artificial neuronal network for surface EMG signal processing

Larisa DUNAI, Isabel Seguí VERDÚ, Lilia SAVA, Dinu ȚURCANU

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Abstract

This study explores the development of an artificial neural network (ANN) designed for processing surface electromyography (sEMG) signals to enable accurate and reliable hand gesture recognition. The primary aim of this work was to create a neural network architecture capable of classifying a range of hand gestures based on the sEMG signal features, while also optimizing the model for deployment on resource-constrained hardware platforms, such as the ESP32. The proposed approach demonstrates the potential of machine learning in advancing the field of gesture recognition, particularly in applications like prosthetics, rehabilitation, and human-machine interaction systems. The study emphasizes the importance of the model's classification accuracy and efficient processing speed, ensuring it is suitable for real-time applications. Using cross-validation and efficient training techniques, the model exhibited strong performance and generalization, critical for deployment in dynamic, real-world environments. Furthermore, the model's design allows for scalability, making it adaptable to a variety of hardware systems with limited computational resources. In addition to its accuracy and efficiency, the proposed system was designed to ensure reliability and adaptability across different users and conditions, addressing common challenges in sEMG-based gesture recognition, such as signal variability and noise. The model enhances its robustness by implementing preprocessing techniques and optimizing network parameters, improving its potential for long-term use in practical applications. Future work will focus on refining the system by expanding the number of recognizable gestures, integrating complementary sensor modalities, and further optimizing its computational efficiency to support broader real-time applications in assistive technology and human-machine interaction.

Keywords: *artificial neural network, hand gesture recognition, prosthetics,*

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