BSc/MSc-project

Title: A real-time communication system to the disabled: An EMG and IMU based system

Description:

Individuals affected by neuromuscular disorders may lose the ability to communicate with the external environment. Such disorders including amyotrophic lateral sclerosis, brain stem stroke, spinal cord injury and numerous other diseases disrupt the nerves that control the muscles [1]. In severe cases, these disorders can cause total paralysis and loss of voluntary muscle control. There is no cure for such disorders and hence impair the quality of patients' life. Thus, the development of technologies that help the patients to communicate with the environment is crucial for improving the quality of their lives.

In a recent work, a system consisting of a microcontroller connected to a gyroscope and an EMG sensor, placed on the hand and forearm, respectively has been developed [2]. The system was able to identify two degrees of freedom in the forearm. The aim of the present thesis is to apply such a system to the disabled user to develop a communication system by translating the EMG signals from the forearm as control commands. It is necessary to optimize the placement of the gyroscope and electrodes i.e., capturing as many degrees of freedom as possible in the forearm EMG of the user to have as many control signals as possible. These control signals (signature waveforms), with the help of supervised machine learning to create algorithms, can help us develop a communication device, which the disabled subject could use independently. The goal is to develop a real-time system that allows the subject to answer yes/No questions without assistance. The algorithm needs to be relatively simple because of the real-time approach. Additionally, it is important that the system can distinguish between voluntary movement of the hand and sudden involuntary muscle tensions that frequently occur in such patients.

[1]. D. J. McFarland and J. R. Wolpaw, “Brain-computer interfaces for communication and control,” Commun. ACM, vol. 54, no. 5, pp. 60–66, May 2011

[2]. Al-Hamdani Mustafa, “EMG-based microcontroller recognition of directional movements”, Special course report, Department of Electrical Engineering, Technical University of Denmark, 2018.

[3]. S.Balasubramanian, E.G-Cossico, N.Birbaumer, E.Burdet, A.R-Murgialday, “Is EMG a viable alternative to BCI for detecting movement intention in severe stroke?”, TBME, DOI 10.1109/TBME.2018.2817688

Prerequisites: Knowledge in signal processing, programming skills and experience with MATLAB

Responsible institution: DTU Elektro

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Allowed no of students per project: 1-2
The project description may be published on the website (yes/no): Yes