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Fig1. Controlling ExerGames interface with gestures using Myo Armband.

EMGesture

ELECTROMYOGRAPHY AND INERTIAL SENSOR-BASED GESTURE DETECTION AND CONTROL

Abstract

Gestures are used naturally in the real world to interact not only with people but also with real objects. The ability to capture, recognize and interpret gestures may thus enable humans to communicate with machines and provide more natural ways of human-computer interaction (HCI).

EMGesture aims at detecting hand, wrist and forearm gestures by employing pattern recognition techniques applied to biosignals and inertial sensor data recorded at the forearm position.

Surface electromyography (EMG) is applied to evaluate the electrical activity produced by skeletal muscles and detect which muscles are involved in each gesture. The data from an inertial measurement unit (IMU) is used to evaluate motion and orientation of the forearm. Considering the complementary features of EMG and IMU, their data fusion can be used to increase the number of gestures that can be recognized with increased accuracy.

Solution

EMGesture uses BITalino for EMG acquisition and a smartwatch for IMU recording. Four EMG channels are used to record muscle activity and to that purpose electrodes are placed on the forearm (Fig2). Twelve different gestures were captured using BITalino and the smartwatch simultaneously, including, hand contraction and extension, wrist extension and flexion, snapping the fingers, among others.

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Features

EMGesture uses data from electromyography in combination with data from an inertial measurement unit to recognize a set of gestures with increased accuracy.

Gestures

- Hand contraction
- Hand extension
- Wrist extension
- Wrist flexion
- Upper arm flexion
- Thumb-Index
- Thumb-Middle
- Hand up
- Hand down
- Snapping the fingers
- Wrist abduction
- Upper arm lateral rotation

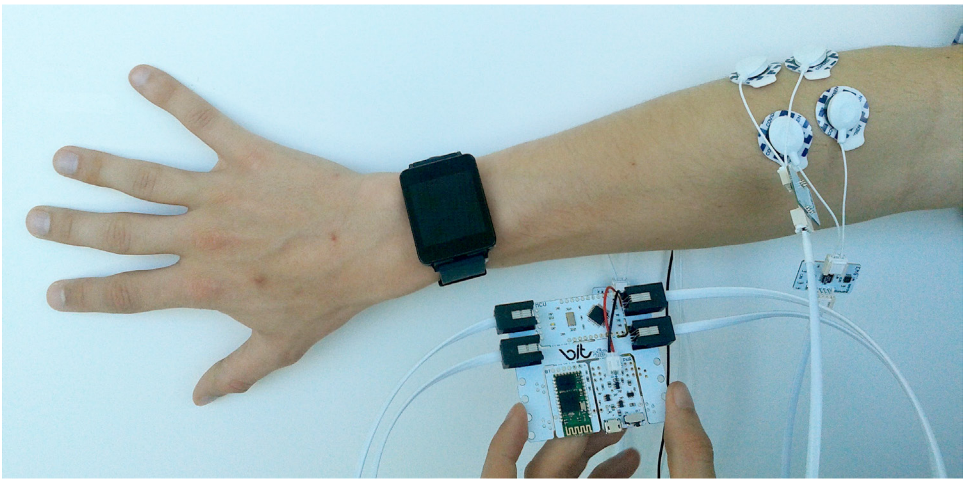

Fig2. Using BITalino and LG G Watch to detect gestures.

EMG signal is pre-processed to evidence moments when muscular activity is present (Fig3). After calculating and selecting the best set of signal features to use, pattern recognition algorithms are applied to discriminate gestures. An accuracy, sensitivity and precision higher than 98% were achieved in the detection of these gestures using k-NN classifier.

The same type of processing and classification techniques is applied to the data acquired by Myo (Fig1). Myo is a gesture armband that already incorporates seven EMG channels and one IMU. Myo lead to an accuracy, sensitivity and precision higher than 92% in the detection of gestures, using the k-NN classifier.

Conclusions

By applying correct techniques, it is possible to perform EMG and IMU sensors data fusion for gesture pattern recognition. The best results in gestures discrimination were achieved using the k-NN classifier.

Comercial input devices, like Myo, can be used in HCI to create intuitive and user-friendly interfaces.

Future Work

In the future, it would be interesting to train the algorithm to be able to distinguish other gestures beyond those currently supported. Besides HCI, the ability to distinguish other gestures could be applied in the rehabilitation area, providing a way to compare normal and disabled movements. Gesture detection can also be applied to the interpretation of sign language.

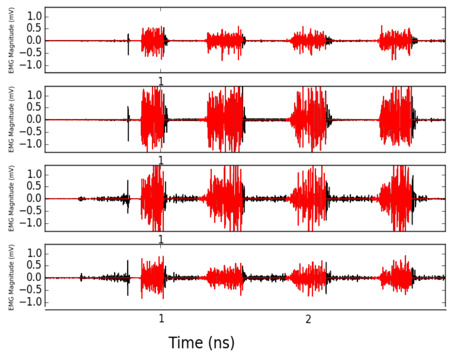

Fig3. Muscular activity present in the recorded signal.

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