Live Demostration

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Live Demostration: Sensor fusion using EMG and vision for hand gesture classification in mobile applications

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***Abstract*—The demonstration shows a mobile application, called "RELAX", for hand gesture classification using multi-sensors fusion. In particular, we integrated the data collected by an electromyography (EMG) sensor with the events produced by an event-based vision sensor, the Dynamic Vision Sensor (DVS). The application runs real-time on any Android smartphone and it is able to recognize five gestures with an accuracy of up to 85%.**

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I. Demonstration setup

The demonstration shows online gesture classification running on a mobile application named "RELAX" using input from two different kind of sensors, namely an EMG sensor and a vision sensor. The mobile application for gesture recognition can be helpful not only for physiotherapists, but for everybody in the context of assisted living, healthcare of the elderly and neurorehabilitation. "RELAX" was developed via the standard Android Application Framework and runs on a Pixel 3 mobile device. It can also be installed on any other Android devices with Android version 5.0 and above.The EMG signal, electric potential generated by the muscles activity, is recorded by the Myo armband from the forearm with 8 non-invasive surface EMG (sEMG) electrodes [1]. Concurrently, the visual information comes from an event-based vision sensor, the DVS [2], which reduces the computational resources needed to process the visual input. This is advantageous given our real-time application on a mobile phone with limited resources. In fact, in contrast to standard frame-based sensors, the DVS asynchronously records changes in the brightness from each single pixel. The output is a stream of temporal events which are only carrying the information of the changing pixel as a result of the movement in the scene, while the static background is directly removed at the front-end. The communication with the smartphone is done via Bluetooth for the Myo and via USB port for the DVS. RELAX is able to classify five different gestures shown in Fig.1. On the application, it is possible to run two different trained classifiers, namely a Support Vector Machine (SVM) and a Convolutional Neural Network (CNN). We compared the results of the two classifiers for different modalities: i) EMG, single-sensor modality, input just from the Myo, ii) DVS, single-sensor modality, using only the frames calculated from the DVS events as the input (accumulation of events in a fixed time window), iii) FUS-DVS, multiple-sensors modality, which fuses EMG and DVS information. It is possible to conclude that, in both cases, the use of sensory fusion reduces the amount of uncertainty in the prediction and improves the classification performance. In particular, the comparison between SVM and CNN showed that the latter presents higher accuracy, 93.4% vs 98.8%.

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II. Visitors Experience

Visitors can challenge the application and directly interact with it. The demonstration setup is shown in Fig.1. Each subject stands in front of the camera wearing the Myo armband and performs a gesture. The five available gestures are: *pinky*, *elle*, *yo*, *index*, *thumb* (Fig.1 on the right). The visitors can observe the classifiers output directly on the smartphone and select the modalities and the classifier they prefer to use: single-sensor modality, EMG or DVS or multiple-sensors modality, FUS-DVS. To increase the performance of the classification the subjects are invited to stay in front of a static background.

Fig. 1: On the left, the demonstration setup: Myo on the subject forearm, DVS looking at the gesture and mobile application. On the right, the five gestures of the classification.

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