WEARPLEX Horizon 2020 Project

Submitted to the ICT-02-2018 - Flexible and Wearable Electronics call for proposals; focus on manufacturability, integration and demonstrators

H2020-ICT-02-2018

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Background

- Medical electrodes market is $1B globally, despite being mostly lab or clinic use.
- Several markets for wearable EMG and FES devices:
  - Stroke Rehabilitation (1 every 2 seconds, expected to be 70 million survivors by 2030).
  - Haptic interfacing, e.g remote control, gaming, assisted living.
  - Posture correction and pain relief.
- Combining with textiles allows easier setup, home use, reduced clinician time, reduced healthcare costs.

Aim: Integrate printed electronics with flexible and wearable textile-based biomedical multi-pad electrodes.

Key Focus: Printed electronics on textiles, printed multi-pad electrodes with integrated logic circuits to re-configure the size and shape of stimulation and recording electrodes.

Key novelty: Development of a smart electrode which can adapt to the subject but also to the recording/stimulation system, allowing an increase from 1 to N channels – flexibility of a matrix recording to 'conventional' recording/simulation systems.

The printed electrode pads will be addressable into virtual electrodes. Software methods developed for automatic calibration of the virtual electrodes to adapt to individual users. The project will make use of virtual electrodes allowing stimulation and recording from the same device.

Figure 1. WEARPLEX concept of 'virtual' electrodes. Electrode 1 (red), electrode 2 (blue), non-selected electrodes (white).

What is FES?

- Functional Electrical Stimulation (FES) is used to electrically stimulate motor nerves to activate paretic muscles.
- The stimulation is controlled and targeted to specific nerves to provide useful movement of a limb (e.g grasping, stepping).
- Treatment for Stroke survivors for upper limb therapy, drop foot for Stroke and Multiple Sclerosis sufferers, muscle pain relief.

What is EMG?

- EMG is Electromyography – a process for measuring the electrical potential generated by muscles.
- By measuring EMG, we can determine the health of muscles and their control nerves.
- EMG is a non-invasive technique, meaning the signals are gathered from contact with the skin.

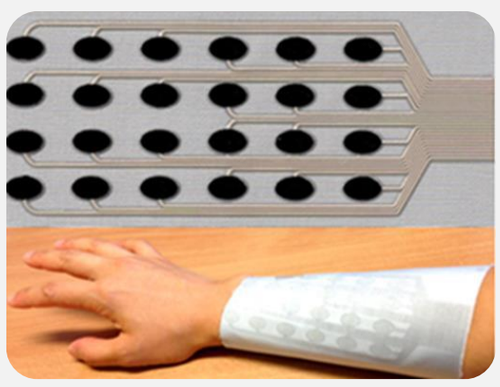
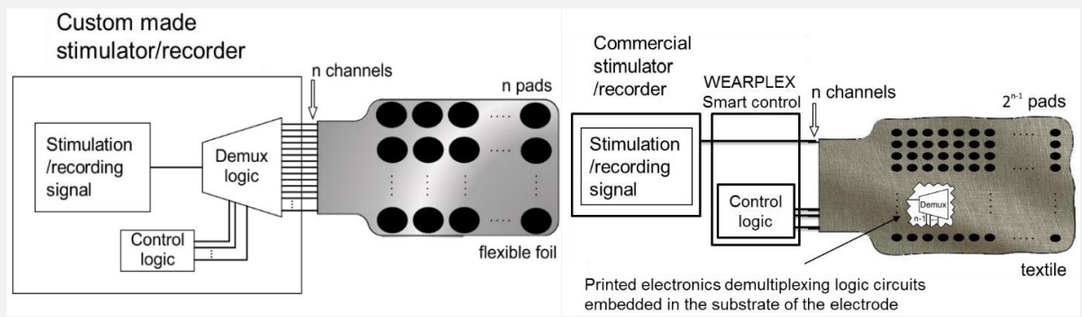


Figure 2. Fully printed Textile FES electrode by University of Southampton.

WEARPLEX Use Cases Examples

To further explain the concept of the WEARPLEX technology several examples describing how it would be used are introduced



(a) (b)

Figure 3. (a) Current state of the art multi-electrode system, (b) Proposed WEARPLEX solution.

Example 1. One-size-fits-all Functional Electrical Stimulation (FES) sleeve as an assistive and therapeutic device for hand paresis

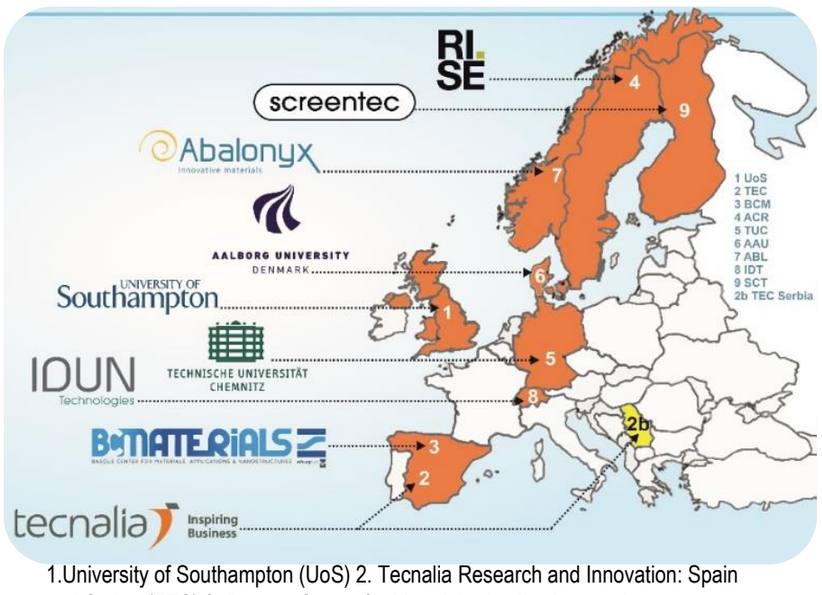
The WEARPLEX sleeve can be used to restore some function to the paretic hand. It controls muscles and forms suitable grasps to handle different objects. The stretchable sleeve is covered with electrodes that are activated in groups formed specifically for each person, to achieve the best grasp, since the optimal motor activation zones vary significantly among users. The system offers several programs to warm up the muscles and practice different types of grasps.

Example 2. Stretchable e-textile sleeve for EMG interface with a computer

The WEARPLEX technology can be used as a novel way to interface with computers and other devices. Thanks to the EMG electrode matrix and individual electrodes being able to send signals, the device is able to recognize even subtle changes in muscle activity. This can be used to let users use gestures to switch the channels on their TV or to deliver more immersive VR and gaming experiences as the WEARPLEX sleeve can track the user's movements with greater accuracy than commercially available movement tracking cameras. It also removes the need for extra devices as it can perfectly integrate into the clothing of the user or be worn as a harness under the user's clothing.

Example 3. Smart posture correcting and pain-relieving tape

Smart stretchable WEARPLEX tape can be used to provide pain relief as it delivers pleasant, low intensity electrical stimulation to the back muscles. The stimulation is distributed and feels like a very light massage. Through a simple integrated interface, the intensity can be increased as the user gets accustomed to the analgesic electrotherapy. Having a large number of electrodes allows the system to modify the activation area, optimizing for the best posture achieved in the shortest time.



1.University of Southampton (UoS) 2. Tecnalia Research and Innovation: Spain and Serbia (TEC) 3. Basque Centre for Materials, Applications and Nanostructures (BCM) 4. Research Institutes of Sweden (RISE) 5.Technical University of Chemnitz (TUC) 6. Aalborg University (AAU) 7. Abalonyx (ABL) 8. IDUN Technologies (IDUN) 9. Screentec (SCT)

Project budget:

€3.7M

Project duration:

3 years, January 2019 to December 2022.

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