

# WIRELESS ELECTRONIC-TATTOO FOR LONG-TERM HIGH FIDELITY FACIAL MUSCLE RECORDINGS

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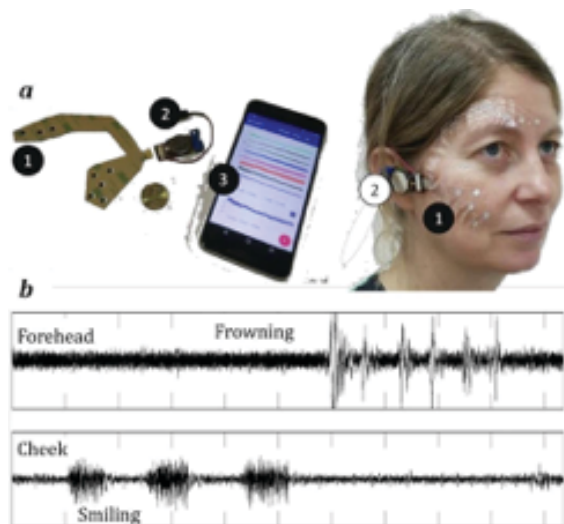
Facial Surface Electromyography (sEMG) is a powerful tool for objective evaluation of human facial expressions with the potential of exceeding the reliability of self-reporting and image analysis. In recent years sEMG was proposed for a wide range of psychological and neurological assessment applications, but owing to technical challenges with cumbersome gelled electrodes, the use of facial sEMG has so far been limited. Researchers from Tel Aviv University, Israel, in Collaboration with **SensoMedical**, demonstrated the feasibility of sEMG as a platform for robust identification and objective classification of facial muscle activation, based on innovative **temporary sEMG tattoos** that were specifically optimized for facial applications. The use of these temporary facial sEMG tattoos achieves differentiation between individual facial muscles, which can be readily applied to discriminate between voluntary and spontaneous expressions. Possible applications for this technology are objective psychological and neurological evaluations, user-experience monitoring, and user-performance management.

## OVERVIEW

The **Wireless Electronic Tattoo Facial sEMG** recording setup consists of **SensoMedical BioPot V2 and TAU temporary facial sEMG tattoo** which includes a wireless Bluetooth Low Energy (BLE) transmitter, and a phone with BLE receiver for data display and storage.

The **SensoMedical BioPot V1** is an ultra-low-power device powered by a button cell battery, which utilizes a Bluetooth Low Energy (BLE) protocol to connect to the host. It is capable of continuous and prolonged (over 10 hr) acquisition of 8 or 16 channels biopotential (EMG/EEG) signals. Bluetooth V4.2 superior specifications allow for a high over-the-air data throughput with low power consumption, monitoring eight channels of raw EMG data at 500 Samples (Android) and up to 2,500 Samples (8 channels Windows) per second. The wireless setup also allows for the continuous upload of data to cloud storage for remote monitoring and advanced data processing.

The **temporary facial sEMG tattoos** consist of highly-soft dry silver-ink traces and carbon-ink electrodes printed on temporary tattoo film with outstanding electromyography recording capabilities and excellent user comfort. The conformity of the electrodes helps establish direct contact with the skin, making the use of a gel superfluous. The electrodes

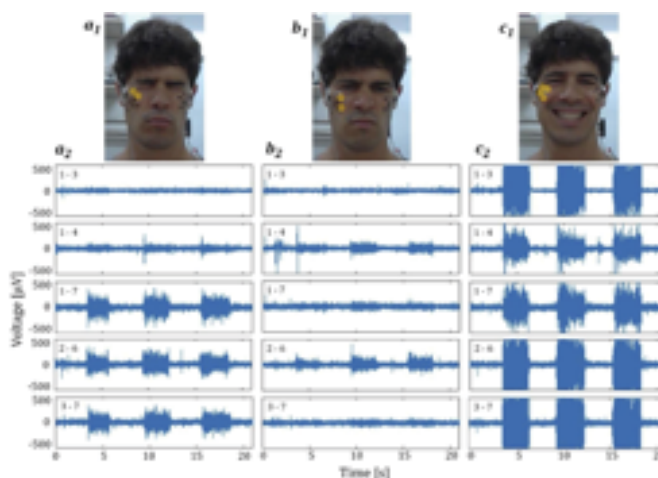


can be placed on the skin in a stable manner with a low electrode-skin impedance for a duration of up to several hours. A plasma polymerized EDOT coating is used to improve the electrode impedance, which is essential for high signal-to-noise ratio (SNR)/high-resolution recordings. The ppEDOT coating yields a capacitance comparable with that of state-of-the-art neuronal electrodes, with an increase in the electrode capacitance by a factor of up to 100 in wet conditions as revealed by cyclic voltammetry measurements.

## APPLICATIONS

Facial sEMG can be applied to obtain objective and genuine responses from patients in response to specific visual, environmental, and other triggers. Unlike image analysis, it captures muscle activation directly and therefore is more sensitive to underlying neurological pathways and can be implemented as an objective assessment tool. Moreover, sEMG provides information on the characteristics of

dynamic changes over time paving the way to understanding expression interpretation rather than expression recognition. Areas, in which the analysis of emotional expression is of interest and was applied, are driving safety, coping strategies of military personnel and their spouses, schizophrenia, and depression.



## SUMMARY

Capturing our emotions and valence towards information, people, and objects is an essential diagnostic and characterization tool that provides great value to patients, therapists, physicians, and educators while also providing economic value to marketers, gamers, film-makers, and designers. **The Wireless Electronic Tattoo facial sEMG** system offers superior performance in recording muscle activation along with excellent user convenience and opens new opportunities in neuro-feedback applications and objective psychological and neurological evaluation. User experience evaluation and user performance management (UPM) is another significant opportunity, with massive societal and economic impact.

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