A Summary of the Class Presentation on OCOSense Smart Glasses

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Abstract

The paper serves both as a summary to the work on ***OCOSense^{TM}*** smart glasses and our class presentation on this topic. In this paper we briefly discussed traditional state-of-the-art technologies for measuring facial muscle activation, and we gave their shortcomings. We also, provided a review of face wearables for measuring facial muscle activation, and their drawbacks. This set the scene for our discussion on ***OCOSense^{TM}*** smart glasses technology which tries to overcome the shortcomings of the face wearables we discussed.

Keywords: OCOsense, Wearables, Smart Glasses, face muscles

1 Introduction

Over the past decade, there has been a notable surge in the popularity of smart devices, encompassing items such as watches, earrings, e-textiles, jewelry, wearable ECG monitors, and eyewear. These wearables are anticipated to serve not only as tools for multi-modal high-accuracy monitoring but also as platforms for biofeedback-informed interventions and research and development.

A majority of sensors focus on measuring arousal metrics, such as pulse rate and electrodermal response. However, in comparison to other physiological cues, facial expressions are acknowledged as the richest source of emotional information. It is important to note that the valence derived from facial expressions is highly context-dependent. Consequently, continuous monitoring of facial activation, integrated with user activities, can provide valuable insights into behavioral and emotional changes.

Against this backdrop, the OCOsenseTM smart glasses, equipped with optomyographic (OMG) sensors, emerge as a significant advancement. These glasses enable real-time monitoring of facial muscle activations, offering a nuanced understanding of user responses and contributing to the evolution of wearable technology in the realm of behavioral and emotional analysis.

2 Existing Traditional Technologies

The traditional methods for measuring muscle contractions are the electromyography, de facto method, and camera-based tracking. These methods are limited by the fact that, firstly, they lack generalizabilty. For instance, the interpretation of a smile can vary, ranging from irony to even conveying a sense of threat. The context in which the smile occurs becomes pivotal in determining its meaning. Secondly, these methods are inherently noticeable and, as a result, not well-suited for seamless integration into everyday wearables [1].

3 Some Novel Approaches to Facial Wearables

3.1 CapGlasses:

In this technology, the face glasses are equipped with face-mounted cameras. The main drawback of this device is that it suffers from electromagnetic interference, and it lacks immunity to different environmental conditions [2].

3.2 Electrooculographic glasses:

These glasses where developed for the detection of facial activation and facial expression. However, it is limited by high sensitivity to head movements and low sensitivity to lower-face actions such as smiling [3].

4 Salient Features of OCOSense Smart Glasses

The $OCOsense^{TM}$ smart glasses equipped with seven (07) optomyographic (OMG) sensors, which allow real-time monitoring of facial muscle activations. The glasses also include 9-axis Inertial Measurement Unit (IMU) and altimeter for activity and head movement tracking, and a dual-speech detection microphones. Moreover, the OCO^{TM} sensor produces output data consisting of only three 16-bit coordinate positions (X, Y, Z) [1]. The MCU polls the sensors at a frequency of 50 Hz, leading to a data rate of 2.4 kb/s for each sensor. Additionally, the sensors' output is transmitted to a mobile device through Bluetooth Low Energy (BLE). The glasses are equipped with two 220-mAh lithium-polymer (LIPO) batteries, providing a system power duration of 4-6 hours. The variability in the user's activity level is taken into account by the $OCOsense^{TM}$ glasses dynamic frame rate power management strategy. Furthermore, the OCO TM sensor's resolution for skin tracking in the XY plane is below 4 μm. Furthermore, the error rate for skin tracking in the XY plane remained consistently at 0.027 mm/mm across the sensor-skin proximity range (8–28 mm) and within a velocity range similar to facial expressions (1000–10000 mm/min) [1].

5 Drawback of $OCOSense^{TM}$ Smart Glasses

One of the drawbacks of $OCOSense^{TM}$ is that Infra Red laser used used by opto-myography (OMG) sensors is affected skin tone, makeup, and perspiration. Another shortcoming of the glasses is that the X and Y-axis skin measurements are interrelated, leading to accumulated errors over time when determining the XY plane coordinates [1].

6 Conclusion

The $OCOSense^{TM}$ smart glasses are not confined to the laboratory; instead, they have entered the commercial market, a testament to their value. Ultimately, this technology is for promising for advances in neuroscience and detection of strokes.

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