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# Live Demonstration: Smart Glasses-based Portable System for Pattern-Reversal Visual Evoked Potential clinical evaluations

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**Abstract**—This Live Demonstration presents a portable and low-cost integrated device, for the Pattern-Reversal Visual Evoked Potential (PR-VEP) clinical test based on smart glasses. Epson Moverio BT-200<sup>®</sup> smart glasses generate the checkerboard pattern for the visual stimulation through a customized Android<sup>®</sup> application. Electroencephalographic (EEG) signals are recorded with an OpenBCI Cyton<sup>®</sup> board and sent wirelessly to a PC where a Matlab<sup>®</sup> real-time algorithm processed and extract the final PR-VEP signal. The visitors can experience and confirm the reliability of the smart glasses-based PR-VEP test here proposed.

## I. INTRODUCTION

Visual evoked potentials (VEPs) are waveforms triggered by repetitive visual stimuli and extracted from the electroencephalogram (EEG) through the signal averaging technique. Nowadays, VEPs are clinically useful when traditional diagnostic tests become insufficient to identify early several neuropathologies because they provide reproducible and quantitative data on the visual pathways function. PR-VEP in healthy subjects presents a series of components at fixed time frame after the stimulus. Anomalies in both the latency and the amplitude of these components, or a total absence of peaks are clear symptoms of a diseased condition. The standard equipment for the PR-VEP test on the market introduces some drawbacks related to the cost and their size. We propose a new integrated device for the PR-VEP test based on smart glasses with performances comparable with available commercial instruments [1], but *low cost*, *portable* and useful especially for uncooperative subjects to keep the visual fixation and those disable to maintain the upright position.

## II. DEMONSTRATION SETUP

In this demonstration smart glasses Epson Moverio BT-200<sup>®</sup> are used as a visual evoked potential stimulator, through an Android<sup>™</sup> application allowing the user to set the stimulation parameters of the checkerboard pattern before performing the test. EEG signal is time-locked to the visual stimulus through an audio jack out of the smart glasses and a customized electronic circuit to generate the trigger signal. EEG signal is recorded from the scalp through gold-cup electrodes and sent wirelessly to the PC with an OpenBCI Cyton<sup>®</sup> board.

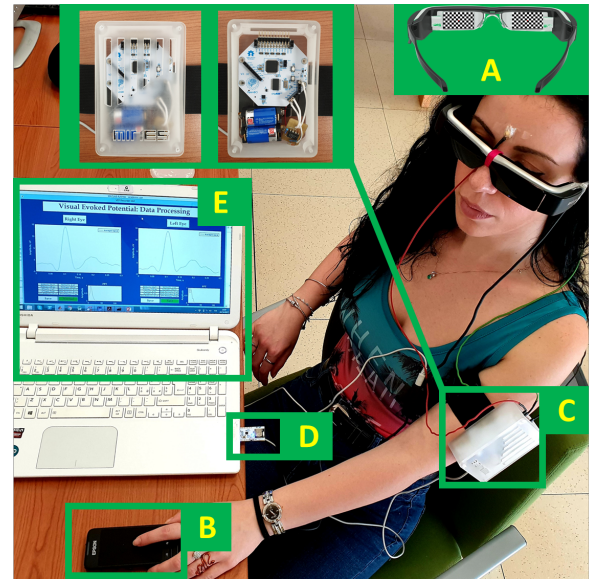


Fig. 1. Demonstration setup: (A) Smart Glasses, (B) Trackpad, (C) EEG Acquisition System + Trigger, (D) Dongle Bluetooth, (E) GUI Signal Processing

Then PR-VEP waveform is extracted, processed and shown to the user by a Matlab<sup>®</sup> real-time algorithm and Graphical User Interface (GUI).

## III. VISITOR EXPERIENCE

The visitors will experience the portability and the ease-of-use of the technology here presented, wearing the smart glasses and interacting with the application through a trackpad. In addition, visitors will acquire knowledge attending a real-time full PR-VEP-test which will be performed on a third subject. In particular, they will be able to appreciate the progressive formation of a typical PR-VEP waveform into the GUI and to understand the meaning of the features extracted from the signal which are commonly used in clinical evaluations.

## REFERENCES

- [1] R. Terracciano, A. Sanginario, S. Barbero, D. Putignano, L. Canavese, and D. Demarchi, "Pattern-reversal visual evoked potential on smart glasses," *IEEE journal of biomedical and health informatics*, 2019. [Online]. Available: <https://ieeexplore.ieee.org/document/8642836>