TrauVibe: A Non-Invasive Vibrotactile Wearable Band for Neural Fingerprint and Multimodal Physiological Detection of PTSD With ACT-Based Monitoring

Kaddour, Mahmoud (School: Obour STEM School)
Ezzat, Mohammed (School: Obour STEM School)

The assessment of Post-Traumatic Stress Disorder (PTSD) currently relies on interviews and self-reported questionnaires, which limit both objective assessment and early clinical diagnosis. To address this limitation, this study represents TrauVibe, a non-invasive vibrotactile wearable band integrated with a mobile application to support diagnosis and enable continuous monitoring. The system delivers controlled 165 Hz vibrotactile stimulation and records multimodal biosignals, including Galvanic Skin Response (GSR) and Photoplethysmography (PPG), throughout a structured protocol including a baseline, stimulation, and recovery phases. These signals capture physiological response dynamics and recovery behavior under a structured experimental protocol. A Neuro-Cardio Coupling Index (NCCI) is introduced to quantify synchronization between electrodermal and cardiac responses as an objective marker supporting PTSD diagnosis. In addition, a neural fingerprint captures individualized response patterns, enabling personalized assessment and phenotyping. Initial evaluation was conducted on 80 adults (40 PTSD, 40 controls; aged 18–40 years), demonstrating strong internal performance with 96.25% accuracy ($p < 0.001$; Cohen's $d > 0.8$). Independent external validation on an expanded cohort of 88 adults (44 PTSD, 44 controls) confirmed robustness, achieving 93.18% accuracy, 95.45% sensitivity, with noticeable sex-based differences. The TrauVibe mobile application enables clinicians to monitor patients in real time while tracking their physiological changes during Acceptance and Commitment Therapy (ACT) treatment. These findings establish TrauVibe as an objective, scalable, and personalized supportive tool for early diagnosis, clinical decision support, and continuous monitoring of PTSD.

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