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An unobtrusive multimodal stress detection model & Recommender System

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***Abstract*— Studies estimate that about 50% of all lost workdays are related to occupational stress (1). In recent years, several solutions for mental health management, including biofeedback applications, have emerged as a way to enhance employee mental health (2,3). Solutions to mitigate risk factors related to the working settings present an enormous potential and a clear contribution. However, most of the work that has been developed is limited to laboratory environments and does not suit real-life needs. Our study proposes an unobtrusive multimodal approach for detecting work-related stress combining videoplethysmography and self-reported measures for stablishing the ground truth in real-life settings.**

The study involved 28 volunteers over a two-month period. Various physiological signals were collected through a videopletismography solution, while users were performing daily working, for approximately eight hours a day. In parallel, self-reported measures were collected via a pop-up application (developed by the research team) that periodically retrieved the user's perceived stress (amongst other variables) in order to label the physiological data. In order to develop the stress detection model, we pre-processed the data and performed Heart Rate Variability (HRV) feature extraction. Then, we experimented with several machine learning models, utilizing both individual and combined physiological signals to explore all available alternatives. After rigorous evaluation, the best-trained model achieved an accuracy of over 80% and an F1 Score of over 85%.

With the stress detection model in place, we are developing a structured intervention model to help reduce stress. This intervention model integrates two interconnected dimensions through digital coaching, which prioritizes personalized recommendations based on user preferences. Our top priority is to ensure user engagement, and we believe that adherence to and adoption of recommended interventions are more likely when users receive recommendations that align with their preferences. Thus, we prioritize personalized recommendations that are tailored to each individual's unique model. After detecting immediate stress peaks and providing real-time feedback on stress levels, our alarm system goes a step further by offering customized recommendations for brief stress relief.

The digital coach (intervention model) offers various recommendations and active lifestyle changes such as exercise, task management, weight management, better sleep habits, structured pauses, and other critical interventions. These critical interventions are also based on user preferences, allowing our system to prevent future stress-related incidents and, most importantly, mitigate long-term stress.

This project and its methodology demonstrate that truly unobtrusive stress detection is possible and can be performed within the scope of ethical demands. In future work, we will evaluate the responses and beneficial outcomes of implementing a recommender system.

Keywords— Occupational Stress; Machine Learning.

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TOPIC

2) Technologies for the Wellbeing
   a. Multiscale Technologies and Devices for Medicine, Environment & Energy

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