
Topic: Evaluating the Efficacy of OpenDBM and Biosignal Fusion in Emotion Recognition based on FaceReader's Gold Standards

Detecting emotional states is crucial within psychology, particularly in examining conditions such as depression, where emotional dysregulation plays an essential role [1, 2]. Several methodologies have been developed to detect emotional states, using different modalities such as videos, physiological signals, texts, and more. [3, 4, 5]. One of the most common and non-invasive approaches is the analysis of facial expressions, which provides insights into a person's emotional state by observing facial movements and micro-expressions [6].

The Facial Action Coding System (FACS) [7] has been widely employed by researchers to discern emotional states from facial videos. FACS provides a detailed understanding of facial expressions, allowing for precise evaluations and the potential for tailored therapeutic interventions [8, 9, 10]. However, according to the literature, individuals diagnosed with depression often show fewer facial expressions compared to those without these conditions [11, 12]. This reduction in expressive behaviour limits relying solely on facial analysis for emotion recognition, especially in clinical populations.

To address this gap, the present study proposes an integrated approach that combines facial expression analysis with physiological signals, such as electrocardiogram (ECG) and respiration (RSP), to detect emotions. Specifically, facial features including facial action units and facial landmarks will be used alongside physiological signals. While facial expressions capture visible indicators of emotions, physiological signals offer insights into unconscious autonomic nervous system responses, making them less susceptible to voluntary control [13]. For instance, emotional experiences often trigger changes in heart rhythm, which can be detected through ECG readings. Hasnul et al. [14] conducted a comprehensive review of 51 papers focused on the classification of emotions using ECG signals, highlighting the significance of this approach. By integrating both facial and physiological data, this study aims to develop a more comprehensive emotion recognition model, particularly in cases where facial expressions alone may be insufficient.

FaceReader [15] is a widely recognized commercial software for emotion detection through the analysis of facial videos. It utilizes the FACS and facial landmarks to calculate probability scores for eight basic emotions: Neutral, Happy, Sad, Angry, Surprised, Scared, Disgusted, and Contempt [16]. This study will use these probability scores as ground truth to assess the performance of the custom model. The goal of this master's thesis is to combine the features of ECG, RSP, and those extracted by the OpenDBM toolkit [17] from facial videos to build a custom model for emotion detection using the EmpkinS D02 dataset [18].

The proposed work consists of the following parts:

- Literature review on the connection between emotions and psychophysiological signals, as well as emotion recognition through both facial expressions and physiological signals.
- Collecting the EmpkinS D02 dataset including video recordings and physiological signals from healthy individuals and those diagnosed with depression.
- Preprocessing data using OpenDBM and FaceReader version 9 software to extract facial features, and NeuroKit2 [19] package to extract features from biosignals.
- Implementing several machine learning algorithms to detect basic emotions.
- Evaluating the effectiveness of the custom models to assess the accuracy and reliability of the developed models.

The thesis must contain a detailed description of all developed and used algorithms as well as a profound result evaluation and discussion. The implemented code has to be documented

and provided. An extended research on literature, existing patents, and related work in the corresponding areas has to be performed.

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