Topic: Machine Learning Approaches for Depression Detection using Physiological Signals

Depressive disorder is a widespread mental health condition marked by a persistent low mood, reduced cognitive function, slower thinking, and in more severe instances, recurring thoughts of suicide [1, 2]. According to the World Health Organization (WHO), approximately 3.8% of the global population is affected by depression [3]. Depression has become a significant global health burden, and the need for objective detection and identification methods is increasingly becoming a public health issue. Current clinical diagnosis of depression relies heavily on subjective judgement of clinician and patient, emphasizing the need for more objective approaches. Such methods can offer physicians an accurate, inexpensive, and non-invasive way to diagnose depression [4]. Recent advancements in machine learning have opened new possibilities for detecting depression through the analysis of physiological signals.

In the context of depression detection, research indicates that physiological signals can give insights into an individual's mental state [4]. Numerous studies have previously utilized physiological signals such as Electromyogram (EMG), Electrocardiogram (ECG), and Respiration (RSP) for the detection of emotion [5 - 8], stress [9, 10], anxiety [11], and depression [4, 12]. Typically, researchers in the prior studies have examined these signals in patients during resting or task-related activities to distinguish depression by analyzing differences between individuals with depression and those without depression [4].

This thesis aims to address a notable research gap by integrating ECG and RSP data, along with EMG data specifically from the Orbicularis Oculi, Zygomaticus, Corrugator, and Masseter muscles, to detect depression and predict the severity of symptoms as measured by the Patient Health Questionnaire (PHQ-8) scoring system [13]. To date, there has been no comprehensive study that integrates all these physiological signals into a multimodal model for depression classification and severity prediction. By leveraging a multimodal approach, this thesis seeks to provide a more nuanced understanding of depression and could lead to the development of more effective diagnostic and monitoring tools.

The proposed work consists of the following parts:

- Review of existing literature on detecting depression through physiological signals.
- Collecting EmpkinS D02 dataset [14] from participants, including individuals both with and without depression.
- Preprocessing and cleaning the acquired data.
- Extracting features from the collected data, including standard statistical features and other features informed by prior literature research.
- Implementation of different classification algorithms to distinguish between participants with and without depression.
- Implementation of different regression algorithms to predict PHQ-8 scores.
- Evaluation and analysis of the developed machine learning 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. Extended research on literature, existing patents and related work in the corresponding areas has to be performed.

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