Brain and Heart Rate Variability Patterns Recognition for Depression Classification of Mental Health Disorder

Authors Qaisar Abbas, M. Emre Celebi, Talal AlBalawi, Yassine Daadaa

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Abstract: Depression is common and dangerous if untreated. We must detect depression patterns early and accurately to provide timely interventions and assistance. We present a novel depression prediction method (depressive -deep), which combines preprocess brain electroencephalogram (EEG) and ECG-based heart-rate variability (HRV) signals into a 2D scalogram. Later, we extracted features from 2D scalogram images using a fine - tuned MobileNetV2 deep learning (DL) architecture. We integrated an AdaBoost ensemble learning algorithm to improve the model's performance. Our study suggested ensemble learning can accurately predict asymmetric and symmetric depression patterns from multimodal signals such as EEG and ECG. These patterns include major depressive state (MDS), cognitive and emotional arousal (CEA), mood disorder patterns (MDPs), mood and emotional regulation (MER), and stress and emotional dysregulation (SED). To develop this depressive-deep model, we have performed a pre-trained strategy on two publicly available datasets, MODMA and SWEEL-KW. The sensitivity (SE), specificity (SP), accuracy (ACC), F1-score, precision (P), Matthew's correlation coefficient (MCC), and area under the curve (AUC) have been analyzed to determine the best depression prediction model. Moreover, we used wearable devices over the Internet of Medical Things (IoMT) to extract signals and check the depressive-deep system's generalizability. To ensure model robustness, we use several assessment criteria, including cross-validation. The depressive-deep and feature extraction strategies outperformed compared to the other methods in depression prediction, obtaining an ACC of 0.96, IOTSE of 0.98, SP of 0.95, P of 0.95, F1-score of 0.96, and MCC of 0.96. The main findings suggest that using 2D s calogram and depressive-deep (fine-tuning of MobileNet2 + AdaBoost) algorithms outperform them in detecting early depression, improving mental health diagnosis and treatment.