Multimodal Hierarchical CNN Feature Fusion for Stress Detection

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Abstract

This study presents a hierarchical CNN-based feature fusion model for detecting stress using EEG signals. By integrating low, mid, and high-level features, the model captures a comprehensive representation of physiological data, enhancing accuracy in classifying stressed versus non-stressed states.

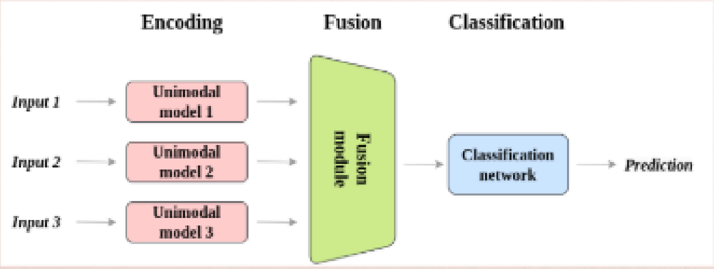

Figure1: Multimodel fusion system

About dataset and code

Data:
- The dataset contained the eeg signals of 58 participants through 8 different channels, watching 36 different videos
- Self-ratings were taken from the participants regarding different senses and feelings

Model Training:
- Built using TensorFlow/Keras with a dense neural network architecture for hierarchical fusion.
- Separate training of low, mid, and high-level feature models, then concatenated for final output.

Stress Classification:
Created a stress indicator based on the self-reports of the participants and binary classification was done through conventional method as well as the proposed fusion method.

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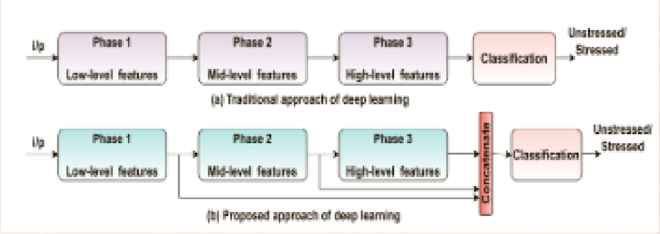
Method

Feature Extraction:
- Low-level features: Basic statistical features (mean, variance, skewness, etc.)
- Mid-level: Frequency-based features (band power, entropy)
- High-level: Complex metrics (fractal dimension, Hurst exponent).

Fusion Strategy:
Hierarchical extraction of EEG data was performed for different feature levels and then was concatenated across feature levels for comprehensive representation.

Classification:
Deep learning classifier trained to classify target label based on fused features. This fusion-based approach enhances the model's ability to detect stress accurately by leveraging comprehensive feature sets across multiple levels of abstraction.



Fugure2: Traditional and proposed deep learning techniques are depicted in (a) and (b)

Results

- The proposed fusion model demonstrated higher classification accuracy in identifying stressed vs. non-stressed states than the conventional
- The conventional model attained the accuracy of around 92-94% whereas the fusion model showed accuracy of somewhere around 96-98%, consistently outperforming the coventional one with 2-4%, as proposed in the paper