Emotional state classification using low-cost wearable VR-EEG headsets: A Dataset for Emotion Recognition using Virtual Reality and EEG (DER-VREEG).

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Editorial

Emotions are seen as a crucial component of human relationships and dialogues, allowing for successful and logical decision making. Emotion recognition employs low-cost wearable Electroencephalography (EEG) headsets to collect brainwave signals and interpret these signals to provide information on a person's mental state, with the implementation of a virtual reality environment in various applications; the gap between human and computer interaction, as well as the understanding process, would be reduced, providing an immediate response to an individual's mental health. The goal of this study is to use a Virtual Reality (VR) headset to induce four classes of emotions (happy, scared, calm, and bored), collect brainwave samples using a low-cost wearable EEG headset, and run popular classifiers to compare the most feasible ones that can be used for this specific setup. To begin, we seek to create an immersive VR database that is open to the public and might potentially aid in emotion identification research utilizing virtual reality stimuli. Second, we employ a low-cost wearable EEG headgear that is both compact and tiny, and can be linked to the scalp without any difficulty, allowing participants to move freely inside the immersive VR environment. Finally, we assess and compare the emotion identification system using prominent machine learning methods for intra-subject and inter-subject categorization. The findings demonstrate that the prediction model for the four-class emotion classification worked well, even for the more difficult inter-subject classification, with the Support Vector Machine (SVM Class Weight kernel) achieving 85.01 percent classification accuracy. This demonstrates that employing fewer electrode channels but with adequate parameter tweaking and selection characteristics influences classification performance. This demonstrates that employing fewer electrode channels but with adequate parameter tweaking and selection characteristics influences classification performance.

Introduction

Emotions are seen as a crucial component of human relationships and dialogues, allowing for successful and logical decision-making. Multiple neurophysiological sensors gather bio-signals released within the human body to better understand how these reactions are made or determined. Electrocardiograms (ECGs) are devices that measure the heartbeat; Electromyograms (EMGs) are devices that measure muscle movements; Electrodermal Activity (EDA) is a device that measures skin conductance; Electrooculograms (EOGs) are devices that measure eye movements; and Electroencephalography (EEG) is a device that measures brainwave signals directly from the brain. Current medical gadgets have been designed to be non-invasive, which decreases hazards and allows many individuals and researchers to conduct tests on human physiology in a safe environment. Many researchers have been drawn to emotion identification utilising EEG data in order to better understand the elicitation of emotional responses from the human brain. Human-computer interaction (HCI), emotion understanding, Brain-Computer Interface (BCI), and medical applications can all benefit from emotion recognition systems. Because of the huge variances in each individual's brainwave patterns, the EEG emotion identification system presents a unique difficulty, especially when each individual's association with emotional events is distinct. EEG data can help with the gathering of brainwave signals by putting non-invasive electrodes on the scalp in accordance with the 10-20 worldwide system placement guidelines. These electrodes then gather EEG data, which are subsequently filtered using the fast Fourier transform (FFT) to produce rhythmic bands such as the delta (4 Hz), theta (4-7 Hz), alpha (8-13 Hz), beta (14-30 Hz), and gamma (>30 Hz). Furthermore, several of the low-cost wearable EEG headsets include an inertial sensor built in that collects gyroscope and accelerometer data.

Related work

The database offered in this study investigates the prospect of categorising emotions by generating reactions using a virtual reality environment that replicates an immersive experience resembling real-life scenarios. To the best of our knowledge, the use of a VR-based stimulus for evoking emotions has rarely been investigated, despite the fact that VR technology has proven to provide significant immersive experiences for entertainment, virtual walkarounds, and simulated driving, providing an opportunity for researchers to collect physiological responses for emotion evaluation and classification. The contribution of this work is to investigate the usage of a VR-based stimulus to elicit emotional reactions from participants and to test this suggested categorization model using machine learning methods.

Conclusion

This study presented the results of classification performances using KNN, SVM, FANN, DRF, GBM, and NB using videos displayed in a VR headset that was paired with a low-cost wearable EEG headset that had four recording electrode channels (TP9, TP10, AF7, and AF8) as well as inertial sensing data to classify the participants' emotions into four distinct emotion classes. The results showed that inter-subject variability had an accuracy of 85.01 percent, although the complexity of a big dataset of 20,000 rows was higher than intra-subject variability with just around 640 rows, which had an accuracy of 97.66 percent. The classifiers' results demonstrated their capability while employing various preprocessing and input characteristics, such as interpolation, single bands, five bands in combination, and inertial sensing data.

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