Machine Learning-Based Identification of Cognitive Engagement States in EEG Data Driven by Visual Stimulation

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Many actions in everyday life are becoming more automated, but critical tasks continue to require human oversight. Automatic driving systems automate repetitive functions through the use of machine learning. However, they rely on a human user to take over instantly when a critical, often life or death, event occurs. How does an automated system ensure that the human user is engaged and ready to take over? Human consciousness is defined as the ability to perceive and model the environment, which is represented as frequencies in the brain. This project assesses a variety of Machine Learning algorithms to identify the features of the neural response to visual stimuli that are most indicative of comprehension of that visual stimuli. Provided EEG data of brainwave measurements was used, which was taken from deaf singers while watching two sets of videos; one, displaying a signer signing different sentences, and two, the same videos played in reverse. These two stimulus conditions were then equivalent in temporal parameters, but only one condition (forward signing) was comprehensible. The peak correlation between the video's motion (optical flow) and the singer's EEG was passed into machine learning algorithms as input parameters. The machine learning algorithms were then trained to classify the subjects brain state into comprehension or non-comprehension based on the correlation between the EEG brainwaves and the optical flow of the videos. This analysis shows that it is possible to classify a person's brain state between comprehension and non-comprehension based on the brain's response to visual input.