SURGE 2023: PROJECT ABSTRACT FOR MIDTERM REVIEW

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PROJECT TITLE: Application of Machine Learning in Cognitive Load Detection and the Effect of Music on It

ABSTRACT:

The amount of mental work needed to execute a task is known as cognitive load, and it can be used to forecast performance, fatigue, and stress levels. With the use of real-time identification and monitoring of cognitive load levels, cognitive load recognition aims to enhance human performance. According to the cognitive load theory, cognitive overload happens when mental activity surpasses the working memory capacity limit because information processing that takes place during the learning process must fit inside this limit.

Cognitive load was measured using electroencephalogram (EEG) analysis. EEG is the flow of electricity generated by signal transmission between brain nerves. Because EEGs exhibit different frequency wavelengths depending on mental activity, the degree of cognitive load can be measured by EEG analysis. Brainwaves are divided into delta (0–4 Hz), theta (4–8 Hz), alpha (8–12 Hz), low beta (12–16 Hz), high beta (16–25 Hz), and gamma (25–50 Hz) waves, depending on their frequency. The intensity of brainwaves varies according to the state of human mental activity, and the degree of human cognitive load can be estimated based on this measurement. Theta waves are present in deeply relaxed,inward focused state with delta waves being prevalent in sleep state. Alpha waves appear mainly in relaxed with passive attention, beta waves appear in problem solving, and gamma waves appear mainly in more complex mental functions.

For this, a public dataset was utilised. It was made up of five subjects' combined 25-hour EEG records while they were performing a low-intensity control task. The task involved utilising the "Microsoft Train Simulator" programme to steer a computer-simulated train. In each trial, participants used the aforementioned computer simulation programme to operate a train for 35 to 55 minutes over a largely featureless course. The three mental states that were looked at in this study were passive but focused attention (0–15 minutes of job), alert but unfocused (15–30 minutes of task), and drowsy (30–45 minutes of task).

Noisy channels and channels with little to no signal range were ignored.A pipeline consisting of a butterworth highpass filter and an STFT (Blackman window) was employed for data pre-processing. Finally, 4 models were compared –SVM-linear, SVM-RBF, KNN, and decision trees ;with SVM-RBF, and KNN performing the best.

Here, two evaluation paradigms (common-subject-all users and subject-specific) were assessed: The mental state detector was specifically trained for each participant in the subject-specific paradigm using data that was exclusively gathered for that person. A single detector was collaboratively trained for each participant in the common-subject paradigm. The best accuracy for all user data was a final 91%.

KEYWORDS: Cognitive Load, Brainwaves , butterworth filter ,STFT, SVM, KNN, Decision trees.

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