A Brain-Gaze Controlled Musical Interface.

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1 Abstract

Brain Computer Interfaces could improve the quality of life of people with severe motor paralysis, like ALS or locked-in syndrome patients. The EyeHarp [1] is a gaze-controlled musical interface. In this poster we extend the EyeHarp to a hybrid Gaze-Brain controlled interface for real time musical expression. Based on the Thayers arousal-valence emotion plane [4], and using the Emotiv commercial EEG device [2] and the OpenVibe software for designing Brain-Computer Interfaces [3] we attempt to estimate the emotional state of the performer. A positive valence value triggers major chords progressions while a negative valence triggers minor chords progressions. The estimated arousal affects the speed and intensity of the arpeggios generated in the EyeHarp musical Interface. Such an interface could enable ALS patients to express their emotions through music in real time.

2 Estimating Valence and Arousal

There are indications that arousal is related to high beta and low alpha activity, while the valence is related to the frontal brain asymmetry ([5], [6], [7], [8]).
For estimating the arousal we compute the (beta power)/(alpha power) over 4 and 20 seconds. By subtracting the 20 seconds value from the 4 seconds value and dividing with their current maximum absolute difference we get an estimated normalized value for the arousal.
In order to obtain a normalized value for the valence, we subtract the right hemisphere' s (beta power)/(alpha power) from the left hemisphere' s (beta power)/(alpha power) over 4 and 20 seconds. Then by subtracting the 20 seconds value from the 4 seconds value and dividing with their current maximum absolute difference we get an estimated normalized value for the valence.
For the computations in the left hemisphere we use electrode F3 (AF3 as a reference), while for the computations in the right hemisphere we use electrode F4 (AF4 as a reference). That way we handle the lack of a central reference electrode in the Emotive EEG device for cleaning the signal.

3 Performing with the Gaze-Brain Controlled Interface

In the EyeHarp interface, four arpeggios are generated. The first one is slow and peaceful, as is consists of quarter notes. The seconds one consists of 8th , the

3rd one of 16th and the fourth one of 32th notes. The volume of each of these arpeggios depends on the estimated arousal value. A high arousal will result in an intense, rapidly changing arpeggios, reflecting the excitement of the performer, while a low arousal value will result to a peaceful rhythmic background.

Three pre-set chord progressions are generated depending on the estimated valence value. Positive values will result to chord progression with major chords, giving a happy feeling, while a negative valence with generate a more sad, based on minor chords, chord progression.

Finally the performer can play a melody in real time with his gaze. The rhythmic and harmonic background depends on his estimated emotional state. At the same time we provide a visual feedback of the emotional state of the performer. The arousal affects the background brightness, while the valence affects the colour of the EyeHarp Interface.

References

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