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Sheet Music by Mind: A BCI for Composing

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Introduction: A direct connection between the human brain and a computer is a so called brain-computer interface (BCI). P300-based BCIs are often used for communication and control and various applications (e.g., speller [1], brain painting [2], environmental controller [3] and web browser [4]) are already implemented. Our aim is to provide a composing system comparable with the brain painting system [2], which can be used in real-world settings.

Material, Methods and Results: We connected a P300-based BCI system with a powerful music composing software (MuseScore, http://www.musescore.org). This software enables the user to compose music for several voices, instruments, and other composing tools. The composed music can either be listened immediately within the application or exported to a MIDI file to be used with real instruments.

Five volunteers (3 male; mean age 24.0±1.7 years) participated in this study. Eight EEG channels (Fz, FC1, FC2, Cz, Pz, PO7, PO8, and Oz) with water-based sensors were used. The biosignal amplifier (Mobita) uses wireless technology to transmit the signals with 24 bit resolution. A classical P300-based BCI (7x6 matrix) using famous faces was setup, see Fig. 1. The first two rows of the matrix are to select the note value and other features of the actual note or bar. The third row represents the different pitches. The following rows are to select other features of the application e.g., next or play bar. Calibration was performed with fifteen highlightings per row and column. The music composing task was started by the operator by selecting ”Music Composing” in the user interface menu. The composing application started automatically on a second screen placed above the matrix screen and the ”letter” matrix from the calibration changes to the ”main menu” matrix (3×6 matrix) of the composer software. First, the participants had to select the ”compose” element out of three other elements (”New”, ”Open”, ”Save”). If the ”compose” element was selected the matrix switched automatically to the 7×6 ”composing” matrix, see Fig. 1, left. Then the participants were asked to copy-compose the first six bars of Alouette, a famous French Canadian children’s song, Fig. 1., right.

Three out of the five participants were able to copy-compose the given melody. Their accuracies were 57%, 58%, 78% 83 and 96%, whereas the best performing participant (P5) needed on average 3.9 (±1.1) sequences until the system stopped highlighting and presented the classifier result.

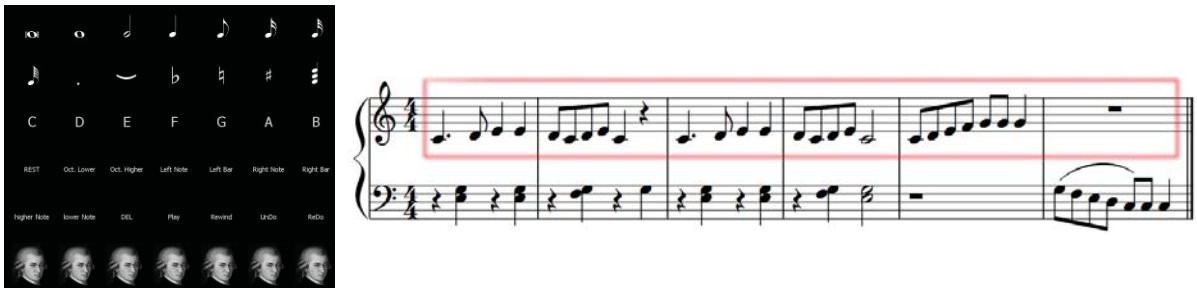

Fig. 1: Left: P300 matrix. Right: music to be composed in the upper row. The base line was given already, to present a nicer music to the participants after the composing task.

*Discussion:*In this pilot study, the idea to compose music with a BCI was introduced and successfully tested. We could show that it is possible to setup a P300-based BCI system (8 channels) and copy-compose a short melody (25 notes, min. 42 selections) within 45 minutes. Three out of five volunteers were able to operate this brain composer with excellent success.

Significance: With this brain composer system it is nicely possible to also really compose music, an example is given in the following video: https://youtu.be/sW9nkC06D94

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