# A Biofeedback System to Compose Your Own Music while Dancing

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**Abstract.** Brain Computer Interfaces can enable engaging interactions between different art forms such as music, dance, painting. Building on this, we present a demo of a biofeedback system: a dancer wearing a NeuroSky headset adapts her performance according to the music she listens to. The same music has been generated by a music-composition software depending on her own real-time mental status represented by different fluctuations of some EEG parameters.

**Keywords:** Brain Computer Interface, Biofeedback, Music.

## 1 Introduction

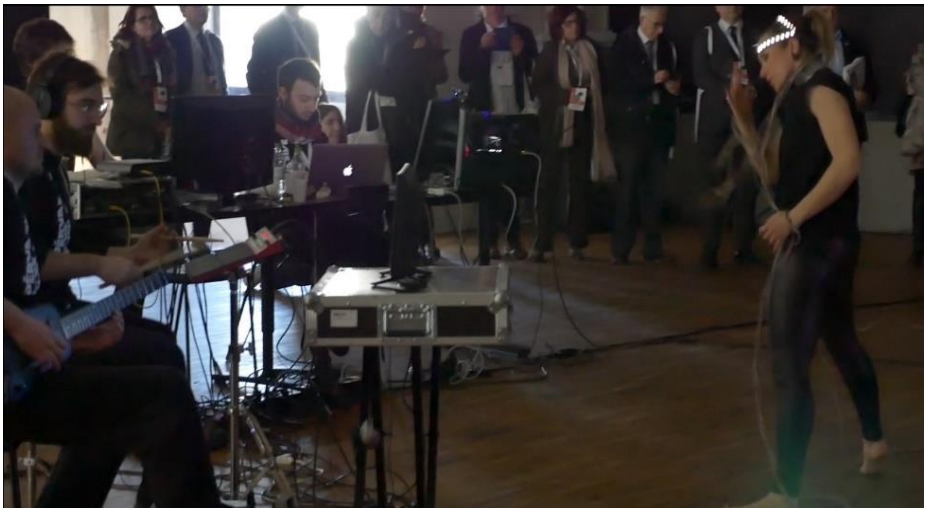

**Fig. 1.** An actual implementation of the proposed biofeedback system.

The relationship between various art forms is one of the fields of investigation that crosses all artistic disciplines, from musicians/composers to choreographers and theater or cinema directors. The interplay between music and dance has profoundly influenced composers of every era by creating new technical-compositional models both in the world of music and in the world of dance itself. At the same time, in Computer Science,

the interest in Brain Computer Interfaces (BCIs) has significantly increased in recent years, because it represents a possibility for implementing a more intrinsic human-machine relationship. Also biofeedback systems [1] are gaining momentum, characterized by the continuous loop between users wearing a BCI and computers.
In this paper, we propose the demonstration of a biofeedback system that puts in a choreographic/compositional relationship a dancer with a music composition software developed on purpose and two musicians. The dancer wears a NeuroSky MindSet device [2] that detects some neurologic parameters, in particular her attention values [3]. Depending on these values, the software generate a music polyphony that is presented on an electronic score to musicians, who play it. In turn, the music thus produced influences the mental status of the dancer, who will adapt her choreography according to what she hears, generating new polyphonic musical bars. A live demonstration of the system is available at https://www.youtube.com/watch?v=G4937hQvDQI

**Fig. 2.** Dancer wearing the BCI headset during a live performance. [1]

## 2 System Architecture and Operation

The hardware part of the system is based on the NeuroSky MindSet, i.e. a device that can detect the brain EEG signal through a dry electrode placed on the forehead at the Fp1 position [4]. It translates electrical impulses related to brain neuronal activitỳ into digital numerical signals that can then be processed by a computer. The electrical signals can be measured by placing the electrode of the device on the forehead. The NeuroSky MindSet headset returns two parameters, namely attention (similar to concentration) and meditation (similar to relaxation) [3], [5].

[1] The cables connected to the dancer's wrists, as well as the light strips on the headset are only for choreographic reasons and do not have any further technical implication.

**Fig. 3.** The NeuroSky MindWave Mobile 2 used in the system.

The general workflow of the system usage is schematized in **Fig. 4**. The *dancer*, wearing the NeuroSky MindSet headset, starts dancing. The device transmits every second her values of attention. The algorithm of *Polyphony Generator* module, depending on the intensity of the attention value, generates strings of rhythmic musical figures. For an high attention status, polyphonic voices are generated with smaller musical values such as quarter note, eight musical note and sixteenth note and relative pause value. For low attention status, polyphonic voices with larger musical values such as whole note, half note and quarter note and relative pause values are generated. Given the attention value, the algorithm selects a set of rhythmic values and generates strings of rhythmic figures in a scramble modality.

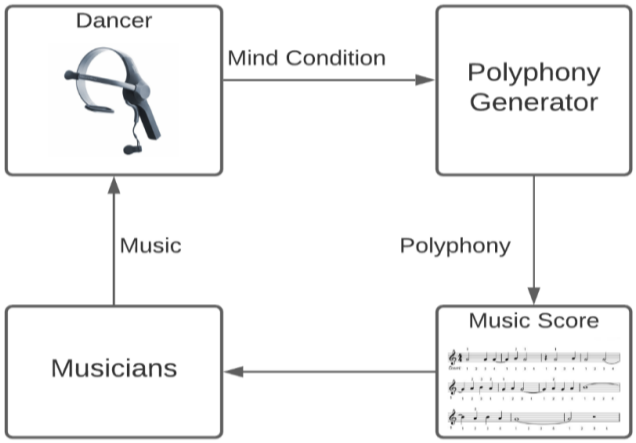


**Fig. 4.** System workflow.

The software is provided with a graphical interface that permits to choose on which musical scales model the polyphony is generated (see **Fig. 5**). All possible scales that can be calculated within an octave interval can be selected. Finally, the generated rhythmic sequences are superimposed on the previously selected scalar model. The process is repeated for all four voices of the polyphony texture. The music score reporting the

resulting polyphony is displayed and continuously updated on a screen, so that Musicians can play it.

## 3 Conclusion

We presented a biofeedback system useful for the interaction between Music and Dance in a BCI context. A possible evolution of this work could be to implement emotion recognition techniques to further improve the interaction between different art forms.

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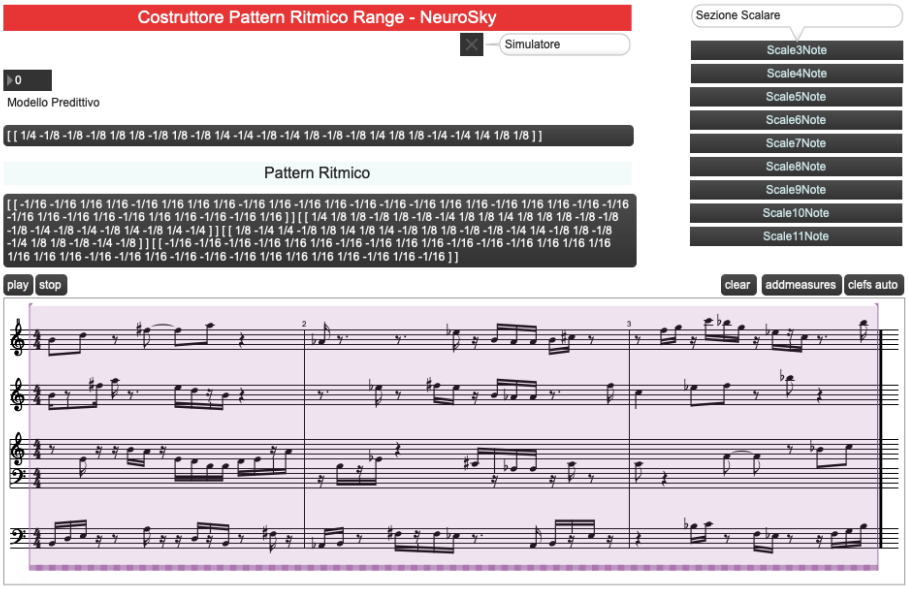


**Fig. 5.** User interface of the Polyphony Generator module.

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