Musikcyklarna/Music bikes: An installation for enabling children to investigate the relationship between expressive music performance and body motion.

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1. BACKGROUND

The generation of a sound with an object implies the need for an action on the object itself which can be exerted for example either from a person or from another object. The same is true when playing a musical instrument: sound is the results of a physical interaction between the player and the instrument.

2. AIM

In a joint project between KTH Royal Institute of Technology and the Tom Tits Experiment Science Centre (TTE), we have created a permanent installation, with the Swedish name *Musikcyklarna* (the Music bikes). The main aim of the installation is to communicate to TTE visitors, in particular children, basic scientific principles of the relationship between movement and emotion in music performance.

We wanted TTE visitors to understand and start reasoning about the concept that there is no sound, hence neither music, without injecting energy in a sound producing system by using movement. Any musical instrument produces sound only when a player is exerting some kind of movements on it, e.g. think about lip vibrations of a trumpet player or finger movements in piano playing.

3. METHOD

We built an installation (see Figure 1) made by two bicycles, two sensors on each bicycle (one detecting the number of rear wheel rotations and another one measuring the rotation angle of the handlebars, corresponding to the rotation angle of the front wheel), one Arduino sensor board receiving data from the two sensors and connected to a computer, two loudspeakers placed on the handlebars (see Figure 1), one large screen for visual feedback, and some software tools including pDM [1]. pDM is a Pure data [1] path for the realtime expressive manipulation of MIDI files which have been pre-processed using Director Musices [2],

[1] Pure data: http://predata.info
[2] Director Musices: http://odyssomay.github.io/clj-dm/

Figure 1. The *Musikcyklarna* installation with two users at thes Experiment. Notice the two loudspeaker on the handlebars, the rotation sensor for the front wheel and the magnetic field sensor behind the rear wheel. The display shows two blobs corresponding to the position of each bicycle in the activity-valence space

a program implementing the KTH rule system [2]; for example the user can move a mouse pointer (or other sensors) in a two-dimensional space corresponding to the activity-valence space, such as that described by Russel [3], and the performance will change emotional expression by adding deviations of time, sound level, and articulation [4, 5].

We choose to map the speed of the rear wheel (correlated to the speed of pedalling) to the amount of activity to be used in the music performance, and the angle of handlebars to the valence in the performance. Handlebars rotated towards right will direct the music performance towards positive emotions, and towards negative ones when rotated to the left. pDM was used for performing the score with the corresponding amount of activity and valence, that was also graphically displayed on the large screen placed in front of the two bicycles, in which the four corners correspond (clockwise from the left upper corner) to anger, happiness, tenderness, and sadness respectively. When the pedals are not moved, the music stops after 5 seconds. The system selects a new music score each time the system has been paused. The installation can be used both in single-user mode or two-users mode.

Active emotions are displayed high up in the screen so that when users start to pedal faster the corresponding vi-

sual feedback is moved towards the top of the screen. When two bicycles are active at the same time (in the two-users mode) the relative distance between the emotions expressed by each of the two users is displayed, and the emotion of corresponding musical feedback is that corresponding to the middle position between the two emotions.

The final design of the *Musikcyklarna* installation was achieved after a few design iterations in which we tested different kinds of both visual and musical feedback after having observed user behaviour. For the visual feedback we tried to make it more clearly associated to musical content and its emotional expression by representing the current position in the activity-valence space with sparkling musical notes changing colour according to the current emotion portrayed by the performance [6]. The musical feedback was made more clear by exaggerating the emotion in the performance, e.g. so that it sounded exaggeratedly sad or happy by increasing the deviations of the acoustic parameters from their average values as defined in a previous study by Bresin and Friberg [5]. This is important specially in the context of TTE in which several visitors are walking and talking in the same exhibition space as the installation, and therefore it can be difficult to appreciate subtle differences in a music performance.

4. RESULTS

The installation has been running in its current form since June 2014, and has been visited by approximately 11000 users. It has proven to be stable also under periods of heavy use (such as Summer holidays and Fall holidays), and engaging.

From observations of user behaviour it clearly emerges that users of all ages understand the metaphors that there is no sound without pedalling and that increasing energy into their actions produces more active performances, either happy or angry depending on the position of the handlebars.

When using two bicycles, visitors of age 10 and above understand the metaphor of collaboration for achieving a joint performance that produces the desired emotion. Younger visitors have a tendency to compete against each other by cycling faster, and producing faster music performances. This is also due to their shorter height that makes it difficult to control the direction of the handlebars.

At the conference we will present preliminary results from interviews to users.

5. CONCLUSIONS AND FUTURE WORK

We are planning a thorough analysis of user behaviour in the near future. We want to make studies based on user age, and this is possible since several school classes with schoolchildren of different ages are visiting TTE during the year. We expect to gather information on children understanding of the interaction between music, motion and emotion, and this varies across children of different age.

Keywords: Emotions, Motion, Music Performance, HCI

Acknowledgments

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