Ginevra Castellano

Scientific Report from ConGAS Short Term Scientific Mission (STSM) to Stockholm

Host institution: Department of Speech, Music and Hearing (TMH), KTH
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Objectives

My visit at KTH aimed to develop a system in which audio-visual feedback is provided to users who are free to move in the space. The feedback depends on the expressivity of the body movements they perform. Specifically, users can render a music performance by controlling in real-time acoustic parameters through their full-body movement and get a visual feedback on a screen in front of them with colours depending on the expressivity their movement communicates.

How the system works

The system is based on the integration of two different software platforms: EyesWeb (Camurri et al., 2004), for multimodal analysis of multiple streams of data, and pDM (Friberg, 2006; Friberg et al., 2006), a software developed at KTH, and that allows to render music performance with different emotional characterizations by manipulating acoustic parameters such as sound level, tempo, and articulation.
The system acquires input from a video camera, processes information related to the expressivity of human full-body movement, extracts expressive indicators and controls the sound expressivity manipulation and the visual feedback generation.
Human movement is being analysed with the EyesWeb platform and expressive motor features are being automatically extracted.
We focused on two expressive motor features: the quantity of motion and the contraction index.
The quantity of motion is directly related to the velocity of the movement performed by the users and the contraction index is a measure of the degree of contraction/expansion of the gestures.
Both the motor features are global indicators of the human movement.

Visual feedback generation

Visual feedback was designed to respond to a specific expressive motor behaviour of the user, by using appropriately colours changing depending on the emotions communicated by the user's movement. More specifically users, moving in the space, can see their own silhouette projected on a screen with different colours, depending on their movement expressivity.
We focused on five emotions, each of them related to one specific combination of quantity of motion and contraction index values: sadness, serenity, happiness, fear and anger.

Accordingly to theories on movement and emotions from psychology (Boone and Cunningham, 1998; De Meijer, 1989; Scherer and Wallbott, 1985; Wallbott, 1998) and previous studies on expressivity conducted both at DIST and at KTH (Camurri et al., 2003, 2005, 2006; Dahl and Frieberg, 2006), we defined the following correspondence between emotions and movement characteristics (table 1):

Emotion	Movement characteristics
Sadness	Slow, contract movements
Serenity	Slow, expanse movements
Happiness	Fast, expanse movements
Anger	Very fast, expanse movements
Fear	Fast, contract movements

Table 1: relations between emotions and movement characteristics

Accordingly to previous studies by Roberto Bresin at KTH (Bresin, 2005), we associated the following colours to the emotions communicated by the movement (table 2):

Emotion	Colours
Sadness	Violet
Serenity	Rose
Happiness	Yellow
Anger	Red
Fear	Blue

Table 2: relations between emotions and colours

Emotions detection based on movement analysis and visual feedback generation were both made by using the EyesWeb platform.
In figure 1 we report an example of visual feedback showed to the user.

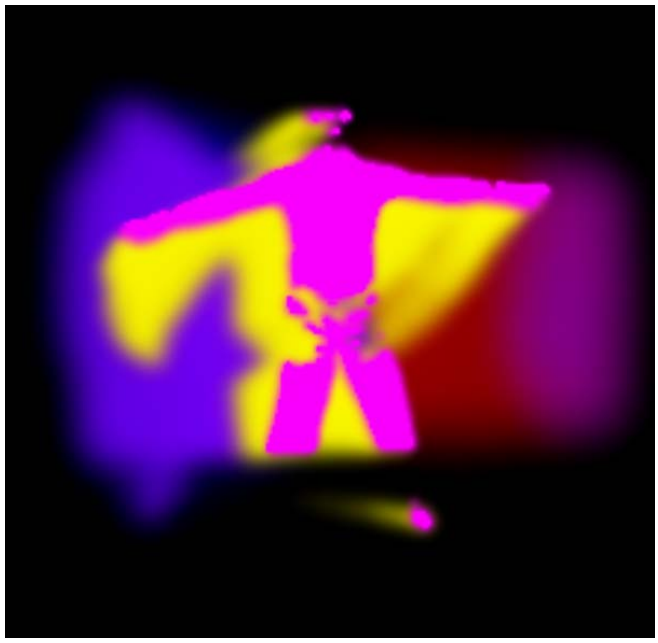

Figure 1: example of visual feedback

Acoustic feedback generation

Acoustic feedback was designed with pDM accordingly to the motor features extracted in real-time with EyesWeb.
We defined the following correspondence between human movement cues and acoustic cues used in pDM for expressive performance rendering:

Quantity of Motion → Tempo, articulation
Contraction Index → Sound level

In the system, the dynamic variations of the motor cues control in real time the dynamics of the acoustic cues: users, moving in the space, can control a music performance.
An increase of the quantity of motion increases the tempo and the articulation, a decrease of the contraction index (high expansion) increases the sound level. The relation between motor cues and acoustic parameters is being designed directly, without defining a mapping with emotions.

Ongoing work and future plans

The application was shown in occasion of a national exhibition in the context of the Festival della scienza at Casa Paganini, Genova (10/26/06-11/07/06).
We received positive feedback from the participants who tested in real time the application.
We plan to do further tests for perceptive studies with subjects, in order to evaluate the effectiveness of the audio-visual feedback in reproducing movement expressivity of users and the impact on user's engagement.
A joint paper between DIST and KTH is planned.

References

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