DANCE

D5.2 – Revised use cases

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Introduction

This Deliverable reports a revised, and final, version of the DANCE project Use Cases (UCs). They cover the entire palette of the DANCE research aspects and perspectives of exploitation. All the UCs stem from models of user's movement quality: UC1 focuses on a single user's body analysis, UC2 on a group of users. Users are involved in a dance experience in a gamification context (UC3), or they can be actors of an artistic performance (UC4). This Deliverable also provides details on how the UCs have been concretely implemented in DANCE. In particular, UC4 finds its main implementation in the artistic project "Atlante del gesto" by Virgilio Sieni, a project involving over 150 non-expert citizens in Genoa and a group of dancers, for a period of over three months, from January to March 2017, with weekly rehearsals in the whole period. This project was presented in a public event at Palazzo Ducale in Genoa on 28 November 2017: the goal is to raise in citizens the awareness of movement qualities, to reconnect and enhance their communication capabilities through embodiment and in-depth experience of gesture and physical social interaction. Its final public presentation is planned on 24, 25, and 26 March in three different sites in the city of Genoa (Palazzo Reale, Palazzo Balbi of University of Genoa, and Auditorium San Filippo). These over 150 citizens will be active participants of these events. This artistic event will also be an occasion to experiment and explore other UCs, including experiences with a blind dancer, as well as non-expert dancers.

The UCs described in this Deliverable have been revised starting from the proposal of the DoW and from Deliverable 5.1, following the feedback obtained by the work in the first half of DANCE, including various meetings with dancers and choreographers (including the famous choreographers Sagi Gross, Jacopo Godani, and Virgilio Sieni), and with scientists and technologists in several public occasions, including the preliminary experiments and feasibility studies, the two EU public events SONAR+D (Barcelona) and STARTS (Brussels), and the above mentioned ongoing artistic project "Atlante del Gesto".

A new UC is proposed, UC3. Its implementation, the serious game scenario *Move In The Dark*, to explore and evaluate movement qualities and sonifications, was presented at a demo session at the MOCO 2016 International Conference in Thessaloniki..

All the UCs exploit the Movement Qualities included in the multimodal analysis framework described in [1].

1 Use Cases

1.1 Use Case 1 – What do you see, when "hearing" a dance ? (Scientific, Individual UC)

A user is either temporarily deprived of vision, or congenitally blind. She learns how to recognize (her own as well as others') movement qualities only by the auditory channel: following one of the main DANCE guidelines, sensory deprivation is here a mean to amplify user's capabilities and sensibility in recognizing individual movement qualities by means of the auditory modality. This UC is structured in two instances, described below.

In the framework of this UC, and by working with the choreographer V. Sieni, we organized a 30 hours long (split into several weekly lessons) workshop titled "Atlante del Gesto - Genova", that will take place in Genoa during the months of January, February, and March 2017. Both experienced (e.g., professional) and non-experienced dancers will be taught how to exploit the V. Sieni's dance vocabulary to express themselves and communicate with each other in a non-verbal way.

Instance 1 - What do you play (with a music instrument), when "hearing" a dance?

The "Emobodies - When Art Meets Science" seminar took place at the Theater aan het Vrijthof (Maastricht) during the Jazz Festival on March the 19th, 2016. Organized by the blind pianist Bert van der Brink and the dancer and choreographer Sagi Gross, the performance exploits technologies developed in the DANCE Project: four IMU (Inertial Movement Unit) sensors are used to capture the dancer's movement. Expressive movement detection algorithms are used to recognize the dancer's movement quality, which is sonified in real-time using sonification models. In the performance, while the dancer performs her choreography, the blind pianist hears the sonification of the dancer's movements through headphones. That is, the audience can hear the pianist improvising to the sonification of the dancer movements.

From this use case, future scientific experiments can be derived. For example, the audience could hear both the sonification of the dancer's movements and the music played by the pianist: does the audience perceive the same "qualitiy"? In another research framework, the pianist's audio and movement qualities could be extracted and correlated with the dancer's movement quality.

Instance 2 - Can you dance like a bat?

On one side of the stage, an expert dancer or choreographer is dancing on the stage. While she moves, her movements are automatically sonified in real-time. On the other side of the stage, there is a blind student dancer, who is used to be taught by the expert dancer/choreographer. The student dancer knows the "vocabulary" of the expert dancer, and is aware of the movement qualities the expert dancer is focusing on during the performance. The blind student dancer hears the sonification produced by the expert's dance. How is the blind dancer going to exploit his/her expanded perception of the expert dancer's sonification to express him/herself through dance? Is there a difference between the student dancer learning a choreography when she is taught by the teacher through words/touch Vs. sonification of the movement (of the dance teacher and/or her own movement)?

In this use case instance we could exploit respiration as a further modality to sonify/perceive dance movements [6]. Respiration is strongly related to any physical activity capable of influencing body movements. At the same time, the body movements (e.g., abrupt bending of arms/legs) influence the respiration pattern. In general, for example, deep/strong expirations correspond to energetic movements. Rhythmicity of movement, a low-level quality allowing us to differentiate between, for example, unexpected Vs. predictable movements, can be detected from respiration, as rhythm of respiration synchronizes with repetitive motoric activities such as running, or rowing.

1.2 Use Case 2 – What do you see, when "hearing" a dance ensemble? (Scientific, Social UC)

This UC can be seen as the social extension of UC1. A user, blindfolded or congenitally blind, listens to the sonification of the qualities of a group of dancers. Analogously with UC1, sensory deprivation is a mean to amplify user's capabilities and sensibility in recognizing, this time, the movement qualities of a group.

In DANCE, we aim to demonstrate the hypothesis that a set of individual movement qualities can be generalized also to a group of users. For example, *intra-personal synchronization* of different joints of a single user's body can correspond to the *inter-personal synchronization* of a group of users, considered as a whole single body. This means that a user may hear the dance of an ensemble in terms of, for example, the qualities learned on her own body or on those learned on another user's body.

This UC will become feasible during the very last part of the DANCE project, as a result of the work made in conjunction with the choreographer Virgilio Sieni, see UC1 for the details about the "Atlante del Gesto_Genova" workshop.

1.3 Use Case 3 – DANCE Serious Game for sonification evaluation

This UC supports the training and validation of interactive sonifications in UC1 and UC2, and it is at the same time an interesting example of exploitation of the DANCE results in the field of serious games.

The objective of the UC is twofold: (i) to design a family of serious games to teach users "to hear dance", i.e., to understand movement qualities in terms of interactive sonification; (ii) to develop a scalable and flexible system based on the EyesWeb software platform to support the development of a number of serious games useful to validate and compare interactive sonifications and qualities of movements.

The basic concept of the serious game is for two or more users, and starts from a repository of (i) interactive sonification models, (ii) movement qualities, and (iii) audio recordings of sonifications of a repository of short dance sequences. The serious game is a competition between two or more users. Users are blindfolded to increase the sensitivity of each user on the auditory channel, and to avoid imitation of the other players. They listen to the same selected recording of an interactive sonification of one or more movement qualities, and are asked to move to match the movement qualities they perceive in the sonification they are listening to. The movement qualities that generate the sonification are compared with those of the users. Each player receives points from the system according to the distance (by means of a given metrics) between her movement quality and the one originating the sonification.

This UC is also an instrument to validate interactive sonifications released during the DANCE project, and represents a useful tool for investigating the perception of movement qualities when translated into sonic material [2].

1.3.1 A serious game for evaluating movement sonification models

An instance of the above game has been implemented at MOCO 2016 [2] and evaluated at the ISon 2016 International Workshop [3]. At MOCO 2016 we presented an initial prototype named "Move in the dark" that uses only fluidity as movement quality and a palette of different sonifications: some of them follow a sonification model we developed in collaboration with the composer A. Cera, others are based on alternative, in some cases opposite, rules. In [3], we hypothesize that our proposed sonification model is the most effective in communicating Fluidity.

To develop our sonification model we exploited 2 different approaches:

- on the one hand, we analyzed the state of the art in the expression of extra-musical qualities in sound design and electroacoustic music. Existing works on cross-modality, provide a very useful and rich background of methodological guidelines for sonically rendering the Fluidity of a movement;
- on the other hand, we took inspiration from cinematographic works. Sound design in cinematography can indeed provide a popular vocabulary, representing a largely shared way to associate sound and physical qualities.

In order to evaluate whether the proposed sound model Vs. the alternative ones is the most effective in communicating Fluidity, we conducted a perceptive study with 22 participants. They explored how their movements were mapped into sound and got acquainted with the sonifications. Then they were asked to recognize the movement qualities only by listening to pre-recorded audio-files that were created using the same sound models. In this way, participants were in blind conditions and we investigated their capabilities and sensibilities in recognizing individual movement qualities only by means of the auditory modality. Results presented in [3] suggest that the sonification following our proposed model is the most effective in conveying Fluidity.

1.4 Use Case 4 – Can you play my dance? (Art / Creativity / Teaching UC)

This UC has been refined, compared to the previous version presented in D5.1, following the evaluation phase of UC1, UC2, UC3, and after further multimodal recordings and analysis with choreographers and dancers.

Together with music composer Andrea Cera and choreographers we have defined artistic scenarios as a means to fertilize the scientific research on movement sonification. Results of this process have been published in [1,3,4,5].

Use case 4 is grounded on a study we are conducting on the expressive vocabulary of the famous choreographer Virgilio Sieni (Director of Biennale Danza, Venice). This vocabulary is exploited in the project for dance teaching

seminars and public performances where the real-time analysis of the vocabulary is applied professional and/or non-expert dancers (e.g., dance amateurs, members of the audience). Figure 1 shows an example of a point light display of an expert dancer performing "uncertain" Vs. "light" (respectively, on the left and on the right in the figure) movements. We split the UC description by providing three possible instances of the UC, focused on different aspects of the dance vocabulary sonification.
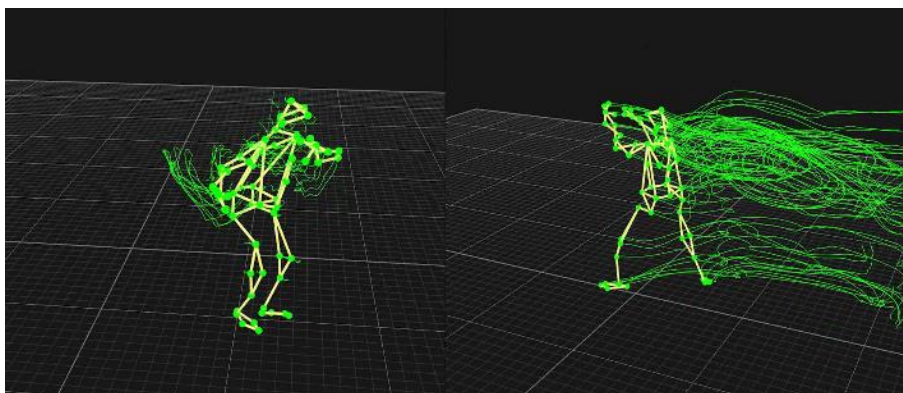

Figure 1. Point light display of a dancer performing "uncertain" Vs. "light" (respectively, on the left and on the right in the figure) movements. From the public presentation of DANCE in occasion of the study of the "dance of the seven veils" in the R.Strauss' Salome Opera, May 2016, opera House of Genoa Teatro Carlo Felice (https://www.youtube.com/watch?v=V0uir8E1yeY).

Instance 1 - Audience involvement

In this UC, people without any experience in dance are invited to participate to a workshop with a dance choreographer, who will teach them how to communicate with their body using an expressive vocabulary. To avoid "scaring" participants with "too difficult" tasks, the workshop is set up in a playful/engaging way. Initially, participants are part of the audience, that is, they have no active roles. The choreographer presents very short movement sequences on the stage, each one lasting less than 15 seconds, demonstrating only one expressive quality from the vocabulary. This is a "simple" starting point, and people are invited to look at the sequences while listening to the explanation provided by the choreographer. One by one, participants can join the choreographer on the stage, and try simple movements, for example: reaching with their arm the teacher's shoulder directly Vs. introducing intermediate "independent" movements (e.g., looking behind them). While performing movements, the teacher underlines the role of the expressive qualities in the vocabulary. The key aspect of this UC is the playful/engaging nature of the interaction between the teacher and the student, and the creation of a "growth/learning path" that is built among participants during the workshop.

Instance 2 - Dance teaching/learning

A serious game is developed, in which dance sonification becomes a mean to teach non-expert users the dance vocabulary. The user stands in front of a screen and sees a dance teacher. The user can hear the teacher's speech and the teacher explain how to perform movements from his/her dance vocabulary (e.g., how movement "lightness" can be expressed). After the explanation phase the user is left alone and he/she can practice the movement qualities explained by the teacher. The user's movements are sonified, as sonification allows the user to be more attentive to and better perceive his/her movement. At the end of the practice session the system evaluates the user's performance quality.

1.5 Use Case 5 – Ease physically demanding body movements

The methods developed in DANCE can be transported to situations where training of body movements is more difficult or more painful than normal. Two specific examples illustrate this. One case is that of dancers or actors that need to go through long straining rehearsing sessions. Dance is often organised in repeated movement patterns. In this use case, the project will test whether the feeling of fatigue in repetitive dance movements can be reduced when listening to the sonification of one's own body motion (Hoffmann, Torregrosa, Bardy, 2012 PlosOne). Achieving this should result in a higher level of enjoyment of dancing for both blind and sighted people. Collaboration of partners with performing artists has already revealed this to be an important application for training. Another example is found in the context of physical exercise. It is well-known since antiquity that singing alleviates the fatigue of performing a

repetitive labour. In a recent study, participants training with fitness machines reported that they felt less exhausted when they performed their workout while listening to music generated from their own movements (Fritz et al. 2013). Methods developed in DANCE can be also exploited in the sonification of wheelchair movements in sports, for helping athletes to better perform and understand their actions.

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