WHOLODANCE

Whole-Body Interaction Learning for Dance Education

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Introduction

This document contains the presentation of the project, as well as the presentation materials, and aims at highlighting WhoLoDancE's objectives while providing some detailed description of different aspects of the project.

WhoLoDancE's outcomes are expected to exert a strong impact on a number of fields including, but not limited to, dance practitioners, and its core concept needs to be presented in a way that can make it understandable to a wide and diverse target audience.

For this reason, five different objectives have been identified, and are described in detail, in this project description. Such structuring around five key points is at the basis of all the project materials, which hinge on the five key technological tools that need to be developed, as well as they target five different audiences which are deemed to be most significantly affected by WhoLoDancE.

1. Project's Objectives

WhoLoDancE - Whole-Body Interaction Learning for Dance Education

Wholodance aims at developing and applying breakthrough technologies to Dance Learning in order to achieve results that will have relevant impacts on numerous targets including, but not limited to, the dance practitioners ranging from Researchers and Professionals to Dance Students and the Interested Public.

Wholodance focuses on five main Objectives listed and briefly described below:

1. **Investigate bodily knowledge** by applying similarity search tools, computational models, emotional content analysis and techniques for the automated analysis of non-verbal expressive movement to dance data that will help investigate movement and learning principles, vocabularies, mental imagery and simulation connected to Dance Practises.

2. **Preserve the Cultural Heritage** by creating a proof-of-concept motion capture repository of dance motions built in methods allowing interpolations, extrapolations and synthesis through similarity search among different compositions, documenting diverse and specialized dance movement practices, and learning approaches.

3. **Innovate the Teaching of Dance** by developing a life-size volumetric display that will enable a dance student to literally step inside the Dance master's body that, by making use of immersive and responsive motion capture data, will allow to identify and respond to collisions between the physical and virtual bodies.

4. **Revolutionize Choreography** by building and structuring an interactive repository of motion capture dance libraries. Custom dance-data blending engines will provide choreographers and dance teachers with a powerful tool to blend and assemble an infinite number of dance compositions.

5. **Widen the access and practice of Dance** by providing access to the created dance database through commercially available consumer grade motion capture devices like the MS Kinect, Intel's real sense and others.

## 1.1. Investigate bodily knowledge
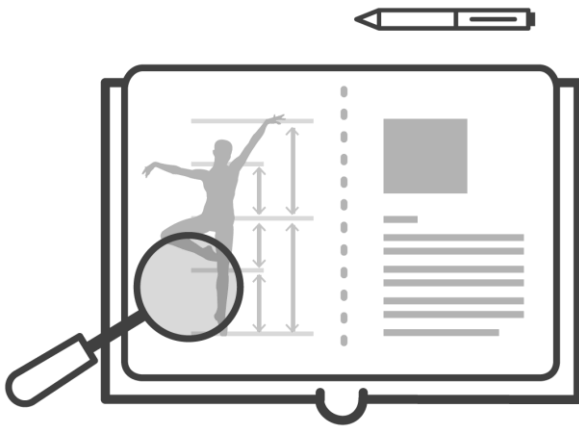
WhoLoDancE is based on a spiral design approach involving coupled interactions between technical and psycho-pedagogical partners, aiming to investigate cognitive hypotheses concerning the mirroring behaviour and its learning efficacy. Dance teaching, is by nature, multimodal. The borders between formal and informal dance learning are vague, the question of offering personalized paths creates an interdisciplinary challenging research issue.

Dance, whether regarded as a creative bodily activity is highly complex by its nature. WhoLoDancE utilises the integration of different forms of capture and projection of dance to investigate the relation of Movement and Sound within a variety of dance genres revealing important insights into more general research questions such as Mind/Body interaction and bodily knowledge in general. The movement captured, segmented, and organized in data libraries will be integrated within a custom WhoLoDance platform that will make possible to identify similarities based on a variety of descriptors in recorded motion.

In order to apply multiple tools and techniques for automated search and analysis of the dance data, high-level Ontologies/Vocabularies (Syllabi, Movement Qualities, Movement Principles, Moods, etc.) for knowledge representation will be developed within the project, based on questionnaires and interviews conducted with dancers, dance teachers, and experts.

1.2. Preserve the Cultural Heritage
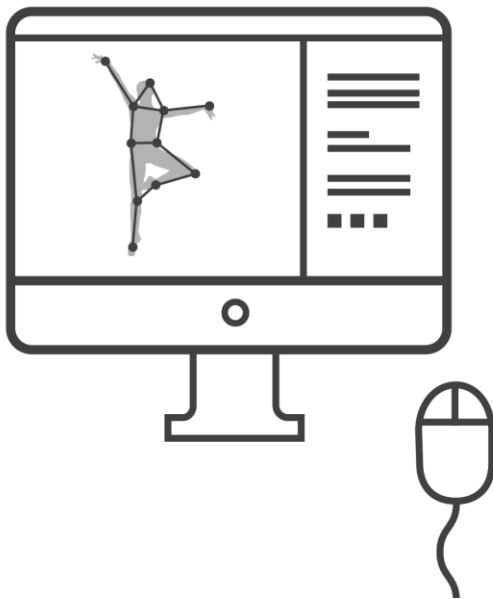
Dance, apart from being a performance art, has been for many years a social expression and is part of intangible cultural heritage. WhoLoDancE creates the tools and methodologies to capture, analyse and project the different aspects of movement to both a wider audience and next generations, providing useful tools for scholars such as Choreologists, Ethnochoreologists, Dance Historians, and Sociologists.

Furthermore, music and dance are also expressions of culture and feelings, transmitted through particular sounds, patterns, and/or dance movements, characteristics of individual personalities and of their collective resonance in specific moments in history. WhoLoDancE, preserving and re-using this valuable heritage, will contribute to the valorisation of Europe's artistic as well as cultural resources.

The ability to easily navigate and explore large collections of dance data will enhance the development of digital learning and teaching resources. The ability to inherently find similar dance sequences will help students to discover the diversity of European dance culture, while at the same time appreciating the commonalities shared across different dance languages.

Furthermore, once the WhoLoDancE paradigm and proof-of-concept development will be established for dance (possibly one of the most complex human activities), a similar approach can be extended to arts, crafts, and professions which have long constituted a European specialty and now risk to get lost and disappear if they are not captured into appropriate 3D visualized databases. WhoLoDancE can not only open the way to further research in Psychology and Cognitive Science, but also to an increased acknowledgement of the possibility of recording, reconstructing, preserving and conserving the representation and heritage of priceless traditional skills, which must not be allowed to fall into universal neglect, and should rather be re-proposed to be viewed and analysed in holographic performances or traveling exhibitions in selected venues, such as theatres, museums, and other appropriate public spaces.

WhoLoDancE is making use of advanced motion capture technologies, EMG and bio-sensors to transfer dance movements into digital data in such a way that makes it possible to blend any specific motion element with any other motion element within the database.

The way that the database is created, converts the raw motion capture data from 3dimensional marker position arrays to joint rotations of an inverse kinematic skeleton, and then in turn, to arrays of velocities and accelerations of all body parts separately creating a coherent and comprehensive motion capture database.

1.3. Innovate the Teaching of Dance

WhoLoDancE disrupts the conventional mode of communication in teaching (my body to your body/your body to my body – in other words - the learning body trying to be a different body), in favour of a doubling or a parsing of a single body – bringing into being a technology that encourages more autonomy in the learner, not making the teacher redundant but enriching the learning process because both will be engaged in a discovery of new information and of its contribution to develop a skilled and expressive dancer.

An immersive projection system (either holographic display of other volume based projection like Fog screen or Ionized air projections) are used to project an avatar moving in the space according to the motion-captured data of the dance teacher.

The student that needs to learn and practice specific dance moves and routines, is positioned inside the same volumetric projection, while the scale of the avatar can be tuned so that, at the start of the game, the student is fully immersed inside the virtual body of the avatar.

When the game begins, the goal of the student is to execute the dance moves that the avatar does without intersecting with the avatar, thus "staying inside the virtual body". When an intersection occurs and the physical body part is outside the enveloping avatar, there is an immediate feedback, through spatial sound and vision, alerting the student and suggesting the right correction. Immersive audio will be based on a spatial distribution of loudspeakers, with coding based on vector-based amplitude panning or ambisonics to give audio feedback to the learner. Interactive sonification techniques will be developed to integrate in the whole multimodal feedback. In addition, Biometrics sensors will also be tested as feedback providers.

WhoLoDancE will attempt to create a fundamental impact on interference patterns-based holography. The proposed dynamic hologram will be projected with high resolution, better image quality, full colour and a very wide angle viewing frustum compared to what is already available in the market. The proposed reconstructed hologram will be within the user's touching reach and will remain in the same coordinates, independent of the viewer's location. The idea of the looped avatar and the avatar that can be slowed down will allow the learner to see more in the movement, possibly striving for 'accuracy' - but it also allows the learner to 'see' the movement differently. Something slowed takes on a different character/quality/resonance – this helps the student (and the teacher) to find more in her own movement range.

Perhaps the most valuable strategic impact of WhoLoDancE is that, once completed, it will offer a standardized platform to enable using the same educational real-time paradigm for learning other skills that are motion driven and require people to learn specific functional movement. This bears applications in Ergonomics, Engineering, Robotics, Architecture, Medical and other motion based performing sectors.

1.4. Revolutionize Choreography
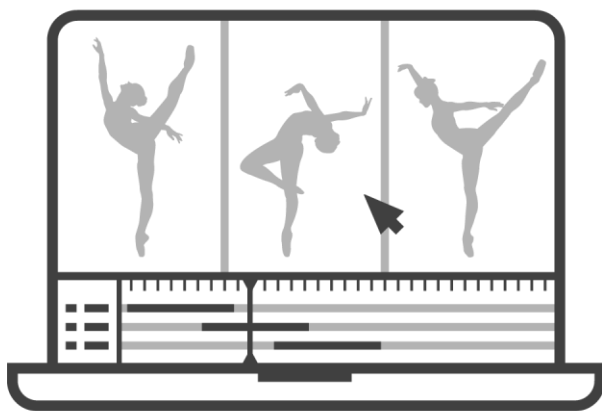
WhoLoDancE offers choreographers the control over a dance database enabling them to create new dance routines through blending, and to extract and synthesize motion capture sequences in the database by converting the raw motion-capture data from 3dimensional marker position arrays to joint rotations of an inverse kinematic skeleton, and then, in turns, to arrays of velocities and accelerations of all body parts, separately.

The blending engine allows the creation of new (never captured) sequences, through an interface that allows the interactive real-time blending of any sub-array of velocities and accelerations of any given body part from the database.

The choreographers will be able to visualize the data as vector flow fields or particle fields that suggests the flow of motion, rather than limiting it to a virtual body. Choreographers will be able to compare choreographic patterns and structures, making use of them as building blocks for creating new original choreographies from existing choreographies with easy-to-access tools and software platforms.

1.5. Widen the access and practice of Dance

The functionalities of the High-end interface motion-capture database will be translated into a less-expensive, simpler, and easy to use, device that can be used in informal education (as well as formal) for both choreographers and Dance Students. The interface will allow the choreographers to visualize the flow of motions via gestural control, using low cost gestural capture tools like the Kinect, Real-sense, Xtion and similar depth camera devices

Dance Students will be able to train and practice choreographies in their preferred training space with the use of any motion-sensing input device, included in their home game video console (e.g. XBOX 360, Wii, etc.)

This use case can have his main application scenario on informal education, and having the advantage of being less expensive, can then become a tool used in any Dance Centre and University, enjoying a wide distribution and commercialization.

2. Project Timeline

First Phase (M1-M12)

Jan 2016 --------------------------------Dec 2016

Preliminary definitions and ground-truth data acquisition:

The first phase, running from M1 to M12 of the project, will deal with the acquisition of the preliminary knowledge coming from the end-users, thus making it possible to have a first definition of the learning scenarios (preliminarily evaluated by the end-users), as well as a definition of the different users' profiles. At the same time, an embryonic definition of the semantic representation models will be deployed. Finally, the pipeline for the motion capture process will be developed and the data acquisition stage of the capture process will be completed. At the end of this phase, the first Milestone will be reached (Milestone 1 - Preliminary definitions and ground-truth data acquisition).

Second Phase (M13-M24)

Jan 2017 --------------------------------Dec 2017

Models, platform, and similarity search basic development:

The second phase will lead to the definition of the emotional representation and music-dance representation models, as well as to the preliminary deployment of data-driven and model-driven analysis software (with relevant libraries defined). Furthermore, the data management platform will be released and tested in its alpha version, and the data integration and similarity search framework will also be defined. At the end of this phase, a functioning mockup graphical user interface will be demonstrated. The Second Milestone will be reached (Milestone 2 - Models, platform and similarity search basic development).

Third phase (M25-M36)

Jan 2018 --------------------------------Dec 2018

Visual User interface and data-driven models, tools and platform deployed – learning scenarios validated

The third and final phase of the project will mainly deal with the deployment of the software and hardware adaptation needed for the deployment of the visual and interactive user interface (with the multi- modal avatar). The mockup GUI built in the seconds phase will be finalised. The interface will be subsequently validated through learning experience scenarios completed on-purpose. Furthermore, during this phase, the different systems (data management platform, similarity search tools, model-based software, with final libraries) will be delivered. Finally, the WhoLoDancE Dance-athon will be organised to disseminate the project results in a public event, conceived of as an artistic performance and demo-live show of the system. At the end of this phase, the Third Milestone will be reached (Milestone 3 - Visual User interface and data-driven models, tools and platform deployed – learning scenarios validated – final dissemination event for public outreach).

3. Presentation Material

Two first posters have been created, with the aim of allowing the project to reach different audiences, and of being printed in different formats, according to the needs of the event in which the presentation will take place.

3.1. Poster 1

The one below will be used for poster presentations at conferences, technology fairs, and dance performances, and will normally be printed in A3 format or bigger.

3.2. Poster 2

The second version of the Poster can be used in a variety of formats, even in smaller ones, and can also be printed in A4 format and delivered at any event with different audiences: