



Introduction

- ∞ Cyprus, among other countries, has a rich history and diverse tangible and intangible cultural heritage, which in recent years has been painstakingly recorded, curated and remediated
 - However, folk dancing cannot be easily preserved
 - rare video recordings from local festivals, weddings and other social gatherings
 - dissemination to the younger generations is given only from few cultural institutions.

Introduction

- ∞ Dance motion should be digitally stored, reproduced, analyzed and processed, for documenting, comparing and further studies
- ∞ The Cypriot folk dances have never been systematically recorded and archived using motion capture technologies
 - develop the first high quality digital archive in collaboration with local cultural institutions

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Introduction



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Computer Animation

Two main categories:

- ☞ Computer-assisted animation
 - 2D & 2 1/2 D
 - In-betweening
 - Inking, virtual camera, managing data, etc
- ☞ Computer generated animation
 - Low level techniques
 - Precisely specifying motion
 - High level techniques
 - Describe general motion behavior



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Definition

- ☞ Motion capture (MOCAP) is an effective 3D animation tool for realistically capturing human motion
 - Motion – the act of physically changing location
 - Capture – take into possession, to seize, to acquire
- ☞ Any suggestions where motion capture can be used?
 - Prosthetics and rehabilitation medicine
 - Movies, entertainment technology, games
 - Simulations, Demonstrations, training systems
 - Ergonomics
 - etc

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Traditional MoCap Technologies

- ∞ **Optical** – uses video capture
 - passive – markers just reflect light
 - active – markers emit light

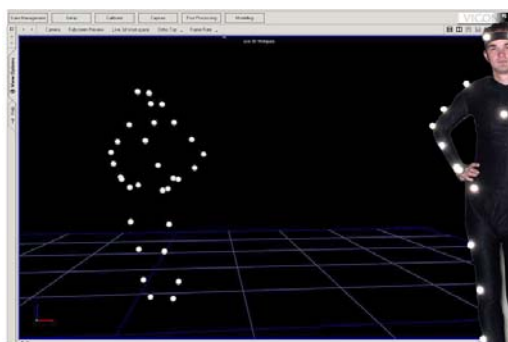
- ∞ **Magnetic** – active sensors sense their position and orientation in magnetic field

- ∞ **Electro-Mechanical** – rotors connected to limb-aligned rods record their status – for hands, optical sensors used sometimes

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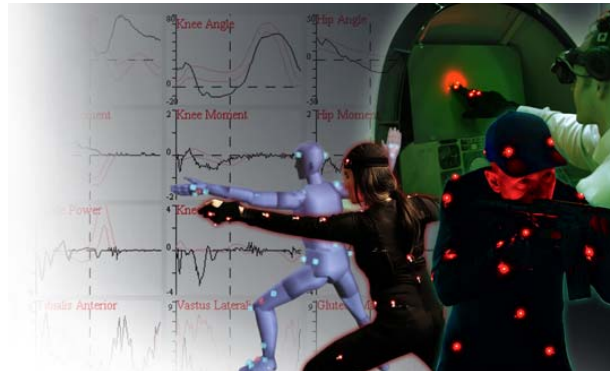
Optical - Passive



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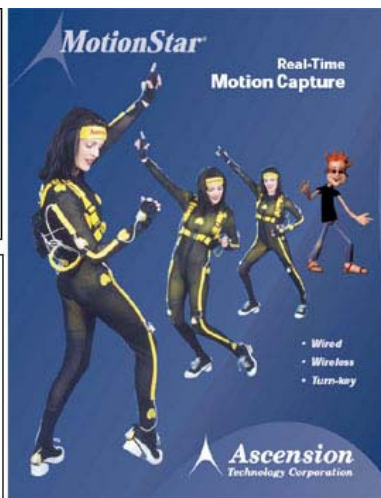
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Optical - Active



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Magnetic



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Electro-Mechanical

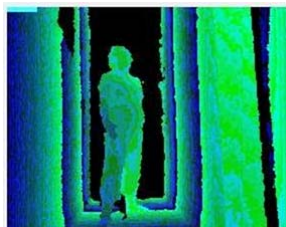
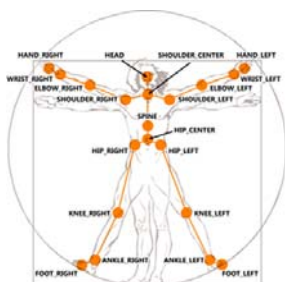


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Newer MoCap Technologies

- Inertial systems (similar to Wii technology)
- Semi-passive imperceptible markers (emit light and observe changes ; Kinect uses infrared)



KINECT
by Microsoft

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Hand and Face capture

- ∞ Give realistic to the movements
 - Hand Gloves, videos, etc
 - Face tracking



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Types of Objects

- Human whole
- Portions of body
- Facial animation
- Animals
- Puppets
- Athletes



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- ☞ PhaseSpace Impulse X2 motion capture system
 - Highly accurate, real time data with a minimum of occlusion and dropout errors

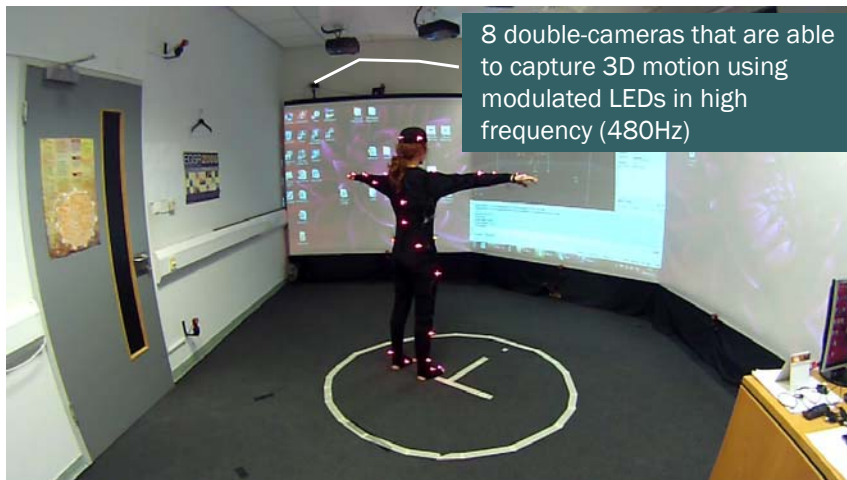


- ☞ 3-wall immersive virtual reality set-up

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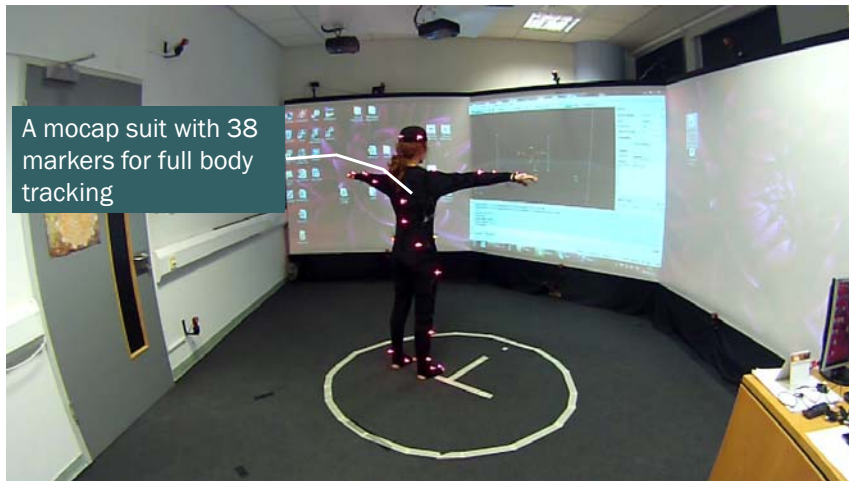
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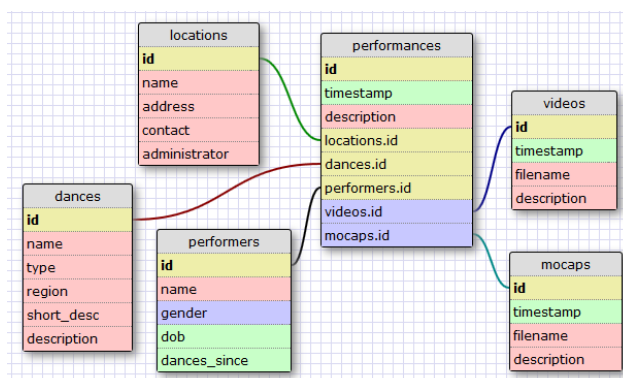


3-wall immersive virtual reality set-up

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Motion capture dance library



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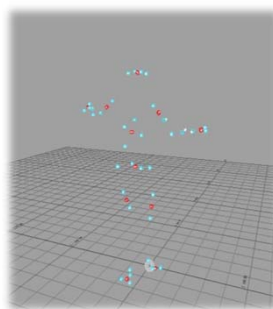
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Motion capture dance library



Video

Dance recording using an HD camera. Data saved in MP4 (MPEG-4 part 10 H.264) or FLV (flash) format



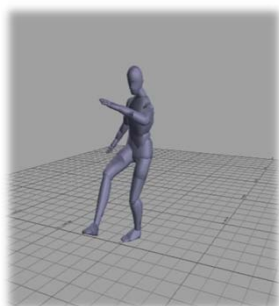
Mocap data

C3D - stored 3D coordinate information, analog data and associated information as it is recorded from the motion capture system.

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Motion capture dance library



Actor data

FBX - the motion of the performer is saved as an actor. Any virtual character (avatar) can be incorporated to perform the dance

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Character data

FBX - A virtual character has been incorporated to the actor. The character cannot be removed

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Motion capture dance library

∞ In addition, each dance will be accompanied with metadata information

- Dance Description
- Performer Description
- Technical Description (fps, sample rate, format, etc.)
- Location Description
- etc

Capturing data

Digitization of Dances

Cypriot 2nd Antikristos

University of Cyprus
Virtual Reality Lab
2012

Example: Cypriot Zeimpekiko

Digitization of Dances

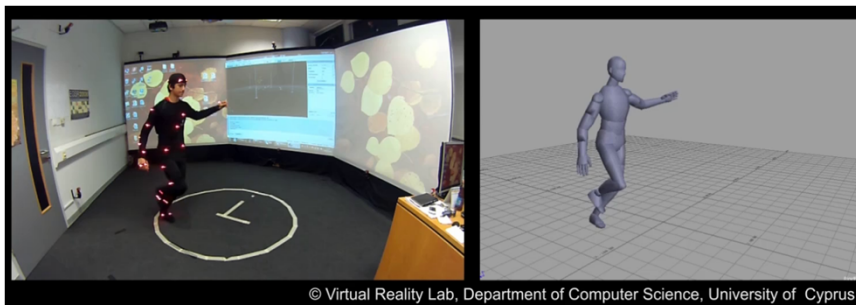
Cypriot Zeimpekiko

University of Cyprus
Virtual Reality Lab
2012

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Why 3D motion capture data?



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Mocap Dance Website

DanceDB Home Performances F.A.Q. People Lab Info Acknowledgments Contact Us

Welcome to the Dance Motion Capture Database!

This website aims to create a publicly accessible digital archive of dance that, in addition to rare video material held by local cultural institutions, state-of-the-art motion capture technologies are utilized to record and archive high quality motion data of expert dancers performing these traditional dances. Apart from the goal of presenting this intangible cultural heritage by digitizing it, the project is interested in increasing the awareness of the local community to its dance heritage.

This is an evolving project and data will be added to our database as we capture them over time.

We store high-quality Autodesk FBX, C3D motion capture data and videos for every performance. You can download any of datasets currently available in the [Performances](#) page. Please read the copyright statement before downloading.

Πανεπιστήμιο Κύπρου
University of Cyprus

<http://dancedb.cs.ucy.ac.cy>

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Processing mocap data

- ∞ Motion capture data (mocap data) is stored 3D coordinate information about the captured subject
- ∞ There are different ways to process mocap data
 - **Automatically:** use of maths for biomechanically accurate skeletal reconstruction
 - This is an area where many animation companies and studios are interested on.
 - We are collaborating with Phasespace Inc, The Imaginarium Studio and individual Unity3D game developers
 - **Manual:** use of motion processing applications, such as Autodesk MotionBuilder

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Processing mocap data

- ⇒ Many companies and researches focus on:
 - a fast, accurate and efficient skeleton reconstruction in real-time.
 - Incorporate physiological constraints to reduce the allowed movements to a feasible set
 - have a system that is able to predict the missing or occluded markers
 - Motion re-targeting
 - etc

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Teaching Cypriot dances using a video game

- ⇒ The game will initially be available at the Cultural Workshop Ayion Omoloyiton in Nicosia (Cyprus)
 - The game features the 3D avatar of a Cypriot dance teacher dressed with the traditional costume and supports a range of template motions performed by experienced folk dancers.
 - The user selects the dance he would like to learn from the motion capture database, described earlier, which is attached to the virtual dancer.
 - The virtual dancer demonstrates the motion to the user, and then the user is asked to perform alongside the virtual teacher.

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Teaching Cypriot dances using a video game

- ↻ The motion of the user is captured in real-time via the Kinect and is attached to a second virtual avatar, so that the user has visual feedback of his movements
- ↻ A motion matching algorithm is used to measure the similarity of the user's motion to the motion template
- ↻ A feedback system provides hints and advice to the end-user as to his performance and parts of the dance that would require more practice and attention by the user

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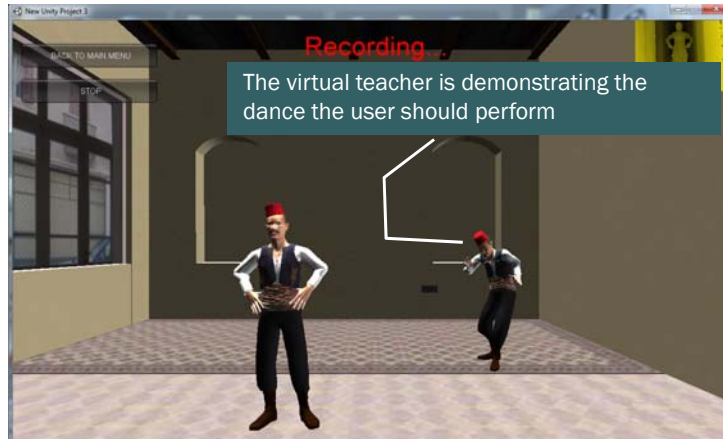
Teaching Cypriot dances using a video game



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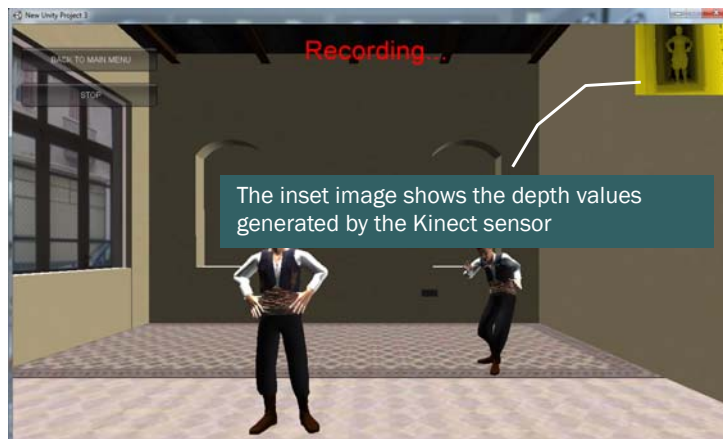
Teaching Cypriot dances using a video game



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Teaching Cypriot dances using a video game



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Limitations

- ∞ Only one character can be capture at each time
 - Different characters can be tracked at different time and motions can be combined during editing
- ∞ No hand tracking
- ∞ No face/emotion tracking
 - Hand and face/emotion tracking is very important in some dances. However, It is possible to capture these data individually and add them in a later time

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Research Approach

- ∞ Most of the computer animation scientists
 - rough simplifications
 - not possible to completely describe the complex human language.
- ∞ The Laban Movement Analysis (LMA) system
 - simple as possible but complex as necessary description of human movements

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LMA COMPONENTS

Body Component:	<ul style="list-style-type: none"> captures the body connectivity and the relation between body parts of the performer.
Effort component:	<ul style="list-style-type: none"> describes the intention and the dynamic quality of the movement, the texture, the feeling tone and how the energy is being used on each motion.
Shape Component:	<ul style="list-style-type: none"> analyses the way the body changes shape
Space Component:	<ul style="list-style-type: none"> describes the movement in relation with the environment

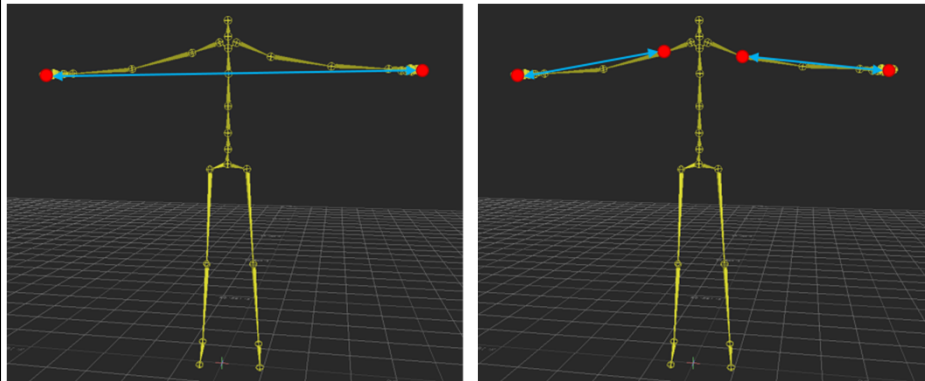
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Effort changes are generally related with the changes of mood or emotion and is essential for the expressivity.

Space	Weight	Time	Flow
<p>Direct: focus is on a single point in space (e.g. giving your hand for a handshake).</p> <p>Indirect: space is giving active attention in more than one thing at once (multi-focused and flexible attention).</p>	<p>Strong: bold, forceful movement.</p> <p>Light: delicate, sensitive movement.</p>	<p>Sudden has a sense of quick, urgent.</p> <p>Sustained has a quality of stretching the time.</p>	<p>Free Flow: related with released movement, outpouring and fluid.</p> <p>Bound Flow: related with the controlled movement, careful and restrained.</p>

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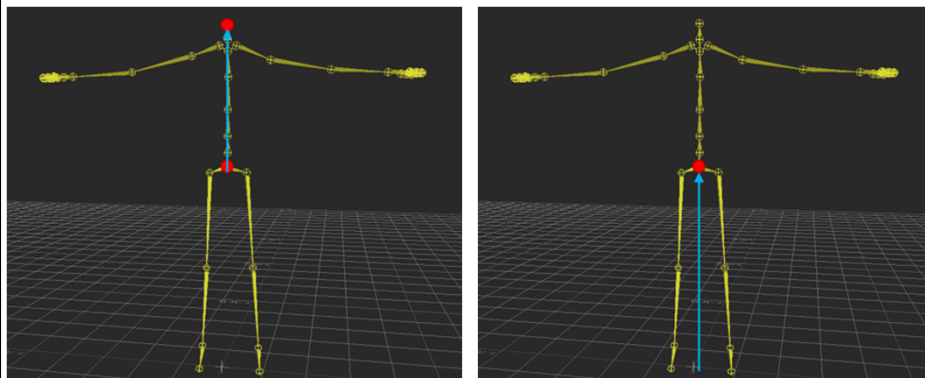
LMA Features — Body components



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LMA Features — Body components



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LMA features — Effort components

Head Orientation

• (Space) Direct vs Indirect movement.

Deceleration of motion

• (Weight) Peaks means Strong movement, no peaks refers to Light movement

Movement Velocity

• (Time) Measure the hip and hands velocity

Movement Acceleration

• (Time) Measure the hip and hands acceleration

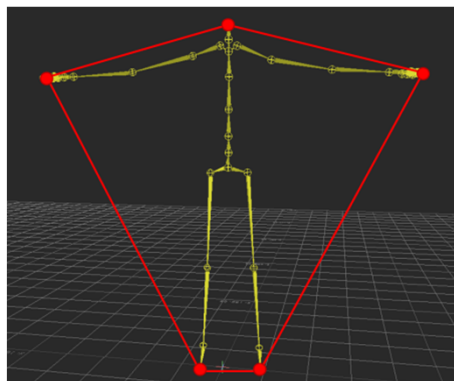
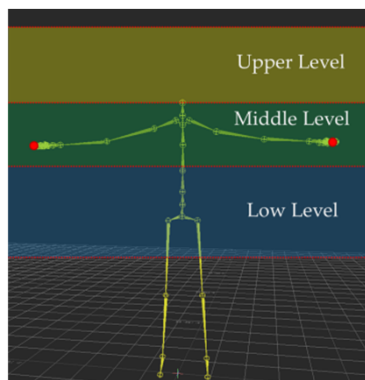
Jerk

• (Flow) Bound motion has large discontinuities with high jerk, whereas Free motion has little changes in acceleration.

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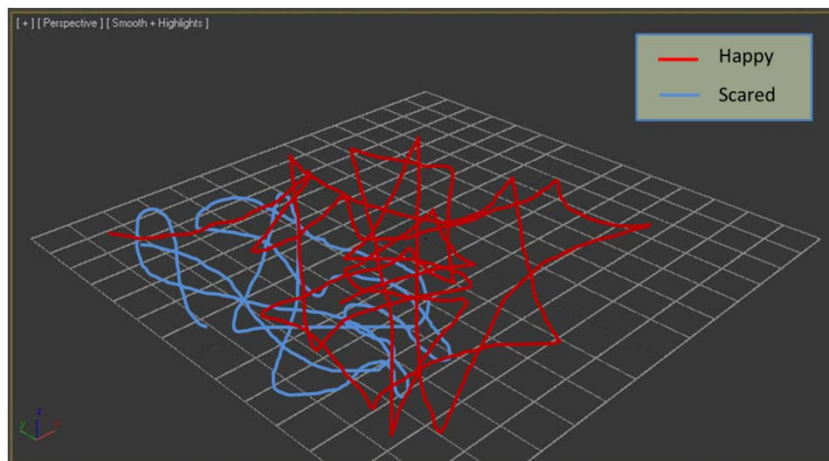
LMA Features — Shape components



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LMA Features — Space components



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Result observations

Emotion	Volume	Torso height	Velocity	Hip height	Acceleration
Happiness	Large	Mainly straight	Fast	Large (jumps)	Small to medium
Activeness	Large	Bends	Fast	From small to large	Medium
Curiosity	Medium to small	Mainly straight	Medium – slow	Very small to medium	Small to large
Sadness	Small	Mainly bends	Slow	Small to medium	Very small
Fear	Small	Bends	Medium – slow	Very small to medium	Very small to large
Nervous	Medium	Mainly straight	Medium to fast	Large (no jumps)	Large

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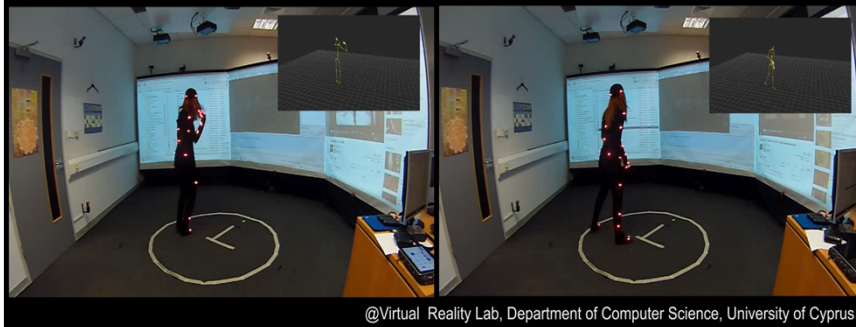
Results

Motion indexing of different emotional states using LMA components

Andreas Aristidou, Yiorgos Chrysanthou

Classified: Active

Classified: Nervous



@Virtual Reality Lab, Department of Computer Science, University of Cyprus

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Conclusions

- ⇒ Lay the foundation for creating a digital archive of Cypriot folk dances (including a dance motion capture database) with public access
 - text, photographs, video, motion capture data.
 - pave the way for documenting the cultural heritage of the Cypriot dance tradition, particularly for traditional dances that tend to be neglected or forgotten
- ⇒ Developed an interaction game for learning Cypriot Folk Dances using Microsoft Kinect
- ⇒ Extracted the qualitative and quantitative characteristic of the movement based on LMA entities.

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Future research directions

- ⇒ Measure the similarity between motions based on the LMA components
 - not only on posture matching but also on the movement quality (effort, shape, space performer's intention).
- ⇒ Capture dances from different countries and find unveil potential similarities in between them
 - We aim to create the a state of the art motion capture dance database (the CMU mocap database has a large collection of different short movements but not a complete dance library)
- ⇒ Create a dance ethnography
 - The ability to compare motions algorithmically could improve our understanding of the origin of dance moves and exchanges of cultural characteristics between ethnicities

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Acknowledgments

- ⇒ This project (ΔΙΔΑΚΤΩΡ/0311/73) is co-financed by the European Regional Development Fund and the Republic of Cyprus through the Research Promotion Foundation
- ⇒ We would also like to thank **PhaseSpace Inc.** for donating the Impulse X2 motion capture system



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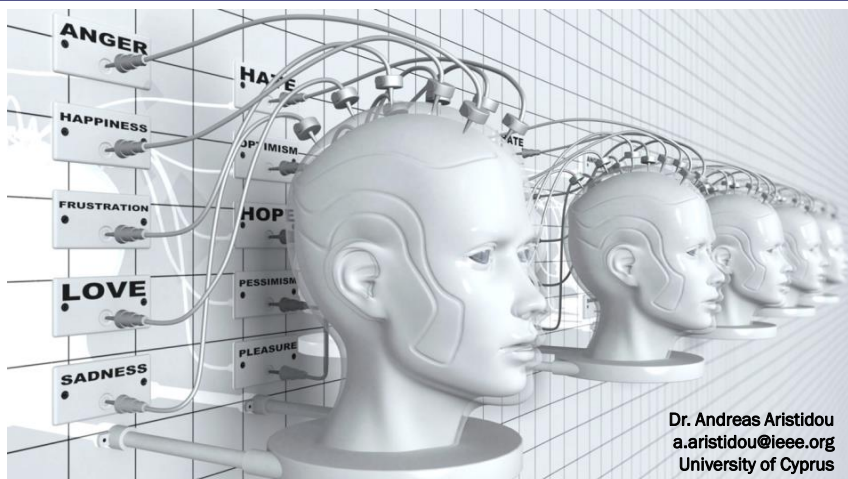
VRLab, University of Cyprus

- ☞ Lab Director:
 - Associate Professor Yiorgos Chrysanthou
- ☞ Lab Location:
 - University of Cyprus, Nicosia, CYPRUS

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Thank you for your attention



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Questions?



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