

# You Move You Interact

## Developing a dancing performance system for full body interaction

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### Abstract

You Move You Interact (YMYI) is an interactive installation, in which a user engages in a body language dialogue with an artificial system resulting in a performing interaction loop consisting of gestures and movements synchronised with virtual animations and sounds. The project aims at exploring an interactive *stage*, where the user is invited to develop his/her own creative inspiration based on the exploration of his/her body kinetic dimension.

Keywords: digital art; interactive art; expressive gesture; performing arts.

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### 1. INTRODUCTION

We present the design and implementation of an interactive system for theatre and performing arts, explicitly considering and enabling the communication of expressive gestures through full body interaction.

YMYI can be classified as interactive art, where the viewer turns out to be an active player dialoguing with the artefact, possibly changing it. Users generate a process of continuous audiovisual and kinetic flow, sometimes dynamic and volatile, generating expressive effects on side of the user, as he/she is an active player when *interacting* with the artwork itself (Paul, 2005). It represents also a form of *virtual art* though it implements forms of perceptual immersion (visual, auditory and not altogether kinetic of the viewer in the artefact. The user starts perceiving himself/herself as a part of a dynamic virtual world, where he/she is at same time the created object and the creator entity (Grau, 2003) (Marcos, 2007).

In this paper, we present first the motivational aspects behind the development of the artefact. Then, we describe briefly some related work. Next, we explain the technical decisions brought into existence by the implementation of the artefact. Finally, we present some field observations of users experiencing with the artefact as also some conclusions.

### 2. MOTIVATION

The Art and Science of Mechanics, Automata and Computer Technology has a long tradition in performing arts, rooting back to the ancient Greeks and theatre has always been populated by scenarios, narratives and objects, like puppets and *deus ex machina*. However, only recently new interactive movement-sensing installations have emerged offering users an opportunity to become actively involved in the creative process through actions which generate images and sound. The human movement became the input leitmotiv to be interpreted by computers. Historically, all the manifestations of gesture art, from the "action painting" of Pollock, Kooning, to the performance-art happenings and events have considered the body capabilities in the artistic embellishment. This was the core subject inspiring our work. Additionally, we made some research on human movements by consulting the Carnegie Mellon University Graphics Lab Motion Capture Database (Website at: <http://mocap.cs.cmu.edu/>) and on adequate sensing devices and computer vision techniques for full-body human capture. We proposed to devise a digital artefact in which the user could generate a dynamic composition by improvising gestural body movements aiming at creating interactive visual and auditive experiences. The act of art creation is always connected in the mind with producing imaginative compositions putting into service the freedom, spontaneity and non-deterministic making in real time to stimulate the

occurrence of a creative thinking. This was a crucial feature underlying our work, because the YMYI digital/interactive art deals with creating “living environments” in self regeneration appealing users to interact through an active participation with a digital system and so opening an affording passage to experience new physical sensations and perceptions under a spiritual and constructive course of action.

Gestures can be defined in a broad sense as a “movement of the body that contains information” [Kurtenbach and Hulteen, 1990]. In artistic contexts and in the field of the performing arts, gesture is intended to convey information related to the emotional domain. Through this perspective, we may consider that “expressive” gestures contain “implicit” messages [Cowie et al., 2001] that communicate a whole expressive content dependent on feelings, moods, affect and intensity of an emotional experience.

YMYI motivation is to allow the performer to observe and give evidence to an artistic expressiveness developing in the mind an array of gesture ongoing instantiations. These physical expressive gestures are rendered in digital compositions formed by musical and visual movements, composing an enriched audio-visual experience.



Fig. 1. The YMYI artefact.

### 3. RELATED WORK

Contemporary art sets the scenery for a body exploration based on movements, actions and behaviours which considered the body as a living organism. State-of-the-art technologies carried performing arts to new dimensions. In interactive art, physical events are sensed by digital devices and computing techniques resulting in metamorphosed outputs displayed on digital canvas providing an ongoing bidirectional communication with users [Quintas & Dionísio, 2005][Gil, 2001][Popper, 1968]. YMYI belongs to this new conception of art, so-called "interactive", by prioritizing the interactivity in real time, connectivity, the body dialogue with interaction instruments allowing body actions to migrate to digital systems. The whole "interactive" environment in YMYI behaves as a synchronised living organism responding to the user's physical gesticulations. YMYI sets so the

onstage for artistic new dimensions brought to light by the active interaction between a body and a digital system.

## 4. IMPLEMENTATION

### 4.1 Vision System

The images from the camera are tracked by using an USB/Firewire interface communicating with the software *Processing* (<http://processing.org/>), an object-oriented programming environment based on Java. The whole user's body shape is tracked by making use of a dedicated system that transforms the received image into a black and white curved silhouette. This silhouette is clean and uniform. In order to increase the image contrast applied to the user body we employ an uniformly illuminated background. The noise inherent to the original image is cleaned up by making use of sequential filters that are applied to each received frame. These filters are applied to the original image in a specific sequence or order: first we apply a low intensity blur effect to make the image more uniform, and then we apply a threshold filter to eliminate the shadows and common noise originated from the camera. We repeat this blur and threshold process as much as needed to get a simple black and white (binary) image with a centred silhouetted area. Next we compute the silhouette extremities and make logical comparisons to detect both the hands, the head and the mass centre in the user's body. Each of these gravitational points are tracked at every instant so we can successfully accomplish the velocity/acceleration capture of the user's body components.

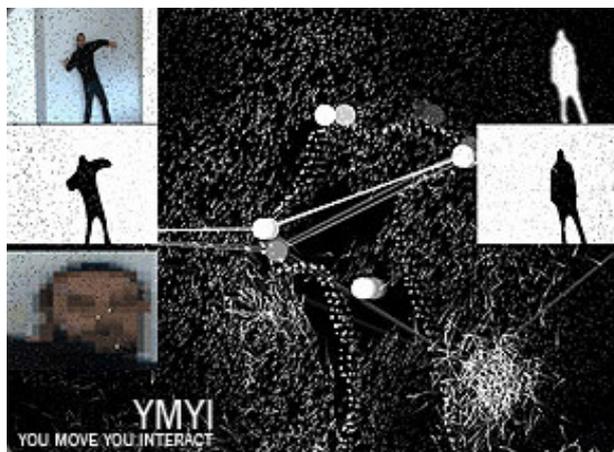


Fig. 2. The YMYI in debug mode.

Figure 2. YMYI in debug mode. On the top left corner, the camera image, next the processed binary image. In the center, the circles indicate the detected extremities and the centre of mass.

### 4.2 Visual Rendering

Every movement and acceleration is embodied on the environment global image, including a set of small particles that feel constantly attracted to the user's body

proximity. There are 3.000 particles in the environment. Each particle has its own movement and acceleration caused by a unique behaviour. This behaviour is due to the *Perlin Noise* function (<http://mrl.nyu.edu/~perlin/>). The *Perlin Noise* algorithm creates a minor predictable reaction compared to the randomised function normally used in computation. This minor predictable reaction gives rise to a more natural behaviour; more similar to what happens in nature atmosphere. The global amount of particles, all of them endowed with a natural and unique behaviour movement, fly over their ever-changing density reactive to the user's body self-endowing inner gesticulation. In the YMYI's visual rendering system there are two sets of particles. The first follows the trajectory of the user's left and right hands over the time. The second set of particles is represented by 2.000 small white points that fill in the whole background with the exception of the shape area, which obviously belongs to the user's silhouette. This area, which is not entirely supplied with the particles points, continues to exist over time, providing the visual effect of the user's shadow. If the user moves to the left or to the right, this shadow will hold firmly on the screen for a couple of seconds, creating the effect of a ghostly body that will disappear in a temporal continuum.

#### 4.3 Audio Rendering

In the YMYI artefact, the human performer and the computer system engage in moulding visual graphics and computer music interactively in real time. The sound system of the artefact relies on the Software *Super Collider* (Website at: <http://www.audiosynth.com/>), an environment and programming language for real time audio synthesis. The system is proposed for automatic music performance based on artificial neural networks and its model produces a musically expressive variation of the control parameters according to all of the gesture dynamics. The sound exerts a reaction to the user's overall movements in the interactive space and it develops a set of associated parameters in intensity, duration and pitch, accordingly. The agent's continuous improvised flow of movements generates harmonic-related rhythms making possible for YMYI to exhibit a high-level mapping between the music, the graphic output and the agent's performance. Both the musical harmony divided in its discrete contours and the instantiation of the animated graphics in the digital scenery altogether with speed, velocity and trajectory of the user's movements, form a combining compound giving rise to an artistic involvement touching the YMYI universal expressiveness.



Fig. 3. The YMYI experience.

### 5. FIELD OBSERVATIONS OF USERS EXPERIENCING THE ARTEFACT

In the exhibitions of the YMYI, our field observations of the users interacting with the installation enabled our better comprehension of the artefact. YMYI was actually experimented by an extensive scope of users - children, teenagers and adults, single users and families during the exhibitions both in the Cultural Forum of the city of Maia between the 29<sup>th</sup> of March and the 12<sup>th</sup> of April of 2008 and in the International Creative Arts Fair held in Oporto City between the 18<sup>th</sup> and the 20<sup>th</sup> of April of 2008.

Steinkamp (2001) reports that "children immediately understand that they are expected to play in the projection." On the other hand, adults prefer to examine and analyse beforehand the system instead of actively interacting with it. Steinkamp's remarks were noticed in our observations. When entering the installation physical space, children gazed with admiration at their anatomic silhouettes embodied in the interface displacing themselves according to their own movements in the stage. Their movements emphasized a lot of physical energy, such as jumping in the air, moving in several directions, playing with objects such as balls, performing somersaults either forwards, backwards or sideways and other acrobatic feats such as standing on one's hand, physically interacting as pairs or small groups forming new silhouettes. We have also observed that the children had a tendency to approach the sensor webcam located in front of them. In their minds, they were in presence of an odd object to be discovered as well. When they found that the system became more reactive to their proximity to the webcam, they explored new entertaining movements and representations.

The adults adopted a more reserved attitude in experimenting the artefact in an open-spaced installation. They seemed not to feel very comfortable knowing they were being observed by other people. This somewhat restrained their spontaneous movements.

A professional dancer reported his own opinion following an opportunity to enact a live performance for about 15 minutes at the International Symposium on

Computational Aesthetics in Graphics, Visualization, and Imaging held in Lisbon between the 18<sup>th</sup> and the 20<sup>th</sup> of June of 2008.

To rehearse his performance, the dancer previously practiced with the artefact for about 3 hours the night before the event. We ensured that he felt free to explore it alone so that he could develop a more intimate relationship with it as well as better learn how the system worked without feeling any sort of restraint.

YMYI was setup on a conference room, shared with other conference activities. At the time of the performance, the computer running the software exhibited some latency to process the movements of the dancer, which were noticed and incorporated by the dancer in his performance. In his words: "My interaction with the machine resulted in a growing adjustment of both my sensitiveness and fine motor skills so that my body became more suitable to every movement to be projected onto the screens. The moving field for the image motion capture that I had at my disposal was a truly narrow space, which posed additional difficulties to my improvising dynamics and composition." He also reported that his interaction with the system posed him some challenges: the standard-slow motion capture of the sensor device compelled him to keep a low performance body speed and from that latency create an imaginative rhythm to keep an interest in both his displayed image and his movements. He stated that to take advantage of the system, he had to reinvent himself to develop thoroughly his whole composition.



Fig. 4. Picture of users experiencing the YMYI artefact.

## 6. CONCLUSIONS

This paper reports the developments and key results of an artefact designed to support an artistic performing choreography between a user's body and his/her virtual embodiments displayed in a digital system. The project is inspired on research of interactive movement-sensing installations and of human gesture expressiveness. YMYI features the human-computer interactivity, enlightening evolving artistic interface designs generated from affordances, interconnected with the relational actions between a user and a digital system. As for

implementation, we focus on the use of a dedicated system able to track the user's body shape and to perform computer music interactively in real time by making use of an environment and programming language for real time audio synthesis.

Finally, we report some field observations of the users experiencing with the artefact.

Videos recording the YMYI experience can be downloaded from:

<http://www.ymyi.org/YMYIpreview.mpg>

<http://www.ymyi.org/YMYIRTP.mov>

or in the official website: <http://www.ymyi.org>

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