Virtual Embodiment: verso un corpo digitale per l’immersione in ambienti virtuali

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Designing for the future we want

- Human Computer Interaction
- It is not just a computer anymore, but not even a smartphone
- Natural and intuitive interaction
- Physical, bodily, gestures
- Virtual Reality

Picture from https://globalvision.ch/product/oculus-quest-vr-headset-rental/
Virtual Reality: what’s?

The fantastic concept:

- Creating imaginary worlds
- Audio and visual stimuli
- Possible and impossible worlds

https://it.wikipedia.org/wiki/Stereoscopia

Photograph by J. R. Eyerman/LIFE Magazine
Virtual Reality Today

- **1980s**
  - Birth of Contemporary VR
  - Jaron Lanier coined the name
  - First commercial Company

- **2010s**
  - VR second golden age
  - Mature technology, ready for commerce
  - Affordable hardware, easy content creation

- **Gartner Hype Cycle 2015 vs 2017**

- **2018-2019**
  - CHI and UX approach
  - Social VR
  - Embodiment

Source: Gartner - ©Gartner, inc.
“One morning, as Gregor Samsa was waking up from anxious dreams, he discovered that in bed he had been changed into a monstrous verminous bug.

He lay on his armour-hard back and saw, as he lifted his head up a little, his brown, arched abdomen divided up into rigid bow-like sections. From this height the blanket, just about ready to slide off completely, could hardly stay in place. His numerous legs, pitifully thin in comparison to the rest of his circumference, flickered helplessly before his eyes. ‘What’s happened to me,’ he thought.

It was no dream.”

_Franz Kafka, The Methamorphosis, 1915_
Sense of Embodiment

What is it?

- The belief of a person that an external body is their physical one and is processed as such.
- In the physical world we take for granted that we possess and control a body.
- In virtual worlds the SoE is mainly given by the representation of a digital body, together with a compound of sensorial stimuli.

Two of its main components are:

- Sense of Ownership (SoO)
- Sense of Agency (SoA)
Body Ownership

The rubber hand illusion

- Previous studies showed how it is possible to cheat human brain to make people believe that a fake part of their body is their own.

- How do we represent a human body, or part of it, to make the person feel like it is their own?

- Movie 1:10

“The Rubber Hand Illusion - Horizon: Is Seeing Believing?” by BBC
https://youtu.be/sxwn1w7MJvk
The active rubber hand illusion

- The feeling that I am making that hand move
- Movie 2:05
  (The participant is the actor Paul Giamatti)

“Is That My Real Hand? | Breakthrough” by National Geographic
https://youtu.be/DphlhmtGRql
What’s Alien Motion?

VR is an ideal environment to study human behavior on bodily modifications.

Someone or something is moving my body despite -or against- my will.

Previous studies focused on:

● The embodiment of steady alien limbs

● The embodiment of alien limbs in case of some cases of active or passive motion

We study the effects of alien motion on the correspondent physical body part

“Leap Motion: Orion” by Leap Motion
https://youtu.be/rlICGw-0R8g
In the relationship between the physical body and its digital avatar

- Not only: PB can influence -through sensors-the behavior of the VB
- But also: VB can influence -through sensorimotor stimuli-the behavior of the PB itself

What we found: Embodiment Simulation Theory
Theories

- **Preoteus Effect**
  - Digital representation on the self influences the online behavior

- **Embodied Simulation Theory**
  - The same brain activity happens when the person experiences something or when the person empathises with someone experiencing the same (i.e. yawning)

- **Homunculus**
  - The brain map of the motor control of the body has big hands with bigger fingers

- **Embodied Alien Motion Theory**
  - Induced Movements Effect

- **Choice to work on Alien Finger Motions**
  - Induced Finger Movements
Through the Digital Body

- Università degli Studi di Torino
- Embodied-Brain Systems Project
- NII - National Institute of Informatics in Tokyo

http://embodied-brain.org/eng/
Virtual Reality System
As a Probing Machine
System

The Victim
The Virtual Hand in the HMD
Evaluation of the UX

Real Motion

Alien Motion
System

The Operator
Schema of the implementation
Development

The Hand Model
The Alien Motion Movements Sequence
MEASURING the induced movements effect

- Distinguish the induced movements from the natural expected movements
- Finding formulas
The poses and the movements

1.
The population

- 16 participants
- 14 males, 2 females
- 10 tried a HMD before (in Tokyo)
- Age: average 28.8, standard deviation 7.0
- All volunteers
- No rewards, beside refreshments
Objective quantitative measurements

- One line per finger
- Signal comparison between Unity3D and SensoGlove
- The playback produces the expected movement
- The data analysis library plots both the data types
Main Finding

The Induced Movements effect only happens when embodiment happens
Applications
-to the Medical Field-
Human Robot Interaction

Video 0:22
Video 0:45

“Telexistence Model H unveil” by Telexistence inc.
https://youtu.be/K00T67zqjpl
Traumatic Brain Injuries

- Biggest cause of neurodisabilities, according to the World Health Organization
- The advancement of surgery techniques created a new population of survivals with disabilities.
- The topic is often included in research investigations on healthy aging.
- There is no pharmacological remedy

Our contribution:
- Apply the Embodied Alien Motion Theory to induce movements in the patients.
Embodied Alien Motion Therapy

Based on the augmentation of the movements (i.e. of the finger angles)

Video 0:24

Video 0:53
Thanks for your attention

ありがとうございました

Special Thanks to the Program Committee and the Organizing Committee
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