VR as a communication tool

Contents
- General concepts
- Hardware tools for VR communication
- Emotional models
- CyberEmotions
  - Concept
  - Interpersonal level
  - Asymmetrical facial expressions
  - Crowd level

Keywords
- Virtual reality as a communication tool

Important reminder
- Non-verbal communication rendering
- \!/ limited resources
- \!/ real-time constraints
Welcome to the new worlds

Context: VR

VR triangle

Immersion
Feeling to be in the 3D Virtual Space

Interaction
Possibility of moving in the 3D space and manipulate objects

Real Time
Actions can immediately modify the state of the space

Communication

What is «communication»?
Communication as a - natural medium - VR medium

Natural conversation

Nowadays virtual world conversation, i.e. text + graphics only

Computer-mediated-communication (CMC)

«VR is likely to emerge as the next dominant medium» Biocca & Levy -1995
Multi-user VR is a particular form of computer-mediated-communication (CMC)

= dissoluzione of traditional media

From 2007 to 2011 advertising spending by medium -% in $ terms
Interpersonal communication

CMC => interpersonal communication

The def. => 2 important implications:
- need for analysing the subjects with their involved VE
- new process and activities developed during interaction => challenge & modify relationship between subject & context

Social actors

No more simple «users» but active «social actors»

=> Means that individuals, attempt to come to grips with the changing world around them
both cognitively and organisationally

=> interact with other individuals and social groups

Context comprehension

A need for non verbal graphical attributes

Importance of facial expression to understand context

Facial expression go beyond verbal reports to enhance context comprehension

Self-identity

Construction of identity for VR-user
- personal attribute
- relationship with others

=> consistency
=> integration
=> balance

«My identity through others eyes»

...less important than relationships
**False identity and stereotypical behavior**

In VE:
- interlocutor appearance increasingly convincing
- identity decreasingly less tangible and plausible

To keep consistency: must represent myself by coding cultural expectation at a symbolic level

**Drawback**
force subjects to massively use stereotypical attitudes

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**E-communities**

In e-societies, only exchange information build a presence

- Commitment to communities
- not based on previous relationship
- but from temporal mutual interest

=> Rise of e-communities

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**VR interfaces**

VR: navigable space for e-communities

To interact from physical to virtual worlds
=> request graphics user interface (GUI)

**Main issues**
- Connection with user sensorimotor channels [orange arrow]
- Manipulation/control of large numbers of parameters [blue arrow]

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**Mental model**

VR interfaces: How realist? => Metaphor or illusion?

Should be an illusion

Why?
=> User needs to construct a mental model

Mental models of the:
- virtual world (A)
- VH bodies (B)
- Objects (C)

Our greatest joys and deepest sorrows, use the body as a yardstick – Damasio 1994

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**Mask of false identities**

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**Multi representation of potential agent**

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Design Challenges

To achieve immersive VR?

a. Design of a space for bodily action
   => Stable and coherent VE

b. Design of other intelligent beings
   => Complex expressiveness

c. Design of the represented body
   => Characteristic of user’s representation, i.e. avatar

Final goal

How developing “satisfying” VE?

a. Measuring the disappearance of mediation

b. Succeeding to reach the sense of community

Cyberspace main characteristic: Interaction
  => new sense of self

Hardware tools for VR communication

Sharing a task – Wii remote – Kinect – a practical example

sharing a task

Communication: about sharing a task
Wiimote

Wiimote as a communication tool

Concepts/purpose
- Wii controller as VR input device
- Head tracking for desktop VR display using Wii remote

Development
motej (Java) ou wiiuse (C++)

Wii remote for VR –2007 J.C. Lee
http://www.youtube.com/watch?v=Jd3eiidUw&feature=fvwrel

Wii Controller for VR –2007 Olivier Kreylos
http://www.youtube.com/watch?v=KyvIlKSA0BA&feature=related

Kinect + HMD + Wiimote

Multi senses => multi hardware

Kinect and Wiimote and Nanotech Construction Kit – Nov. 2010
http://www.youtube.com/watch?v=8fZJoKRjJBg&NR=1
http://www.youtube.com/watch?v=rKhWcvpkks&feature=player_embedded
http://www.youtube.com/watch?v=WDlvn3voblQ

Kinect + HMD Virtual Reality – Dec. 2010


Kinect open source driver demo
http://www.youtube.com/watch?v=ZS33cENjyRs

A school of Art

Applied to civil engineering Architecture
Issue: large project
=> team management
=> sharing tasks
VR brings an interactive visualization tool
Helping sharing:
=> past states
=> present designing
=> future tasks
How
=> virtual visiting
=> scaling change

Mock-up real-time rendering

(a) geometry
A complex model
E.g. How solving the slope issue and mixing nature?

Real and artificial views

Archit. Michel Marot (inaug. 1972)
### Mock-up real-time rendering

**Example of light trap**

**(b) lighting**
- In terms of lighting
  - => A philosophy of light developed using light traps and wells
- Disadvantage: heavy computational cost
- Advantage: radiosity rendering especially efficient for simulating concrete

Question: which ones are real pictures?

<table>
<thead>
<tr>
<th>(a)</th>
<th>(b)</th>
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### Task to achieve

Development of an interface of 2D windows in immersive 3D VE

=> navigating and manipulation 3D object

New tool for modelling and designing buildings

HMI difficult to develop, many issues:

=> CS, CG, 3D design, multi-param., haptic, psycho., physio., etc.

### Complexity of VE

Compare to reality...

Graphical rendering are not realistic

Is it an issue? What is important?

### Emotional models
What is «emotion»?

Solution
Psy. estimations → Linguist statistics

"An emotion is the complex psychophysiological experience of an individual's state of mind..."

"Emotions are very complex experiences..."

Models of emotion => two strategies
(a) Try to extract clues for a set of emotion

Main issue
Limitation of classification
Models of emotion

=> 2 types of strategy

(b) Define emotional driven dimensions

Valence

Energy / arousal

Dominance / Potency

3D interpretation with potential associated emotions

Facial expressions & emotional model

How can estimated parameters be linked with facial emotion?

Data mining

→ Large data base

→ Language classifiers

→ Lexical classifiers

Complexity of emotional events

Two types of events

Very 1st step:

→ focus on Text to emotion

Only events of type 1

CyberEmotions: Concept

WP2: Computer graphics non-verbal communication
Our tasks

Computer graphical metaphor of emotion in Virtual Reality
Create a virtual society composed of VH, capable of reactions, emotions, and social behavior
Develop interpersonal relationships and nonverbal communication in a virtual society

Context

Virtual worlds
"Ingredients"
- Network
- Cells
- Links
- Worlds
- Environment
- 3D design
- Communication
- Verbal
- Non-verbal

Psy. fact: Non-verbal communications have more consequences than semantic content

Objective

Perception \(\rightarrow\) Action
Events occur for both
Our focus \(\rightarrow\) emotional events

Overview

Internet virtual environments
New worlds can be forecast
Primary application \(\rightarrow\) Social network
Based on communication
Non-verbal communication: very important part of total com.
Virtual social networks: almost only verbal com.
From a dialogue to its CG interpretation

**Dialogue**
A: "Hello"
B: "Hi chick!"
A: "What? 😞"
B: "sorry..."
A: "It's ok 😊"

**Associated dialogue:**
Emotional correlation:
Emotional computation:

**CG animations**

**A first CG metaphor of emotion model**

One sentence → one {v,a} emotion

**Improved the model**

One sentence → one {v,a} emotion

**CG animations**
- Facial and body emotional interpretations

**WP3** "SuperClassifier"

**WP5** Formal approach

**WP3** Improved and new database

**Dialogue**
A: "Hello"
B: "Hi chick!"
A: "What? 😞"
B: "sorry..."
A: "It's ok 😊"
A second CG emotional model

WP5
- [v,a,d]
- Target
- Polarity

Dynamic event manager
- Multi user
- Free interaction

VH emotional mind
- 3D emo. model [v,a,d]
- Memory based on history of dialogs

CG animations
- Facial and body emotional interpretations

Dialogue
A: "Hello"
B: "Hi chick!"
A: "What? 😳"
B: "sorry..."
A: "It's ok 😊"

WP3
- "SuperClassifier"
- "ANEW"

Vi events & sub-events

One event generates multiple non-verbal events.
Each non-verbal event -> CG interpretations.

Event and sub-events

1 event occurs
The event is noticed
The event is identified
The strong emotion was actually fun
Peek of the emotion

CyberEmotions: Individual level
Concept, Architecture, User test, Results

Practical example at individual level

Main purpose
Individual and social behavior
Platform for experimentation – tested.

1 avatar ↔ 1 autonomous agent conversations
Avatar: user’s anthropomorphic representation
Autonomous agent: fully controlled by computer(s)

Avatar: user’s anthropomorphic representation
Autonomous agent: fully controlled by computer(s)
### Engines for a Simple Chat

<table>
<thead>
<tr>
<th>Communication: meaning &amp; emotional sub-pipelines</th>
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<tbody>
<tr>
<td><strong>Event engine</strong> ➔ Managing all events and network connections</td>
</tr>
<tr>
<td><strong>Data mining engine</strong> ➔ Extracting basic parameters based on classifiers</td>
</tr>
<tr>
<td><strong>Refinement engine</strong> ➔ Generating emotional 2D histogram PEH</td>
</tr>
<tr>
<td><strong>Graphics engine</strong> ➔ Managing all graphics</td>
</tr>
<tr>
<td><strong>Human</strong> ➔ Represented by his/her avatar</td>
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- **Agent engine** ➔ Conversational systems

### User Test Conditions

<table>
<thead>
<tr>
<th>XP parameters</th>
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<tbody>
<tr>
<td>Around 50 users</td>
</tr>
<tr>
<td>1h each</td>
</tr>
<tr>
<td>4 conditions</td>
</tr>
<tr>
<td>Consent</td>
</tr>
<tr>
<td>For free</td>
</tr>
</tbody>
</table>

- Expressionless
- Relatively subtle emotional expression

**Chatting with the affect bartender —agent**

**Chatting with a Wizard of Oz —avatar**

### User Test Sequences

Four steps for each condition of the (following) four conditions:

- a) The user sees his/her avatar arriving in the virtual bar
- b) Meeting and greetings with the affect bartender
- c) Conversation / dialogue between VHs
- d) Observation of non-verbal communication

### Architecture

A relatively complex architecture

- **Human** ➔ Represented by his/her avatar
Correlation between physical and virtual worlds facial expressions?
None! 😊

Questionnaire part 1:
Statistic
Questions comparing the 4 conditions

Statistic analysis
Comparing the 4 sessions one by one:
Considering: # of participant and standard deviation
Conclusion 1
When chatting with a human "Wizard of Oz"
With or without subtle facial expressions
Facial expression $\Rightarrow$ tendency to improve
- Enjoyment
- Emotional connection
- Dialog seems more consistency

Questionnaire part 2
General questions
1. Did you enjoy seeing the other person's emotions?
2. Did you enjoy seeing your own emotional expressions?
3. Do you think that AI graphics enhance the chatting?
4. Would you like to repeat a similar experiment?
5. How well did you identify yourself with your avatar?
6. Do you think that 20 minutes of conversation was long enough?

CyberEmotions: Asymmetrical facial expression
Overview – Model based on 2D emotional models – Resulting facial expressions
### Overview

#### Goal
Visualizing various 3D facial expressions

From an input of 2D emotional model

#### Approach
Proposed an emotional circumplex space

Defined asymmetric emotional samples

Generated facial expressions by controlling joints

### 2D circumplex models of emotion

3 models at once!
- Russell’s model
- Barrett’s model
- Scherer’s model

### Model & Emotional Samples

Associating a specific asymmetrical facial expression to each emotion

#### Advantage
Realistic expression

#### Drawback
Large amount of work

\[ \Rightarrow 48 \text{ Dofs for the face control} \]

### Model in image

Circumplex Space Diagram
(Selection of 26 Emotion Samples)
Results: Facial expressions

- Our method applied to different VHs and emotions

Results: Applied to virtual scene

- Any valence and arousal as input [-1.0 ~ +1.0]
- Shows asymmetric facial expressions

CyberEmotions: Crowd level

Physical and virtual worlds

- Two worlds – Two parallel communities
- Six possible types of communications
Improving individual model

Emo-MMO: "massive" user interaction
First "emoMotion" library
- 27 emotions
- Applied to 4 VH skeletons
Making VH more alive
- Breathing simulation
- Lips movement & speech
- VH gaze
Brand new architecture
- VR server / VR Clients
- GUI
- Event manager
- VH emoMind

A new architecture

From simple chat system – individual level – to VR-server/clients system; /!
architecture seems similar

GUI engine
- Managing all graphics & user commands
Conversational systems
VR server
- VH emoMind
- Event manag.
VR clients
- User's point of view of the VE

Emo-MMO: dynamic event manager

Complexity of architecture for emotional events
- Spread into sub-events with threshold
- Real-time related rendering
- Different time related animations – facial and body, see next slide
- Indirect emotional related events

Number of event quickly grows
- Most events are related to emotion dynamics
- Local computer discussion O(n)
- VR-server/client discussion O(n^2)
  - Due to sub-event generation and "Ping-Pong" emotional effect
  - Need to be tested

Improving immersion => presence

Main issue to avoid: BIP, break in presence
=> Taking into account all important context
- Lips movement => synchronized with text
- Ambient sounds => VH position in VE
- VHs can now breath => a simple add-on
- VH gaze => an essential like in the conversation model
27 emoMotions

- MoCap = Motion capture
- 3 emotional axes, v, a, and d
- Asymmetrical model used for realism

27 emoMotions: applied on 20 VHs

- 3D emotional model based on valence, arousal, and dominance

emoMotion applied to other VHs

27 emoMotions: 4 examples in video
Result: a virtual social environment including verbal and non-verbal communication

Questions and remarks

CG & non-verbal communication