

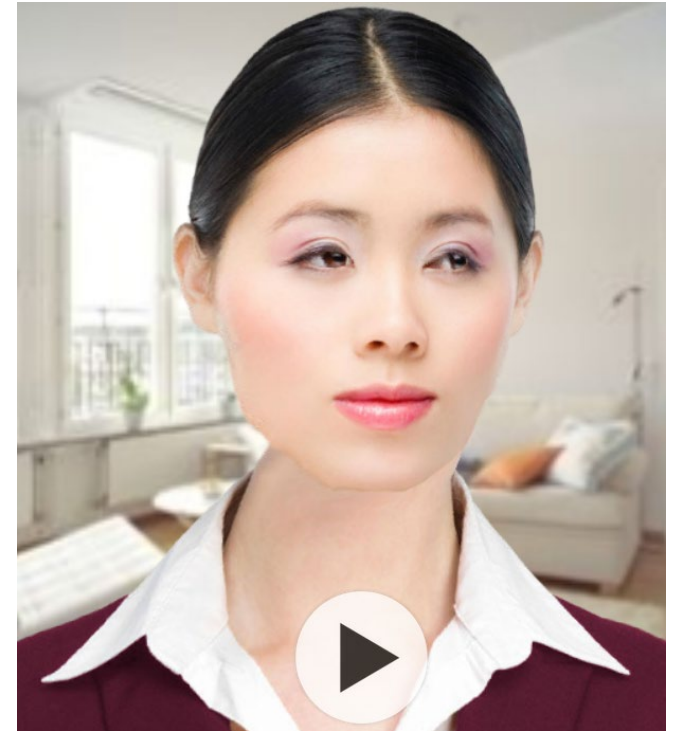
What makes a Virtual Human Alive ?

1. Avatar & Autonomous Virtual Humans
2. The complexity of expressive movements
3. From artificial to real: the uncanny valley
4. Motion capture is part of the solution (offline/online)
5. Perception of real-time animation
6. Core real-time VH believability factors
7. Exercises & R&D efforts

video3

6. Core real-time VH believability factors (1)

- The first key factor is “**animation**” :
 - from latin word “**anima**” : animal life, breath, soul, mind
 - Hence the Virtual Human **MUST NOT BE STILL** otherwise it appears at best as a statue or worse as a dead body.
 - Movement can be procedurally generated or re-synthesized from captured movement through motion graphs [vW 2010]
 - Many commercial chatterbots, e.g. (USA) => <http://sitepal.com/demo>



6. Core real-time VH believability factors (2)

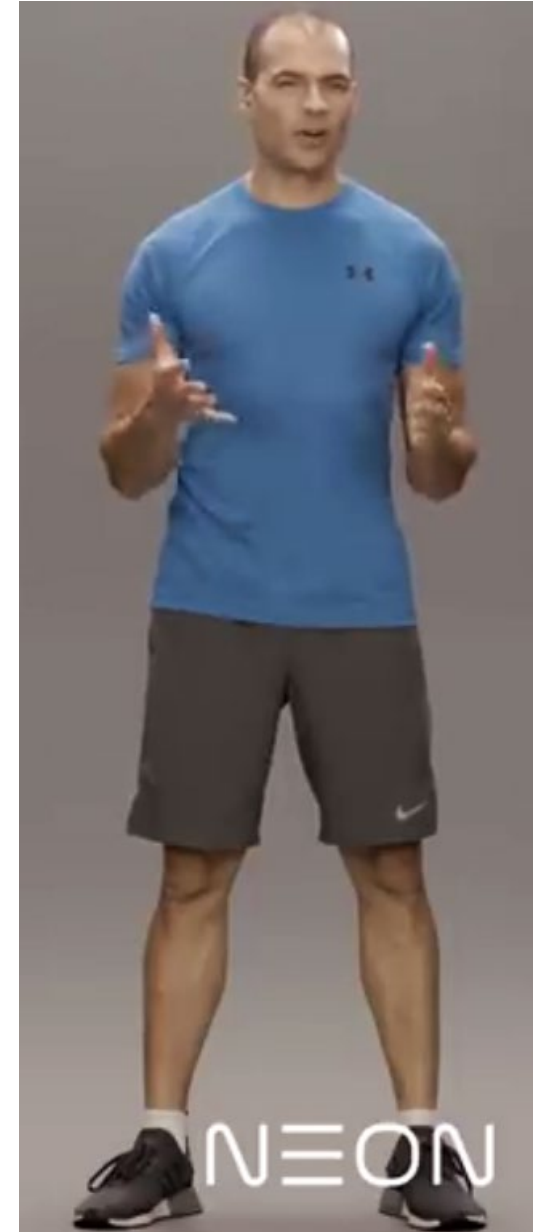
- Minimal background animation :
 - Breathe gently : sine wave in the spine at the thorax level
 - Eye blinking (5 to 20 /min)
 - Gentle random head movements, possibly coordinated with gaze
 - Gentle balance swaying if standing, possibly with idle movements
- Principle of Perlin noise for VH animation [P1995]:
 - Add noise functions with decreasing amplitude as frequency increases:
 - F= 1 Hz, amplitude: 128
 - + F= 2 Hz, amplitude: 64
 - + F= 4 Hz, amplitude: 32
 - + etc..
 - Smooth/interpolate the result to produce in-between frames at display rate (e.g. 60 Hz)



[SimSensei 2014 ICT]

6. Core real-time VH believability factors (3)

- Animation has to be coherent with the second key factor : **interaction**, i.e. being responsive to user input [TVR], including :
 - Plausible **speech understanding & generation** : *minimize latency*
 - **Must be coordinated**: facial expressions, head movement and eye gaze
 - Gestures: handle or precompute **transitions** between prerecorded gestures instead of sequences of gestures that always start and end with the same neutral posture
 - continuous flow of **idle movement** when not actively interacting
 - Handle eye contact with care: *gaze to express the wish to speak [K2014]*
 - Emotion display is application-dependant: happiness, surprise, interest, smile is generally a safe default.
 - If possible, subtle **mimicry** of the user head movement by the virtual human (e.g. with 4s delay) produces social influence but it backfires if detected because considered as a form of deception [Bailenson 2008]



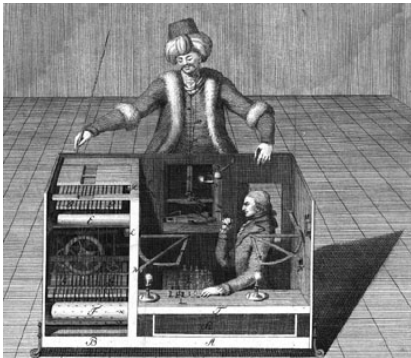
[NEON 2020 Samsung STAR labs]

6. Core real-time VH believability factors (4)



- integrate a *hidden operator* when real-time constraint prevent the synthesis of sufficient quality movement or social experience:

- Performance animation for animating a synthetic character in TV shows or theme parks to interact with the public.



- Mechanical Turk (inspired by a false chess automaton from the XVIII century), e.g. teleoperated realistic puppet of Hiroshi Ishiguro (see uncanny valley slide) for fairs, theme park, etc...



- Wizard of Oz (inspired by the novel from F. Baum), e.g. for scientific experiments or training of complex social skills: the operator select predefined actions, sentences, behaviors etc based on the instantaneous user input (cf Presence course).

6. Core real-time VH believability factors (5)

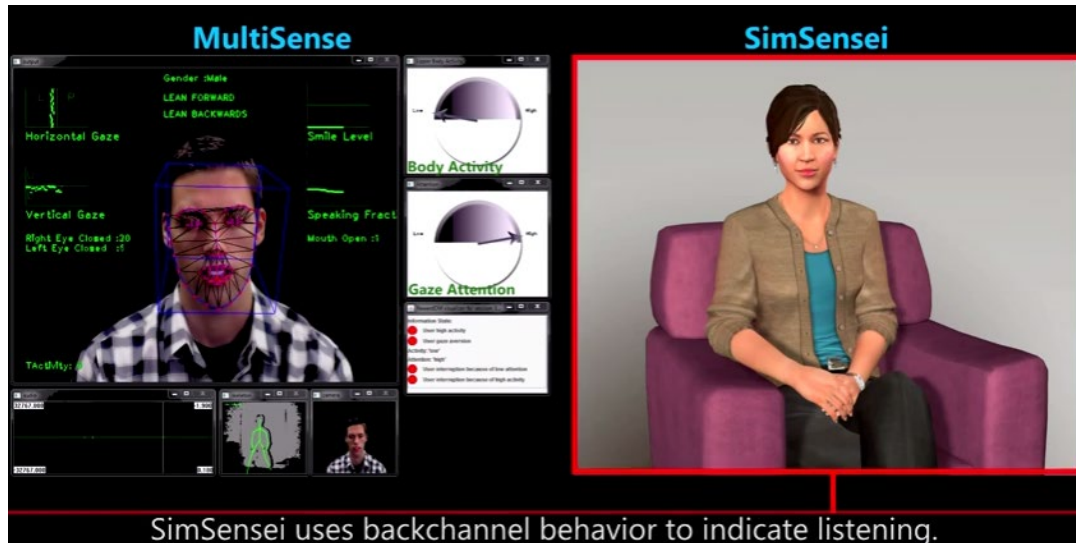
- Combine with tangible interface if necessary
 - in case a touch or haptic feedback is also needed, the VH should be collocated with a tangible interface, e.g. in [R 2009] a physical mannequin is manipulated by the trained medical doctor (e.g. for a breast exam) while seeing a VH patient in a HMD.
- In that specific study, an additional feature of Virtual Social Perspective-taking (VSP) required the medical student user to switch roles with the patient to better understand the patient concerns and show more empathy for future real-world patients.



7.1 Exercise : spot key believability factors of these demos

2014: S. Rizzo & LP Morency et al

MultiSense (emotion tracking) & SimSensei (VH agent)



<https://www.youtube.com/watch?v=ejczMs6b1Q4>

2023: [REPLICA smart NPCs “Matrix awakens”](#)



TMARTN2 mid-2023 : trying to convince NPCs that they are living in a simulation

<https://www.youtube.com/watch?v=aihq6jhdW-Q>

7.2 Exercise : spot key believability factors of these products

Gallery of chatterbot demos from Sitepal.com

<http://www.sitepal.com/demo>



March 2024 Ubisoft AI-powered NPC : demo of the "Bloom" character

<https://www.youtube.com/watch?v=1od2pls9220>

Commercial Library of full-body 3D characters from Rocketbox studio (2010)

<https://www.youtube.com/watch?v=zlqtWivC4Hg>



CES 2020 Cnet discussion of Neon Virtual Humans from /Samsung StarLab

https://www.youtube.com/watch?v=ODucR4xum_4



Morph3D => Tafi avatars

Mixamo

<https://www.youtube.com/watch?v=kPb6cF8rnB8>



7.3 R&D efforts

- Academic groups involved in RT Autonomous VH:
 - ICT (USA) : S. Rizzo & LP Morency/ MultiSense (emotion tracking) & SimSensei (VH agent)
 - INRIA-BUNRAKU/ Golaem (FR) : normalized postural control, Behavior
 - Paris-Tech (FR) : speaking agent GRETA, Catherine Pelachaud
 - Grenoble GIPSA-lab: Prosody & emotions, Gérard Bailly, Rémy Ronfard
 - DFKI (DE): Thomas Rist, Michael Kipp
 - UK teams: Ruth Aylett, Marc Cavazza
 - Other US teams: Justine Cassell, Andrew Cowell, Ari Shapiro
- Industrial solutions: Ubisoft [NEO NPCs gameplay ; AI powered characters](#)
 - Replica smart NPCs <https://www.replicastudios.com/smart-npc>
 - Numerous full body 3D assets available with UNITY3D (e.g. [Mixamo](#))
 - Web site characters focus on spoken interactions with “chatterbots”: often limited to a 2D/3D speaking head/torso
 - Language understanding tools (converging towards google/amazon assistants)

[References]

[Bailenson 2008] J. N. Bailenson, N. Yee, K. Patel, and A. C. Beall. 2008. Detecting digital chameleons. *Comput. Hum.*

[K2014] Kerstin Ruhland, Sean Andrist, Jeremy Badler, Christopher Peters, Norman Badler, et al.. Look me in the eyes: A survey of eye and gaze animation for virtual agents and artificial systems. *Eurographics 2014 - State of the Art Reports*, Apr 2014, Strasbourg, France. pp.69-91, 2014, <10.2312/egst.20141036>

[P 1995] K. Perlin, “Real Time Responsive Animation with Personality,” *IEEE Trans. Visualization and Computer Graphics*, vol. 1, no. 1, pp. 5-15, Mar. 1995

[R2009] A. Raij et al, *Virtual Experiences for Social Perspective-Taking*, IEEE VR 2009

[TRV 2006] *Traité de Réalité Virtuelle*, Ed. P. Fuch, vol 2, chap 17, Eds A. Berthoz & J.L. Vercher

[W 2009] van Welbergen, H., van Basten, B.J.H., Egges, A., Ruttkay, Z., Overmars, M.H.: Real Time Animation of Virtual Humans: A Trade-off Between Naturalness and Control. In: *Eurographics - State of the Art Reports*, Eurographics Association, pp. 45–72 (2009)

[Web References]

Unreal Engine 5 Replica smart NPCs: <https://www.replicastudios.com/smart-npc>
evaluation: <https://www.youtube.com/watch?v=aihq6jhdW-Q>

Ubisoft AI-character: <https://www.youtube.com/watch?v=1od2pls9220>

Ellie : <https://www.youtube.com/watch?v=ejczMs6b1Q4>

NEON discussion at CES 2020: https://www.youtube.com/watch?v=ODucR4xum_4

Demo of the 2010 EU project SEMAINE interacting agent: <https://semaine-db.eu/>

Web site of Prof. Ken Perlin: <http://www.mrl.nyu.edu/~perlin/>