

AR/VR

Research Papers

SWEN422

Human Computer Interaction

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SWEN 422 – Lecture Schedule

- ~~Week 6 – Information Visualization~~
- ~~Week 7 – Information Visualization~~
- ~~Week 8 – Information Visualization~~
- ~~Week 9 – Gestural Interfaces~~
- Week 10 - AR/VR (Introduction and Research Papers)
- Week 11 - AR/VR (Research)
- Week 12 - no lectures (work on project)

https://ecs.wgtn.ac.nz/Courses/SWEN422_2024T1/LectureSchedule

Class Announcements

- Assignment 2 extension 2359 Friday 24 May
- Assignment 3
- NZ Tech Week 20-26 May
 - <https://techweek.co.nz/>
- NZ Testing Conference @ VUW – 27 June
 - Want volunteers
 - volunteer@nztestingconf.nz
 - <https://nztestingconf.nz/>
- Kiwi Python Conference, Wellington, 23-25 August
 - <https://kiwipycon.nz/>

Research Papers

- [Understanding mid-air hand gestures: A study of human preferences in usage of gesture types for HCI](#)
- [Understanding 3D mid-air hand gestures with interactive surfaces and displays](#)
- [10 Scientific Problems in VR](#)
- [VR: How Much Immersion Is Enough?](#)
- [Navigation in desktop virtual environments](#)

For Each Paper

- Who is the intended audience?
- What are the objectives of the research?
- What is the study design?
- What are the main results of the study?
- What are the research contributions?

GSpeak – Oblong Technologies



Minority Report - 2002

<https://www.youtube.com/watch?v=33Raqx9sFbo>

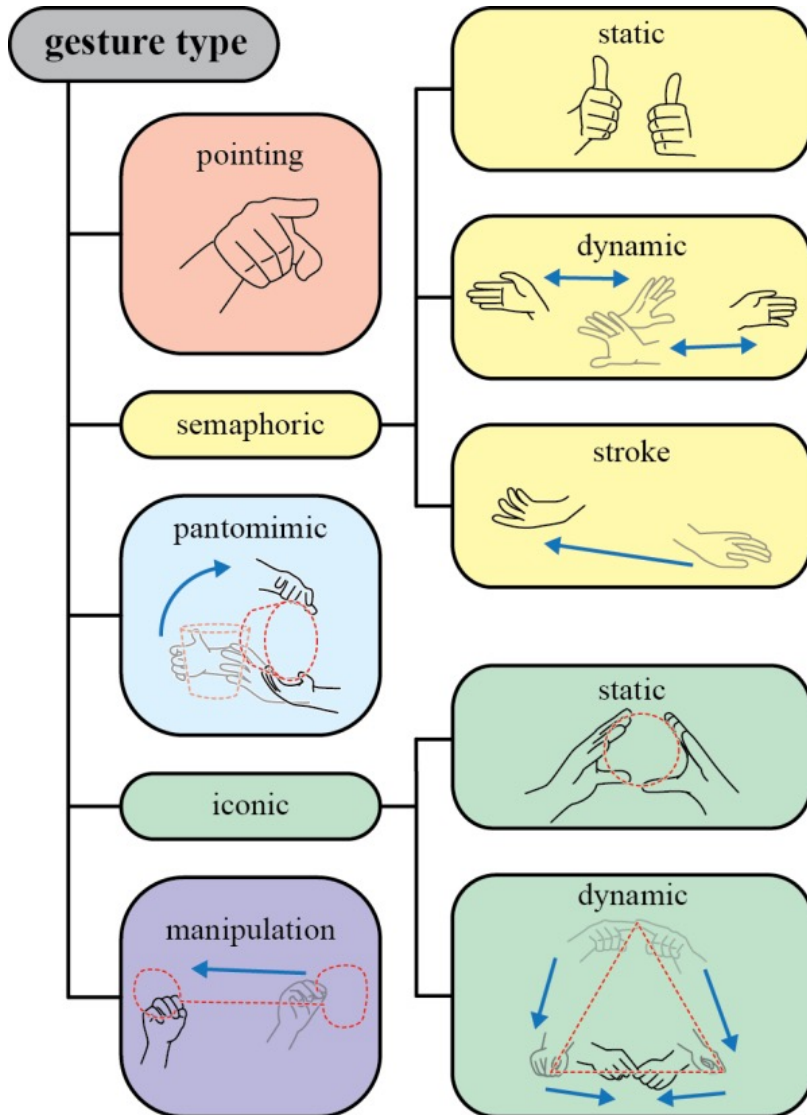
<https://www.youtube.com/watch?v=Zkj5WSae3Uc>

GSpeak

<https://www.youtube.com/watch?v=fe0fHTHEL9w>

https://www.ted.com/talks/john_underkoffler_drive_3d_data_with_a_gesture_6

Understanding Mid-Air Hand Gestures



Understanding mid-air hand gestures: A study of human preferences in usage of gesture types for HCI. Aigner et al. TechReport MSR-TR-2012-111, Microsoft Research, 2012.

<https://www.microsoft.com/en-us/research/publication/understanding-mid-air-hand-gestures-a-study-of-human-preferences-in-usage-of-gesture-types-for-hci/>

https://www.youtube.com/watch?v=rSh_YyIppy0

3D Gestures Literature Review

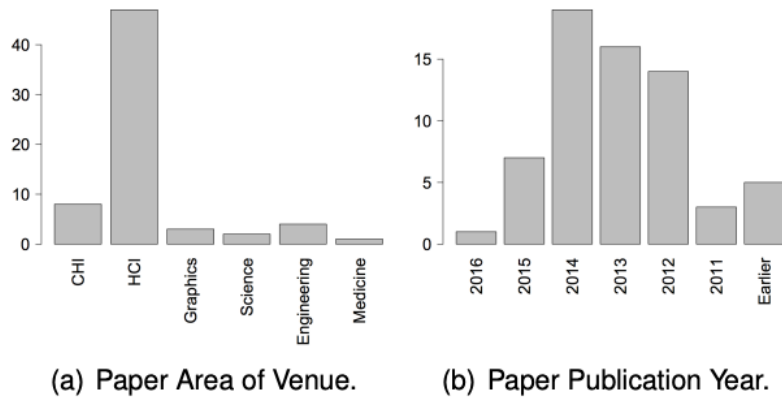


Figure 2: Overview of literature review papers.

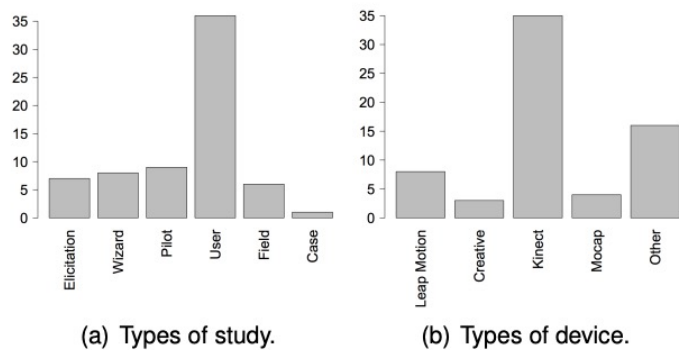


Figure 4: RQ3 - Types of evaluation performed and types of devices used for gesture detection.

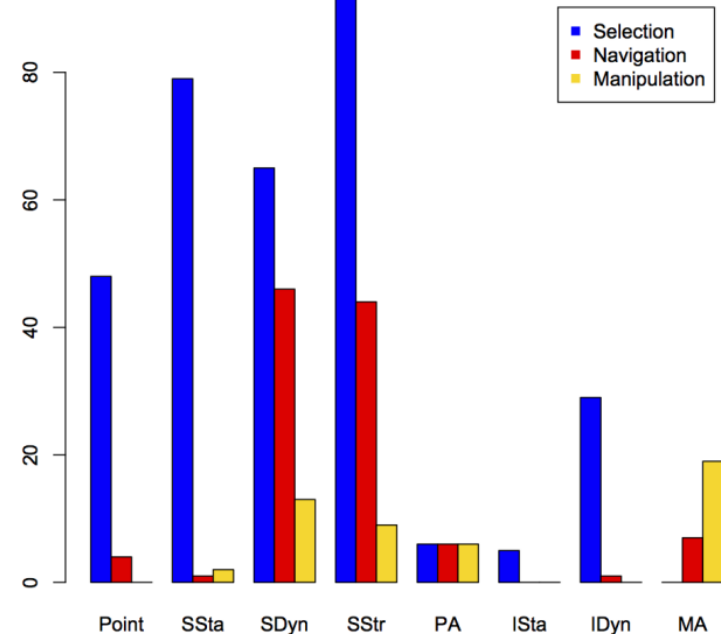


Figure 3: RQ2 - Gesture Classification Results from the papers identified in the literature review. Gestures in order from left to right: Pointing, Semaphoric-Static, Semaphoric-Dynamic, Semaphoric-Stroke, Pantomimic, Iconic-Static, Iconic-Dynamic, and Manipulation.

Understanding 3D mid-air hand gestures with interactive surfaces and displays: a systematic literature review Groenewald, Anslow et al. British HCI, 2016.

<http://homepages.ecs.vuw.ac.nz/~craig/publications/britishHCI2016-groenewald.pdf>

3D Gestures Literature Review



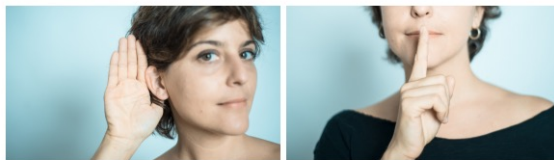
(a) Backwards

(b) Forwards



(c) Pause/Start

(d) Close/Quit



(e) Volume Up

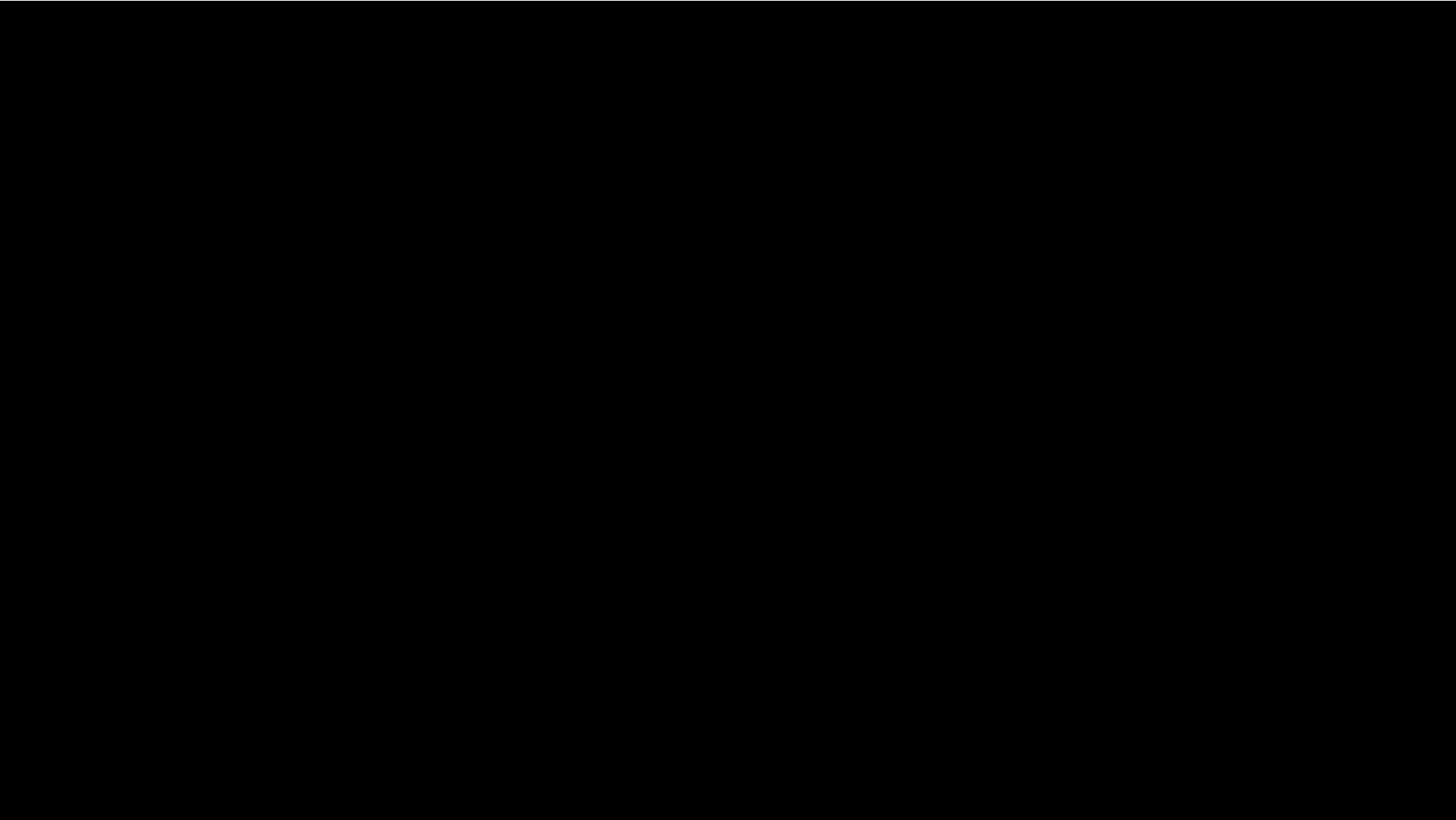
(f) Volume Down

Cat.	Open Code	Concepts
Selection (179) (# of papers: 63)	Item (47) (P1, P4, P5, P6, P7, P8, P11, P12, P14, P15, P17, P19, P20, P24, P26, P27, P28, P30, P31, P32, P36, P37, P38, P39, P42, P43, P44, P45, P49, P51, P52, P53, P54, P57, P58, P59, P63, P65) (# of papers: 38)	Activation (38) [P1, P4, P5, P6, P7, P8, P11, P12, P14, P15, P17, P19, P20, P24, P26, P27, P28, P30, P31, P32, P36, P37, P38, P39, P42, P43, P44, P45, P49, P51, P52, P53, P54, P57, P58, P59, P63, P65]. Global/Context/Sub Menu Item (4) [P5, P6, P54, P58]. Group of Items (3) [P11, P42, P53]. Highlight (1) [P37]. Arrange (1) [P52]
	Command Execution (61) (P6, P7, P10, P15, P17, P20, P22, P26, P32, P33, P34, P35, P37, P39, P42, P44, P45, P49, P50, P51, P52, P53, P54, P56, P57, P58, P62, P64) (# of papers: 28)	Start/Open/On/New (15) [P6, P10, P20, P32, P35, P39, P42, P45, P49, P51, P53, P57, P58, P62, P64]. End/Close/Off (12) [P10, P17, P35, P42, P44, P45, P50, P51, P52, P53, P56, P58]. Cancel/Undo/Redo/Escape (6) [P7, P26, P42, P49, P53, P54]. Restart/Reset/Return (5) [P33, P35, P37, P56, P57]. Help (4) [P10, P42, P53, P58]. Insert/Cut/Copy/Paste/Delete/Duplicate (3) [P42, P44, P53]. Show Action (2) [P7, P42]. Identification/Authentication (2) [P22, P34]. Find (2) [P42, P53]. Save (2) [P42, P53]. Minimise/Maximise (2) [P42, P53]. Hide Action (2) [P7, P58]. Lock Selection (1) [P7]. Unlock Screen (1) [P15]. Set Measurement Callipers (1) [P17]. Switch Task (1) [P42]
	Media Control: Video, Audio, Phone (54) (P16, P18, P21, P41, P42, P44, P45, P50, P51, P53, P55, P58, P61, P64) (# of papers: 14)	Go Backward/Previous/Next/Favourite/Random/Last Visited (9) [P18, P41, P42, P45, P51, P53, P58, P61, 64]. Play/Resume (7) [P18, P41, P50, P51, P53, P55, P61]. Increase/Decrease/(Un)Mute Sound/Tempo (7) [P21, P42, P45, P51, P53, P58, P61, P64]. Fast Forward (5) [P18, P41, P42, P45, P51]. Pause (5) [P18, P50, P51, P53, P61]. Stop (4) [P18, P41, P53, P61]. Skip Scene (2) [P18, P53]. Record video message (1) [P16]. Stop recording a video message (1) [P16]. Break into live video chat (1) [P16]. Check Messages (1) [P44]. Answer Call (1) [P44]. Ignore Call (1) [P44]. Place on Hold (1) [P44]. End Call (1) [P44]. Place Call (1) [P44]. Check Calendar (1) [P44]. Protest Song (1) [P64]. Equip with (1) [P64]. Aim (1) [P64]. Throw (1) [P64]. Change equipment (1) [P64]
Confirmation (17) (P1, P5, P8, P10, P13, P33, P35, P42, P44, P53, P55, P58) (# of papers: 12)	Accept (12) [P1, P5, P8, P10, P13, P33, P35, P42, P44, P53, P55, P58]. Refuse (5) [P10, P42, P44, P53, P58]	
Navigation (88) (# of papers: 40)	Zoom (29) (P2, P3, P4, P15, P17, P20, P29, P32, P40, P42, P43, P46, P47, P48, P49, P50, P52, P53, P54) (# of papers: 18)	Zoom In (Linear/Circular) (18) [P2, P3, P4, P15, P17, P20, P29, P32, P40, P42, P43, P47, P48, P49, P50, P52, P53, P54]. Zoom Out (Linear/Circular) (11) [P2, P4, P15, P42, P43, P47, P48, P49, P50, P53, P54]
	Scroll (25) (P1, P4, P7, P10, P15, P16, P17, P20, P21, P26, P29, P32, P33, P35, P43, P44, P49, P53, P55, P57, P63) (# of papers: 21)	Move left/right (17) [P1, P4, P10, P16, P17, P20, P21, P26, P29, P32, P35, P43, P44, P49, P53, P55, P57]. Move up/down (8) [P7, P15, P20, P33, P35, P43, P49, P63]
	Move Cursor (15) (P3, P6, P7, P12, P17, P20, P23, P26, P31, P32, P37, P39, P40, P42, P56) (# of papers: 15)	Move cursor up, down, left, right (14) [P6, P7, P12, P17, P20, P23, P26, P31, P32, P37, P39, P40, P42, P56]. Handle Bar - Translate, Rotate, Extend, Modify (1) [P3]
Manipulation (39) (# of papers: 18)	Pan (10) (P3, P15, P18, P42, P43, P47, P48, P49, P50, P53, P54) (# of papers: 11)	Point and Move (6) [P42, P47, P48, P50, P53, P54]. Grab and Move (3) [P15, P43, P49]. Joystick4D/Joystick360 (1) [P47]
	View Control (9) (P3, P18, P19, P31, P40) (# of papers: 5)	View Rotate (2) [P3, P40]. Pan (2) [P3, P18]. Zoom (1) [P18]. Move Left/Right (1) [P19]. Move Forward/Backwards (1) [P19]. Look Up/Down (1) [P19]. Toggle Camera Position (1) [P31]
	Single Object (SO) (32) (P3, P9, P20, P25, P26, P27, P28, P31, P33, P42, P46, P48, P49, P50, P52, P53, P56, P60) (# of papers: 18)	Rotate (12) [P3, P20, P31, P33, P42, P46, P48, P49, P50, P53, P56, P60]. Translate (8) [P20, P25, P26, P31, P42, P52, P53, P56]. Scale (6) [P3, P9, P31, P42, P52, P56]. Change State (3) [P27, P28, P60]. Extrude (1) [P9]. Set Extrude Height Constraint (1) [P9]. Constrained Rotation (1) [P3]
Multiple Objects (7) (P3, P9) (# of papers: 2)	Scale (2) [P3, P9]. Select Active Objects (1) [P3]. Rotate (1) [P3]. Alignment (1) [P3]. Extrude (1) [P9]. Set Extrude Height Constraint (1) [P9]	

Table 3: Mid-Air Hand Gestures Overview – categories, open codes, and concepts extracted from the included papers in this literature review. Numbers in bold parentheses show the number of occurrences of each concept and code from the included papers.

Comparing Different Interfaces for Navigation: Mouse, Touch, 3D Gestures





AR vs VR

	Virtual Reality <i>Replaces Reality</i>	Augmented Reality <i>Enhances Reality</i>
<i>Scene Generation</i>	Requires realistic images	Minimal rendering okay
<i>Display Device</i>	Fully immersive, wide field of view	Non-immersive, small field of view
<i>Tracking</i>	Low to medium accuracy is okay	The highest accuracy possible

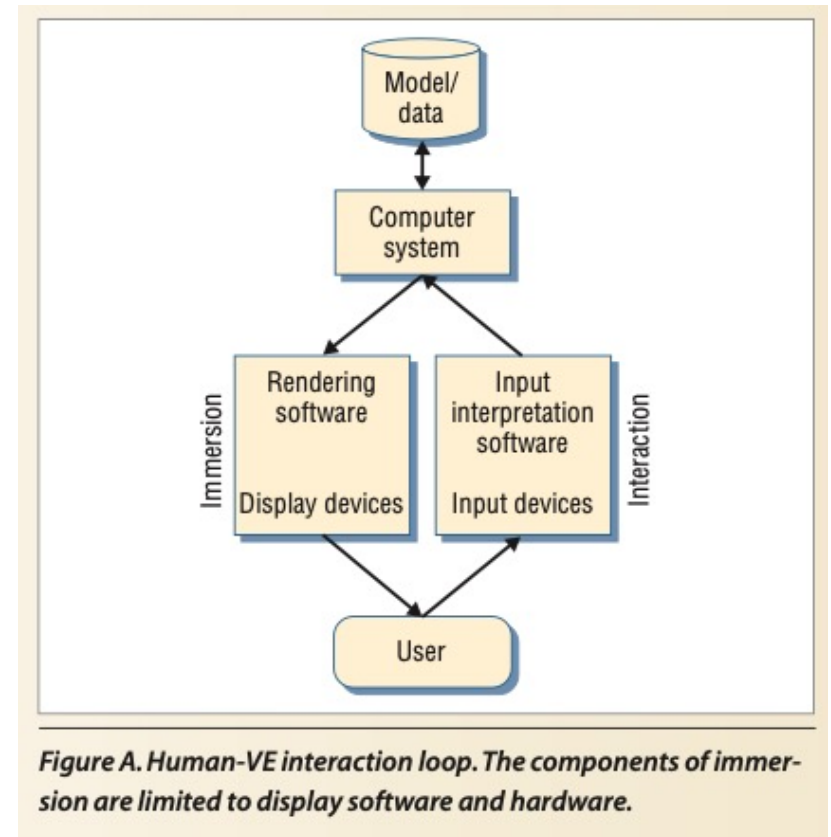
Immersion & Presence

“**Immersion** refers to the objective level of sensory fidelity a VR system provides”

“**Presence** refers to a user’s subjective psychological response to a VR system”

Immersion Factors

- Field of View (FOV)
- Field of Regard (FOR)
- Display size & resolution
- Stereoscopy
- Head-based rendering
- Realism of lighting
- Frame rate
- Refresh rate



10 Scientific Problems in VR

1. *Digital Model* – possible to model any object?
2. *Complexity* – possible to measure complexity of an object?
3. *Model Credibility* - how much immersion is enough?
4. *Model Similarity* – how is model similarity measured?
5. *Image Quality* - What standards are available for evaluating image similarity and image quality?
6. *Real-time Fidelity* – balance visual and temporal realism
7. *Basic (meta-) Elements*
8. *Material and Behaviour Models*
9. *Image Integration* - Can image- based and graphics-based models be integrated seamlessly?
10. *Performance Evaluation* - Most performance indexes lack metrics for VR systems

Virtual Reality Navigation

- **Tasks**

- Orientation.
- Way-finding.
- Travelling.

- **Problems:**

- Lack of binocular vision affects judging distance/depth.
- Motion cues.
- Sufficiently wide view?

Virtual Reality Navigation

- Visual momentum.
- Collision avoidance.

- Controls:
 - Zero-order: position control.
 - First-order: velocity/rate control.
 - Second-order: acceleration control.