

The activation of modality in virtual objects assembly

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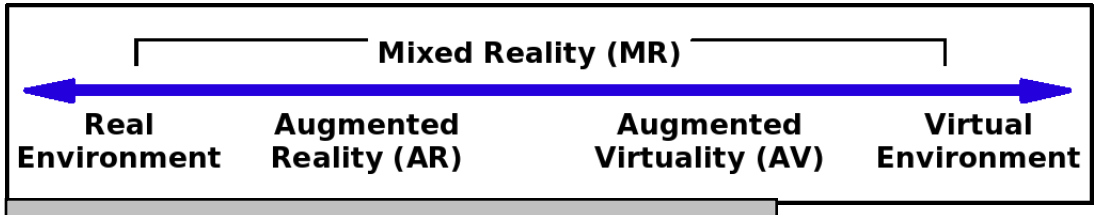
Workshop on the Challenges of Engineering Multimodal Interaction: Methods, Tools, Evaluation
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Tangible User Interface (TUI)

- Augmented Virtuality



Milgram and Kishino IEICE TIS 1994

PinWheels



Ishii *et al.* CHI'01

- TUIs "give physical form to digital information, employing physical artefacts both as representations and controls for computational media"

Ullmer & Ishii IBM System Journal 2000

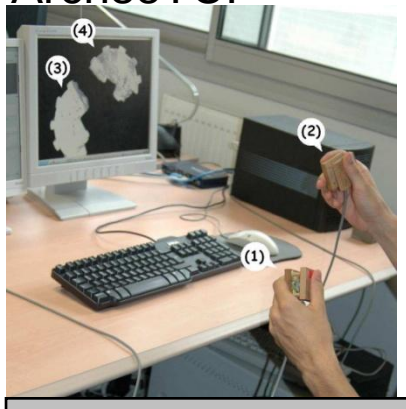
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The virtual objects assembly

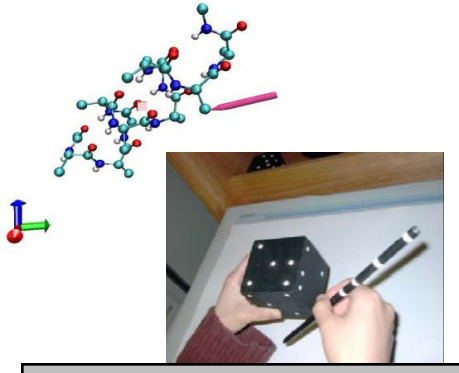
- Tangible bimanual interaction
- Both hands are requisitioned
- Problem
  - Put down the props
  - Reposition hands during the process of assembly

ArcheoTUI



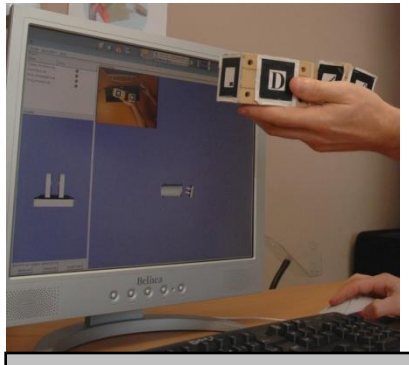
Reuter *et al.* VAST'07

Molecular Visualization



Qi *et al.* OZCHI'05

ESKUA



Garreau *et al.* RIIN'05



How to activate a modality?

- Let *m=<prop, (x,y,z)>* be a modality
  - where moving the props leads to move the corresponding virtual object in 3D space
- Solutions to activate/inactivate this modality:
  - Vocal modality
  - Gestural modality
  - Modality embedded in the prop
  - Modality embedded in a foot pedal

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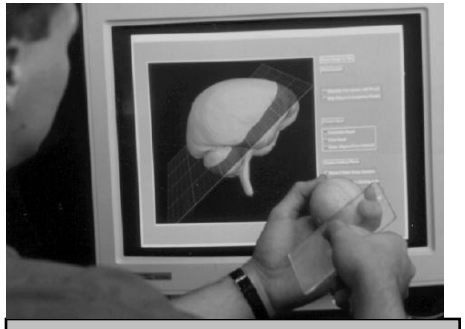


Vocal modality

- "Put-that-there" first combines voice and gesture to interact with data on large displays

Bolt SIGGRAPH'80

- The passive props for neurosurgery
  - Need to clutch the props position
  - "move <prop>"
  - "stop <prop>"



Hinckley *et al.* CHI'94



Gestrural modality

- Define a period of time *T* in the system
- Observe moves of the props
- If the user freezes the props position more longer than *T* then inactivate the props



Modality embedded in props

- The passive props for neurosurgery
  - A button is placed on the rectangular plate
  - first a thumb button, later a membrane switch

Hinckley *et al.* CHI'94



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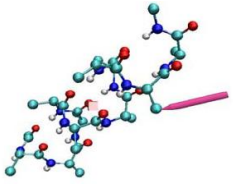
Modality embedded in foot pedal

- The passive props for neurosurgery
  - A foot pedal to cluch the doll's head



Hinckley *et al.* CHI'94

- Molecular Visualization
  - A double foot pedal







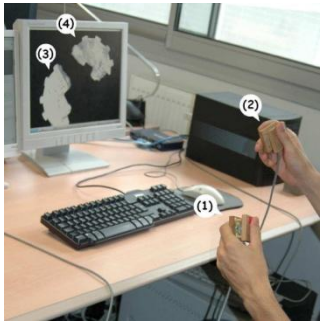


Qi *et al.* OZCHI'05

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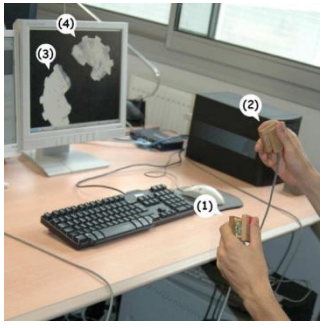
The study for ArcheoTUI



- 1. Vocal modality: no
  - Experimented in **Hinckley *et al.* CHI'94**
  - Delay introduced by speaking the command (a discrete action is better)
  - Speech interfere with short-term memory
- 2. Gestural modality (freezing): no
  - User cannot stop moving when thinking
  - Delay to wait before the action is triggered



The study for ArcheoTUI

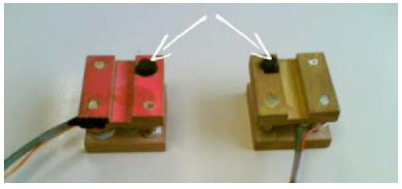


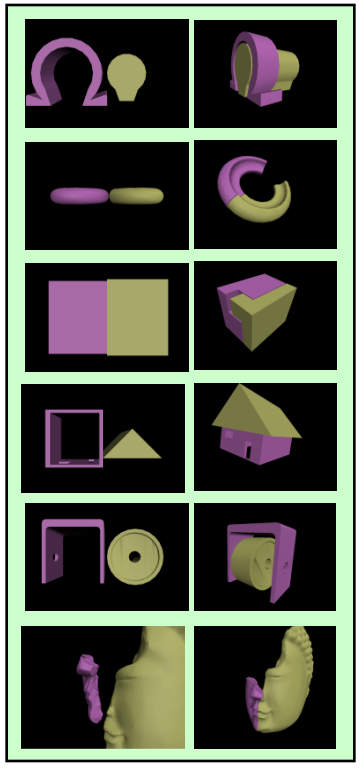
- 3. Modality embedded in props
  - *<button, activate/inactivate>*
- 4. Modality embedded in foot pedals
  - *<foot pedal, activate/inactivate>*
- Experimental study to choose between the two modalities



The experimental study







- Preferences: 57% 43%
- Log file analysis:

	Pedals	Buttons
Mean time of movements	6.59s	3.96s
Avg. number of declutching actions	9.76	12.15

  - Pedals: long, continuous actions
  - Buttons: short, jerky movements

– With foot pedals, the user's gesture is closer to the real-world behaviour



Conclusion

- The activation of modality is a problematic in tangible bimanual interaction,
- Voice, freezing or buttons solutions are often suggested by users,
- However foot pedals are better for virtual assembly !
- Impact on the interaction ...

Thank you for your attention.



See the poster during the demo session,

A video is available.



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