CS 414 – Multimedia Systems Design

Lecture 39 – Hot Topics in Multimedia

Klara Nahrstedt

Spring 2009

Announcements

- Homework 2 due Wednesday, midnight, May 6th
- Final exam on Tuesday, May 12, 7-10pm, 1109 SC
- Don’t forget Peer Evaluations!! (by Friday, May 8 email to klara@illinois.edu)

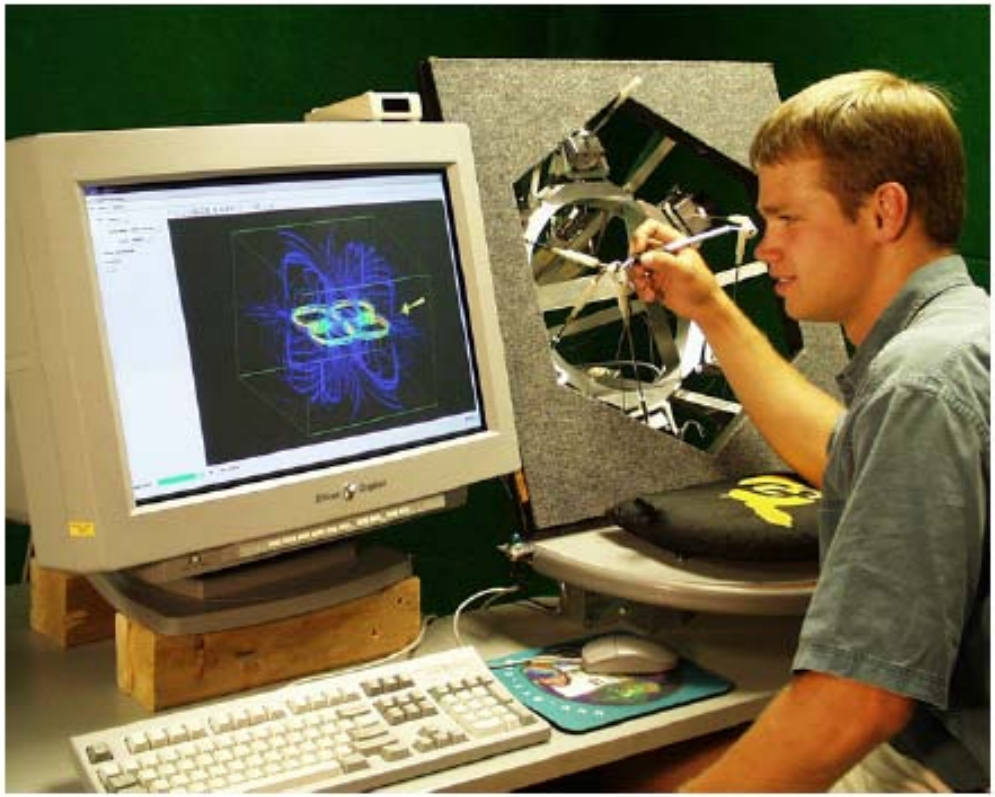
Haptics – Important Part of Multimedia

- Haptics – sense of touch
- Haptics technology – technology that interfaces with the user through the sense of touch
- Haptic perception – process of recognizing objects through touch

Haptic Devices

- Pen-like devices
- Mobile devices with haptic feedback
- Wii device for view control

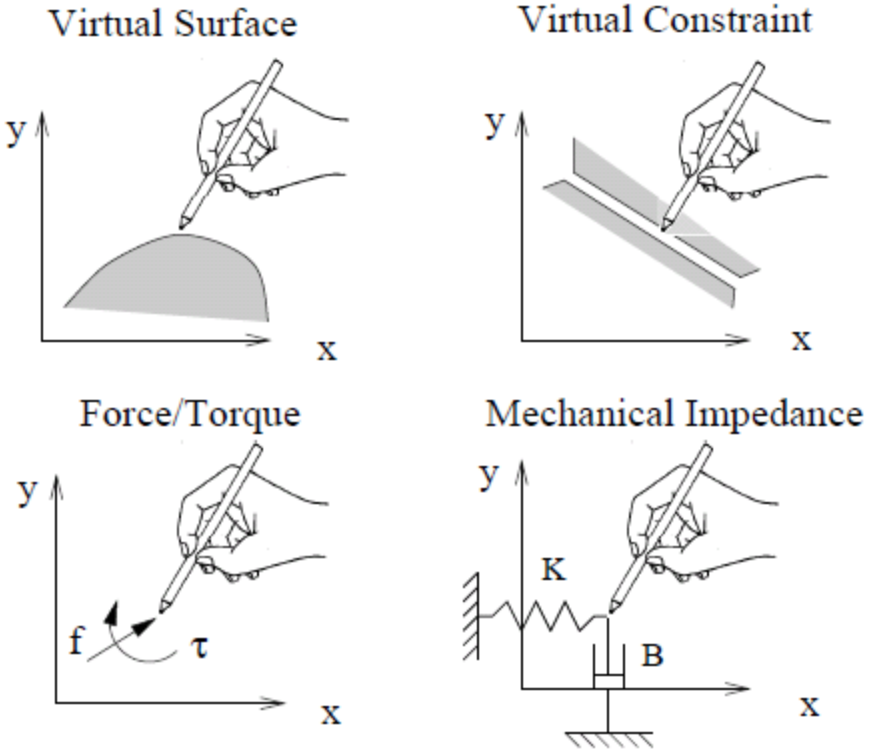
Haptic Interface Hardware – parallel haptic interface



University of Colorado research

Issues

- Challenges
  - Mechanics and control design
- Ideal interface has
  - large range of motion,
  - multiple degrees of freedom (DOF) and
  - high fidelity transmission of forces to the user's fingers



Issues

- To avoid corrupting rendered data by artifacts from the interface itself
  - 60 Hz bandwidth force control look is used to provide accurate tracking of force commands in 5 DOF
  - Suppression of forces due to friction and other mechanics dynamics

Mobile Devices with Haptic Feedback

- iPhone haptics
- Haptic feedback presented via touch-screen by applying forces, vibrations or motion to user's fingertips
- Haptic Keyboard
  - U. Glasgow research

Haptic Keyboard (U. Glasgow)

- One of the key features lost in touch-screen interaction is ability to feel buttons
  - No natural haptic response which occurs when button is touched
- Haptic feedback added to figure down and up events

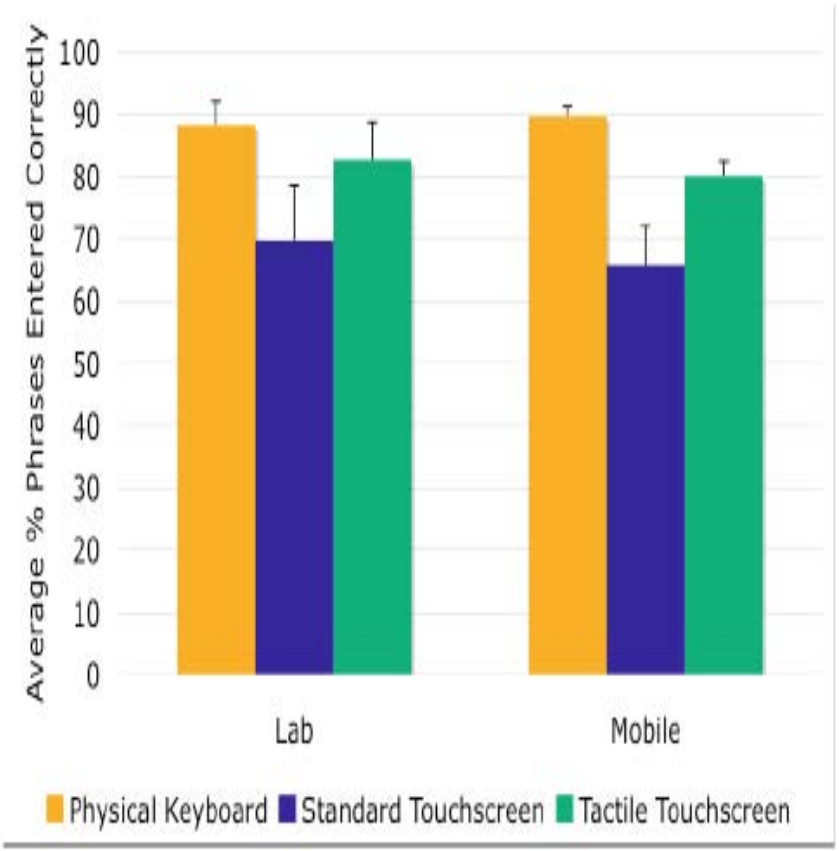
- iPhone's built-in vibro-tactile actuator
  - Turned on when keyboard buttons are pressed
  - Vibrates at 12 different speeds offering wide range of tactile sensations

Haptic Keyboard (U. Glasgow)

- Key feature lost in a touchscreen keyboard is the ability to feel edges of keys
- Solution:
  - Created tactile equivalent to this so that users can feel around display and know when they were on key or moving between one key and the next
- Solution: Event is triggered whenever the fingertip moved over the edge of any button on the screen, indicating a transition or slip from one to the next
  - fingertip slips can be troublesome for users and can cause errors that are often undetected

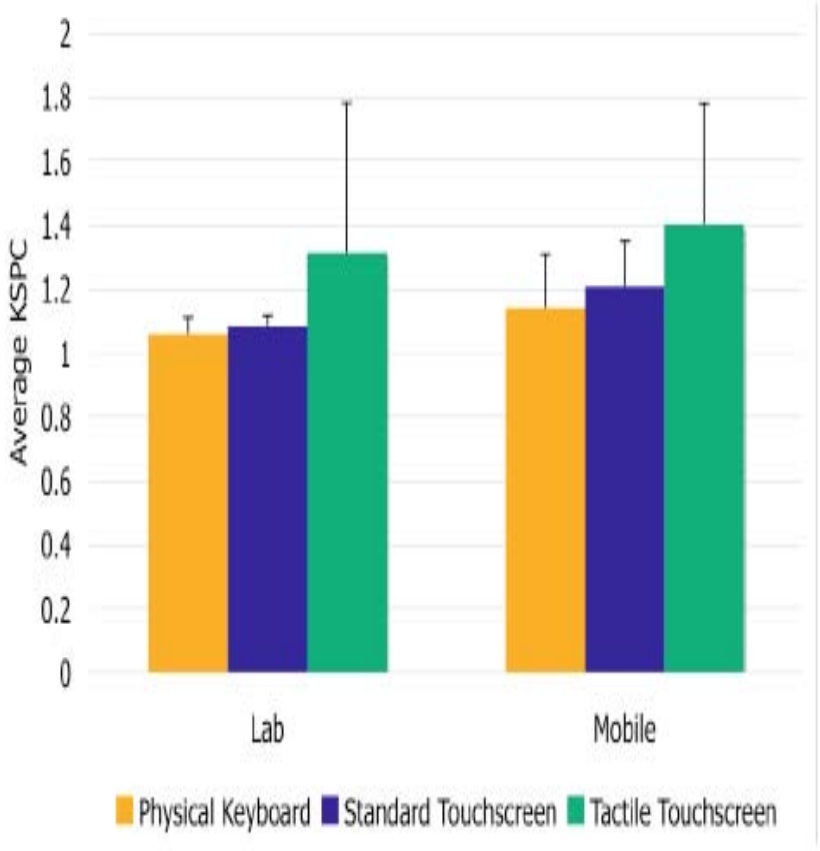
Investigation of Effectiveness of Tactile Feedback for Mobile Touch-screens (CHI 2008)

- Lab and Mobile study
  - 12 participants; students of U. Glasgow
  - Participants memorized a phrase and type it in using keyboard for each condition

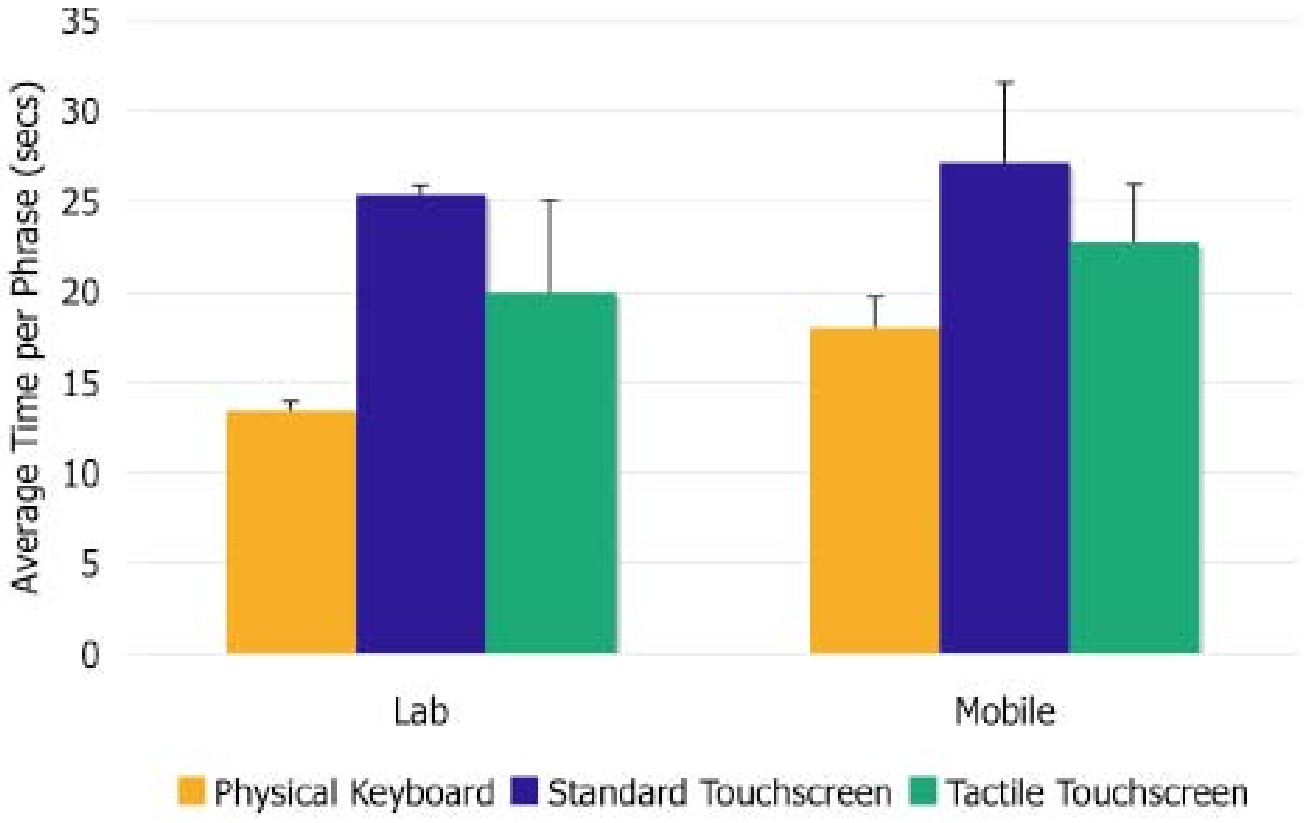


KSPC – Keystroke per character (CHI 2008)

- Recorded for each keyboard type
- Accuracy scores were based on whether or not submitted phrase matched given phrase exactly and did not include corrections as errors and KSPC was recorded



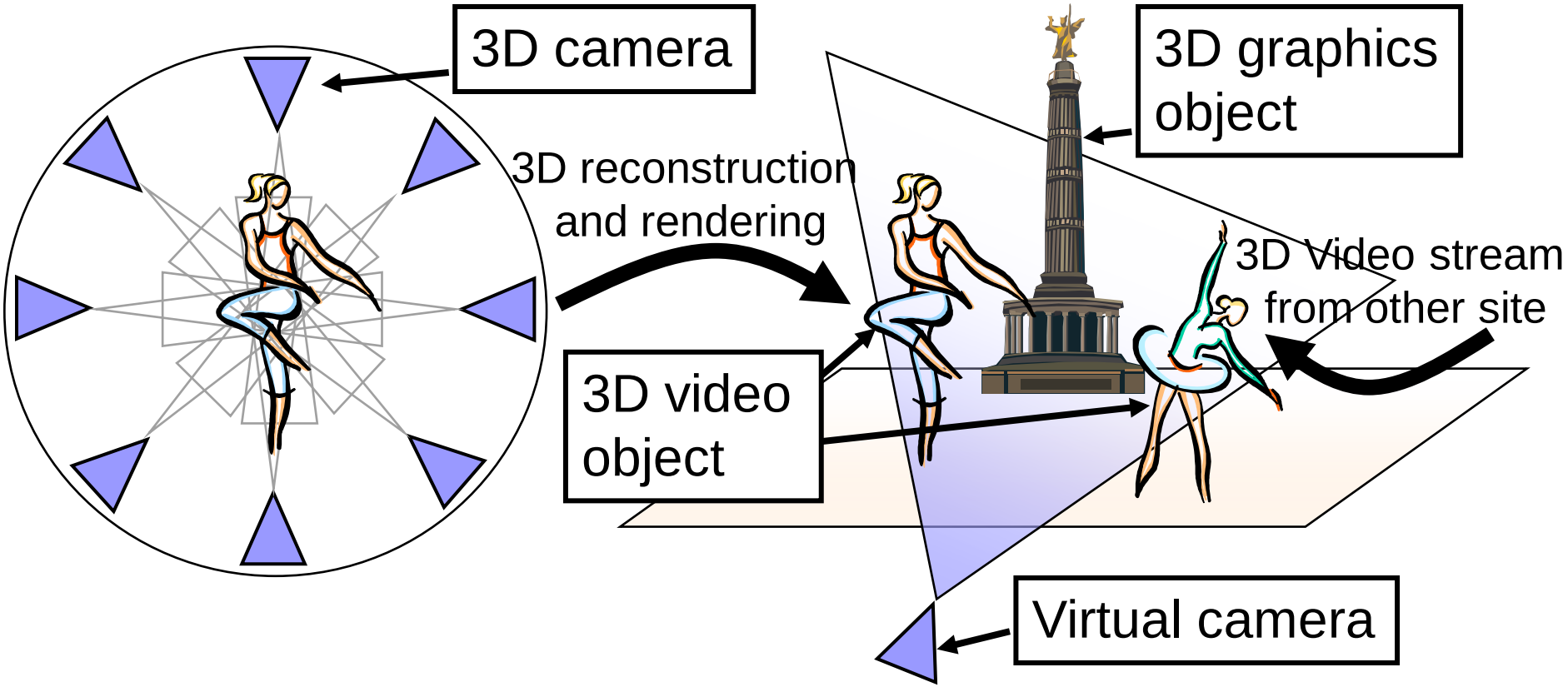
Time to Enter Phrases (CHI 2008)



Wii Haptic Device

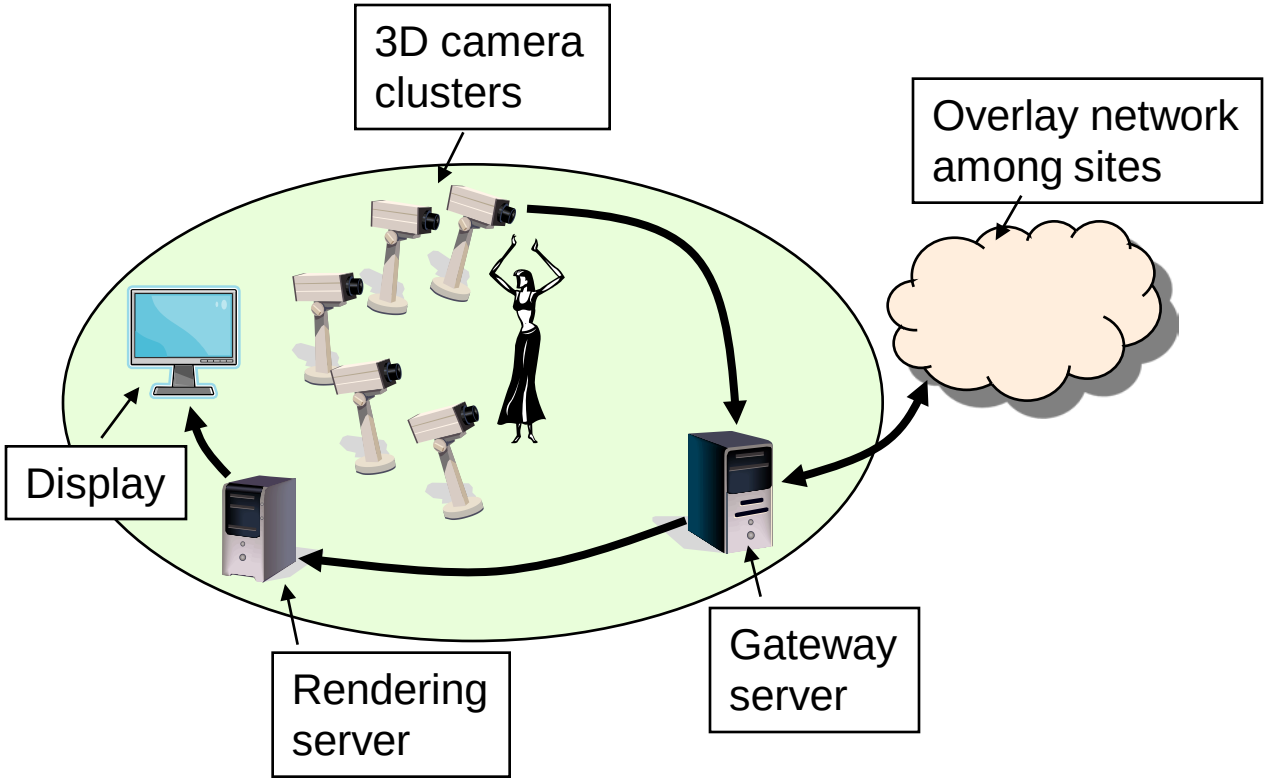
- Usage in 3D Immersive Environments
- Usage as an interface to control multiple views
- University of Illinois Urbana-Champaign research
  - Published in IEEE ICME 2008

3D Tele-immersive Environment



(a) Real space **(b) Virtual space**

Local 3DTI Environment



- **A site produces multiple 3D video streams**
  - Each 3D video stream is captured from one view direction of a 3D camera
  - 3D video streams are exchanged and aggregated through the overlay network among sites

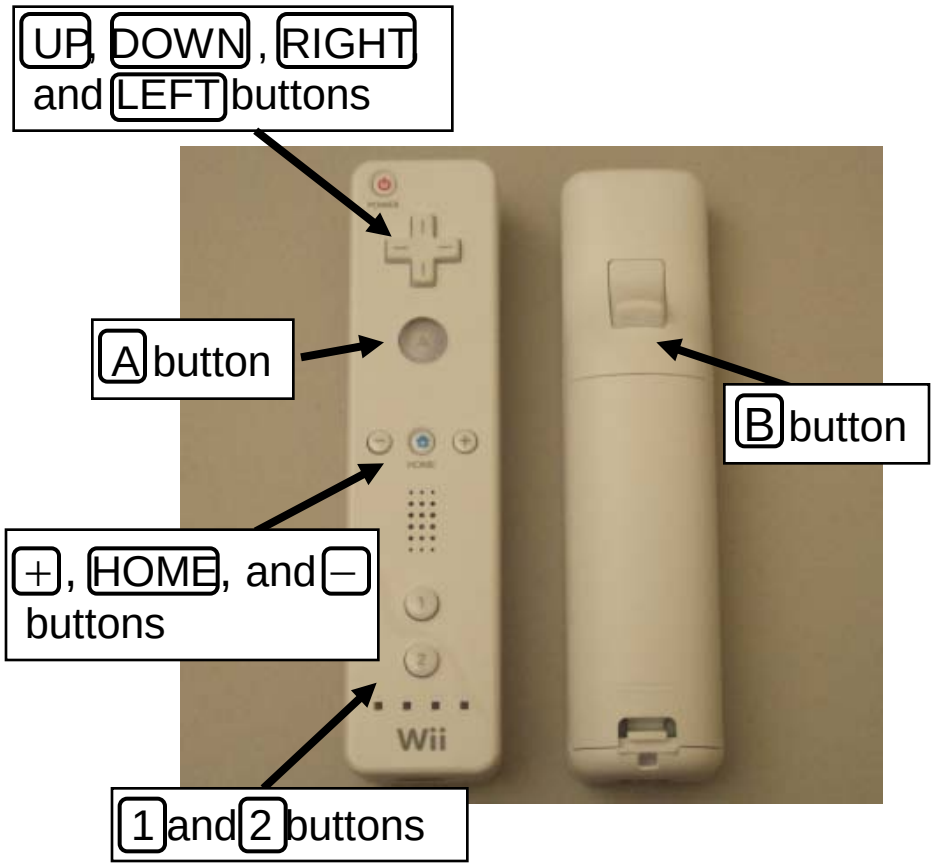
Requirements

- **Needs for user interface**
  - Users want to change their view direction
  - Users want to rearrange the positions of 3D objects, and look at 3D objects from different view directions
- **Requirements for user interface**
  - Doesn’t hinder user’s activity
  - Not to be difficult to use: intuitive to use

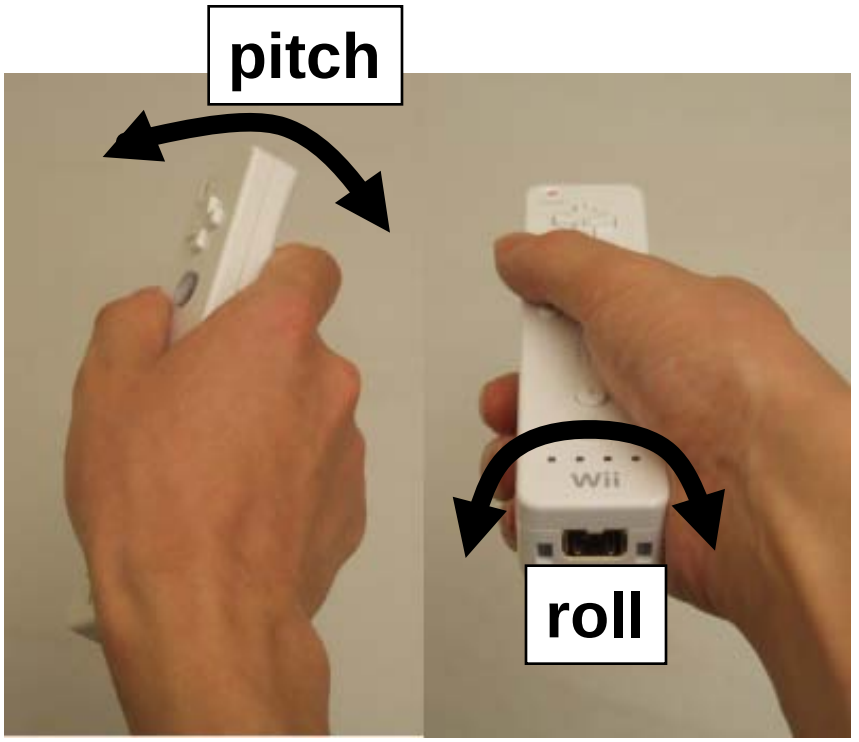
Related Work

- **Wired mouse**
  - This severely restricts user's activity
- **Wireless mouse / Wireless laser pointer [4]**
  - These are pointing-based interfaces, and difficult to operate correctly during activities involving body movement
  - These are mainly focused on 2D environments, so it is difficult to map 3D operations on it
- **Head tracking [5,6] / Motion capture device [7,8]**
  - These are sensitive to tracking error and need calibration [9]
  - The users need to wear a special tracking device

Wii Remote Interface



(a) Buttons:
Allows the user to control view correctly during activities involving body movement

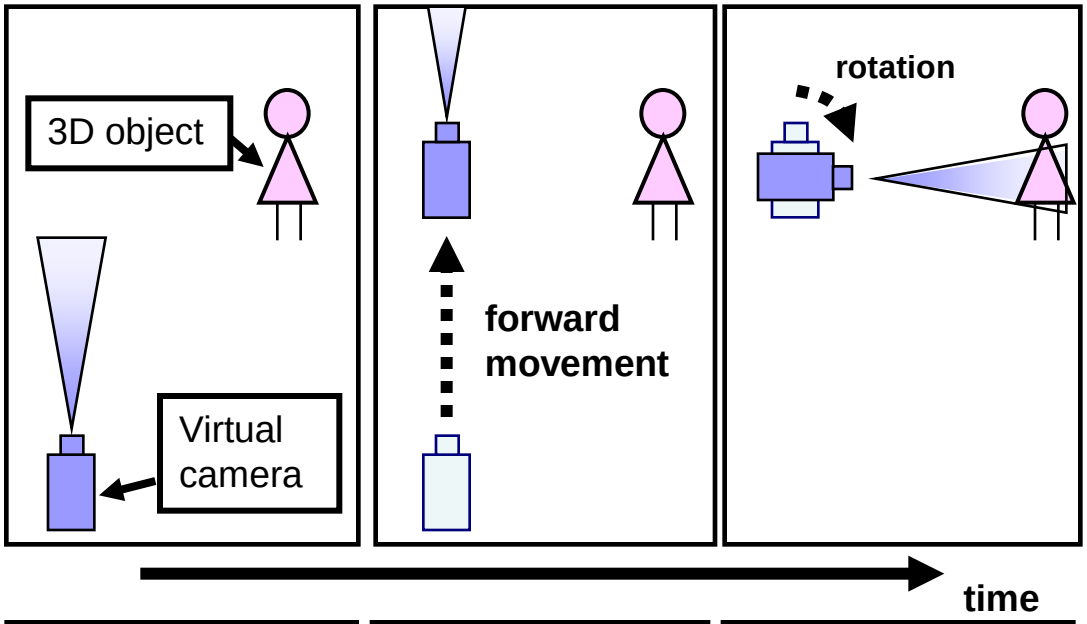


(b) Motions:
Allows the user to change his/her view more intuitively using hand movement

View Control Operations

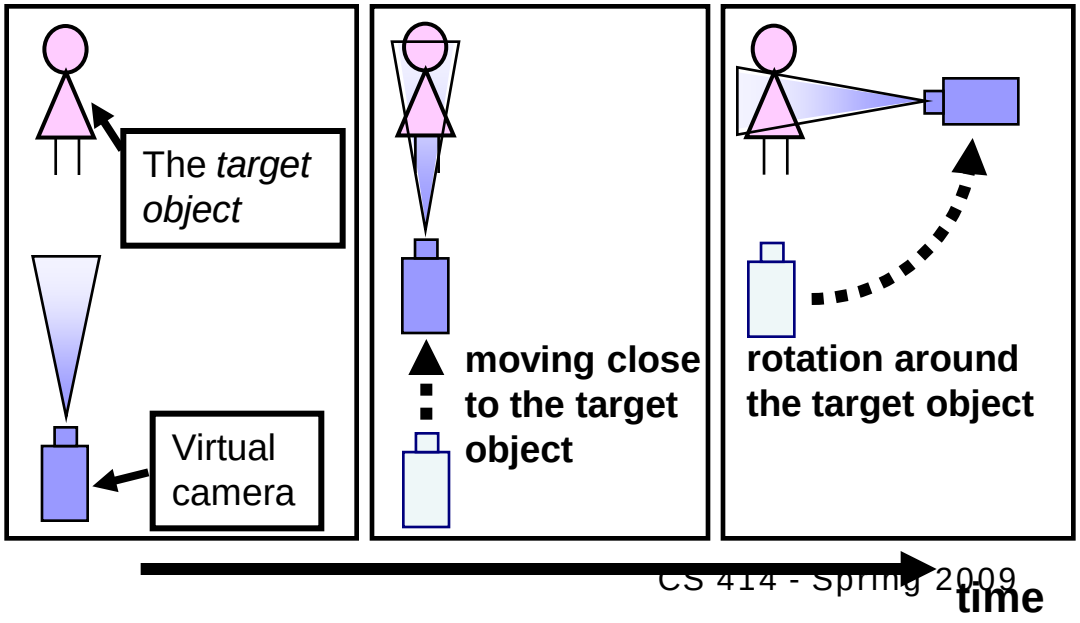
(a) First-person view control method

Allows user to work around the virtual space



(b) Target-centered view control method

Allows user to look at a specific target object from different angles



Mapping Between Buttons/Motions and View Control Operations

- Camera Mode: control the virtual camera
- Object Mode: control the 3D objects

Button or Motion	Camera Mode	Object Mode
Up / Down	F/B movement	F/B movement
Left / Right	L/R rotation	L/R movement
+ / −	Next/Prev object	Next/Prev object
Pitch motion	Moving close/away	N/A
Roll motion	Rotation around target object	Rotation
A	SW to object mode	SW to camera mode

User Study

- **Application**: dancing in the virtual space
- **Participants**: a professional dancer and five students
- **Purpose**: understand the usability of our interface in comparison with mouse
- **Tasks**:
  - Task1: Co-located teaching of a dancing pose
  - Task2: Remote teaching
  - Task3: Improvisation dance
- **Ranking questions (1: low, 5: high)**:
  - Ease of use: Does the interface make it easier for the user to control objects/virtual camera?
  - Efficiency: How quickly can user control objects/virtual camera?
  - Effectiveness: How effectively can user control objects/virtual camera?
  - Overall accuracy of the task: How accurate was the information delivery for each task?
  - Creativity: How does the interface support creativity in body movement?

Results

	Task1 (Mouse/Wii)	Task2 (Mouse/Wii)	Task3 (Mouse/Wii)
Ease of use	**3 / 5**	**4 / 5**	**3 / 5**
Efficiency	**4 / 5**	**4 / 5**	**3 / 5**
Effectiveness	**3 / 5**	**2 / 5**	**3 / 4**
Accuracy	**4 / 4**	**2 / 4**	**N/A**
Creativity	**N/A**	**N/A**	**1 / 5**

- Our interface is ranked much higher than mouse for almost all questions
- Creativity is ranked significantly higher

Dancer's Comments

- *Wii interface establishes direct connection between view control functionality and body movement. This encourages the user to manipulate the 3D objects and the virtual camera more naturally when doing a particular task*
- *Wii interface is useful for choreography design, because it creates another dimension/element (i.e., view angle) in the design process*

Conclusion

- Different types of haptic devices/actuators are coming
  - Pen interfaces are becoming common
  - Haptic interfaces on cell-phones are comming
  - View control interface for 3DTI environments using Wii Remote
    - allows user to control view intuitively with buttons and through motions
    - shows that our interface is preferred by most of the participants, because it is much easier and more natural to use