Mixed Reality and Human Centered Media for Social and Physical Interactive Computer Entertainment

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New Media

- "… it is the speed of electric involvement that creates the integral whole of both private and public awareness. We live today in the Age of Information and of communication because electric media instantly and constantly create a total field of interacting events in which all men participate", Marshall McLuhan, Understanding Media, 1964, p. 248

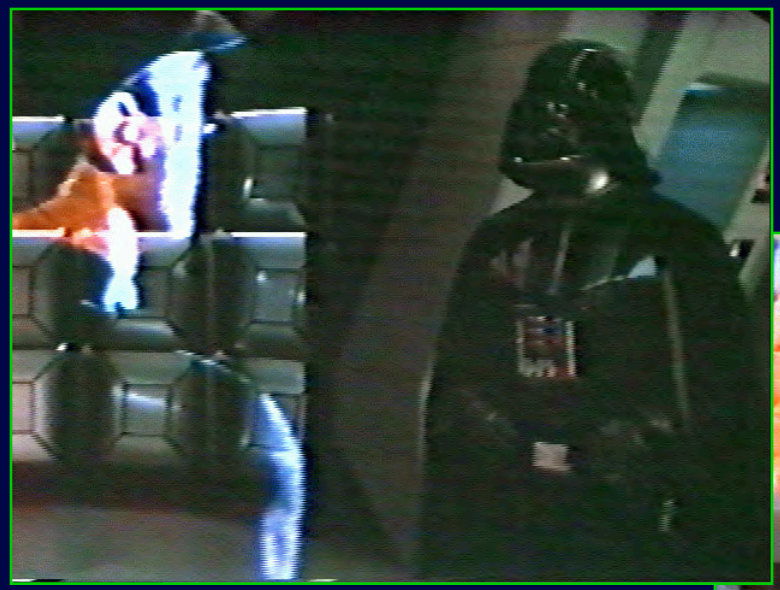
New Media

- New Media means much more than the convergence of telecommunications, traditional media, and computing.
  - Marshall McLuhan's "extension of man"
- various forms that humans can extend senses and brains into the world
- natural and humanistic ways of interfacing with machines, as well as other people networked remotely over large distances using the full range of human gestures
- new ways of communication between people, between cultures and races, between humans and machines, and between machines and machines.

The View from 1968

- Networked Interaction
- 2d Video Conferencing
  - lack of spatial cues
  - limited participants
  - 2D collaboration
  - separation from real world

The View from 1979



Remote Conferencing

Face to face Conferencing

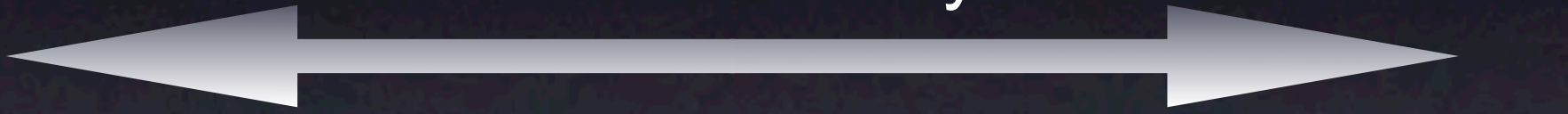
Research Issues

- Merge real world and virtual world as seamlessly as possible (but not just mixed reality)
- Interaction of natural physical space with virtual world
- Networked social interaction in physical/ real world and virtual world
- Computing for purpose of bringing delight and social bonding in humans and societies

Carrol, "Beyond Fun" ACM Interactions Sep-Oct 2004

Milgram's Reality-Virtuality Continuum

Mixed Reality

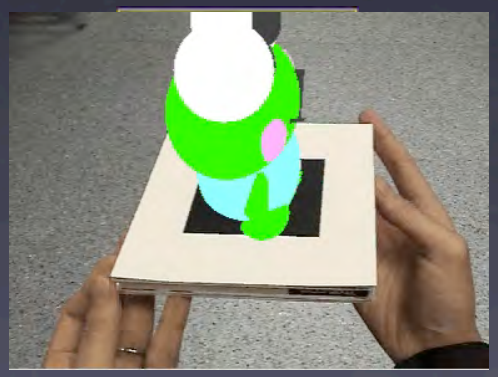


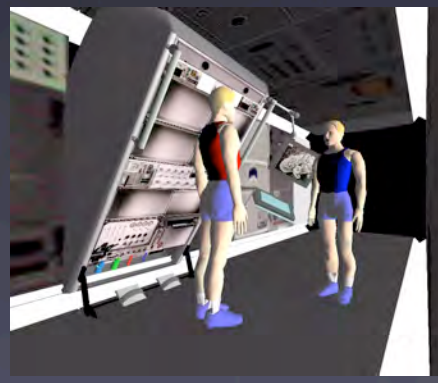
Real Environment

Augmented Reality (AR)

Augmented Virtuality (AV)

Virtual Environment





Reality - Virtuality (RV) Continuum

Networked Interactive Mixed Reality System: 3d-live

- Conventional 2-D human capture and network conferencing does not allow large user movements and gestures to be captured [Heath 91], there are no spatial cues between participants [Sellen 92], and participants cannot easily make eye contact [Sellen 95].
- Goal of 3d-live is to enhance the human remote interaction by developing a 3-D human capture mixed reality system.

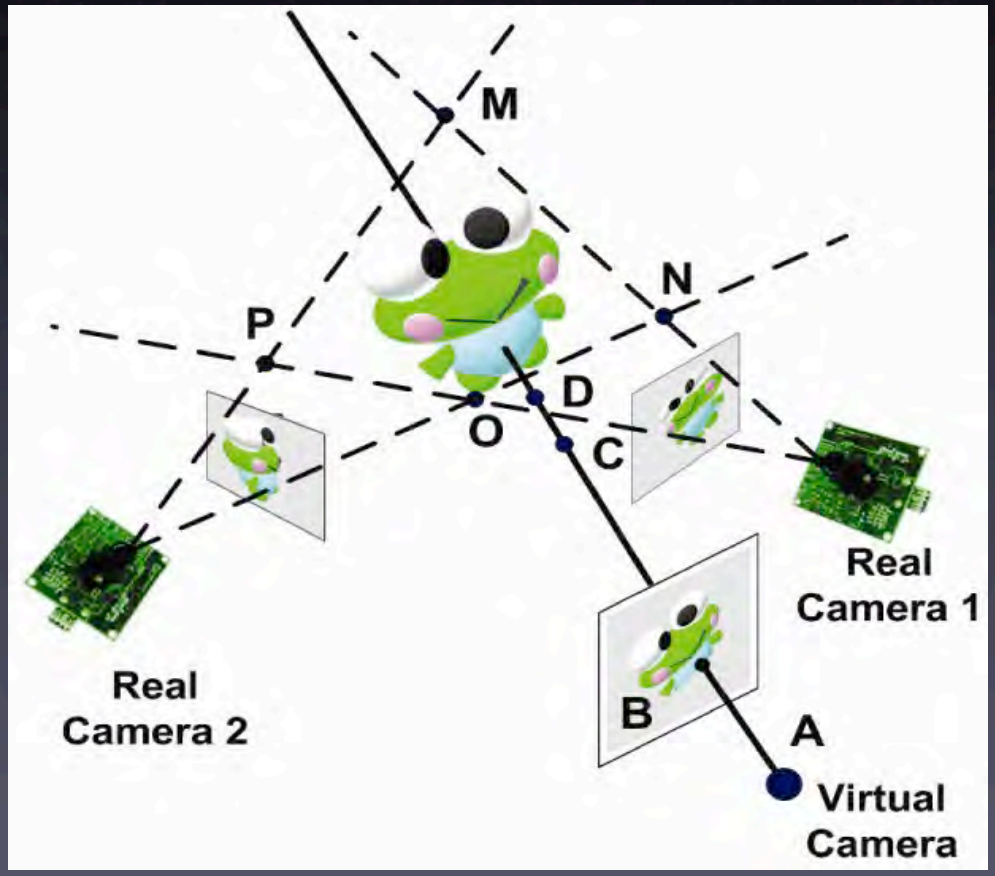
Cheok et. al IEEE ISMAR 2002 Frankfurt

Zhou and Cheok et. al IEEE Transactions on Multimedia, 2005

Networked Interactive Mixed Reality System: 3d-live

- System is based on shape-from-silhouette information. Capable of capturing 3D models and textures at 30 fps and displaying them from an arbitrary viewpoint.
- 2002: System produces 450x340 images at 30 fps, based on 15 cameras.
- 2003: System produces 640x480 images at 30 fps using 6 to 9 firewire web-cams

Real Time Virtual Viewpoint



SIGGRAPH
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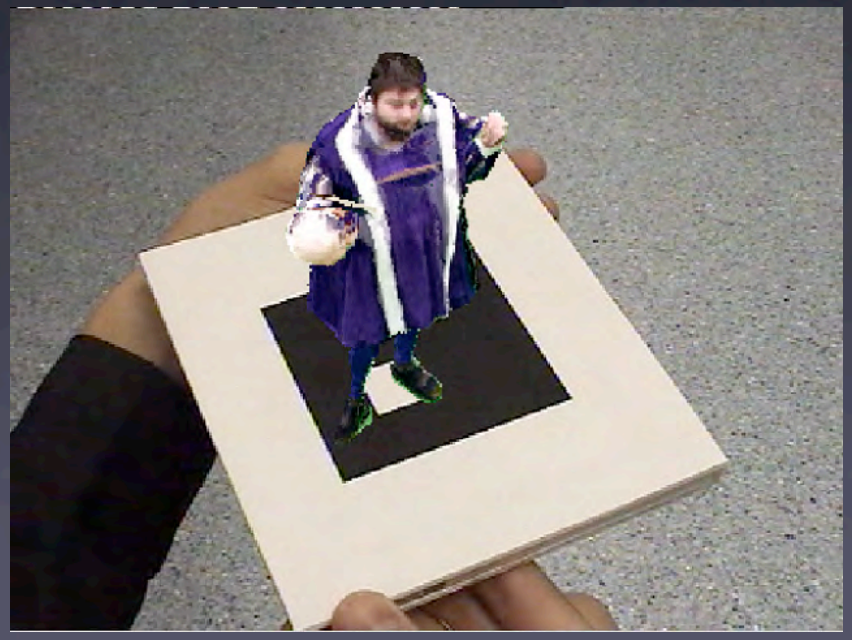
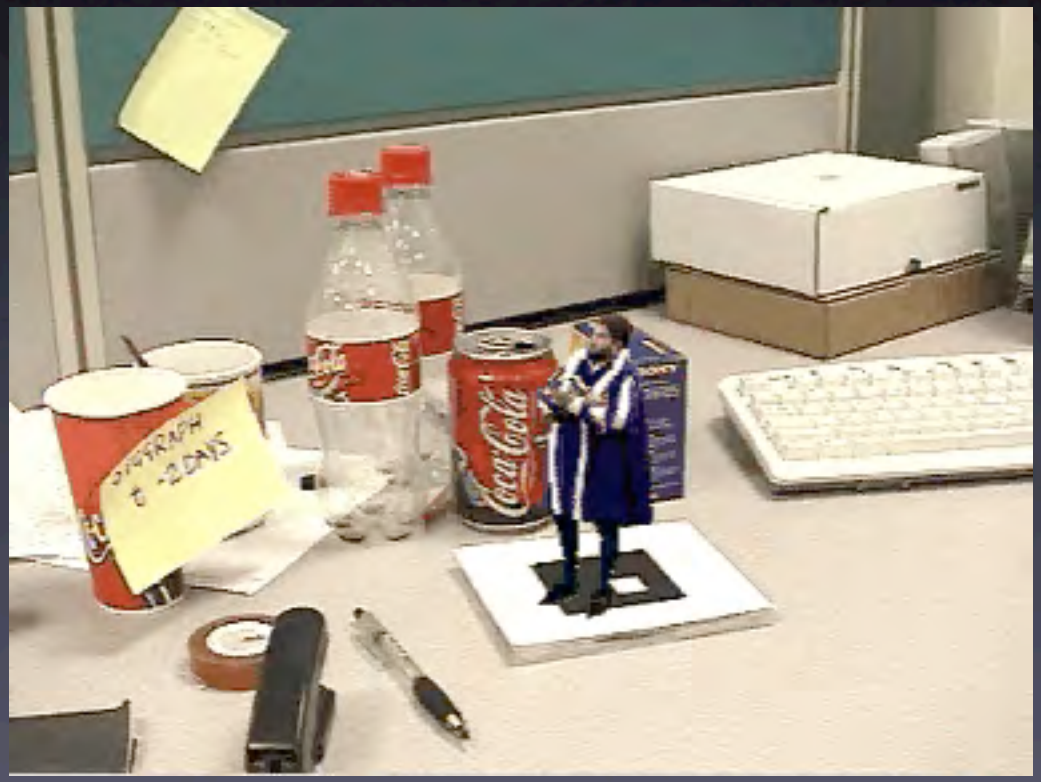


3d Live Videos

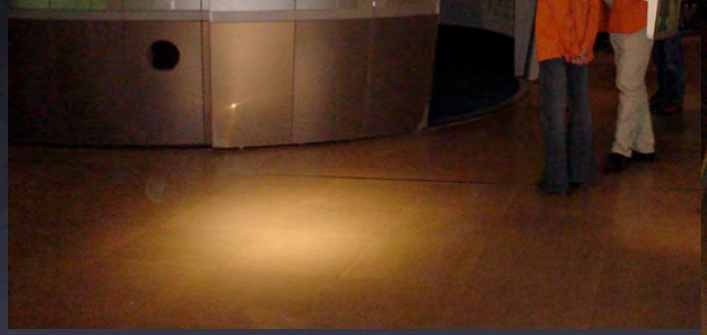


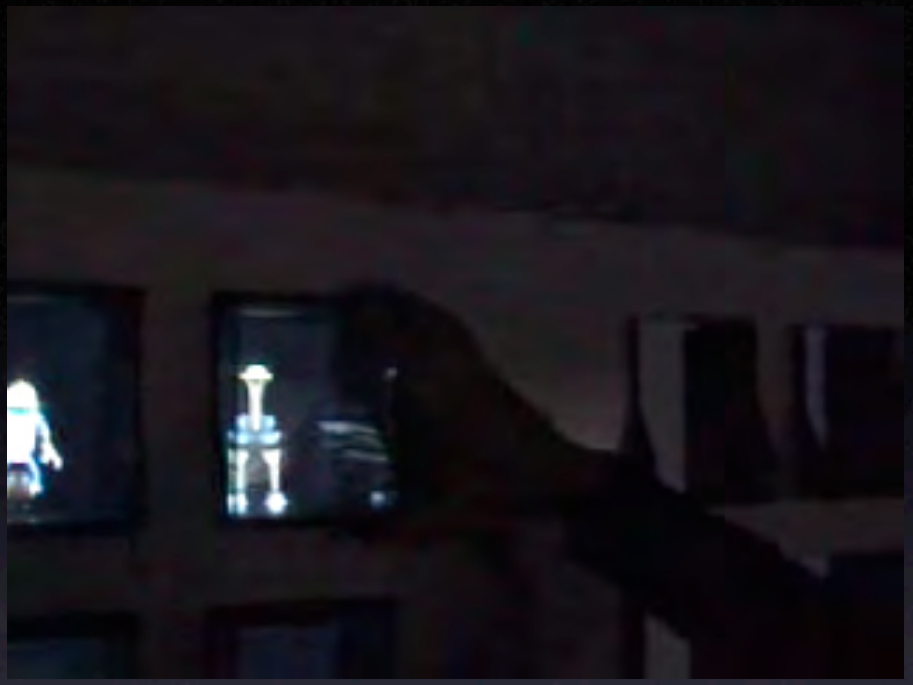
3d Live Videos

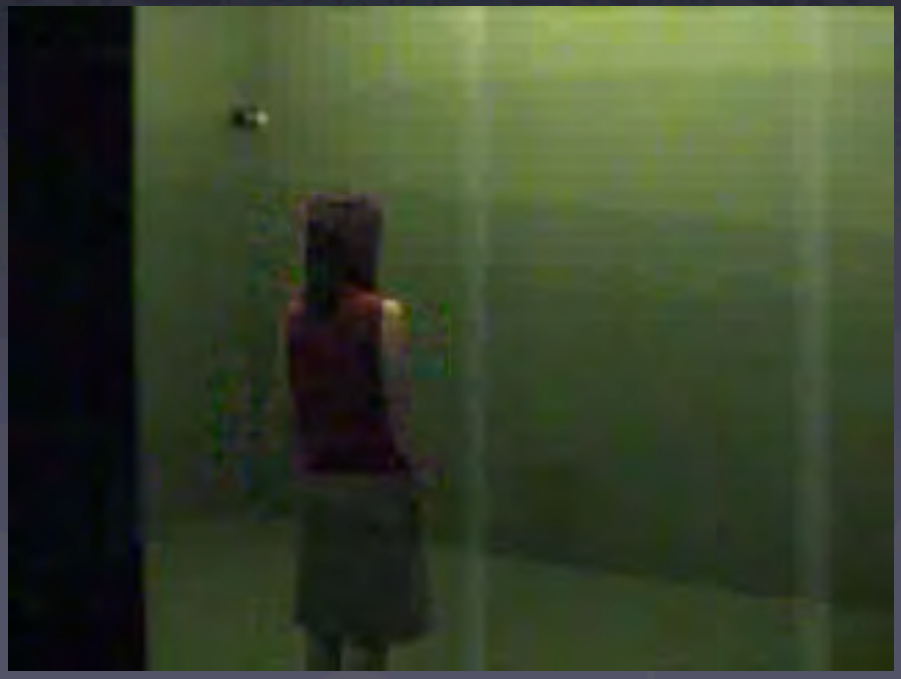
Ars Electronica Sep. 2003
Museum of the Future

Linz Austria

INFO-BENCHES







Potential Applications

- Holo-phone technology
- 3d books
- Sports training
- Training Simulators
- Computer games
- Live virtual tours
- Architecture

See Demo at ACM Portland CHI 2005

Interactive / Entertainment Applications of Mixed Reality

- Computer entertainment USD $40 Billion industry (2004), a driver of technology
- Use of computers expanded into leisure activity, family interaction, civic life
- HCI: Usability has been broadened to encompass well being, collective efficacy, cultural identity, and social capital ACM Interactions Special Issue Funology Sep-Oct 2004
- MR expected to be part of the forefront of the next generation computer entertainment and games

Interactive Networked Physical Computer Entertainment

- New form of interacting with digital media
- Humans, as social creatures find physical interaction, touch, and human-to-human presence essential for the enjoyment of life [Bowlby 83].
- Present computer entertainment focuses the user's attention mainly on computer screens or 2D/3D virtual environments, rather than interactions between humans.

In the pre-computer age, games were designed and played out in the physical world that we live in, in order to make use of real world properties, such as physical objects, our sense of space, and spatial relations.

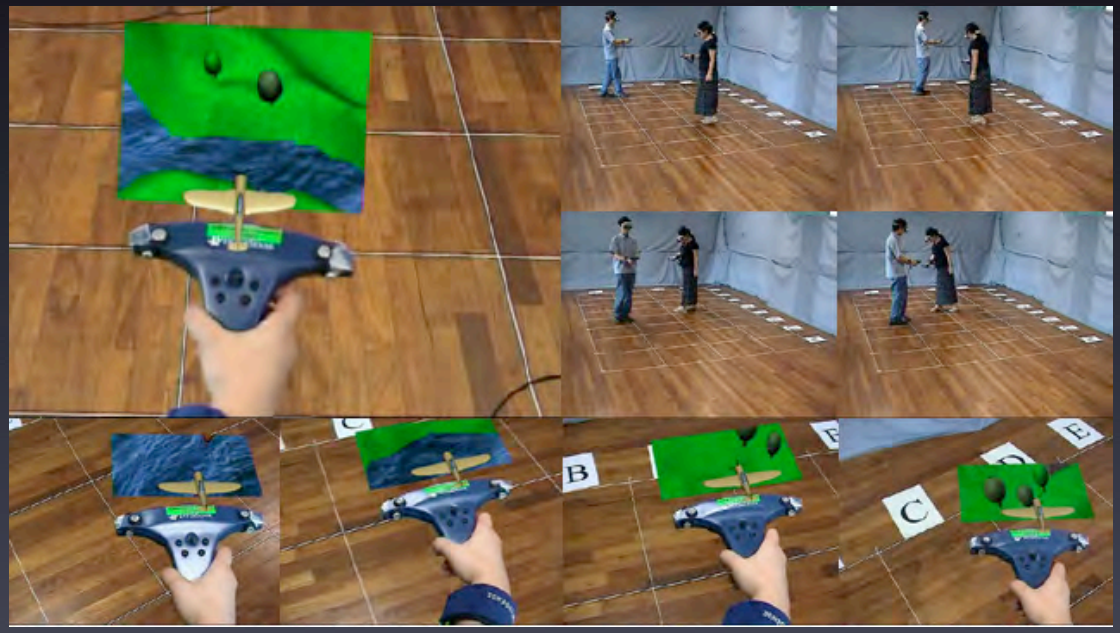
Ancient Chinese Game Jiu Ju

we can see that interactions in pre-computer games consisted of two elements: human to physical world interaction and human to human interaction.

Touch Space

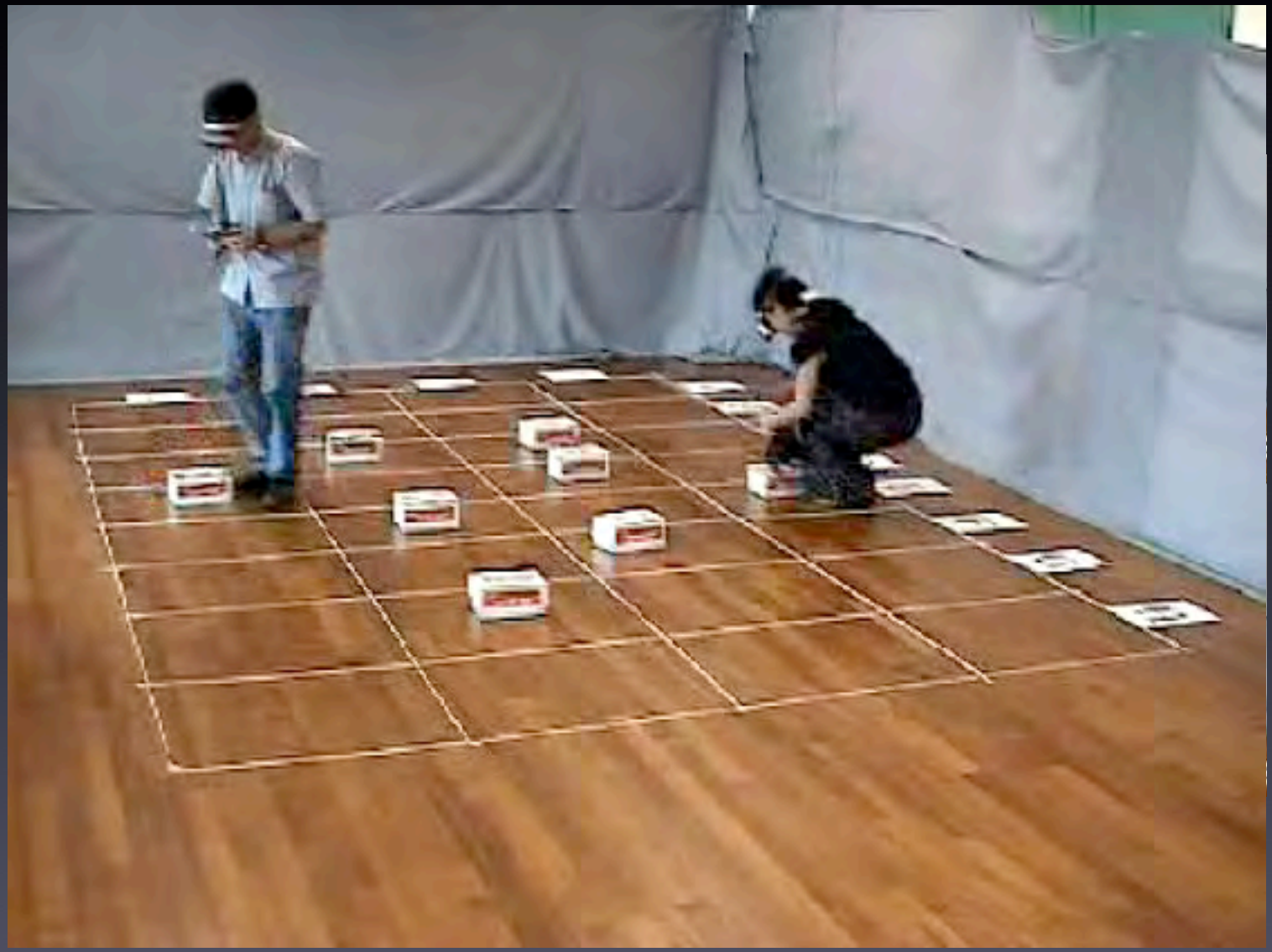
Stresses the seamless interaction with virtual objects and virtual figures with body movement,

Seamless transitions between AR world and the VR world.

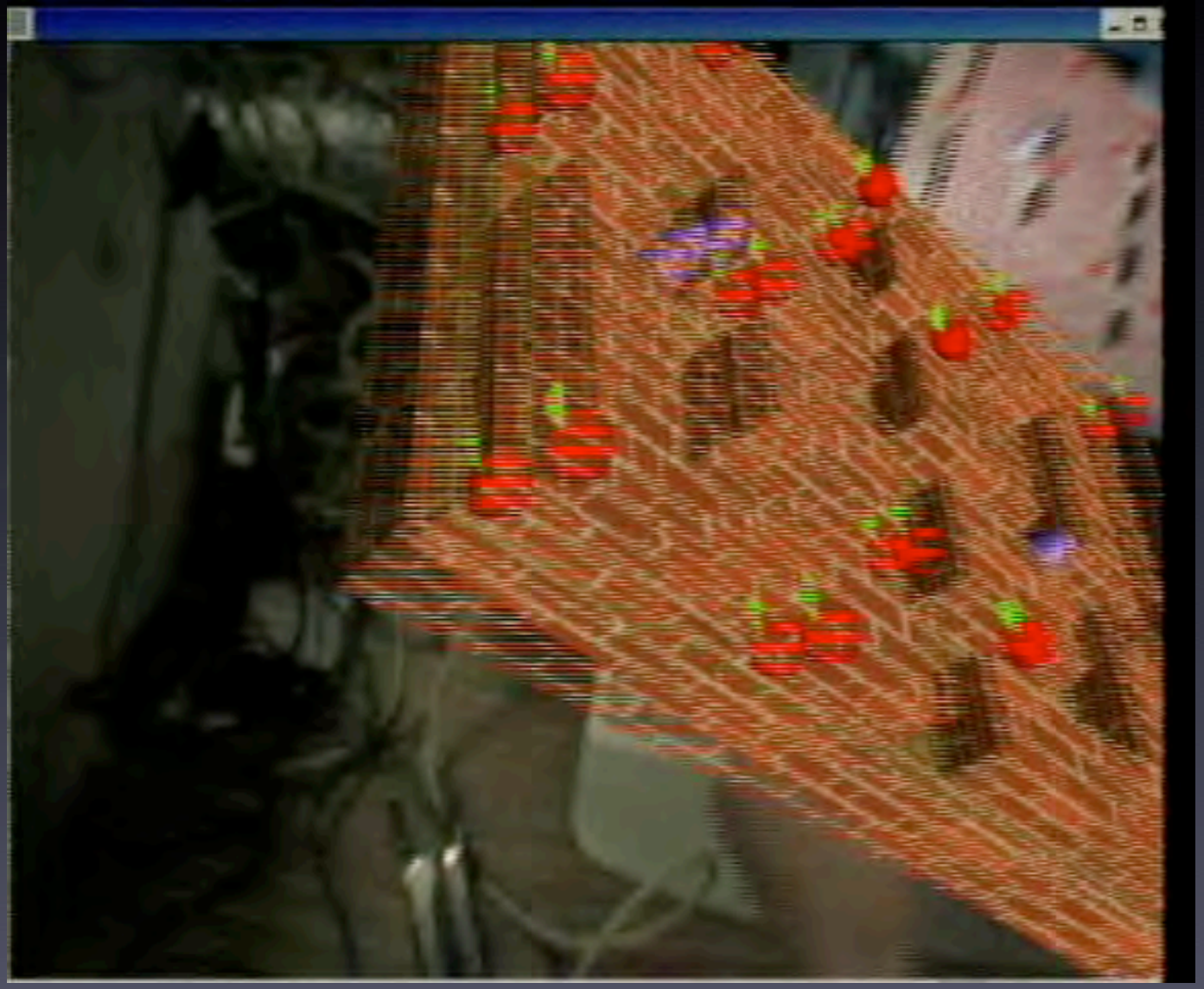


Cheok et. al Entertainment Computing, 2001

Cheok et. al Personal and Ubiquitous Computing Journal, 2002



Tilt Pad



Human Pacman

- **novel computer gaming experience by embedding the natural physical world ubiquitously and seamlessly with a fantasy virtual playground.**
- **collaboration and competition between players in a wide outdoor physical area that allows natural wide-area human-physical movements together with remote players on the internet**
- **Pacmen(women) and Ghosts are now real human players in the real world experiencing mixed computer graphics fantasy-reality**

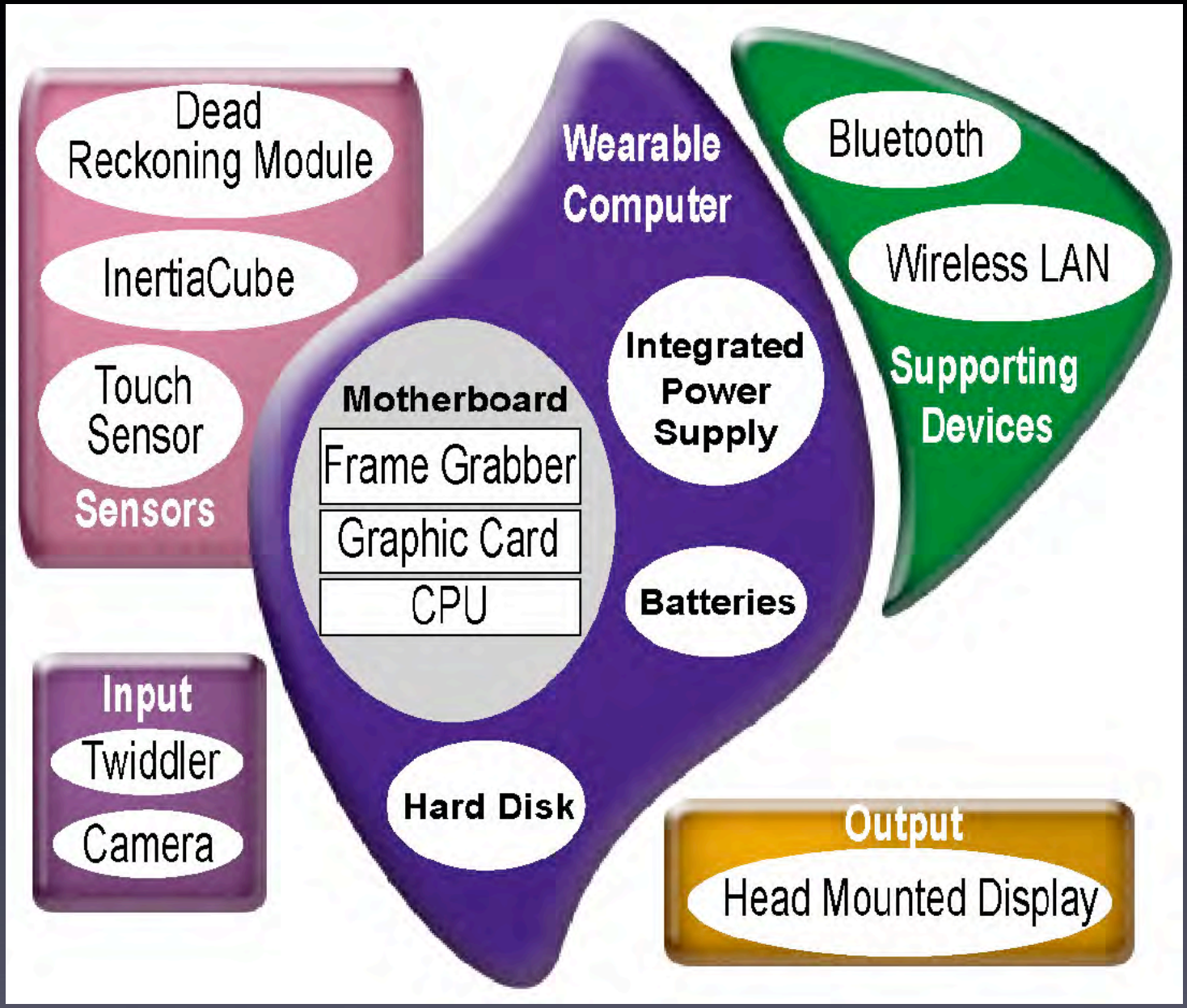
Cheok et. al Mobile HCI, 2003 Udine

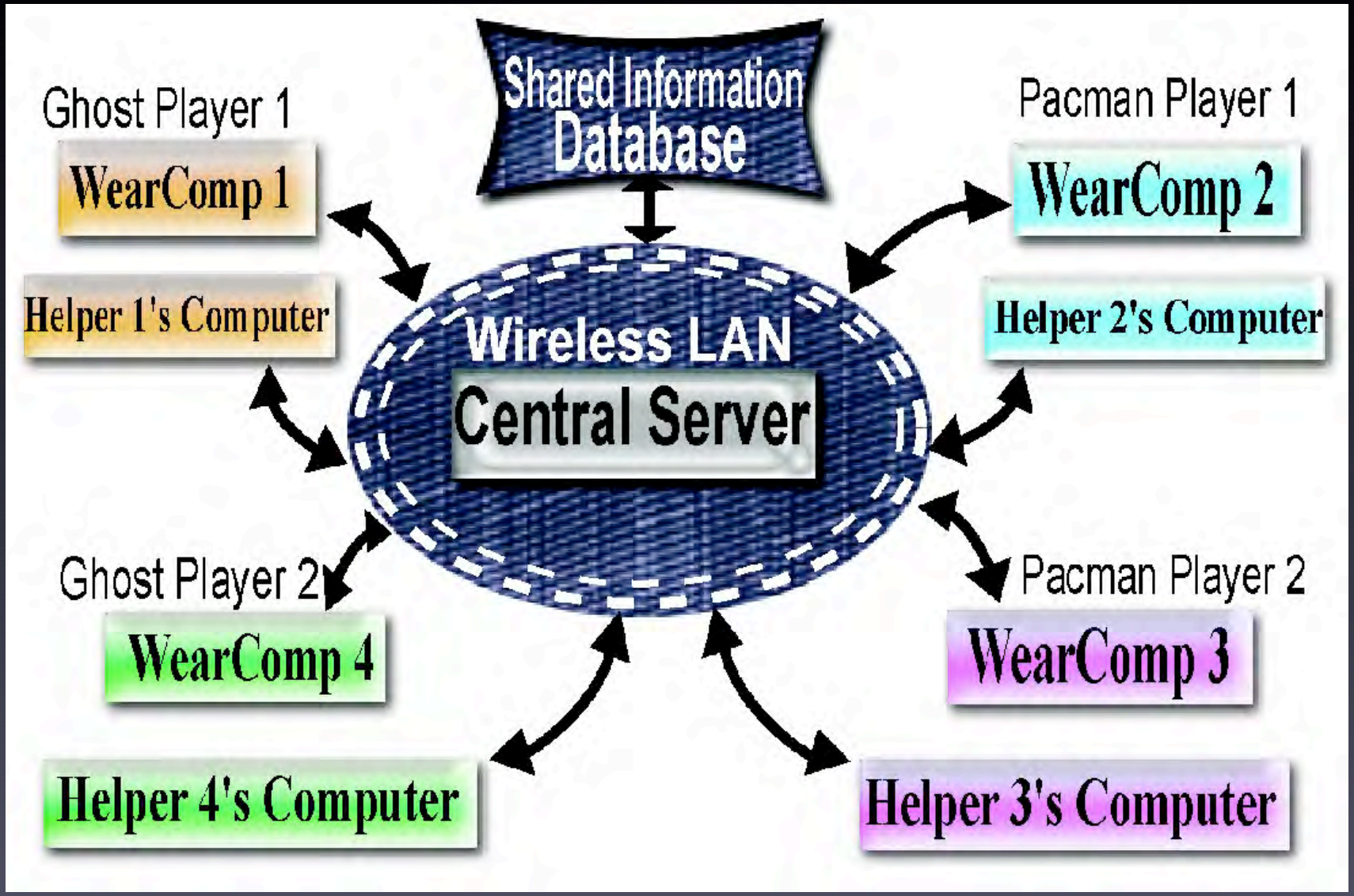
Cheok et. al CHI 2004 Vienna

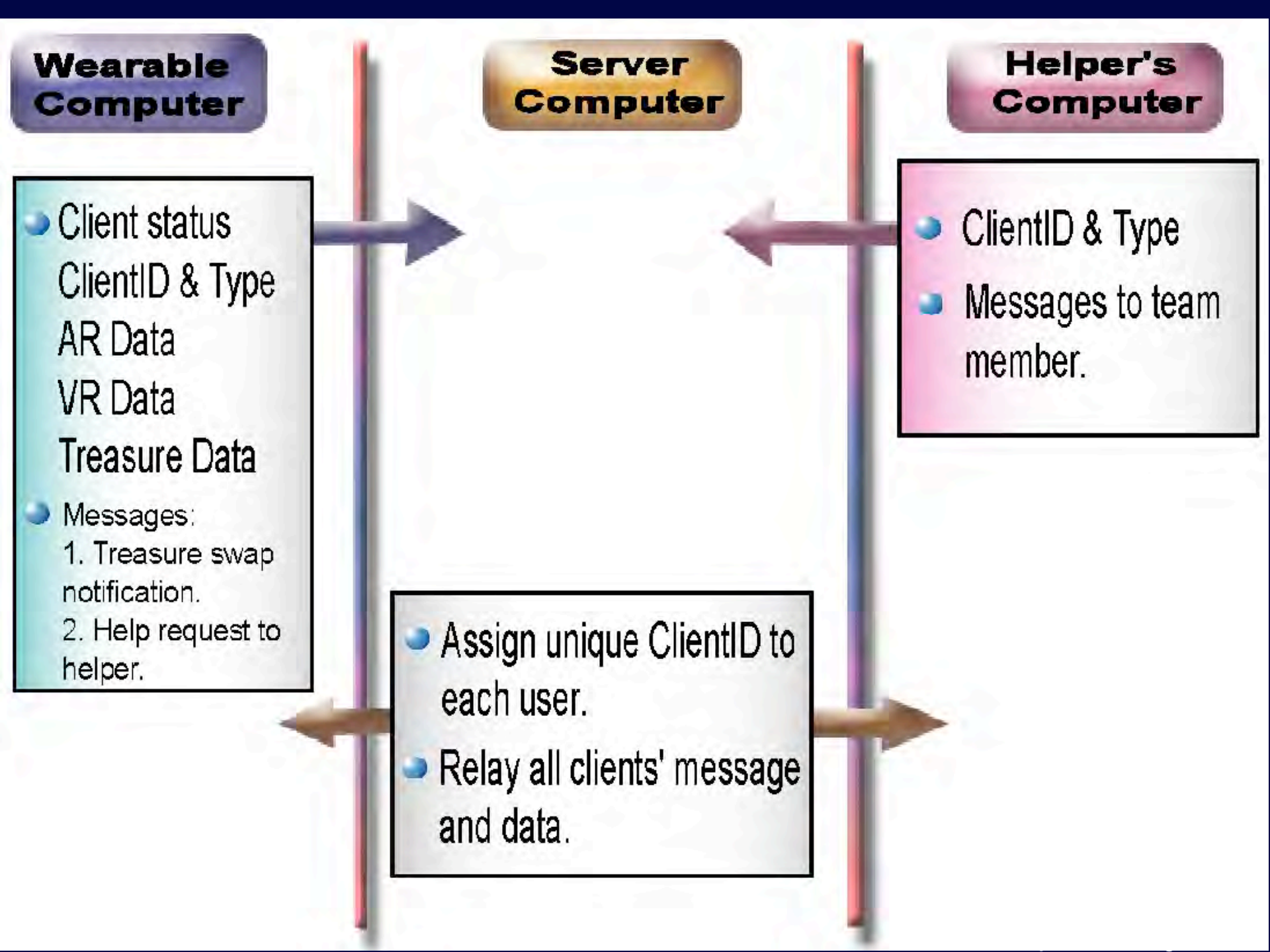
Cheok et. al Personal and Ubiquitous Computing Journal, 2004

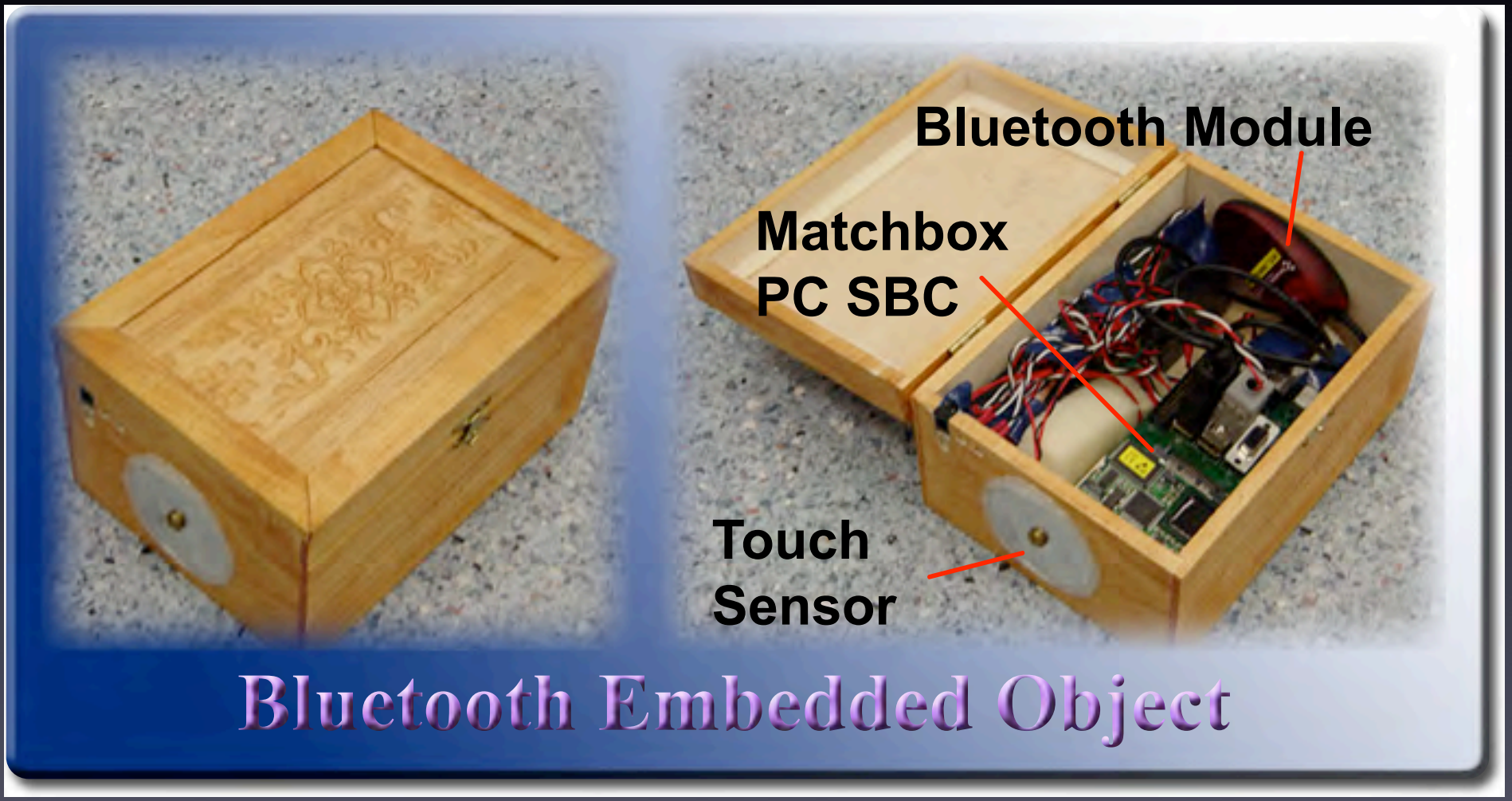
Features

- Players have to physically roam around the outdoor area and collect virtual cookies in the process.
- Find and collect ‘Ingredients’ that are actually Bluetooth embedded objects
- Physical objects are linked in real time to their virtual Pac-world
- Another role in Human Pacman is known as the Helper. She is participating in the game remotely via a computer terminal over Wireless LAN.


Dead Reckoning Module
InertiaCube
Touch Sensor
Sensors
Wearable Computer
Motherboard
Frame Grabber
Graphic Card
CPU
Integrated Power Supply
Batteries
Hard Disk
Bluetooth
Wireless LAN
Supporting Devices
Input
Twiddler
Camera
Output
Head Mounted Display


Shared Information Database
Ghost Player 1
WearComp 1
Helper 1's Computer
Wireless LAN
Central Server
Pacman Player 1
WearComp 2
Helper 2's Computer
Ghost Player 2
WearComp 4
Helper 4's Computer
Pacman Player 2
WearComp 3
Helper 3's Computer

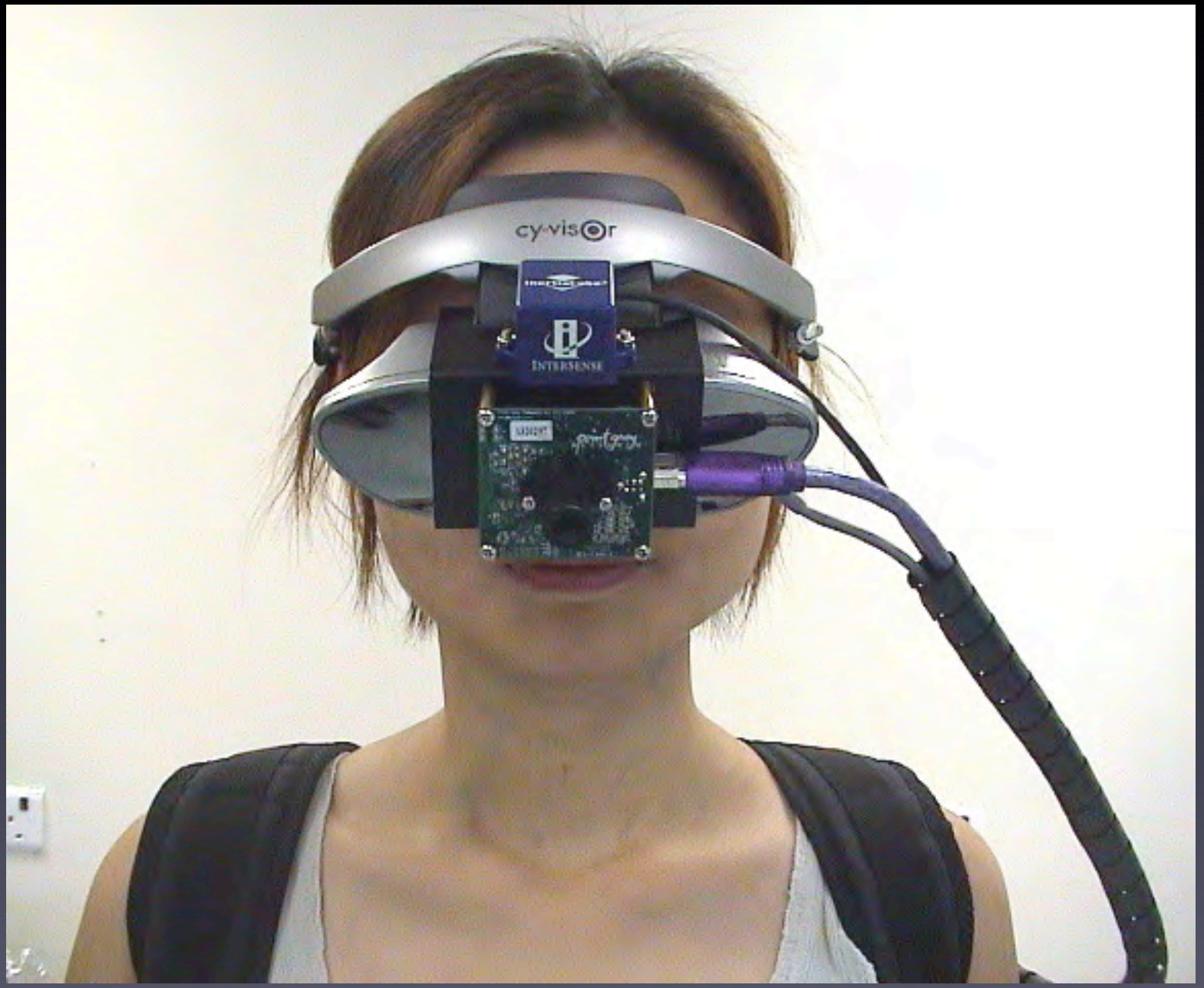

Wearable Computer
Server Computer
Helper's Computer
Client status
ClientID & Type
AR Data
VR Data
Treasure Data
Messages:
1. Treasure swap notification.
2. Help request to helper.
ClientID & Type
Messages to team member.
Assign unique ClientID to each user.
Relay all clients' message and data.



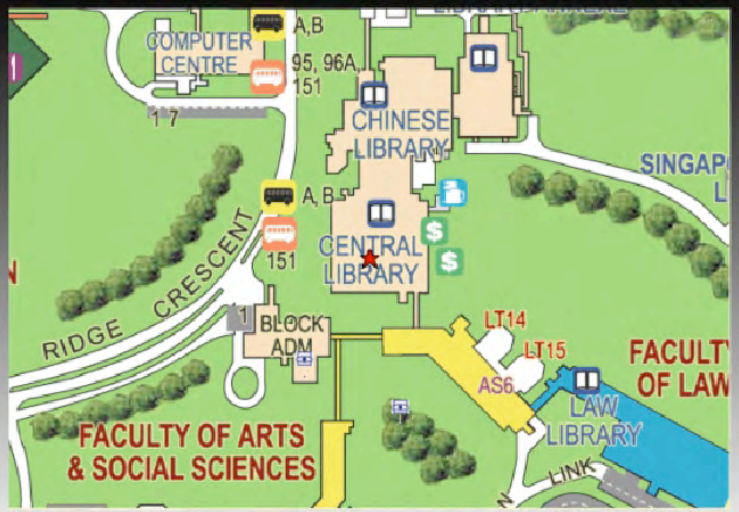
Bluetooth Embedded Object

Version 2: August 2003

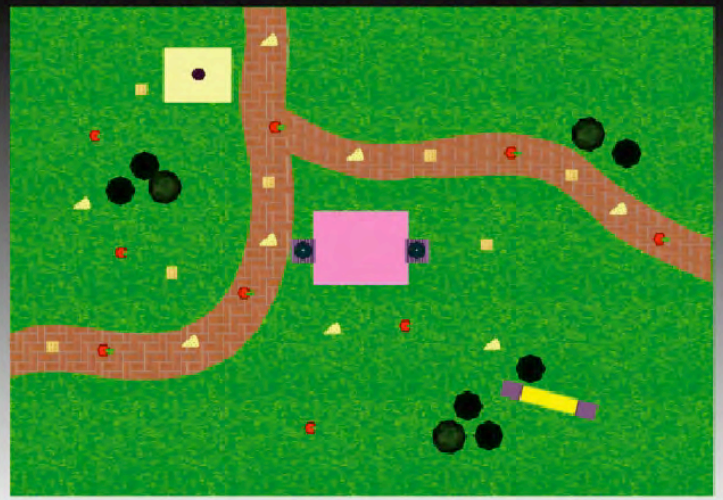
30 FPS


cy·visor
INTERSENSE

Mobile Mixed Reality: Human Pacman



2D Map of Physical Space for Pac-World

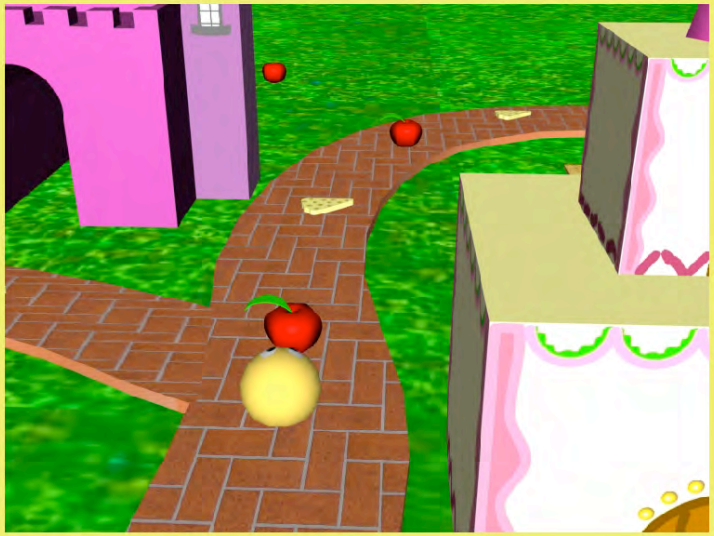


3D Map of Virtual Pac-World

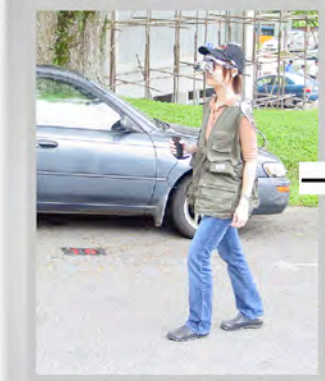
Bird Eye View of 4 Players and the Corresponding Virtual World

PacMan at outdoor area
Helper in front of Desktop Computer
Display in HMD
Scene of Collaboration between Players

Player walks across a cookie and it disappears.



Corresponding virtual world update in real time.



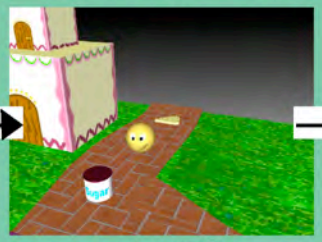
Walking in the area

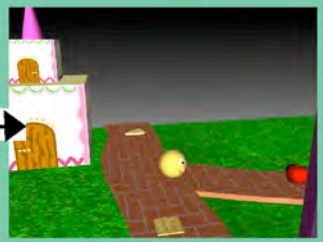
Found sugar jar

Pick up sugar jar

Walking away

View Inside HMD



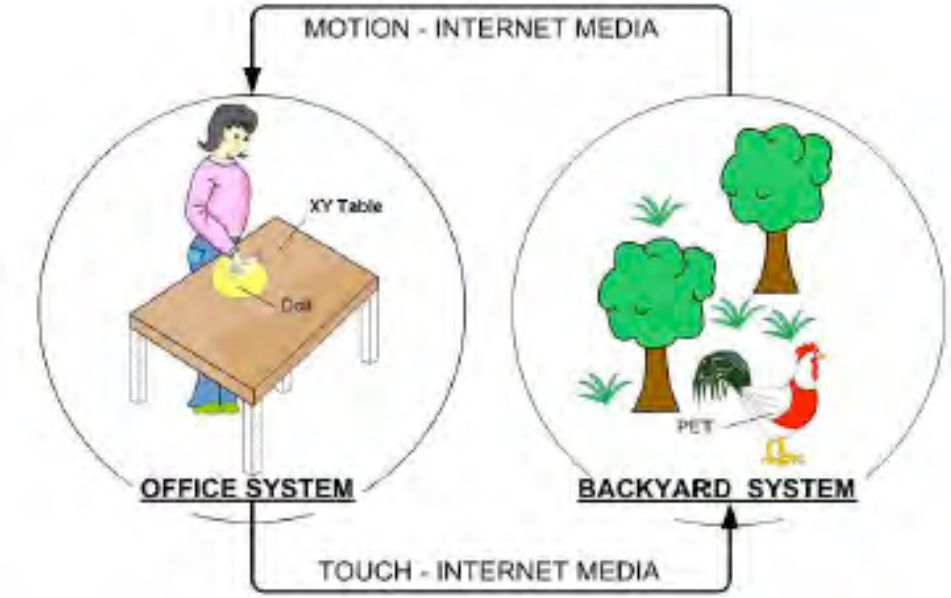


Corresponding Pac-World View

These sequences of pictures show what happen when a PacMan picks up an Ingredient in all 3rd person, 1st person, and virtual world view.

Demo in WIRED NextFest Chicago June 2005

Poultry.Internet: A Cybernetics system for Human-Pet Interaction through the Internet



Lee and Cheok,Personal and Ubiquitous Computing, 2005

Novelties:

- Human-pet haptic interaction through Internet
- Remote tangible touching sensation
- Pet-computer cybernetics moving mechanism

– A physical representation of pet using a moving doll

Why Chickens?

- In South East Asia, chickens have traditionally been kept as family pets
- Poultry is terribly treated animal in modern society (production of eggs and meat)
- Studies have shown that chickens respond to stroking and touch in a positive manner

Why Human-Pet Interaction?

- Pets provides social support, makes people feel unconditionally accepted
- Pets are used for human psychological therapy
  - AAT (*A*nimal *A*ssisted *T*herapy)
- Pets satisfy children's need to nurture
  - Help in social-emotional development of children

Why Remote through Internet?

- To feel the presence of pets no matter where we are
  - Nowadays people are too busy
- To allow people allergic to animal a chance to have pets
  - Cyber-pets
- To allow people to stroke dangerous animals in the zoos
  - Touch a crocodile

System Overview

Consist of 2 Sub-systems:

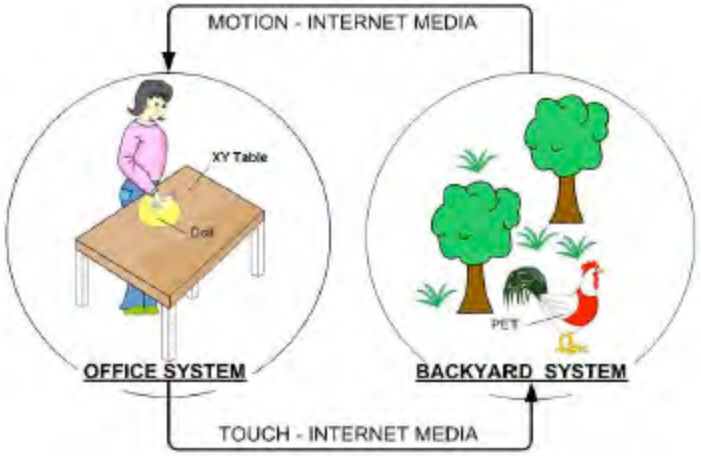
- Office System

– Human (pet owner) interacts with avatar (doll) of real pet (rooster)

- Backyard System

– Real pet (rooster) senses fondling by human remotely (chicken tracked by camera)

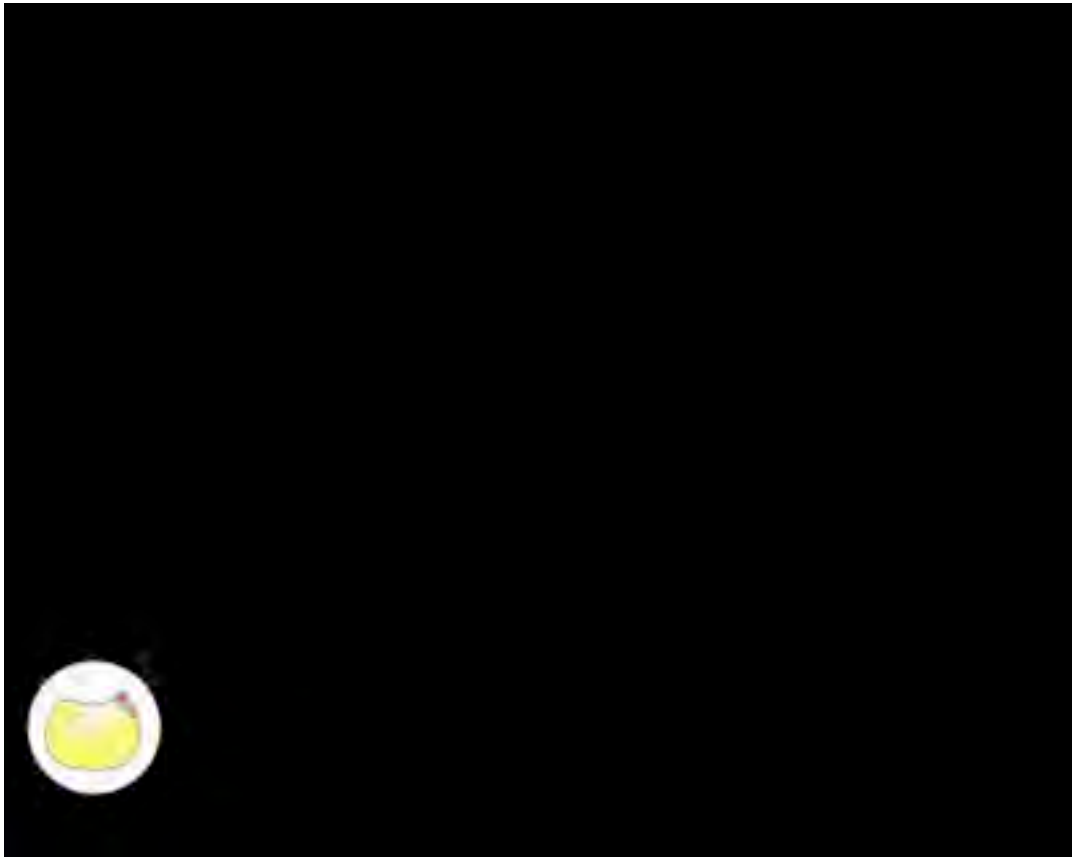
- Both systems are remote, and interconnected by Internet



System Overview

How it works:

- Pet owner touches the doll in the Office
- Rooster feels the touch in the Backyard, excited and moves around
- Pet owner then sees the doll move, following the path of the rooster



Experimental Results

- Red door / Blue door test
- Weighted door test
- Over 80% average
- Humans preferred this method over voice, web cam

Future work

- More sensors on pet (heart rate, temperature)
- Different animals
- Camera on pet
- Sensors and electro-exciters on human for human-pet touch/dance

Conclusions and Future Work

- We envision a new type of delightful media experience that has two main features:
- Integrated ubiquitous context-awareness and sociality into the computer interaction context, which entails ubiquitous, tangible, and social computing.
- A seamless merging of physical world, augmented world and virtual world exploration experience.

Contact Details

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- ACM SIGCHI ACE2005 June 2005
  - www.ace2005.org Valencia Spain
  -
- Entertainment Computing 2005 EC2005; Japanese Domestic Symposium
  - www.entcomp.org/ec2005