

# Networked Telepresence Using Omni-directional Camera and Web Browsers

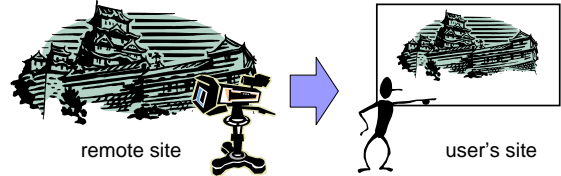
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## Telepresence

The technology allows users to experience a remote site through a virtualized real world.



### Application fields

- Entertainment
- Remote surveillance
- Education
- Remote conference

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## Our Previous Works

The telepresence systems using omni-directional images

- Changeability of a user's view direction
- Little delay of changing view direction
- Feeling of rich presence



[S.Morita et al. '02]



[S.Ikeda et al. '03]

✗ Problem: un-networked (stand-alone) system  
or networked system using P2P connection

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## Research Purpose

Realization of the networked telepresence system which enables **multiple users** to see a virtualized real world **easily through the internet connected PCs**

### Approach

- Presentation using web browsers
  - For seeing a virtualized remote site easily
- Video transmission using multi-cast protocol
  - For scalability of user increase

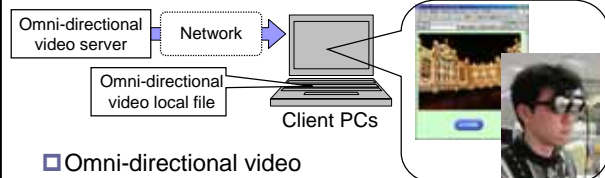
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## Demonstration

<http://www.sei-i.com/>

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## Overview of Proposed System



- Omni-directional video
  - Acquired by omni-directional video cameras
- Video transmission
  - Using multi-cast protocol
- Presentation of omni-directional video
  - Using web browsers or HMDs

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## Omni-directional Video Contents

- Stored video contents
  - ✓ High-resolution omni-directional videos impossible to encode and transfer in real-time
  - ✓ For on-demand-service
- Live video contents
  - ✓ Standard-resolution omni-directional videos possible to encode and transfer in real-time
  - ✓ For providing service like TV broadcasting

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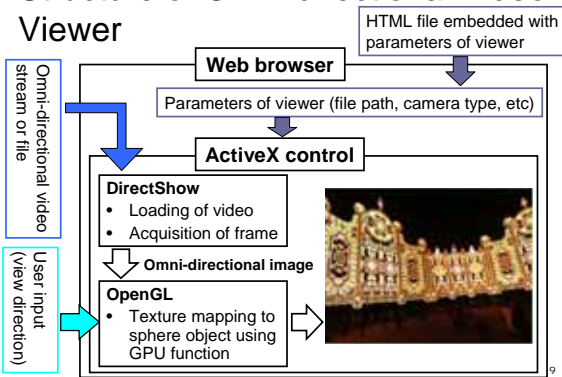
## Omni-directional Video Viewer



- Auto installation and execution by access of web page
- Interactive view control using keyboard, mouse, or gyro
- Nothing to take care of parameters of viewer

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## Structure of Omni-directional Video Viewer



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### Experiment Using Stored Video Contents

## Experiment Using Stored Video Contents



Omni-directional Multi-camera System (Ladybug)

### Spec. of Ladybug

- Mounting six XGA cameras
- 75% of full spherical view
- Image acquisition at 15fps

Used omni-directional videos

- Resolution: 1344 × 672
- Format: MPEG1
- Bit Rate: average 8Mbps

Generated in offline process

Omni-directional videos were transferred from a server connected with LAN.

Panoramic video

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### Experiment Using Stored Video Contents

## Result of Presentation



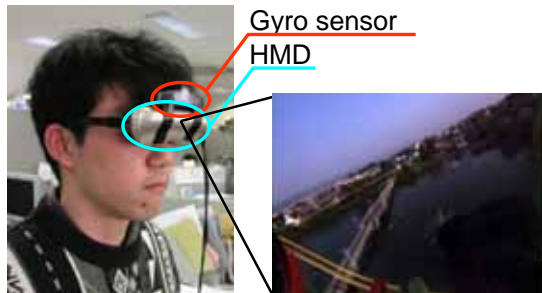
Spec. of PC for presentation  
 CPU: Pentium4 2GHz  
 Memory: 512MB  
 Graphics card: RADEON 9700pro

- Renew of image: 15fps as same as input video
- Change of view direction: 30fps

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### Experiment Using Stored Video Contents

## Presentation Using HMD



Gyro sensor  
HMD

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Experiment Using Stored Video Contents

## User and User's View

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Experiment Using Live Video Contents

## Experiment Using Live Video Contents

HyperOmni Vision  
Resolution: 720 x 480  
Frame rate: 15fps

PC for encoding and multi-cast transmission  
Format: WindowsMediaVideo9  
Bit rate: 832Kbps (included sound)  
Frame rate: 24fps

Road in campus      Laboratory in indoor

Car mounted omni-directional camera      Wireless LAN IEEE802.11g Multi-cast      AP      Wireless LAN IEEE802.11g/a Multi-cast      Client PCs

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Experiment Using Live Video Contents

## Car under Running and Result of Presentation

Frame rate: 24fps, Time delay: about 10sec

Though the client PC increased, the load of network was constant.

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Experiment Using Live Video Contents

## View-dependent Presentation

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## Summary and Future Work

### Summary

- We proposed a system for seeing the omni-directional video contents easily and interactively through the internet connected PCs.
- In experiments, the users could see high-resolution videos stored in a server and live videos distributed by multi-cast protocol.

### Future work

- Reduction of the delay in transmitting an omni-directional video stream
- Novel view generation using multiple images from fixed cameras for changing user's view point

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