Technologies for Collaborative Digital Contents

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Lab. introduction

- **Research focuses on Digital Content with HCI and VR technologies**

- **Members**
  - Prof. Jee-In Kim (HCI and VR)
  - Prof. HyungSeok Kim (VR and CG)
  - Prof. Mingyu Lim (VR and Networks)
  - 4 Ph.D students, 10 master students, 2 staffs
  - 5 Research assistants (assistants and interns in Undergraduate, Master and Ph.D level)

- **In collaboration with international research groups**
  - Roger Kornberg Lab., Stanford University, USA
  - Stony Brook University, USA
  - RheinMain University of Applied Sciences, Wiesbaden, Germany
Overview on Recent Research Activities in Collaborative Digital Content

- **Digital Content Technology**
  - Real-time Simulation & Rendering
  - Modeling

- **Interaction Methods**
  - Interaction Devices
  - Collaborative Interaction Platform

- **Applications**
  - Medical
  - Edutainment/Commercial
Digital Content

- **Real-time Simulation & Rendering**
  - Real-time rendering of complex objects with animation
  - Real-time fur animation for garments

- **Modeling**
  - Multi-resolution Model for Animation of Textured Mesh
  - Global Illumination
  - Authoring Virtual Environment
Real-time Simulation for Wet Fur

Goal
- Realistic fur representation via flexible wet degree control
- Fur simulation via mass volume and mass distribution

Approaches
- Flexible wet degree control – Get continuous wet fur models
- Mass volume – Set mass values to each vertices on shared-vertex structure
- Mass distribution – Set stabilities and surface viscosity via mass values

Fig. 1. Result of flexible wet degree control
Fig. 2. Mass Volume
3D Reconstruction of Ancient Buildings and Artifacts

- Recovering 3D geometry from single 2D geometry - a model free approach
- Image Based Modeling

Process Flow:

1. Image
2. Pixel set
3. Multiple Constellations
4. Pixel set Labels
5. 3D Model

INPUT

OUTPUT

3D MODEL
Multiple users can participate in a synchronous / asynchronous collaboration.
Asynchronous Collaborative Design

Asynchronous Collaboration

Diagram showing a process with time lines and conflicts highlighted. The diagram illustrates how work items (W1, W2, W3, W4, W5) are handled in an asynchronous collaborative environment, with conflicts marked at specific points (W2, W3, W4) and the need to rollback and work again indicated.
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Interaction Methods

- Gesture-based interaction devices
- VR-based interaction devices
- **u-Table**
  - Collaborative Visual Interaction Platform
  - Fingertip-based interaction methods
  - Recognition of mobile devices
  - Interaction for multiple users
A Slim Hybrid Multi-Touch Tabletop Interface with a High Definition LED Display and Multiple Cameras

- Hybrid optical method for better recognizing fingertips
- Slim and simple structure for multi-touch tabletop
- Full HD Resolution by using High definition LED Display

Received Special Merit Award for Outstanding Paper at IEEE ICCE 2012 (co-located with CES 2012, Las Vegas)
A Steerable Tangible Interface and Its Evaluation

- Utilize ROI using Tangible Interface
- Separate ROI (from context by tangible interface)
- Stimulate User Experience

Magic Lens!

- **Select** Object by **Fixing** STI
- **Navigate** Contents by **Steering** STI
- **Move** to another layer by **Rotating** STI

[1] WooHyeon Kim, Jun Lee, HyungSeok Kim, MinGyu Lim and Jee-In Kim, A steerable tangible interface and its evaluation, UIC 2010, LNCS 6406, pp138-150 ([STI Demo](#))
Practical Representation of 3D GIS Information using an IR Camera and an LCD Display

[1] Woohyeon Kim, Jonghwa Kim, Daehyeon Kim, Sujung Moon, Wookjin Nam, Jee-in Kim, Representing GIS information by using IR Camera and LCD Display, in proceedings of Conference on Smart Contents, 2011, South Korea
Collaboration Framework

Collaboration with Tabletop Interface & Networked Devices

Face to Face Environment
A: Tabletop Interface / Public Space
B: Mobile Device / Private Space
C: Tangible Interface

Conventional Environment
Interactions with Heterogeneous Devices

- **Mobile + Table top**
  - Provide effective view of large workspace on small mobile screen
  - Provide contents sharing between different devices
Content and Interaction Adaptation

Article Adaptation Layout Adaptation Interaction Adaptation Personalization

\[ F(N,O,W,V) = (H,H,L,H) \]

- All contents - 3D interior content is Converted to 2D image

\[ F(N,O,W,V) = (H,H,L,H) \]

- Original Layout

\[ F(N,O,W,V) = (H,H,L,H) \]

- Original Contents

**<Simple Layout>**

\[ F(N,O,W,V) = (L,L,H,H) \]

- Frame 1

\[ F(N,O,W,V) = (L,L,H,H) \]

- Frame 2

\[ F(N,O,W,V) = (H,H,L,H) \]

- Frame 1 - Common Region

\[ F(N,O,W,V) = (H,H,L,H) \]

- Frame 2 - Personal Region

\[ F(N,O,W,V) = (H,H,L,H) \]

- Layout for Cooperation

\[ F(N,O,W,V) = (L,L,L,H) \]

- All contents - 3D interior content is Converted to 2D image

\[ F(N,O,W,V) = (H,H,L,H) \]

- All contents - 3D interior content is Converted to 2D image

\[ F(N,O,W,V) = (H,H,L,H) \]

- All contents - 3D interior content is Converted to 2D image

**[1]** Soo Jeong Kim, Kyung Jun Gil, HyungSeok Kim, Sang Beom Lim and Jee-in Kim, Template-based Adapted Interactions for Heterogeneous Devices in proceedings of 2009 Intermedia Summer School, Chania, Greece, 2009

**[2]** Soo Jeong Kim, Kyung Jun Gil, HyungSeok Kim, Sang Beom Lim and Jee-in Kim, Adapted Interactions in Shared Virtual Environments for Heterogeneous Devices, Computer Animation and Virtual Worlds Journal, 2010
Content Adaptation for Heterogeneous Devices

- Can be applied to SNS
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Tools for Bio-Informatics

Portal Server

Molecular Simulation System using parallel GPUs

VRMMS

Cooperative modeling & education using smart board and u-Table

Serious Bio Game using Wii

Collaborative Education with secondlife
VRMMS

- Virtual Reality Molecular Modeling System

- Collaborative Molecular Modeling
  - Supports collaborative works for molecular model

Molecular Simulation using Parallel GPUs (1)

- **Molecular Simulation**
  - Calculate chemical and 3d geometric information of molecule
  - Usually uses distributed or parallel computer

- **Using GPU for Molecular Simulation**

![Diagram showing Molecular Simulation using Parallel GPUs](image)

- Transmit to GPU
- (3D Atom Data)
- (Serialized Atom Data)
- Sub1
- Sub2
- CPU
- result
Molecular Simulation using Parallel GPUs (2)

- Performance Result
  - Energy minimization equation for docking.
  - At least 40 times faster than cpu.

Energy minimization result
Veterinary Medical Training System with AR

- **Injection of intravenous vein for a dog**
  - Essential process of animal medical activities
  - Difficult to get samples and takes a lot of time

- **AR system provides experiences for veterinary medical students**

- *(Video)*
Edutainment/Commercial

- Edutainment for Elderly People
- Virtual Fashion
AirScope: Massive Data Visualization (1)

- Designed for micro-scale air quality management system
- Intuitive visualization methods
- Ubiquitous Sensor network
- Video

<Visualization of air pollutant using VR>
<Visualization of air Traffic using AR>
Conclusion

- New world, New technology
  - Ubiquitous Computing Environment in Real Life
  - Natural Interactions -> User Experience (UX)
  - 3D Digital Content -> Multi-modal Experiences

- Maximizing UX for communication through VR & AR technology