Interactive 3D Processing Framework

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3D Human-Computer Interaction

Auto-stereoscopy

Gestural interaction
Modes of Interaction
Modes of Interaction

INPUT

Physical space

OUTPUT

Virtual space
Modes of Interaction

Physical space

Virtual space

INPUT

OUTPUT

VIRTUAL SPACE

PHYSICAL SPACE

INPUT

OUTPUT

VIRTUAL SPACE

PHYSICAL SPACE
Stereoscopy Mode

Cam 1
NTSC video stream

Cam 2

Frame Grabber

Cameras

Anaglyph Filter

ZBT Controller

Virtual Camera Controller

Virtual Cam Position

Update signal

3D Renderer

Wireframe model

ROM

BRAM

VGA Controller

VGA data

Monitor

User-selected mode

Frame data

mux

Read line
Gesture-based Interaction Mode

Cam 1
NTSC video stream
Frame Grabber
Frame data
Anaglyph Filter
User-selected mode
ZBT Controller
Virtual Camera Controller
Virtual Cam Position
Update signal
Wireframe model
3D Renderer
Frame data
BRAM
User-selected mode
VGA data
VGA Controller
Read line
Default
Monitor
ZBT Frame Buffer Controller

- Frame grabber writes to the back buffer
- VGA controller and Virtual camera controller read from frame buffer
- Buffer updated in between VGA frames
Anaglyph Images

Left image

Right image
Anaglyph Images

Anaglyph-filtered image
Anaglyph Images

3D glasses

Anaglyph-filtered image
Anaglyph Filter

Right pixel (RGB)

\[ v_R = [r_R, g_R, b_R] \]

Left pixel (RGB)

\[ v_L = [r_L, g_L, b_L] \]

Anaglyph-filtered pixel (RGB)

\[ v_{anaglyph} = [0.7 \cdot g_L + 0.3 \cdot b_L, \ g_R, \ b_R] \]

Source: http://3dtv.at/Knowhow/AnaglyphComparison_en.aspx
Gesture-based Interaction Mode
Virtual Camera Controller: Block Diagram

Fetch Controller → Center of Mass Calculator → Dot Location Calculator → Integrator

- Address
- Request
- Data ready
- Left frame
- Right frame

- CoM 1
- Done
- Reset
- CoM 2
- Change in virtual camera position
- Ready
- Enable

Virtual camera position → Update
Center of Mass Calculator

- Takes camera frame data and finds a black dot
- Filters out possible noise using a low pass filter
Dot Location Calculator

- Determines the location of the dot in 3D space
- Takes distance and angle between two cameras into account
Dot Location Calculator

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Gesture-based Interaction Mode
3D Renderer

[Vertex 1, \ldots, Vertex 8] = [(0,0,0), \ldots, (1, 1, 1)]

[Edge 1, \ldots, Edge 12] = [(1, 2), \ldots, (7, 8)]

Virtual Camera Position = (r, \Theta, \Phi)
Organization

• **Two milestones**
  – Stereoscopy mode
  – Gestural interaction mode

• **Division of work**
  – Tim (Frame Grabber / ZBT Controller)
  – Andrew (Anaglyph Filter / 3D Renderer)
  – Adam (Virtual Cam Controller)
Organization

- **System Design**
  - By Week 3

- **Anaglyph Milestone**
  - By Week 4
  - ZBT controller + frame grabber
  - Anaglyph Filter
  - 3D simulations

- **Camera Controller Milestone**
  - By Week 6
  - Integration
  - 3D Renderer
  - Camera Controller
Q & A