Virtual Juggling

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System Overview

• Juggling simulator
• Camera captures user’s motions
• User moves hands to juggle virtual balls
• Balls obey laws of virtual physics
  » Anyone can juggle with us
• Display shows user and virtual balls
System Overview
## System Overview

<table>
<thead>
<tr>
<th>VIDEO PROCESSOR</th>
<th>Frame N READY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Camera begins frame N</td>
<td>PROCESSING FRAME N</td>
</tr>
<tr>
<td>BALL MANAGER</td>
<td></td>
</tr>
</tbody>
</table>
| Overlay balls and hands for frame N-1 onto frame N | Physics for frame N  
| | draws balls for frame N |
| OUTPUT | |
| | Wipe ZBT  
| | Draw balls for frame N (from MANAGER) |
Controller

- Synchronizes user input to modules
  - Reset
  - Gravity
  - Ball Increment/Decrement
- Generates and delegates memory clock for ball manager and output modules
Video Processor

- Finds hands of juggler by locating specially colored blobs on screen
- Computes position using center of mass
- Computes running velocity
- Generalizes position and velocity to logical motions of throw and catch
Video Processor
Ball Manager

• Computes and stores location and velocity of balls
• Keeps track of balls’ states
• Calculates pixel value and location for balls
• Sends pixel locations and color values for balls to ZBT memory
Output Module

- Receives camera image as RGB video
- Overlays ball and hand information stored in ZBT buffer
Output Module

- **VIDEO PROCESSOR**
  - RGB VIDEO (WITH HANDS)
  - WRITE REQUEST
  - WRITE READY
  - 21 PIXEL LOC
  - NEW PIXEL VALUE
  - 8

- **BALL MANAGER**
  - 21 PIXEL LOC
  - 8

- **OVERLAY LOGIC**
  - PIXEL REQUEST
  - PIXEL VALUE
  - 21 PIXEL LOC
  - 8

- **CONTROL LOGIC**
  - PIXEL LOC to ADDRESS TRANSLATION
  - MEMORY SIGNALS
  - ZBT

- **MEMORY CLOCK**

- **CONTROLLER**

- **OUTPUT**
  - VIDEO OUT

- **OUTPUT**
  - 37

- **OUTPUT**
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Questions?