

graphics

hardware

06

High-Speed Distributed Rendering in the HoloVizio System

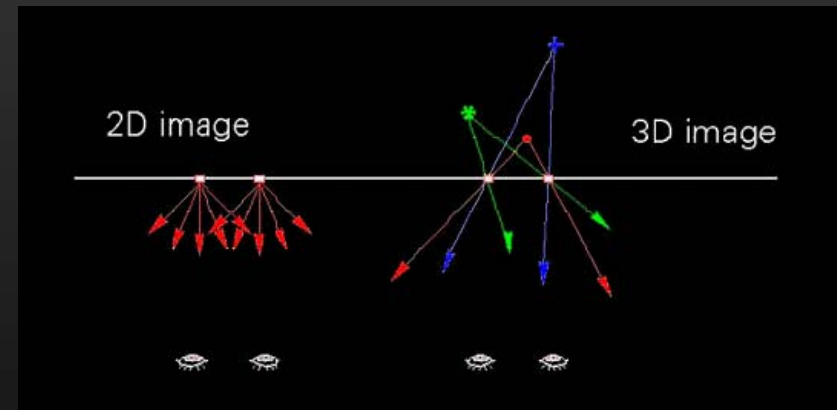
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Holografika

3D Display Technologies

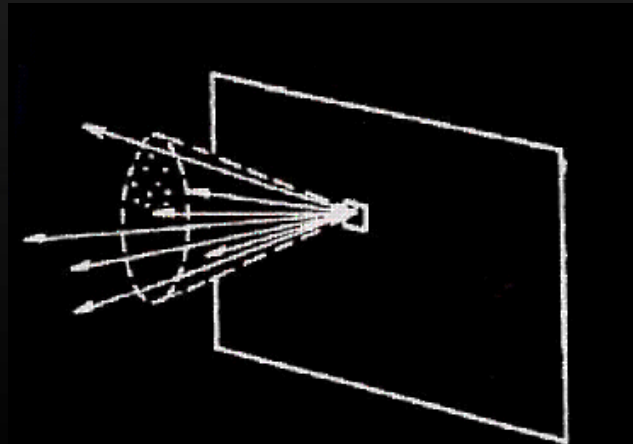
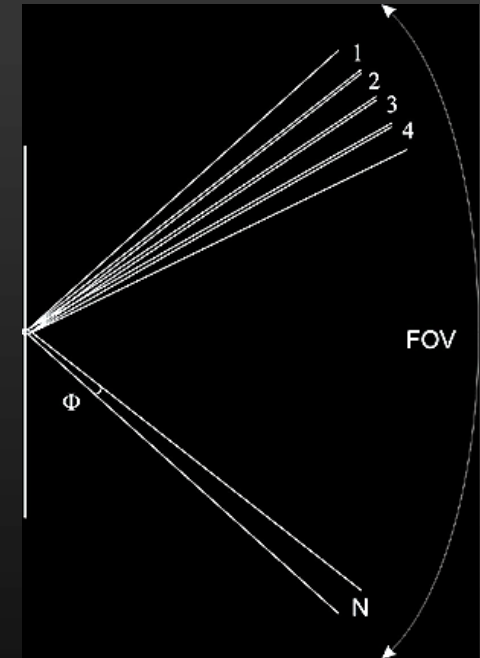
Background

- 3D images contain more information than 2D
 - Stereoscopic: 2x (L+R)
 - Multiview: $\sim 8-16x$
 - Volumetric: 20-200 slices
 - True 3D: continuous ($\sim 100x$)
- Total number of beams law, points/sec rate
 - Determine the quality of any 3D solution
- Direction selective light emission
 - Common for all 3D systems having a screen



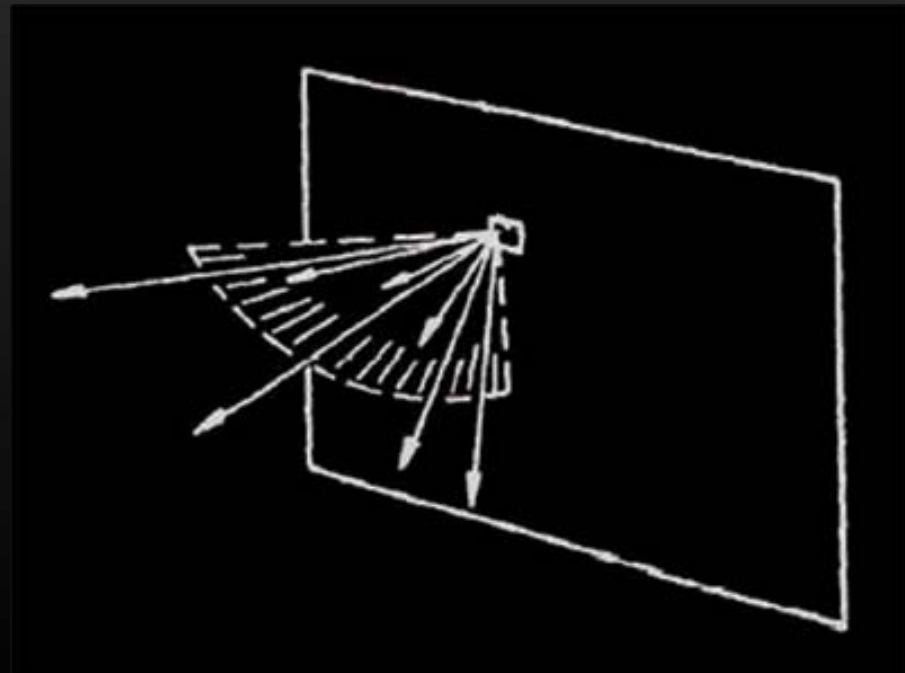
Fundamentals of 3D Displaying

- Additional independent variant to X, Y : Φ
 - Emission range: FOV
 - Number of independent beams in the range: Angular resolution
 $\Phi = \text{FOV} / n$
 - Angular resolution determines FOD



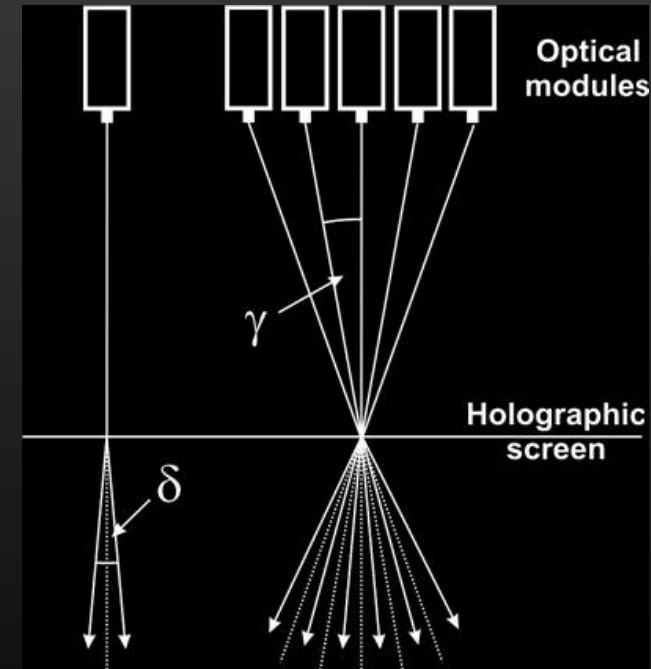
Fundamentals of 3D Displaying

- Vertical / horizontal parallax
 - Reduce the number of beams by omitting vertical parallax
 - Different horizontal and vertical angular resolution



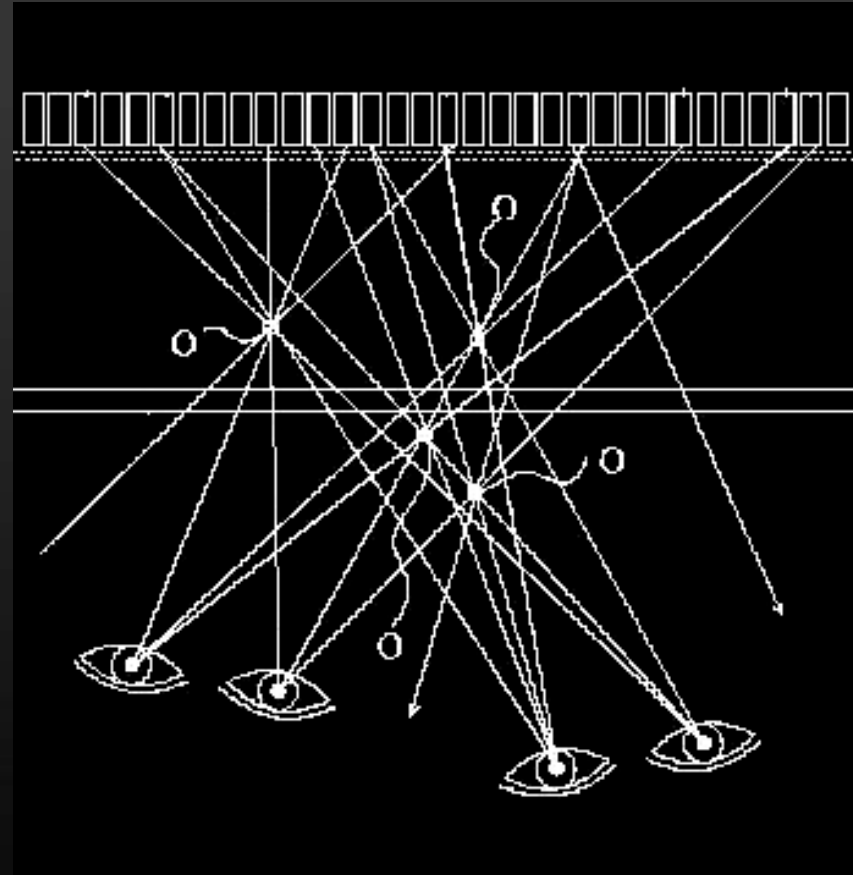
The HoloVizio System

- Optical modules
 - Project light beams to the points of the screen from various angles
- Holographic screen
 - Direction selective property with angularly dependent diffusion characteristics
- Emission angle geometry determined
 - The screen performs the necessary optical transformation, but makes no principal change in directions
 - No optical road-blocks like at parallax barrier, lenticular lenses



The HoloVizio System

- Specific distributed image organization
 - A module is not associated to a direction
 - Each view of the 3D image comes from multiple modules
 - Smooth and continuous transition between views
- Light field reconstruction instead of views



The HoloVizio System

- Freedom in system design
 - Emission angle
 - Angular resolution
 - Horizontal / vertical parallax
- Scalability
 - High pixel count
 - Any aspect ratio
 - Large scale systems
- Price / Performance
 - Possible to build perfect 3D displays

Steps to get there

Historical background

- First labor experiments, basic patent 1992-93
- 21" laser based monitor 1996-97
- Color labor mock-up 1998
- 32" color display prototype 2001

Steps to get there

First labor experiments, basic patent 1992-93



Steps to get there

21" laser based monitor 1996-97



Steps to get there

Color labor mock-up 1998



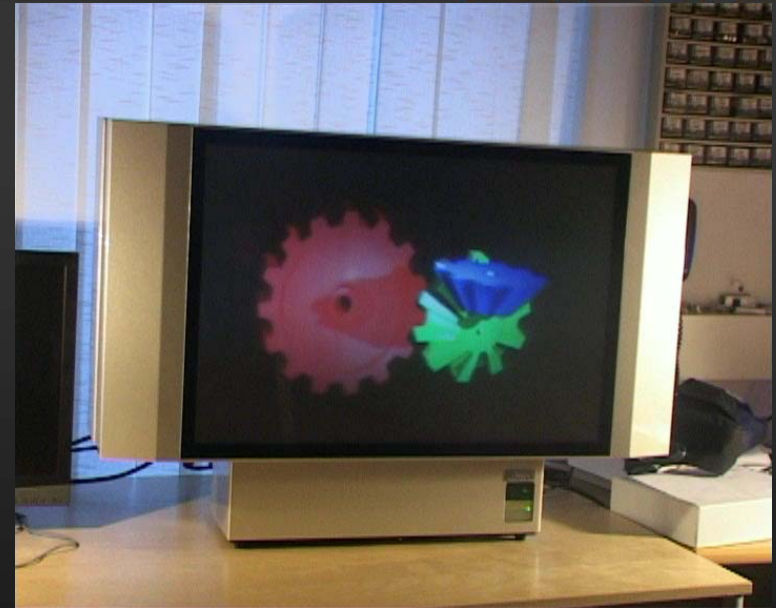
Steps to get there

32" color display prototype 2001



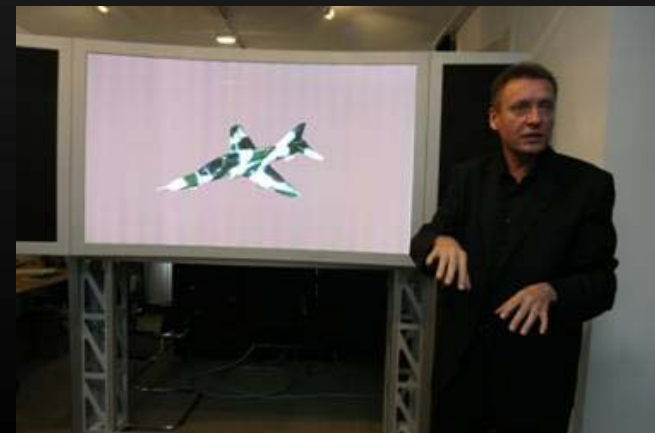
HoloVizio Displays

- HoloVizio Monitors
 - HoloVizio 128WD
 - 32", 10 Mpixel, 16:9
 - HoloVizio 96ND
 - 26", 7.4 Mpixel, 4:3
 - 128 and 96 modules
 - 50° FOV, 0.8° Φ
 - 2D equiv. res: 512x320
 - Up to 4 DVI inputs
 - 3 channels for 25 FPS



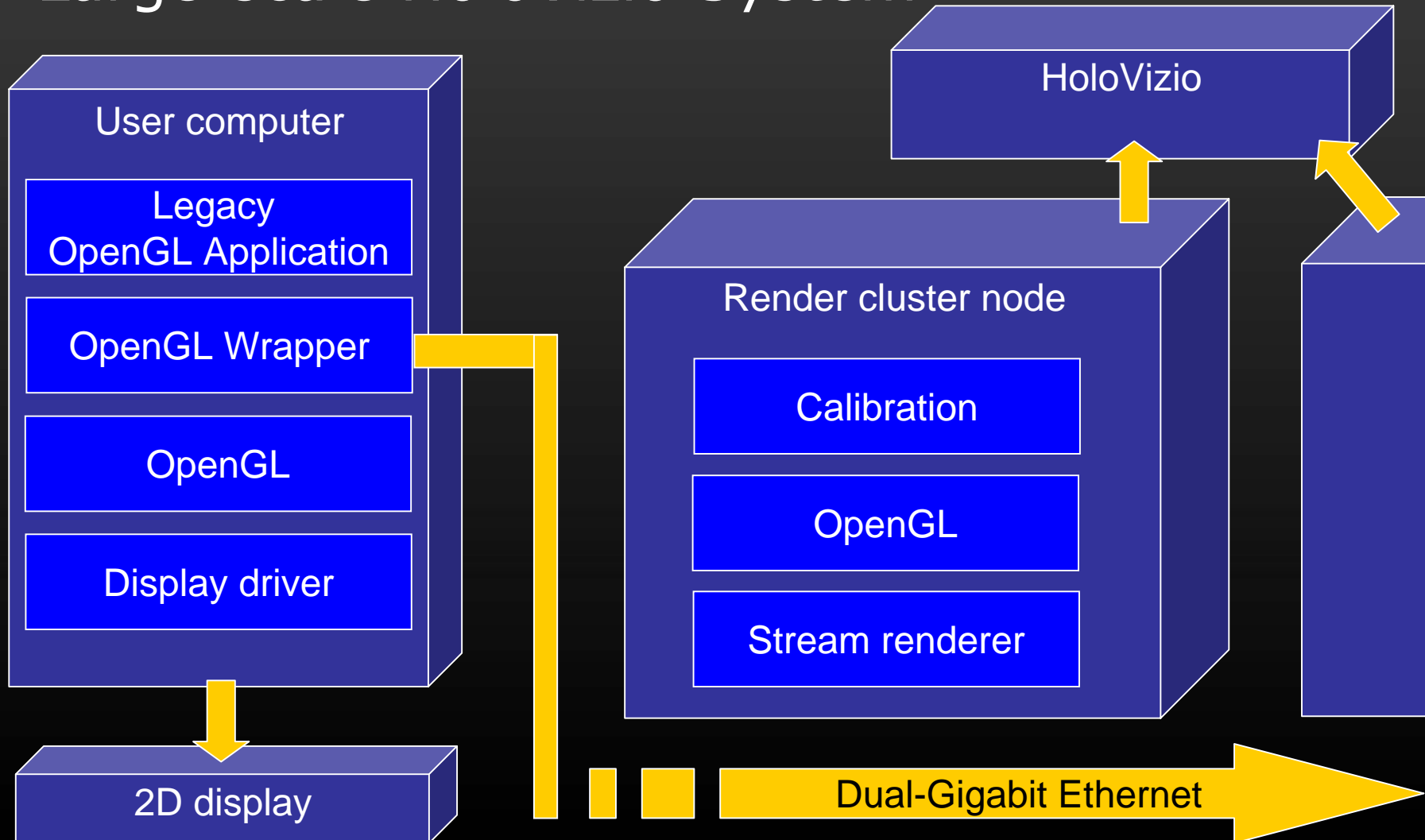
HoloVizio Displays

- Large-scale HoloVizio System
 - HoloVizio 640RC
 - 72", 50 Mpixel, 16:9
 - 50-70° FOV, 0.9° ϕ
 - 2D equiv. res: 1344x768
 - Input: Dual Gigabit Ethernet
 - PC-based render cluster
 - Control system



HoloVizio Displays

- Large-scale HoloVizio System



The Near Future

New HoloVizio Monitor

- 125 Mpixel, monitor scale
- 96 x SXGA images
- Planned for mass production
- New developments make it cheaper, smaller, and provide better image quality
- Software architecture
 - Basic operation
 - Plug-in operation
- How to render 125 Mpixels?

Possible Solutions

- Ideal solution
 - Single graphics board rendering a 125 Mpixel image
 - Huge GPU performance in a small package
 - Lots of video outputs
 - Impossible today (?)
- Use a computer cluster
 - Multiple CPUs, multiple GPUs
- Game console cluster
 - Performance / Licensing problems

Possible Solutions

- Embedded renderer, IP core
 - Put more GPUs into an ASIC
 - Not available to small companies
 - Does GPU manufacturers have agreement with a company that could produce custom chips for us?
- GPU cluster
 - Rapid improvements these days
 - Best performance and quality
 - Only built of workstation GPUs, no desktop or mobile GPUs
 - A bit expensive
 - Custom cluster for our purposes

Thank You!

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