Realidade Virtual e Interfaces Modernas

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Displays em Realidade Virtual

Tópicos

- Tecnologias de display
- Sistemas de displays

Tecnologias de display

- Vista direta
  - Tubo de Raios Catódicos
  - Acoplado a fibra óptica
  - Painel plano
    - Luminescente
      - LED
      - Plasma
    - Incandescente
- Projeção
  - Tubo de Raios Catódicos
  - Válvula de luz
  - Laser

Luminescência catódica

- Tubos à vácuo com ânodo coberto em fósforo, fluorescentes com bombardeamento de elétrons.
- Alta voltagem, consumo mais baixo que CRT
- Grade metálica com tensão intermediária
- Utilizado para display de alfa-numéricos, mas existem displays de 23mm com 241x246 pixels
- Limitado espectro de cores e necessita sobreposição de filtros

Eletroluminescência

- Alta voltagem, baixo consumo
- Baseado em propriedades do ZnS sob campos elétricos
- Tensão deve alternar entre os eletrodos
- Cor alaranjada
- Indexação de pixel por matriz de grade cruzada

Light Emmiting Diodes

- Baixa potência e voltagem, forte brilho
- Resolução limitada
- Produz muito calor
- Semicondutor dopado
- Emissão espontânea na junção p-n
- Alimentação DC

Descarga em Gás – Painéis de Plasma

- Painel de Plasma AC e DC
- AC
  - Gera um campo elétrico abaixo do potencial necessário para descarga
  - Para iniciar a descarga eleva-se o potencial
  - Para terminar a descarga é necessário reduzir significantemente o potencial
- DC
  - Malha dielétrica entre linhas e colunas impede descarga entre pixels

Incandescência

- Elevação de temperatura de um filamento produzindo luz
- Uso para backlighting ou projeção
- Chaveamento lento
- Produz muito calor

Telas de Cristal Líquido

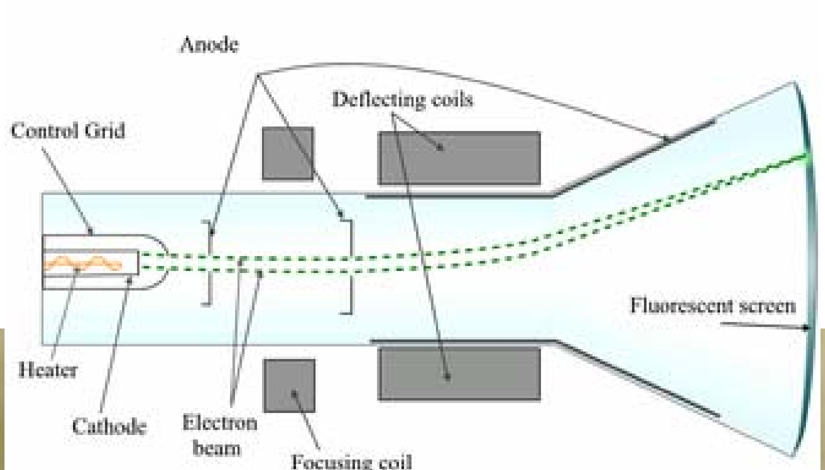
- Não emite luz
- Opacidade controlada através do alinhamento de moléculas orgânicas longas sob a presença de campo elétrico.
- Construção
  - Polaróides ortogonais
  - Eletrodos transparentes
  - Camada de cristal líquido
- Baixa voltagem e consumo
- Sensível à temperatura e corrente DC

LCD – Matriz ativa

- Endereçamento de LCD costuma ser pixel-a-pixel
- Capacitância não segura por tempo suficiente para realizar uma varredura
- TFT (thin film transistors), um por pixel, que podem ser ligados ou desligados
- Luz é provida por lâmpada fluorescente
- Cor é obtida por filtros e o pixel é produzido por um conjunto de elementos do LCD
- Imagens em movimento deixam rastro

CRT – Tubos de raios catódicos

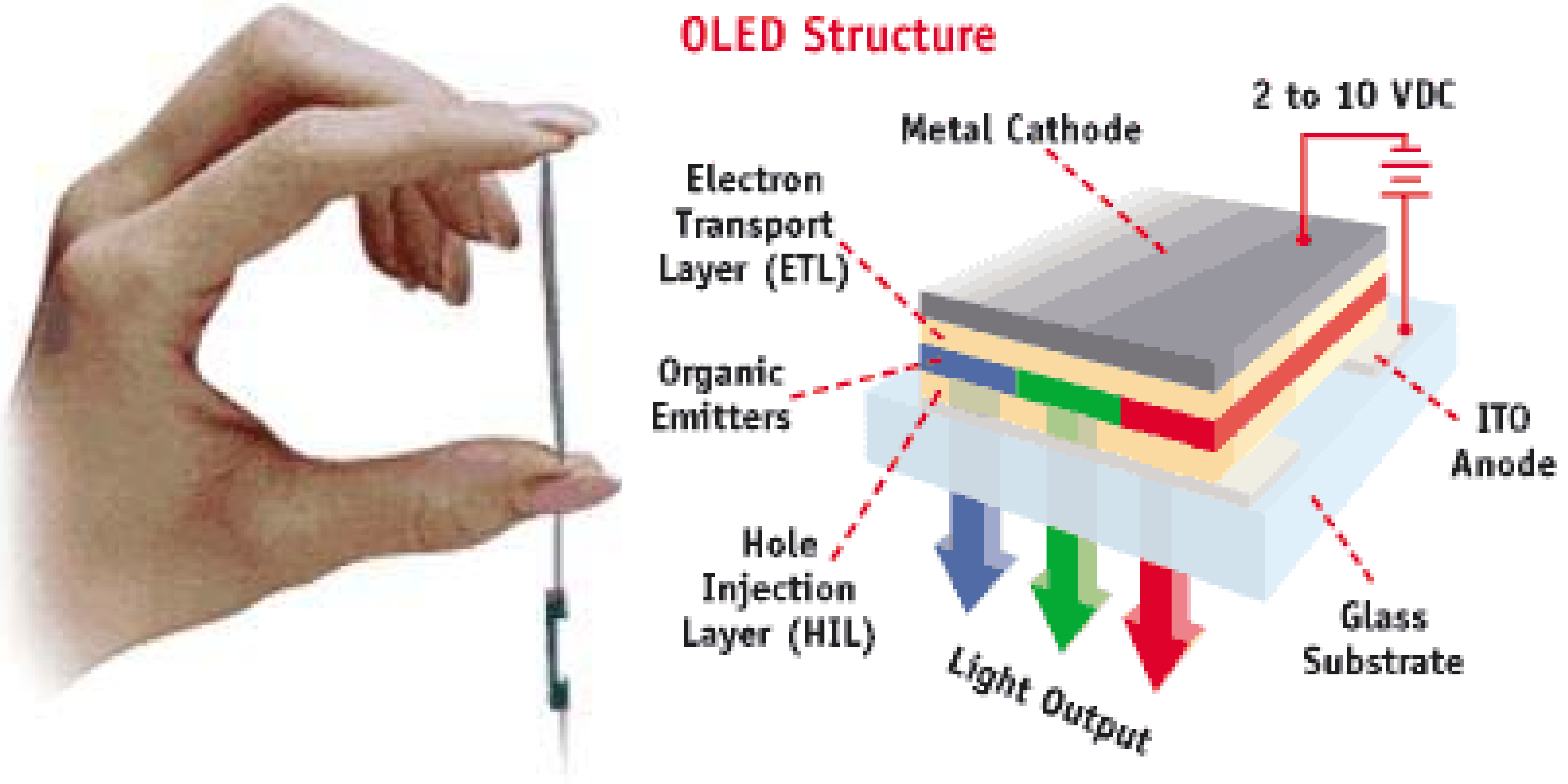
- Máscara de Sombra
  - Fósforos de 3 cores arrumados em tríades
  - 3 canhões, um para cada cor com placa metálica perfurada pra garantir que atinge a cor apropriada
- Indexação de Raios
  - Um canhão, 3 cores de fósforo
  - Varredura, alinhar no tempo o canhão e o pixel
  - Display mais claro
- Problema
  - Emissão de Raios-X



OLED

- **In an active-matrix OLED display, each individual pixel can be addressed independently via the associated TFT's and capacitors in the electronic back plane. That is, each pixel element can be selected to stay "on" during the entire frame time, or duration of the video. Since OLED is an emissive device, the display aperture factor is not critical, unlike LCD displays where light must pass through aperture.**
- **Therefore, there are no intrinsic limitations to the pixel count, resolution, or size of an active-matrix OLED display, leaving the possibilities for commercial use open to our imaginations. Also, because of the TFT's in the active-matrix design, a defective pixel produces only a dark effect, which is considered to be much less objectionable than a bright point defect, like found in LCD's.**

OLED



OLED Structure
2 to 10 VDC
Metal Cathode
Electron Transport Layer (ETL)
Organic Emitters
Hole Injection Layer (HIL)
ITO Anode
Glass Substrate
Light Output

OLED

- Robust Design - OLED's are tough enough to use in portable devices such as cellular phones, digital video cameras, DVD players, car audio equipment and PDA's.
- Viewing Angles – Can be viewed up to 160 degrees, OLED screens provide a clear and distinct image, even in bright light.
- High Resolution – High information applications including videos and graphics, active-matrix OLED provides the solution. Each pixel can be turned on or off independently to create multiple colors in a fluid and smooth edged display.
- "Electronic Paper" – OLED's are paper-thin. Due to the exclusion of certain hardware goods that normal LCD's require, OLED's are as thin as a dime.
- Production Advantages – Up to 20% to 50% cheaper than LCD processes. Plastics will make the OLED tougher and more rugged. The future quite possibly could consist of these OLED's being produced like newspapers, rather than computer "chips".
- Video Capabilities – They hold the ability to handle streamlined video, which could revolutionize the PDA and cellular phone market.
- Hardware Content – Lighter and faster than LCD's. Can be produced out of plastic and is bendable. Also, OLED's do not need lamps, polarizers, or diffusers.
- Power Usage – Takes less power to run (2 to 10 volts).

Papel eletrônico

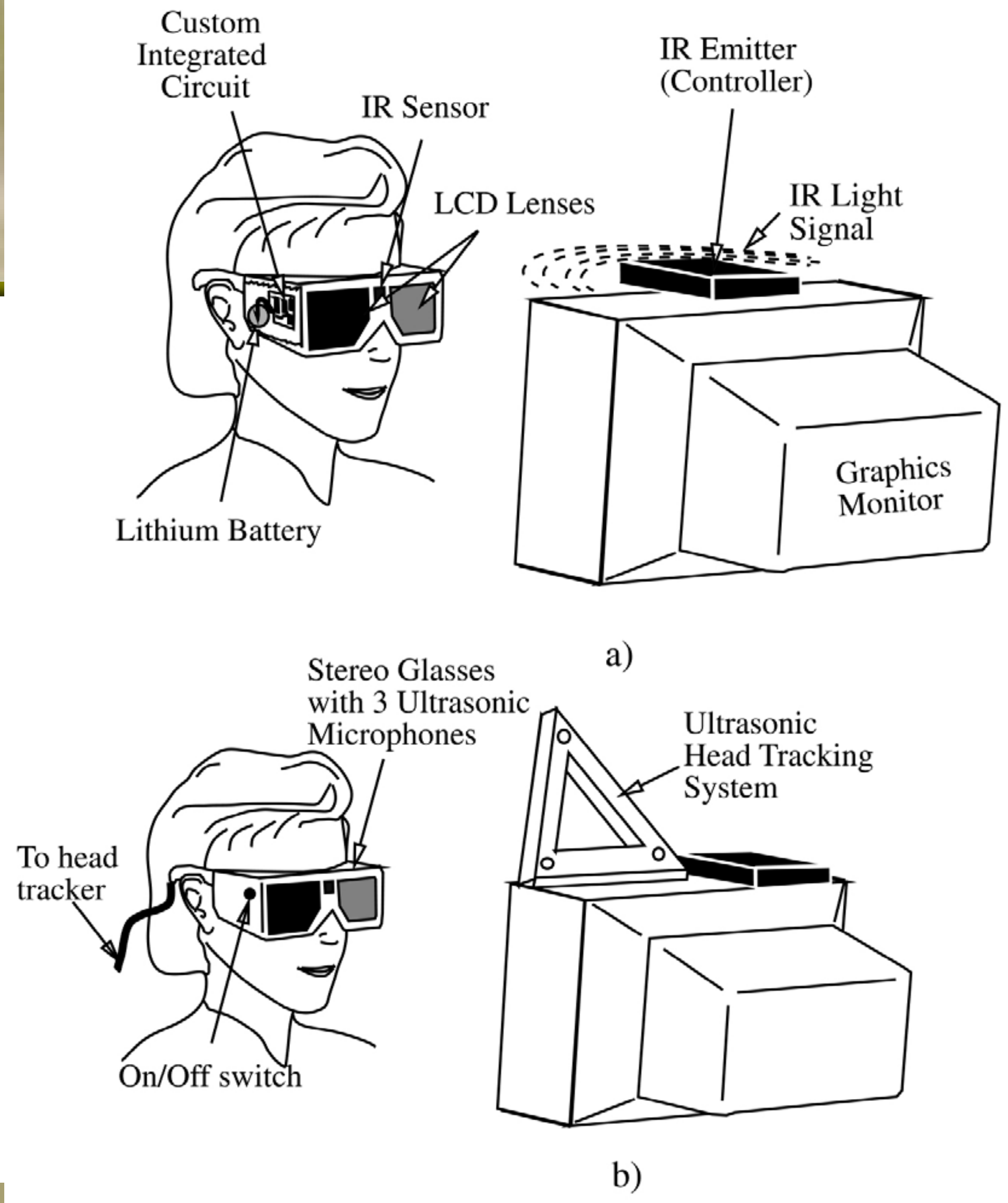
- **Electronic paper**, or e-paper, is a technology that allows the text on a piece of paper to be re-written. The "paper" is actually made of organic electronics that use conductive plastic which contains tiny balls that respond to an electric charge, changing the page in much the same way that pixels change on a computer monitor.

Shutters

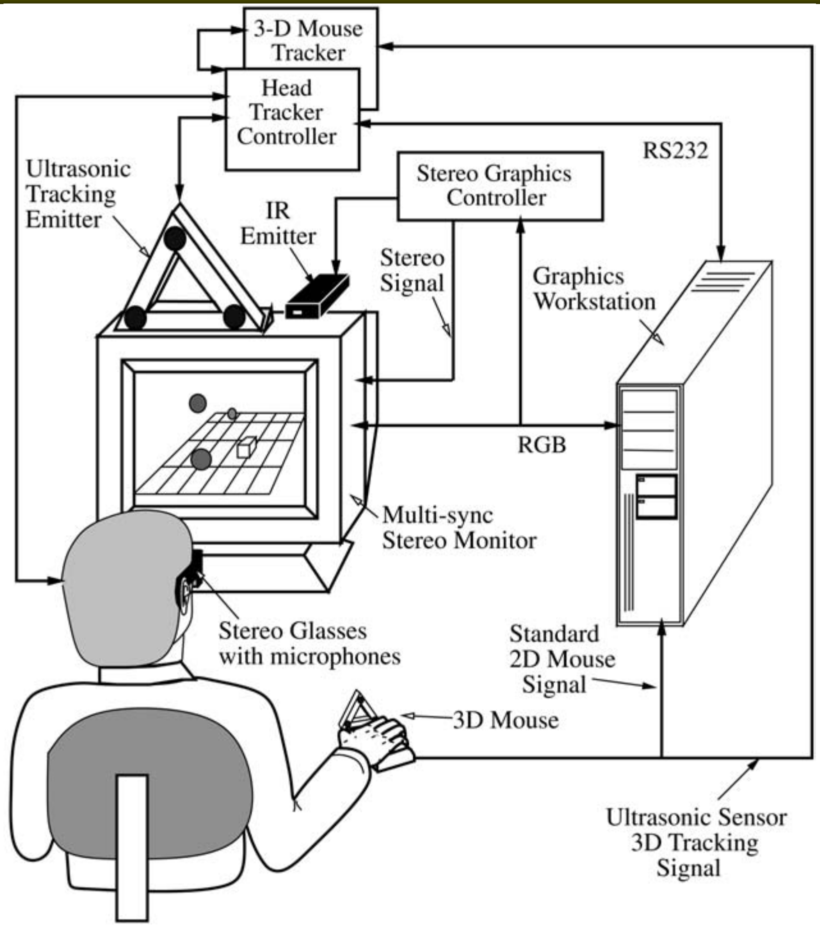
- Some advantages:
- no cables if head position is not tracked;
- light and ergonomic (can be used over vision glasses);
- work well with large volume displays.
- allows full screen resolution 1280x1024

- Some disadvantages:
- lose 2/3 of image light intensity through LCD filtering;
- require special CRT "stereo ready" that has twice
- the hardware refresh rate (Hz) 120 Hz or more;
- require direct line of sight for IR controller;
- different viewing metaphor "through the window".

Shutters


Custom Integrated Circuit
IR Sensor
IR Emitter (Controller)
LCD Lenses
IR Light Signal
Lithium Battery
Graphics Monitor
a)
Stereo Glasses with 3 Ultrasonic Microphones
Ultrasonic Head Tracking System
To head tracker
On/Off switch
b)

Shutters



3-D Mouse Tracker
Head Tracker Controller
RS232
Stereo Graphics Controller
Ultrasonic Tracking Emitter
IR Emitter
Stereo Signal
Graphics Workstation
RGB
Multi-sync Stereo Monitor
Stereo Glasses with microphones
Standard 2D Mouse Signal
3D Mouse
Ultrasonic Sensor 3D Tracking Signal

Projetores

- Tubo de Raios Catódicos
- Válvula de luz
- Scanner Laser
- DMD Digital Micromirror Devices

Tubo de Raios Catódicos

- Projeção
  - Maior consumo
  - Dissipar calor
  - Fósforo mais brilhante
  - EHT (extra high tensions)

Válvula de luz

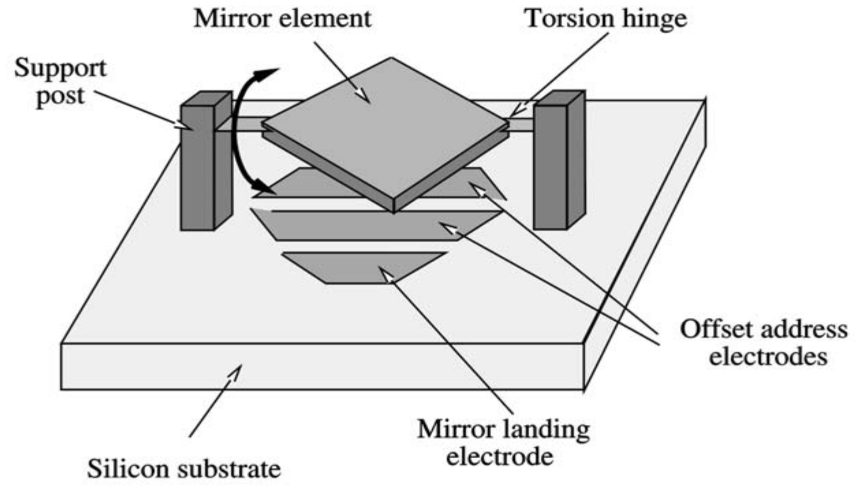
- Alto brilho
- Controlar a luz através de transparência ou reflexão
- Célula de cristal líquido com fotossensores ativada por imagem de CRT fica transparente nos pixels em que foi ativada, permitindo a passagem da luz emitida por uma fonte de alto brilho.

Scanner laser

- Fonte laser e espelho rotatório
- Alto brilho e resolução

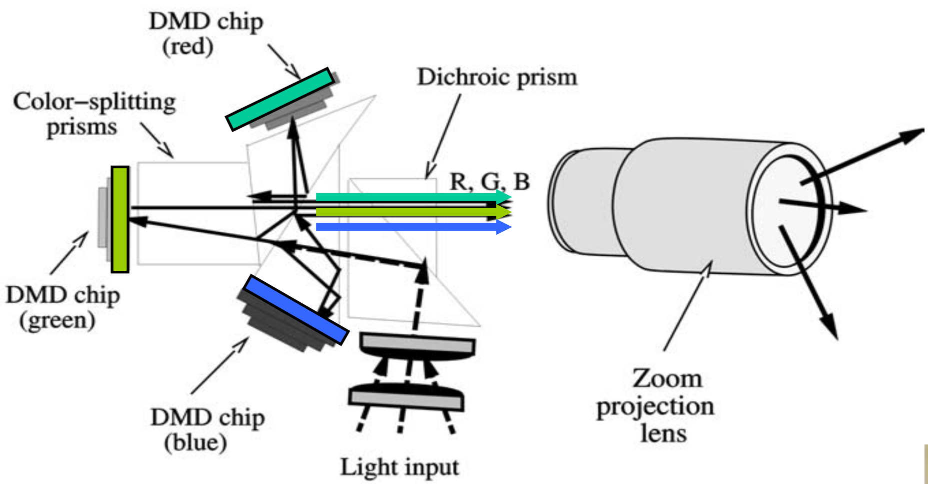
Dispositivos Micromecânicos

Digital Micro-mirror Device Display



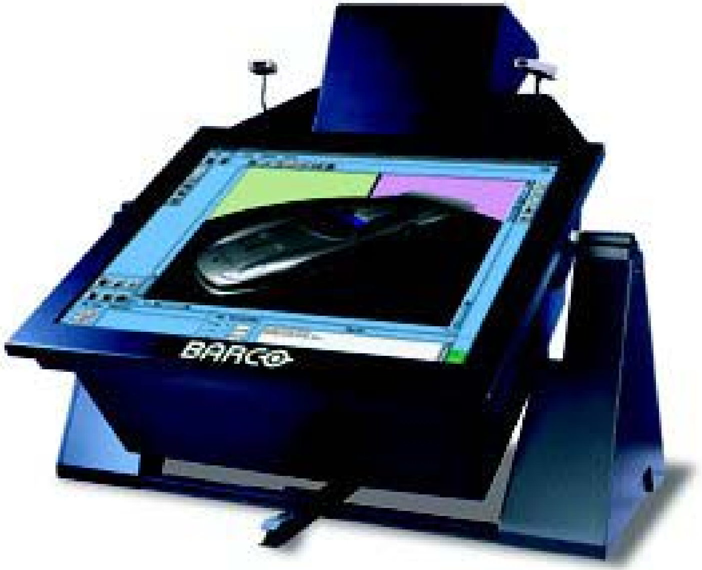
a)

Light intensities are much larger than for CRT-based projectors
300 lumens to 1000 or more lumens
Thus ambient light does not hinder image quality



b)

Dispositivos Micromecânicos



Dispositivos Micromecânicos

- Texas Instruments – Digital Light Processing
- Design de 1-chip: roda colorida, cor multiplexada no tempo, causa um efeito arco-íris.
- Design de 3 –chips: combinação por prisma

LCOS – LC em Silício

- Superfície refletora e Cristal Líquido

Imagem retinal

- HIT labs – Universidade de Washington

Display de Nanotubos

Nanotubes enter flat-panel display market

23 May 2005

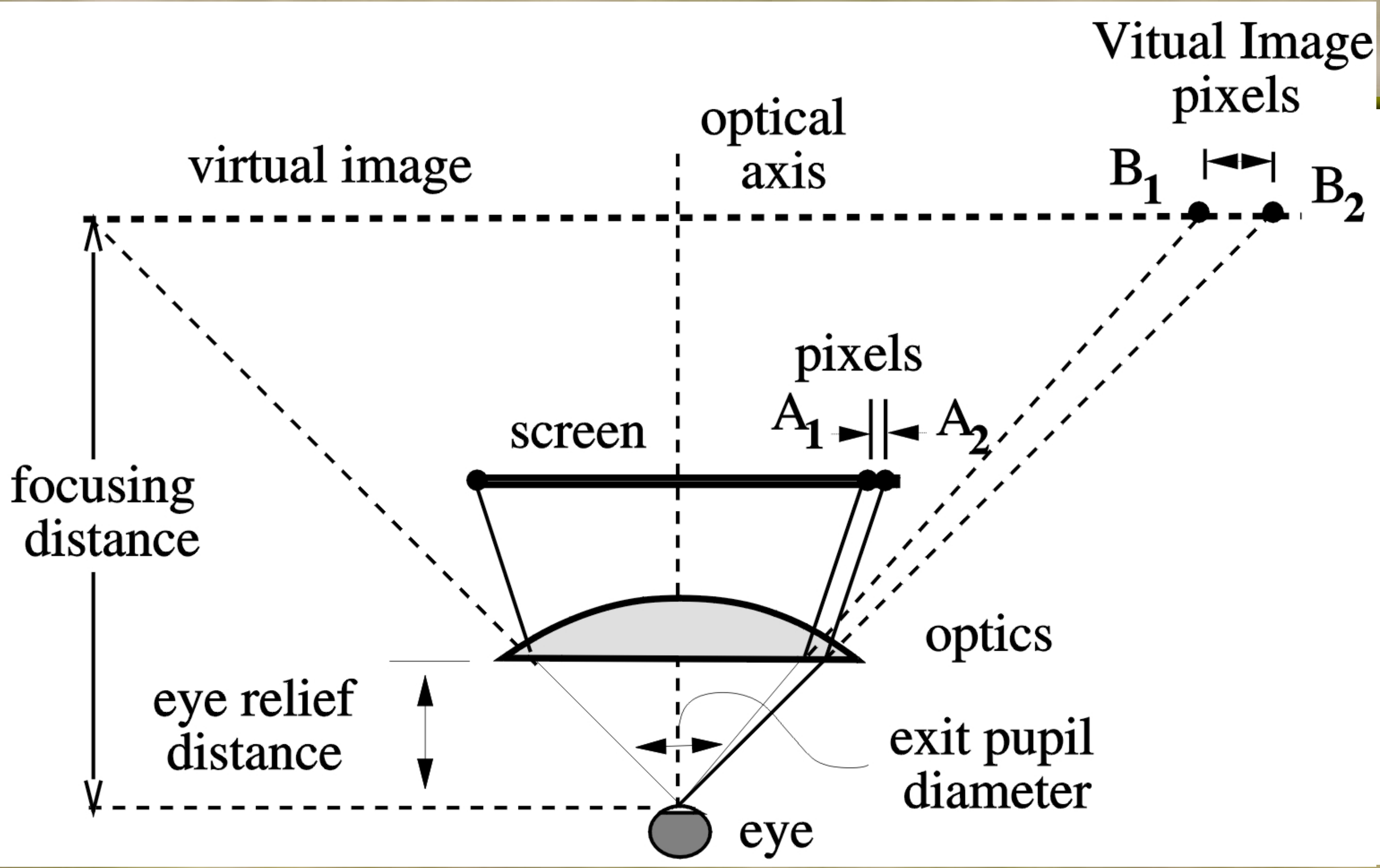
LCD, plasma and OLED displays could soon have a new challenger. Motorola Labs, the applied research arm of Motorola, has unveiled a prototype nano-emissive display (NED) based on carbon nanotubes.

Sistemas de displays

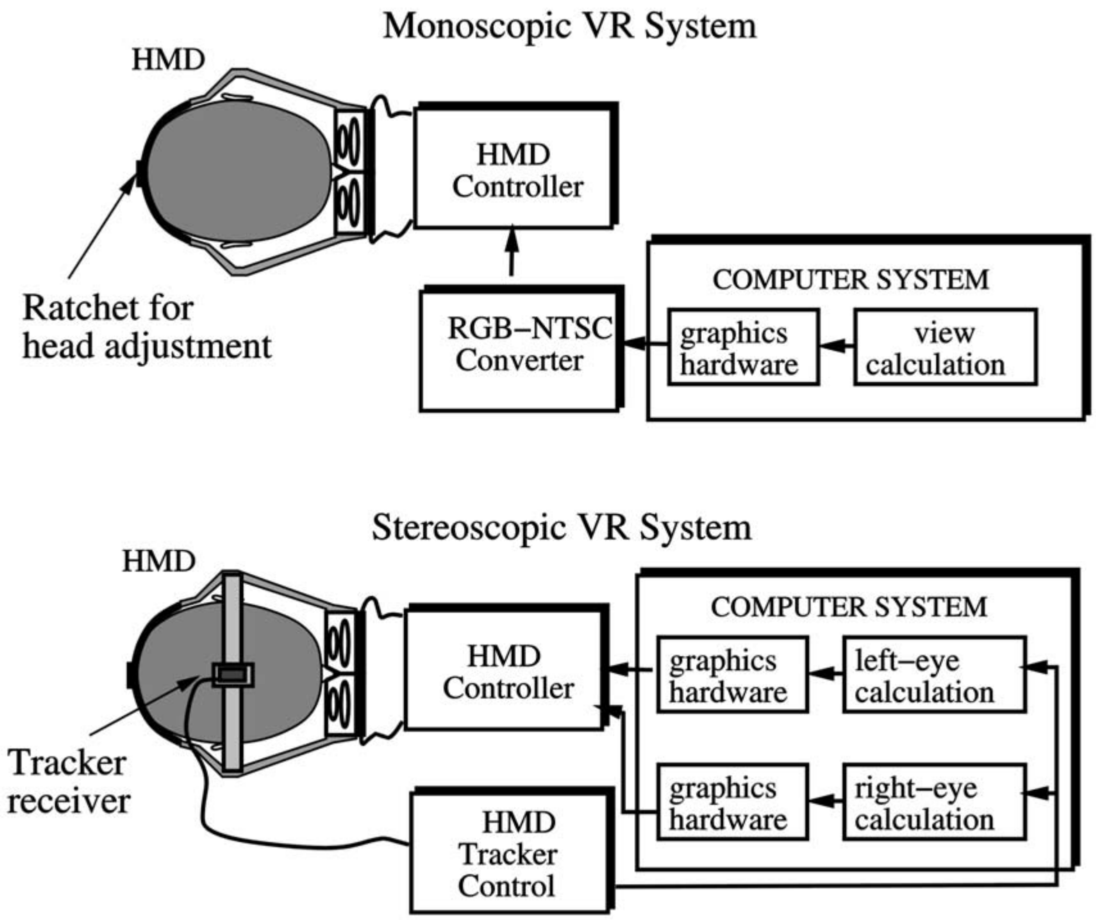
- HMDs
- Binóculos, Telescópios, Microscópios ...
- BOOM
- CAVE
- etc

HMD

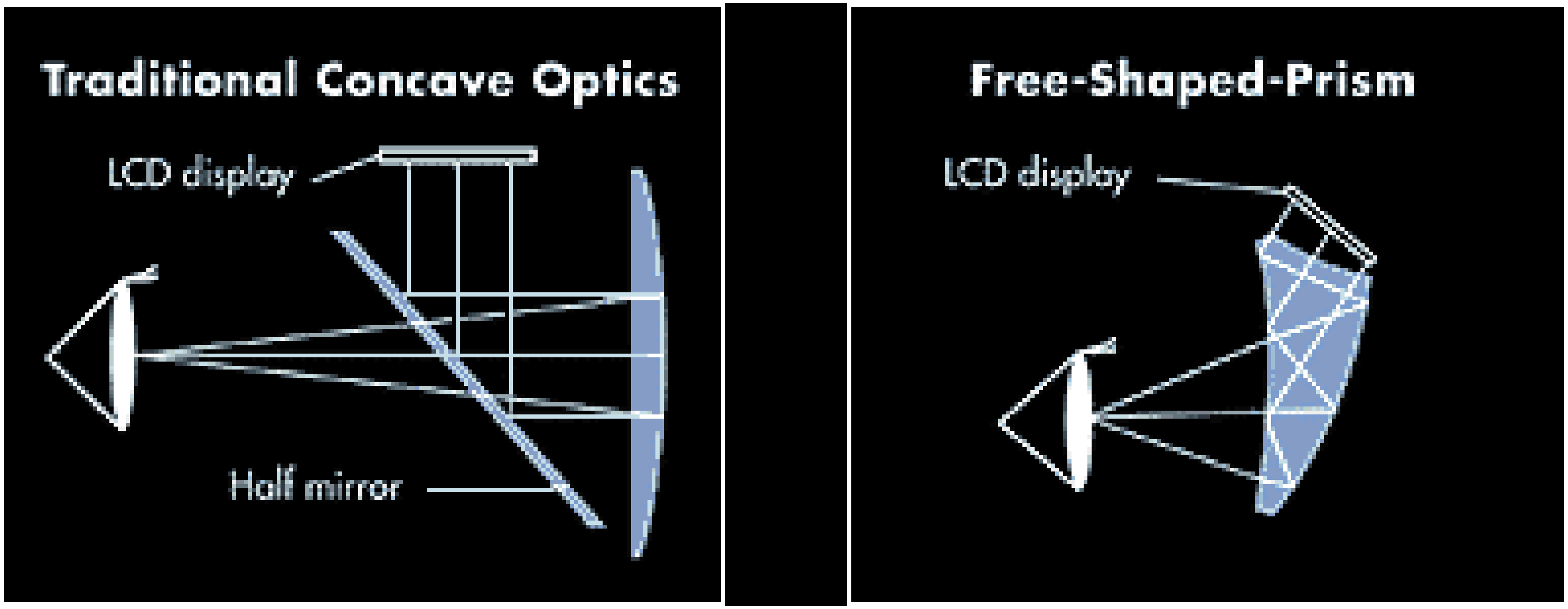
HMD


Vitual Image
pixels
virtual image
optical
axis
B1
B2
pixels
A1
A2
screen
focusing
distance
optics
eye relief
distance
exit pupil
diameter
eye

HMD


Monoscopic VR System
HMD
HMD Controller
COMPUTER SYSTEM
Ratchet for head adjustment
RGB–NTSC Converter
graphics hardware
view calculation
Stereoscopic VR System
HMD
COMPUTER SYSTEM
HMD Controller
graphics hardware
left–eye calculation
Tracker receiver
graphics hardware
right–eye calculation
HMD Tracker Control

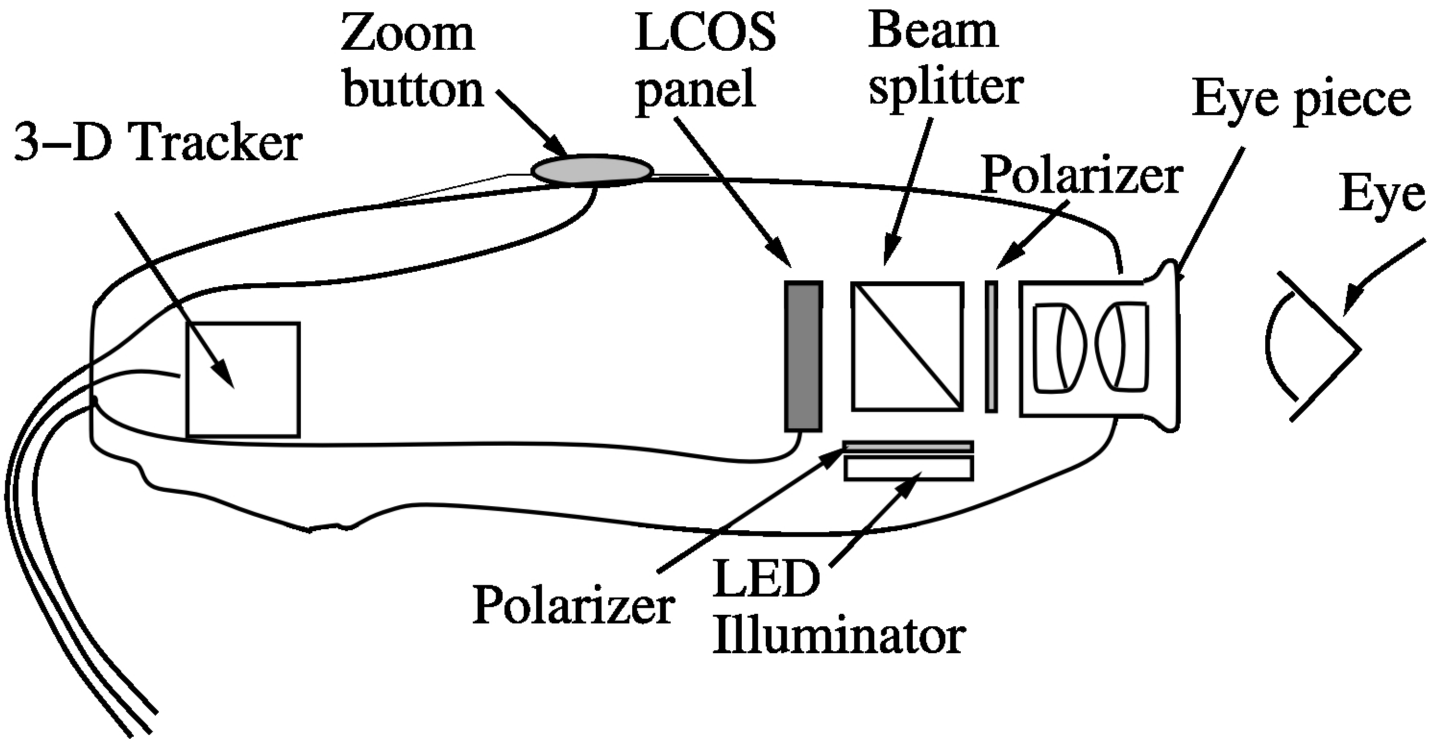
HMD


Traditional Concave Optics
LCD display
Half mirror
Free-Shaped-Prism
LCD display

HMD

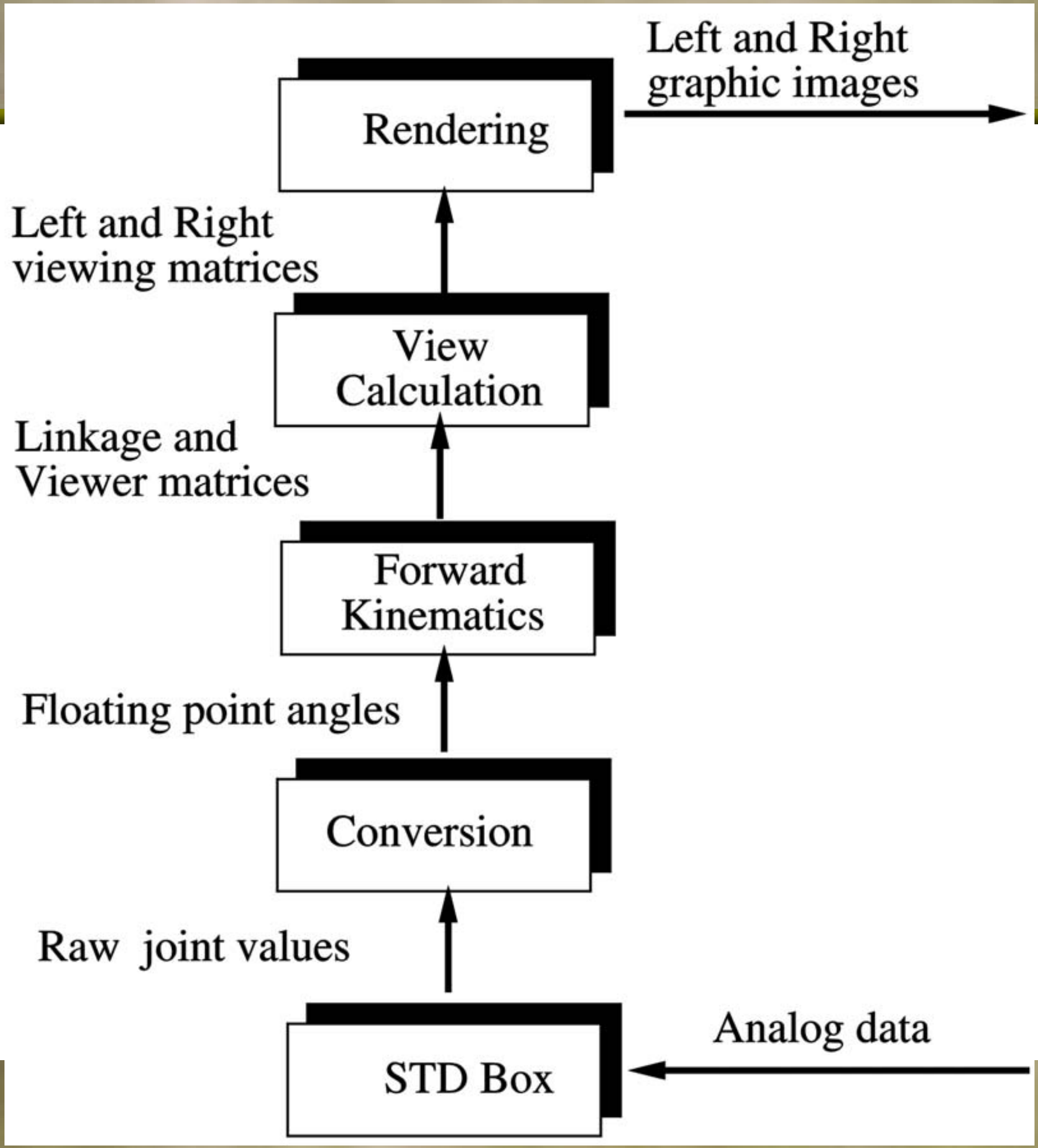
Samsung Emagin z800 OLED HMD
Weight 8 oz
PC connection - USB, RGB input
SVGA resolution (800x600 pixels) stereo
Tracking - 360 degrees pan
60 degrees pitch
899 USD www.3dvisor.com

Binóculo



Zoom
button
LCOS
panel
Beam
splitter
Eye piece
3–D Tracker
Polarizer
Eye
Polarizer
LED
Illuminator

BOOM

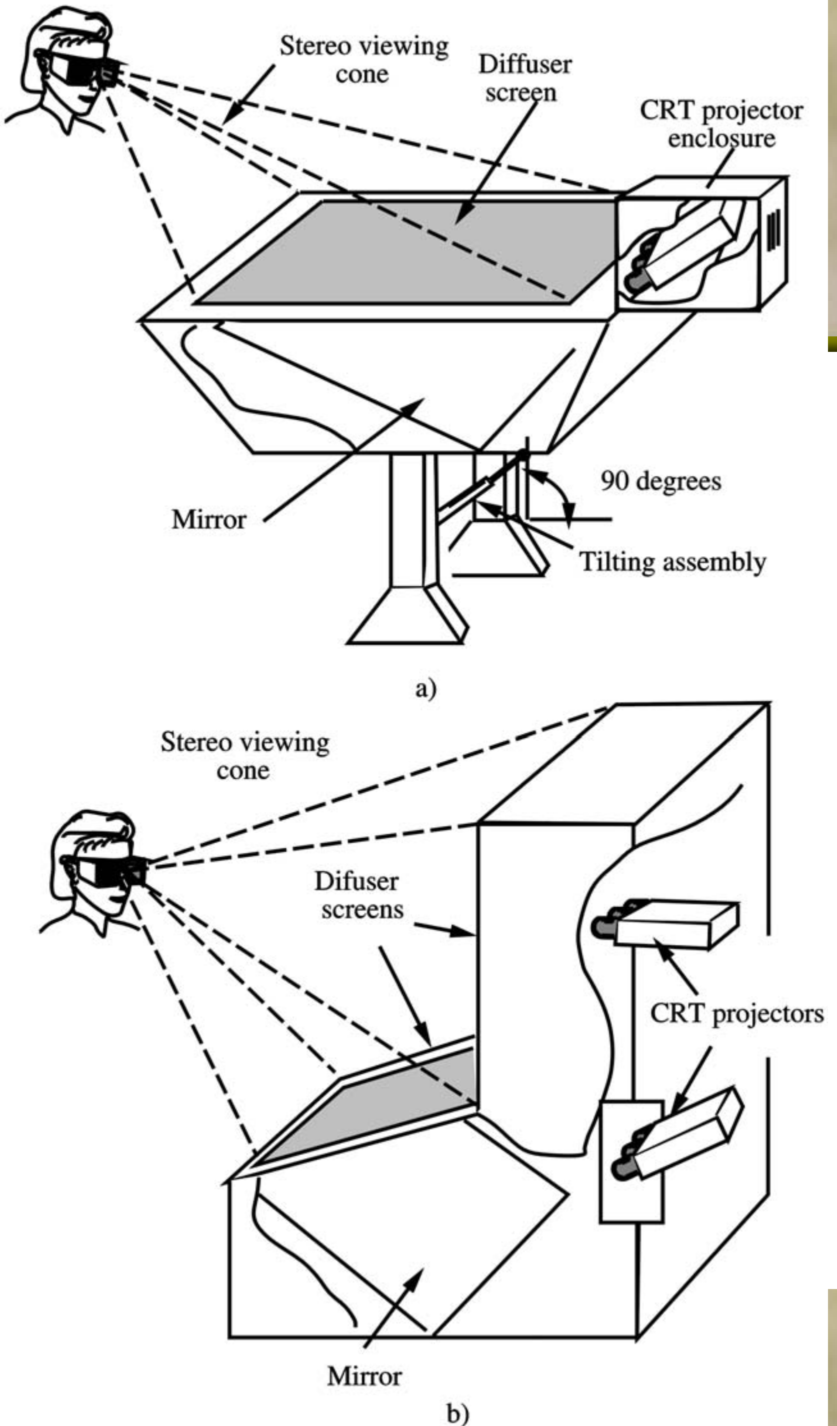

Left and Right
graphic images
Rendering
Left and Right
viewing matrices
View
Calculation
Linkage and
Viewer matrices
Forward
Kinematics
Floating point angles
Conversion
Raw joint values
STD Box
Analog data

BOOM

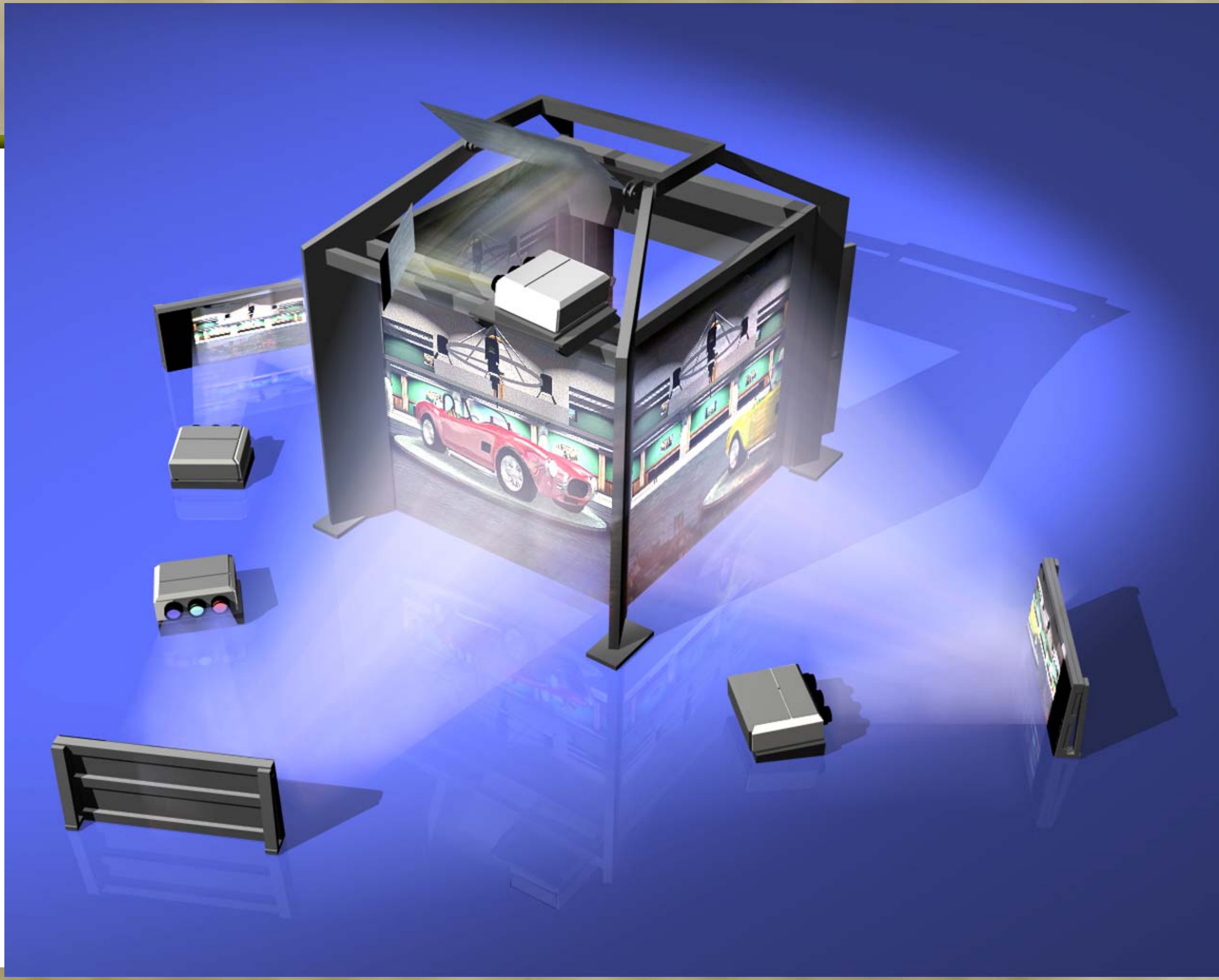
- Binocular Omni-Orientation Monitor
  - Contrapeso
  - Rastreio opto-mecânico
  - 6 graus de liberdade
  - Preciso
  - Monousuário
  - Ocupa as mãos
  - Usuário pode interagir por teclado

BOOM-like

Workbenches



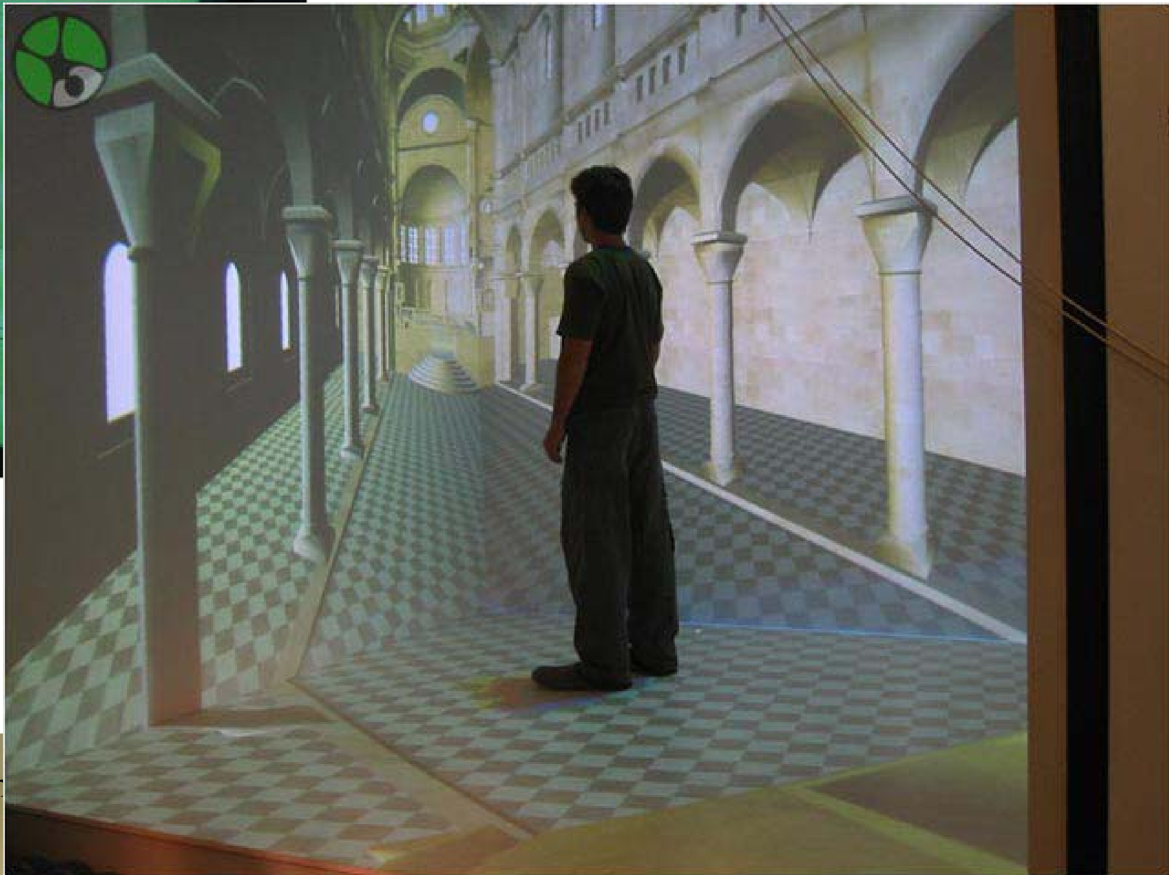
CAVE



CAVE

- A **Cave Automatic Virtual Environment** (better known by the recursive acronym **CAVE**) is an immersive virtual reality environment where projectors are directed to four, five or six of the walls of a room-sized cube. The name is also a reference to "The Simile of the Cave" in Plato's Republic where a philosopher contemplates perception, reality and illusion.
- The first CAVE was developed in the Electronic Visualization Lab at University of Illinois and was announced and demonstrated at the 1992 SIGGRAPH.

CAVE na USP



Displays Largos

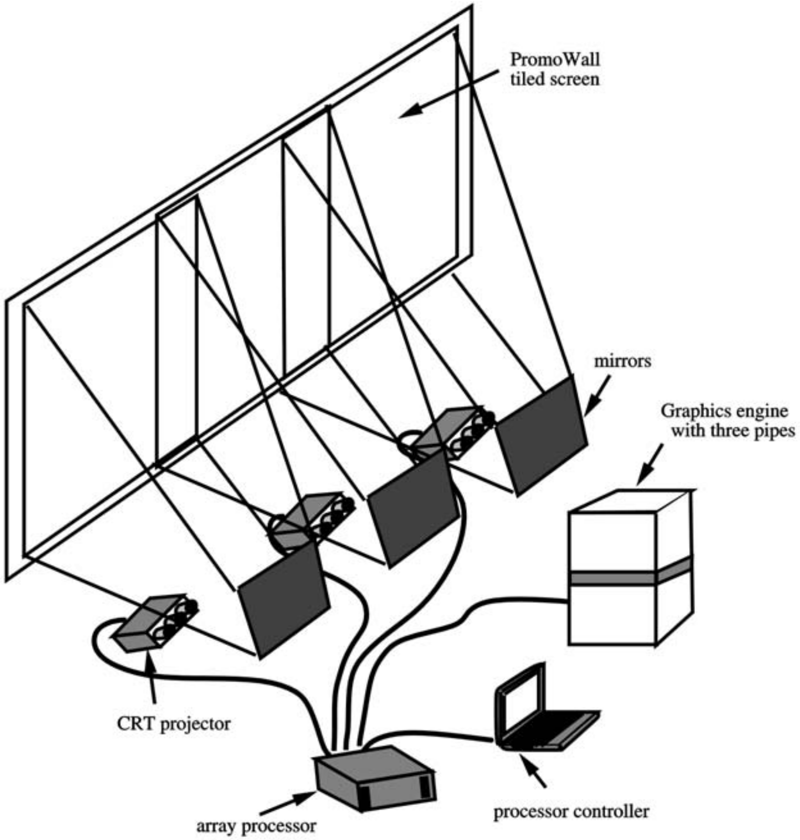
- Large Volume Displays
  - Allow several co-located users to view a monoscopic or stereoscopic view of the virtual world;
  - Can be classified as *monitor*-based large
  - volume displays or *projector*-based large
  - volume displays.
  - Allow more freedom of motion vs. personal displays.

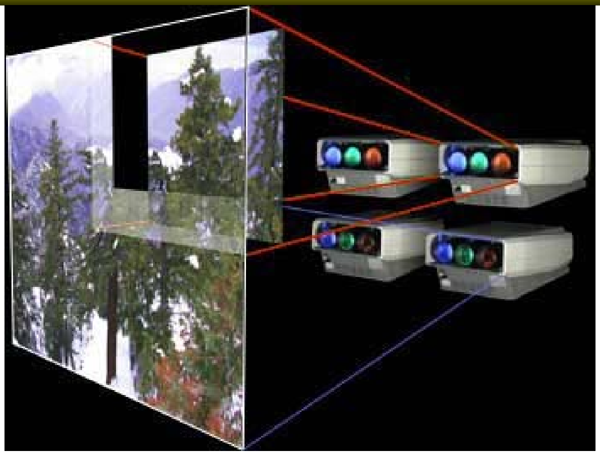
Monitor-based Large Volume Displays

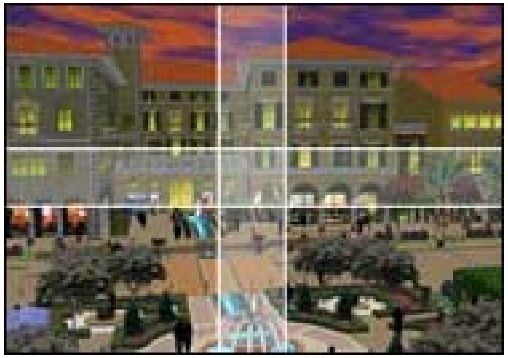
- Use active or passive glasses;
- Several users can look at a monitor;
- Can have a *single* monitor, or *multiple* side-by-side monitors;
- If side-by-side, image continuity becomes an issue.

Múltiplas telas

Múltiplos projetores







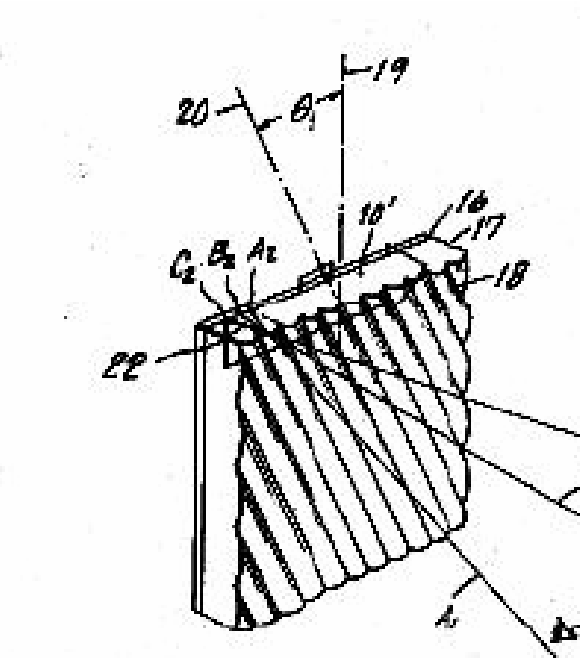
Desktop VR

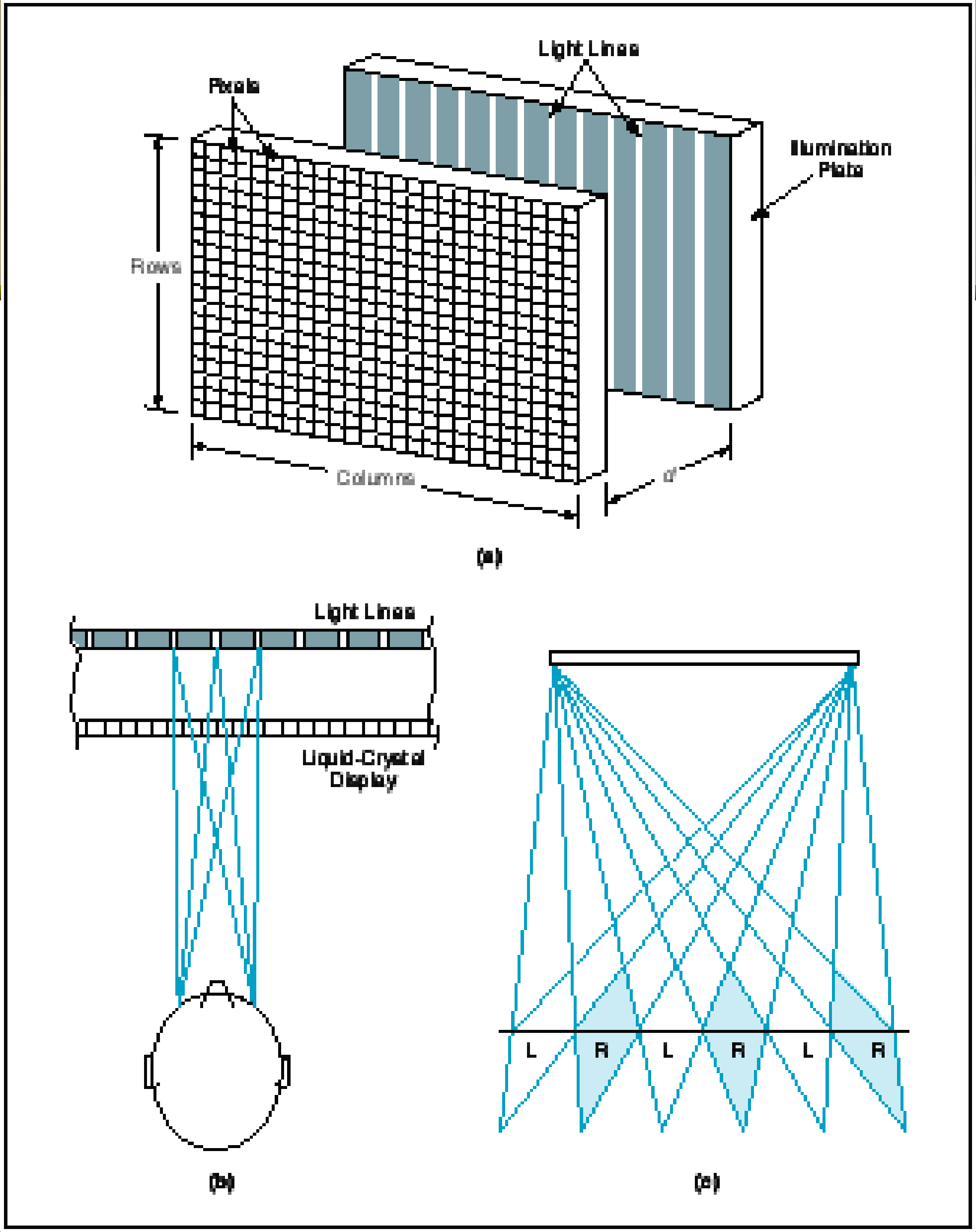
- Fish-tank VR
- Baseada em tela 3D ou visão estéreo com shutters

Outros

- Powerwalls
- Workbenches
- Reality centre
- Chamelleon
- Microscópios
- Telescópios

Displays 3D




Light Lines
Pixels
Illumination Plate
Rows
Columns
d
(a)
Light Lines
Liquid-Crystal Display
(b)
L
R
L
R
L
R
(c)

Displays 3D

Active tracking accommodates ±25 degrees change in view direction