COMPUTER GRAPHICS HARDWARE

WHAT'S IN STORE

GRAPHICS CARDS

GRAPHICS CARDS

DEDICATED (EXTERNAL)

High performance
Power consumption
Heat emission

INTEGRATED (INTERNAL)

Low power, low heat
Mobile devices, on board
Integrated with CPU

ARCHITECTURE

VERTEX SHADERS (TRANSFORM GEOMETRY)
GEOMETRY SHADERS (CREATE NEW GEOMETRY)
PIXEL SHADERS (COLORS, SHADOWS...)

UNIFIED SHADERS

One type of processors for all operations
GTX 680 = 1536 unified shader cores

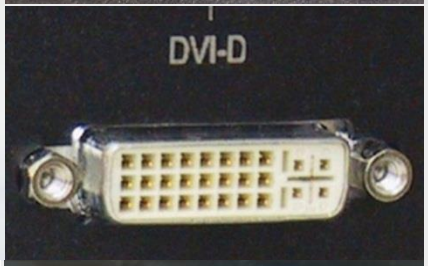
CUDA, GPGPU

General (not only graphics) performed on GPU
Parallelism (HW video encoding, numerical computations)

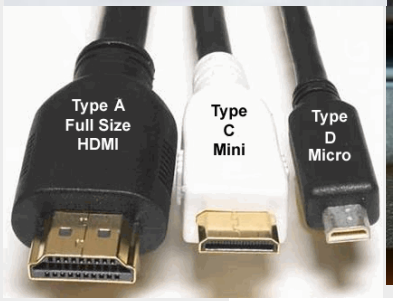
CONNECTORS

VGA
Analog

DVI
Digital + Analog



HDMI
Digital
miniHDMI, microHDMI



DISPLAYPORT
Digital, Analog
Mini DisplayPort (Apple)

MANUFACTURERS

NVIDIA
GeForce, Quadro, Tesla

AMD (FORMERLY ATI)
Radeon, FirePro

INTEL
Integrated in Core CPUs

POWERVR

ARM
Mali

DISPLAYS

CATHODE RAY TUBE (CRT)

CATHODE RAY TUBE (CRT)

ANALOG TVS

OLD COMPUTER MONITORS

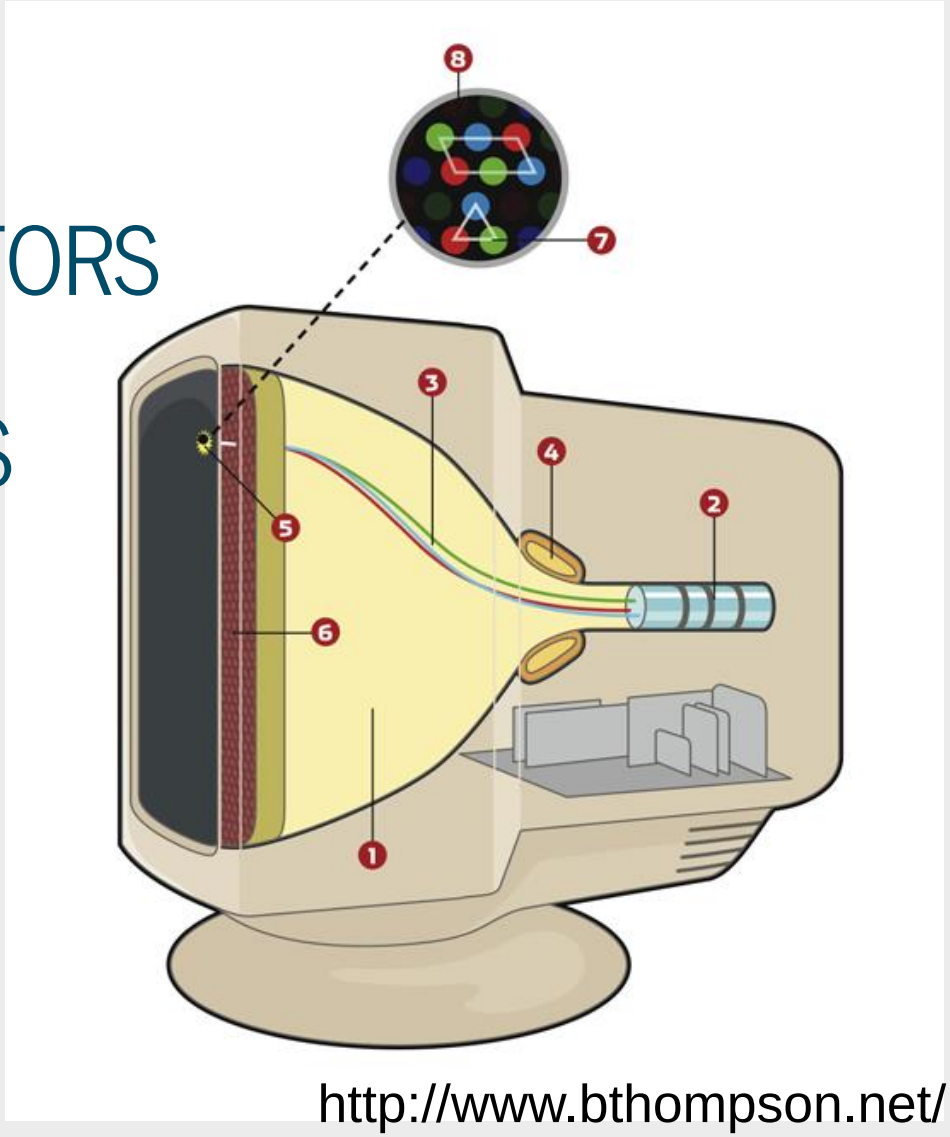
MEDIUM SIZE DISPLAYS

LIGHT EMISSION

Black is black

FLICKER

75-100 Hz for work



http://www.bthompson.net/

PLASMA (PDP, NEO-PDP)

NOT SUITABLE FOR COMPUTER DISPLAYS

LARGE SCREENS (30”+)

LIGHT EMISSION

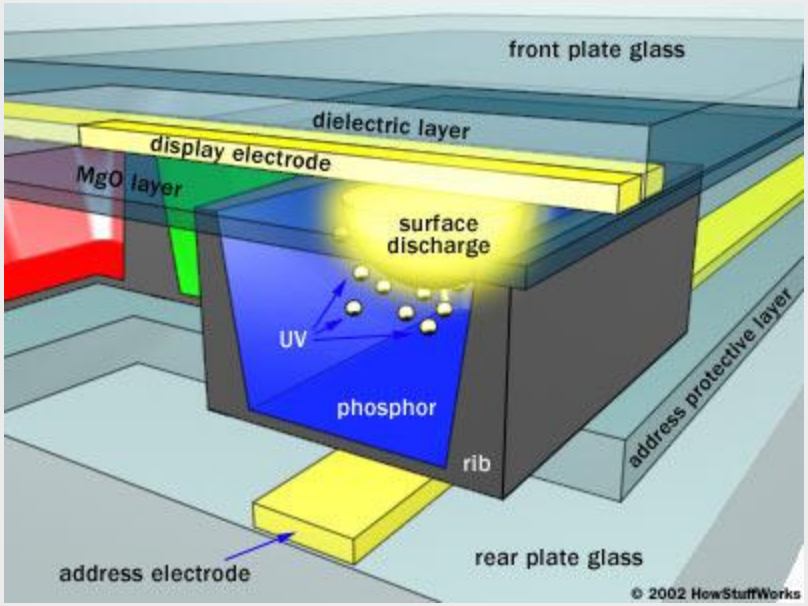
Black is black

HIGH ENERGY DEMANDS

VIEW ANGLE DOESN’T MATTER

IMAGE RETENTION

Reduced for Neo-PDP



LIQUID CRYSTAL DISPLAY (LCD)

CRYSTALS BLOCK LIGHT FROM BACK SOURCE

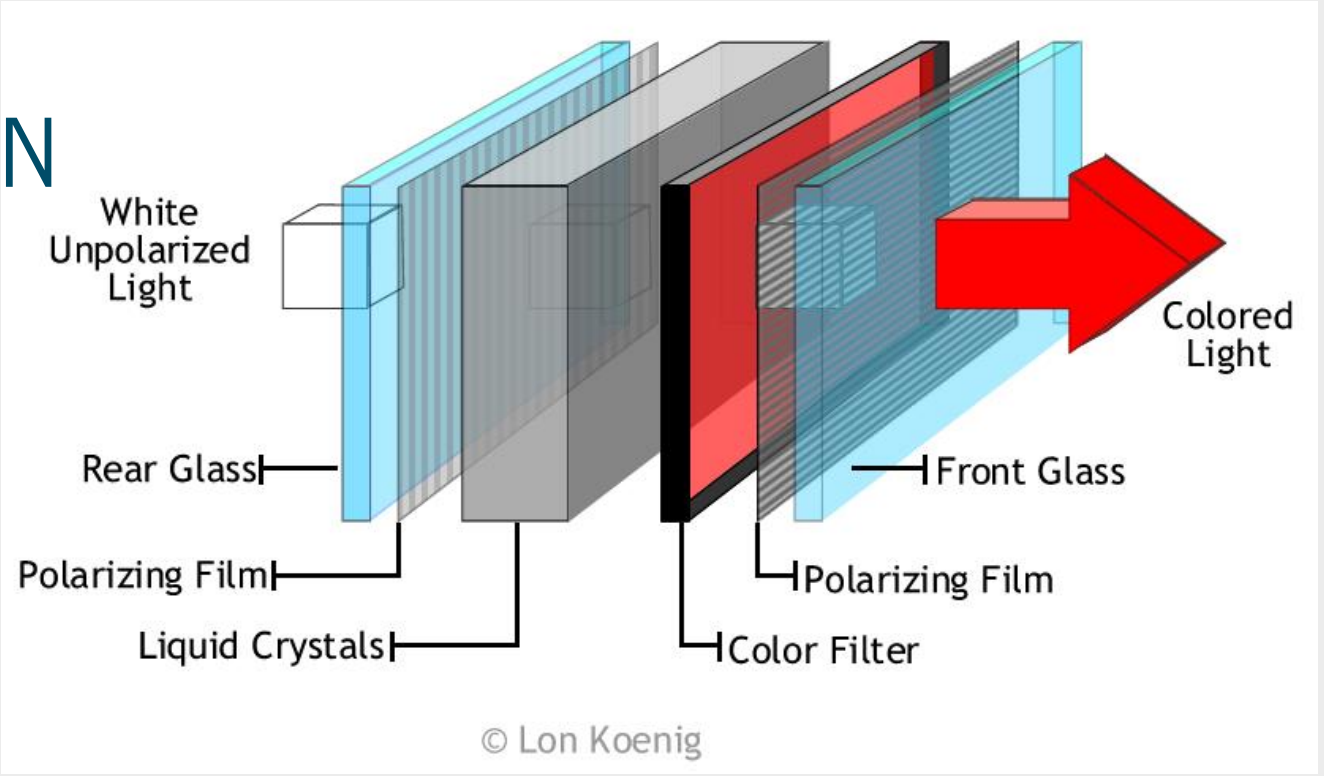
Black is hard to achieve

DIFFERENT TECHNOLOGIES (TN, IPS, MVA, ...)

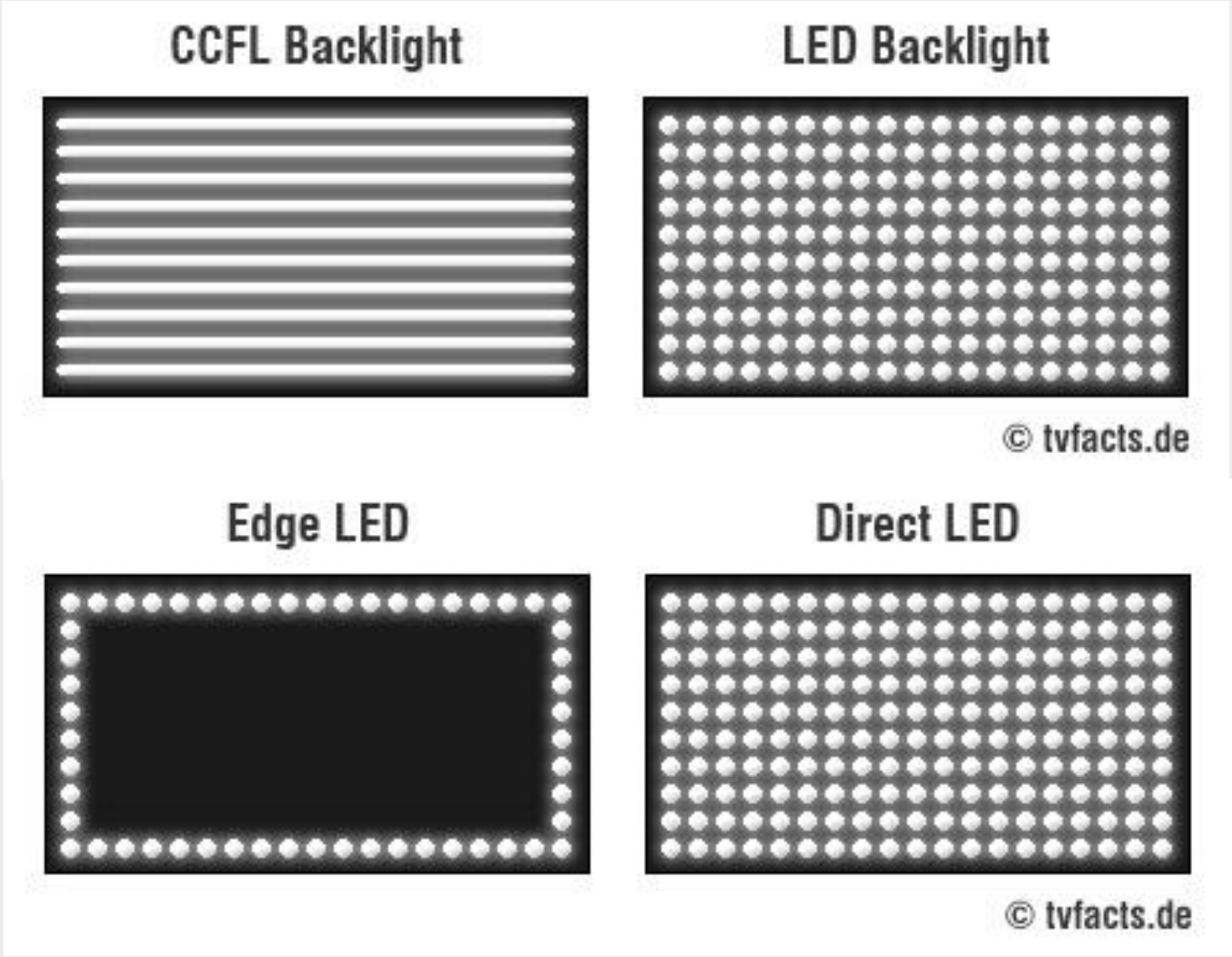
LOW ENERGY CONSUMPTION

LARGE SCREENS

VIEW ANGLES ISSUE



LCD LED CONFUSION



OLED (ORGANIC LIGHT-EMITTING DIODE)

LIGHT EMISSION

GOOD CONTRAST AND COLORS

EXPENSIVE PRODUCTION
Small screens so far

LOW ENERGY

POTENTIALLY FLEXIBLE

VIEW ANGLE DOESN'T MATTER

MANUFACTURERS

PANASONIC, SAMSUNG, LG, PHILIPS, SHARP ...
Consumer

EIZO, IIYAMA
Professional

HEAD MOUNTED DISPLAYS

SEE-THROUGH

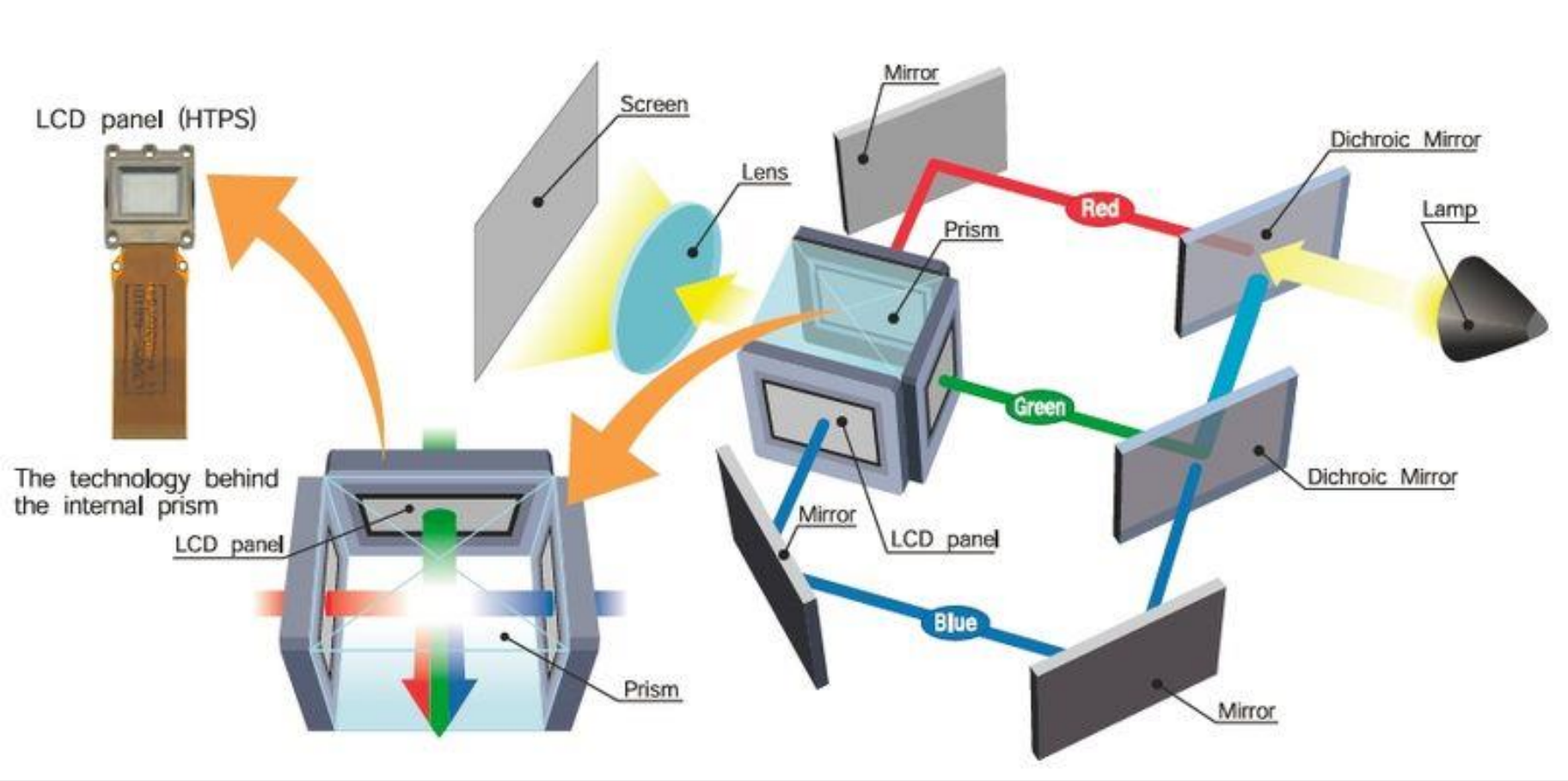
Optical spatial registration
Vuzix, Google Glass

HELMETS

External spatial registration
Or no spatial information

PROJECTION

3LCD

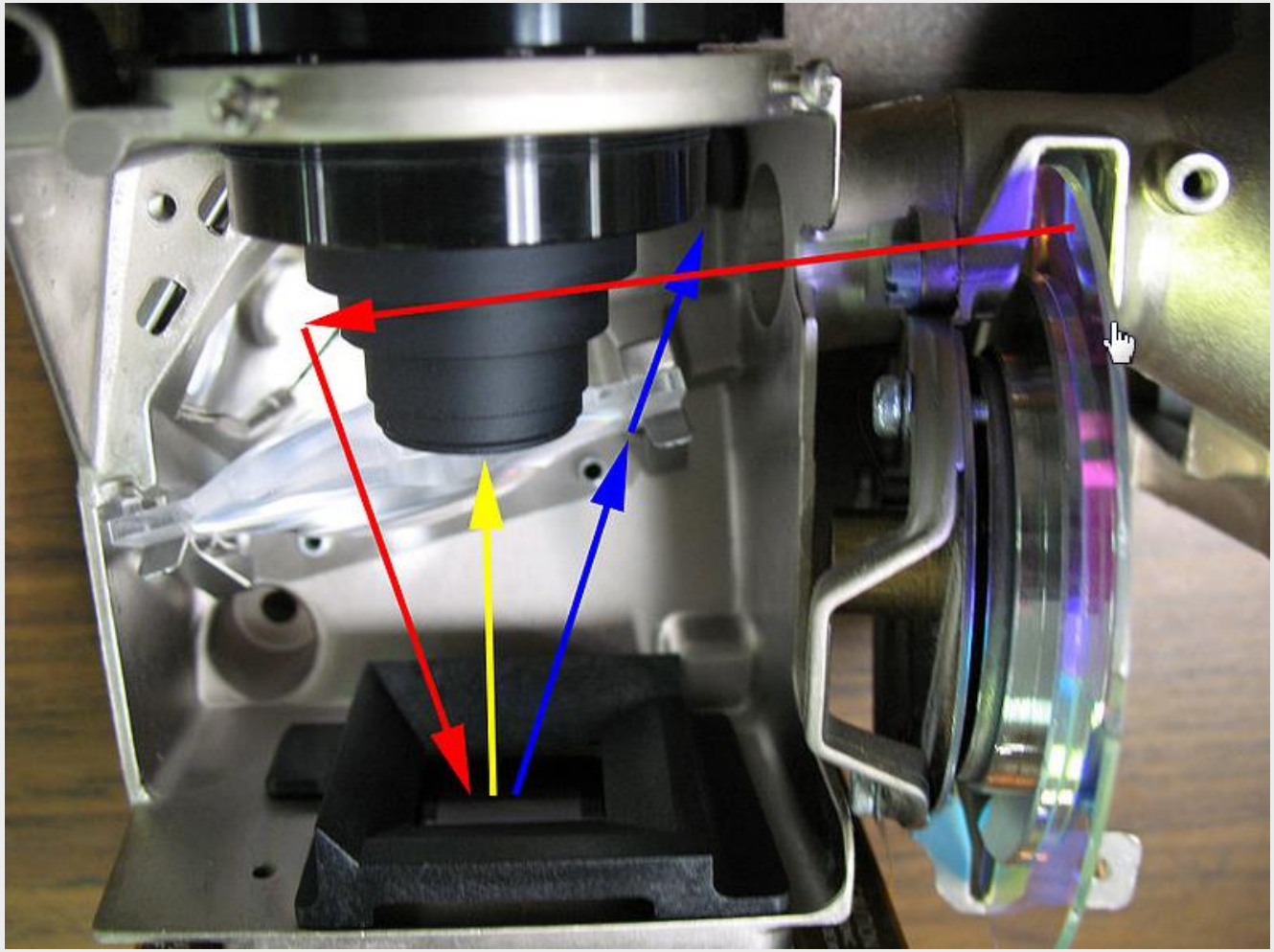

LCD panel (HTPS)
Screen
Lens
Mirror
Dichroic Mirror
Lamp
Red
Prism
Green
Dichroic Mirror
The technology behind
the internal prism
LCD panel
Mirror
LCD panel
Blue
Prism
Mirror

DLP

SINGLE CHIP

THREE CHIPS

CINEMA



MAKE ONE YOURSELF ☺






http://www.youtube.com/watch?v=b7lWqKHpGuc

GRAPHIC TABLETS

PEN TABLET (WACOM INTUOS)

PEN DISPLAY (WACOM CINTIQ)

NATURAL USER INTERFACES

TOUCH-BASED INPUT

REPLACING KEYBOARD/MOUSE

SINGLE TOUCH
MULTI-TOUCH
Up to 32 touch

GESTURES

NATURAL USER INTERFACE (NUI)

http://www.evoluce.com

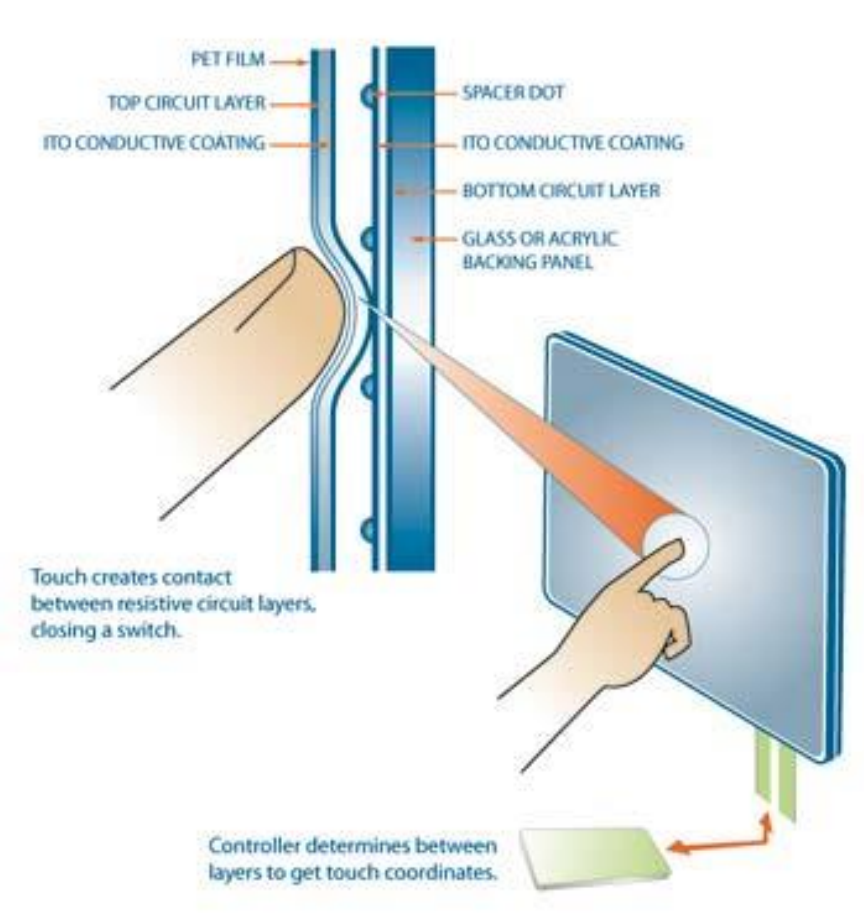
RESISTIVE TOUCH INPUT

ANY OBJECT
Incl. stylus

WEAK MULTI-TOUCH

NO GESTURES

GOOD PRECISION



http://www.planartouch.com/101/select/
http://www.nextwindow.com/optical/comparison.html

CAPACITIVE TOUCH INPUT

ONLY BARE FINGERS

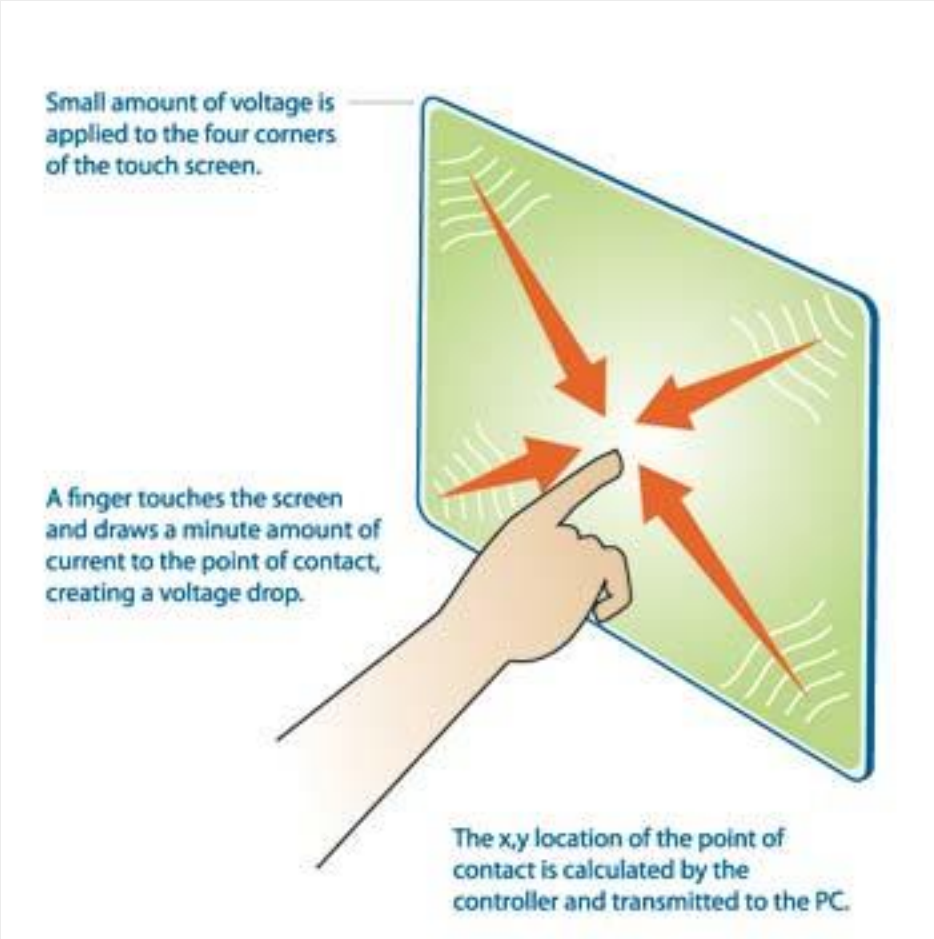
Only special stylus

No gloves

GOOD MULTI-TOUCH

PHONES, TABLETS

LOWER PRECISION



OPTICAL SENSING

ANY OBJECT

NO ADDITIONAL LAYER = DURABLE

MEDIUM PRECISION

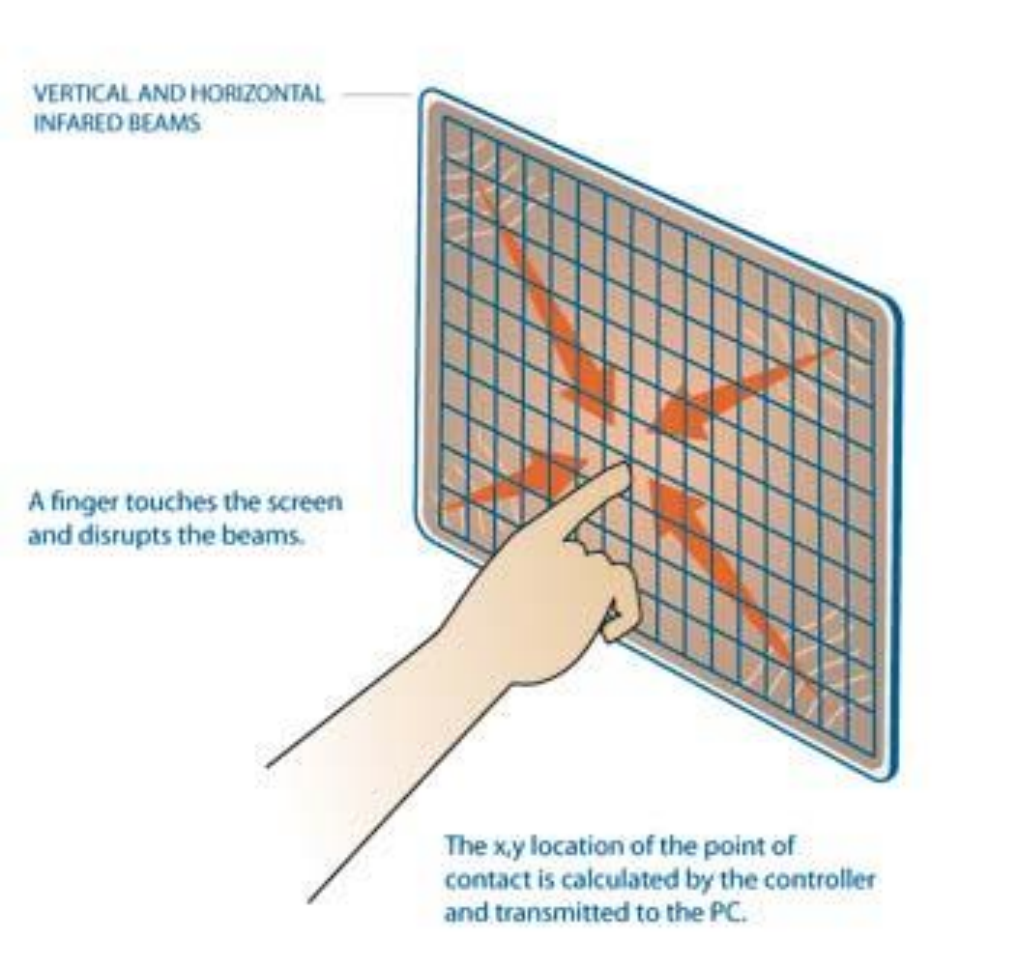
GOOD MULTI-TOUCH

TOUCH AREA SIZE

LARGE SIZES

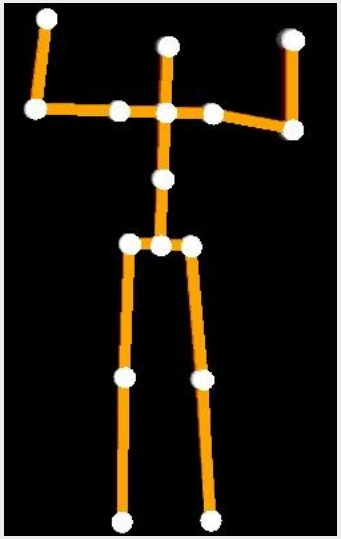
EARLY ACTIVATION

When not touching



KINECT

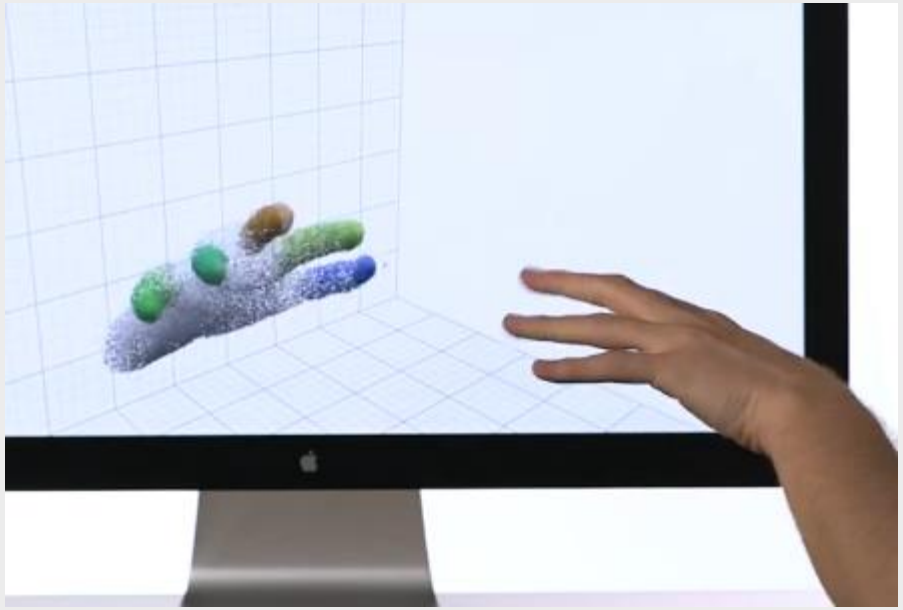
RGB, INFRARED, DEPTH
SKELETON EXTRACTION
FACE & GESTURE
RECOGNITION

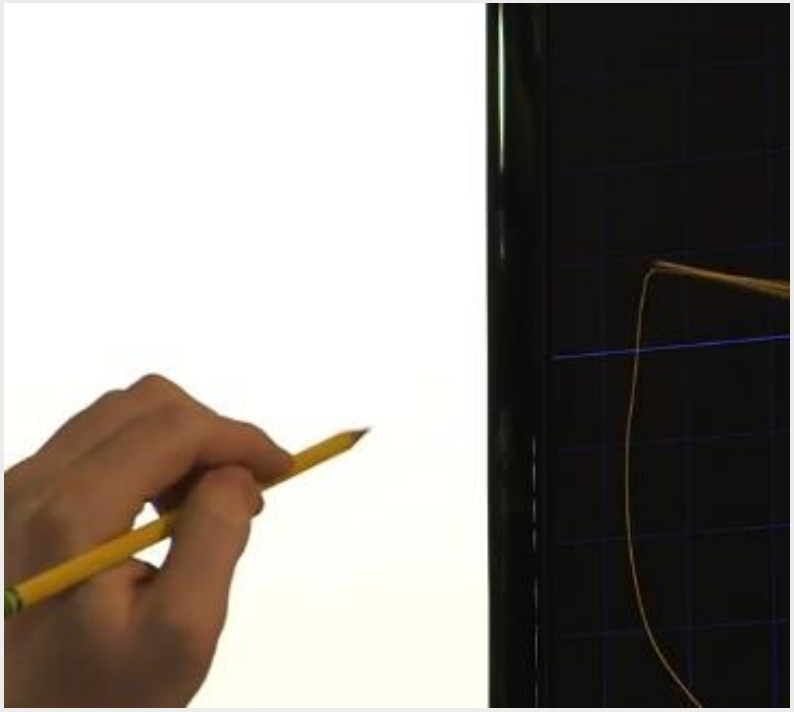


LEAP

CLOSE DISTANCE MOTION RECOGNITION

”KINECT FOR HANDS”





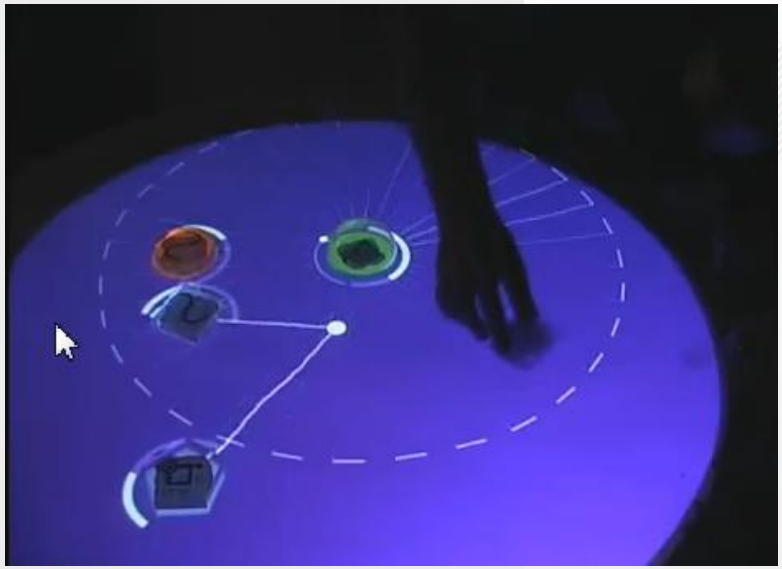
leapmotion.com

SPECIAL EXAMPLER: REACTABLE

MUSIC COMPOSITION AND PROCESSING

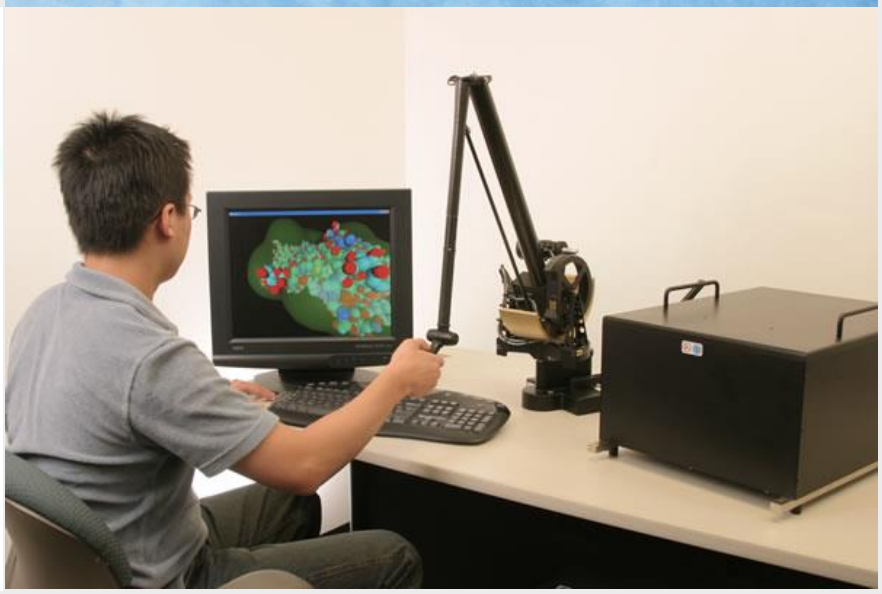
BOXES = ICONS FOR SOUND OPERATIONS

Samplers, sequencers, effects ...



HAPTIC DEVICES

FORCE FEEDBACK
TANGIBLE INTERFACE
SPATIAL MOVEMENT
WITH CONSTRAINTS



3D STEREOSCOPICS

USAGE

ENTERTAINMENT INDUSTRY

RESEARCH

Augmented reality used for surgery planning

Monsters vs. Aliens
First movie published in Blu-ray 3D

PRINCIPLE AND FORMATS

2D = ONE PICTURE @ (2X ONE EYE)
3D = 2X (ONE PICTURE @ ONE EYE)

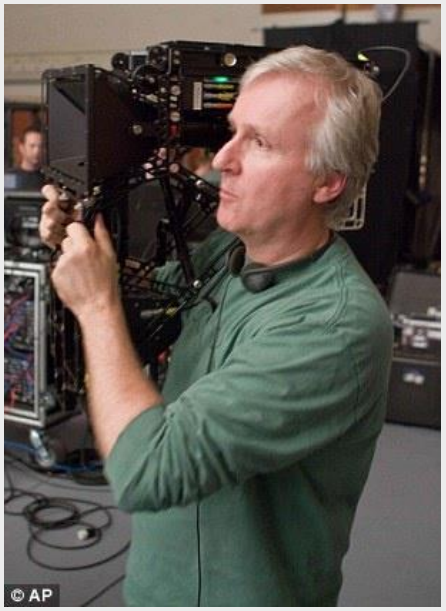
ANAGLYPH

HEAD-MOUNTED DISPLAY

ACTIVE SHUTTER

POLARIZATION

AUTOSTEREOSCOPY



www.reald.com

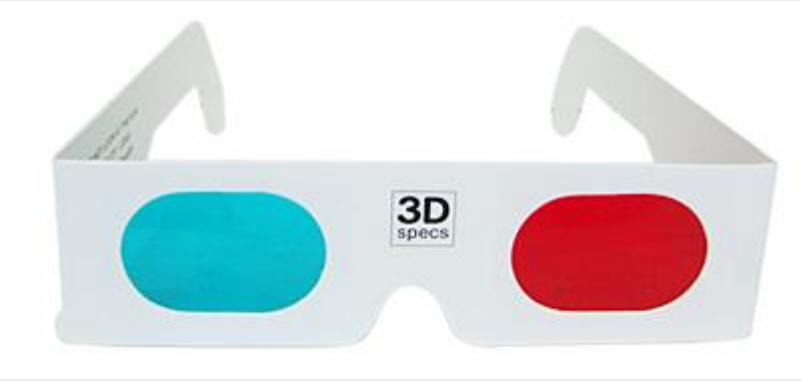
ANAGLYPH

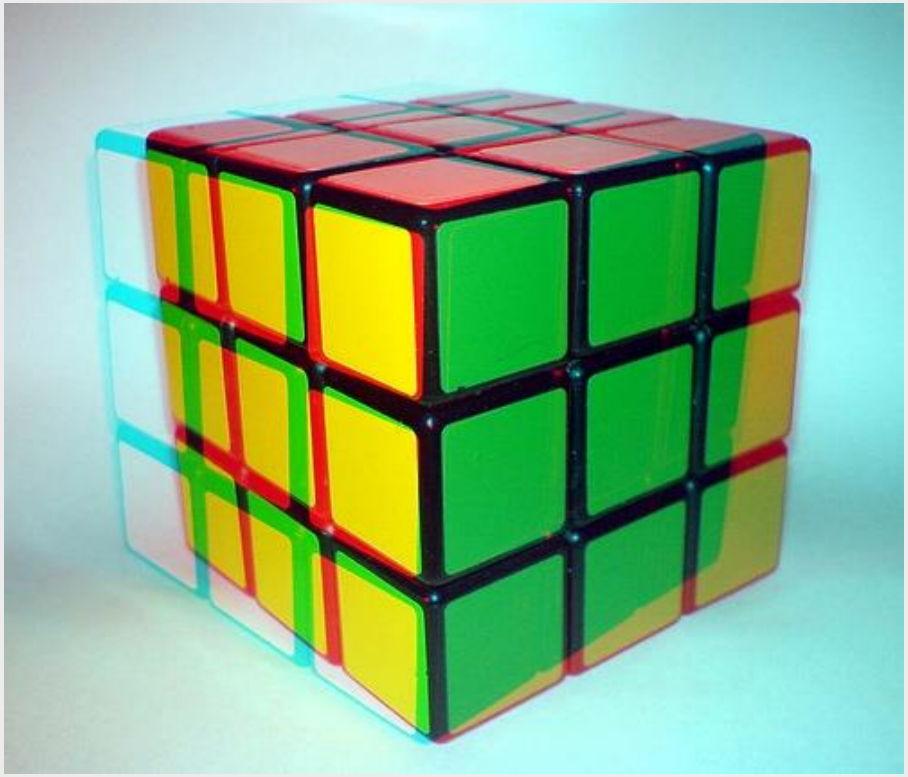
CHEAPEST, OLDEST
PASSIVE (WORKS FOR PRINTS)

UNDESIRED COLOR MODULATION

RED-CYAN

MAGENTA-RED





HMD

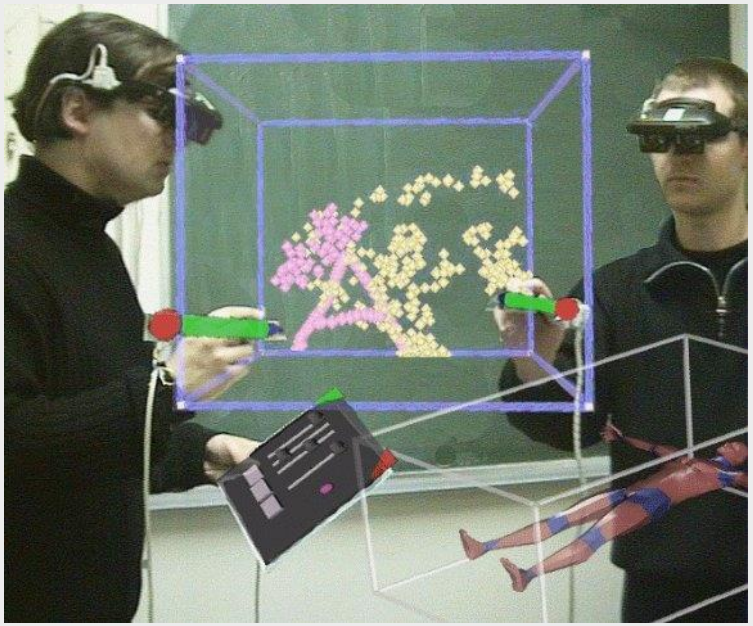
HEAD-MOUNTED DISPLAY

SEPARATE DISPLAY
FOR EACH EYE

HEAVY

CABLES

LOW IMAGE RESOLUTION



ACTIVE SHUTTER & POLARIZATION

LIGHTWEIGHT, NO CABLES SHUTTER GLASSES

Active, need batteries
Glasses ”open/close”
Full brightness but flickers

POLARIZED GLASSES

1 eye gets ½ of the signal
No flicker but less brightness

AUTOSTEREOSCOPY

NO GLASSES

LENTICULAR LENS

PARALLAX BARRIER

SENSITIVE TO VIEWING ANGLES