University of Colorado
Boulder

Introduction to Virtual Reality

3D Technologies

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Types of 3D Stereo Technologies

Viewers

Autostereoscopy

3D Stereo Viewers

Active:

- Shutter glasses

Passive:

- Stereoscope
- Polarized or anaglyph glasses
- HMD
- Virtual Retinal Display

Shutter Glasses

1922 – Teleview 3D theater in New York City

+Enable full color spectrum

+Full image resolution

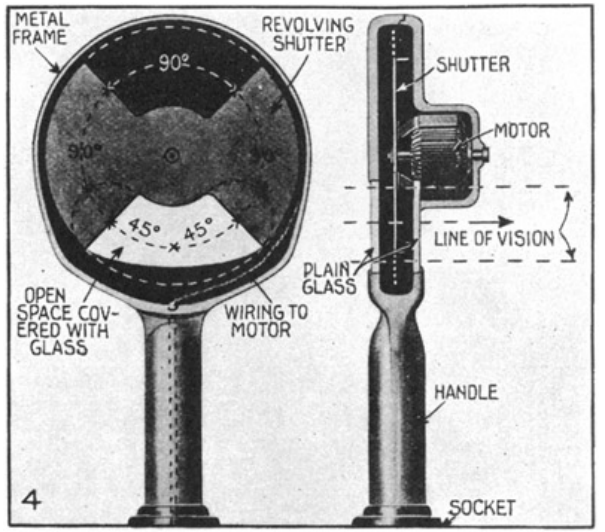
-Flicker or crosstalk (leakage) if refresh rate is too slow

-Dark

-Requires double frame rate

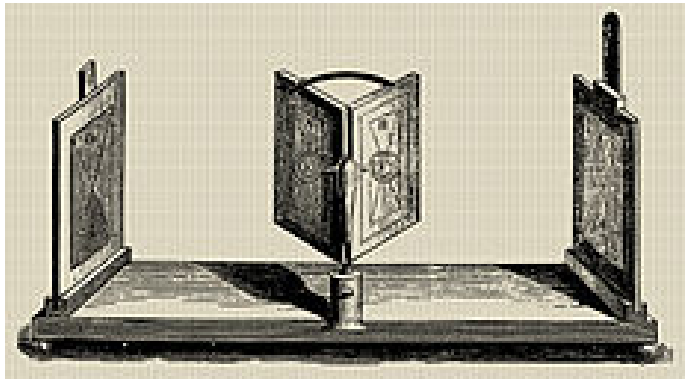
-More expensive and complex than passive systems

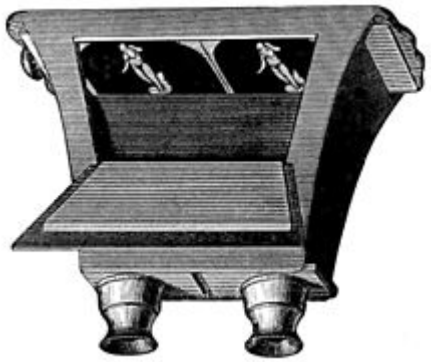
-Can lead to depth distortion for objects moving horizontally



Stereoscopes

Daguerreotype (first photographic process) – 1837 – 1839
Wheatstone stereoscope – 1838
Brewster stereoscope – 1839
Holmes stereoscope – 1861





Anaglyph

1852 – anaglyph illustrations

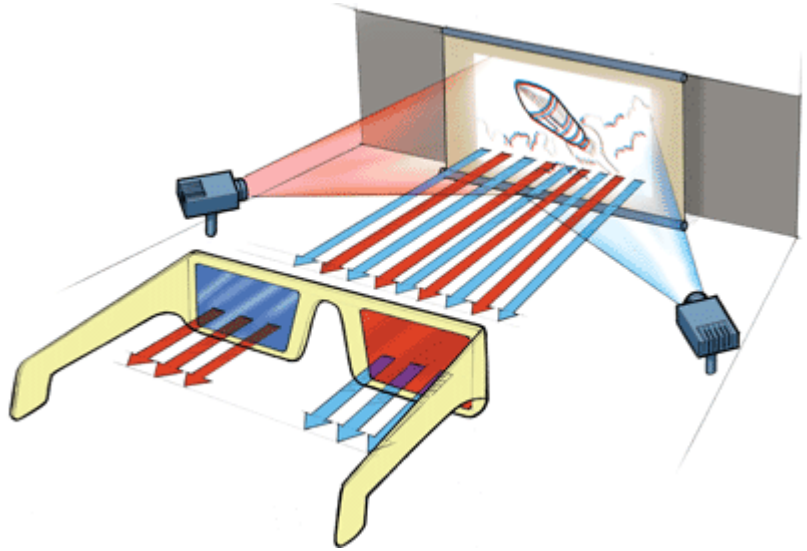
1858 – Anaglyph slide shows

1891 – First printed anaglyphs

1893 – First public exhibition of anaglyph motion picture

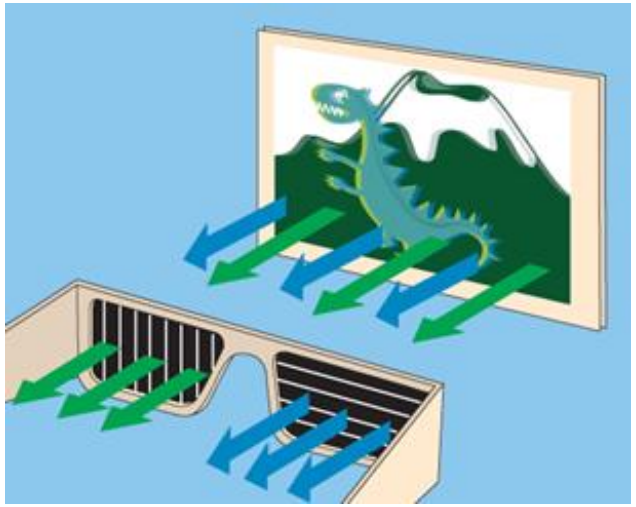
Many techniques and tradeoffs to producing anaglyph and which colors to use

Binocular rivalry



Anaglyph

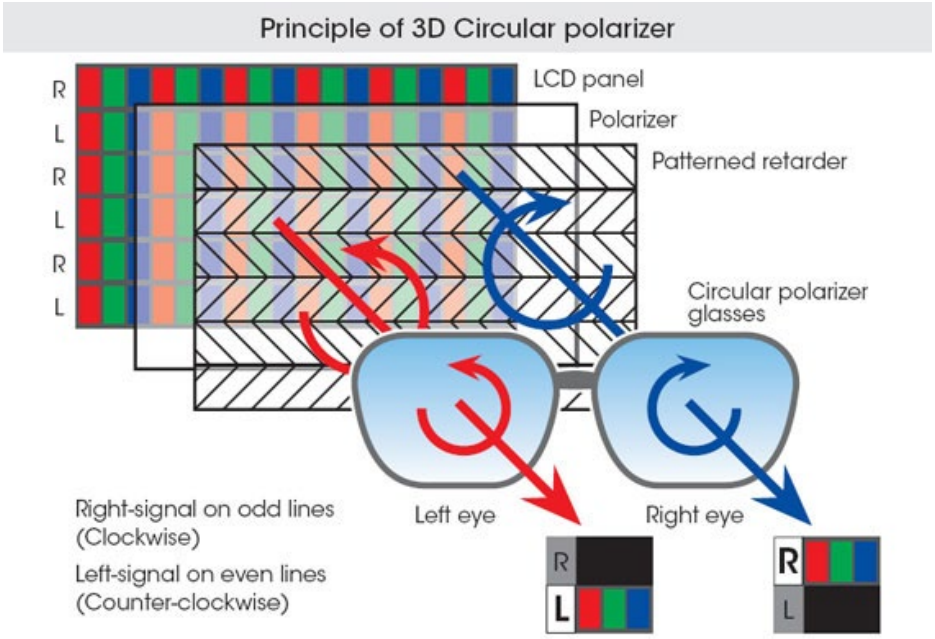
Polarized Glasses



Linear or circular filters

Requires special screen coating to maintain polarization in reflection

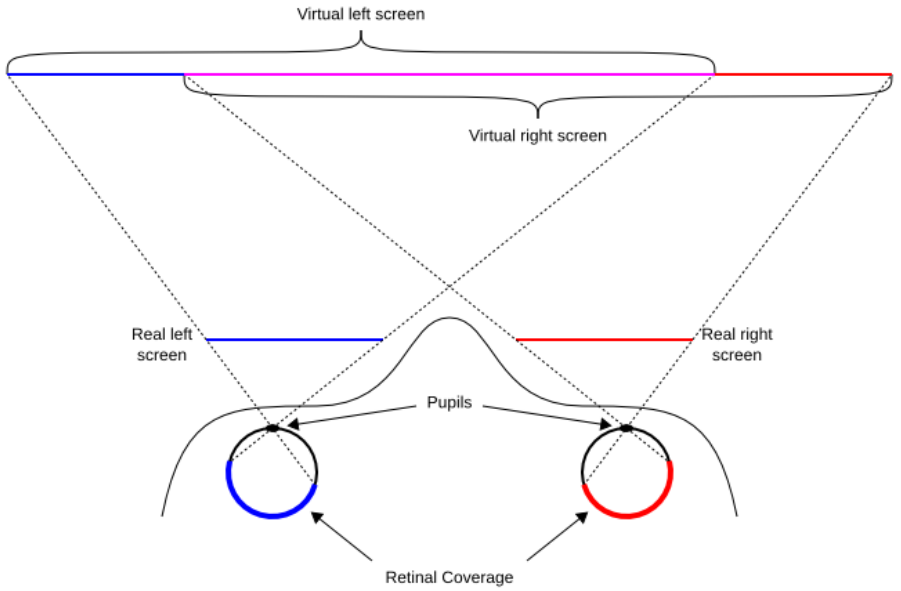
½ frame resolution with “over-under” projection



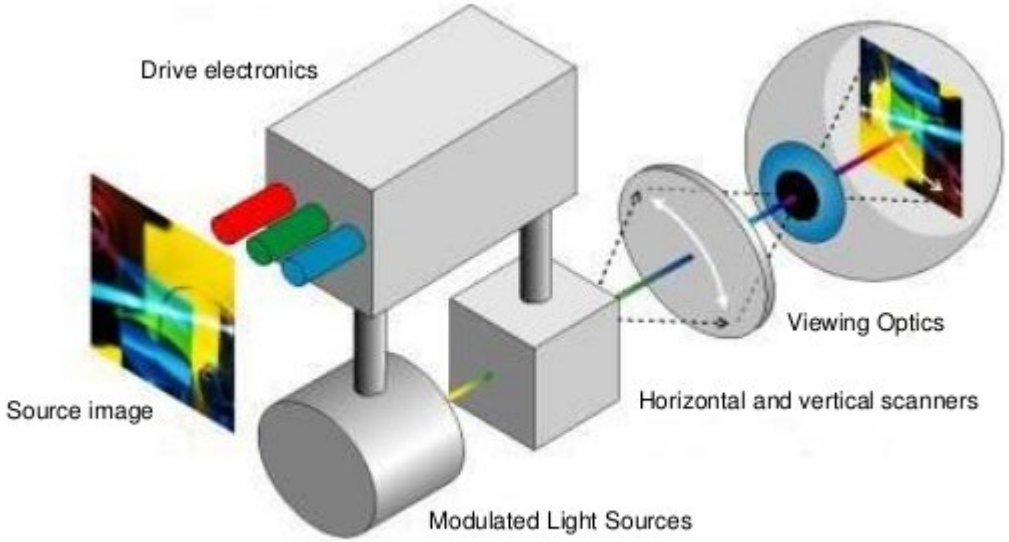
HMDs

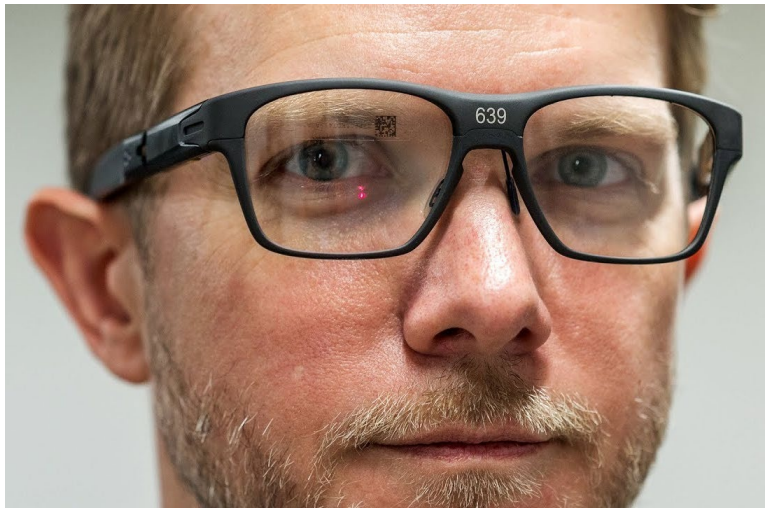
LCD (or other) screen feeds separate video to each eye

Lenses allow for greater field of view and enable image to appear further from eyes



Virtual Retinal Display (VDR)





- Intel Vaunt (cancelled)

Autostereoscopy

“Glasses free”

Autostereogram

Wiggle stereoscopy

Parallax barrier

Lenticular Lens

Volumetric Displays

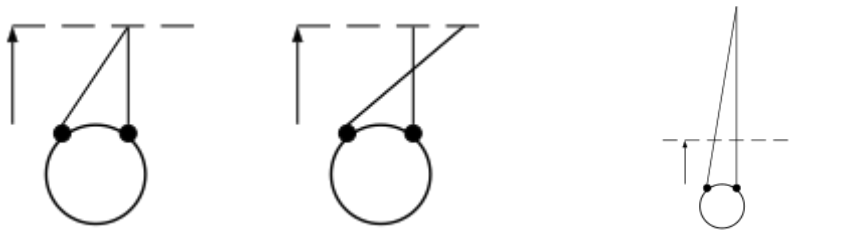
Autostereogram

"Wallpaper effect:" David Brewster – 1849 – 1850

Brain has difficulty matching views from each eye when viewing repeated patterns

"Magic Eye"

Two types: wall-eyed vs cross-eyed



Random Dot Stereogram

Autostereogram made from random dots and depth map

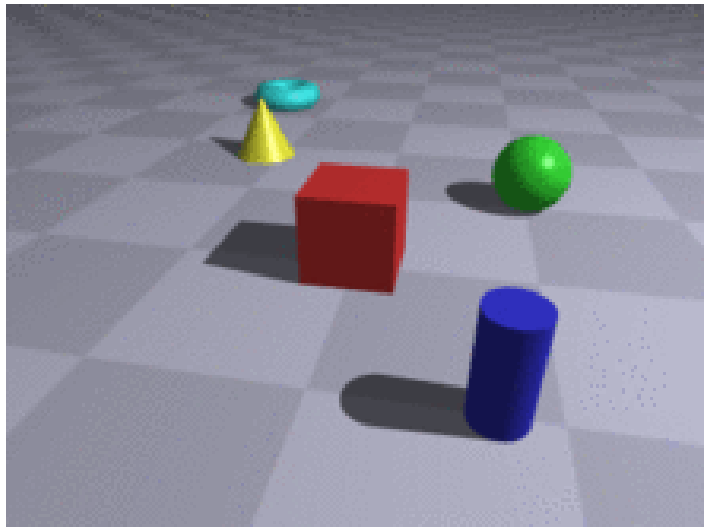
Offset distance between repeated elements is what gives sense of depth = “z-axis” or “z-buffer” value

Given a depth map, repeat pattern of random dots with offset based on depth map

Wiggle Stereoscopy

Animate left and right images of a stereogram

Depth from motion parallax and occlusion changes



Parallax Barrier

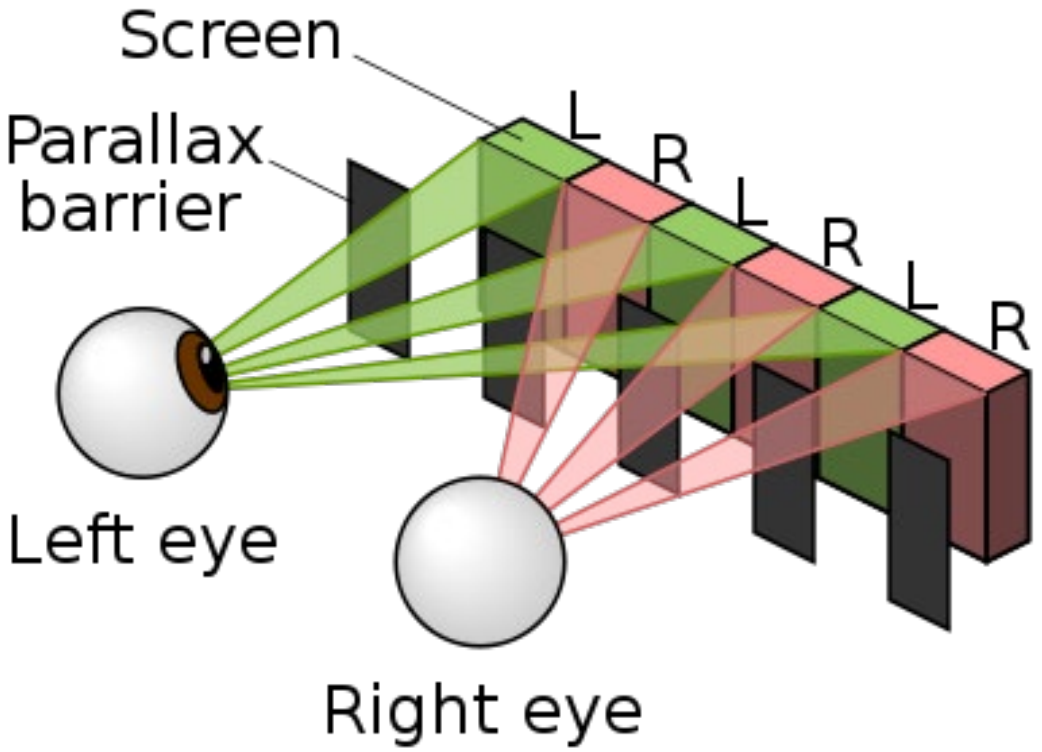
Used in Nintendo 3DS

Precision barriers ensure each eye sees different image

-Viewer must be position at correct angle

-1/2 horizontal resolution

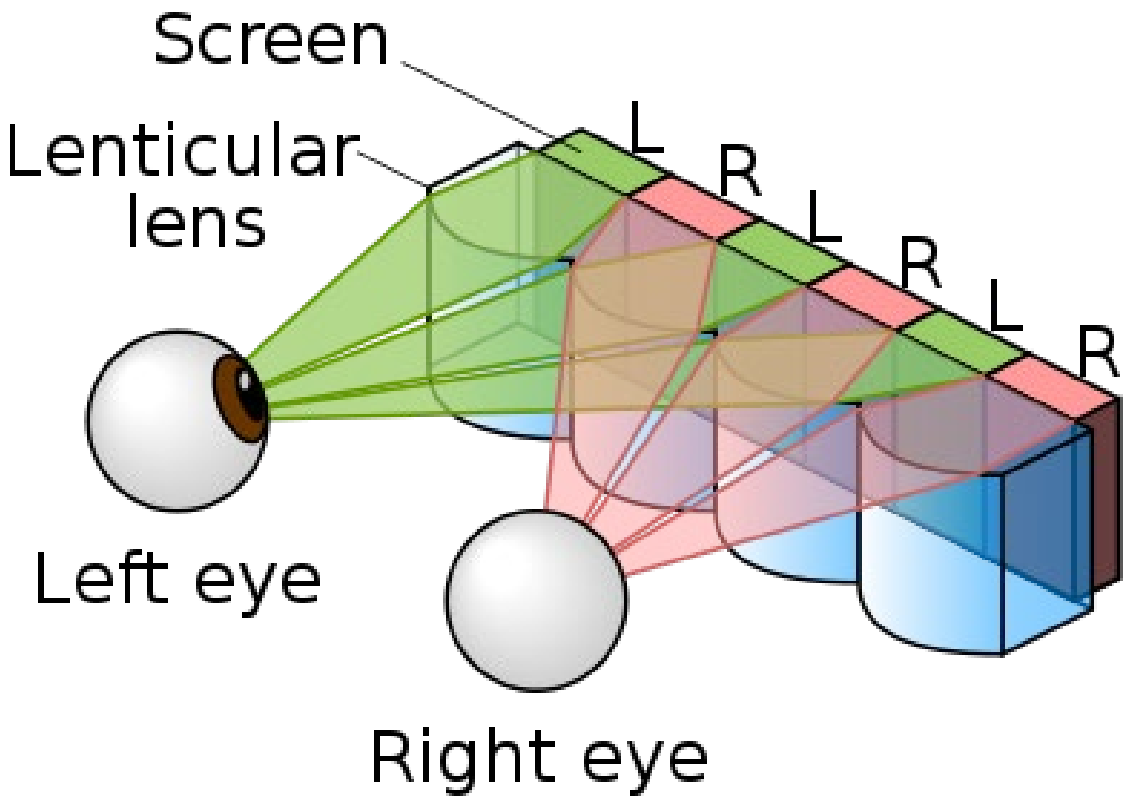
-Potential for crosstalk



Lenticular Lens

Similar to parallax barrier but uses lenses

Curved lenses direct light to each eye



Volumetric Display

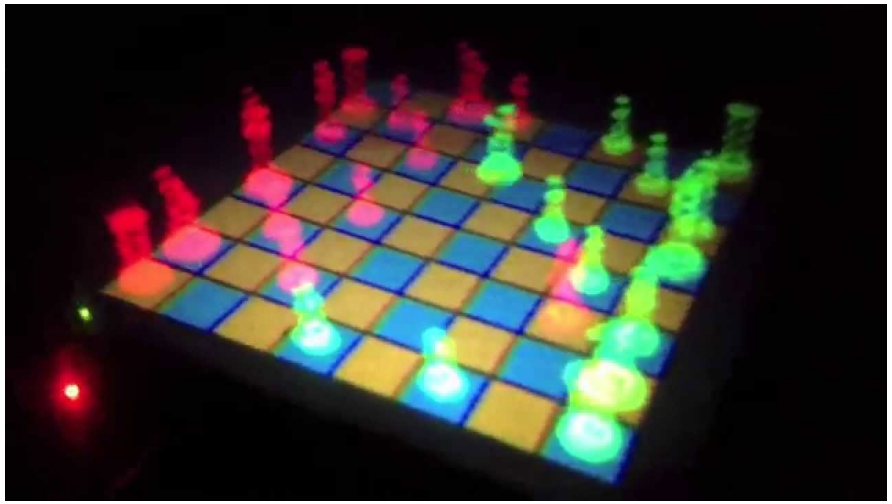
Under development

Swept-volume display: spinning LED's

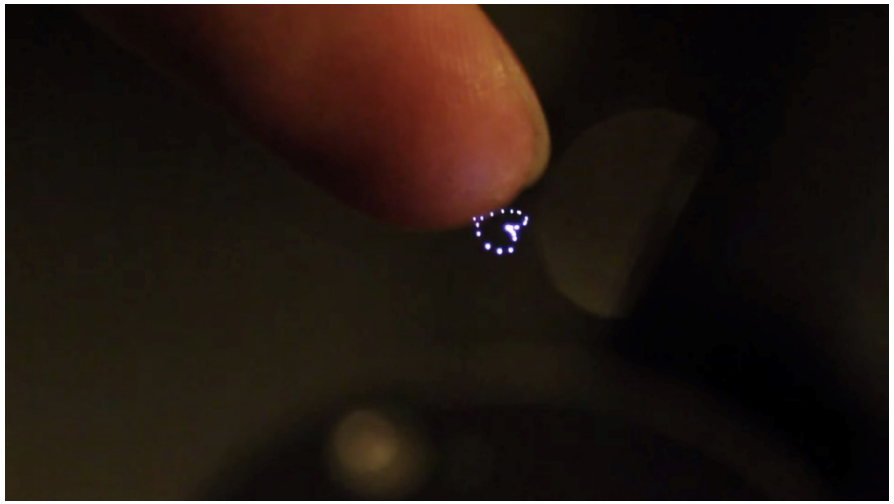
Static volume: area of space illuminated (voxels) using lasers, plasma, fog, etc.

Hologlyphics: artistic use of volumetric displays

Volumetric Displays



Voxiebox



Fairy Lights

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THANKS!

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