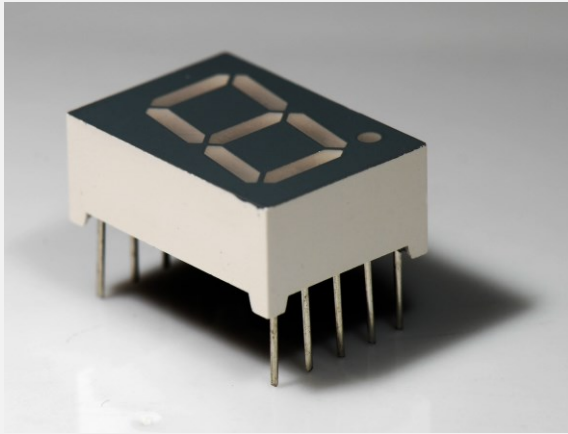


Display

显示

陈宝权

显示设备



数码管显示器



阴极射线显示器



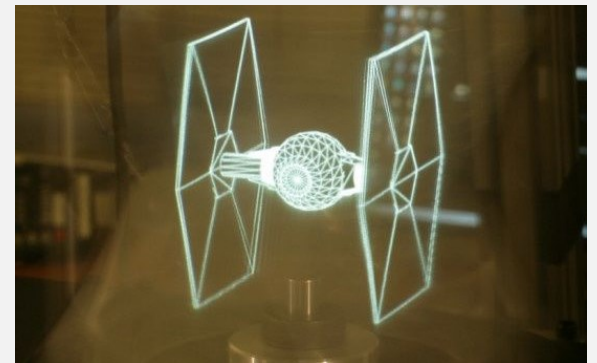
等离子显示器



液晶显示屏

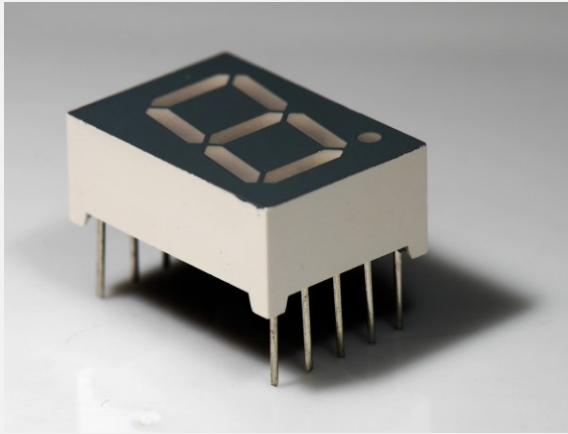


眼镜

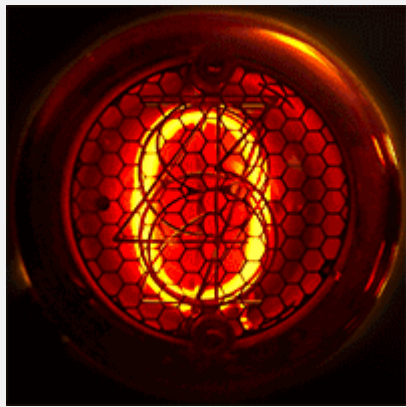


光场显示器

二维显示技术



数码管显示器



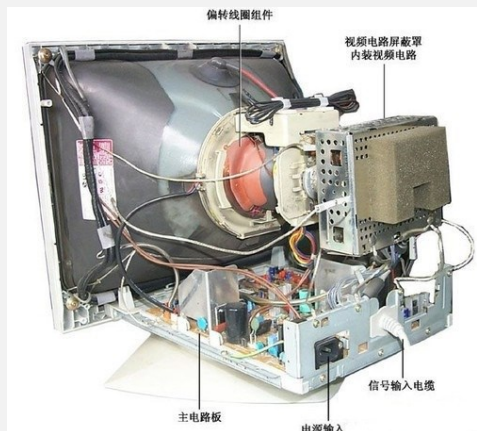
原理：

用大量发光二极管集成控制显示

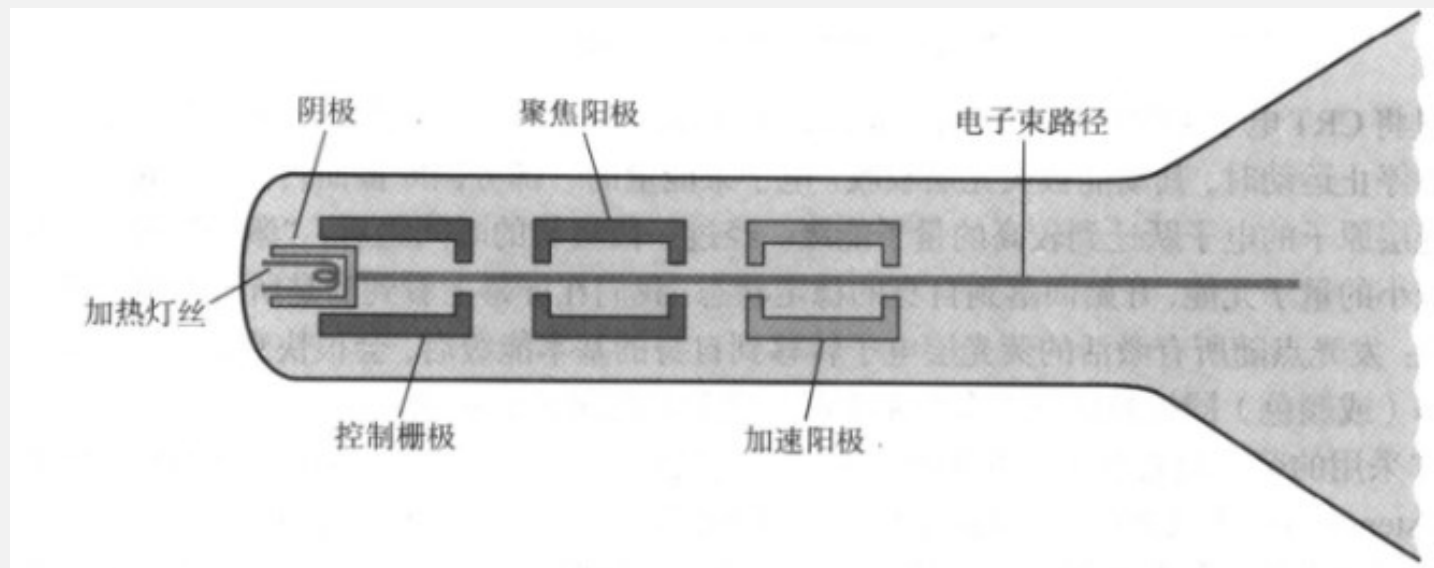
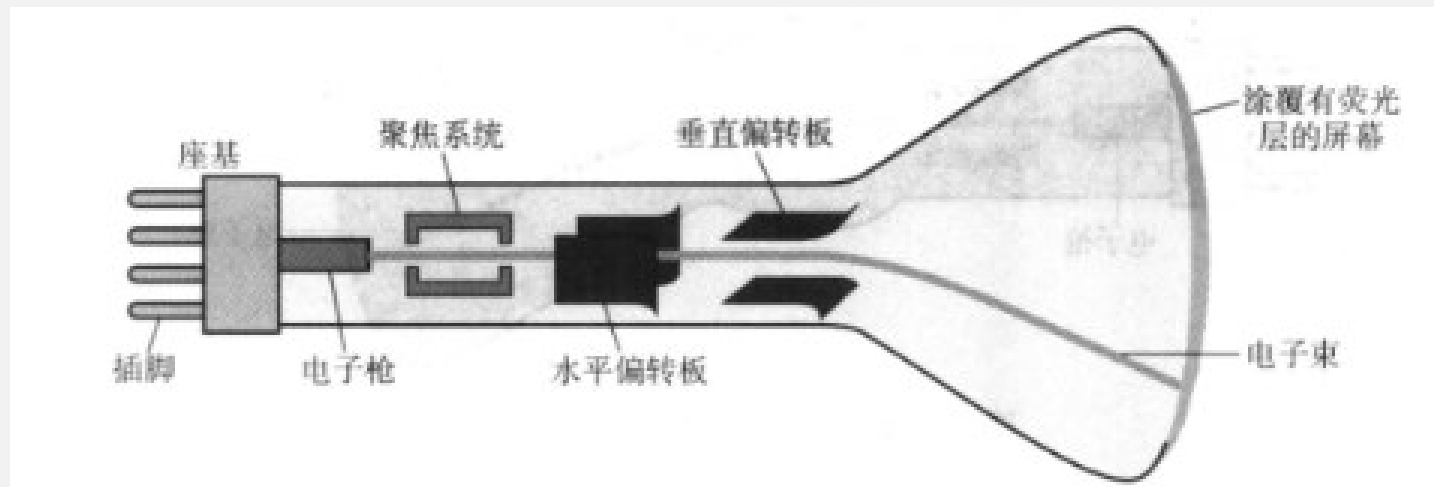
场景：

资讯发布、户外媒体、体育场馆、室内大型显示

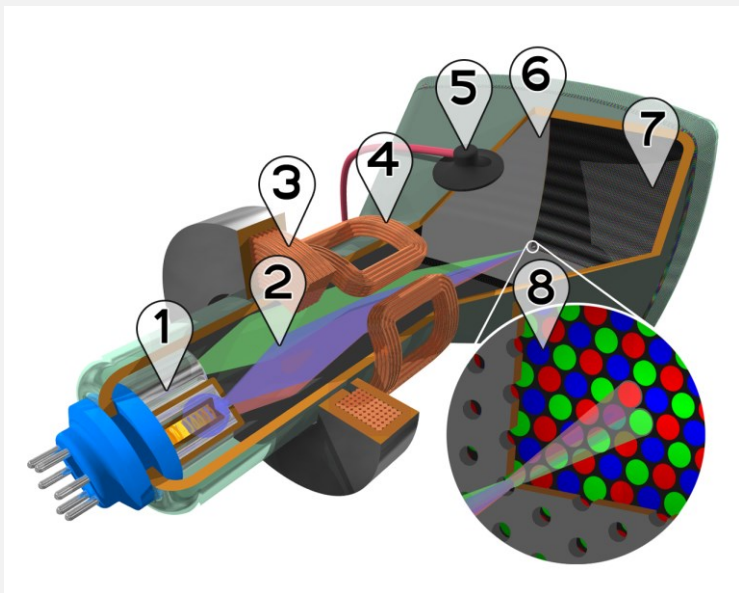
二维显示技术



阴极射线显示器

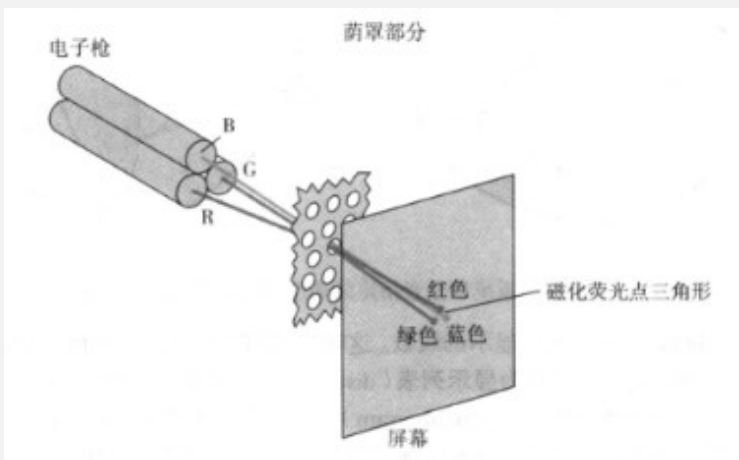


二维显示技术

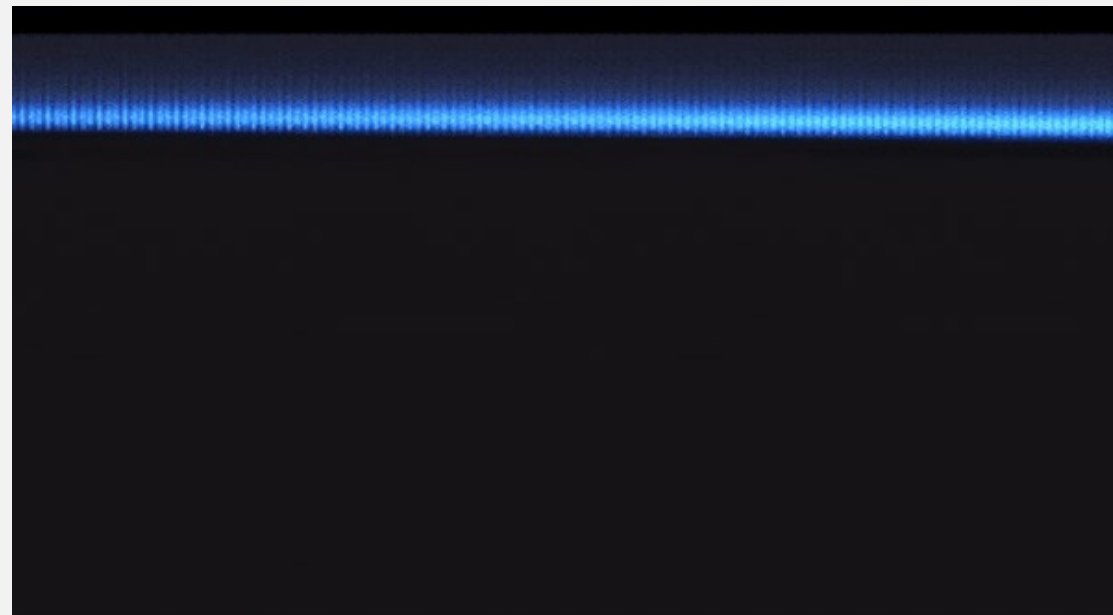
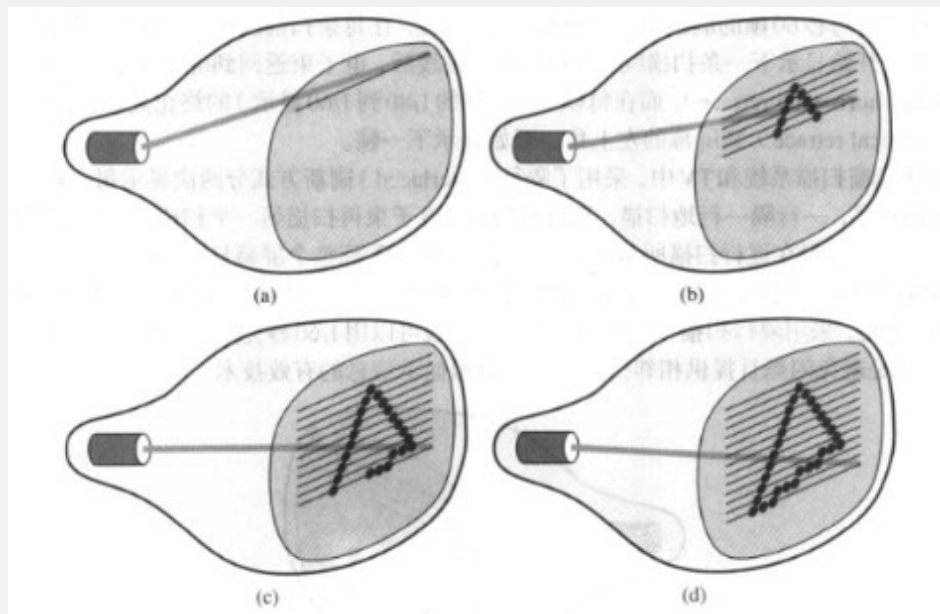


彩色阴极射线管的剖面图：

1. 电子枪
2. 电子束
3. 聚焦线圈
4. 偏向线圈
5. 阳极接点
6. 电子束遮罩区隔颜色区域
7. 荧光幕分别有红绿蓝荧光剂分区涂布
8. 彩色荧光幕内侧的放大图

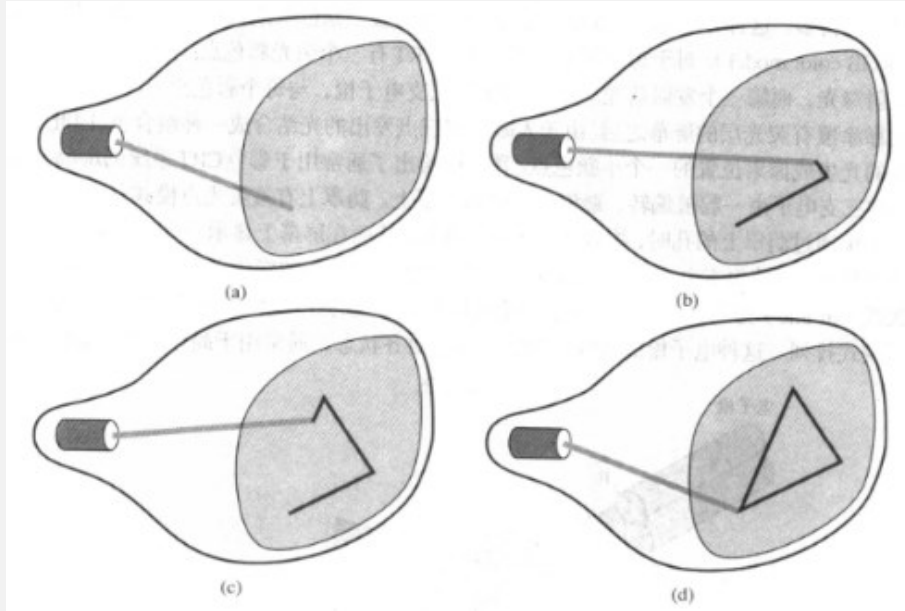


二维显示技术



光栅扫描显示器

二维显示技术



随机扫描显示器

随机扫描系统刷新依赖于显示的线数。

系统周期地按显示文件中的一组命令依次画出组成线条。

二维显示技术

像素：每个可由电子束点亮的屏幕点

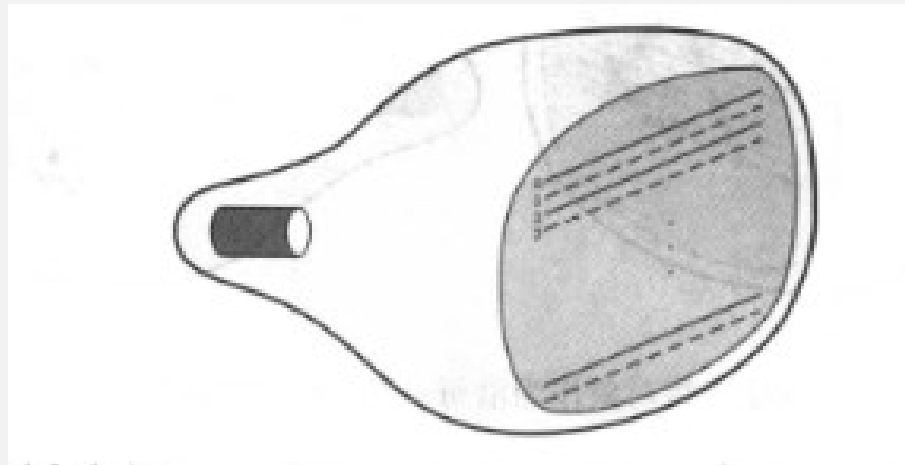
分辨率：屏幕能显示的像素个数

纵横比：像素列数除以行数

帧：屏幕所显示的一个画面

帧率：每秒屏幕刷新的帧数

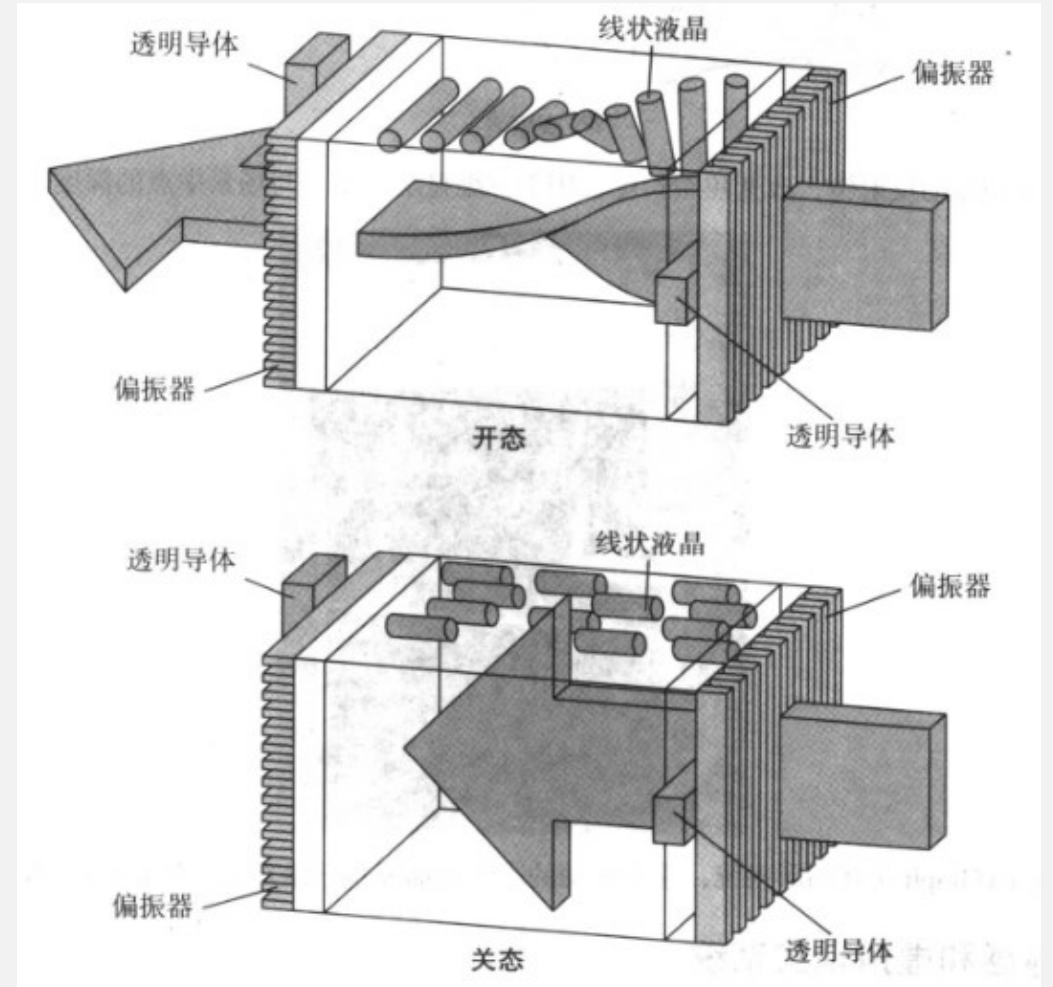
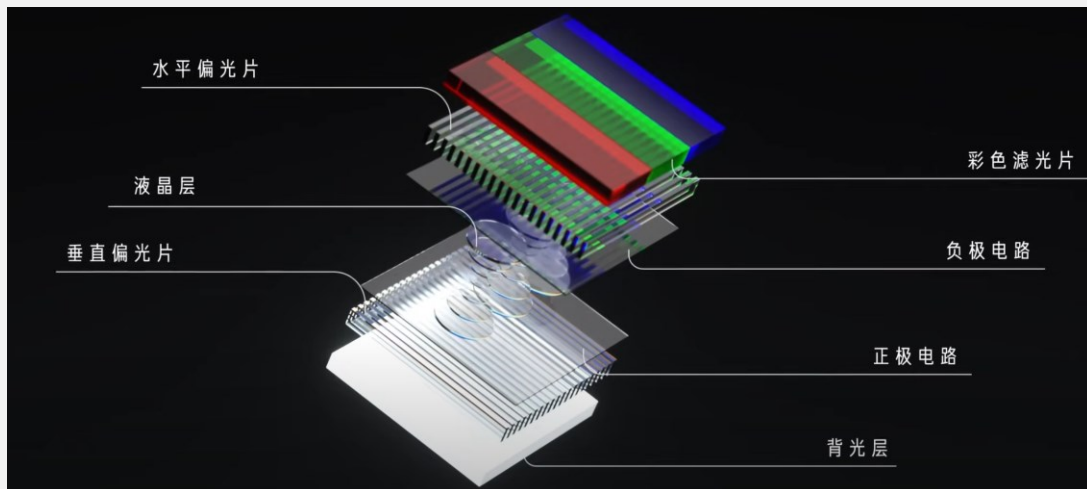
隔行扫描：保证屏幕亮度均衡，提高帧率



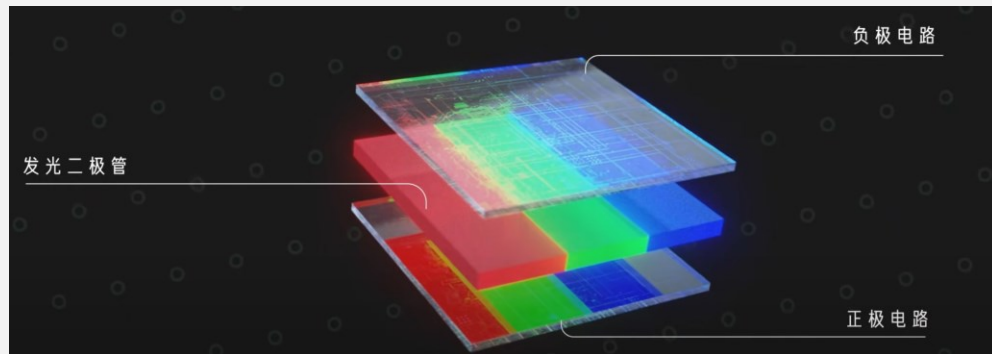
二维显示技术



液晶显示屏 (LCD)



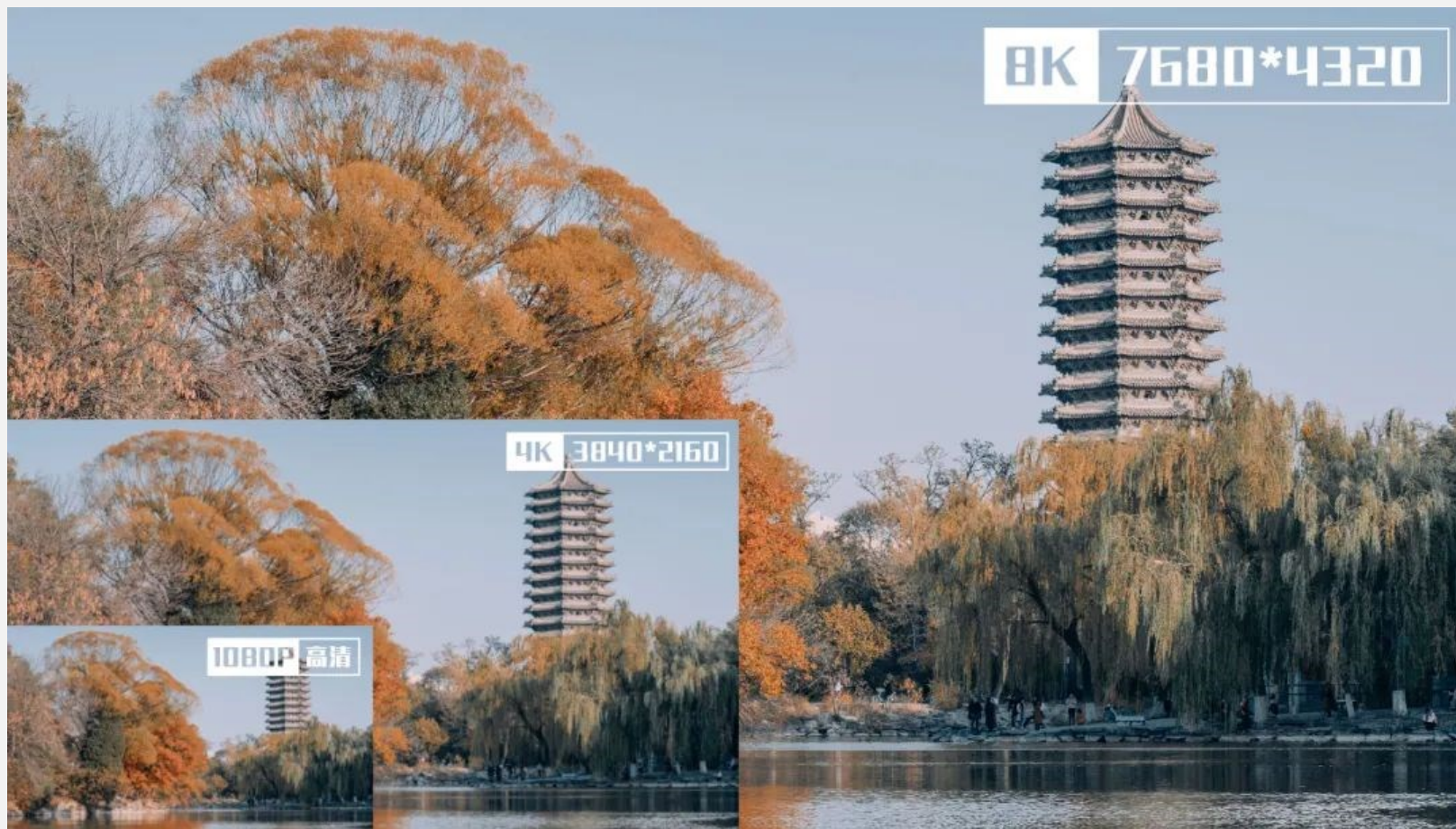
二维显示技术



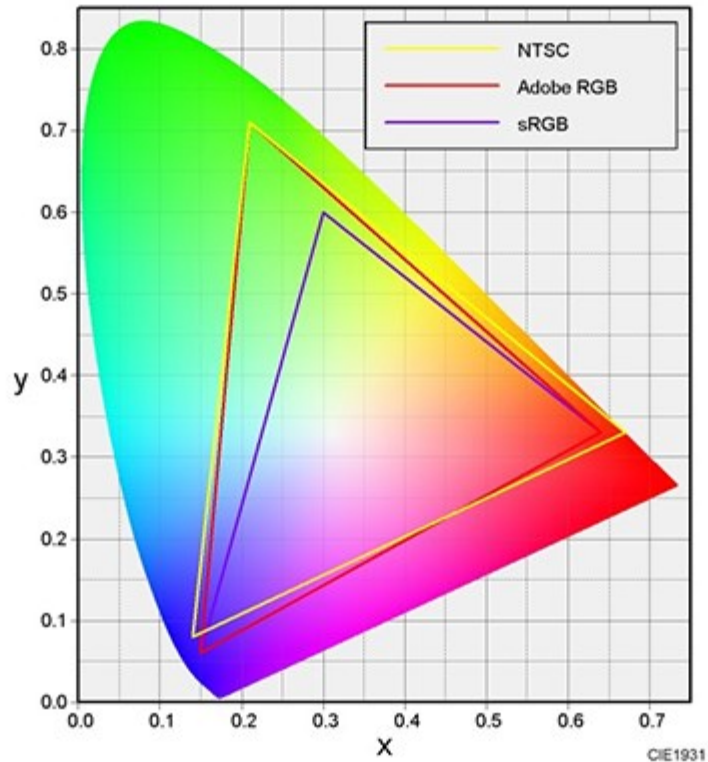
有机发光半导体显示器
(OLED: Organic Light-Emitting Diode)



像素标准 (8K超高清)



色域



NTSC: 美国国家电视标准委员会

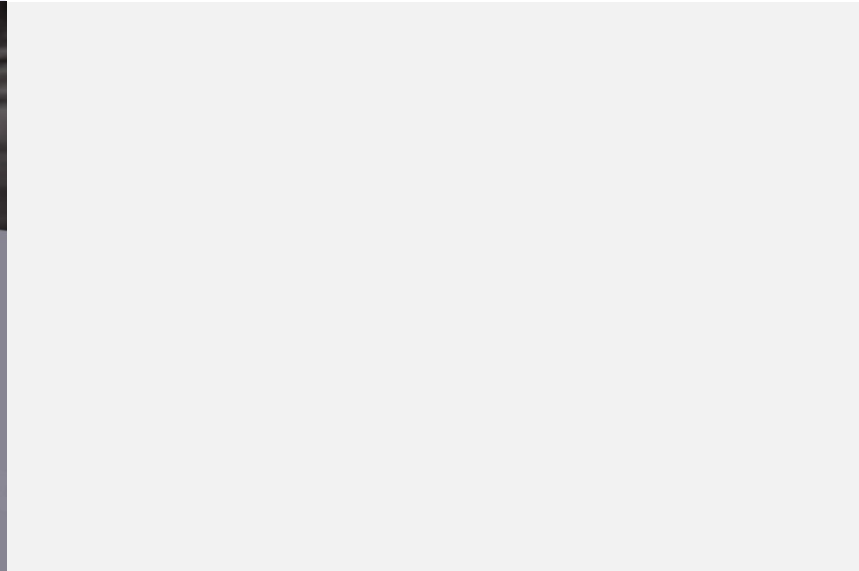
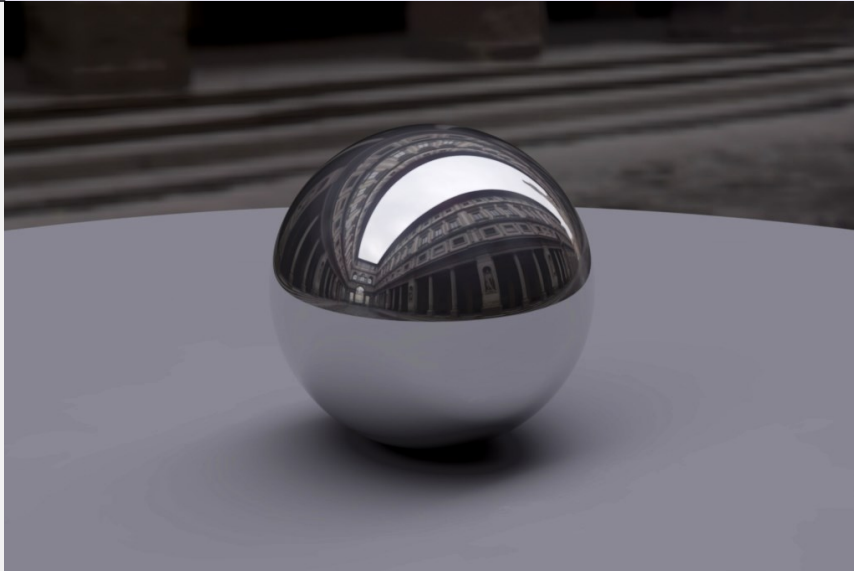
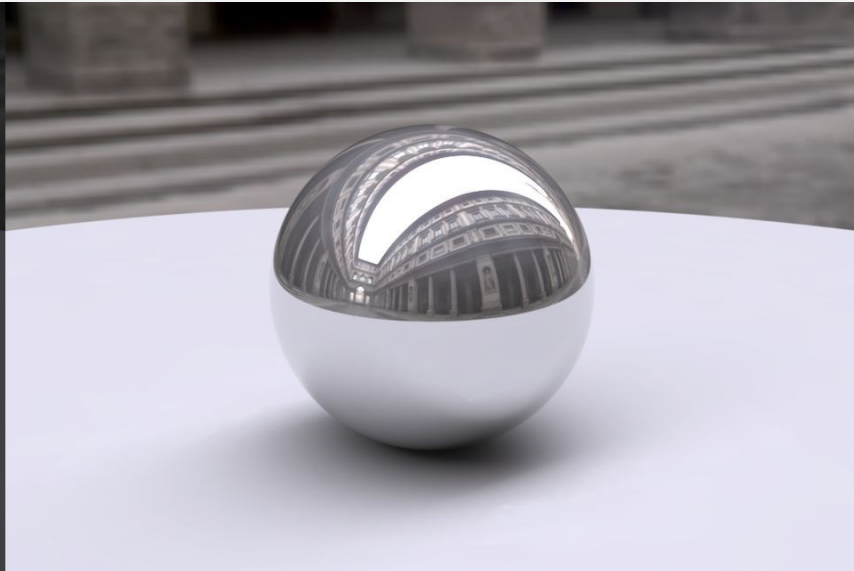
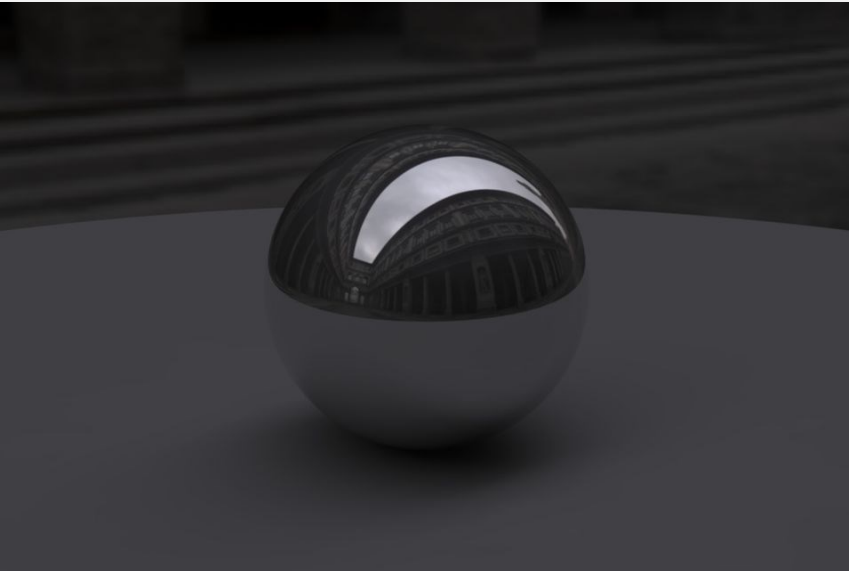
sRGB: 微软, HP

DCI-P3: Apple

BT2020: 4K

ARGB: Adobe

高动态范围成像(HDR)



超分辨率显示技术

GigaPixel Display



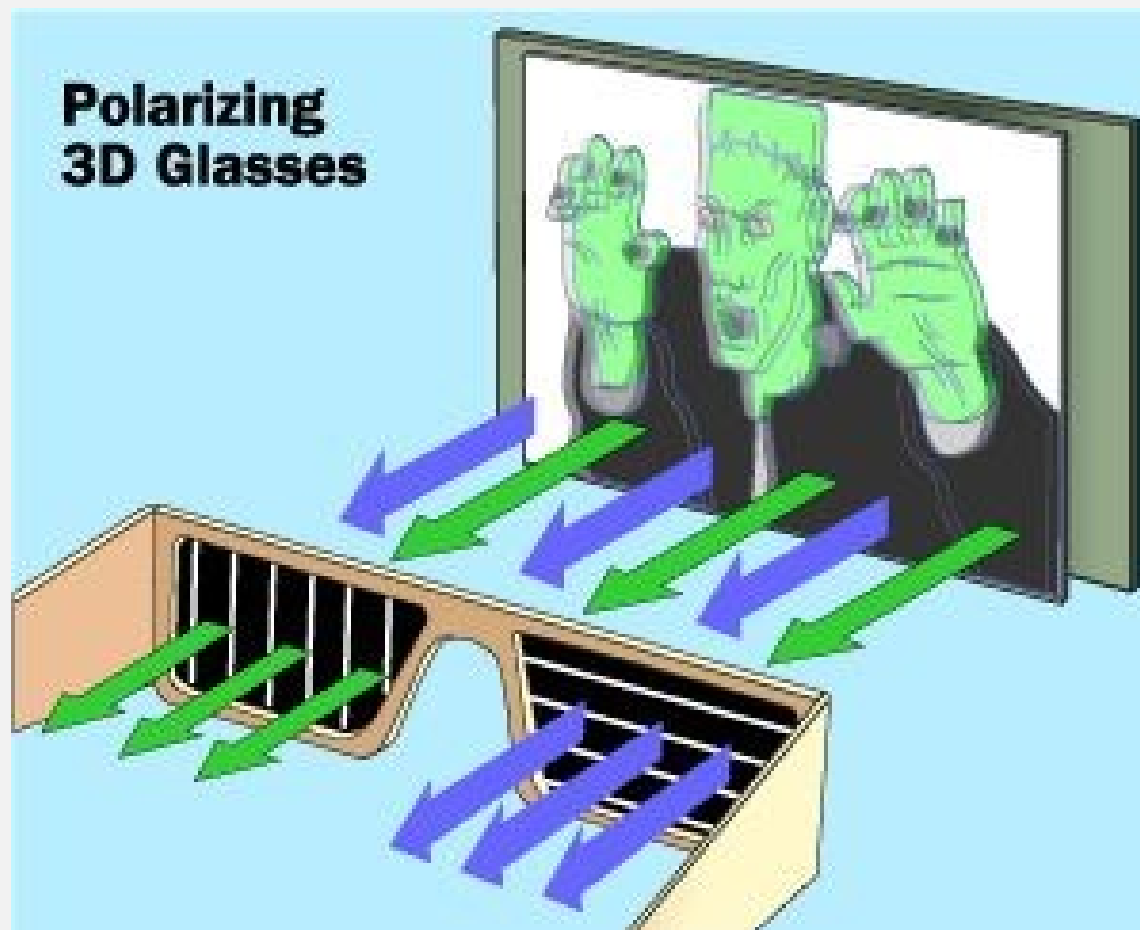
立体显示原理



双目视觉

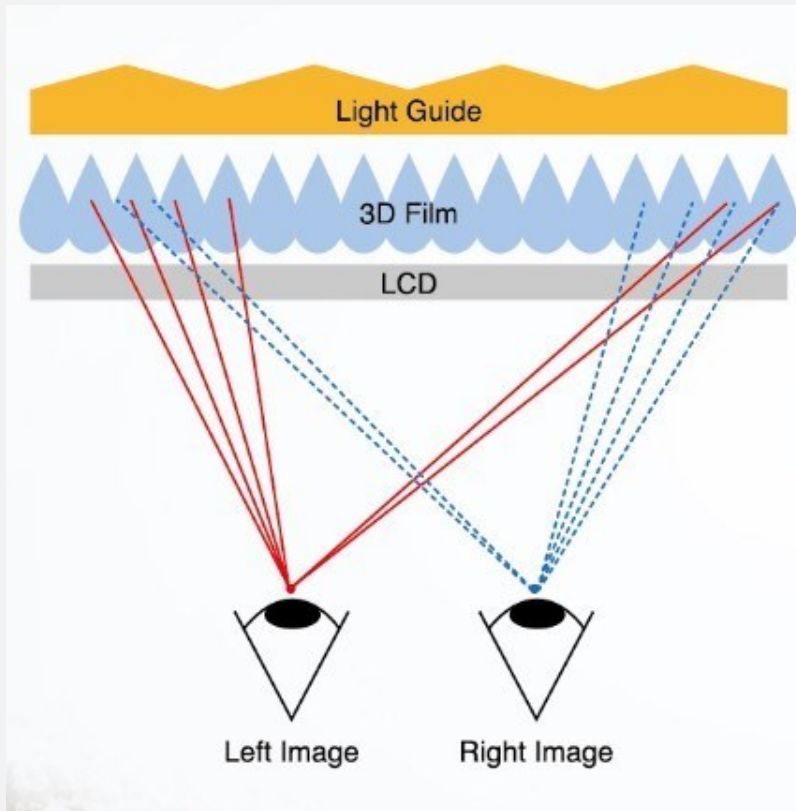
立体显示技术

偏振光3D技术

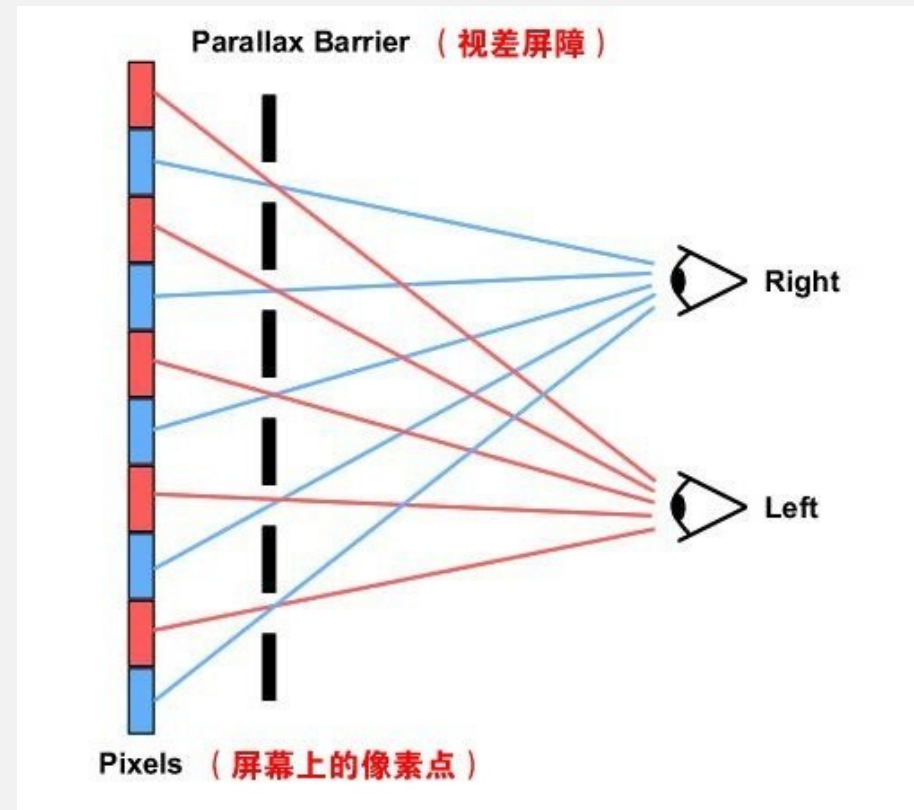


立体显示技术

裸眼3D技术（固定视点）



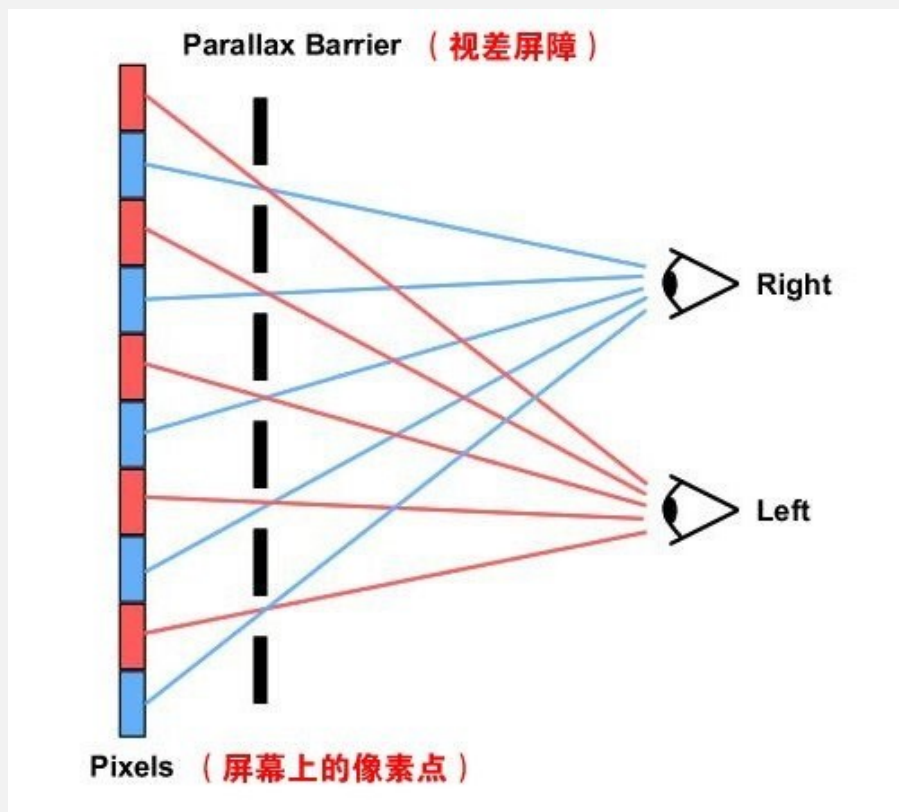
微柱透镜3D技术



光屏障式3D技术

3D显示技术

动态裸眼3D + 眼睛跟踪



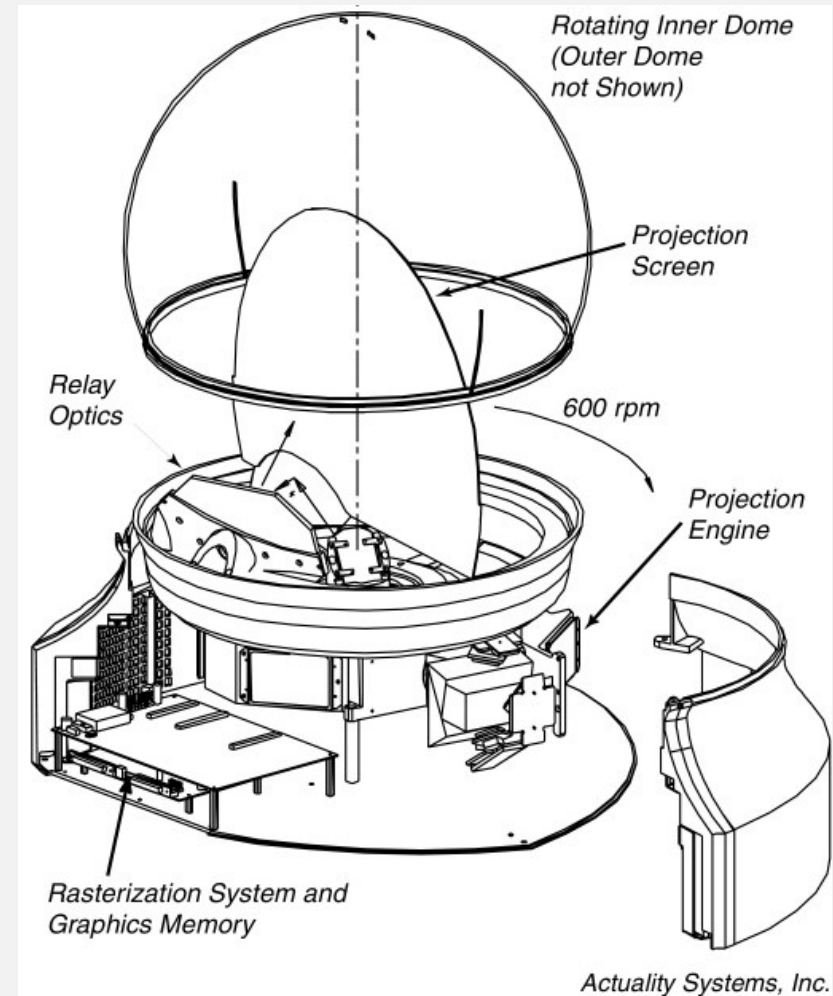
光屏障式3D技术

实现方案：

1. 眼睛跟踪
2. 视差屏障动态改变

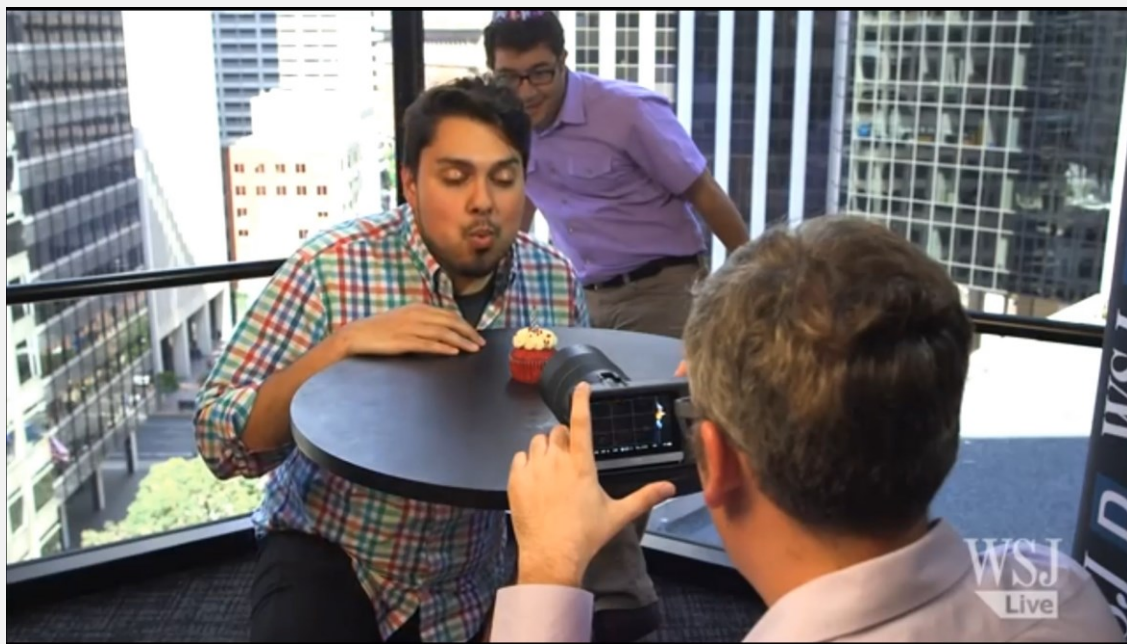
三维显示技术

裸眼3D技术 (动态视点, 非立体)

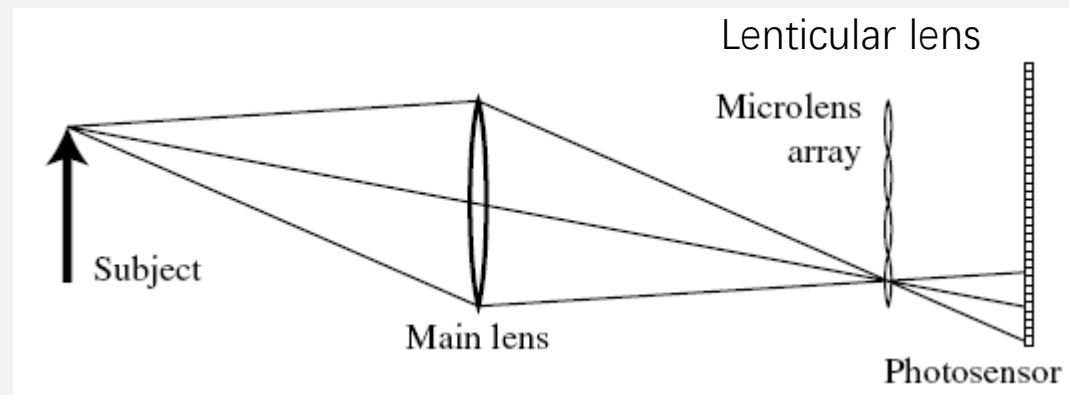


3D显示技术

光场显示技术 (lightfield display)

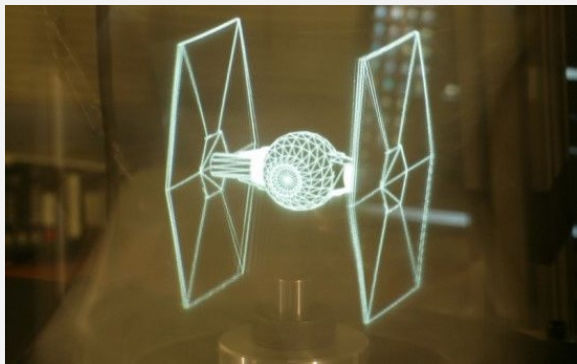


光场相机 (Lytro)



原理

3D显示技术



全息投影技术
(Holographic display)

$$O(x, y) = O_0(x, y) \exp[i\varphi_o(x, y)]$$

光波场 振幅 相位

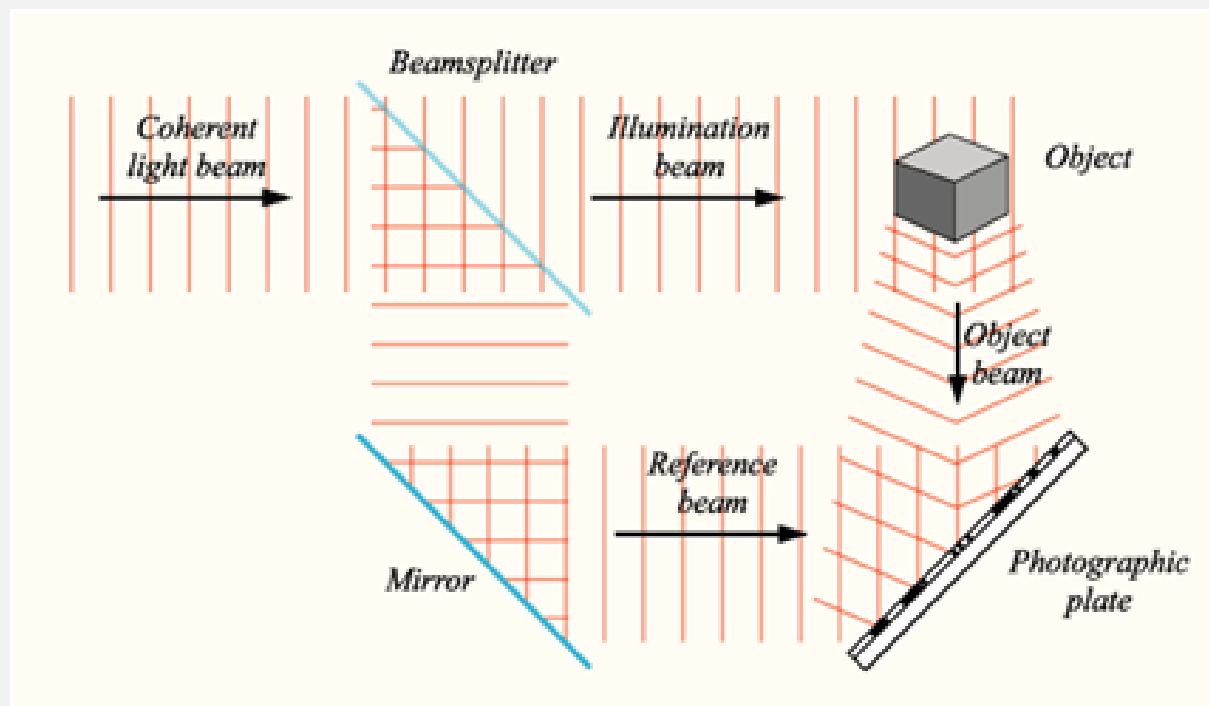
$$\begin{aligned} I(x, y) &\propto |O_0(x, y) \exp[i\varphi_o(x, y)]|^2 \\ &= |O_0(x, y)|^2 \times \underbrace{|\exp[i\varphi_o(x, y)]|^2}_{= 1} \\ &= |O_0(x, y)|^2 \end{aligned}$$

光强（只有振幅信息）

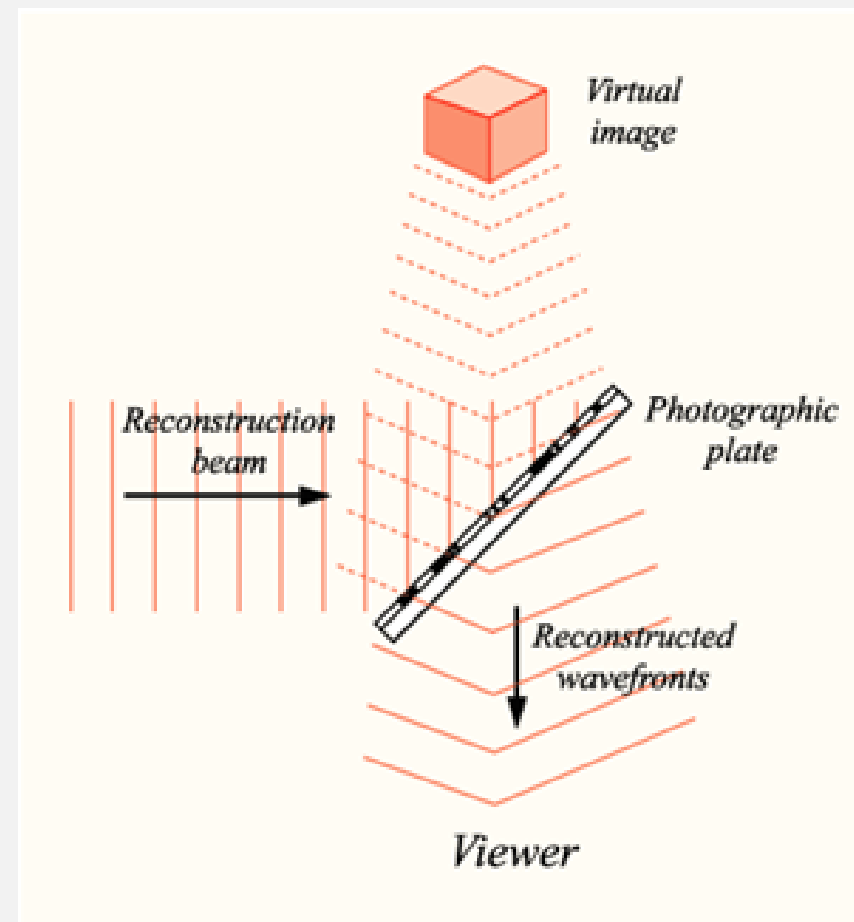
$$R(x, y) = R_0(x, y) \exp[i\varphi_R(x, y)]$$

用参考光干涉获得相位信息

3D显示技术



利用干涉记录波前信息



利用衍射重现物光波场

Haptic Display (力反馈显示)

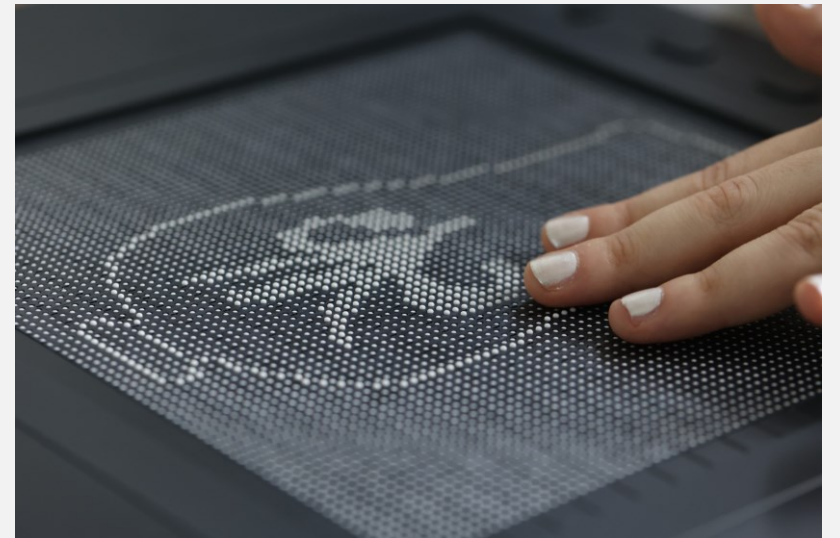


<https://www.3dsystems.com/haptics>

Tactile Display (触觉显示)



A random paper:
<https://iopscience.iop.org/article/10.7567/JJAP.56.06GN19/meta>



Olfactory Display (嗅觉显示)

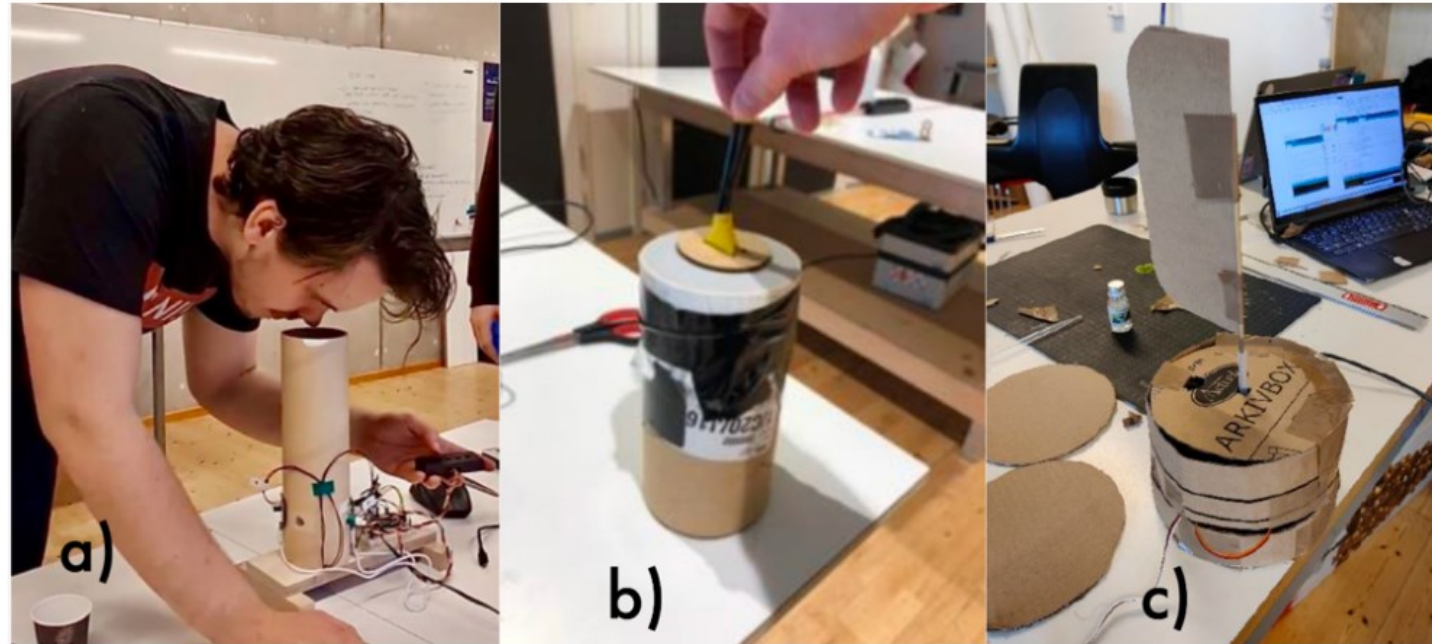


Figure 4: a) Scentony paper prototype with two scents. b) VortexNova paper vortex cannon with manually operated membrane. c) Ambians paper prototype with natural diffusion.

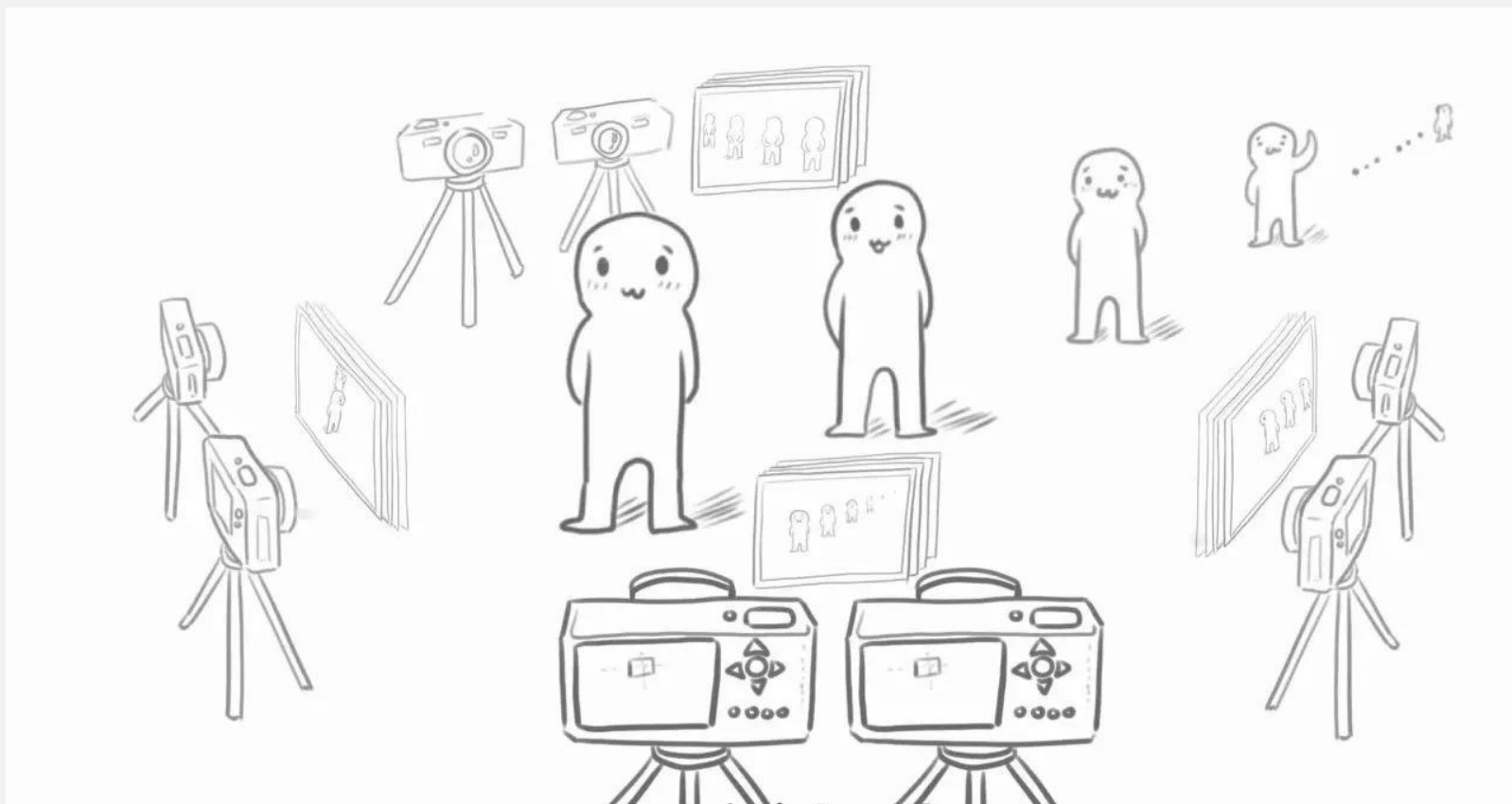
Liam Aljundi, Thomas Bengtsson, Snezhana Bogeva, Ebba Bolin, Lisa Maliqi, Liam Melin- Higgins, Iana Minakova, Per-Anders Welin, Victor Baquero Wihlborg, Johannes Lund With & Simon Niedenthal. "Olfactory display development in interaction design education." Smell, Taste, and Temperature Interfaces Workshop at ACM CHI 2023 (STT23).

体感互动 (Somatosensory interaction) 显示



沉浸式3D显示技术

不固定视点（立体）显示



双目视觉+位姿定位

实现方案：

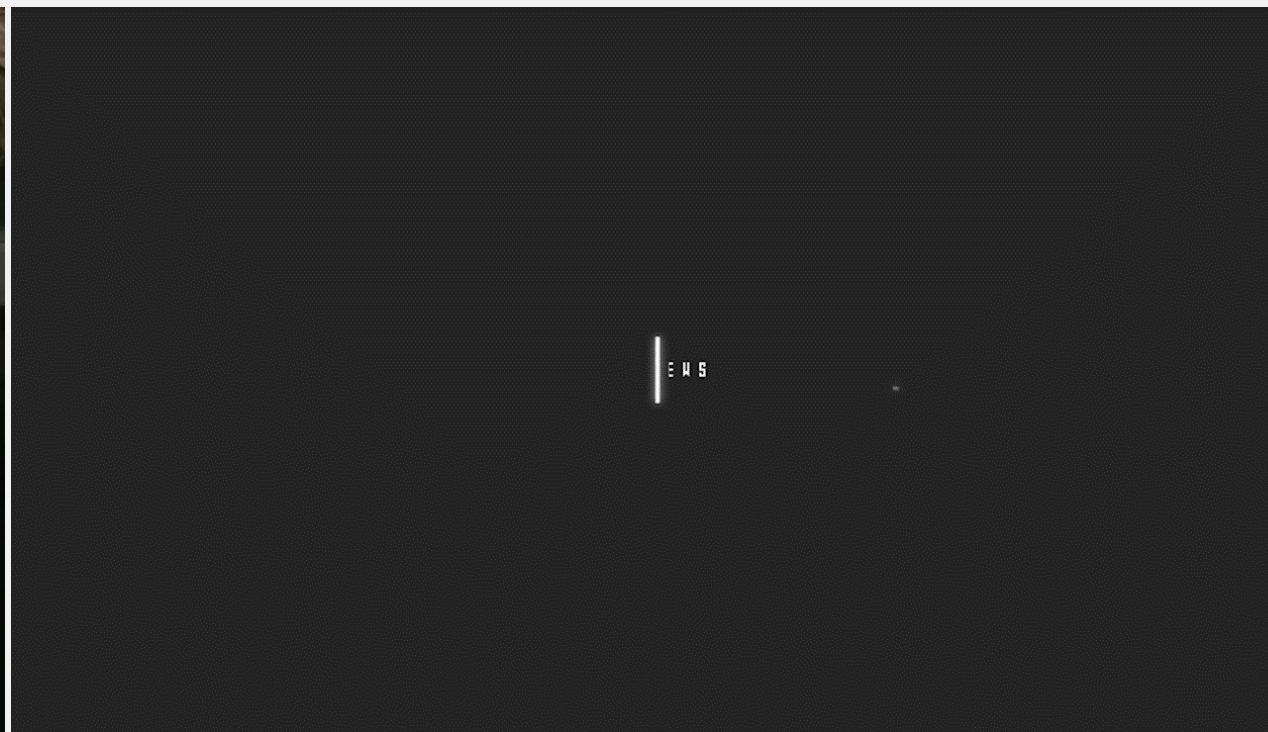
1. 跟踪头显
2. 裸眼3D + 眼睛跟踪

3D显示技术

头显跟踪



虚拟现实头显技术
Meta Quest (Oculus)
(HTC Vive)



增强现实头显技术
Microsoft HoloLens
(Google Glass)

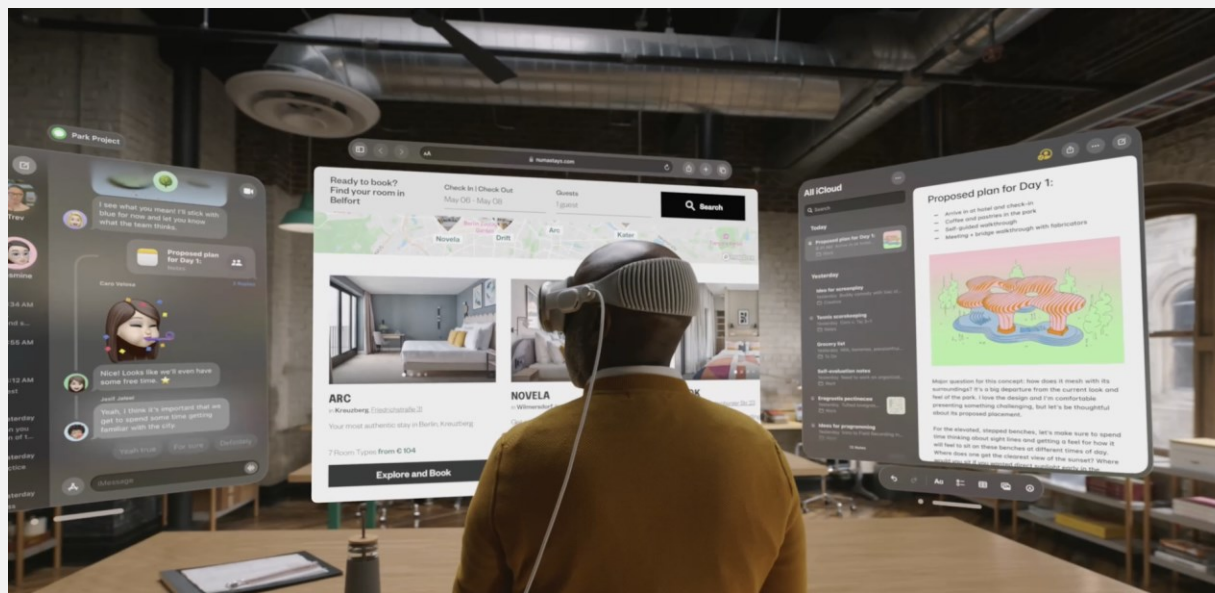
增强现实显示技术

optical see-through



Google Glass

video see-through



Apple Vision Pro