AR VR DISPLAY

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https://cambum.net/index.htm

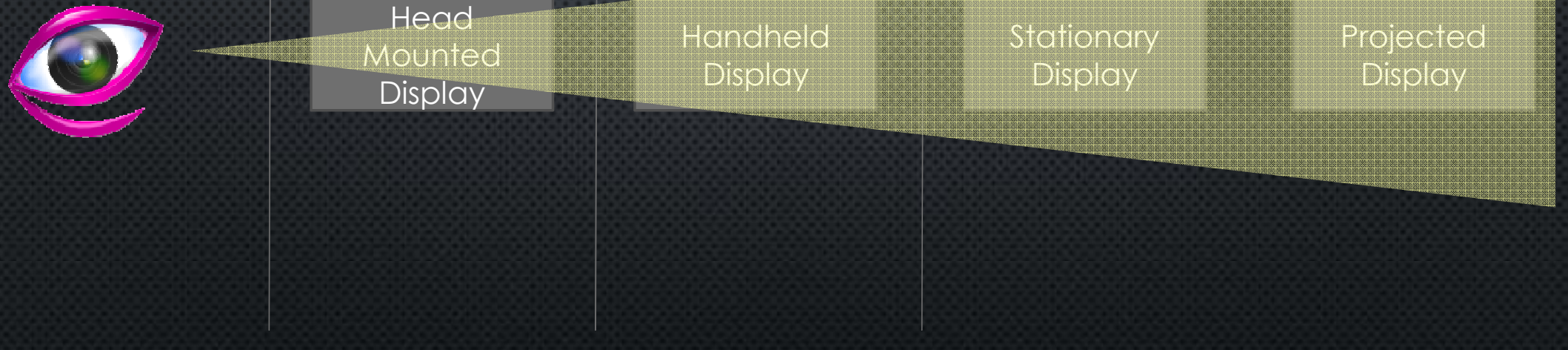
HISTORY

Year	Event
1964	The Uniscope 300 machine had a built-in CRT display. While not a true computer monitor, it was a precursor to CRT monitor technology.
1965	Touch screen technology was invented by E. A. Johnson in 1965.
1973	The Xerox Alto computer, released on March 1, 1973, included the first computer monitor. The monitor used CRT technology and had a monochrome display.
1975	The first resistive touch screen display was developed by George Samuel Hurst in 1975. However, it was not produced and used until 1982.
1976	The Apple I and Sol-20 computers were the first computers to have a built-in video output port, allowing for the connection of a computer monitor or video screen.
1977	LED display technology was developed by James P. Mitchell in 1977, but LED monitors were not readily available for purchase on the consumer market until about 30 years later.
1977	The Apple II, released in June 1977, allowed for color display on a CRT monitor.
1987	The first VGA monitor, the IBM 8513, was released by IBM in 1987.
1989	The SVGA standard for computer displays was officially defined by VESA in 1989.
late-1980s	By the late 1980s, color CRT monitors were capable of a 1024 x 768 resolution display.

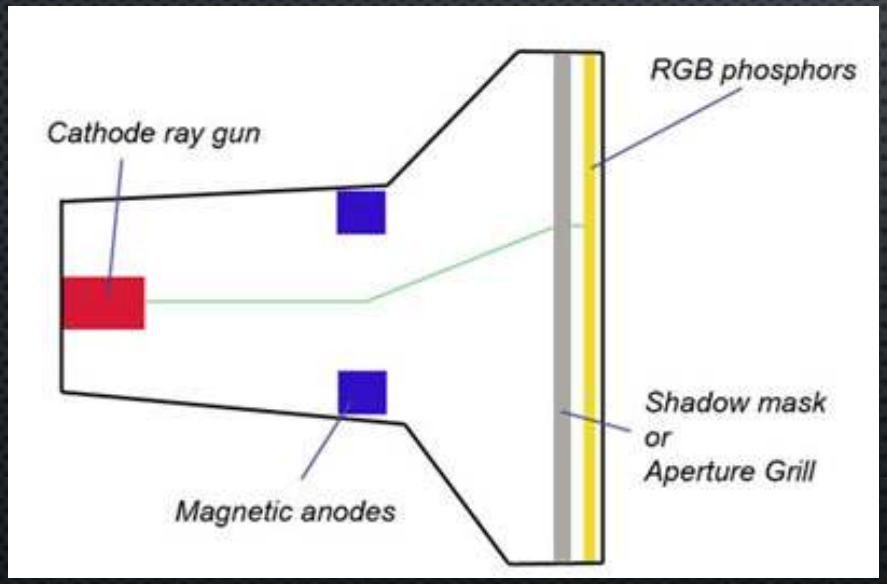
Year	Event
mid-1990s	One of the first LCD monitors for desktop computers was the Eizo L66, manufactured and released by Eizo Nanao Technologies in the mid-1990s.
1997	Apple, IBM, and Viewsonic begin developing color LCD monitors that offer comparable or better quality and resolution compared to CRT monitors.
1998	The Apple Studio Display was one of the earliest affordable, color LCD monitors for desktop computers, manufactured by Apple in 1998.
2003	LCD monitors outsell CRT monitors for the first time in 2003. By 2007, LCD monitors consistently outsell CRT monitors, becoming the most popular type of computer monitor.
2006	The first interface-free, touch-based computer monitor was introduced at TED by Jeff Han in 2006.
2009	NEC was one of the first companies to manufacture LED monitors for desktop computers. Their first LED monitor, the MultiSync EA222WMe, was released in late 2009.
2010	AMD and Intel, along with a handful of computer monitor manufacturers, announced they were phasing out support for VGA starting in December 2010.
2017	Touch screen LCD monitors start to become cheaper, more affordable for the average consumer in 2017. Prices for 20 to 22-inch touch screen monitors drop below $500.

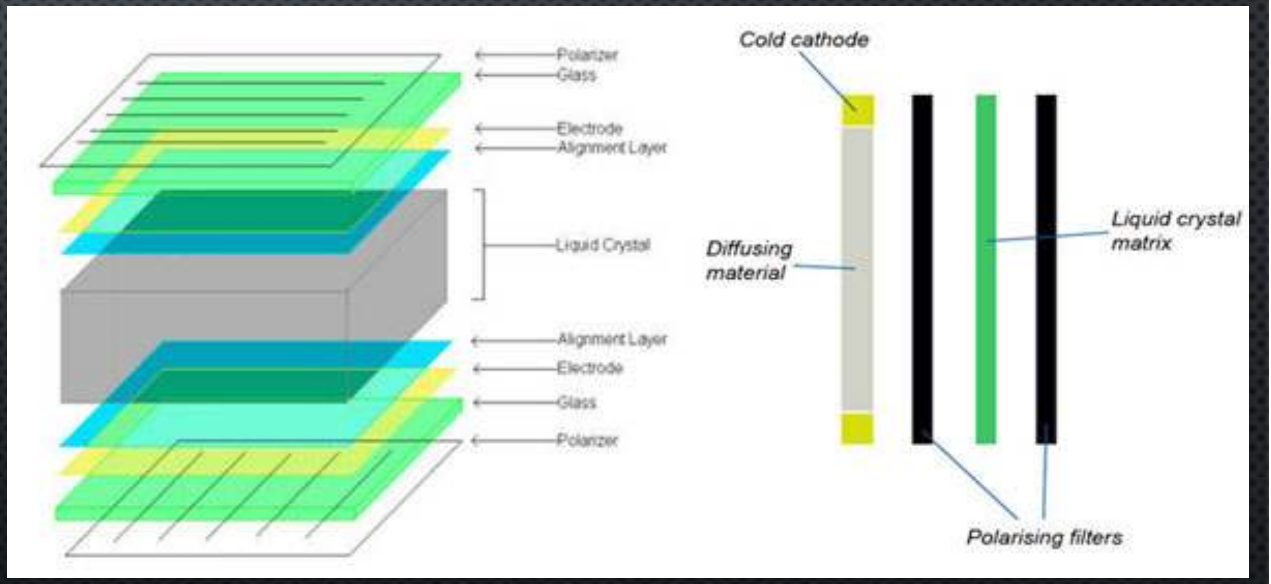
Source: https://www.computerhope.com/history/monitor.htm

SPECTRUM OF DISPLAYS



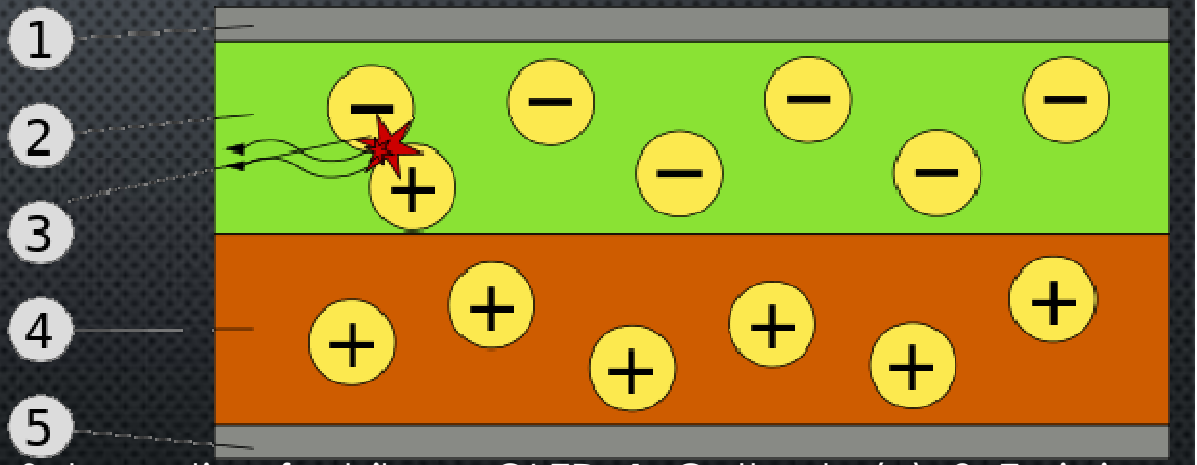
CRT AND LCD DISPLAY





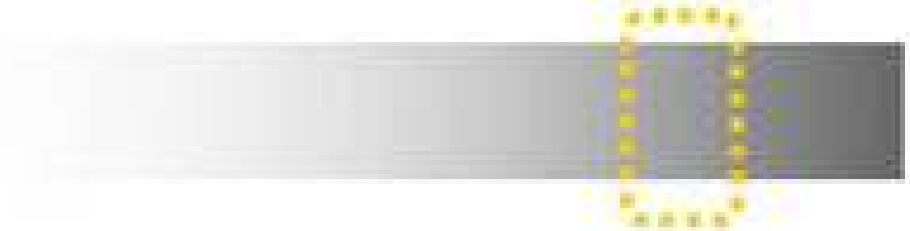
LED / OLED DISPLAY

- A **LED-BACKLIT LCD** IS A FLAT PANEL DISPLAY THAT USES LED BACKLIGHTING INSTEAD OF TRADITIONAL COLD CATHODE FLUORESCENT (CCFL) BACKLIGHTING
- AN OLED DISPLAY WORKS WITHOUT A BACKLIGHT BECAUSE IT EMITS VISIBLE LIGHT. THUS, IT CAN DISPLAY DEEP BLACK LEVELS AND CAN BE THINNER AND LIGHTER THAN A LIQUID CRYSTAL DISPLAY (LCD).
- IN LOW AMBIENT LIGHT CONDITIONS (SUCH AS A DARK ROOM), AN OLED SCREEN CAN ACHIEVE A HIGHER CONTRAST RATIO THAN AN LCD, REGARDLESS OF WHETHER THE LCD USES COLD CATHODE FLUORESCENT LAMPS OR AN LED BACKLIGHT.

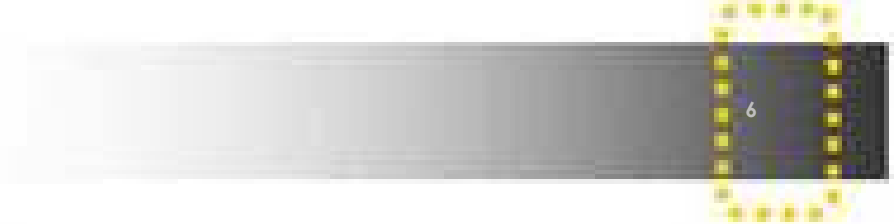


Schematic of a bilayer OLED: 1. Cathode (−), 2. Emissive Layer, 3. Emission of radiation, 4. Conductive Layer, 5. Anode (+)

LCD Monitor contrast and image quality 50000:1



LED Monitor contrast and image quality 1000000:1



CHARACTERISTICS OF DISPLAY

- Stereoscopy: VST requires separate images for each eye, OST is naturally binocular
- Focus: Accommodation Vergance Conflict
- Occlusion: between virtual and real objects
- Resolution: VST is constrained camera resolution
- Refresh Rate: Flicker, image lag and ghosting
- FoV: Camera vs display in VST; Angular Resolution = f(FoV, Spatial Resolution) in HMD
- Viewpoint Offset: Calibration for VST
- Brightness & Contrast: Outdoor contrast for OST
- Distortion: Fish eye effect for VST, Bayer Mask
- Ergonomics: Weight and size, cybersickness

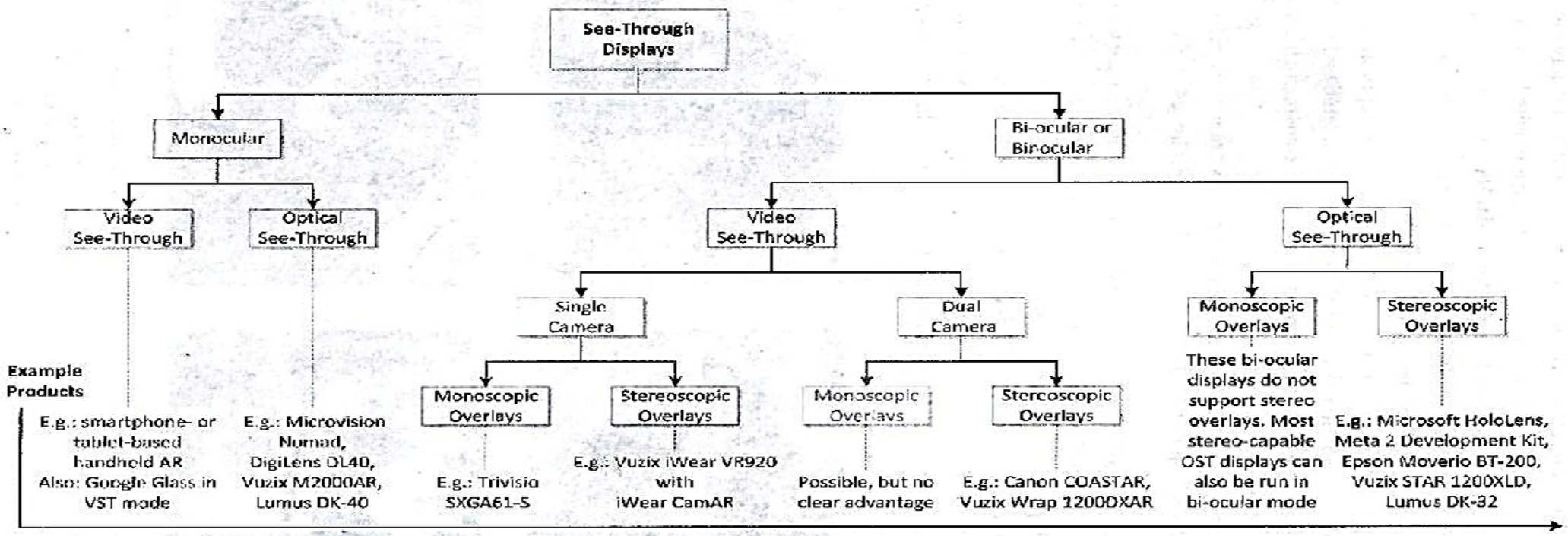


Figure 2.7 Categorization of see-through displays based on stereo capabilities.

OPTICAL SEE THROUGH DISPLAY

- PARTIALLY TRANSMISSIVE AND PARTIALLY REFLECTIVE OPTICAL ELEMENT
- COMPUTER GENERATED IMAGE OVERLAID ON REAL WORLD

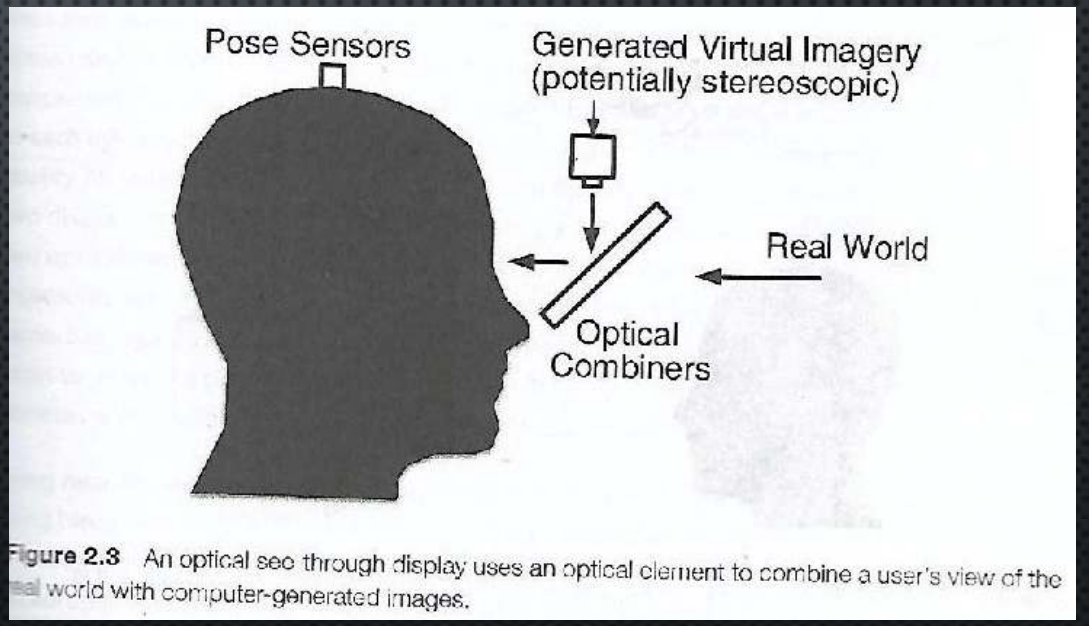


Figure 2.3 An optical see through display uses an optical element to combine a user's view of the real world with computer-generated images.

DEMO - IHUD


Vent Control
Climate Control
Seat Control
Emergency
0.6 mi
31 mph
33 min
34 mi
Eye
Interactive HUD
I3D Lab, IISc
Maps
Music/Video

VIDEO SEE THROUGH DISPLAY

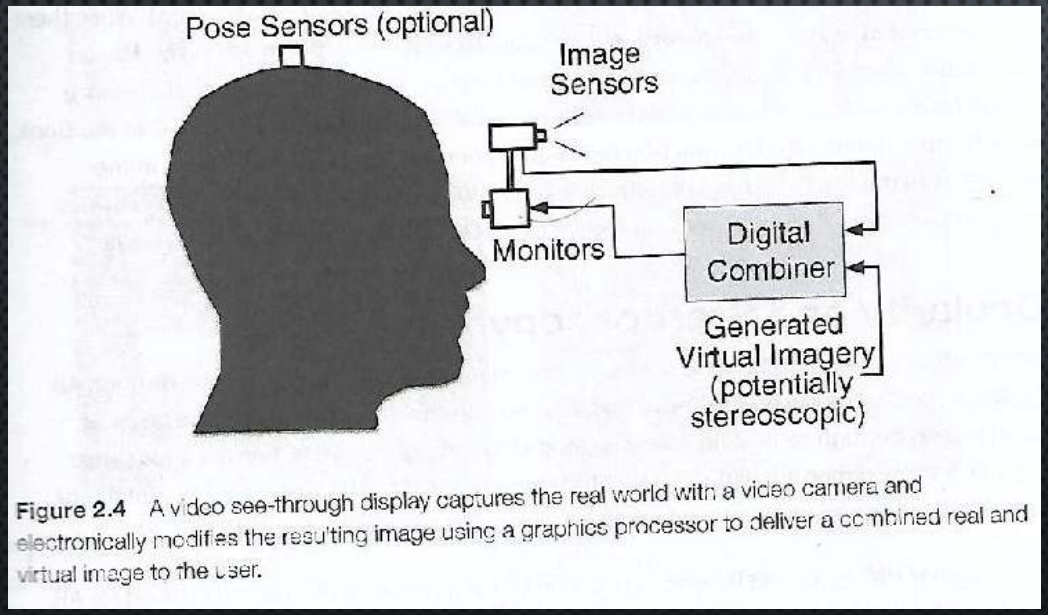
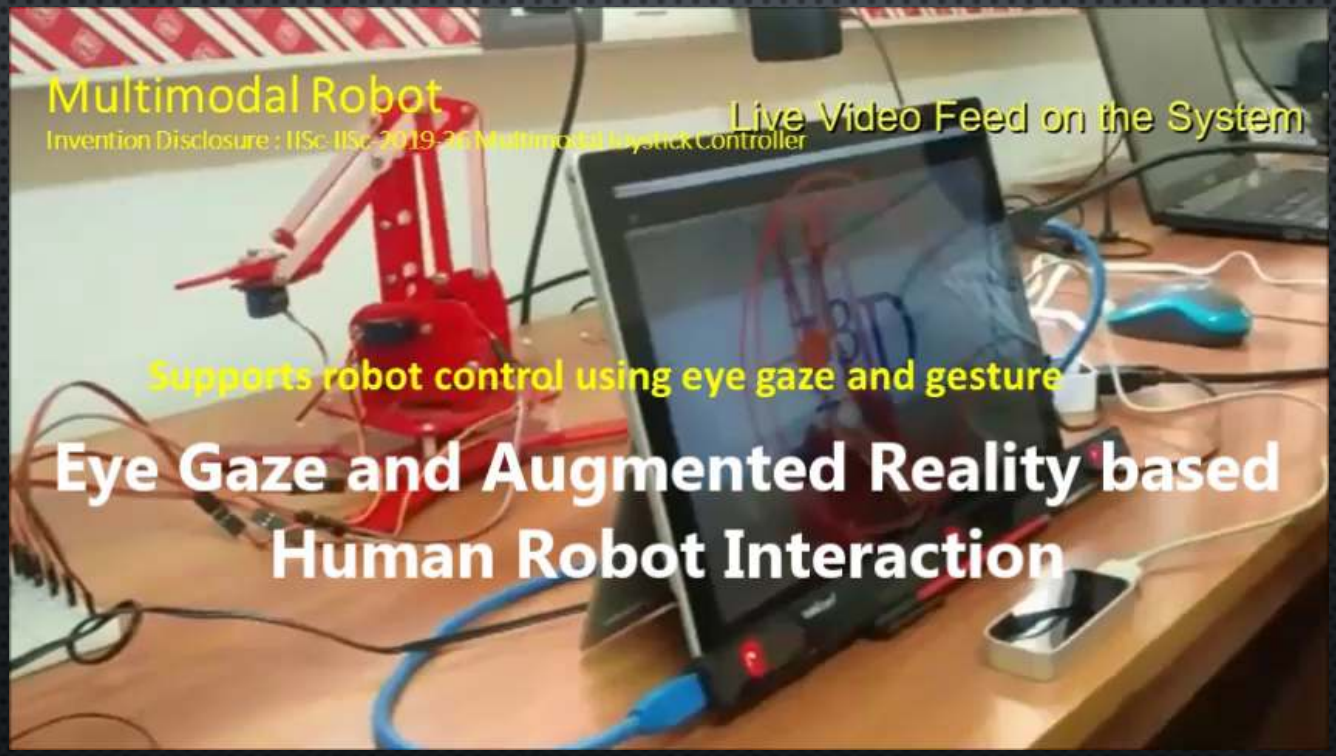


Figure 2.4 A video see-through display captures the real world with a video camera and electronically modifies the resulting image using a graphics processor to deliver a combined real and virtual image to the user.

- REAL WORLD IS CAPTURED THROUGH VIDEO CAMERA
- COMPUTER GENERATED IMAGE / TEXT IS OVERLAID ON LIVE VIDEO

DEMO - HRI


Multimodal Robot
Invention Disclosure : IISc-IISc-2019-36 Multimodal Joystick Controller
Live Video Feed on the System
Supports robot control using eye gaze and gesture
Eye Gaze and Augmented Reality based Human Robot Interaction

PROJECTED DISPLAY

- AR DISPLAY IS GENERATED BY A LIGHT PROJECTOR
- VIRTUAL IMAGE IS DIRECTLY PROJECTED ON REAL WORLD

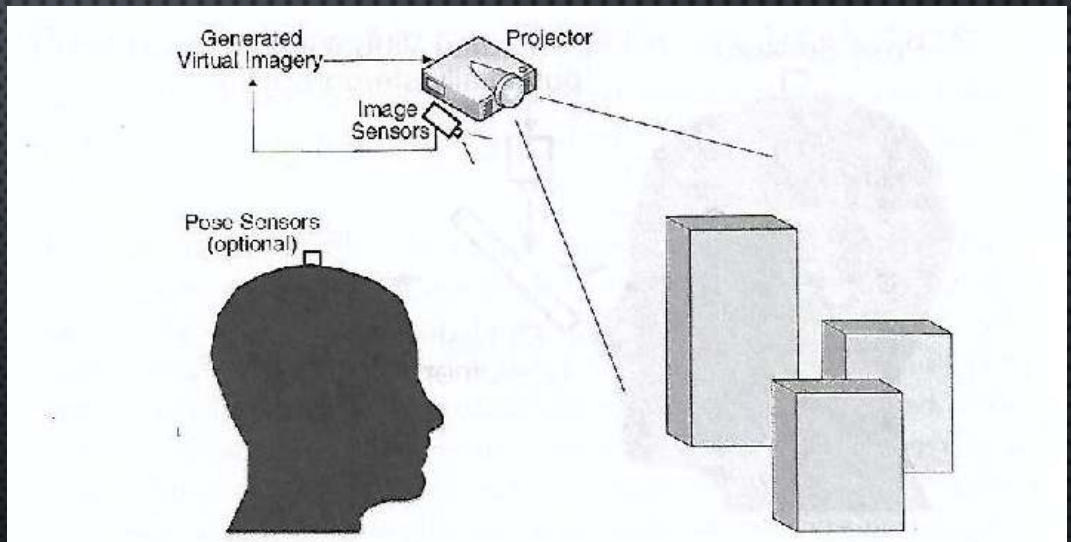


Figure 2.5 Spatial projection casts images directly onto real-world objects; no combiner unit is required.

DEMO – SENSOR DASHBOARD

HEAD MOUNTED AR DISPLAY

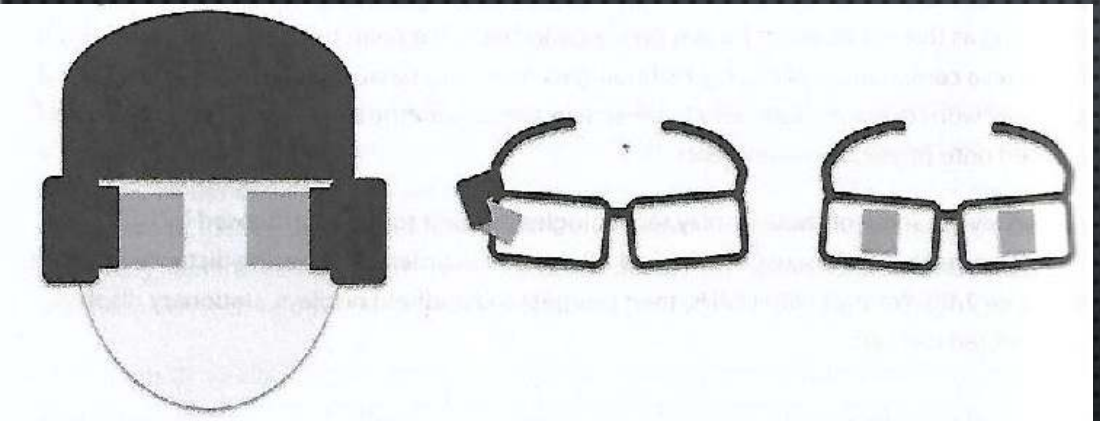


Figure 2.19 Different display mounting options. (left) Helmet-mounted display, like that used by Rockwell Collins SimEye. (middle) Clip-on display, like that used by Google Glass. (right) Visor display like that used by Epson Moverio.

- Optical and Video See through displays
- Main Challenges
  - Placement of display
  - Ergonomics
  - Controlling amount of light on eye
  - Combining wide FoV with small, lightweight form factor

VR DISPLAY

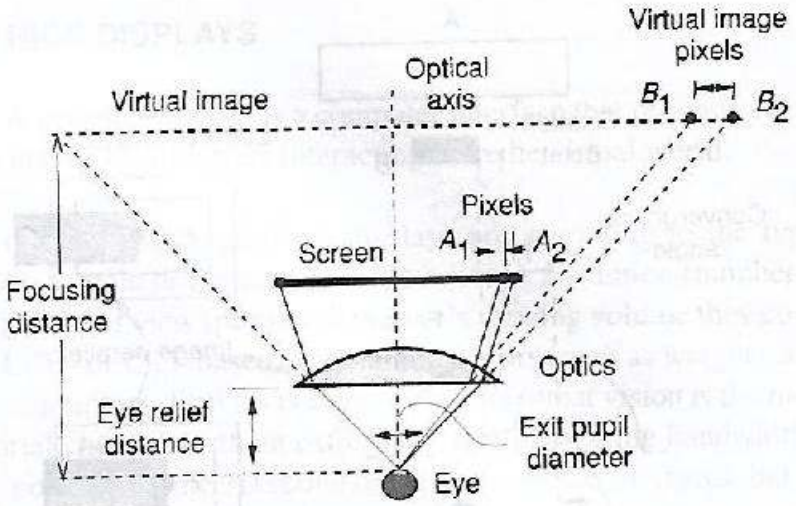


Fig. 3.2 Simplified optics model of an HMD. Adapted from Robinett and Rolland [1992] ©1992 Massachusetts Institute of Technology. Reprinted by permission.

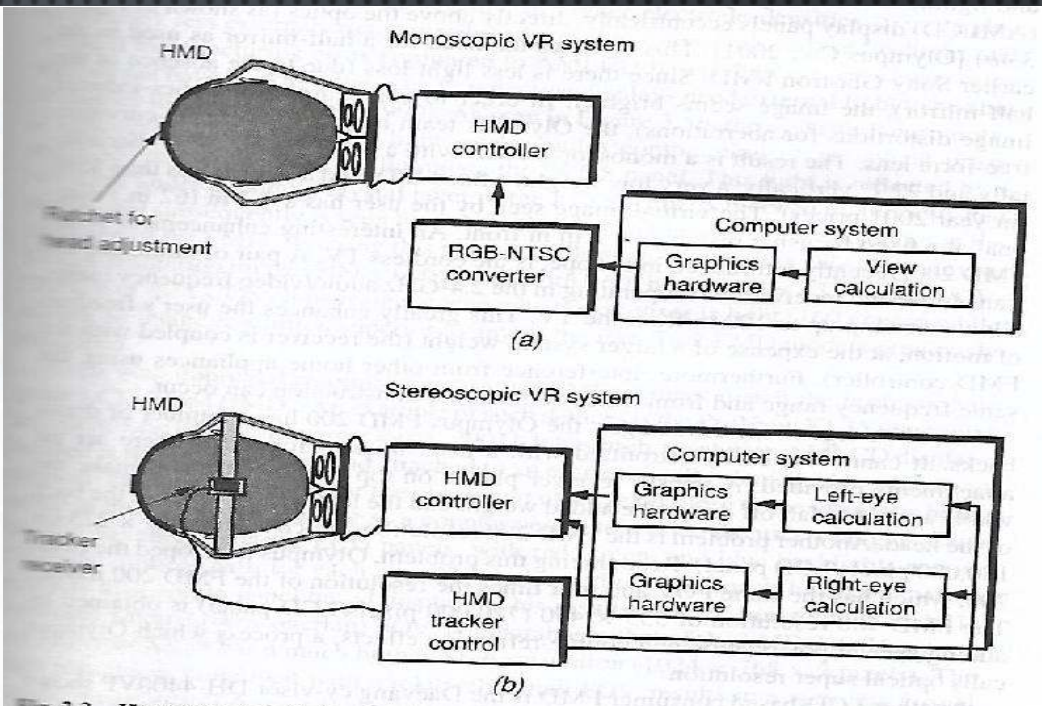


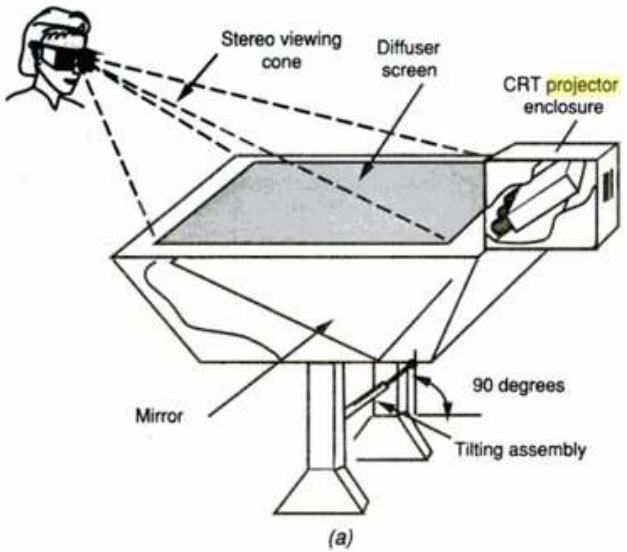
Fig. 3.3 Head-mounted display (HMD) integration in a VR system for: (*a*) consumer (monoscopic) HMD; (*b*) professional (stereoscopic) HMD. Adapted in part from Pimentel and Teixeira [1993]. Reprinted by permission.

OCULUS TEARDOWN

- Two OLED displays with a combined resolution of 2160 x 1200
- 90 Hz refresh rate
- Accelerometer, gyroscope, and magnetometer
- 360-degree headset tracking via Constellation IR camera
- Horizontal field of view greater than 100°

https://www.ifixit.com/Teardown/Oculus+Rift+CV1+Teardown/60612

PROJECTOR BASED VR



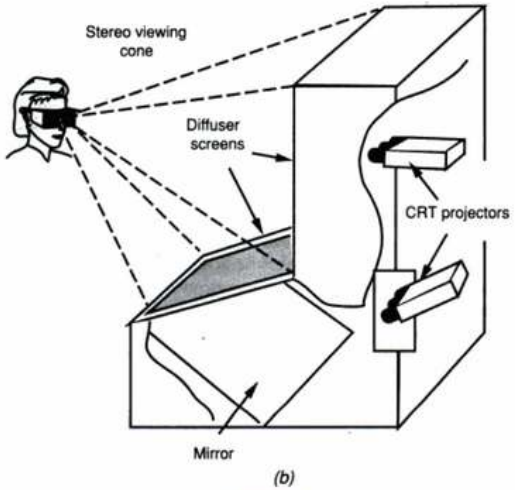


Fig. 3.16 Workbench displays. (*a*) Single-projector tilting configuration. Adapted from Barc Baron [1999b]. Reprinted by permission. (*b*) Dual-projector L-shaped configuration. Adapte from Trimension Systems Ltd. [2001]. Reprinted by permission of SEOS Ltd.

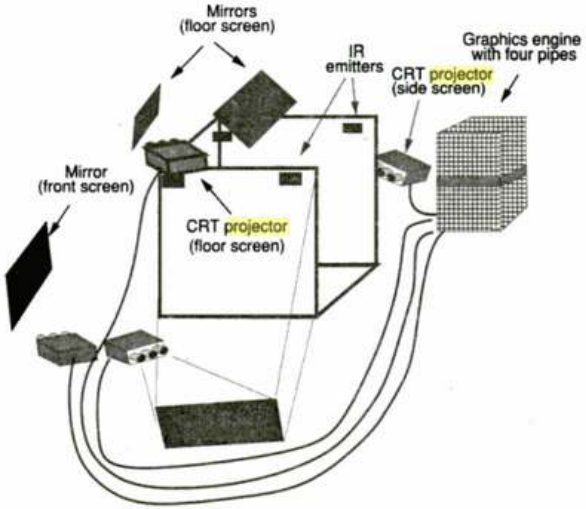


Fig. 3.17 The four-projector CAVE® display. Adapted from Pape et al. [1997]. Reprinted by permission of Electronic Visualization Laboratory, University of Illinois at Chicago.

3-D DISPLAY

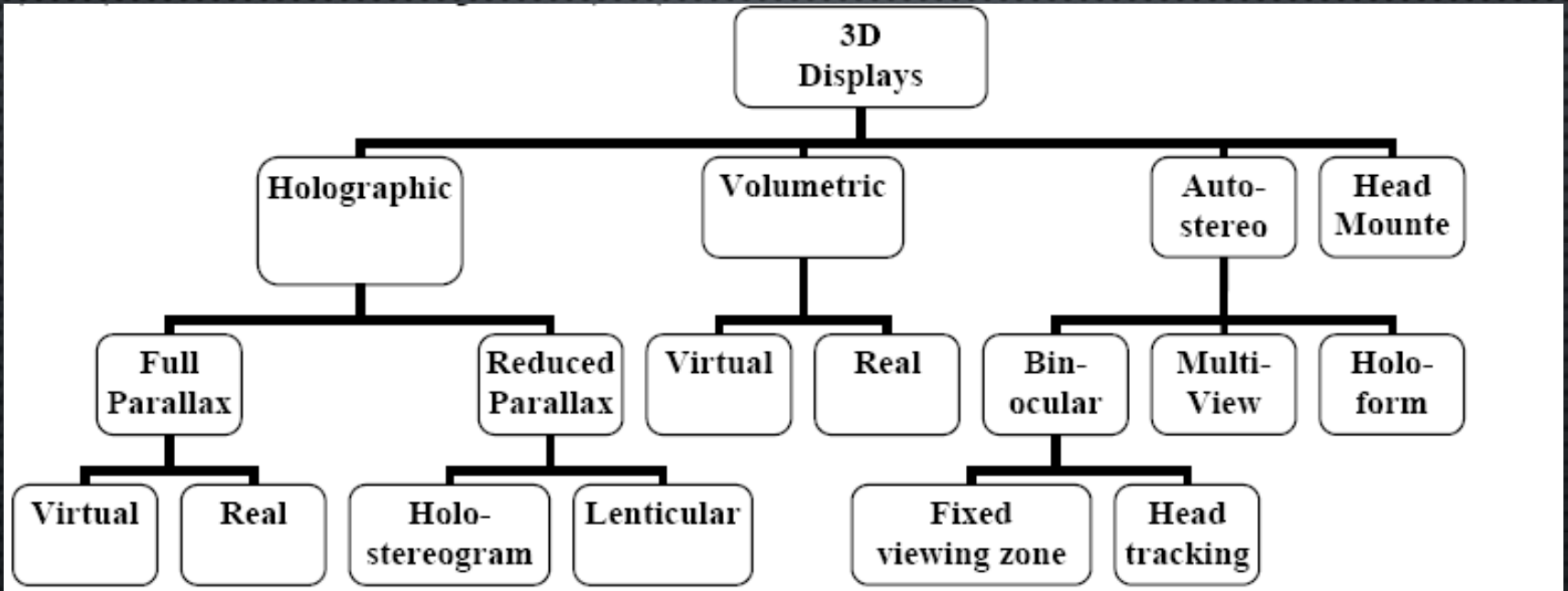
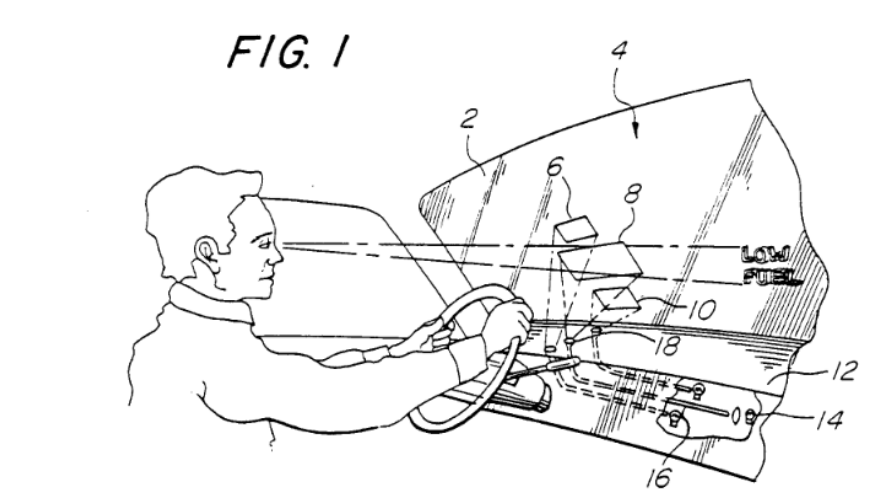


Figure 1: Classification of 3D Display Techniques.

HOLOGRAPHIC DISPLAY



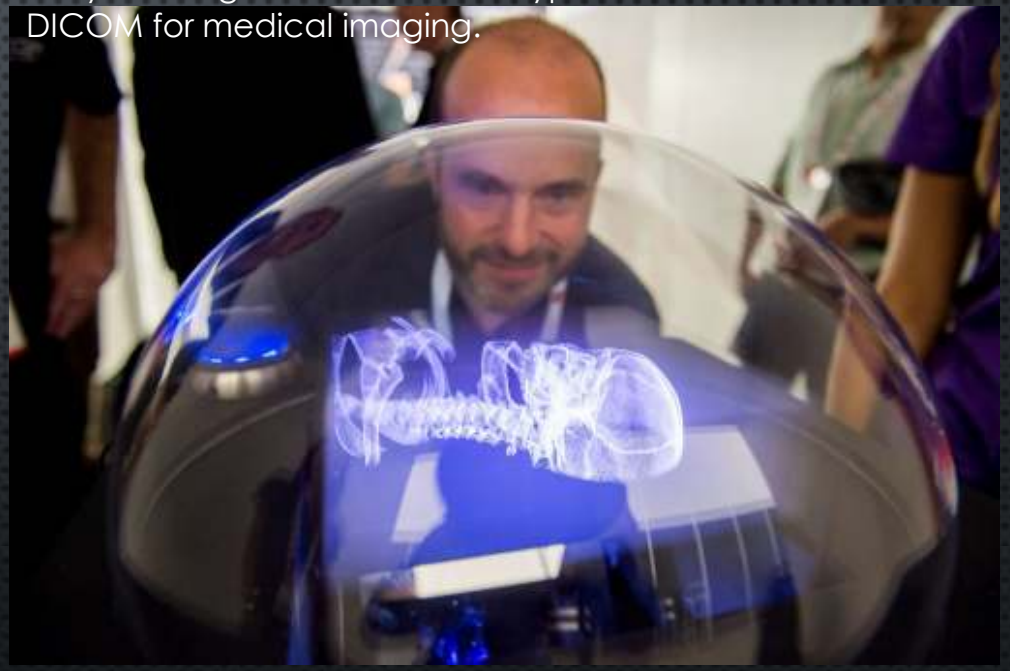
HOLOGRAPHIC DISPLAY PANEL FOR A VEHICLE WINDSHIELD, WO 88/05176 (14.07.88 88/15)

- A **HOLOGRAPHIC DISPLAY** IS A TYPE OF DISPLAY THAT UTILIZES LIGHT DIFFRACTION TO CREATE A VIRTUAL THREE-DIMENSIONAL IMAGE OF AN OBJECT.
- HOLOGRAPHIC DISPLAYS ARE DISTINGUISHED FROM OTHER FORMS OF 3D IMAGING IN THAT THEY DO NOT REQUIRE THE AID OF ANY SPECIAL GLASSES OR EXTERNAL EQUIPMENT FOR A VIEWER TO SEE THE IMAGE.

VOLUMETRIC DISPLAY

- A **VOLUMETRIC DISPLAY DEVICE** IS A GRAPHIC DISPLAY DEVICE THAT FORMS A VISUAL REPRESENTATION OF AN OBJECT IN THREE PHYSICAL DIMENSIONS, AS OPPOSED TO THE PLANAR IMAGE OF TRADITIONAL SCREENS THAT SIMULATE DEPTH THROUGH A NUMBER OF DIFFERENT VISUAL EFFECTS. ONE DEFINITION OFFERED BY PIONEERS IN THE FIELD IS THAT VOLUMETRIC DISPLAYS CREATE 3D IMAGERY VIA THE EMISSION, SCATTERING, OR RELAYING OF ILLUMINATION FROM WELL-DEFINED REGIONS IN (X,Y,Z) SPACE.
- A TRUE VOLUMETRIC DISPLAY RENDERS A DIGITAL REPRESENTATION OF A REAL OBJECT IN A PHYSICAL SPACE (VOLUME), THE RESULTING "IMAGE" DISPLAYS SIMILAR CHARACTERISTICS TO A REAL WORLD OBJECT ENABLING AN OBSERVER TO VIEW IT FROM ANY DIRECTION, FOCUS A CAMERA ON A SPECIFIC DETAIL AND SEE PERSPECTIVE MEANING PARTS OF THE IMAGE CLOSER TO THE VIEWER WILL APPEAR BIGGER THAN PARTS THAT ARE FURTHER AWAY.
- VOLUMETRIC 3D DISPLAYS ARE AUTOSTEREOSCOPIC, THAT IS, THEY CREATE 3D IMAGERY VISIBLE TO THE UNAIDED EYE.

Voxon Photonics VX1 has a volume area that is 18cm * 18cm * 8cm deep and can render up up 500 million voxels per second. Content for the VX1 can be created using Unity or using standard 3D file types such as OBJ, STL and DICOM for medical imaging.



TAKE AWAY POINTS

- History of Display Development
- Different Types of Display
- AR and VR related Displays
- Classification
- Characteristics
- Futuristic work