

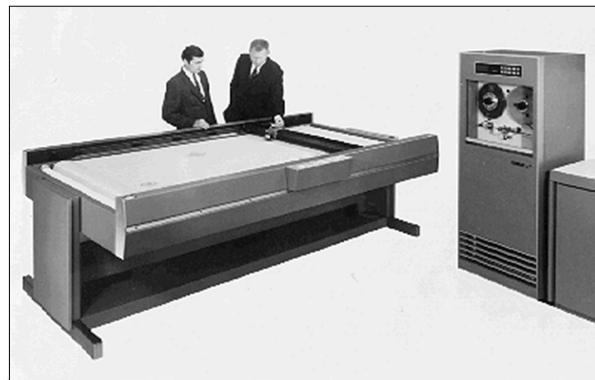
MIT

Luiz Velho
IMPA

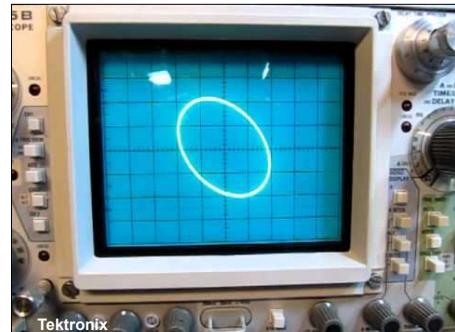
The Birth of Graphics Devices

The 1950s

- Pen Plotters
- Computer-controlled oscilloscopes



Calcomp



Tektronix

The 1960s

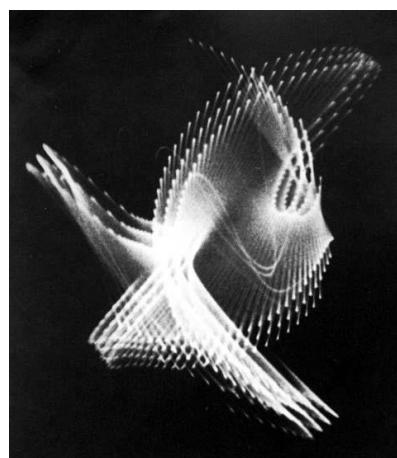
- Ivan Sutherland's SketchPad project
- Interaction
- Vector displays



The Early MIT Years

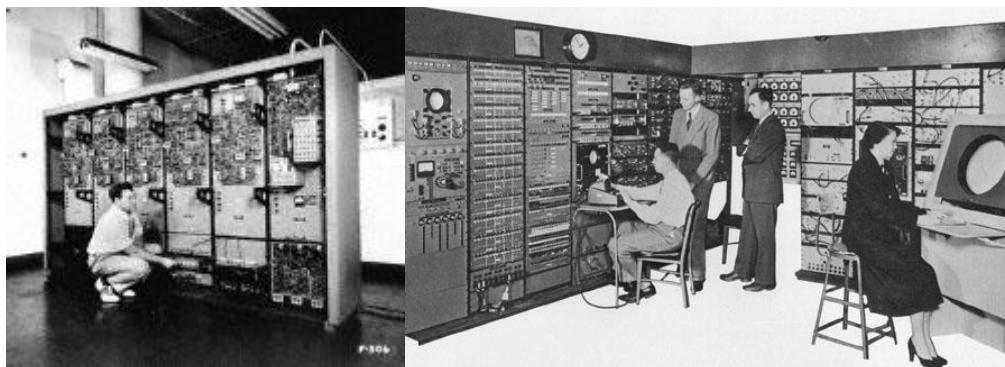
First Graphic Image

- 1950: The first graphic images are created by Ben Laposky using an oscilloscope to generate waveform artwork produced by manipulating the analog electronic beams.



Whirlwind

- 1951: Designed to support military preparedness, **Jay Forrester and Robert Everett** of the Massachusetts Institute of Technology (**MIT**) produce the **Whirlwind**, a mainframe computer with a **CRT** to plot blips representing incoming aircrafts based on radar-gathered data.



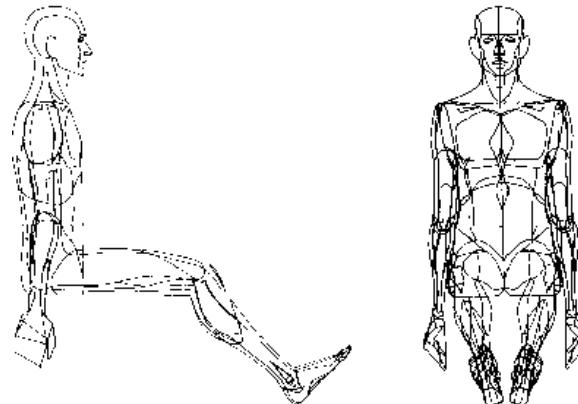
SAGE

- 1955: Direct descendant of the Whirlwind, the SAGE (Semi-Automatic Ground Equipment) air defense system is designed by **Bert Sutherland** at **MIT**. It uses **simple vector graphics** to display on analog CRTs radar images with a wireframe outline of the region being scanned, as well as the **first light pen** as an input device that operators would use to pinpoint planes flying over regions of the United States. It becomes a key part of the US missile defense system.



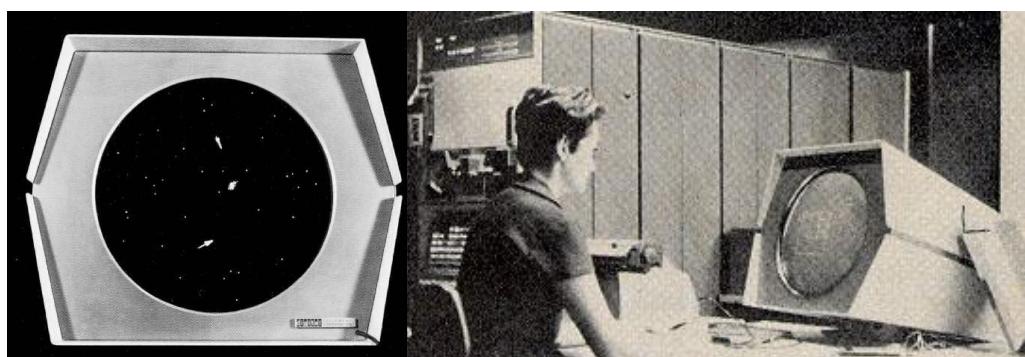
We Have a Name

- 1960: The term “computer graphics” is coined by **William A. Fetter at Boeing** to describe the new design methods for his human factors cockpit simulations. Two years later, he will create the “First Man” digital human for cockpit studies.



Spacewar

- 1961: **Spacewar**, the first video game, is developed by **MIT** student **Steve Russell** for the DEC PDP-1 minicomputer.



Who is Ivan Sutherland

A Man with a Vision

- Computer-Aided Design
 - Sketchpad, 1962
- Virtual and Augmented Reality
 - Head Mounted 3D Display, 1965
- Academic Think Tank
 - Utah Program in Graphics, 1968
- Visual Simulation
 - Evans and Sutherland, 1968

Sketchpad

The 1st CAD System

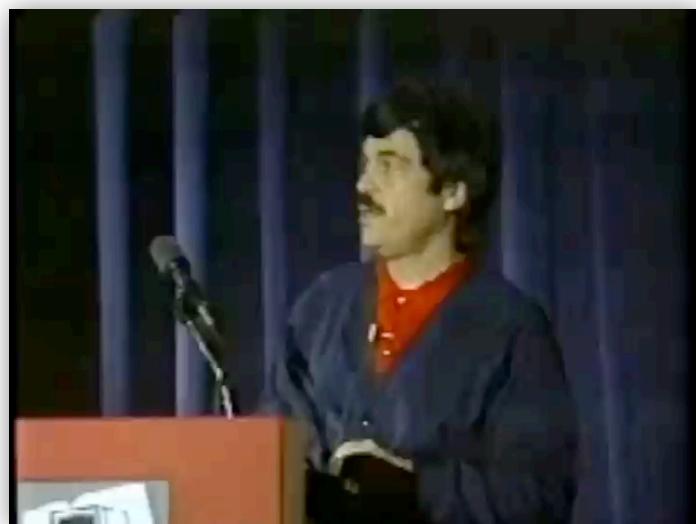
- 1963: For his doctoral thesis at MIT, **Ivan Sutherland** develops **Sketchpad**, the first **Computer-Aided Drafting and Design** (CADD) package allowing shapes to be interactively drawn on a vector-based display monitor using a **light pen input device** wired into the computer. The light pen uses a small photoelectric cell in its tip to emit an electronic pulse when the pen “sees” the electron beam.



The Sketchpad System

- Interactive 2D Computer Graphics
 - MIT Ph.D. Dissertation
 - Lincoln Lab TX-2 computer / Light Pen
- Master Instance Coupling
 - Object-Oriented Programming
- Geometric Constraint Maintenance

The System in Action

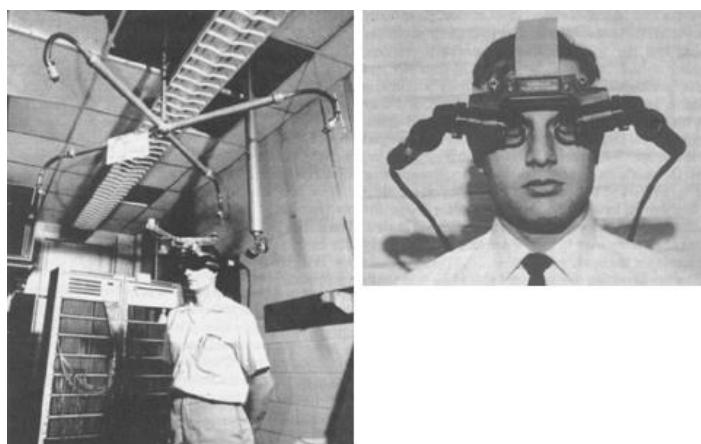


- Demo by Alan Kay

The Sword of Damocles

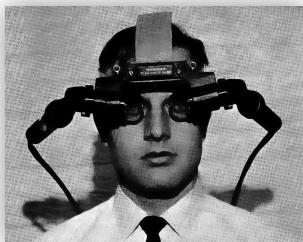
The First HMD

- 1966: **Ivan Sutherland** creates the first **head-mounted display**, the *Sword of Damocles*, which displays separate wireframe images, allowing depth perception.

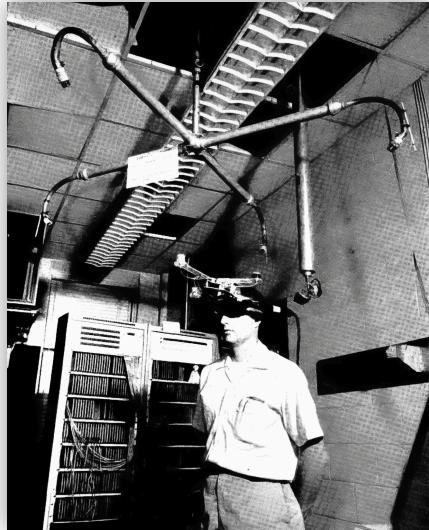


Hardware Prototype

- MIT Lincoln Lab

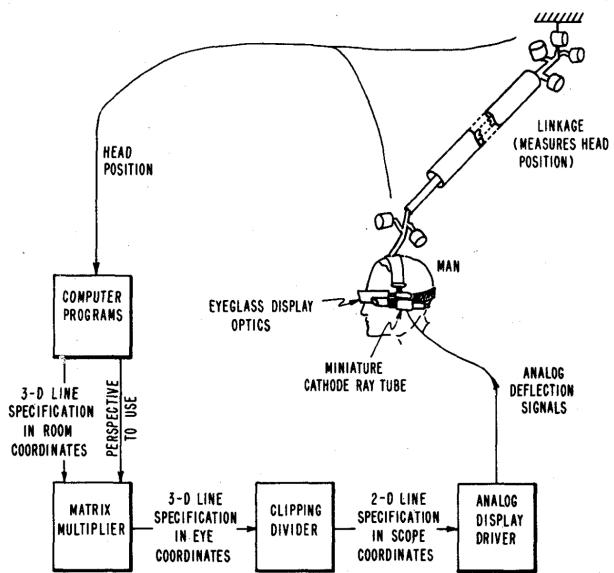


HMD



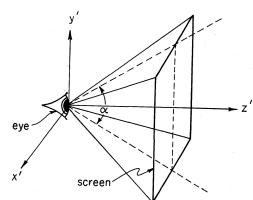
The Sword

System's Components

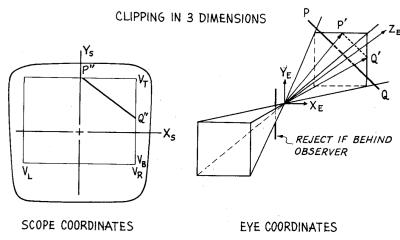


Software Architecture

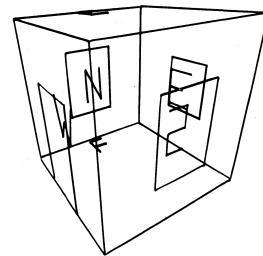
- The Inception of 3D Graphics



Virtual Camera



Viewing Transformations



3D Display

Room with a View



- First Demo @ Lincoln Lab

Camelot

Evans & Sutherland

- 1967: MIT's Center for Advanced Visual Studies is founded by Gyorgy Kepes.



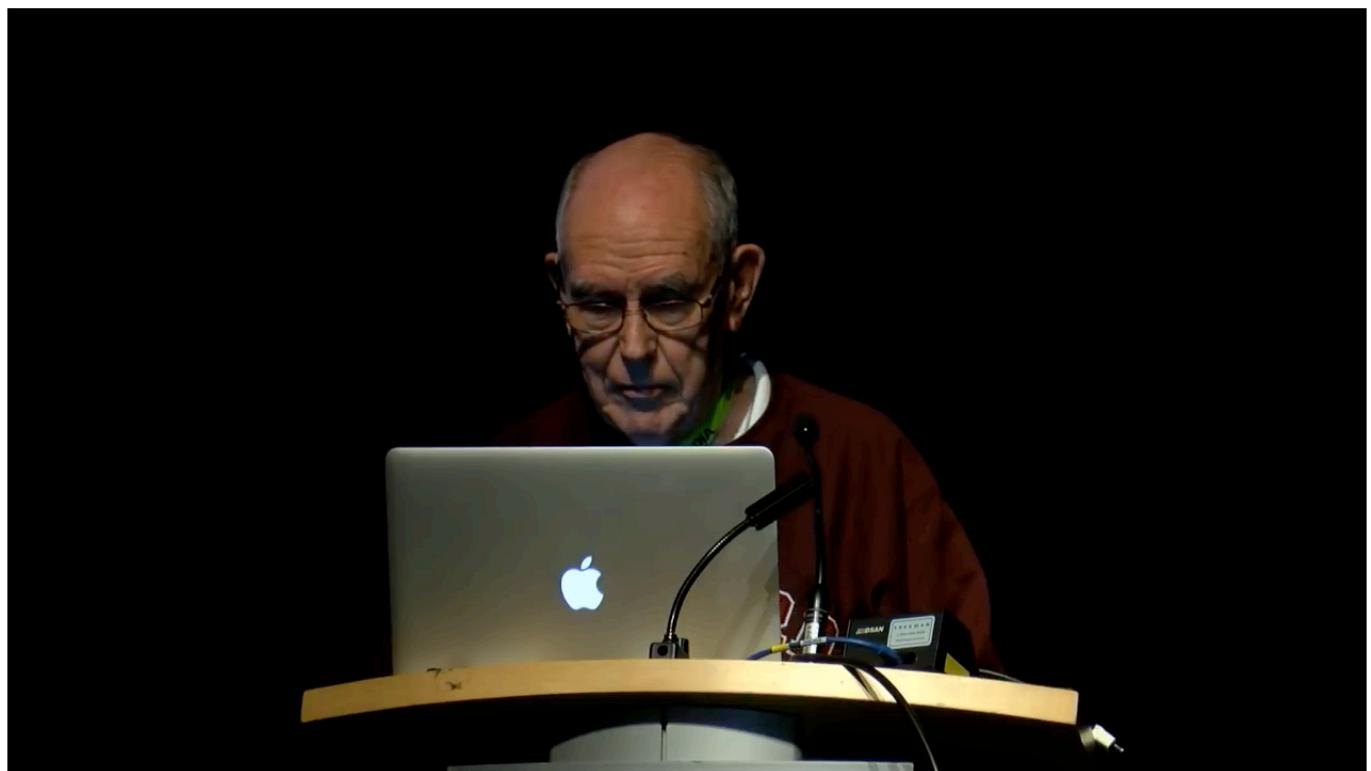
- 1968: Dave Evans joins the computer science department at the University of Utah and forms a CG group. Sutherland also joins the University of Utah.



- 1968: Frustrated by the lack of graphics hardware available, Evans & Sutherland then found their own company.



The Godfather of VR



Sutherland's VR Vision

*"Don't think of that thing as a **screen**;
think of it as a **window**.*

*Through that **window**, one looks into a **virtual world**."*

Looking into the Future

Sutherland VR Challenge

- Complete **Immersion** in Virtual World
- Eye and Body **Tracking**
- Image Generation produces a World that **Looks Real**
- User **Directly Manipulates** Virtual Objects
- Computer Maintains World Model in **Real Time**
- Virtual World **Sounds Real, Feels Real**

Challenges of Requirements

- System
 - Display: Resolution, Color, Stereo, Field-of-View
 - Sound: Spatial
 - Haptics: Touch, Pressure, Heat-Flow
- Modeling the Virtual World
 - Geometry, Texture, Color
 - Illumination, Optics, Physics

Watch @ Home

- Utah Graphics in the Bay Area



*group gathering
(kool & the gang meeting)*