

# CEG3500



# Introduction to Augmented and Virtual Reality



Image courtesy of Forbes

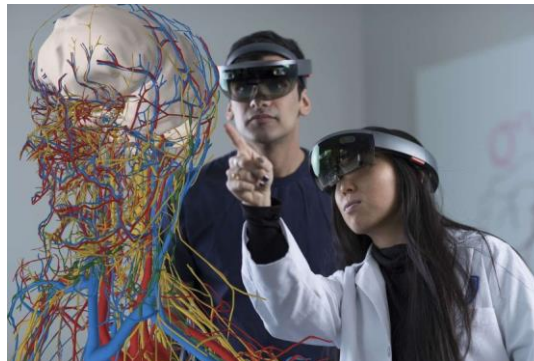


Image courtesy of Chronicle of Higher Education



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# Outline

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A project-based course to learn about augmented and virtual reality and to develop software for dedicated augmented and virtual reality hardware.

This course introduces students to extended reality (XR) technologies and their use. Extended Reality includes augmented reality (AR) and virtual reality (VR) among others. The course will explore different technologies, concepts, and development environments that can be used for these types of content delivery. Students will directly apply these principles to design different prototypes using the available equipment.

# Literature

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Creating Augmented and Virtual Realities: Theory and Practice for Next-Generation Spatial Computing 1st Edition, Erin Pangilinan, Steve Lukas, Vasanth Mohan, O'Reilly Media; 1 edition (2019).

Unity Virtual Reality Projects: Learn Virtual Reality by developing more than 10 engaging projects with Unity 2018, 2nd Edition by Jonathan Linowes (2018).

Unity 2018 By Example: Learn about game and virtual reality development by creating five engaging projects, 2nd Edition by Alan Thorn (2018)

Unity 3D: <https://unity3d.com/>

HTC Vive: <https://www.oculus.com/rift/#oui-csl-rift-games=star-trek>

Vuforia: <https://www.vuforia.com/>

Magic Leap: <https://www.magicleap.com/>

What is VR, AR, MR, XR, 360 (Unity): <https://unity3d.com/what-is-xr-glossary>

# Literature (continued)

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The Difference Between VR, AR, MR, and XR: <https://hackernoon.com/the-difference-between-ar-vr-mr-xr-and-how-to-tell-them-apart-45d76e7fd50>

Getting Started with VR Development (Unity):  
<https://unity3d.com/learn/tutorials/topics/xr/getting-started-vr-development>

Getting Started with Viewforia in Unity:  
<https://library.vuforia.com/articles/Training/getting-started-with-vuforia-in-unity.html>

XR in Unity: <https://unity3d.com/learn/tutorials/s/xr>

HTC Vive Unity Tutorial: <https://circuitstream.com/htc-vive-tutorial/>

Magic Leap Creator Portal: <https://www.magicleap.com/creator>

Software development for VR and AR in different environments:  
<http://avida.cs.wright.edu/software.html>

# History

## Virtual Reality was created to

- An artificial environment created with software and presented to the user so that the user
- Suspends belief
- Accepts it as real environment
- VR is experienced through two senses – sight and sound
- Create an immersive experience where the user feels “presence”



# History

## Morton Heilig

- Attempted to stimulate the different senses during the 1950s
- Used a machine called **Sensorama** to provide a visual treat
- Included moving chairs and odor meters



# History

## Ivan Sutherland

- Student at the University of Utah
- In 1965, mimicked the physical world with the use of his invention – **Ultimate Display**
- It would look like the world the person lived in

## Ultimate Display (1965)

Ivan Sutherland is a pioneer in the field of computer graphics and in 1965 he described 'The Ultimate Display', which included interactive graphics and force-feedback devices.

In 1968, he described a prototype virtual reality system in his paper 'A head-mounted three-dimensional display'.

But it was a team at the NASA Ames Research Center who really opened up the possibilities of virtual reality worlds with their Virtual Interface Environmental Workstation (VIEW), developed during the 1980s as a training system for future astronauts.

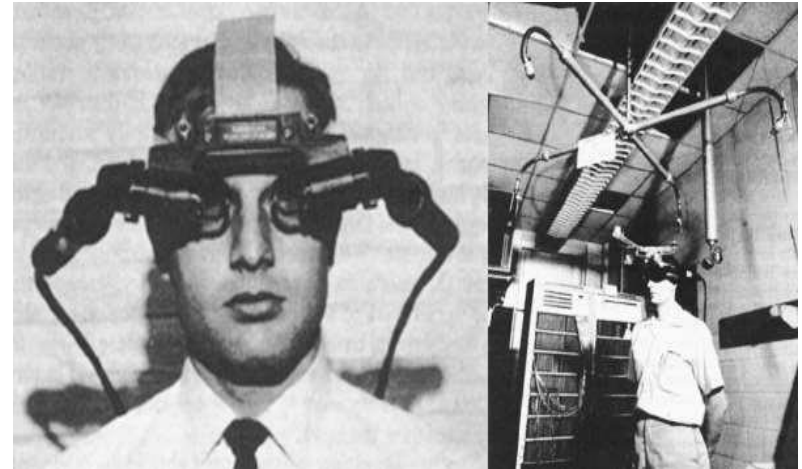


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# History

## Philco Corporation

- In 1961, devised project '**Headsight**'
- Produced visual stimulation and a tracking system
- Also used for military purposes
- E.g. Pilots could train under **Headsight** to simulate flying in complete darkness





# History

## 1985 – VPL Research was Founded

- Founded by the ex Atari VR research team
- Invented the “EyePhone” an HMD incorporating inertial sensors and Fresnel lenses (featured in The Lawnmower Man)
- Invented the Data Suite, a full body suite capable of tracking arms, legs and torso
- Invented the data glove, which was licensed to Mattel and released as the Power Glove



## 1995 – Nintendo Virtual Boy

- Stereoscopic 3D graphics
- First widescreen display
- Commercial failure

# History

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In 2012 Oculus launched a kickstarter campaign to fund development of the Oculus Rift VR platform. The Success of that campaign launched a VR and AR arms race.

Major Players in the Current VR/AR market:

## PC Platforms

- Oculus Rift
- HTC Vive
- Starbreeze Star VR
- Microsoft HoloLens (AR)

## Mobile Platforms

- Samsung Gear
- Google Cardboard / Daydream
- Mattel View-Master
- Numerous AR Applications

# Virtual Reality vs Augmented Reality

The key distinction between VR and AR is that VR is meant to immerse the user in a virtual environment, while AR introduces virtual elements onto the real world.

- A VR system typically uses a headset in combination with a variety of sensors to track the users movement and relay the appropriate images/feedback creating the sensation of interacting with the virtual world.
- An AR system will typically utilize clear lenses or a pass-through camera allowing the user to see the world around them in real time while virtual elements are projects on the lenses or rendered on the camera output.



# VR and AR Applications

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VR and AR platforms are ideally suited for a wide variety of educational applications. The following is an attempt to cover what is arguably an endless list of potential applications with very broad strokes.

Applicable areas include, but are not limited to:

- Skilled Trade Programs
- Music / Fine Arts Education
- History and Geography
- STEM programs
- Sports and Athletic Training
- Medical Training

VR and AR applications provide controlled and repeatable scenarios rehearsing muscle memory and situational awareness.

VR applications make it possible to explore places otherwise inaccessible.

VR applications have the potential to provide access to resources that may be prohibitively expensive or otherwise inaccessible.

VR and AR applications provide innovative ways to visualize and manipulate data.

# Terminology

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Virtual Reality (VR): Replace the entire real world with a virtual one to fully immerse the user

Augmented Reality (AR): Add items to the real world, i.e. augment it; the real world is still visible

Extended Reality (XR): Attempt to define a term that is inclusive of both augmented and virtual reality

Mixed Reality (MR): Windows version of coining an inclusive term; MR supports devices such as HoloLens and Mixed Reality headsets