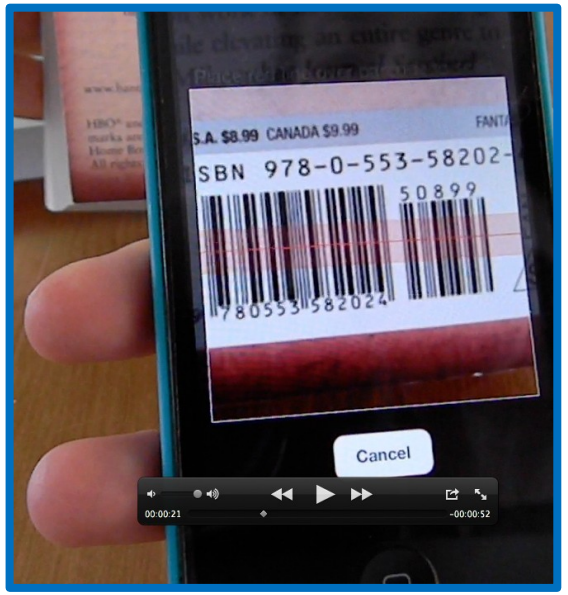
Why Augmented Reality

- Images presented in games, movies, and other media are detached from our physical surroundings
- Main interest we have in our daily life, which is not directed toward some virtual world, but rather toward the ***real world*** surrounding us

Location Based Services

Barcode for Supermarket

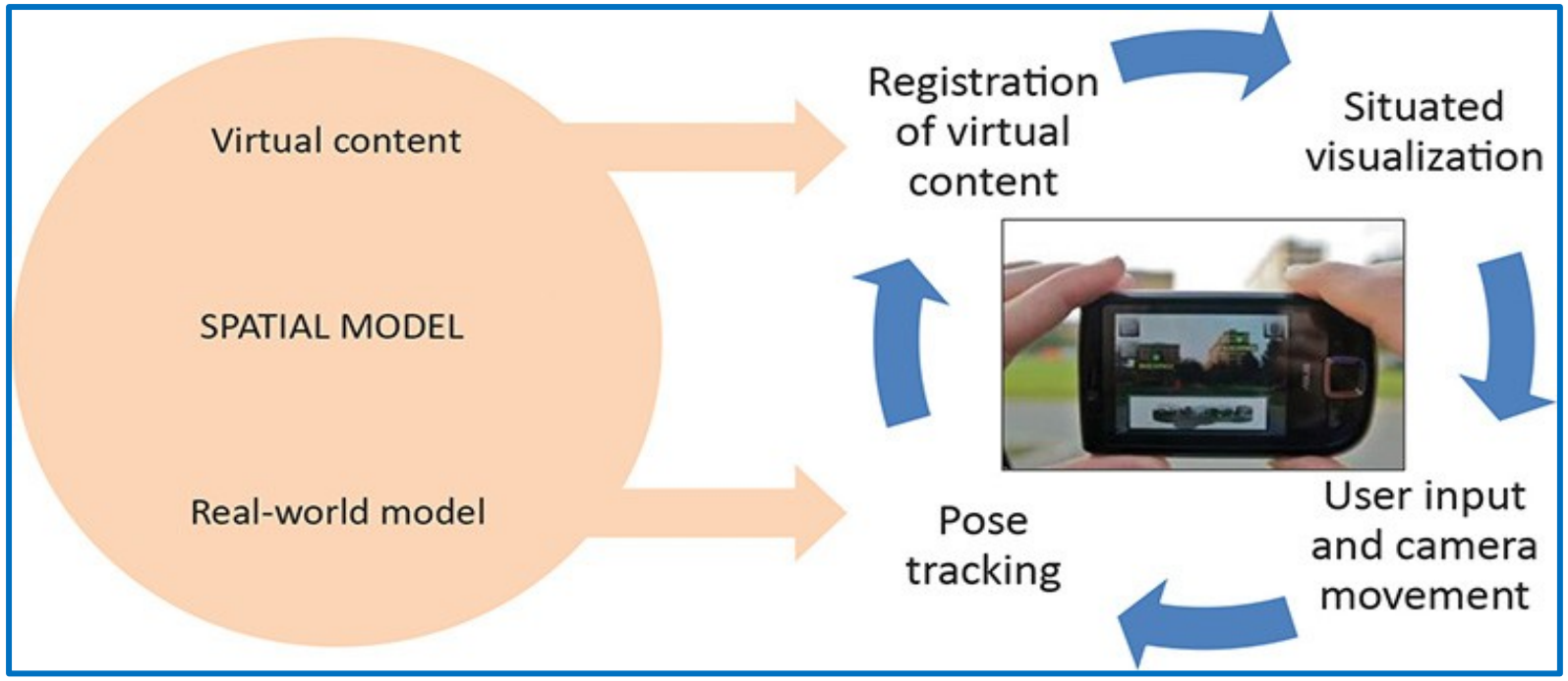


Barcode for books

Why Augmented Reality

- Augmented reality holds the promise of creating direct, automatic, and actionable links between the physical world and electronic information.

- A lot of technological advancement has occurred in the field of location-based computing and services, which is sometimes referred to as ***situated computing***



AR uses a feedback loop between human user and computer system

A Brief History

“The ultimate display would, of course, be a room within which the computer can control the existence of matter. A chair displayed in such a room would be good enough to sit in. Handcuffs displayed in such a room would be confining, and a bullet displayed in such a room would be fatal. With appropriate programming such a display could literally be the Wonderland into which Alice walked.”

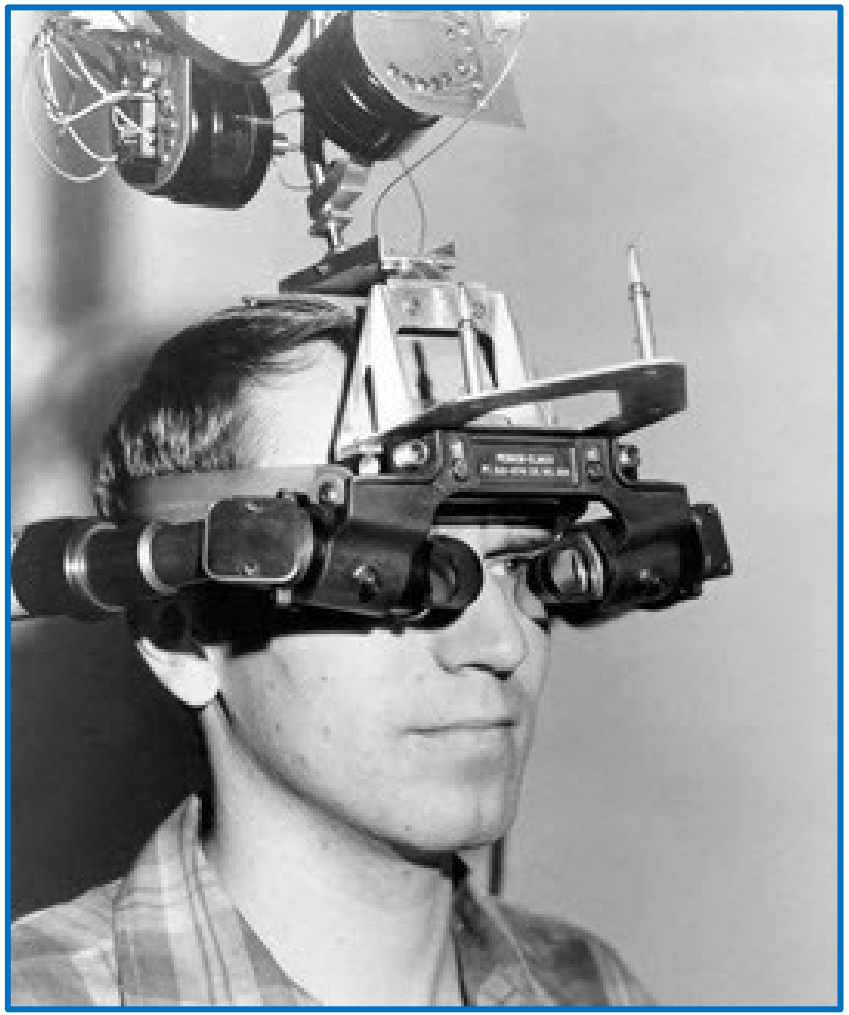
- Ivan Sutherland

Sword of Damocles

- The Sword of Damocles was the nickname of the world’s first head-mounted display, built in 1968. Courtesy of Ivan Sutherland

- Advances in computing performance of the 1980s and early 1990s were ultimately required for AR to emerge as an independent field of research

- Myron Krueger, Dan Sandin, Scott Fisher experimented with many concepts of mixing human interaction with computer-generated overlays on video for interactive art experiences

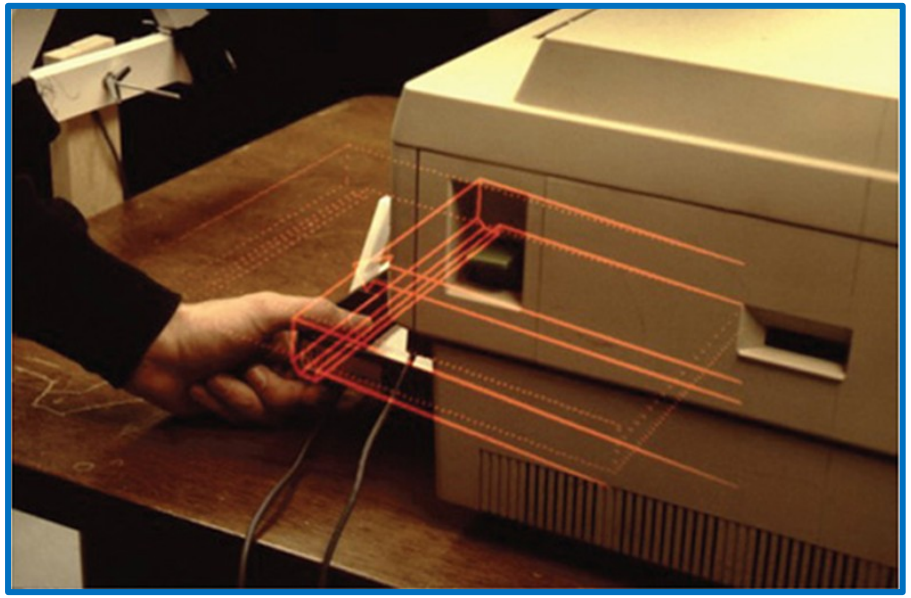


Guide the assembly of wire bundles for aircraft

- 1992 marked the birth of the term **“Augmented Reality.”**
- Caudell and Mizell [1992] at Boeing, sought to assist workers in an airplane factory by displaying wire bundle assembly schematics in a see-through HMD.

KARMA

- In 1993, Feiner introduced **KARMA**, a system that incorporated knowledge-based AR
- Automatically inferring appropriate instruction sequences for repair and maintenance procedures



KARMA was the first knowledge-driven AR application

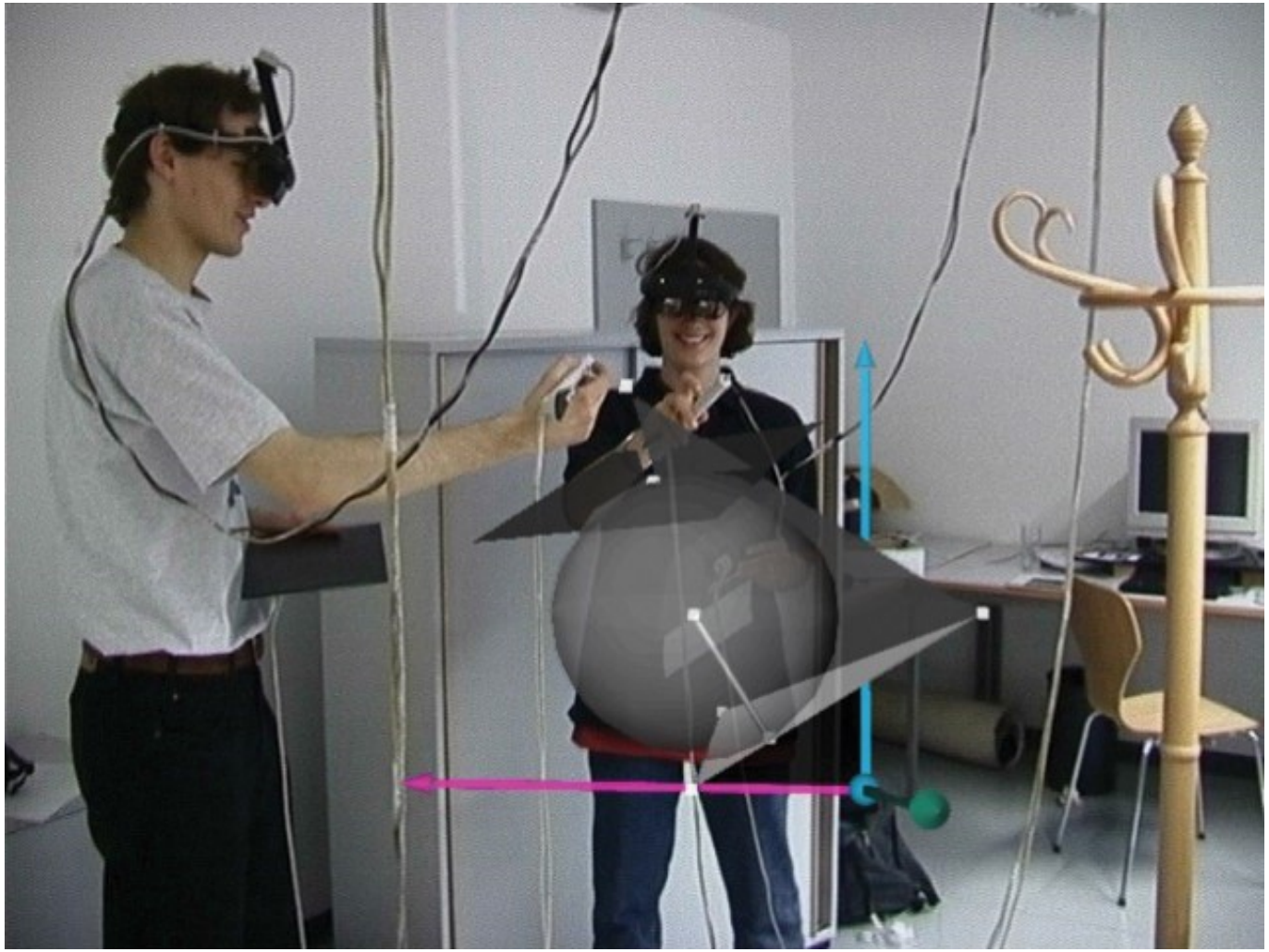
Medical AR

- In 1994, at the University of North Carolina compelling medical AR application was developed.
- It was capable of letting a physician observe a fetus directly within a pregnant patient

View inside the womb of an expecting mother

Studierstube

- In 1996, Schmalstieg developed first collaborative AR system called Studierstube
- Multiple users could experience virtual objects in the same shared space
- One of the showcase applications was a geometry course
- Studierstube system was teaching geometry in AR to high school students

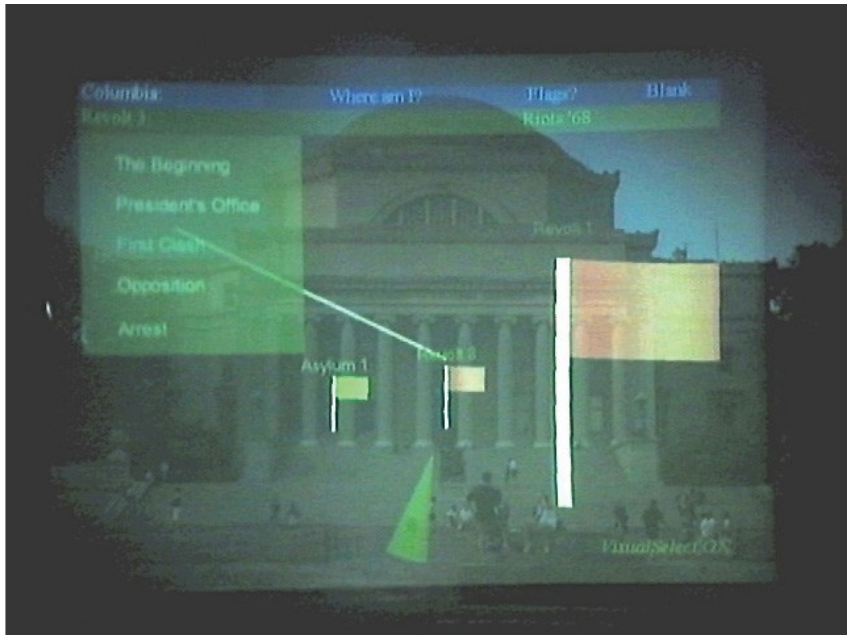


Japanese Influence on games

- From 1997 to 2001, the Japanese government and Canon Inc. jointly funded the Mixed Reality Systems Laboratory.
- One of the largest industrial research facility for mixed reality (MR)
- First coaxial stereo video see-through HMD, the COASTAR was developed
- *RV-Border Guards* was a multiuser shooting game developed in Canon's Mixed Reality Systems Laboratory

Touring Machine

- In 1997, Feiner et al. developed the first outdoor AR system, the Touring Machine
- The Touring Machine uses a see-through HMD with GPS and orientation tracking
- Delivering mobile 3D graphics via this system required a backpack holding a computer, various sensors, and an early tablet computer for input



The Touring Machine was the first outdoor AR system (left). Image of the *Situated Documentaries* AR campus tour guide running on a 1999 version of the Touring Machine (right).

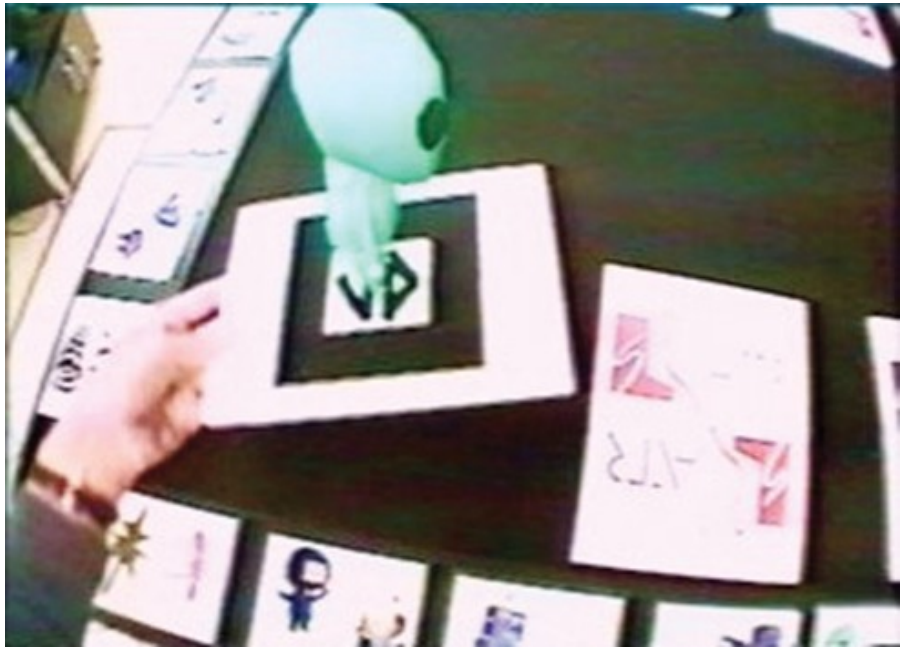
ARQuake

- in 1998, Thomas et al. published their work on the construction of an outdoor AR navigation system.
- This platform was used for advanced applications, such as 3D surveying, but is most famous for delivering the first outdoor AR game, ARQuake

Screenshot of ARQuake, the first outdoor AR game

ARToolKit

- ARToolKit, the first open-source software platform for AR
- It featured a 3D tracking library using black-and-white fiducials, which could easily be manufactured on a laser printer



A person holding a square marker of ARToolKit

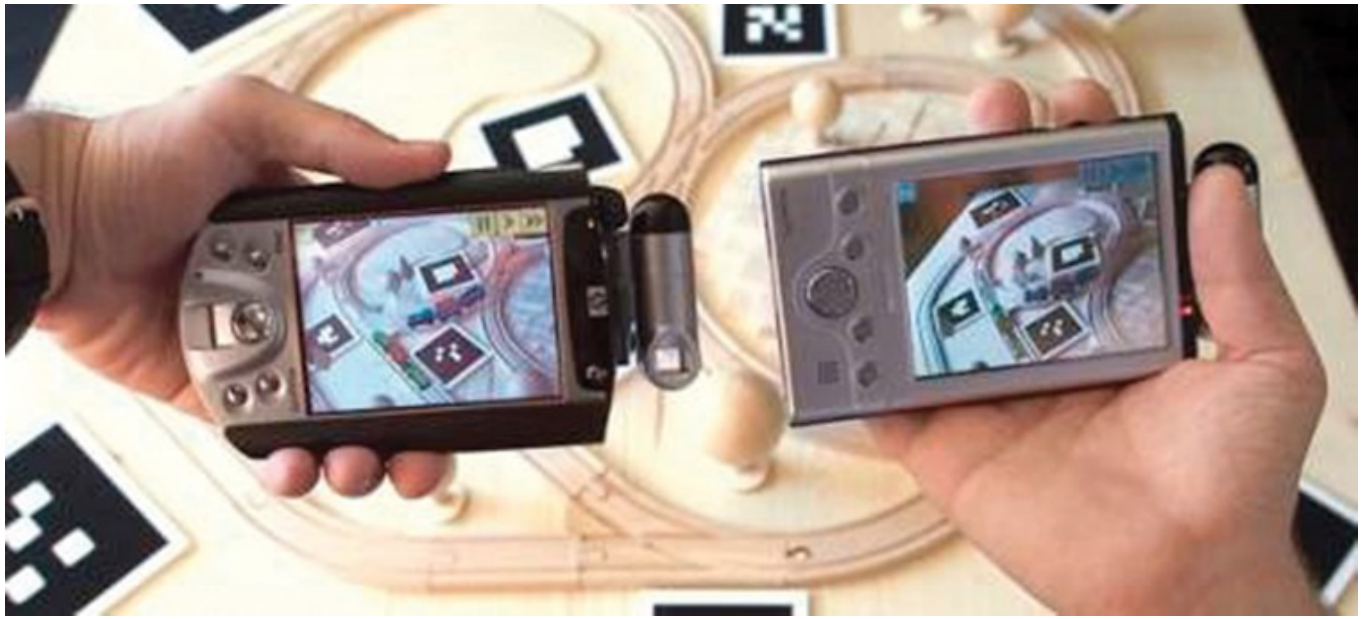
https://chev.me/arucogen/

https://docs.opencv.org/4.5.3/d5/dae/tutorial_aruco_detection.html

Invisible Trains

- In 2003, Wagner and Schmalstieg presented the first handheld AR system running autonomously on a “personal digital assistant”

- Train, a multiplayer handheld AR game was experienced by thousands of visitors at the SIGGRAPH Emerging Technologies show floor.



Virtual Trains on Real Wooden tracks

Vuforia AR Engine

- 2008, for the first truly usable natural feature tracking system for smartphones was introduced
- Today, AR developers can choose among many software platforms, but these model systems continue to represent important directions for researchers.

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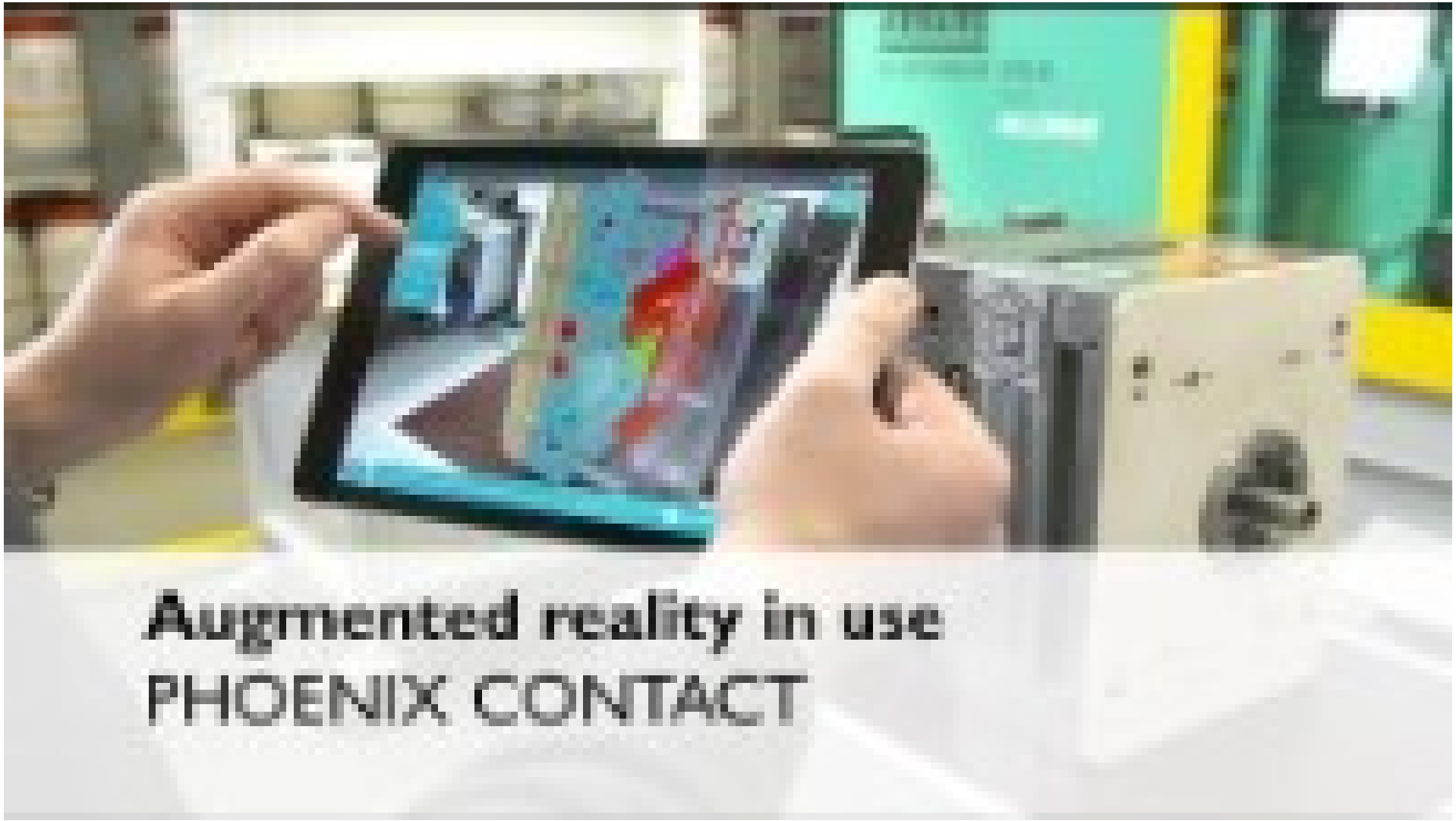
Where is AR useful in contemporary world?

Industry and Construction



Industry and Construction

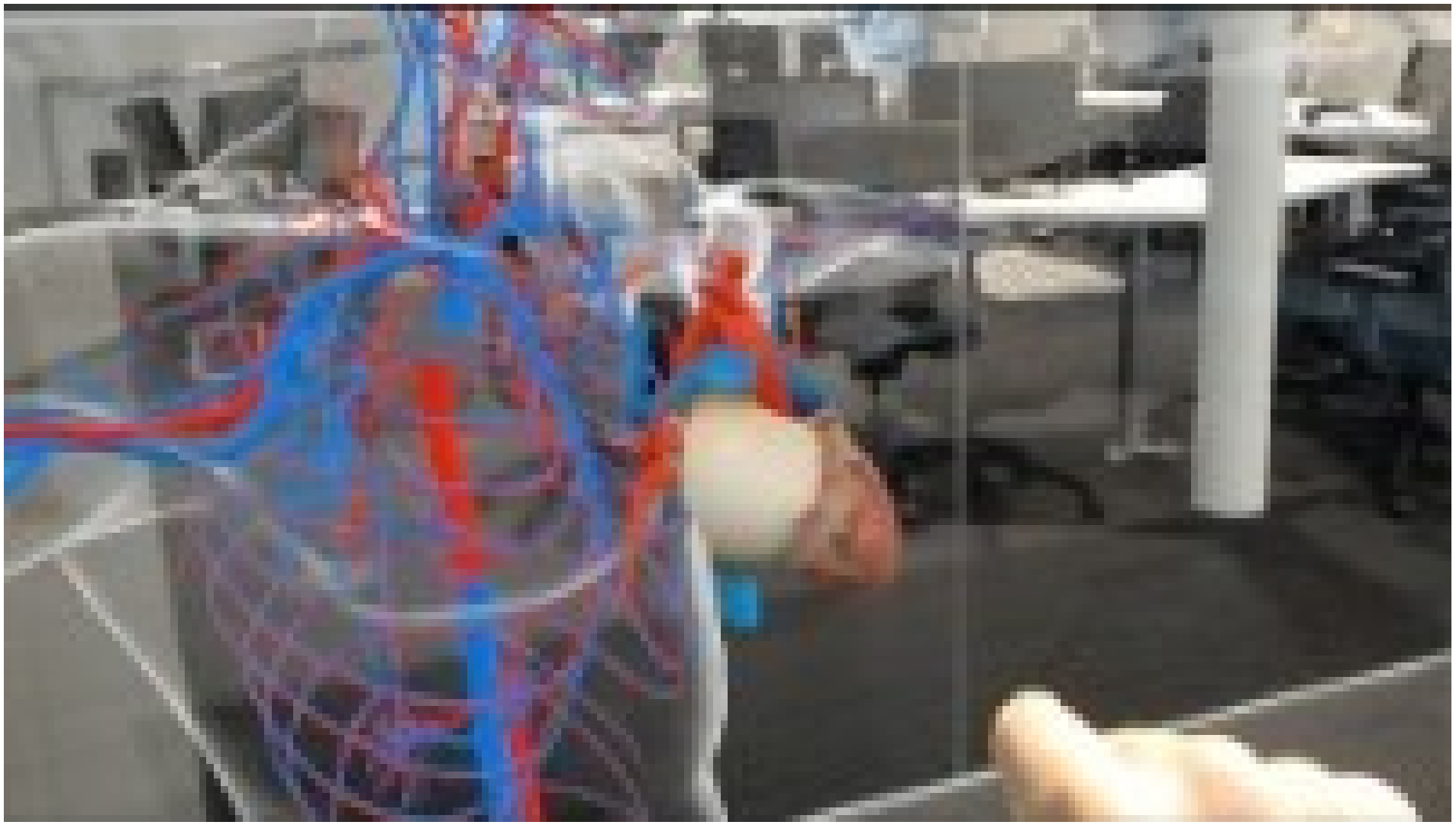
Industry and Construction

Maintenance and Training

Maintenance and Training

Medical

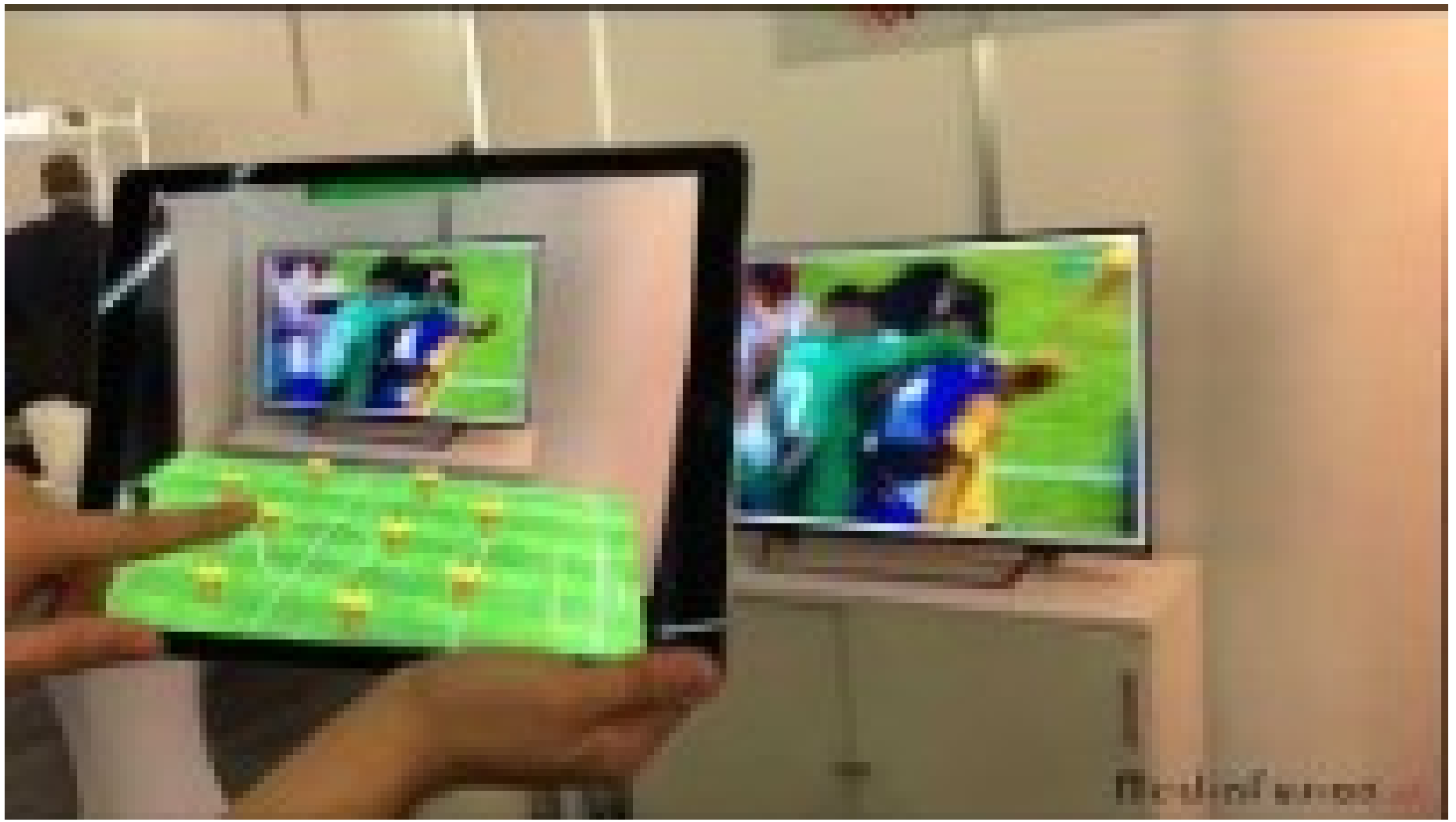
Medical



Personal Information Display

Navigation

Television



Television

E-Commerce and Marketing

E-Commerce and Marketing

Games