

## SARABHAI INSTITUTE OF SCIENCE AND TECHNOLOGY



# AUGMENTED REALITY

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**"Reality is merely an illusion, albeit a very persistent one."**

**- Albert Einstein**



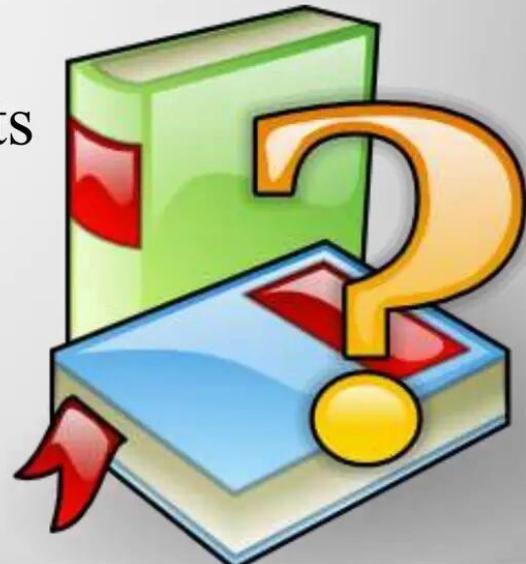
# Introduction

- Augmented Reality (AR) is a growing area in virtual reality research.
- The world environment around us provides a wealth of information that is difficult to duplicate in a computer.
- This is evidenced by the worlds used in virtual environments.



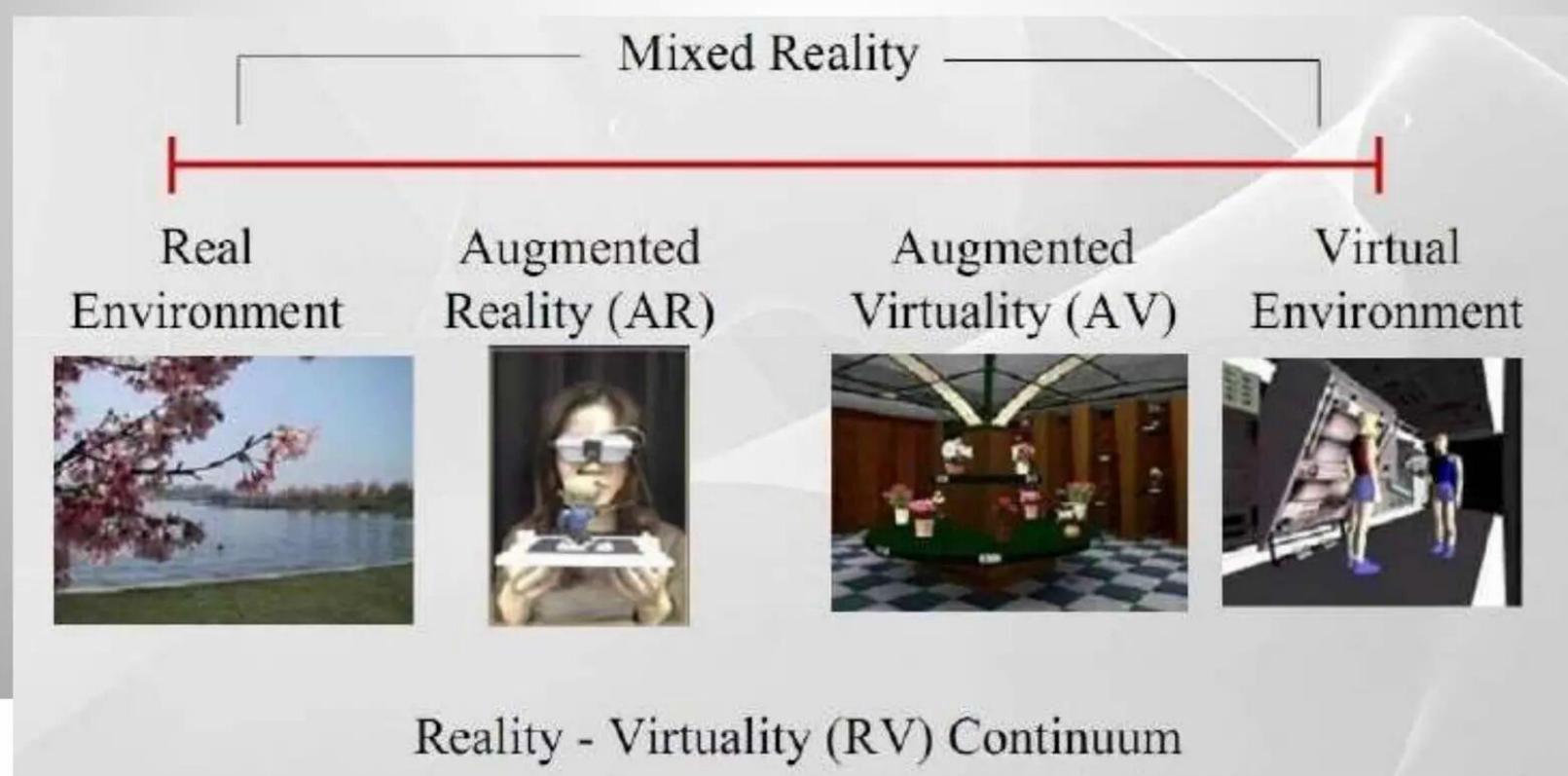
# What is AR?

- The process of superimposing digitally rendered images onto our real-world surroundings, giving a sense of an illusion or virtual reality. Recent developments have made this technology accessible using a Smartphone.
- Ronald Azuma defines an augmented reality system as one that:
  - Combines real and virtual world aspects
  - Is interactive in real-time
  - Is registered in three dimensions



# Milgram's Reality - Virtuality Continuum

- Virtual and real environments are at opposite ends of this continuum
- AR is closer to the real environment



# History

- The beginnings of AR, as we define it, date back to Sutherland's work in the 1960s, which used a see-through HMD to present 3D graphics. However, only over the past decade has there been enough work to refer to AR as a research field.
- In 1997, Azuma published a survey that defined the field, described many problems, and summarized the developments up to that point.
- Since then, AR's growth and progress have been remarkable.



## Historical Background

- 1957-62 – Morton Heilig, Sensorama (VR device)
- 1966 – Ivan Sutherland, head-mounted display
- 1975 – Myron Krueger, Videoplace
- 1989 – Jaron Lanier coined the term *Virtual Reality*
- 1992 – Tom Caudell coined the term *Augmented Reality*
- 1997 – Ronald Azuma summarised *Augmented Reality*

## Historical Timeline

- 1994 – Julie Martin, AR Theater
- 1999 – Hirokazu Kato, AR Toolkit
- 2000 – Bruce Thomas, ARQuake
- 2008-09 – Wikitude, AR Travel Guide and Navigation System
- 2009 – AR Toolkit ported to Adobe Flash

# **Augmented Reality vs. Virtual Reality**

## **Augmented Reality**

- System augments the real world scene
- User maintains a sense of presence in real world
- Needs a mechanism to combine virtual and real worlds
- Hard to register real and virtual

## **Virtual Reality**

- Totally immersive environment
- Senses are under control of system
- Need a mechanism to feed virtual world to user
- Hard to make VR world interesting

## How does it work?

- Using a mobile application, a mobile phone's camera identifies and interprets a marker, often a black and white barcode image.
- The software analyses the marker and creates a virtual image overlay on the mobile phone's screen, tied to the position of the camera.
- This means the app works with the camera to interpret the angles and distance the mobile phone is away from the marker.



# Implementation Framework

## ❖ Hardware

To make the system to be as lightweight and comfortable as possible, off-the-shelf hardware can be used to avoid the expense, effort, and time involved in building our own.

## ❖ Software

Software infrastructure Coterie, a prototyping environment that provided language-level support for distributed virtual environments.

# This is how AR works

- Pick A Real World Scene
- Add your Virtual Objects in it.
- Delete Real World Objects (if needed)
- Not Virtual Reality since Environment Real.



# Display

- **Head-mounted Display(HMD)**
  - device paired to a headset such as a harness or helmet
- **Eye Glasses**
  - eye wear that employs cameras to intercept the real world view and re-display it's augmented view through the eye pieces



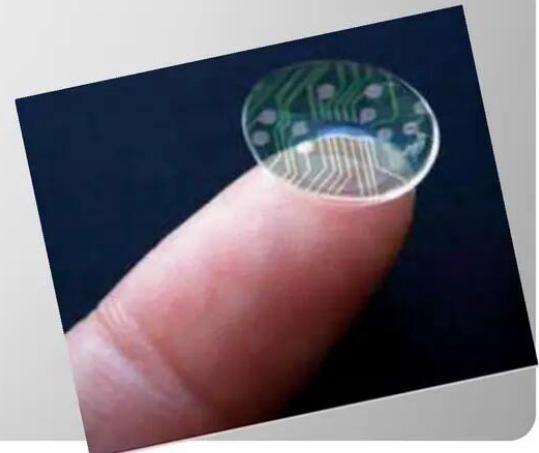
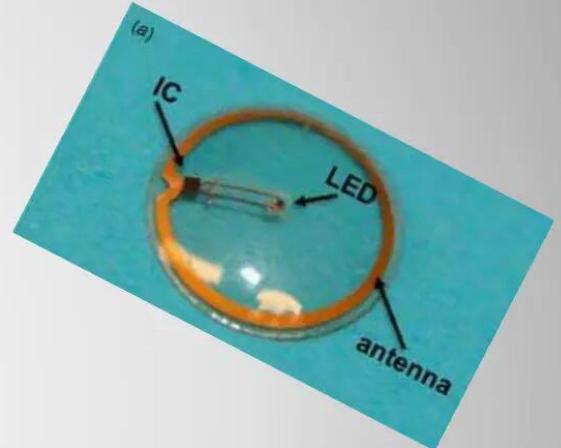
# Display(cont..)

- **Contact Lenses**

- Contain the elements for display embedded into the lens including integrated circuitry, LEDs and an antenna for wireless communication.
- Under development

- **Virtual Retina Display**

- a personal display device under development .
- a display is scanned directly onto the retina of a viewer's eye.



# Display(cont..)



## □ Handheld

- a small display that fits in a user's hand.
- Portable
- Ubiquitous
- Physical constraints of the user having to hold the device
- Distorting effect



## □ Spatial

- makes use of digital projectors to display graphical information.
- user is not required to carry equipment or wear the display over their eyes.
- can be used by multiple people at the same time without each having to wear a head-mounted display.

# Display Technologies

- Monitor Based
- Heads Up Display
- Head Mounted Displays:
  - Video see-through
  - Optical see-through



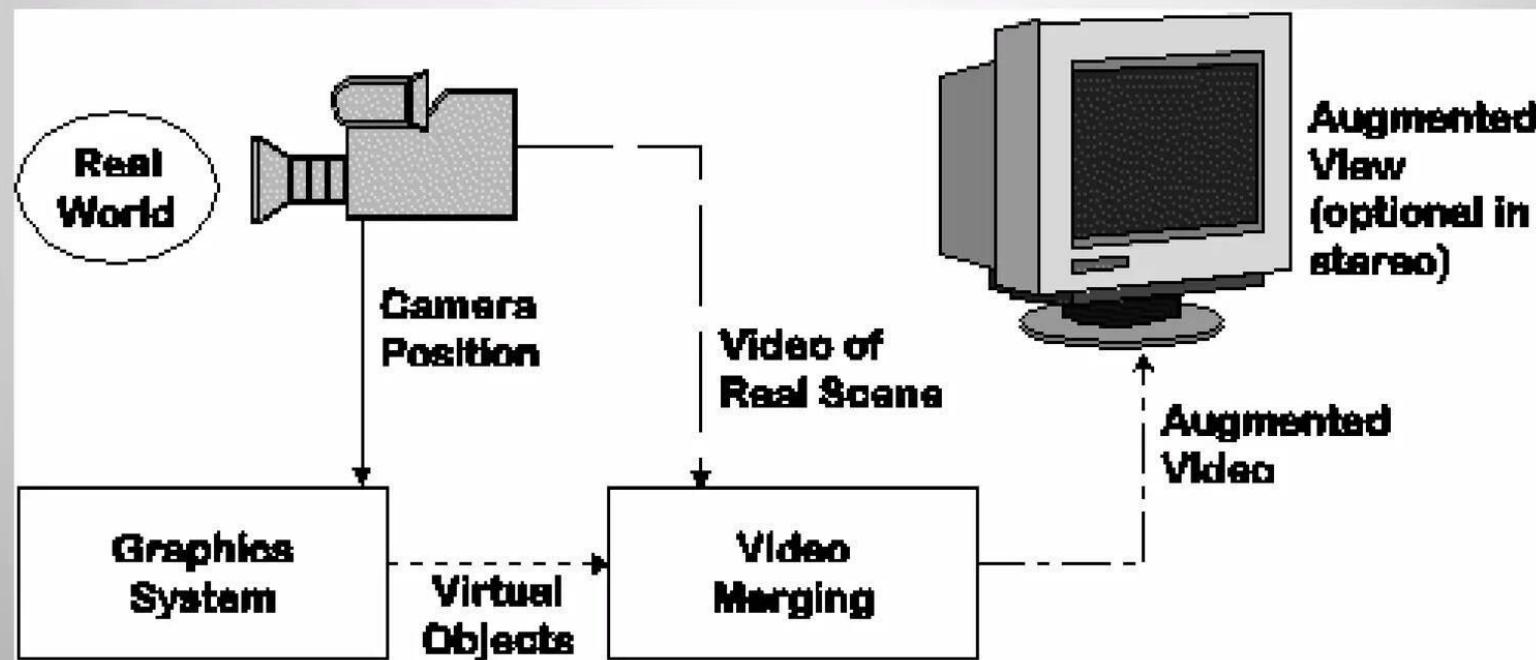
SVGA Head-Mounted Display



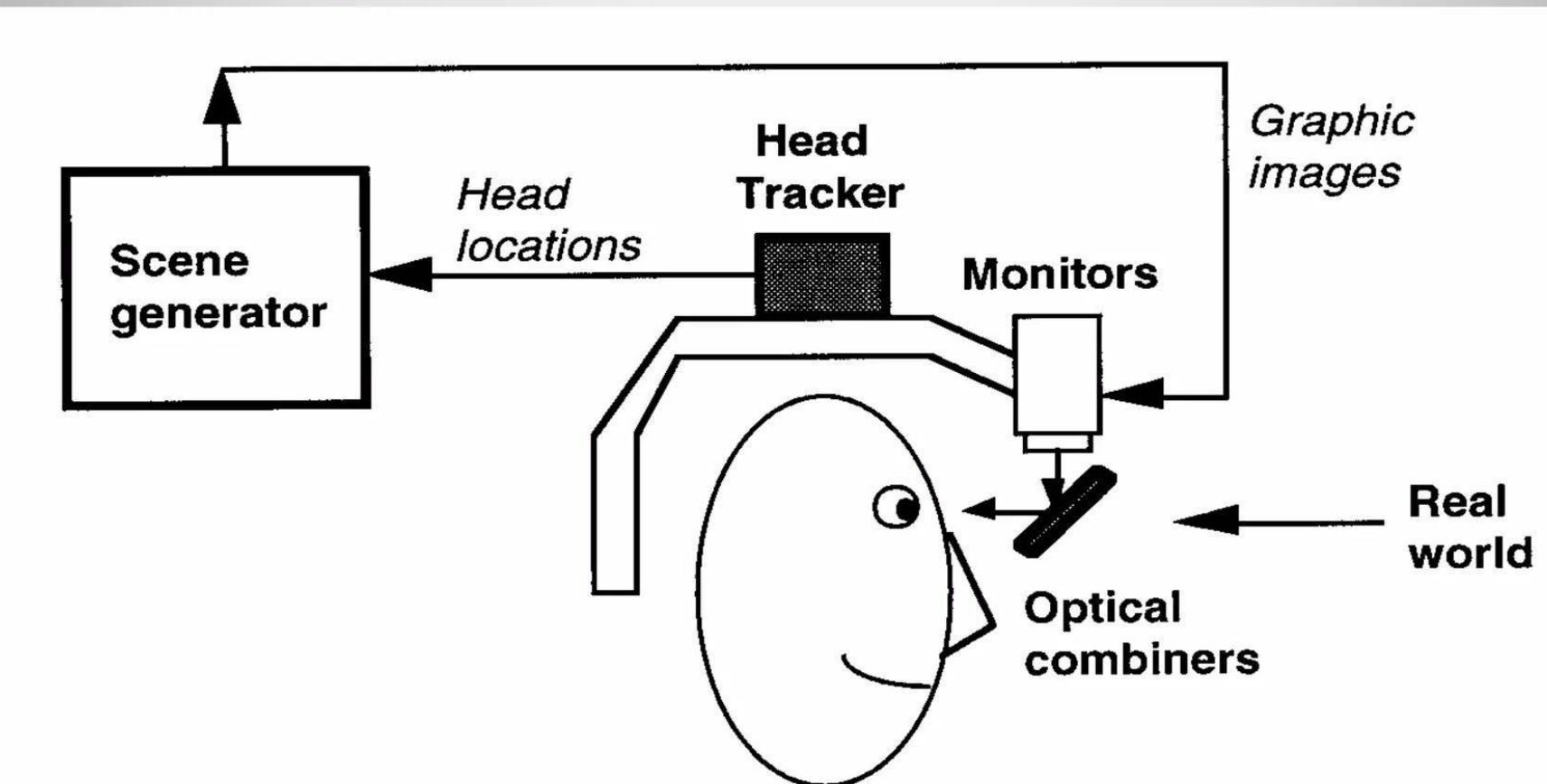
Vehicle Heads-Up Display

# Monitor Based Augmented Reality

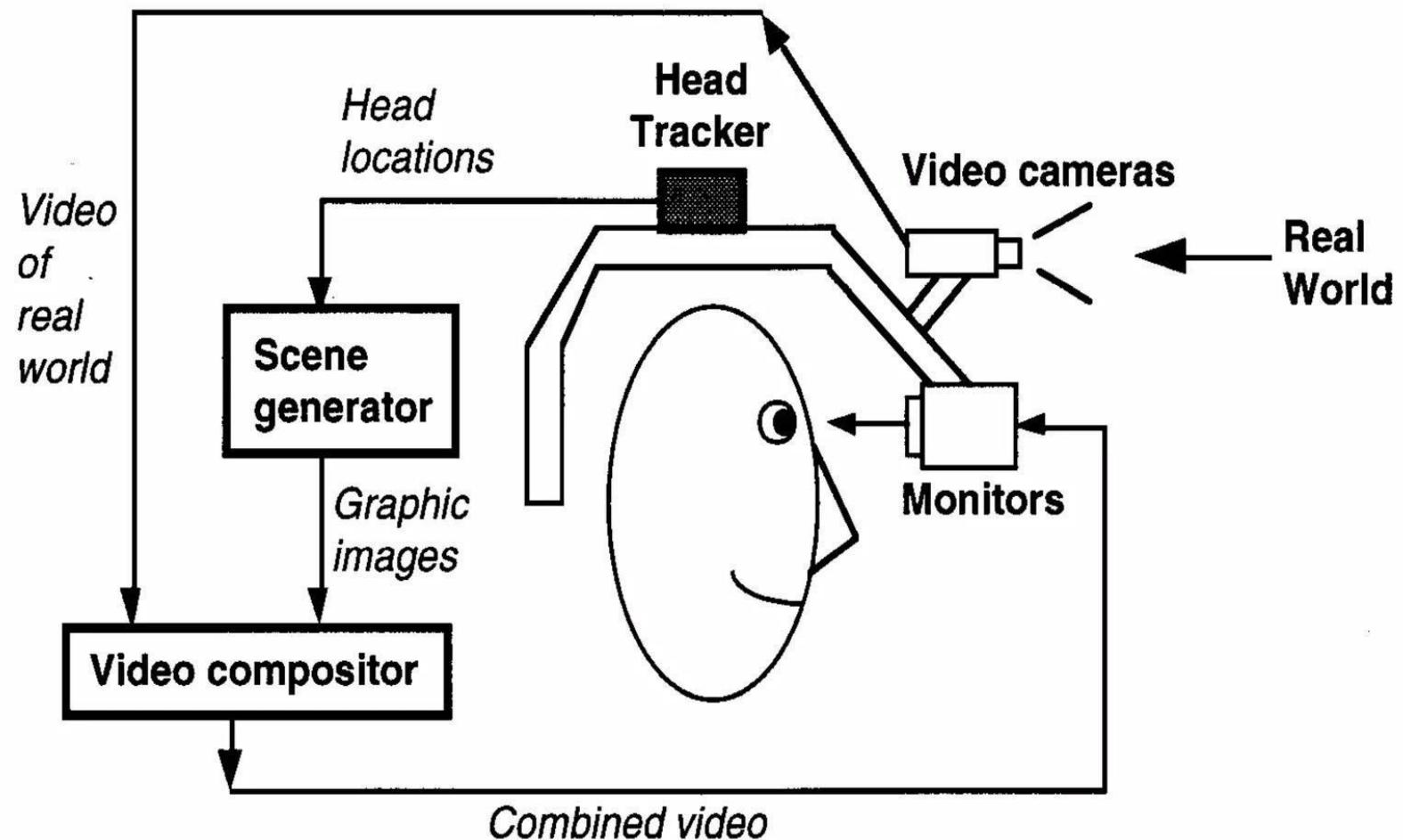
- Simplest available
- Little feeling of being immersed in environment



# Optical See-Through HMD



# Video See-Through HMD



# Video Composition for Video See-Through HMD

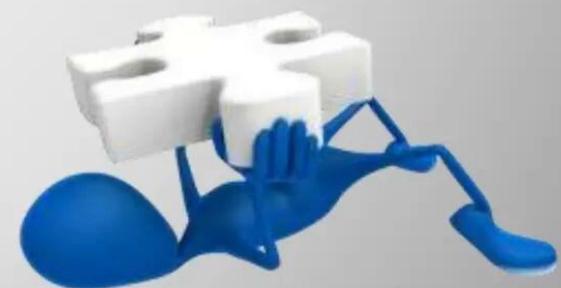
- Chroma-keying
  - Used for special effects
  - Background of computer graphics images is set to a specific color
  - Combining step replaces all colored areas with corresponding parts from video
- Depth Information
  - Combine real and virtual images by a pixel-by-pixel depth comparison

## Advantages of AR

- Can increase the interest to attain knowledge and information
- People can share experiences with each other in real time over long distances
- Games that provide an even more "real" experience
- Things come to life on people's mobile
- Form of escapism

## Disadvantages of AR

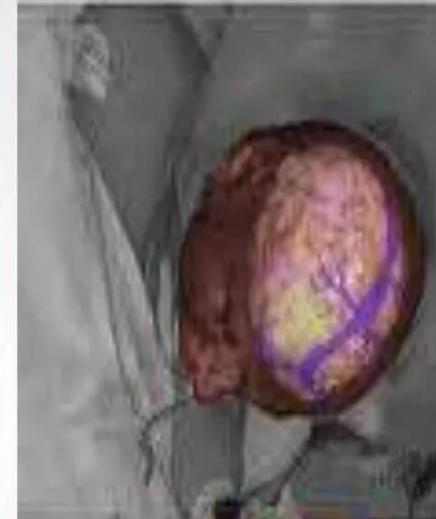
- Spam and Security
- Social and Real-Time vs. Solitary and Cached
- UX (User Experience): Using AR can be inappropriate in social situations.
- Openness: Other people can develop their own layers of content to display



# Applications

- Medical
- Manufacturing and repair
- Annotation and visualization
- Entertainment
- Military aircraft
- Military Training
- Engineering Design
- Robotics and Telerobotics
- Manufacturing, Maintenance, and Repair
- Consumer Design
- Hazard Detection
- Audio

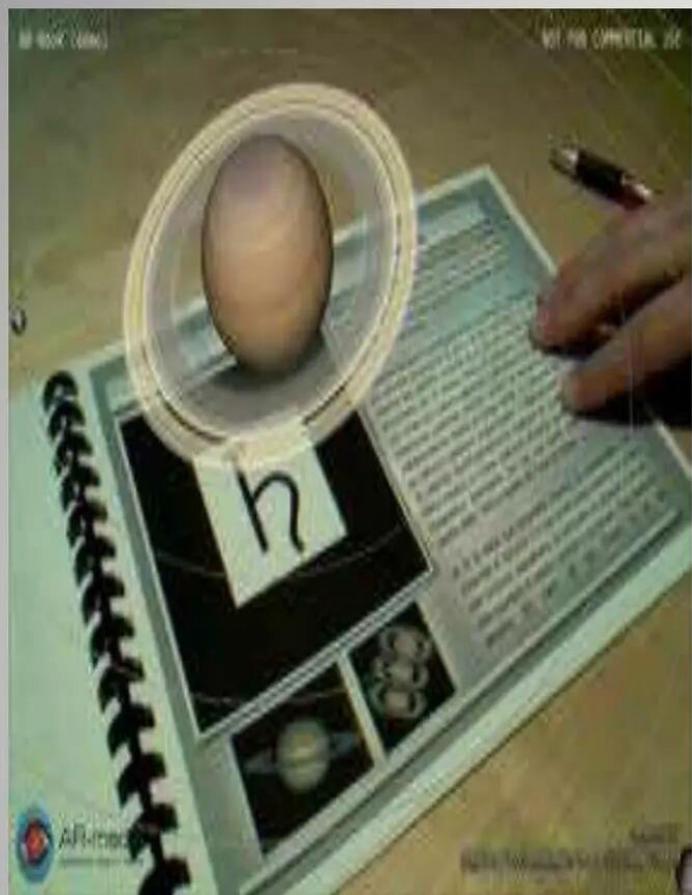
# Medical



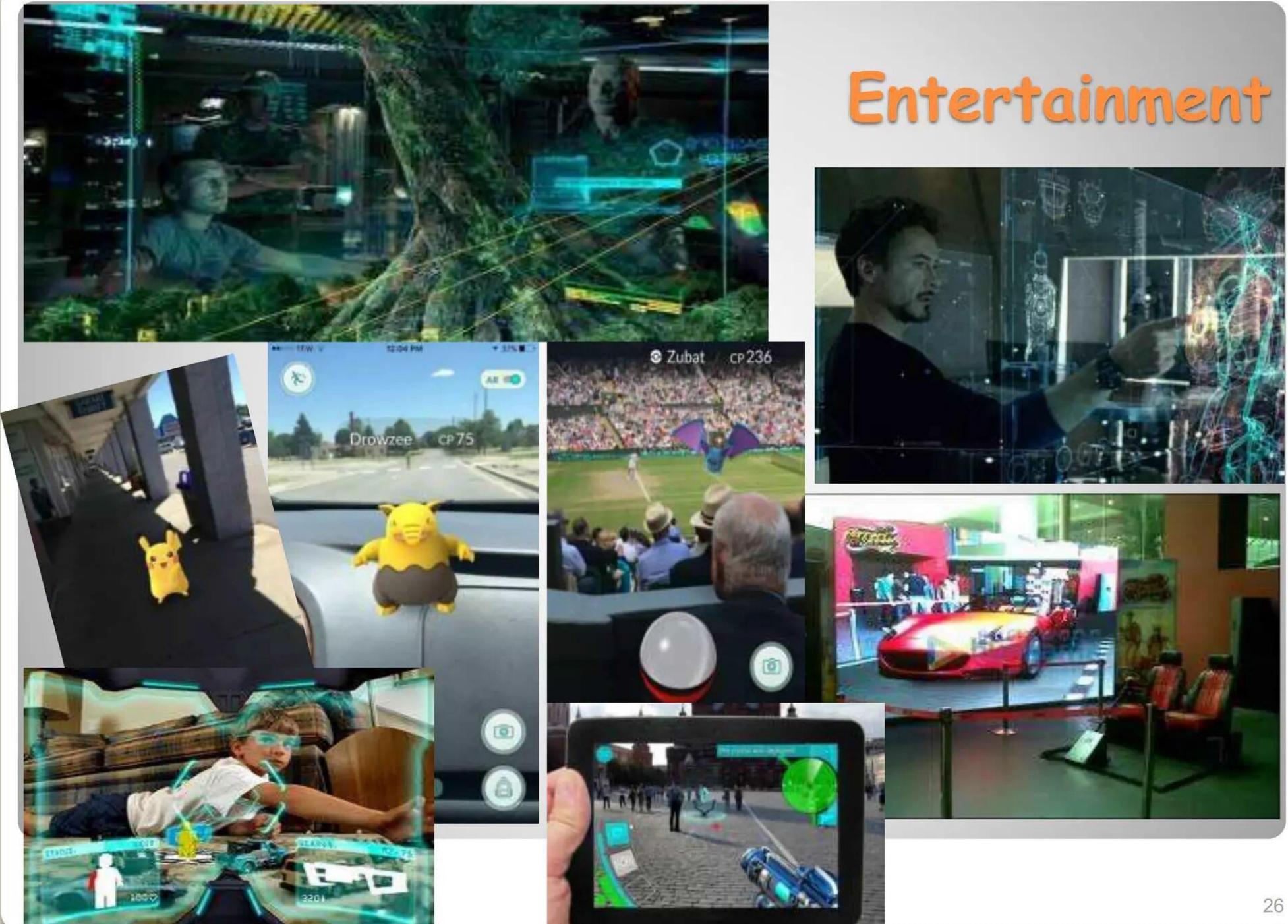
## Military/Defence



# Education



# Entertainment



# Life-Clipper

- LifeClipper is a wearable AR system being used in Switzerland.
- When walking around a chosen culturally interesting area, the user will feel as though they are watching a film.



# Wiki-tude - AR Travel Guide

- Mobile travel guide for the Android platform (open source OS for cell phones).
- Plan a trip or find about current surroundings in real-time.





# **Issues in Augmented Reality**

- **Performance Issues**

Real time processing of images can be a challenge and often can slow down augmented reality systems.

- **Interaction Issues**

Users within a mixed environment because of augmented reality have difficulties interacting with the environment as normal.

- **Alignment Issues**

People working in an augmented reality are more sensitive to alignment errors. Proper calibration and alignment with the reference frame of the world is crucial.

# Challenges

- Technological limitations
- User interface limitation
- Social acceptance

## Pokemon Go players feel real-world pain

LOS ANGELES: 'Pokemon Go', a new smartphone game based on cute Nintendo characters like Squirtle and Pikachu, can be harmful to your health.

The augmented reality game, which layers gameplay onto the physical world, became the top grossing app in the iPhone app store just days after its Wednesday release in the U.S., Australia and New Zealand. And players have already reported wiping out in a variety of ways as they wander the real world 'eyes glued to their smartphone screens' in search of digital monsters.

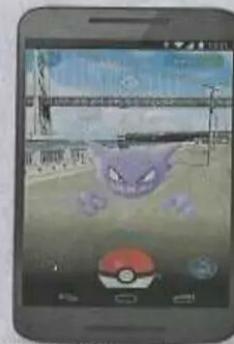
Mike Schultz, a 21-year-old communications graduate on Long Island, New York, took a spill on his skateboard as he stared at his phone while cruising for critters. He cut his hand on the sidewalk after hitting a big crack, and blames himself for going too slowly.

"I just wanted to be able to stop quickly if there were any Pokemons nearby to catch," he says. "I don't think the company is really at fault."

The game was created by Niantic Inc., a San Francisco spinoff of Google parent Alphabet Inc. that previously became known for a similar augmented-reality game called 'Ingress'.

To play, you fire up the game and then start trekking to prominent local landmarks represented in the game as 'Pokestops' where you can gather supplies such as Pokeballs. Those are what you fling at online 'pocket monsters', or Pokemon, to capture them for training. At other locations called 'gyms' which may or may not be actual gyms in the real world Pokemon battle one another for supremacy.

Naturally, the game has also induced people to post pictures of themselves on so-



Pokemon Go, a new smartphone-based game.  
— PHOTO: NYT

The augmented reality game is leading to injuries during the real hunt for digital monsters

cial media chasing creatures in all sorts of dangerous situations.

Zubats and Paras have appeared on car dashboards. Caterpies have been spotted at intersections. Police in Darwin, Australia, have even asked players not to waltz into their station, which of course is a Pokestop in the game.

"You don't actually have to step inside in order to gain the pokeballs," the Northern Territory Police Fire and Emergency Services says on its Facebook page.

Ankle injuries, mishaps with revolving doors and walking into trees have been among the painful results.

As an upside, players get more exercise than usual and can learn more about the historical landmarks incorporated into the game as Pokestops. — AP

We are paying you to work,  
not chase fictional video  
game characters with your  
cell phone all day.



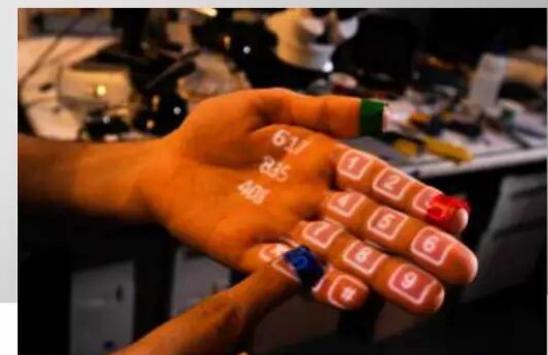
Save it for your break time or  
lunch. Otherwise you'll have  
plenty of time unemployed to  
"Catch them all".

## Why continue research in AR?

- AR systems will instantly recognize what someone is looking at, and retrieve and display the data related to that view.
- There are hundreds of potential applications for such a technology, gaming and entertainment being the most obvious ones.
- Any system that gives people instant information, requiring no research on their part, is bound to be valuable to anyone in any field.

# Conclusion

- Augmented reality is another step further into the digital age as we will soon see our environments change dynamically either through a Smartphone, glasses, car windshields and even windows in the near future to display enhanced content and media right in front of us.
- This has amazing applications that can very well allow us to live our lives more productively, more safely, and more informatively.



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# Handwriting

