SNS COLLEGE OF TECHNOLOGY

Coimbatore-35
An Autonomous Institution

Accredited by NBA – AICTE and Accredited by NAAC – UGC with 'A+' Grade
Approved by AICTE, New Delhi & Affiliated to Anna University, Chennai

DEPARTMENT OF INFORMATION TECHNOLOGY

16IT AUGMENTED REALITY AND VIRTUAL REALITY

III YEAR – V SEM

UNIT 2 – INTERACTION AND MOBILE AUGMENTED REALITY

TOPIC 1 – Mobile Augmented Reality

UNIT – 2
INTERACTION AND MOBILE AUGMENTED REALITY

Introduction to Interaction – Mobile Augmented Reality – Advantages and Disadvantages of Mobile Augmented Reality – Architecture for Mobile Augmented Reality Systems – Applications of Augmented Reality


Augmented Reality
Hush puppies $200
Lee cooper $219

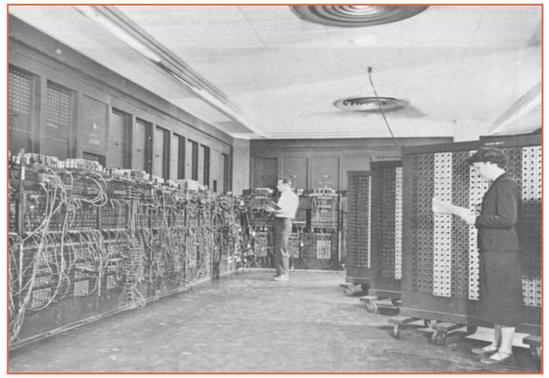

aero3Dpro
Your world in true 3D
TUAL CITY: ADELAIDE

A Brief History of Time



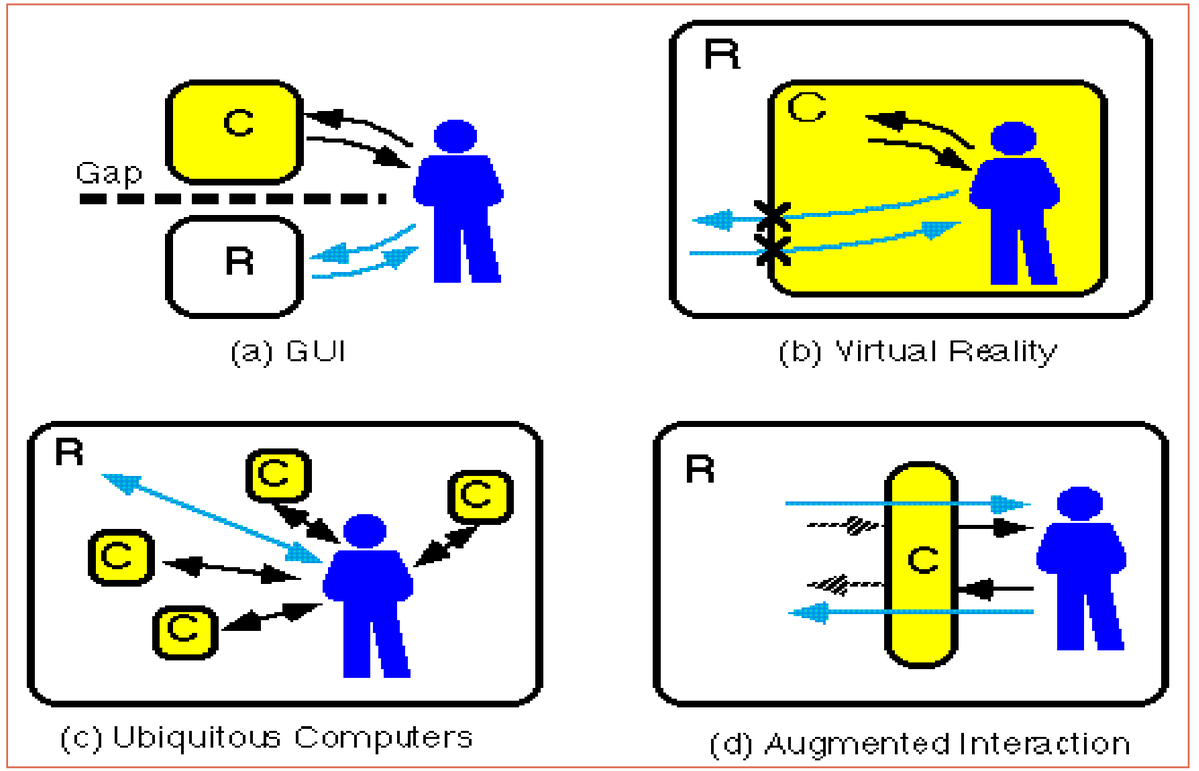

- Trend
  - smaller, cheaper, more functions, more intimate
- Technology becomes invisible
  - Intuitive to use
  - Interface over internals
  - Form more important than function
  - Human centered design

A Brief History of Computing



- Trend
  - smaller, cheaper, faster, more intimate, intelligent objects
- Computers need to become invisible
  - hide the computer in the real world
    - Ubiquitous /Tangible Computing
  - put the user inside the computer
    - Virtual Reality

Making Interfaces Invisible



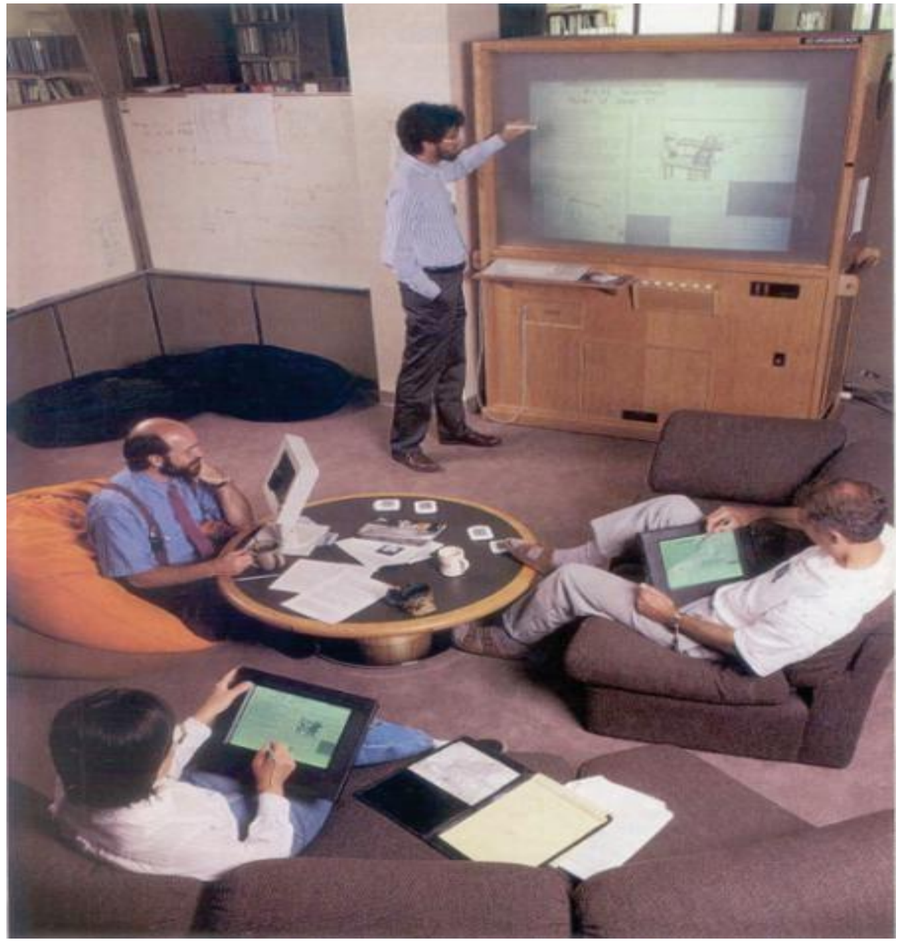
Rekimoto, J. and Nagao, K. 1995. The world through the computer: computer augmented interaction with real world environments. In *Proceedings of the 8th Annual ACM Symposium on User interface and Software Technology. UIST '9*5. ACM, New York, NY, 29-36.

Ubiquitous Computing

Ubiquitous computing is the method of enhancing computer use by making many computers available throughout but the physical environment, making them effectively invisible to the user.

– Mark Weiser

Ubiquitous Computing

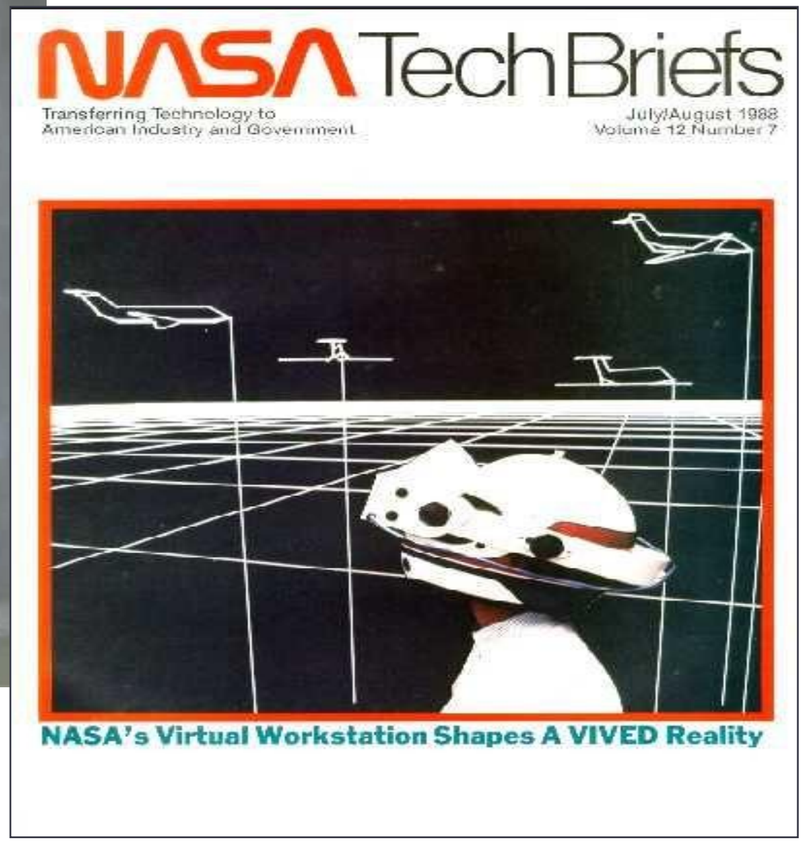


- Mark Weiser, Xerox PARC
- TAB, Slate, Wall display

Ubiquitous Computing

Smart Home Sensor Networks

Virtual Reality

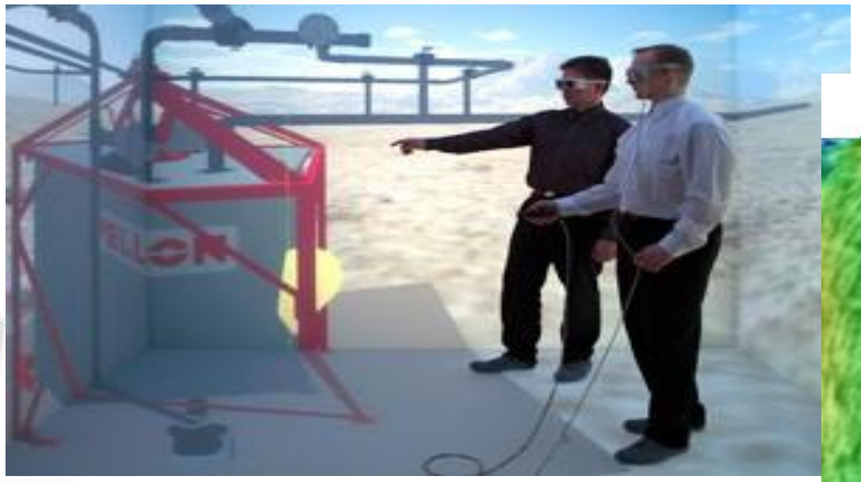


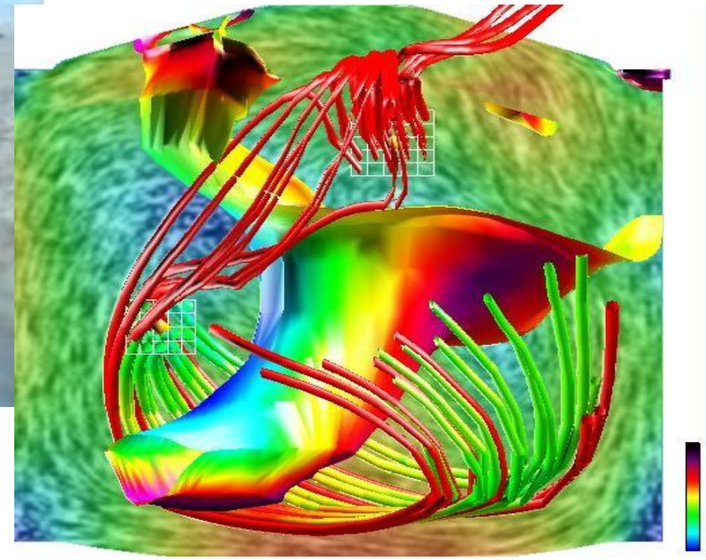
- 1989...

Virtual Reality

- Immersive VR
  - Head mounted display, gloves
  - Separation from the real world

Virtual Reality Today





- > $5 Billion VR business (+ > $150 B Graphics Industry)
  - Visualization, simulation, gaming, multimedia,, etc

1977 - Star Wars - Augmented Reality

Augmented Reality Definition

- Defining Characteristics [Azuma 97]
  - Combines Real and Virtual Images
    - Both can be seen at the same time
  - Interactive in real-time
    - The virtual content can be interacted with
  - Registered in 3D
    - Virtual objects appear fixed in space

Azuma, R. T. (1997). A survey of augmented reality. Presence, 6(4), 355-385.

2008 - CNN

Augmented Reality Examples

AR vs VR

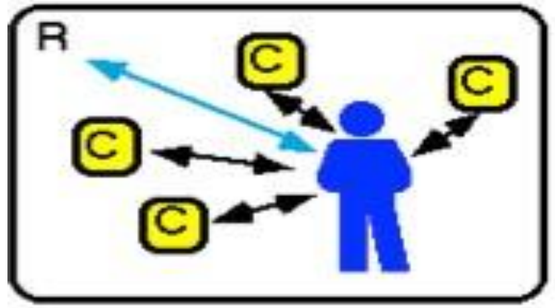
	Virtual Reality *Replaces Reality*	**Augmented Reality** *Enhances Reality*
Scene Generation	Requires realistic images	Minimal rendering okay
Display Device	Fully immersive, wide field of view	Non-immersive, small field of view
Tracking	Low to medium accuracy is okay	The highest accuracy possible

Where Can You Use AR/VR?

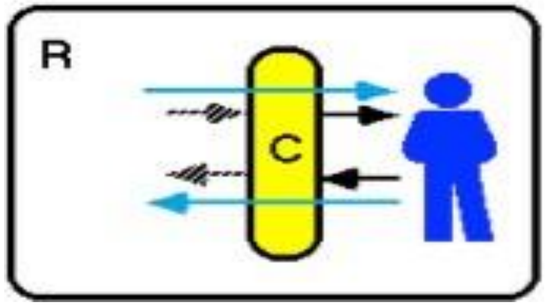
VR – stable environments

AR - anywhere

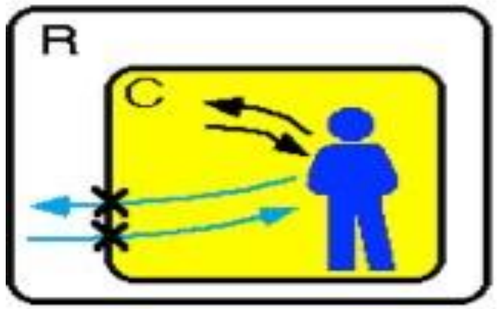
From Reality to Virtual Reality



Ubiquitous Computing



Augmented Reality



Virtual Reality

Milgram's Reality-Virtuality continuum

"...anywhere between the extrema of the *virtuality continuum.*"

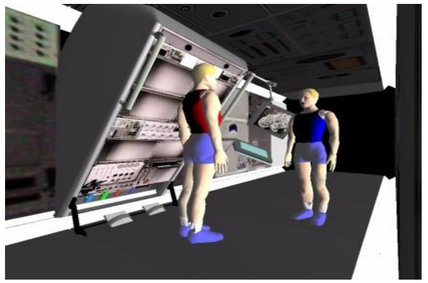
Mixed Reality

Real Environment

Augmented Reality (AR)

Augmented Virtuality (AV)

Virtual Environment

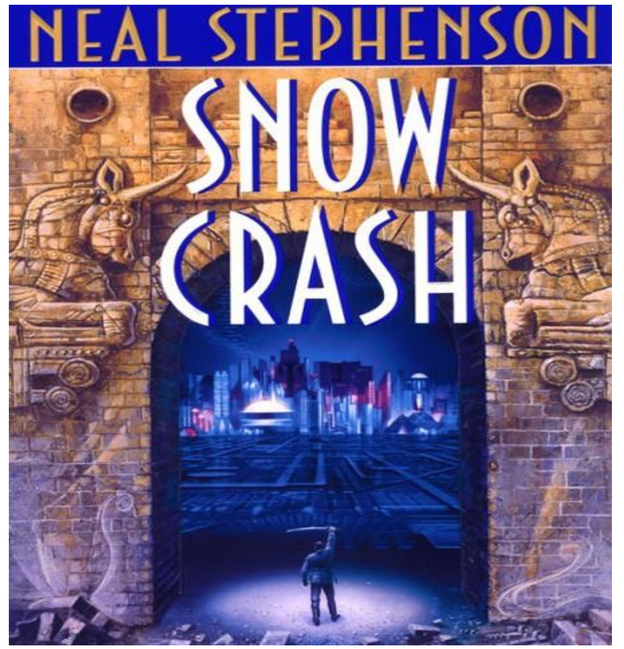


Reality - Virtuality (RV) Continuum

P. Milgram and A. F. Kishino, Taxonomy of Mixed Reality Visual Displays
IEICE Transactions on Information and Systems, E77-D(12), pp. 1321-1329, 1994.

Metaverse

- Neal Stephenson's "SnowCrash"
- The Metaverse is the convergence of:
  - 1) virtually enhanced physical reality
  - 2) physically persistent virtual space
- Metaverse Roadmap
  - http://metaverseroadmap.org/

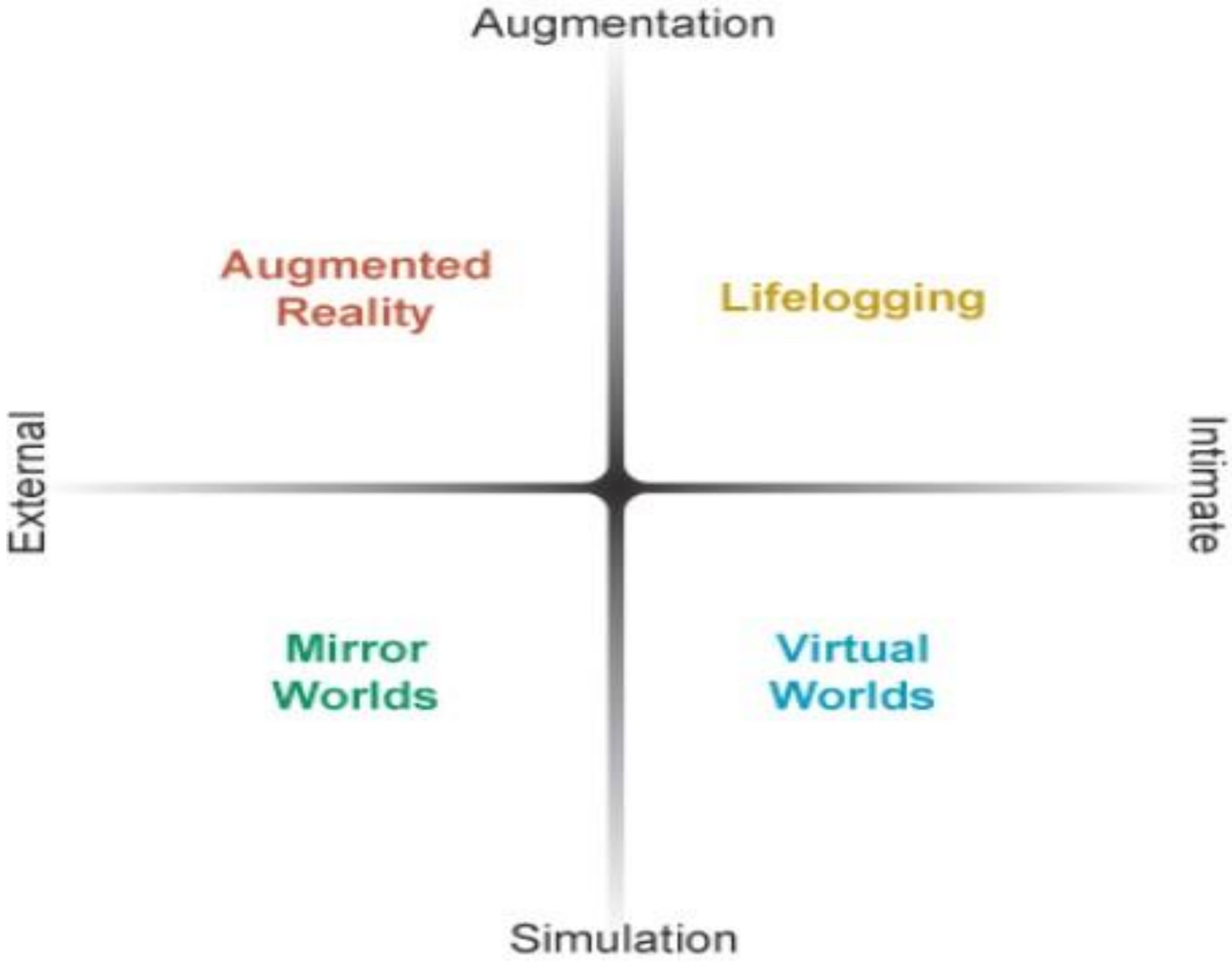


Metaverse Dimensions

- *Augmentation* technologies that layer information onto our perception of the physical environment.
- *Simulation* refers to technologies that model reality
- *Intimate* technologies are focused inwardly, on the identity and actions of the individual or object;
- *External* technologies are focused outwardly, towards the world at large;

Metaverse Components

- Four Key Components
  - Virtual Worlds
  - Augmented Reality
  - Mirror Worlds
  - Lifelogging


Augmentation
Augmented Reality
Lifelogging
External
Intimate
Mirror Worlds
Virtual Worlds
Simulation

Mirror Worlds

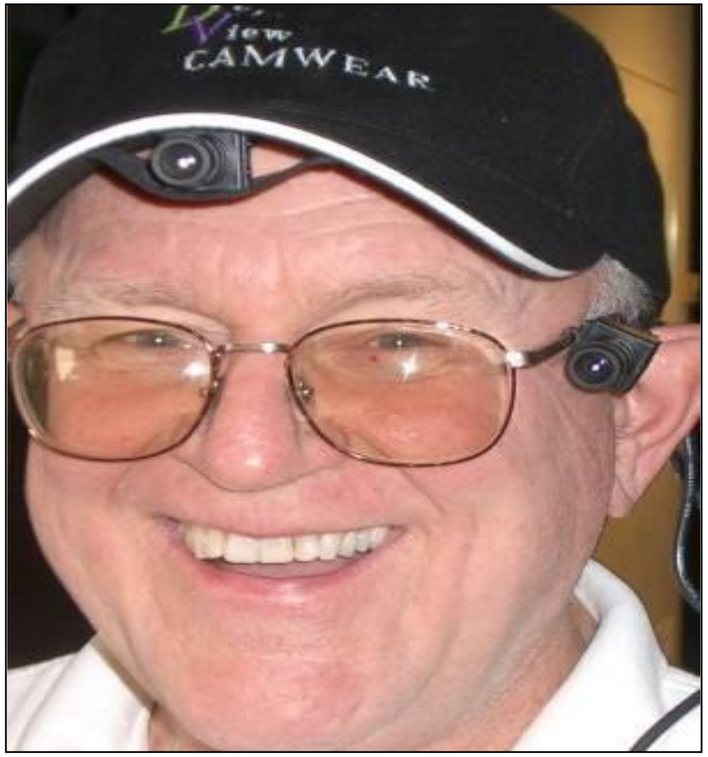
- Mirror worlds are informationally-enhanced virtual models or "reflections" of the physical world.
  - Google Earth, MS Street View, Google Maps


Google maps
73A Wharenui Rd, Upper Riccarton, 8041, New Zealand
Search Maps
Show search options
Find businesses, addresses and places of interest. Learn more.
Print
Send
Link
Janet St
© 2009 Google
Report a problem
Hustler - www.topstreetwear.fi - Skandinaavian suurin Streetwear valikoima. Yli 120 vaatemerkkiä.
Sponsored Link

LifeLogging

- Technologies record and report the intimate states and life histories of objects and users
  - Nokia LifeBlog, Nike+

Gordon Bell: LifeLogging



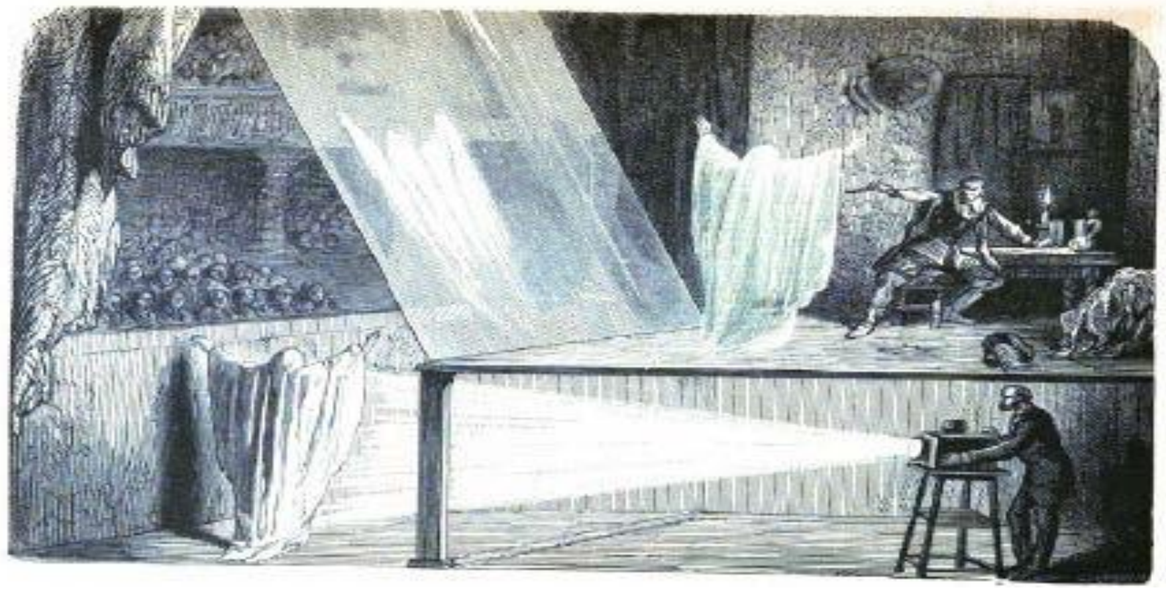
1 TB to store 65 years of data

Summary

- Augmented Reality has three key features
  - Combines Real and Virtual Images
  - Interactive in real-time
  - Registered in 3D
- AR can be classified alongside other technologies
  - Invisible Interfaces
  - Milgram's Mixed Reality continuum
  - Stephenson's MetaVerse

HISTORY

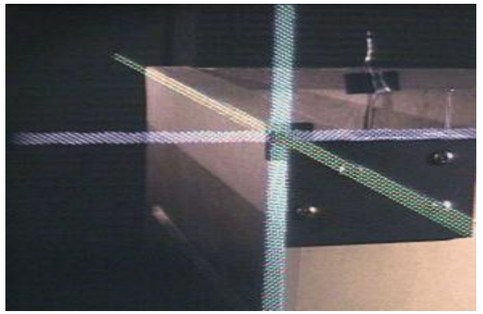
Pepper's Ghost (1862)

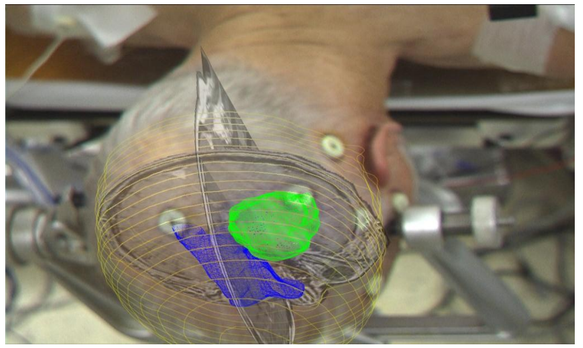


- Dates back to Giambattista della Porta (1584)

AR History

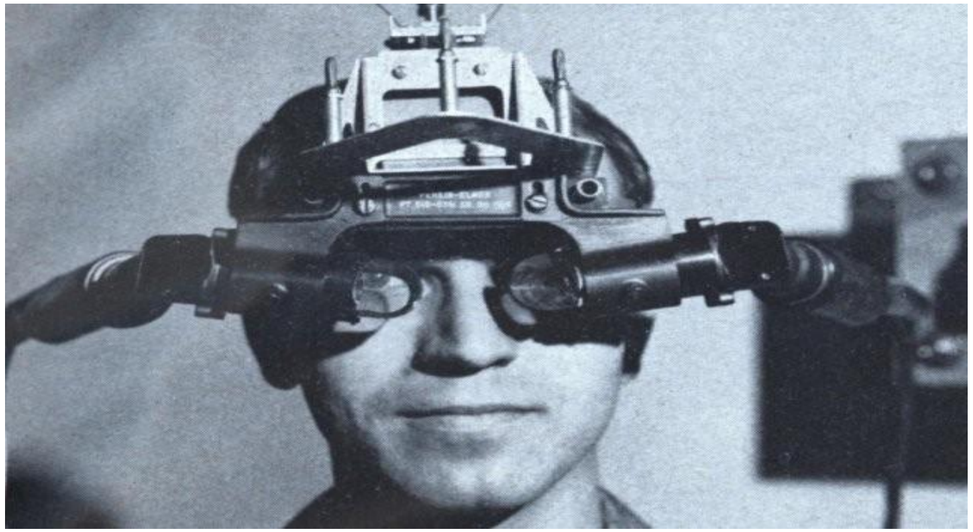
- 1960’s – 80’s: Early Experimentation
  - Military, Academic labs
- 1980’s – 90’s: Basic Research
  - Tracking, Displays
- 1995 – 2005: Tools/Applications
  - Interaction, Usability, Theory
- 2005 - : Commercial Applications
  - Games, Medical, Industry, Mobile





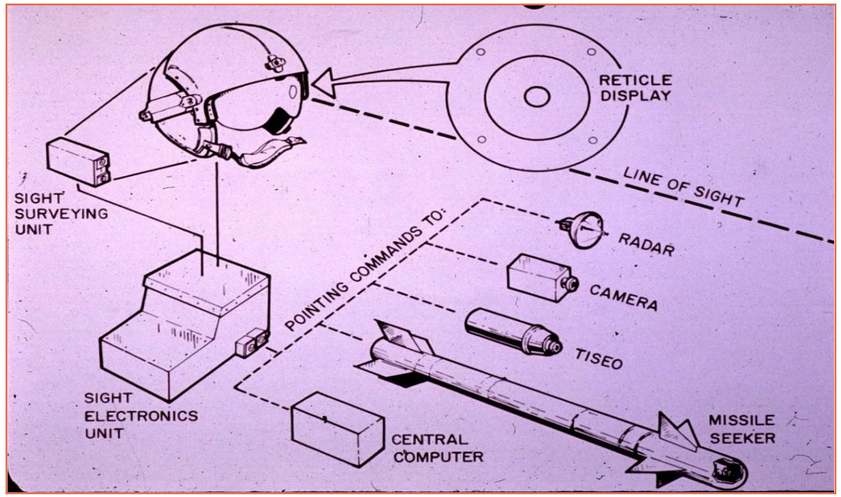
Early HMDs and HUDs (1960's)

Bucaneer HUD (1958)



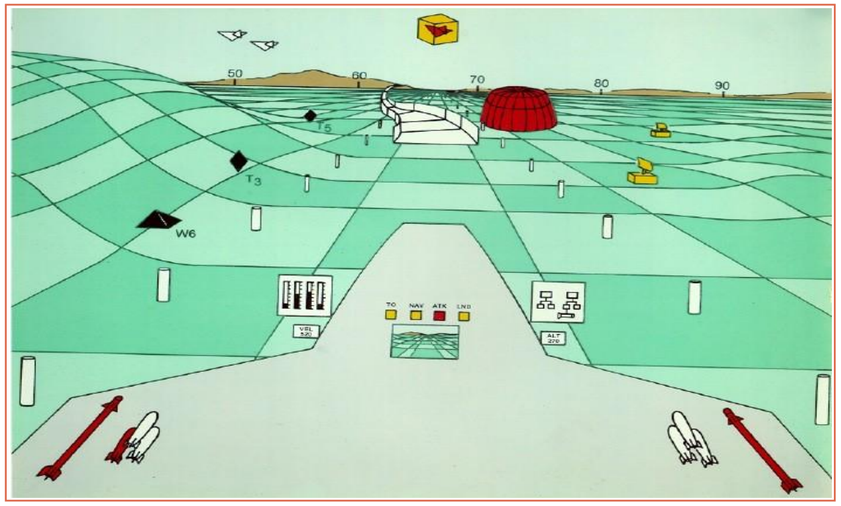
Sutherland / Sproull's see- through HMD (1965)

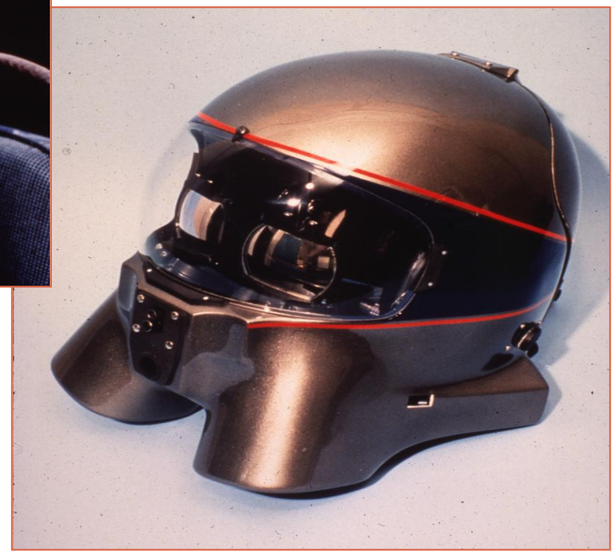
Military Research



1960 - 70’s: US Air Force helmet mounted displays (T. Furness)

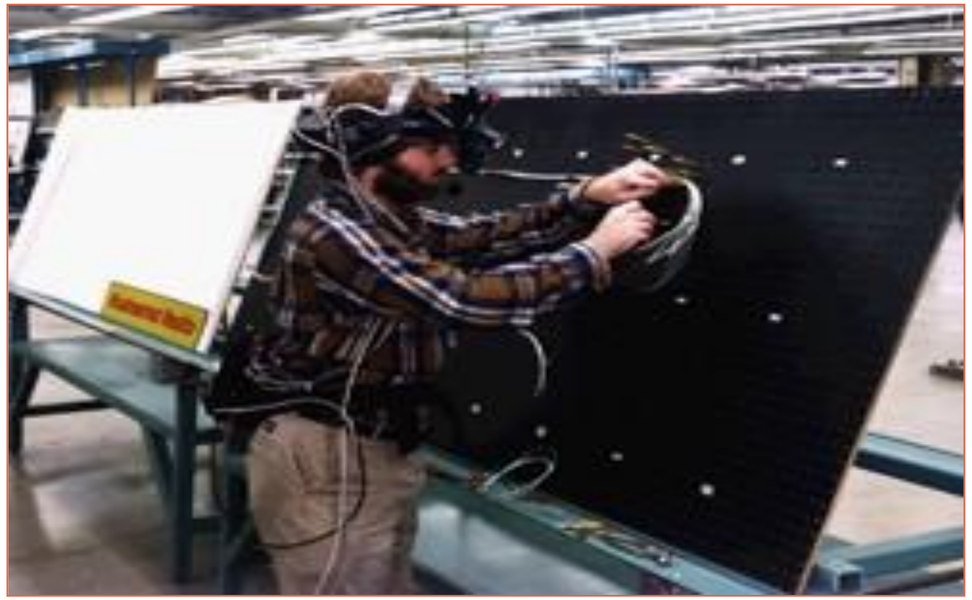
Military Research

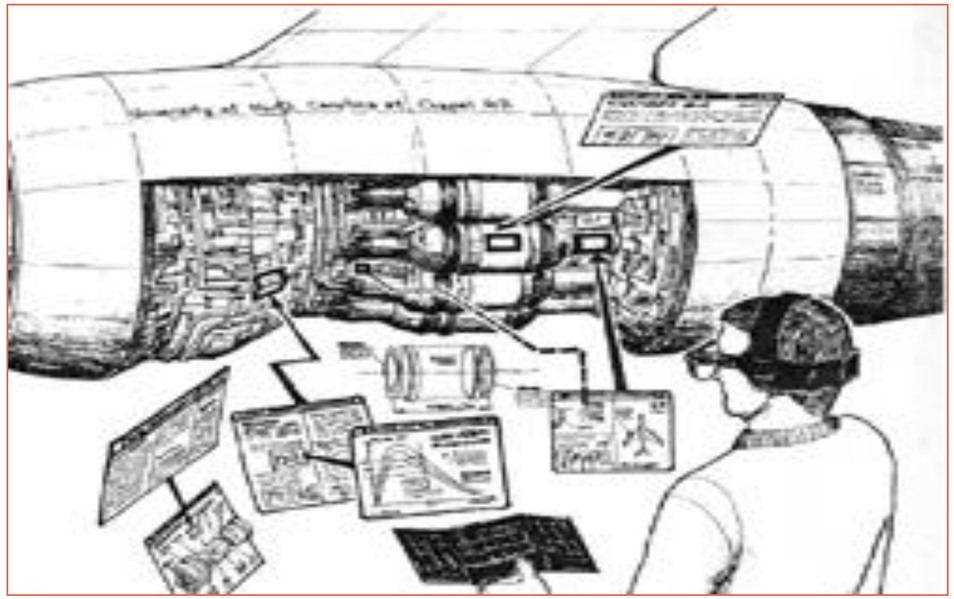




1970 – 80's: US Air Force Super Cockpit (T. Furness)

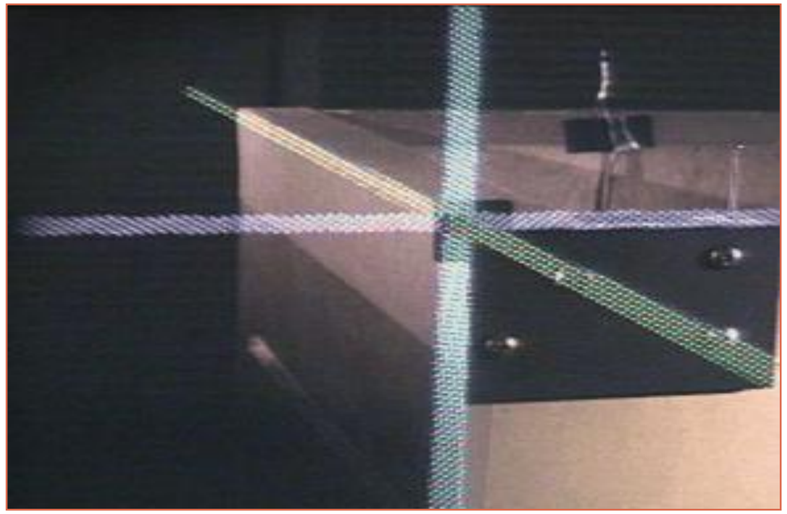
Early Industrial Research





- Early 1990's: Boeing coined the term "AR." Wire harness assembly application begun (T. Caudell, D. Mizell).
- Early to mid 1990's: UNC ultrasound visualization project

Early Academic Research



- 1994: Motion stabilized display [Azuma]
- 1995: Fiducial tracking in video see-through [Bajura]
- 1996: UNC hybrid magnetic-vision tracker

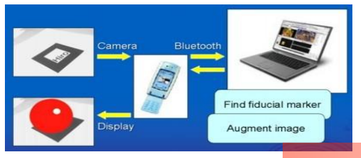
Spreading AR Research

- 1996: MIT Wearable Computing efforts
- 1998: Dedicated conferences begin
- Late 90's: Collaboration, outdoor, interaction
- Late 90's:Augmented sports broadcasts
- 1998 - 2001: Mixed Reality Systems Lab

MOBILE AR HISTORY

Evolution of Mobile AR

Camera phone



Camera phone
- Thin client AR

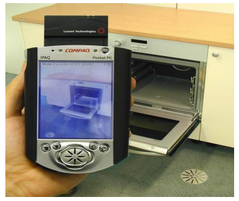
Camera phone
- Self contained AR

Wearable Computers

Wearable AR

Handheld AR Displays

PDAs
-Thin client AR



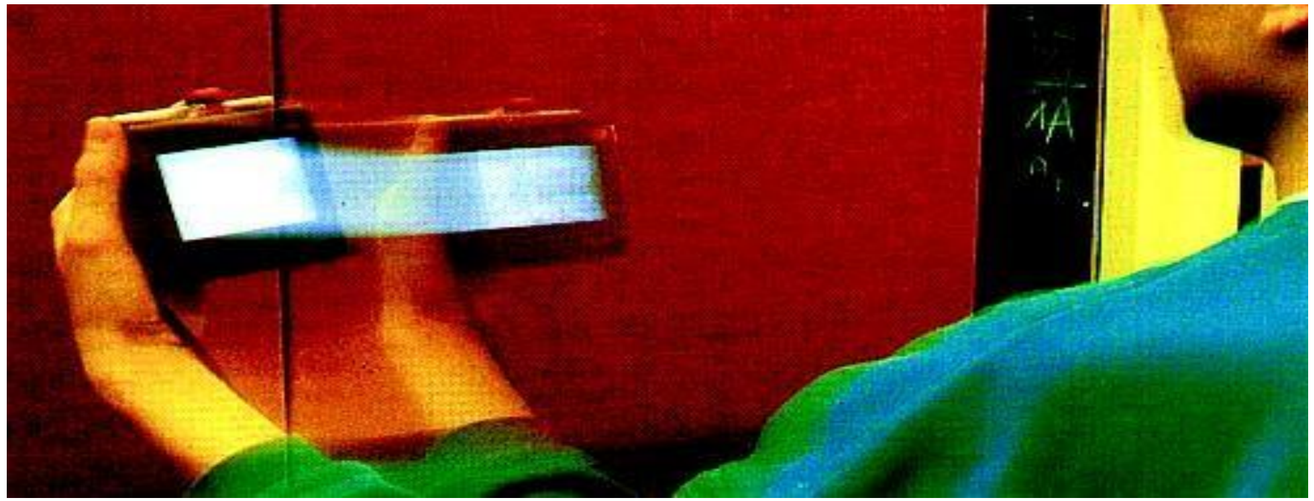
PDAs
-Self contained AR

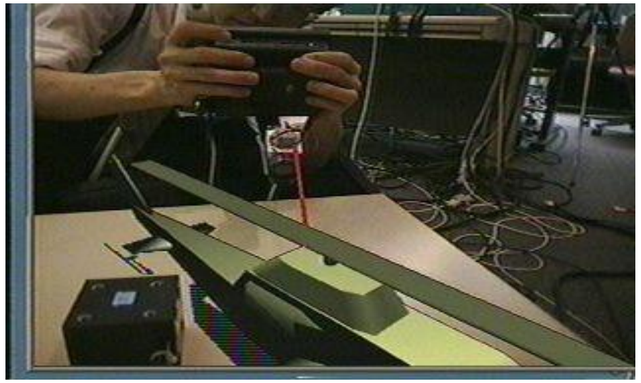
1995 1997 2001 2003 2004

Handheld Displays

Tethered Applications

- Fitzmaurice Chameleon (1994)
- Rekimoto's Transvision (1995)
- Tethered LCD
- PC Processing and Tracking

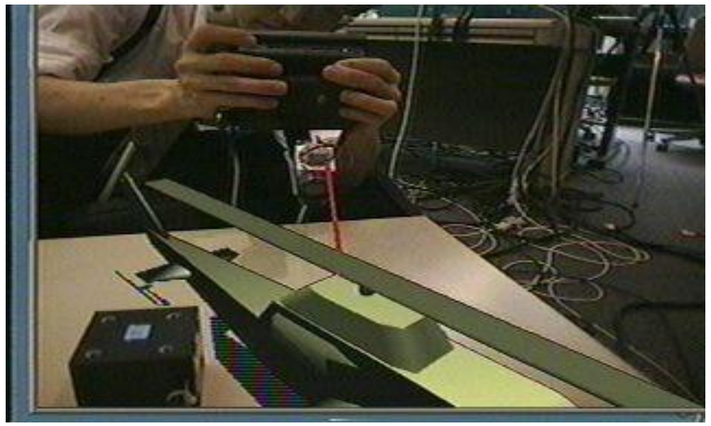




Handheld AR Display - Tethered

1995, 1996 Handheld AR

- ARPad, Cameleon
- Rekimoto's NaviCam, Transvision
- Tethered LCD
- PC Processing and Tracking



NaviCam (Rekimoto, 1995)

Information is registered to real-world context

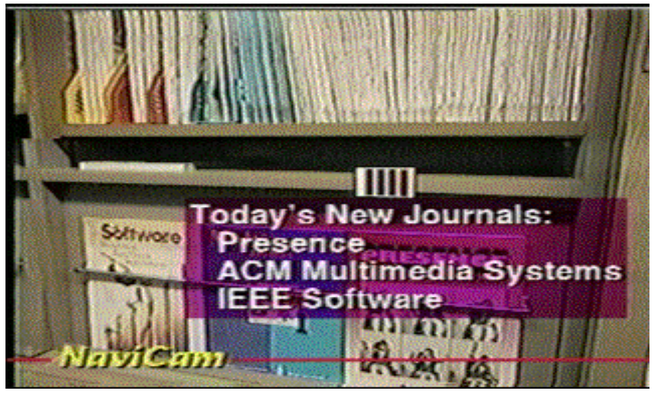
- Hand held AR displays

Interaction

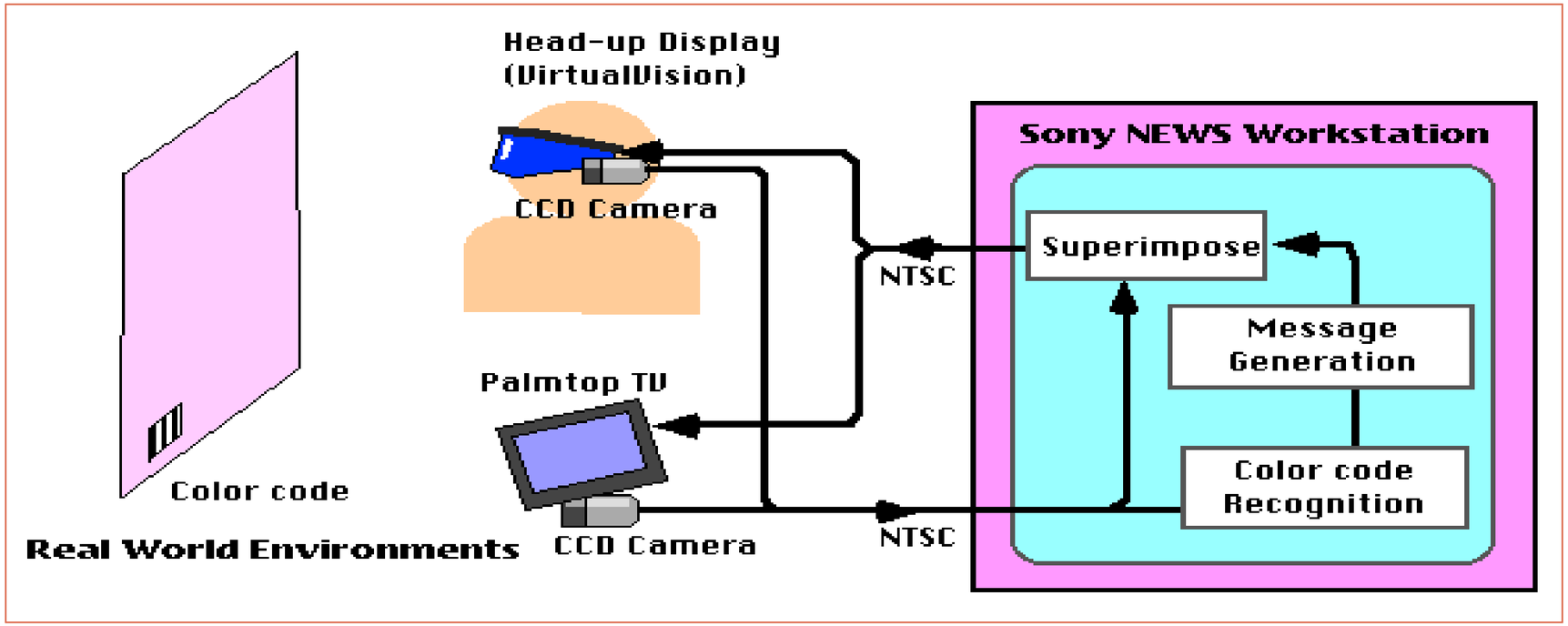
- Manipulation of a window into information space

Applications

- Context-aware information displays



NaviCam Architecture

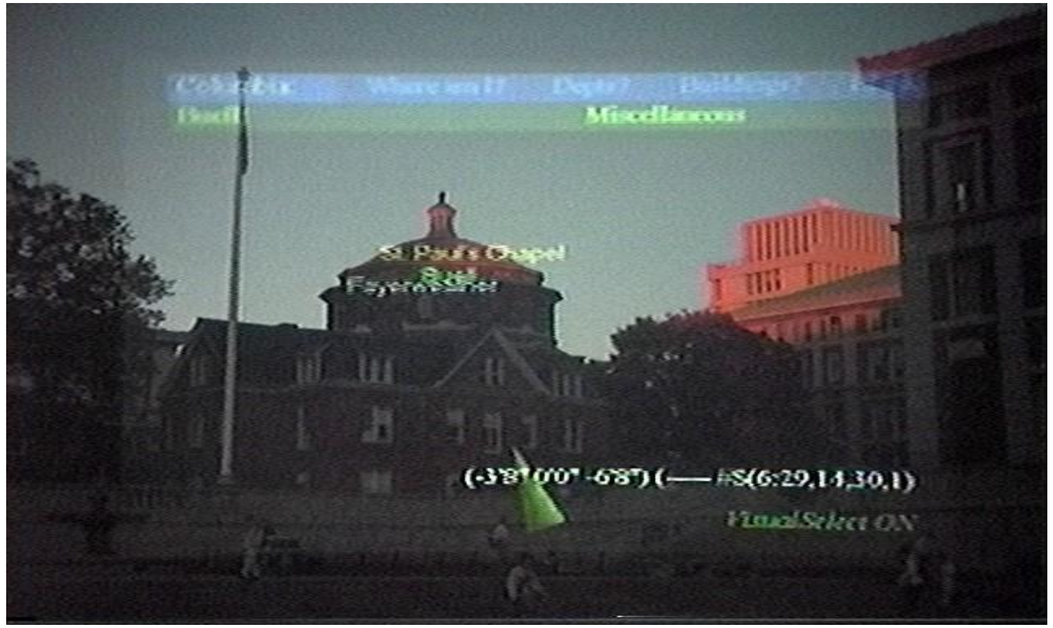


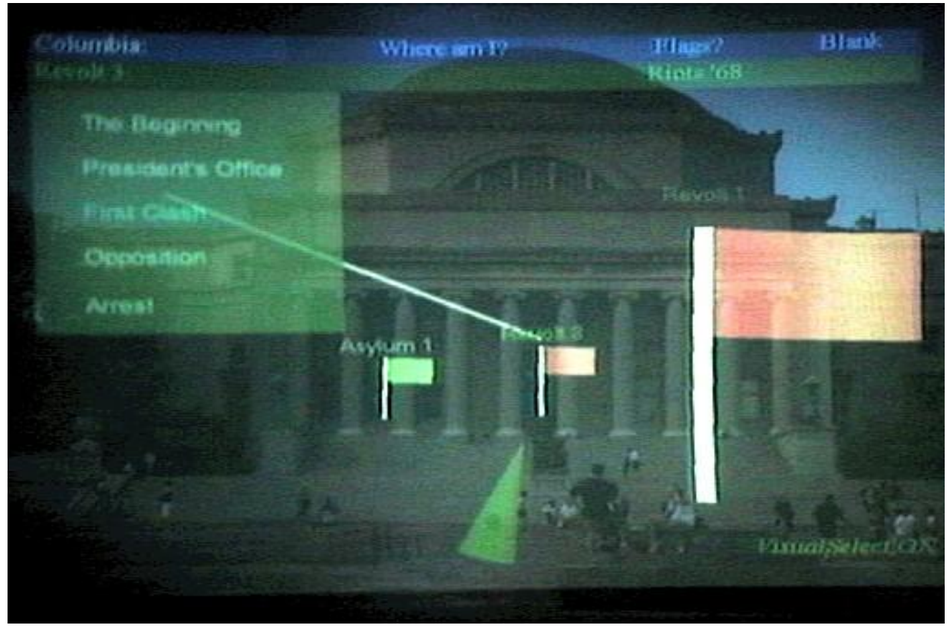
Jun Rekimoto and Katashi Nagao, "*The World through the Computer: Computer Augmented Interaction with Real World Environments*", User Interface Software and Technology (UIST '95)

Mobile AR: Touring Machine (1997)

- University of Columbia
  - Feiner, MacIntyre, Höllerer, Webster
- Combines
  - See through head mounted display
  - GPS tracking
  - Orientation sensor
  - Backpack PC (custom)
  - Tablet input

MARS View





- Virtual tags overlaid on the real world
- "Information in place"

Backpack/Wearable AR

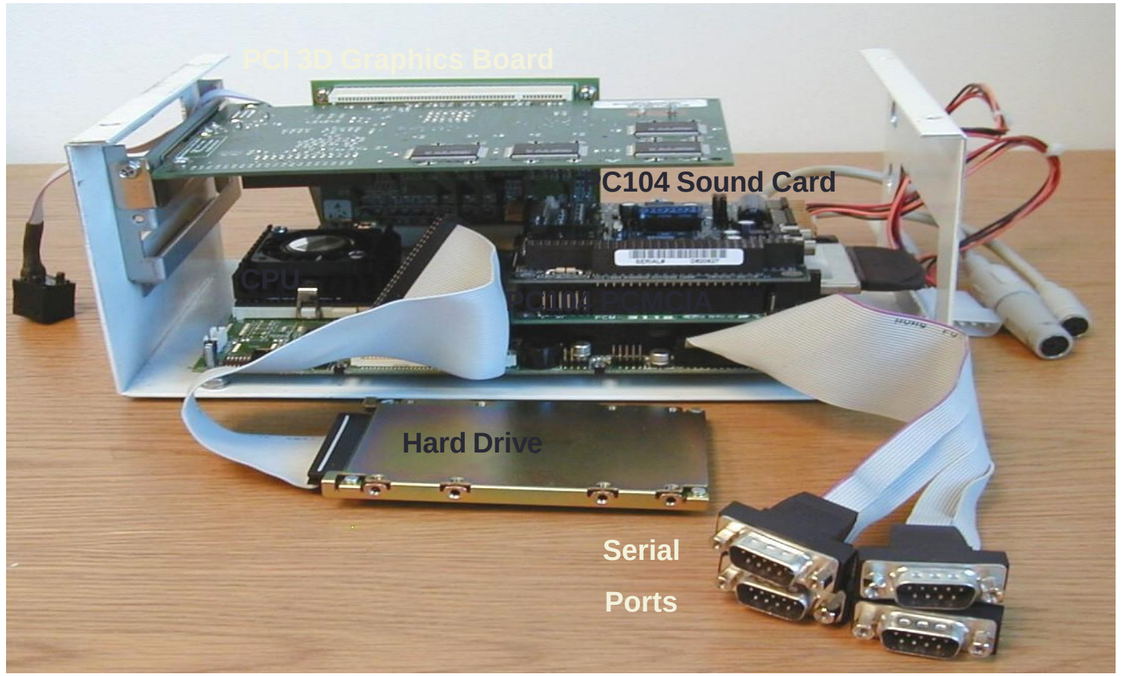
1997 Backpack AR

- Feiner's Touring Machine
- AR Quake (Thomas)
- Tinmith (Piekarski)
- MCAR (Reitmayr)
- Bulky, HMD based

Mobile AR - Hardware

Columbia *Touring Machine*

Example self-built working solution with PCI-based 3D graphics

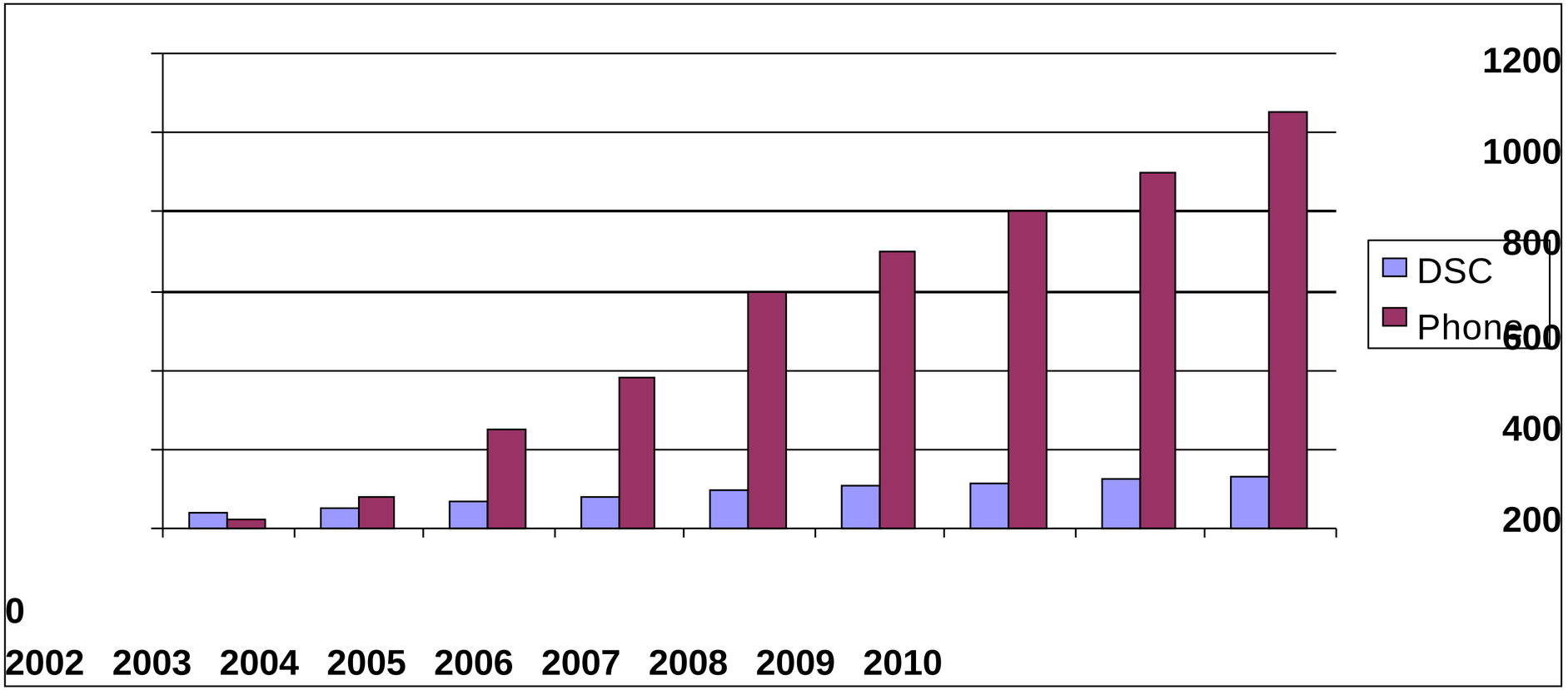


First Camera Phone

Sharp J-SH04

- 1997 Philip Kahn invents camera phone
- 1999 First commercial camera phone

Millions of Camera Phones



Handheld AR – Thin Client

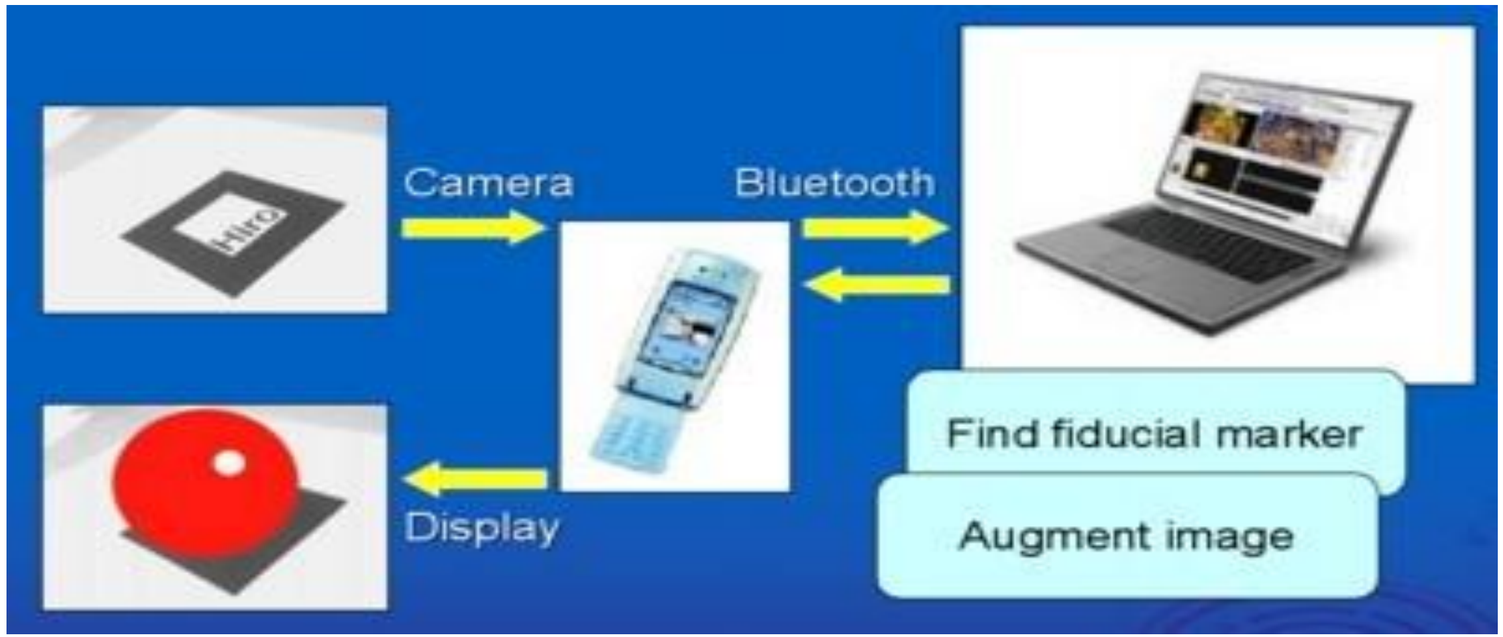
2001 BatPortal (AT&T Cambridge)

- PDA used as I/O device
- Wireless connection to workstation
- Room-scale ultrasonic tracking (Bat)

2001 AR-PDA (C Lab)

- PDA thin graphics client
- Remote image processing
- www.ar-pda.com

Mobile Phone AR – Thin Client



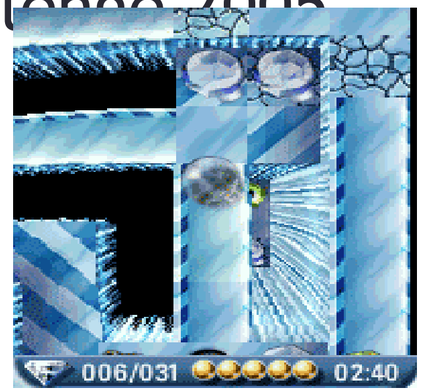
2003 ARphone (Univ. of Sydney)

- Transfer images via Bluetooth (slow – 30 sec/image)
- Remote processing – AR Server

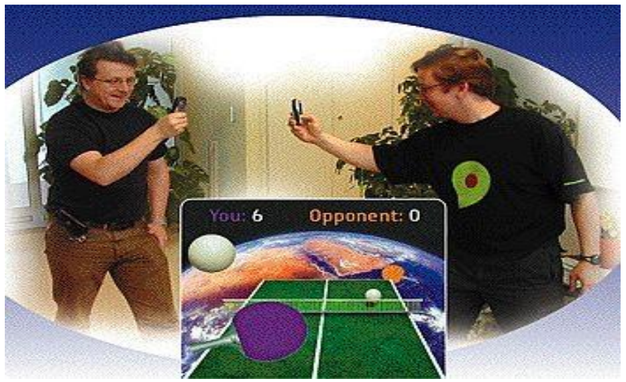
Early Phone Computer Vision Apps

2003 – Mozzies Game- Best mobile game Optical motion flow detecting phone orientation Siemens SX1 – Symbian, 120Mhz,VGA Camera

2005 – Marble Revolution (Bit-Side GmbH) Winner of Nokia's Series 60 Challenge 2005



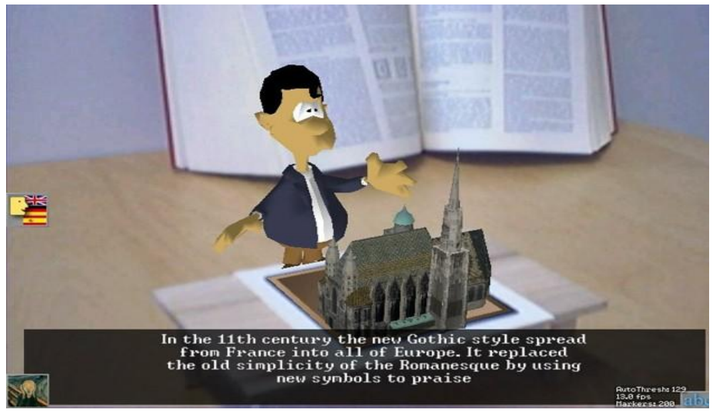
2005 – SymBall (VTT)



Handheld AR – Self Contained

2003 PDA-based AR

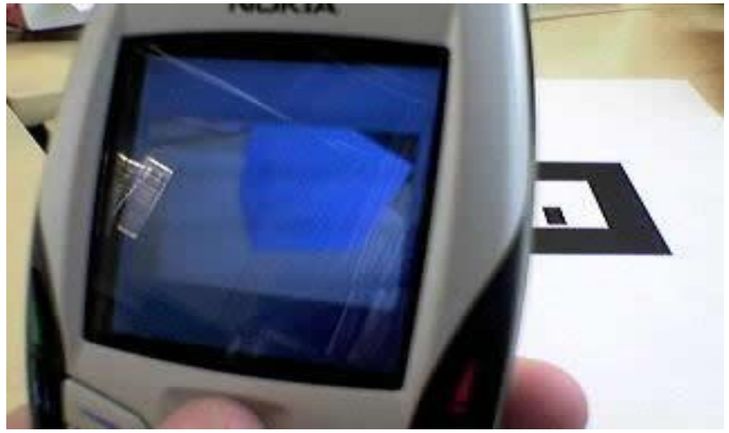
- ARToolKit port to PDA
- Studierstube ported to PDA
- AR Kanji Educational App.
- Mr Virtuoso AR character
- Wagner's Invisible Train
  - Collaborative AR



Mobile Phone AR – Self Contained

2004 Mobile Phone AR

- Moehring, Bimber
- Henrysson (ARToolKit)
- Camera, processor, display together



AR Enters Mainstream (2007-)

- Magazines
  - MIT Tech. Review (Mar 2007)
    - 10 most exciting technologies
  - Economist (Dec. 2007)
    - Reality, only better
- Games
  - Sony “Eye of Judgement”
    - 300,000+ units shipped
- Broadcast TV
  - Sports broadcasting

Google Searches for AR

Browser Based AR (2008 -)

- Flash + Camera + 3D graphics
- High impact
  - High marketing value
- Large potential install base
  - 1.6 Billion web users
- Ease of development
  - Lots of developers, mature tools
- Low cost of entry
  - Browser, web camera

Mobile AR (2005 -)

- **Mobile Phones**
  - Camera, processor, display
  - Computer vision based AR
- **Advertising**
  - HIT Lab NZ (2007)
  - AR print advertisement
  - Txt to download app

Mobile Outdoor AR (2009 -)

- Mobile phones with GPS
- Tag real world locations
  - GPS + Compass input
  - Overlay graphics data on live video
- Applications
  - Travel guide, Advertising, etc
- Wikitude, Layar, Junaio, etc.
  - Android, iOS based, Public API released

Motorola Droid

Layar - www.layar.com

Qualcomm

- Acquired Imagination
- October 2010 - Releases free Android AR SDK
- Computer vision tracking - marker, markerless
- Integrated with Unity 3D renderer
- http://developer.qualcomm.com/ar

Rock-em Sock-em

- SharedAR Demo
- Markerless tracking

Wearable Computing

- Computer on the body that is:
  - Always on
  - Always accessible
  - Always connected
- Other attributes
  - Augmenting user actions
  - Aware of user and surroundings

Google Glass (2013)

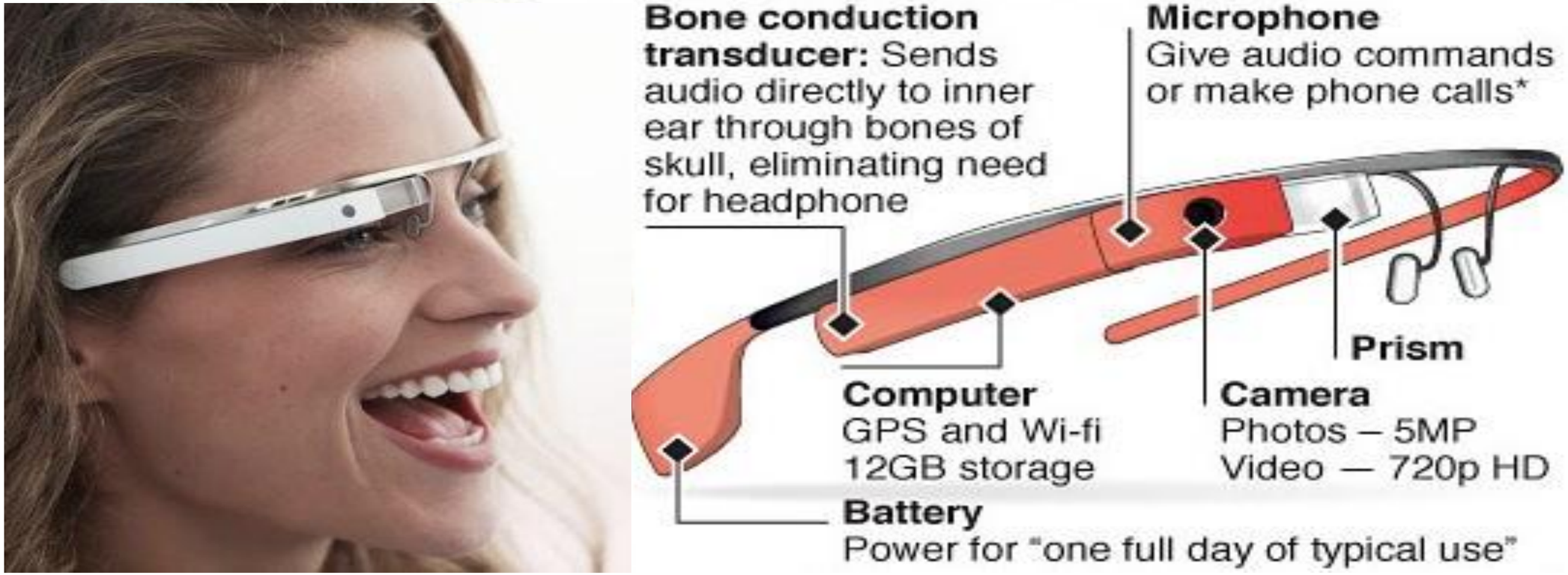
View Through Google Glass

Always available peripheral information display

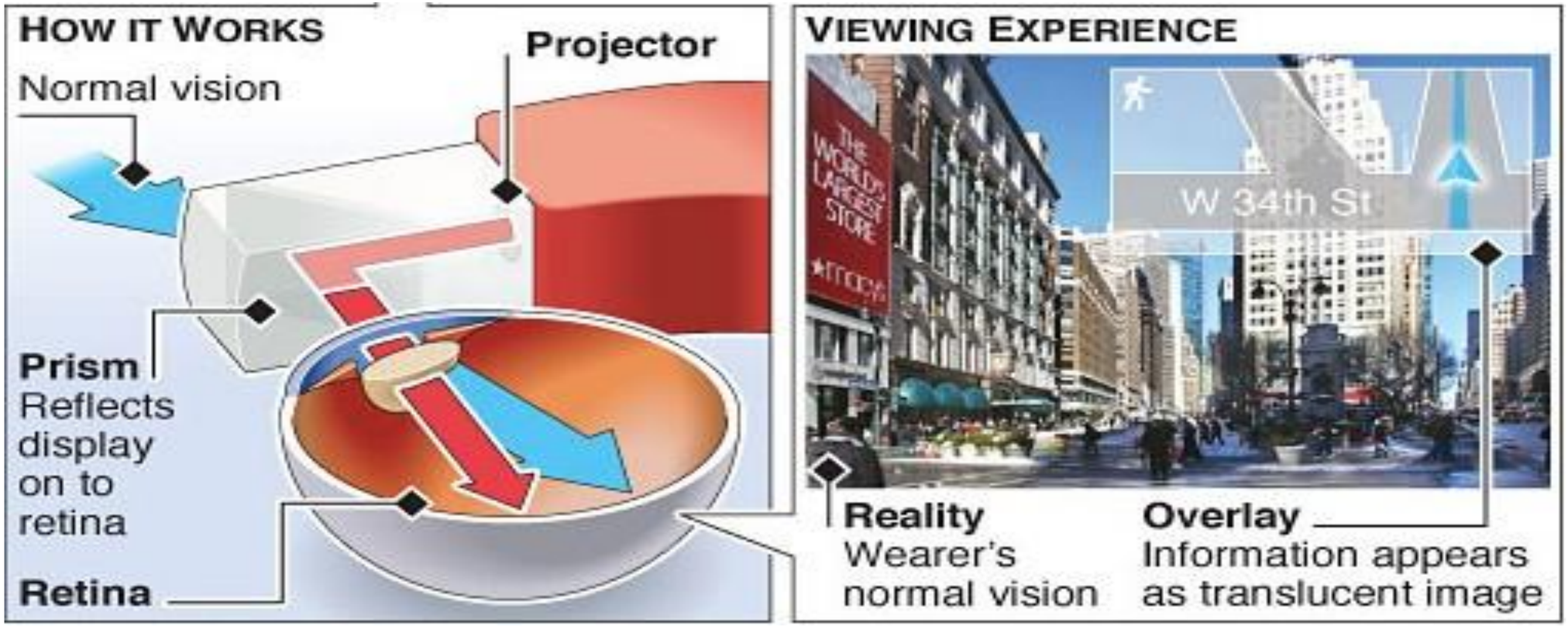
Combining computing, communications and content capture

Google Glass augmented reality computer

Google Glass, a wearable computer with a head-mounted display, has gone on sale to early adopters at a cost of $1,500



Glass and AR


HOW IT WORKS
Projector
Normal vision
Prism
Reflects display on to retina
Retina
VIEWING EXPERIENCE
W 34th St
Reality
Wearer's normal vision
Overlay
Information appears as translucent image

Display Competitors

- Vuzix M100
  - $1000
- Recon Jet
  - $600, more sensors, sports
- Optinvent ORA
  - 500 Euro, multi-view mode
- Epson Moverio BT-200
  - $700 Binocular, stereoscopic 3D

AR Today

- Key Technologies Available
  - Robust tracking (Computer Vision, GPS/sensors)
  - Display (Handheld, HMDs)
  - Input Devices (Kinect, etc)
  - Developer tools (PTC, Wikitude)
- Commercial Business Growing
  - Thousands mobile AR apps
  - Gaming, GPS/Mobile, Online Advertisement
    - >$5 Billion USD by 2016 (Markets and Markets)
    - >$600 Million USD in Mobile AR in 2014 (Juniper Research)

AR Business Today

- Around $600 Million USD in 2014 (>$2B 2015)
- 70-80+% Games and Marketing

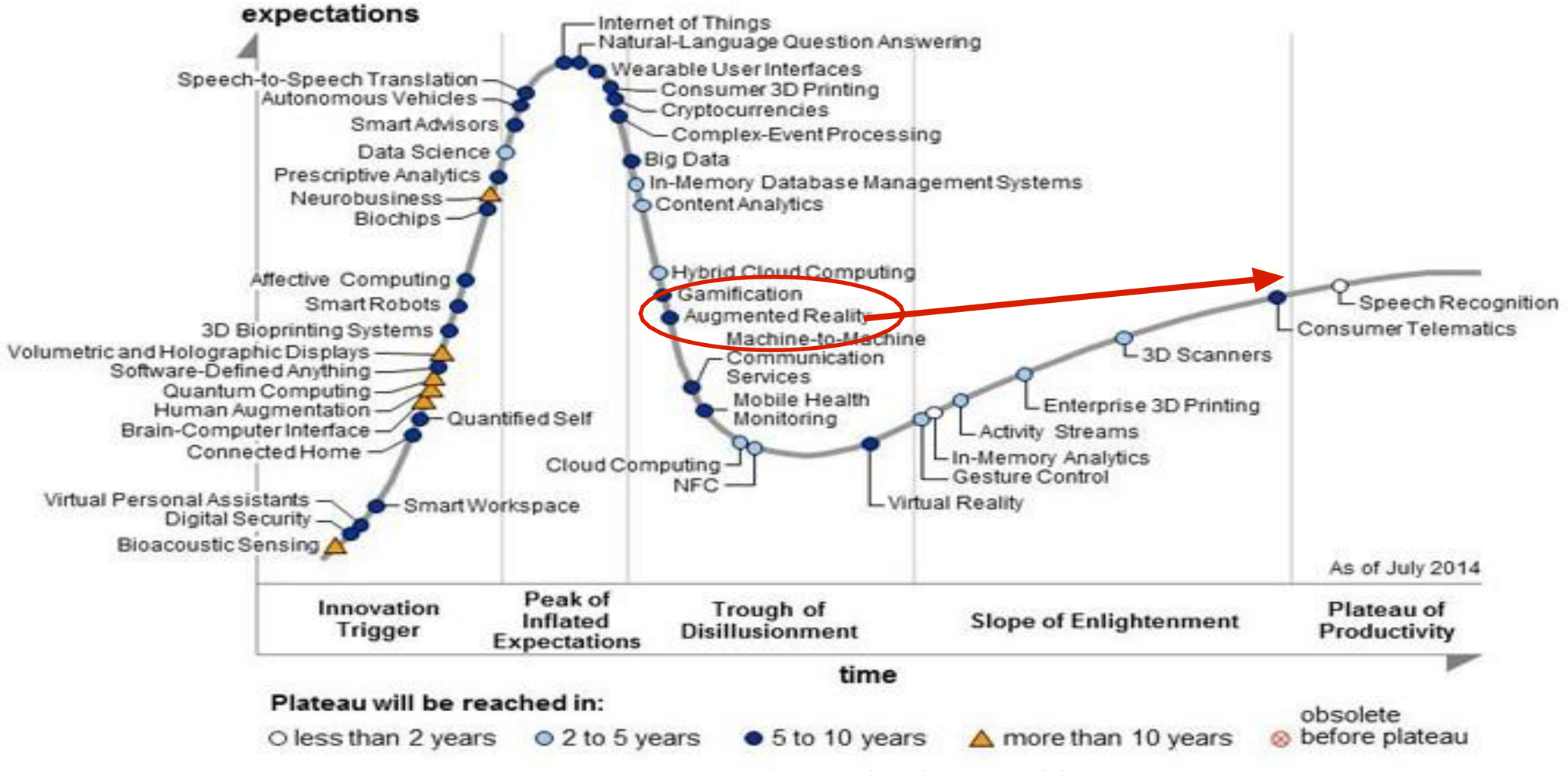
AR Business Today

- Marketing
  - Web-based, mobile
- Mobile AR
  - Geo-located information and service
- Gaming
  - Mobile, Physical input (Kinect, PS Move)
- Upcoming areas
  - Manufacturing, Medical, Military

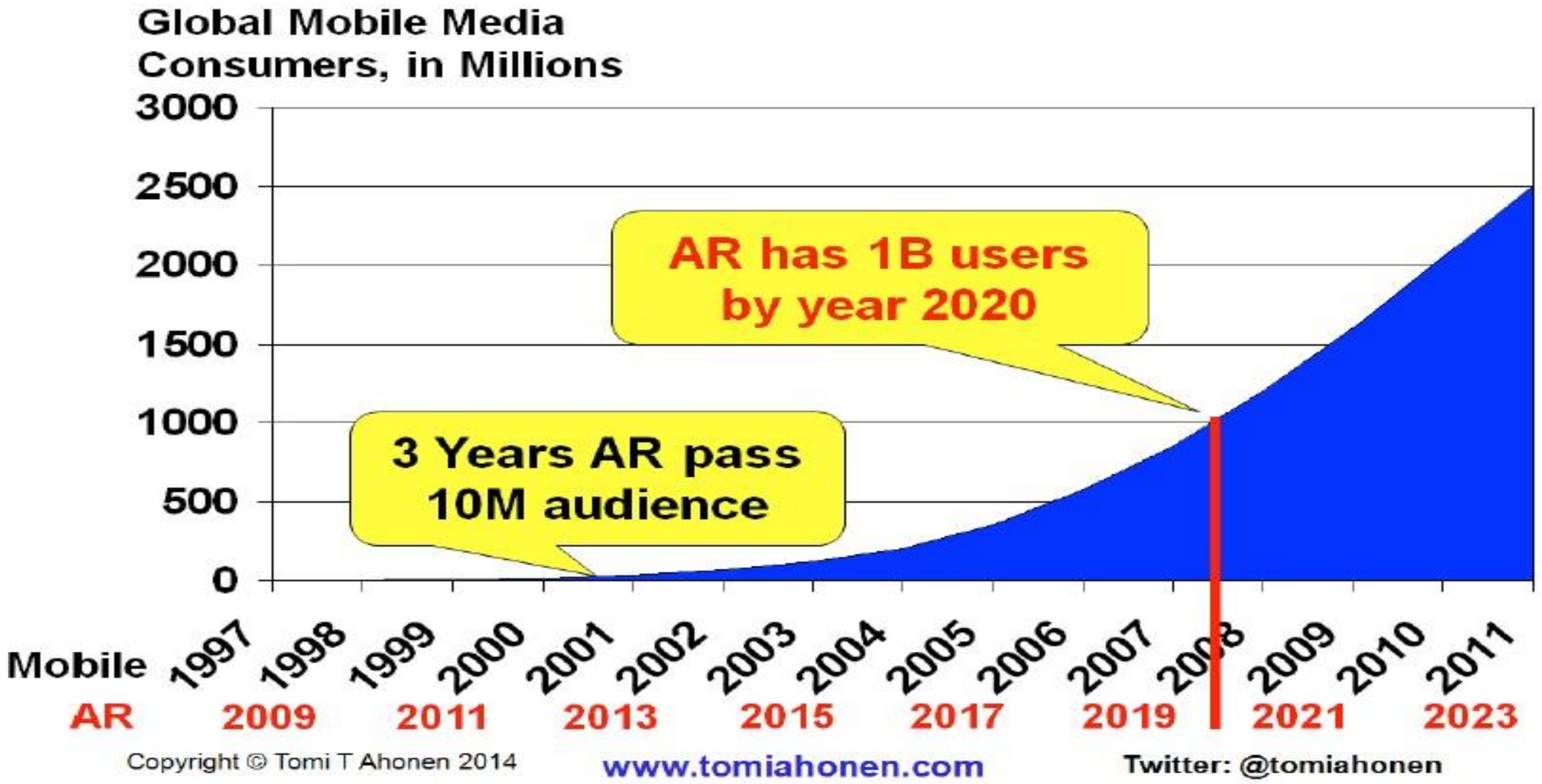
Augmented Reality Landscape

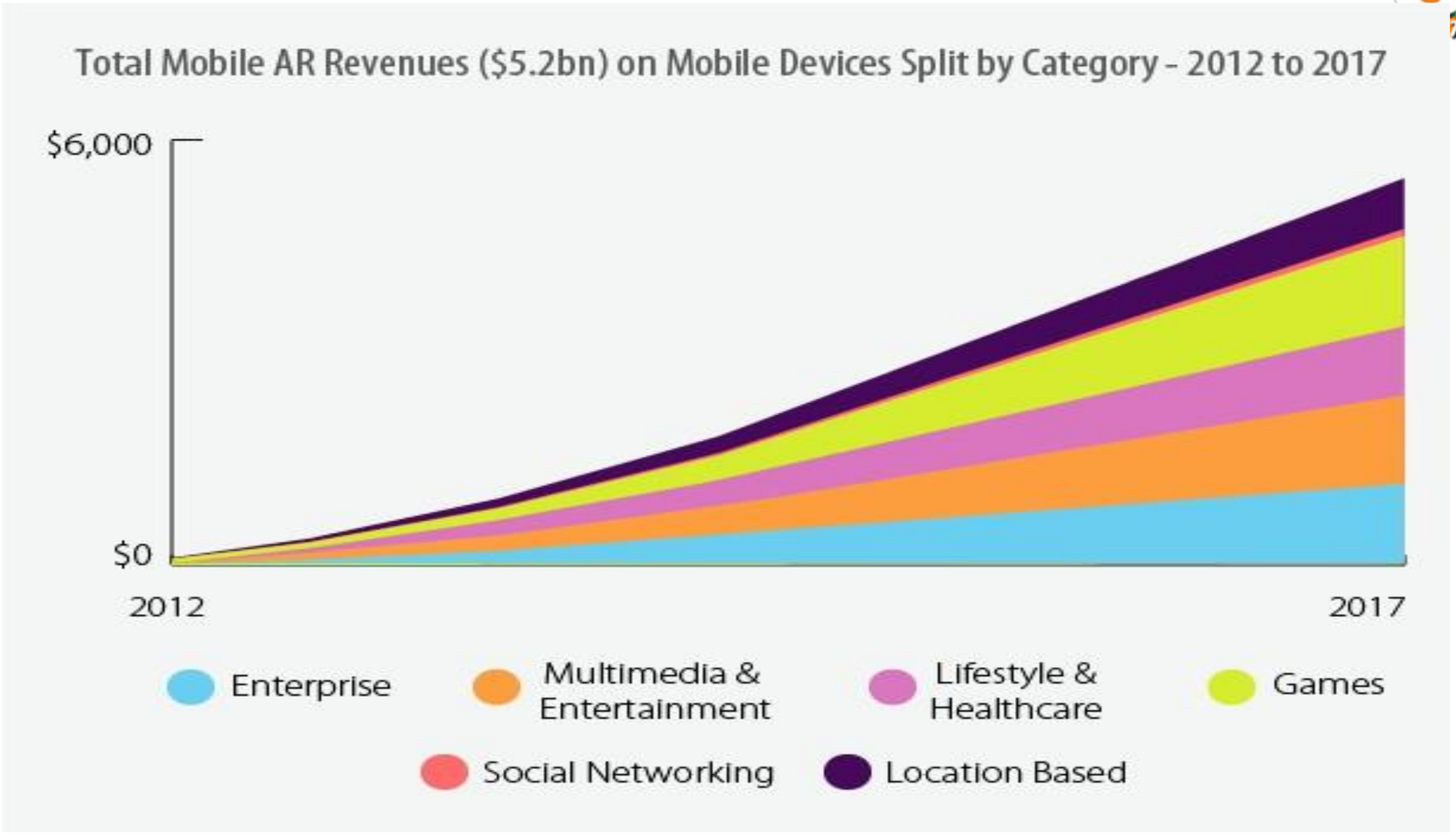
Version 1.4, May 11th, 2013

Gartner Hype Cycle

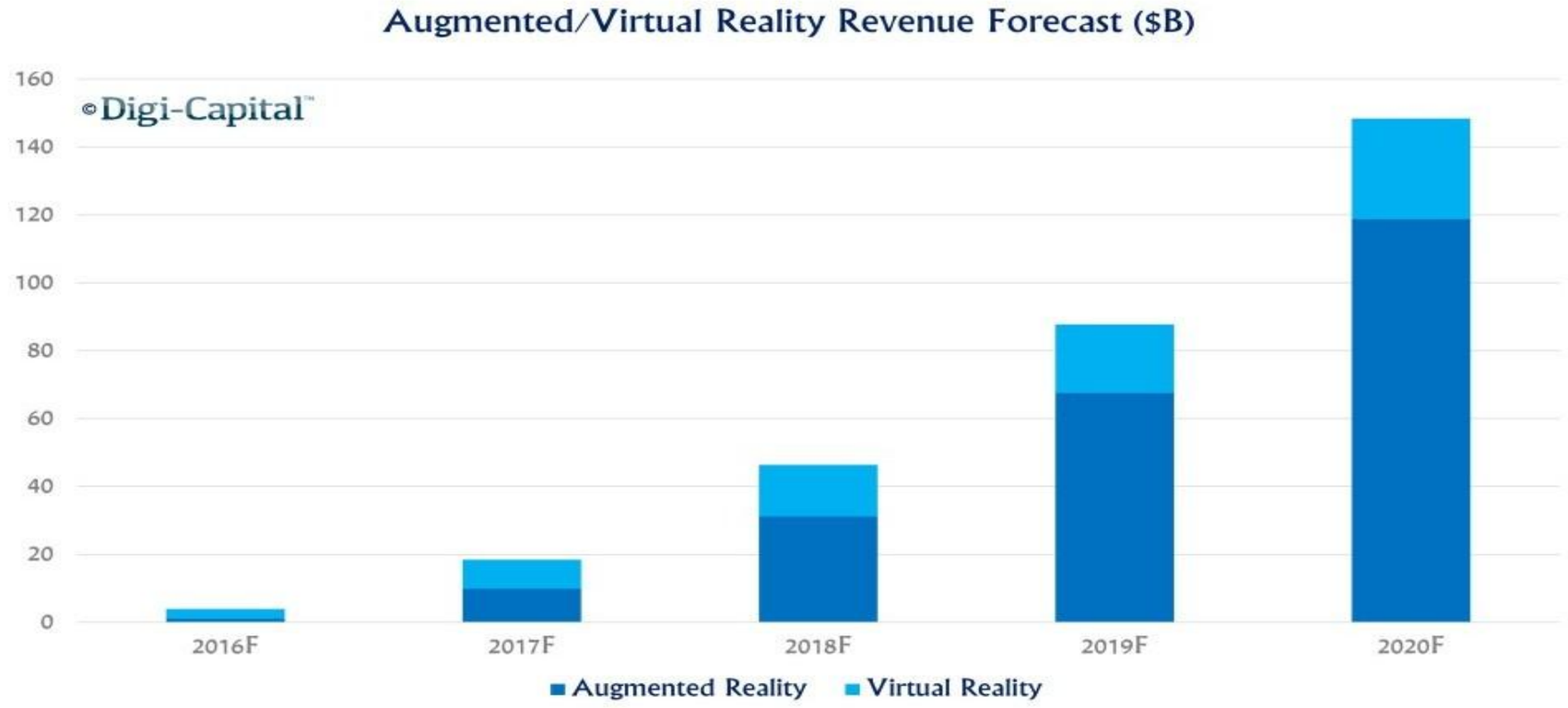


User Forecast

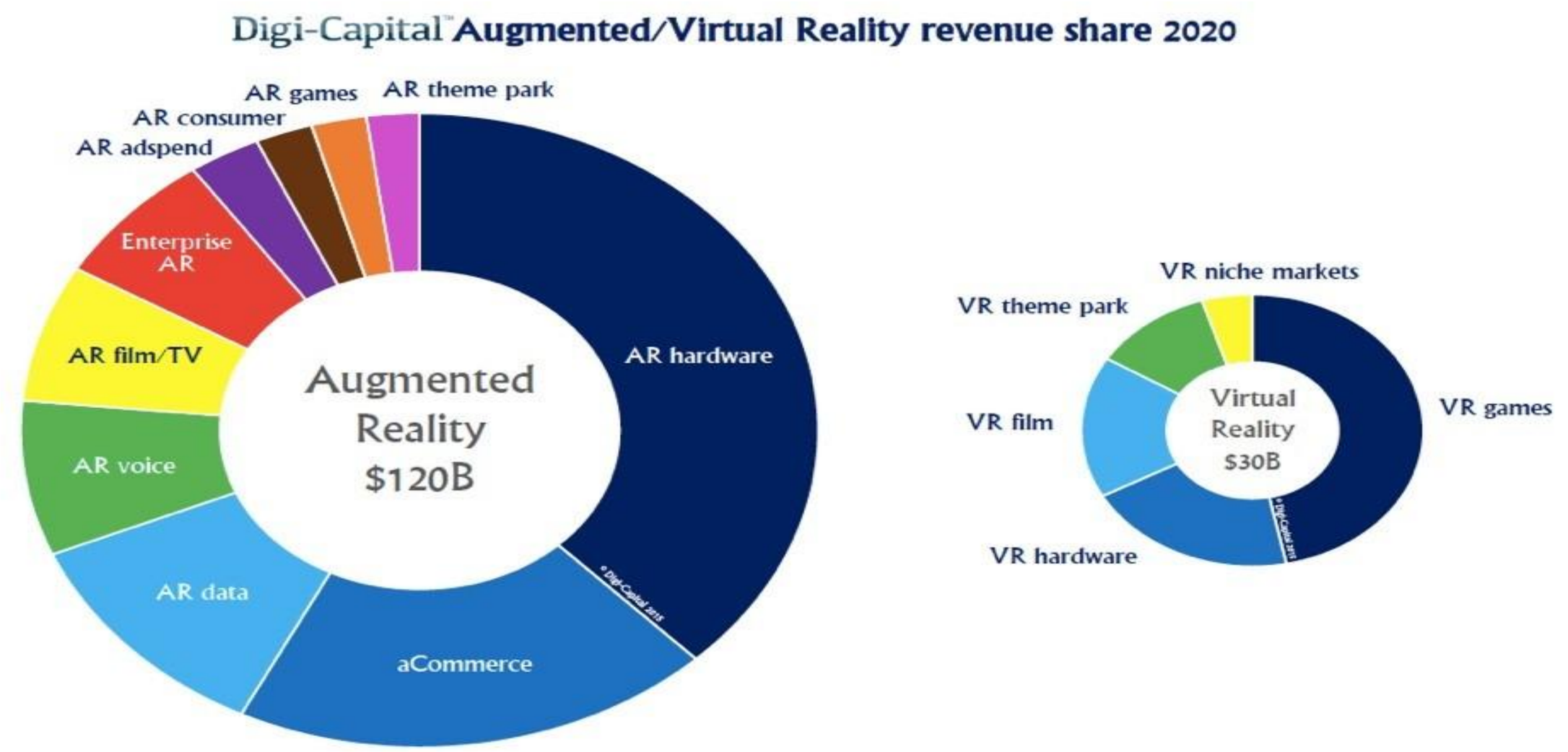



Total Mobile AR Revenues ($5.2bn) on Mobile Devices Split by Category - 2012 to 2017
$6,000
$0
2012
2017
Enterprise
Multimedia & Entertainment
Lifestyle & Healthcare
Games
Social Networking
Location Based

Market Forecast



Up to $120B by 2020 – 5 x VR market


Digi-Capital™ Augmented/Virtual Reality revenue share 2020
AR games
AR theme park
AR consumer
AR adspend
Enterprise AR
AR film/TV
AR voice
AR data
aCommerce
AR hardware
Augmented Reality $120B
© Digi-Capital 2015
VR niche markets
VR theme park
VR film
VR hardware
VR games
Virtual Reality $30B
© Digi-Capital 2015

What Markets will AR/VR Cannibalize and Grow?

VR

Tens of millions of users

AR

Hundreds of millions of users

The Addressable Markets

VR

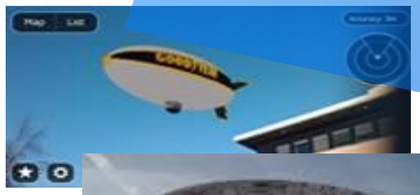
AR

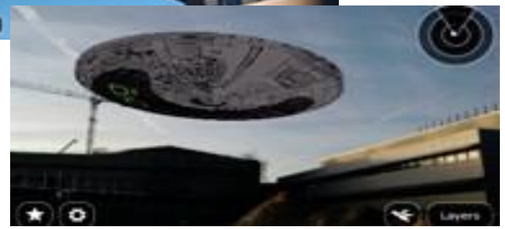
Mobile AR Apps

Wikitude
(Mobilizy)

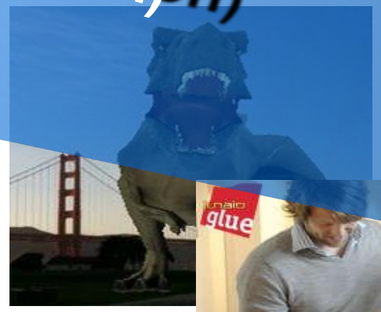
ScanSearch

From GeoInfo/Tagging To Entertainment
Richer 3D Graphics
More Accurate Tracking
(with Computer Vision)





Layar
(SPRX Mobile)



junaio
(Metaio)

Firefighter360
(Presselite)

Invisimals
(Sony)

Kweekies
(int13)

ARf
(Georgia Tech)

Summary

- Augmented Reality has a long history going back to the 1960's
- Interest in AR has exploded over the last few years and is being commercialized quickly
  - Smart Phones with sensors/cameras
- Mobile AR is growing in a number of areas