CST3140: Novel Interaction Technologies
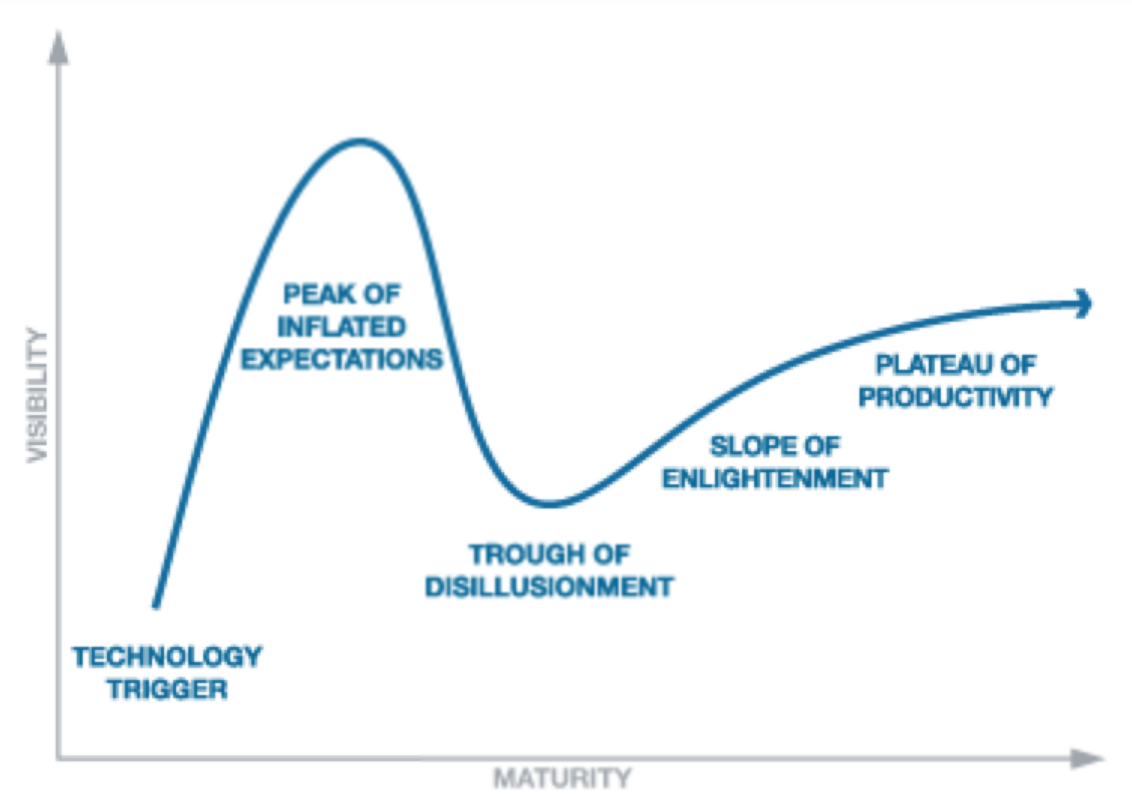
Week 3 Lecture:

Designing Augmented Reality

Today…

- Technology lifecycles
  - Where are we now?

- Design considerations for AR
  - Design principles
  - AR Design Patterns
  - AR for learning
  - AR in the museum

Technology Hype Cycles

- Technology Trigger
- Peak of Inflated Expectation
- Trough of Disillusionment
- Slope of Enlightenment
- Plateau of Productivity

The Hype-Cycle stages

Technology Trigger: In this stage, a technology is conceptualized. There may be prototypes but there are often no functional products or market studies. The potential spurs media interest and sometimes proof-of-concept demonstrations.
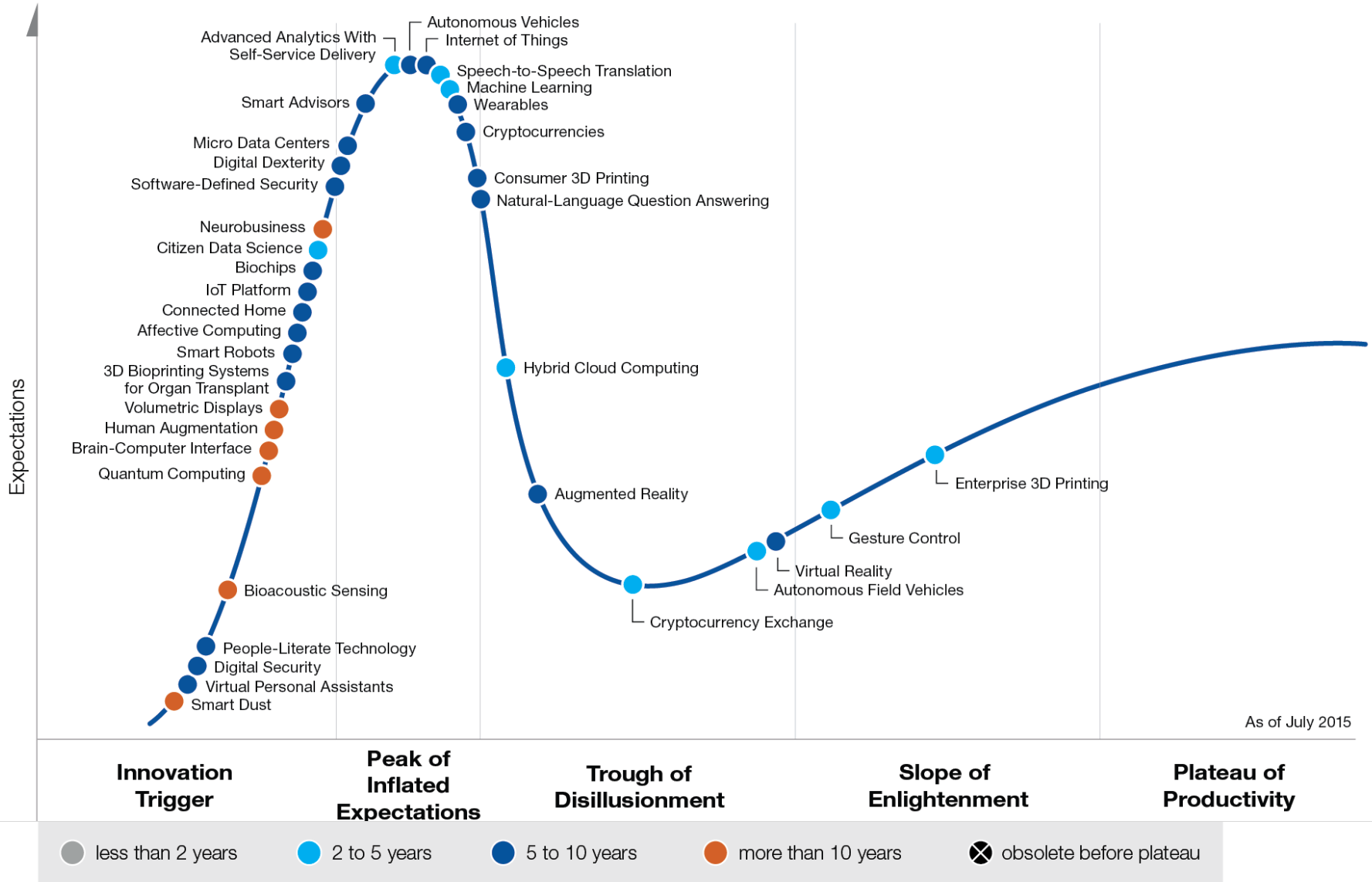
Peak of Inflated Expectations: The technology is implemented, especially by early adopters. There is a lot of publicity about both successful and unsuccessful implementations.

Trough of Disillusionment: Flaws and failures lead to some disappointment in the technology. Some producers are unsuccessful or drop their products. Continued investments in other producers are contingent upon addressing problems successfully.

Slope of Enlightenment: The technology's potential for further applications becomes more broadly understood and an increasing number of companies implement or test it in their environments. Some producers create further generations of products.

Plateau of Productivity: The technology becomes widely implemented; its place in the market and its applications are well-understood. Standards arise for evaluating technology providers.
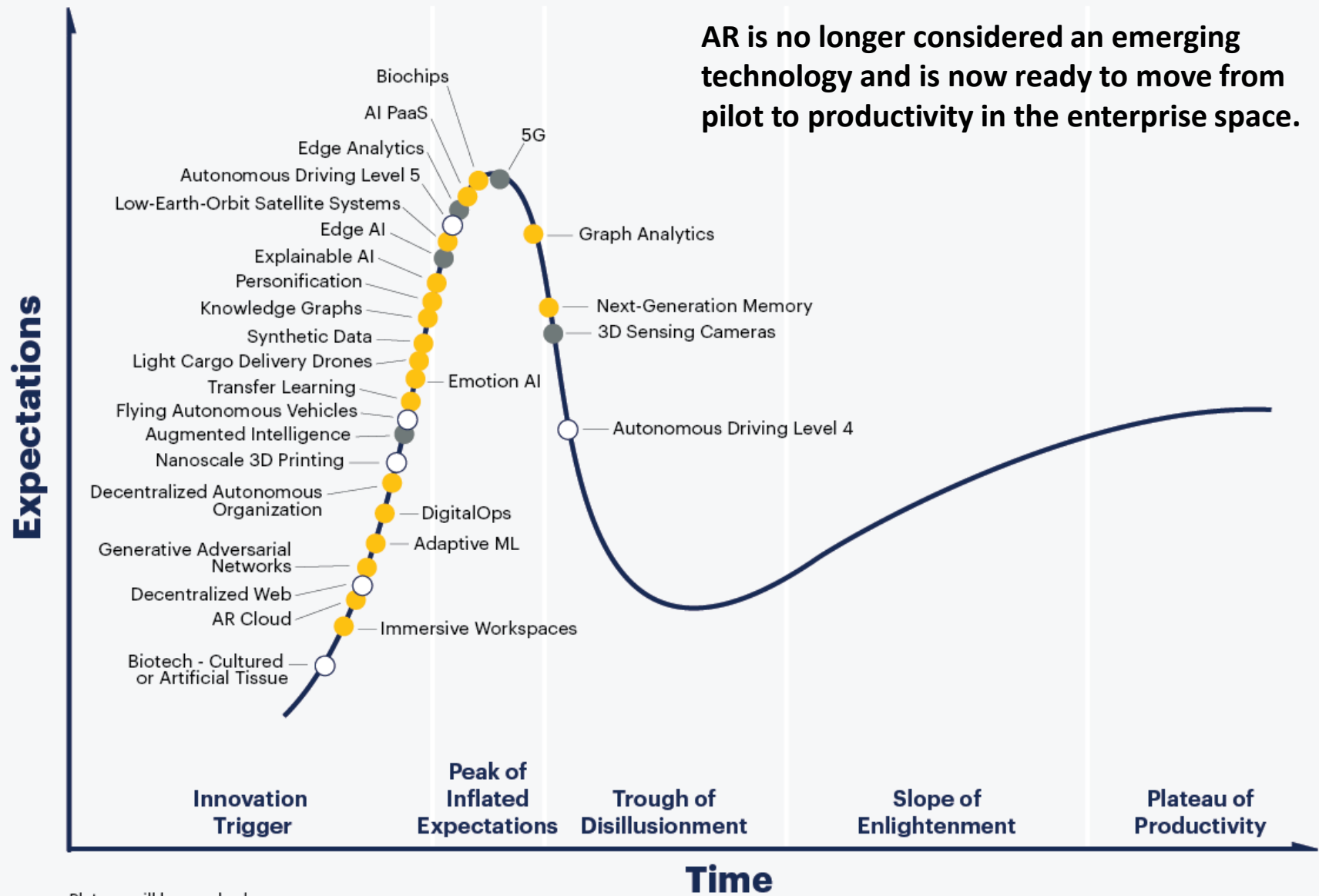
Hype Cycle for Emerging Tech 2016

Expectations

Advanced Analytics With Self-Service Delivery
Autonomous Vehicles
Internet of Things
Speech-to-Speech Translation
Machine Learning
Wearables
Smart Advisors
Cryptocurrencies
Micro Data Centers
Digital Dexterity
Software-Defined Security
Consumer 3D Printing
Natural-Language Question Answering
Neurobusiness
Citizen Data Science
Biochips
IoT Platform
Connected Home
Affective Computing
Smart Robots
3D Bioprinting Systems for Organ Transplant
Volumetric Displays
Human Augmentation
Brain-Computer Interface
Quantum Computing
Hybrid Cloud Computing
Augmented Reality
Enterprise 3D Printing
Gesture Control
Virtual Reality
Autonomous Field Vehicles
Cryptocurrency Exchange
Bioacoustic Sensing
People-Literate Technology
Digital Security
Virtual Personal Assistants
Smart Dust

As of July 2015

Innovation Trigger | Peak of Inflated Expectations | Trough of Disillusionment | Slope of Enlightenment | Plateau of Productivity

less than 2 years | 2 to 5 years | 5 to 10 years | more than 10 years | obsolete before plateau

Hype Cycle for Emerging Technologies, 2018

Plateau will be reached in:
- less than 2 years
- 2 to 5 years
- 5 to 10 years
- more than 10 years

Digital Twin
Biochips
Smart Workspace
Brain-Computer Interface
Autonomous Mobile Robots
Smart Robots
Deep Neural Network ASICs
AI PaaS
Quantum Computing
Volumetric Displays
Self-Healing System Technology
Conversational AI Platform
Autonomous Driving Level 5
Edge AI
5G

Deep Neural Nets (Deep Learning)
Carbon Nanotube
IoT Platform
Virtual Assistants
Silicon Anode Batteries
Blockchain

Connected Home
Autonomous Driving Level 4

Mixed Reality

Blockchain for Data Security
Neuromorphic Hardware
Human Augmentation
Knowledge Graphs
4D Printing

Artificial General Intelligence

Smart Dust
Flying Autonomous Vehicles
Biotech — Cultured or Artificial Tissue

Augmented Reality

Expectations

Time

Innovation Trigger

Peak of Inflated Expectations

Trough of Disillusionment

Slope of Enlightenment

Plateau of Productivity

As of July 2018

Gartner Hype Cycle for Emerging Technologies, 2019

AR is no longer considered an emerging technology and is now ready to move from pilot to productivity in the enterprise space.

Biochips
AI PaaS
Edge Analytics
Autonomous Driving Level 5
Low-Earth-Orbit Satellite Systems
Edge AI
Explainable AI
Personification
Knowledge Graphs
Synthetic Data
Light Cargo Delivery Drones
Transfer Learning
Flying Autonomous Vehicles
Augmented Intelligence
Nanoscale 3D Printing
Decentralized Autonomous Organization
Generative Adversarial Networks
Decentralized Web
AR Cloud
Biotech - Cultured or Artificial Tissue

5G
Graph Analytics
Next-Generation Memory
3D Sensing Cameras
Emotion AI
Autonomous Driving Level 4
DigitalOps
Adaptive ML
Immersive Workspaces

Expectations

Innovation Trigger | **Peak of Inflated Expectations** | **Trough of Disillusionment** | **Slope of Enlightenment** | **Plateau of Productivity**

Time

From Pilot to Productivity

By graduating from the Hype Cycle, augmented reality evolves from "a technology to watch" to one to use.

This means AR has reached maturity and became an industry-proofed technology that executives can safely invest in to improve and innovate their business.

Microsoft HoloLens 2 - $3,500.00

Other examples: https://www.wareable.com/ar/the-best-smartglasses-google-glass-and-the-rest

Augmented Reality Evolution - Gartner Hype Cycle 2005 -2018
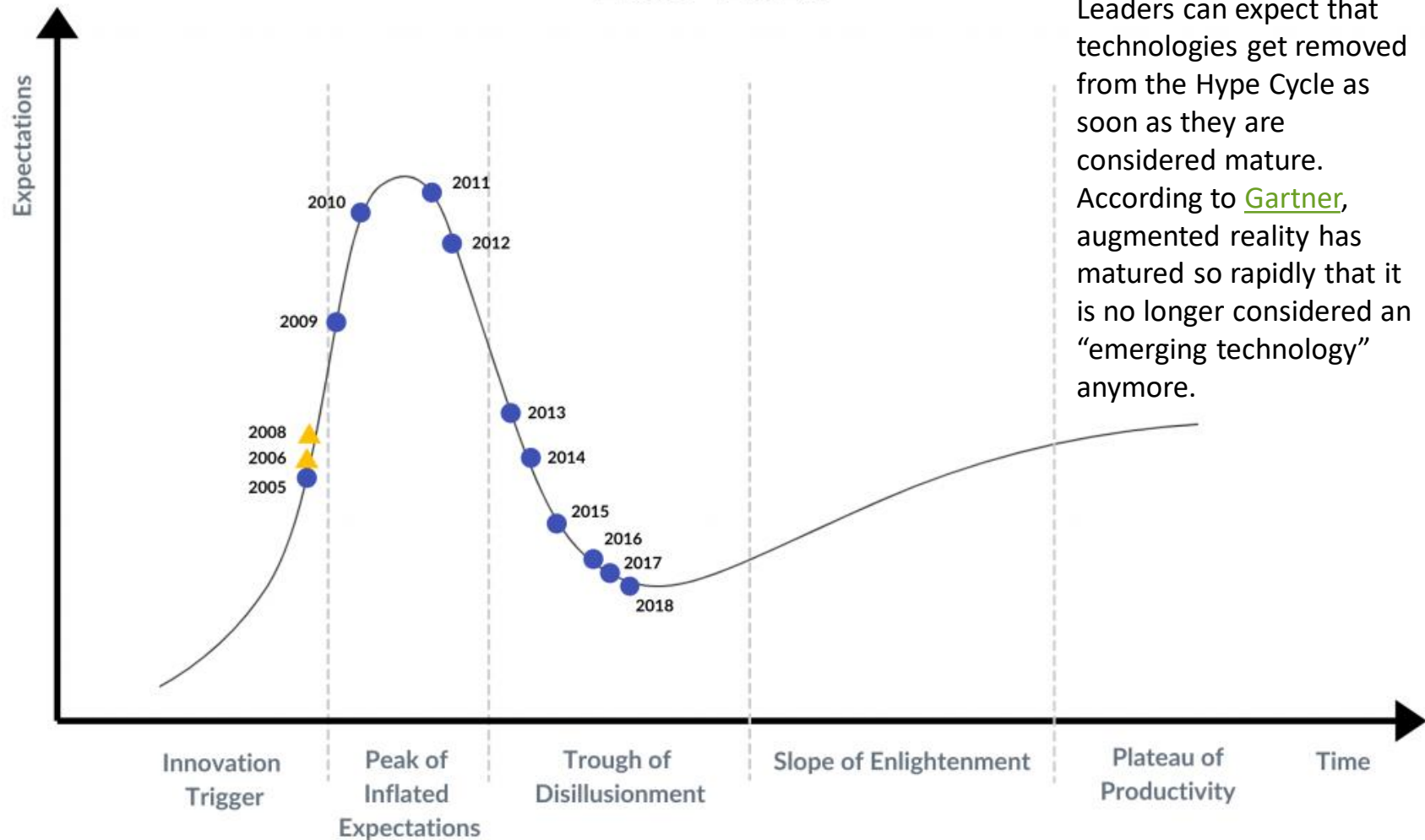
Leaders can expect that technologies get removed from the Hype Cycle as soon as they are considered mature. According to Gartner, augmented reality has matured so rapidly that it is no longer considered an "emerging technology" anymore.

Expectations

2011
2010
2012
2009
2013
2008
2006
2014
2005
2015
2016
2017
2018

Innovation Trigger | Peak of Inflated Expectations | Trough of Disillusionment | Slope of Enlightenment | Plateau of Productivity | Time

Plateau will be reached

◯ Less than 2 years   ● 2-5 years   ● 5-10 years   ▲ More than 10 years

wikitude

How does this happen?

- How do products progress through the cycle?

- Why do some products fail?

- Why do people choose to use some technologies and not others?

External variables such as social influence is an important factor to determine the attitude. When these things (TAM) are in place, people will have the attitude and intention to use the technology. The perception may change depending on age and gender because everyone is different.

Davis, F. D. et al. (1989), "User acceptance of computer technology: …",
*Management Science, **35** (8): 982–1003, doi:10.1287/mnsc.35.8.982*
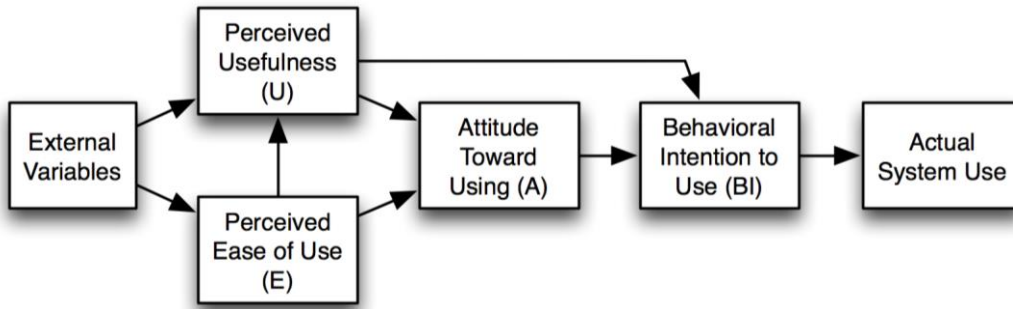
Technology Acceptance Model

The model suggests that when users are presented with a new technology, a number of factors influence their decision about how and when they will use it, notably:

Perceived usefulness (PU) – This was defined by Fred Davis as "the degree to which a person believes that using a particular system would enhance his or her job performance". It means whether or not someone perceives that technology to be useful for what they want to do.

Perceived ease-of-use (PEOU) – Davis defined this as "the degree to which a person believes that using a particular system would be free from effort" (Davis 1989). If the technology is easy to use, then the barriers conquered. If it's not easy to use and the interface is complicated, no one has a positive attitudes towards it.

attitude (A) is the general impression of the technology

Behavioral intention is a factor that leads people to use the technology. The behavioral intention (BI) is influenced by the *attitude*.

The *actual system use* is the end-point where people use the technology.

Implications

- AR has some way to go before the 'plateau'

- Opportunities exist now as interest and usefulness increases!

- Technology already capable – and developing rapidly

- What's needed? What's missing?
  - Better understanding of useful applications?
  - Methods, techniques and principles for usability?

Principles for design…

- Understanding of good interaction design developed over many years

- Good practice and design experience captured in the form of guidelines
  - Heuristic evaluation

  - Apple Human Interface Guidelines
    https://developer.apple.com/news/?id=yyz8lqtw

Heuristics Evaluation
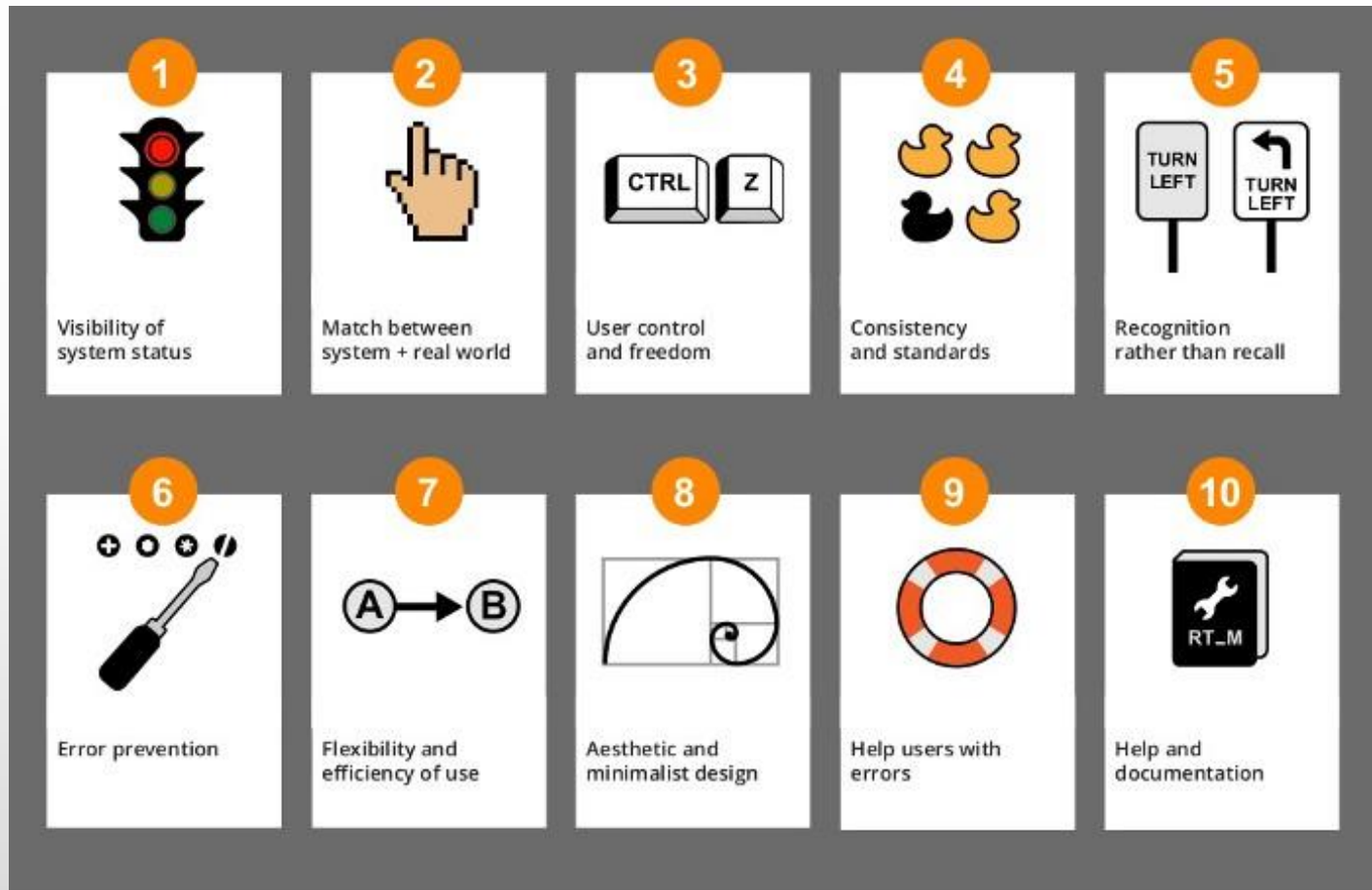
Designing Augmented Reality

- Principles for AR design

- AR design patterns

- AR for learning

- AR in the museum

Principles for AR design

- Improve reality - don't just add to it
  - What are we trying to augment?
- Be clear and simple
  - Let people know what they're seeing and what they can do
- Be predictable
  - Users need to know what will happen
- Protect the field of view at all costs
  - Don't stop the user from seeing the real world!
- Be natural

Principles for AR design

- Be invisible
  - Add enhancement, not artificial layers
- Speak clearly
  - And give clear feedback
- Think about the big picture
  - 'fit' with the rest of life – design the ecosystem
- Don't waste color
- Be social
- Be flexible

AR Design Patterns

Design patterns describe precisely how to use design techniques in order to achieve certain positive effects, at the same time providing insight and creating a shared vocabulary in the form of a pattern language. More precisely, design patterns "express a relationship between particular design contexts, forces [...], and desired ('positive' or good) features" .

- 'Design Patterns' capture solutions to commonly occurring problems or situations
- Should be reusable and applicable to similar problems

https://www.researchgate.net/publication/2902235_Design_Patterns_for_Augmented_Reality_Systems

https://www.wikitude.com/showcase/augmented-reality-sewing-patterns-by-pattarina/

AR Design Patterns

- Head-Up Display

- Familiar style of AR?

- Add information about real in-view objects

- Create a mixed-reality experience

AR Design Patterns

- Holochess

- New, completely virtual objects added into real space

- May be combined with real objects

- Examples: Games, Lego Digital Box, Apparition

AR Design Patterns

- X-Ray Vision

- Reveal hidden details, internal structure

- Possibly showing schematic or abstract view

- Examples
  - BMW Service Assistant
  - Medical applications
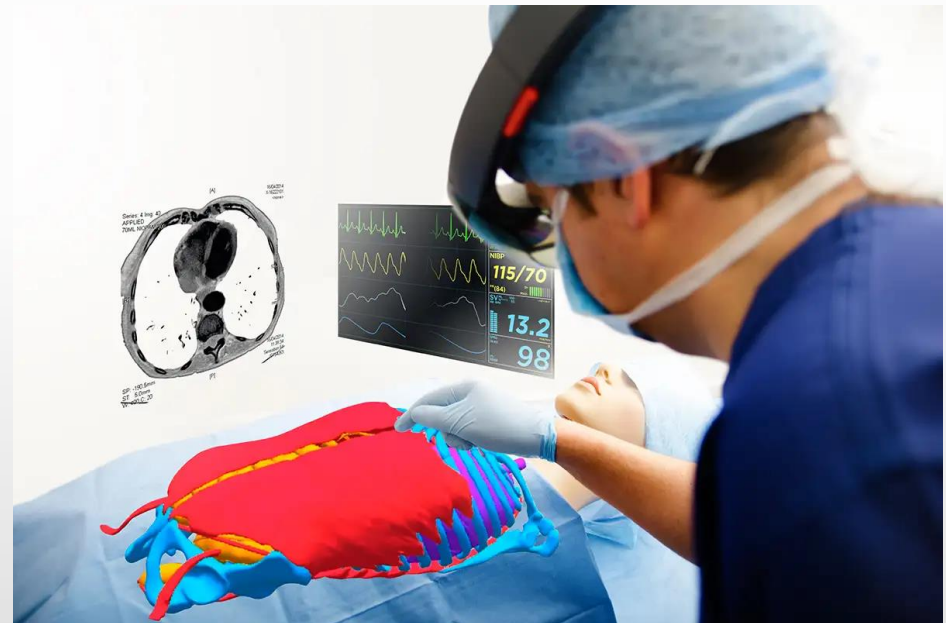
AR for Learning

- Three principles for using AR in learning environments:
  - Enable and then challenge
  - Drive by gamified story
  - See the unseen

Dunleavy, M. (2014). Design Principles for Augmented Reality Learning.

AR in the Museum

- The British Museum
- "A gift for Athena" AR App
- Allows visitors to explore Parthenon gallery

AR in the Museum

- The British Museum: five lessons in augmented reality

- 5 guidelines / suggestions emerge from reflecting on A Gift for Athena

- Allow AR to advance a narrative

- Keep the interface as simple as possible

- Augment something misunderstood

- Think of different 'keys'

- Aim for native

AR in the Museum - Metaio

- Metaio demonstrations – explore a range of ways that AR can be used
  - Identify artifacts; add additional information
  - Highlight significant details
  - Show original context
  - Reveal hidden details
  - Discover related artefacts
  - Compare past and present

Note: Metaio was an AR toolkit, no longer available, that became Apple's ARKit.
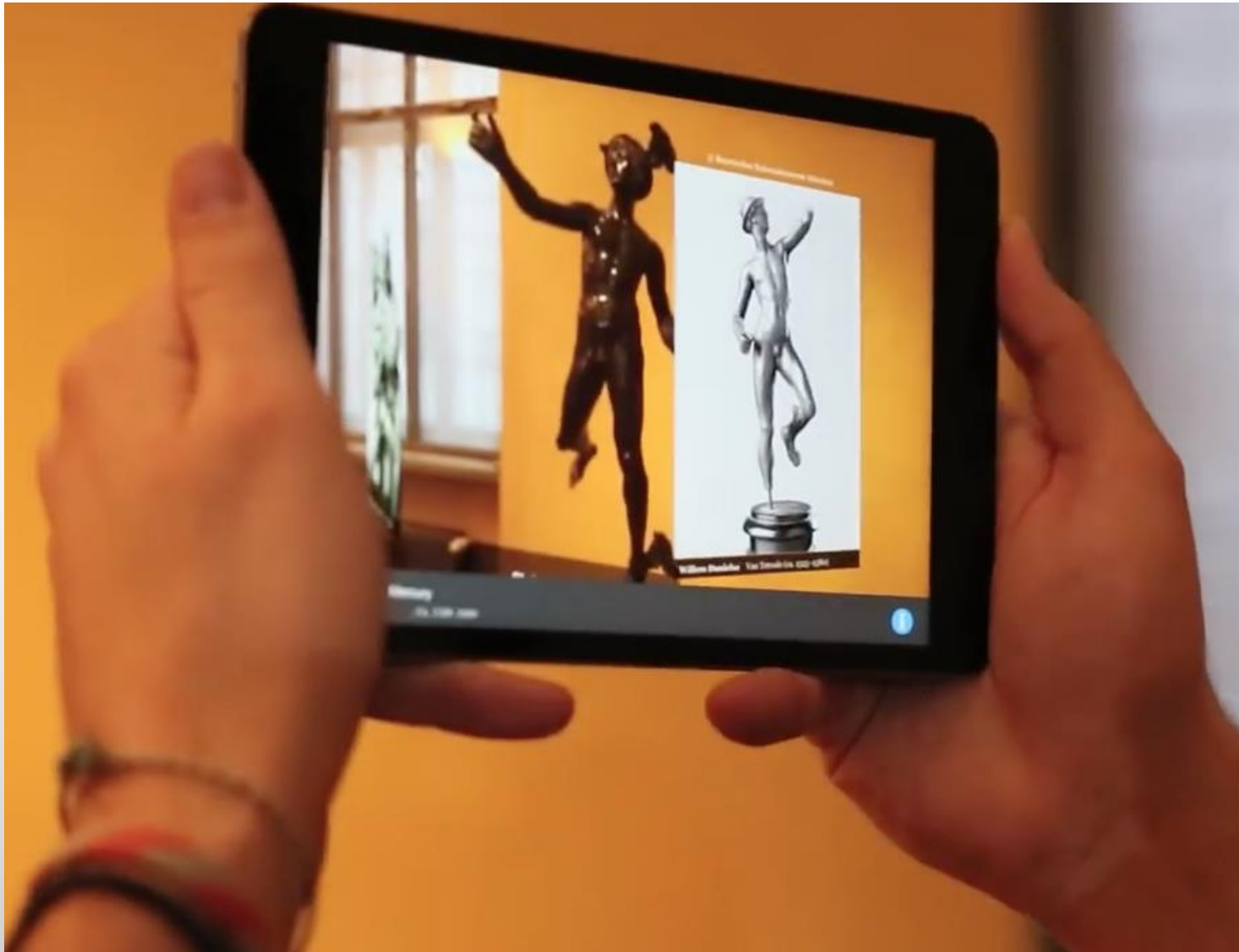
Identify artefacts & add information

Highlight significant detail
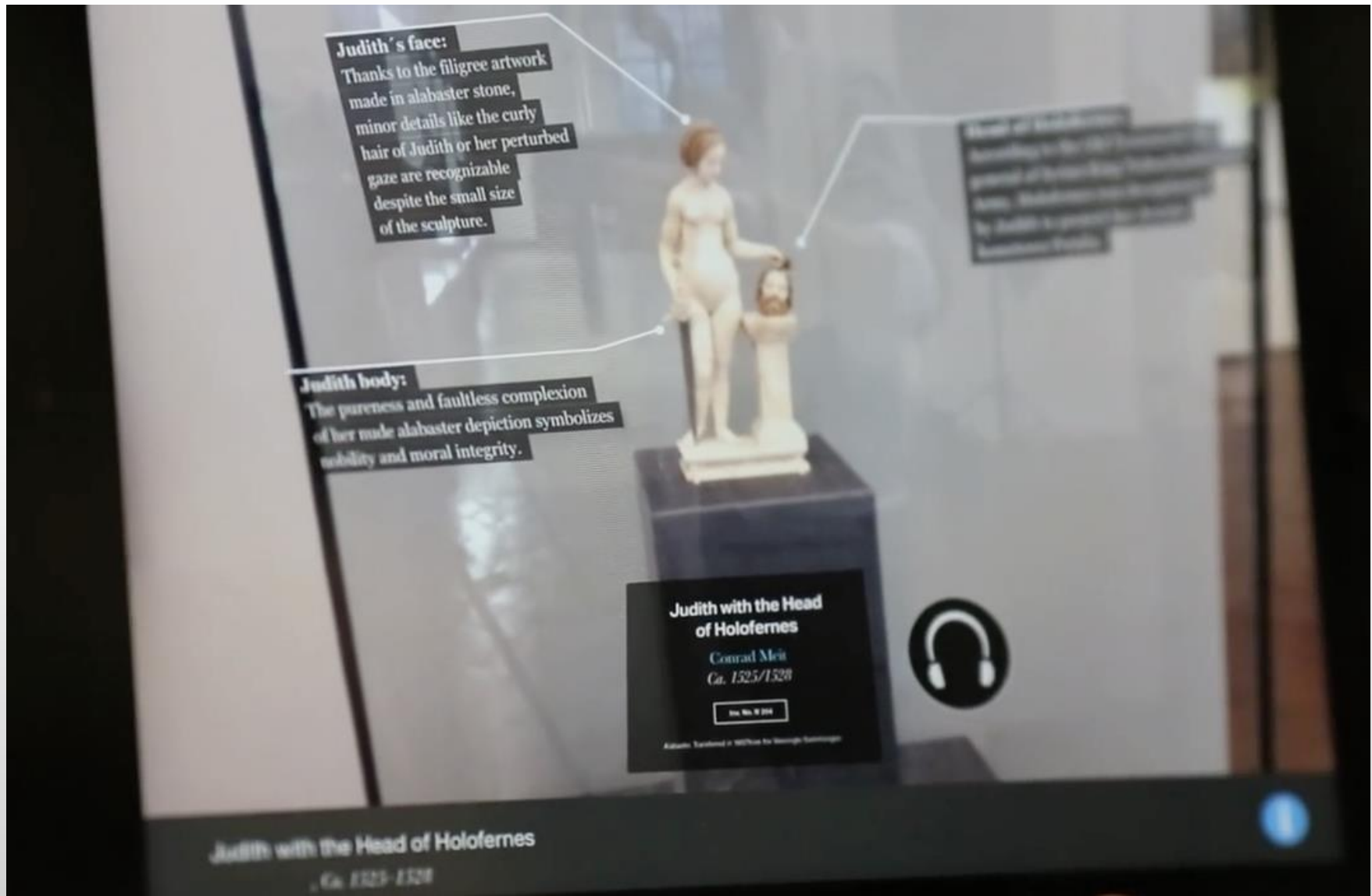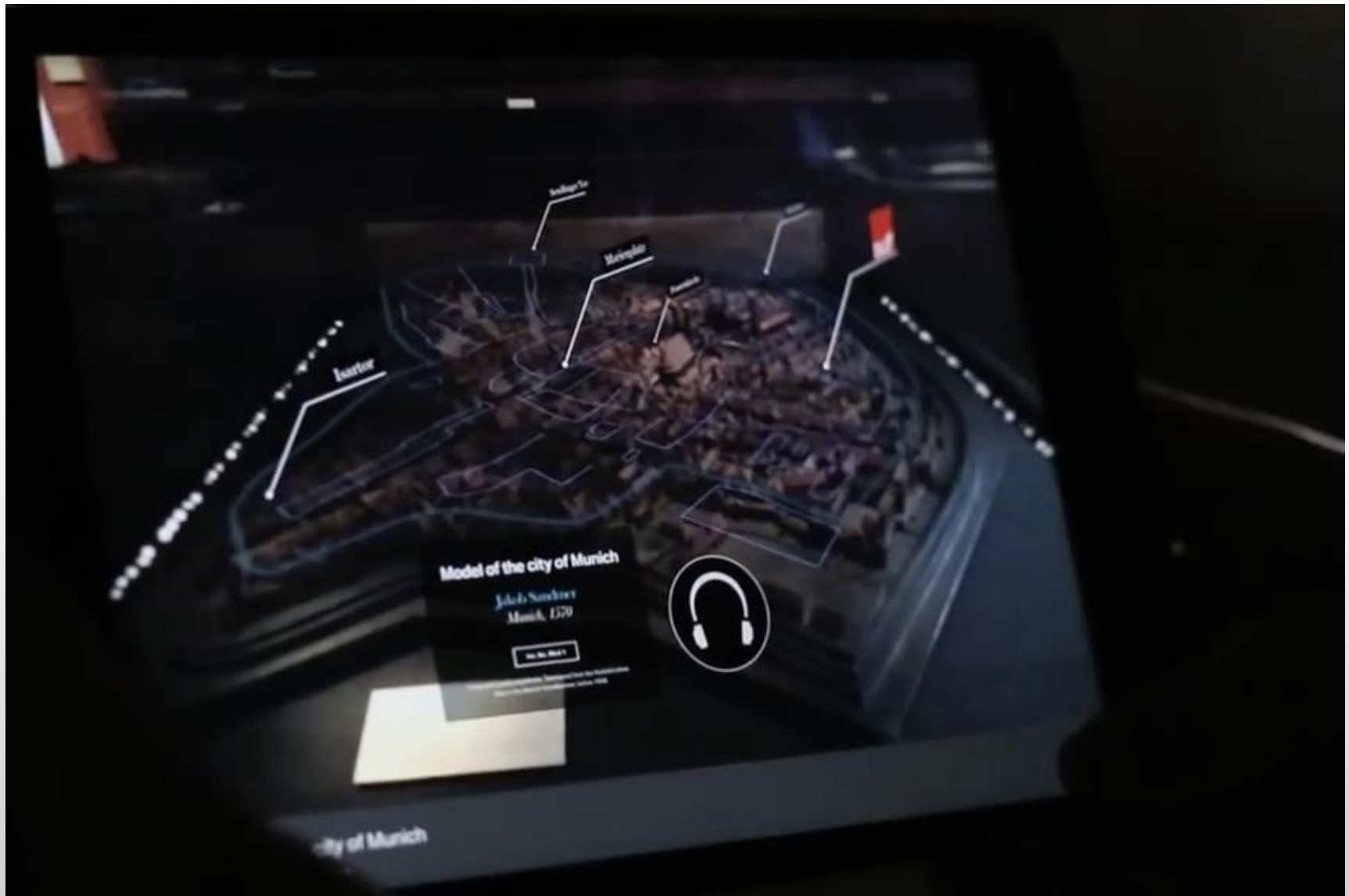
Show original context

Discover related artefacts

Compare past and present

Who's doing what?

AR at Ferrari showroom: http://www.youtube.com/watch?v=BipmUstUMjk

AR by Apple https://www.apple.com/augmented-reality/

AR by Samsung https://www.youtube.com/watch?v=ZftwfXizh80

AR by Ikea https://www.youtube.com/watch?v=UudV1VdFtuQ

GuideBOT https://www.youtube.com/watch?v=7vZWAfXkoDo

Summary

- A wealth of guidance can help us to build effective AR experiences
  - Improving usability and user experience – by not forgetting the lessons of the past
  - Patterns for effective AR
  - Using AR effectively in a Museum context