GW SCHOOL OF ENGINEERING & APPLIED SCIENCE

Augmented and Virtual Reality

CSCI 3907/6907

Spring 2022

3:30 PM - 6:00 PM, Thursdays

Week 13

Dr. Hurriyet Ok

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GW SCHOOL OF ENGINEERING & APPLIED SCIENCE

Festival of Animation

* TENTATIVE *

Tuesday, April 26, 2022

5:00 pm – 7:00 pm ET

GW SCHOOL OF ENGINEERING & APPLIED SCIENCE

Festival of Animation

VIRTUAL FESTIVALS

Spring 2021: https://hubs.mozilla.com/cbtfc9w/spring-2021-main-hall/
Fall 2020: https://hubs.mozilla.com/ETU4ruZ/fall-2020-main-hall
Spring 2020: https://hubs.mozilla.com/o7bqFh6/welcome-hall

Ceremony at the First Virtual Festival of Animation Spring 2020
https://web.microsoftstream.com/video/187ca3de-09b1-44c9-b418-29fcba657e9f?st=15

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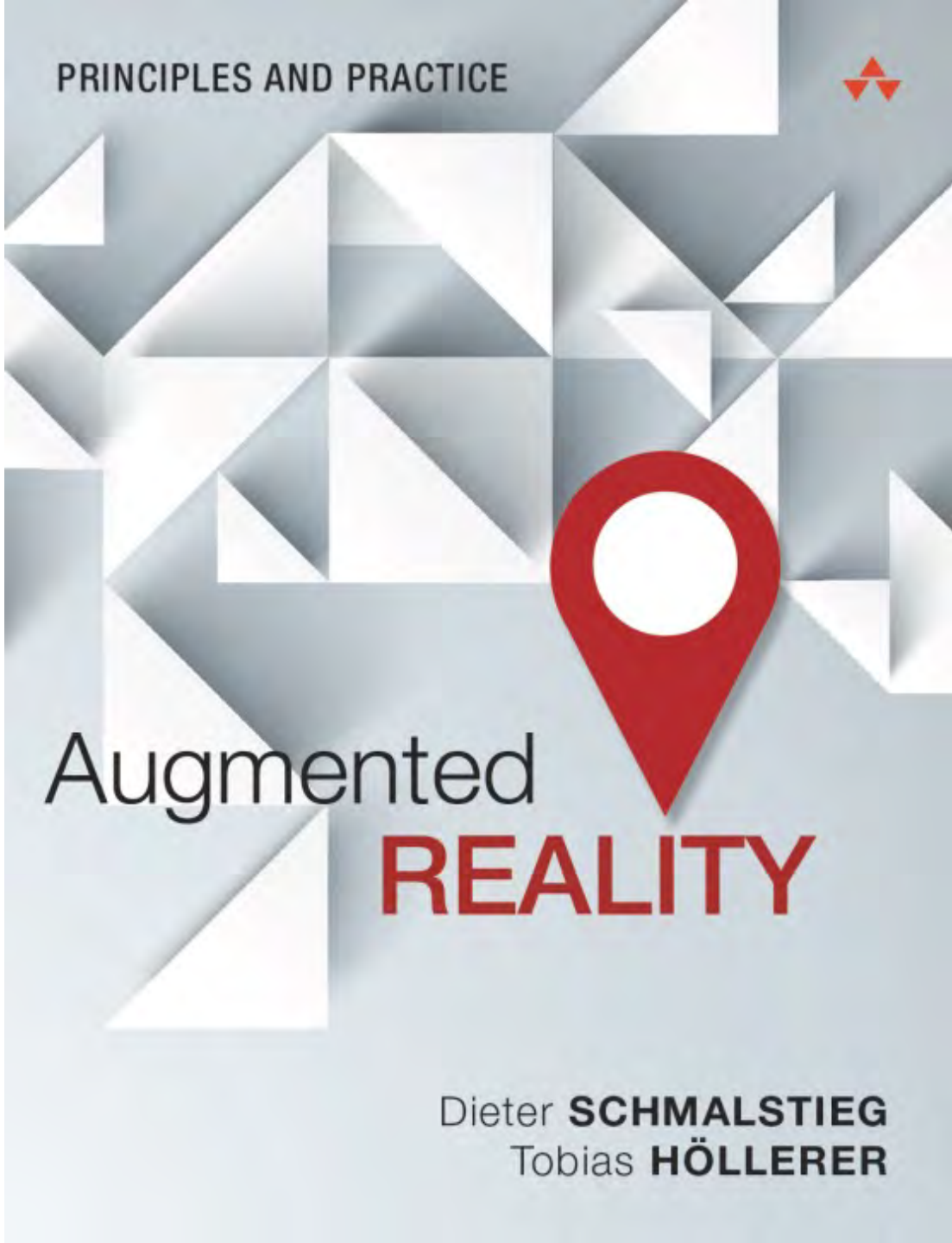
Chapter 14: The Future

Augmented Reality – Principles and Practice

Dieter Schmalstieg

Graz University of Technology

http://www.augmentedrealitybook.org



History of the Information Age

- Digital technology is free from physical constraints
- Moore's law applies to many kinds of digital phenomena
  - 1980's: Digital office work
  - 1990's: Digital private life (email, photography, music)
  - 2000's: Social and mobile computing
  - 2010's: Cloud (hardware irrelevant), IoT, Ubicomp
- But: not *calm* computing
  - App for every aspect of life?
  - AR can provide *situated*, less obtrusive interaction

What May Drive Business Cases

- Commercial exploitation of AR cannot rely on just having proof-of-concept demonstrations.
- Paying customers require value for their money.

AR Use Categories:

- Professional Users
- Consumers

Professional Users

- New technologies are potential tools for achieving a certain objective either faster (and, hence, cheaper) or with higher quality.
- It is acceptable to buy and use hardware, even if it is expensive, if the gains from using the new tool are believed to be sufficiently substantial.
- Even ergonomic limitations, such as the need to carry heavy equipment, can be tolerated in such a case, e.g., the tools used by an engineer at a construction site or a surgeon in an operating theater.
- Expect reliability and continued profit from using the technology.
- Reluctant to change if doing so means disrupting their established workflow. There must be a clear-cut advantage if the new tool is to be competitive.

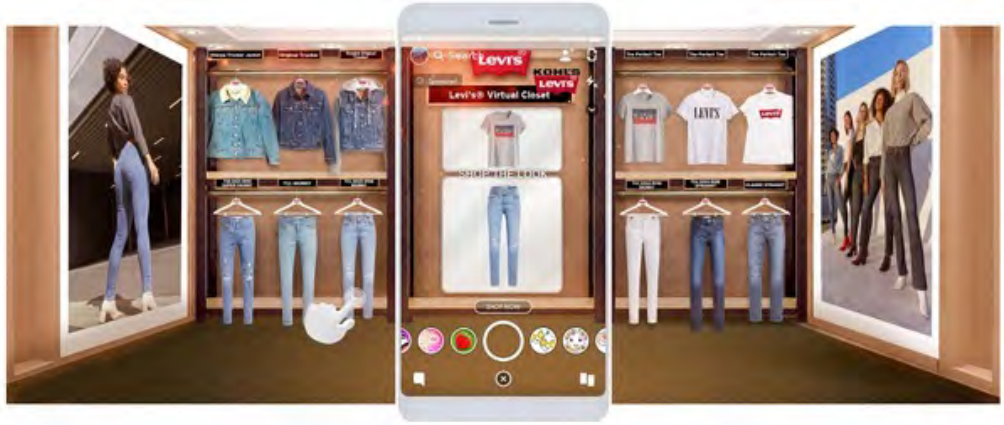
realwear.com

Professional Users

- AR applications for the professional domain must be robust and well-tested.
- They may be expensive, require special hardware, or even be difficult to use (up to a certain point, if trainable), but they must provide substantial gains that cannot be achieved with traditional alternatives.
- In terms of software quality, this easily means a tenfold increase in the software engineering effort over the work invested in a research prototype.
- It may also require deep integration of the AR application with existing resources, such as enterprise information systems.

Daqri:
Enterprise-grade AR headset

Consumers



Kohl's Snapchat Virtual Closet

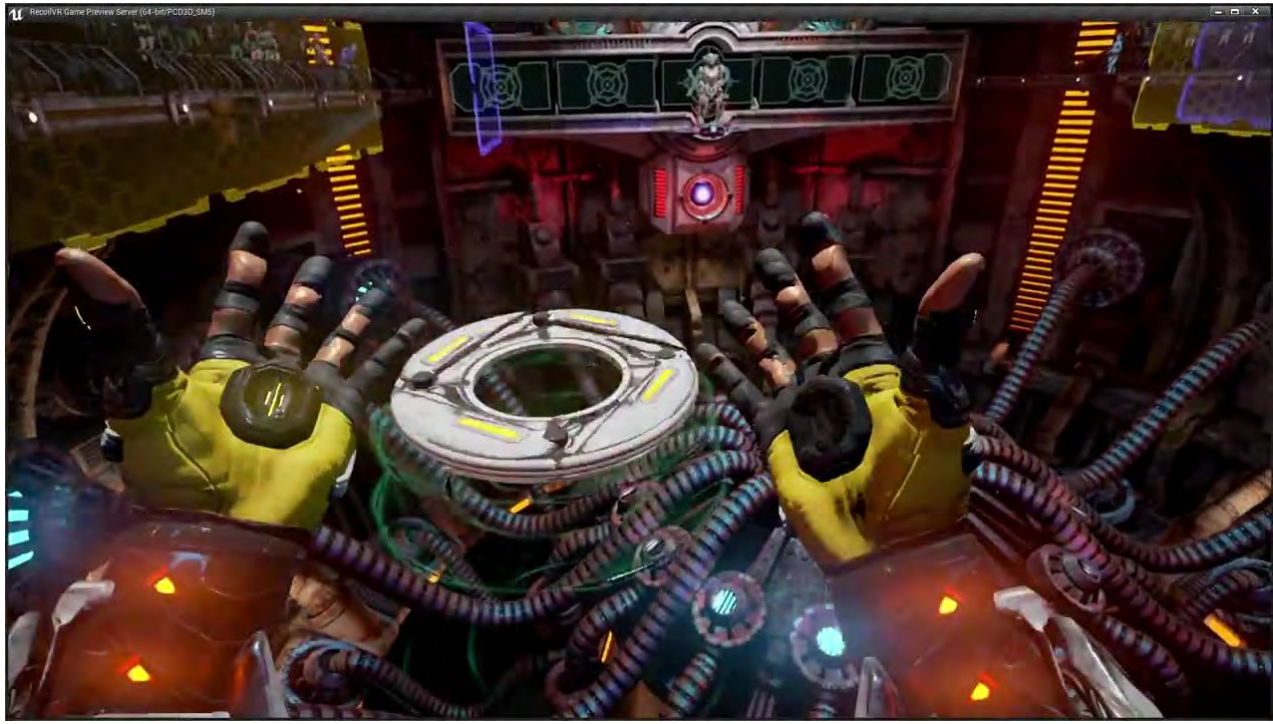
- The threshold for accepting a new technology is lower, as no lasting benefit is required for adoption. This makes AR attractive in the short term for purposes such as advertising and games, where an interesting and amusing experience is in itself the desired achievement.
- Novelty effects and initial excitement quickly wear off and cannot compensate for shortcomings of the technology.
- Technology problems are exacerbated by the fact that in absence of a novel platform, which is hard to establish, AR for consumers must be a strict software-only solution delivered to devices the users already own

Consumers

- A consumer application must be very easy to use, require almost no training, and rely solely on additional peripheral devices, such as HMDs, in exceptional cases.
- The expectations of the users concerning the quality of the content are very high.
  - Users have come to expect the visual quality of today's premium movies and games everywhere, and this includes AR.
  - They are not likely to be tolerant of jittery tracking and low-polygon models.

Consumers

"Facebook Shuttering 'MARVEL Powers United VR' & 'Ripcoil'"



MARVEL Powers United VR

- One of the most expensive games
- Inconsistent concurrent user numbers
- Just a super hero-flavored wave shooter

Ripcoil

- Uncomfortable sliding locomotion scheme

Source: https://www.roadtovr.com/marvel-powers-united-vr-oculus-facebook

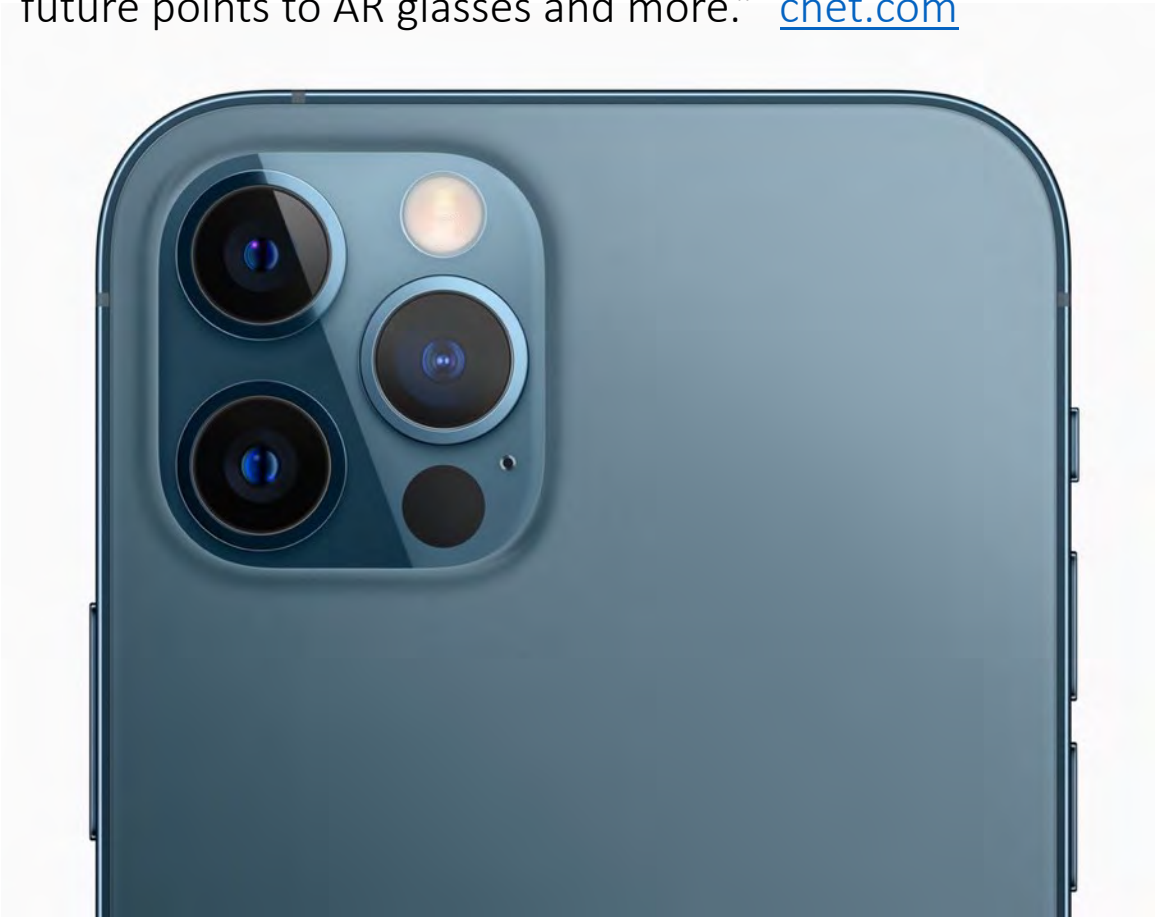
Professional Users and Consumers

- An application that relies on a conservative set of features combined with well-tuned technology and content will have a much better chance of succeeding in the marketplace than a radical, but unfinished product.
- In turn, it may take longer than expected for novel developments to enter the commercial domain.
- In particular, AR applications may depend on other infrastructure (e.g., online services for indoor maps, 5G) to be established before commercialization fully takes off.

An AR Developer's Wish List

- Mobile computing is clearly a key enabling technology for AR.
- Mobile devices such as smartphones enable us to use substantial computational capabilities on the go.
- However, smartphones are multipurpose devices and must make difficult tradeoffs concerning size, weight, energy consumption, and—not to be forgotten—cost.
- Head-worn AR: Large companies such as Google and Microsoft are already pursuing some of these goals, but have not yet brought the results to a large-scale consumer market.

"The iPhone 12 Pro and 2020 iPad Pro have a new sensor that adds depth scanning for better photos, but the future points to AR glasses and more." cnet.com



Wish List

- Low-Level Camera API
- Multiple Cameras
- Wide-Field-of-View Cameras
- Sensors (e.g., lidar)
- Unified Memory
- Parallel Programming on the Mobile GPU

Taking AR Outdoors

- Most commercial AR scenarios are still situated indoors, because it is significantly more difficult to take AR outdoors.
- If we want AR to become a breakthrough technology, it must work anywhere, *especially* outdoors.
- Image-based localization is a major challenge and relying purely on built-in sensors such as GPS and inertial orientation tracking tracking is delivering rather poor experiences.

Taking AR Outdoors

There is a dire need for enhancements in several areas pertaining to outdoor localization:

- Uncooperative Users: AR systems must be really simple to use.
- Limited Device Capabilities: Localization must work directly on the device. Edge Computing?
- **L**ocalization Success Rate: Need to use all tricks in the text book to increase the localization success rate.

Taking AR Outdoors

Addressing all challenges simultaneously requires extremely sophisticated software engineering and infrastructure in the form of cloud services.

Prediction: *Several years of further development will be necessary before serious outdoor AR emerges*.

Smart Objects

- Internet of things allows control over physical environment
- But physical objects have no input or output
- AR can provide direct manipulation of the parameters
  - Assume that the AR system is able to detect which objects the user is currently looking at or touching. The AR system can make contact with a target object via IoT and let the user take control of that object. This control can be carried out either directly, via a *tangible interface* for direct physical manipulation, or via a virtual interface.

Example: Spotify's Magic Leap app

Spotify's Magic Leap app will change playlists as you change rooms

With an interface that appears in your real-world environment

Nov 13, 2019

"The app will show a location-aware three-dimensional Spotify interface on top of your world with the ability to automatically change playlists as you move between rooms"

https://www.theverge.com/2019/11/13/20962662/spotify-magic-leap-app-music-streaming-augmented-reality

Confluence of Virtual and Augmented Reality

- Real-time 3D sensing can drive perfect Augmented Virtuality
- Visual Turing Test

- Challenge: Realistic display of touch sensation

AR as a Dramatic Medium

- AR progresses from technology to dramatic medium
- New medium has new characteristics
  - Before “Citizen Kane”, movies were like stage recordings
- Characteristics of AR as a medium
  - Combines real+virtual → can display content anywhere
  - Spatially registered → free choice of viewpoint
  - Interactive in real time → always interacting with physical space
- Requires new conventions
  - E.g., narrative focus vs free camera control
  - No cut scenes as in games
  - AR is more like a theater stage

AR as a Communication Medium

- AR as a medium for *communication*
- Content provided by
  - Professionals (entertainment, journalists etc.)
  - Authorities (traffic etc.)
  - Individuals → *social*
- Not geo-location, but precise spatial annotation (part of an object)
- *Linking* (like web links) between virtual and *real*
- *Channels* (like blogs) to organize content
- Always-on, context-driven, non-linear presentation of streams

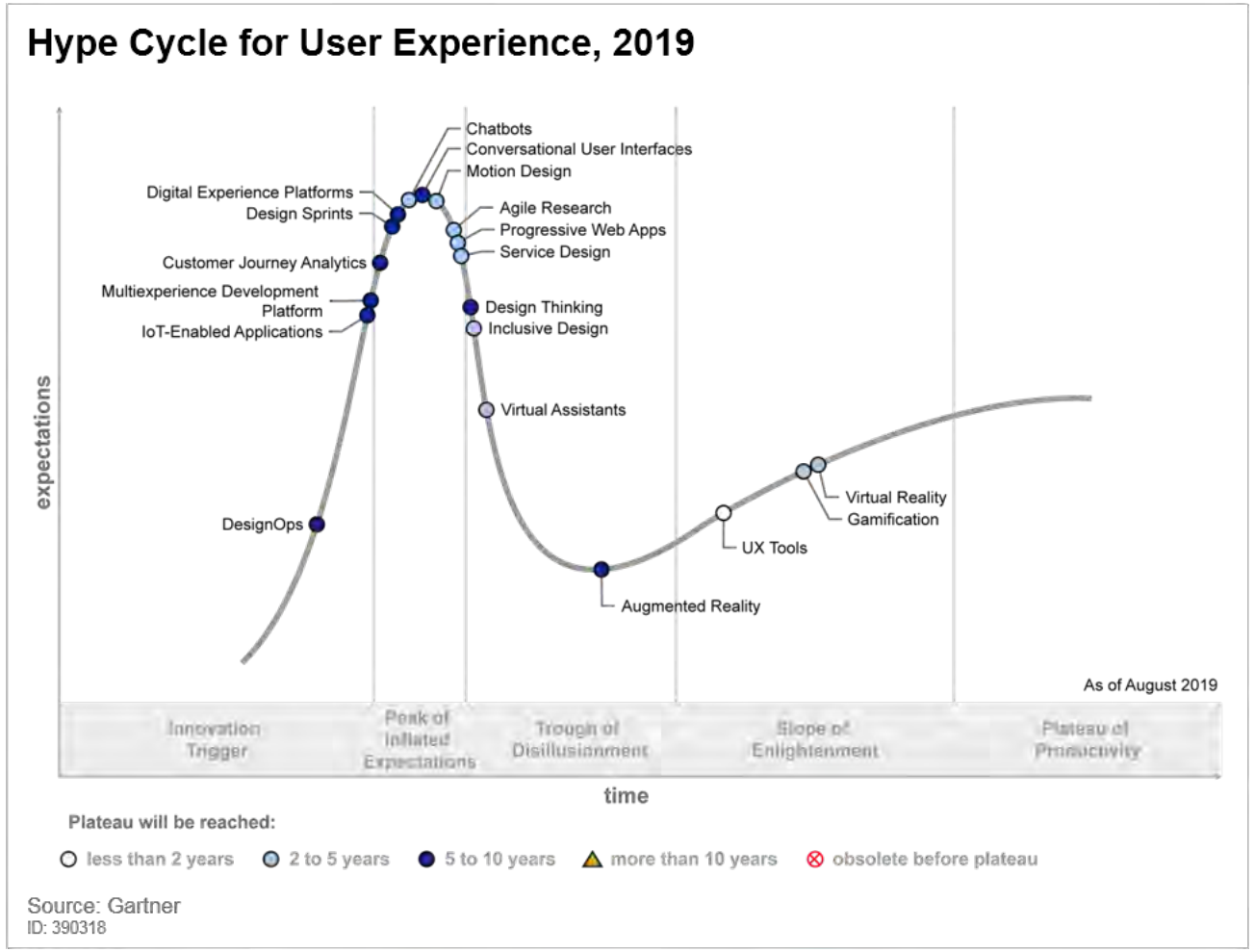
Summary

- The future is becoming the present, as we speak.
- Many of the opportunities mentioned in this lecture are very close to being released to mainstream audiences.
- While market success and widespread adoption depend on many factors and are notoriously hard to predict, we explored some areas where AR has already begun to conquer important business cases.
  - ✓AR will interface with the emerging Internet of smart objects.
  - ✓It will be adopted by humans who need assistance.
  - ✓It will be picked up by storytellers.
  - ✓It will be used as a social medium.
  - ✓All of these areas can (and do) exist independently of AR, but with AR, they can become so much more.

Opportunities

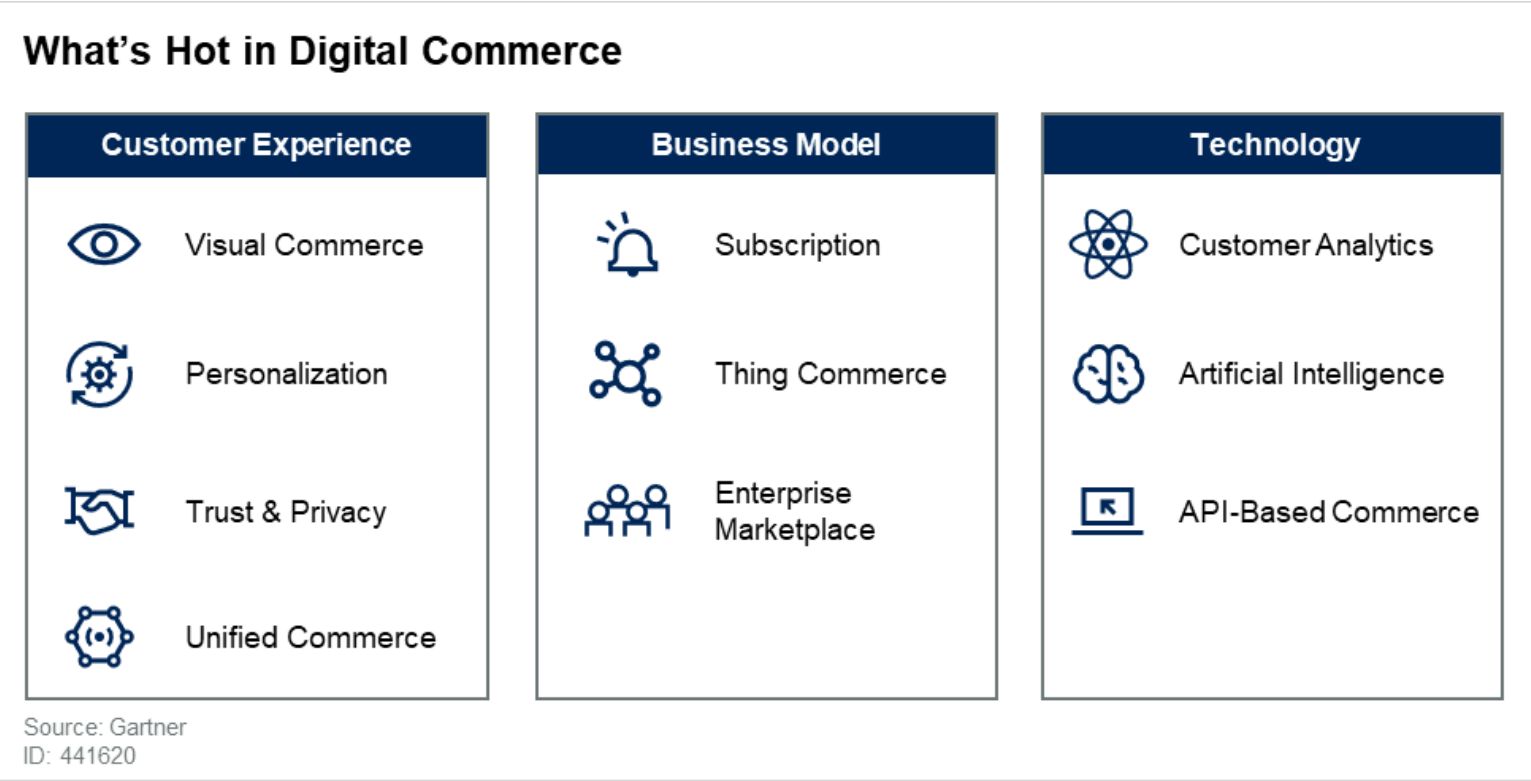
- AR offers many fantastic opportunities, both for technology and design.
- I challenge you, to make a great contribution to its evolution!

Hype Cycle for User Experience, 2019



Visual Commerce

Visual commerce enables users to interact with a brand's products in a visual, immersive manner. Visual commerce technology spans 360-degree video, 2D and 3D configuration, visual search, augmented reality (AR), mixed reality and virtual reality (VR).



Visual Commerce

"The old rulebook of how we understand and interact within the real world no longer applies, and in many mays, the pandemic has been a catalyst for this digital transformation. Physical retail must evolve in response, and AR has proven that it can add enormous value for consumers in the shopping journey."

How AR Is Redefining Retail in the Pandemic
by Helen Papagiannis
October 07, 2020
https://hbr.org/2020/10/how-ar-is-redefining-retail-in-the-pandemic

Is VR or AR the future?

Mark Zuckerberg sees the future of AR inside VR like Oculus Quest
https://www.cnet.com/features/mark-zuckerberg-sees-the-future-of-ar-inside-vr-like-oculus-quest/

https://www.youtube.com/watch?v=hPIs-h9uevM

The role of AR-VR technology in the future of care

AR to Improve Public Safety Operations

https://vimeo.com/vrtu/a1rhologramhud