Ubiquitous Knowledge Sharing with Mobile Augmented Reality

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Augmented Reality Overview

Reality — Augmented Reality — Virtual Reality

- AR adds computer generated content to real world
- Key challenges for AR adoption
  - Social acceptance
  - Good enough experience
  - Hardware prevalence
  - Content availability
  - Legal and privacy
  - Killer applications

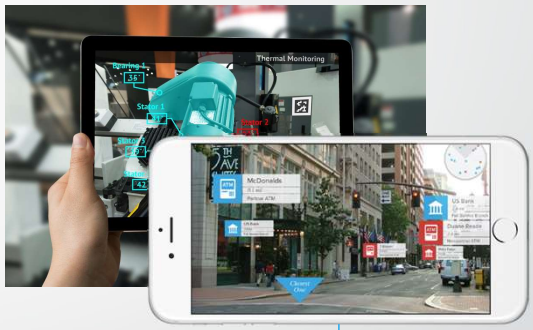
The Increasing Presence of AR in Our Lives

AR Use cases & Knowledge Sharing

- Advertisement
- Education
- Entertainment
- Field Service
- ⋮

- All use cases involve knowledge sharing
- AR: immersive, more natural knowledge acquisition
- Critical to knowledge sharing with AR
  - What - relatively easy
  - Where - somewhat achievable
  - When - heavy research

The Evolution of AR Hardware



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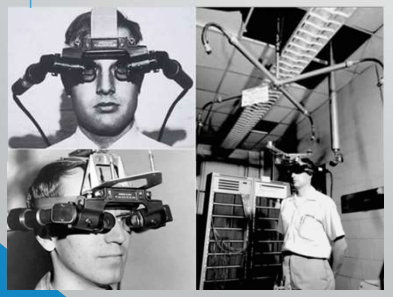


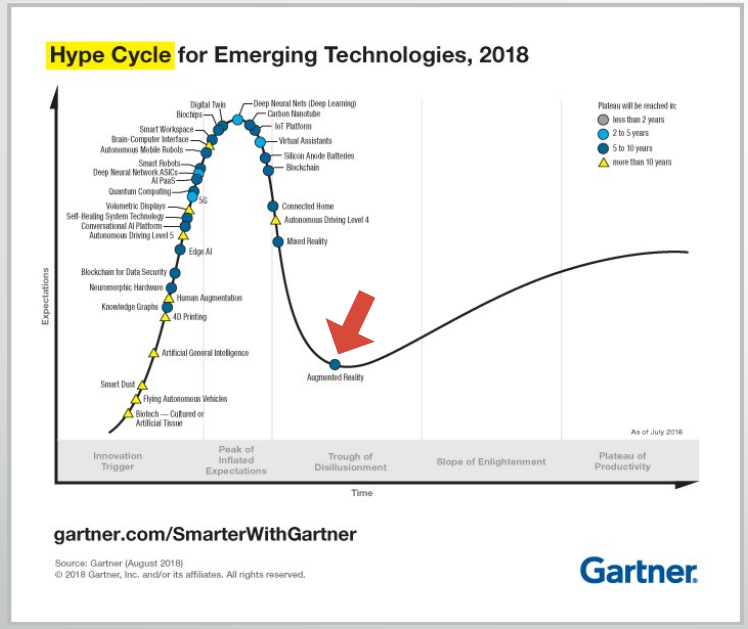
Under the Hood of Mobile AR

- Recognition & tracking – *What*
  - image, 3D object, face …
- Mapping & localization – *Where*
  - map the environment and track the 6DoF camera pose
- Scene understanding – *When*
  - planes, feature points …
- Rendering – *Make it real*
  - lighting, texture, scale, position, shadow …

Mobile AR Software

- Visual trackers with less hardware dependency
  - Vuforia
  - Wikitude
  - Open source (ORB-SLAM, OpenCV)
  - …
- VIO (Visual Inertial Odometry) tracker with hardware support
  - ARKit: calibrated to Apple hardware
  - ARCore: previously Tango with reference hardware design
  - …

The Maturing of AR Eco System



ARCore

Microsoft HoloLens

magic leap

vuforia™

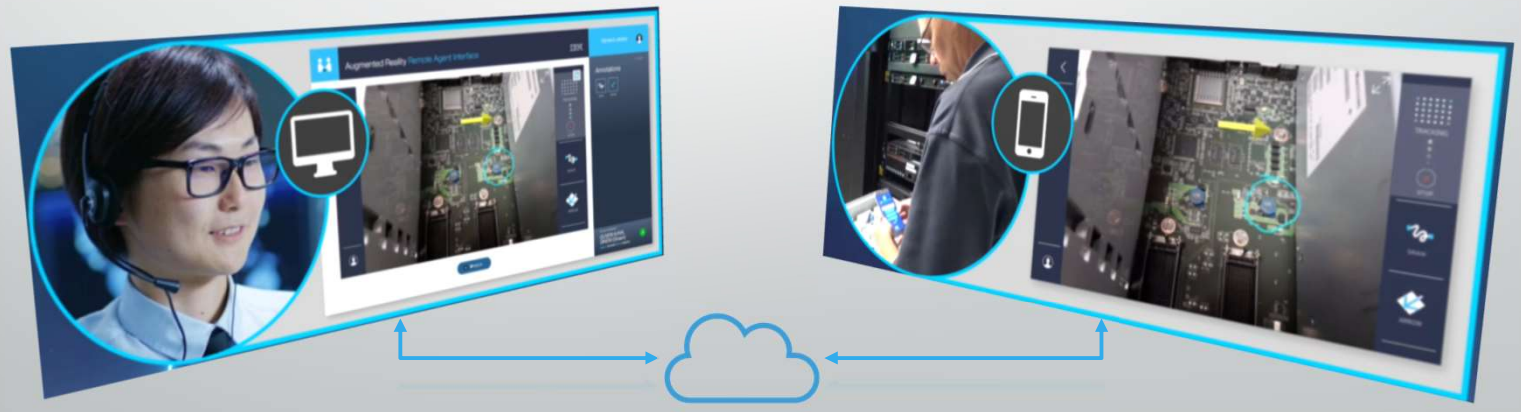
ODG

wikitude
See more.

augumenta
AMPLIFY LIFE

AR for Remote Maintenance & Support

- Solution developed for IBM Technology Support Service (link)
- Use AR to enable remote expert to effectively share knowledge with field technician or end user



Self Assist : More Scalable Knowledge Sharing

- Content creation at scale
  - Persistent content
  - Object modeling
  - Tracking in noisy environment
- Scene understanding and context awareness
  - Changing scene or object state

Persistent, Cloud-based AR

- Persistent AR experience
  - Enabled in ARCore 1.2 and ARKit 2.0
  - Persisting virtual content in great accuracy in real world
  - Shared experience across users or sessions
- What is AR Cloud?
  - Build and maintain AR content related to physical world
  - Enable ubiquitous access
  - Integrate domain-specific knowledge into AR experience

ARCore

6D.AI

BLUE VISION

UBIQUITY6

Auto-generating AR Content for Self Assist

Remote Assist

Images
Annotations

Security

Content Distribution

Model Training

Content Curation

Content Retrieval

AR Cloud

Self Assist

Expert
Crowdsourcing

Modeling Service

AR Cloud

- Content Curation
  - Acquire and generate reusable AR content: point clouds, key frames, annotations, meta data
- Model Training
  - Train models for 2D or 3D object recognition, scene and context recognition
- Content Retrieval
  - Find most relevant AR content based on user requests and environmental context
- Content Distribution
  - Deliver AR content and models to mobile app in real time (caching, latency …)
- Security & Privacy
  - Ensure only using non-personally identifying meta-data, access control, encryption/decryption

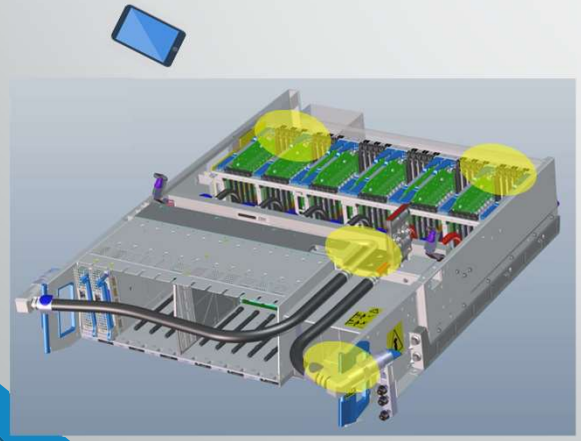
Remaining Challenges in AR

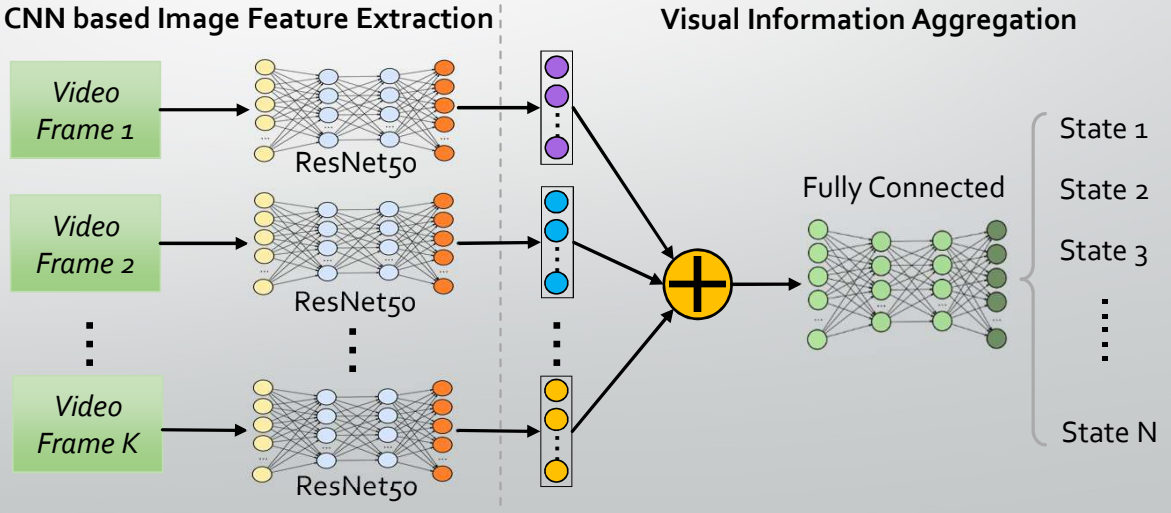
- Scene understanding
  - Deep learning for 3D classification and segmentation
  - ScanNet, PointNet, …
- 3D reconstruction
  - Shape and structure detection
  - Collision and occlusion

Source: http://stanford.edu/~rqi/pointnet/

Tracking State Changes for Hardware Objects

- Model and understand the state change of hardware during maintenance*
  - Capture video frames on POI (Points of Interests) from mobile camera
  - Train CNN models for automated recognition of current state, to enable AR-based self assist





* Joint work with Bing Zhou and Prof. Fan Ye at Stony Brook University

Summary

- Mobile AR ecosystem is maturing
- Mobile AR will revolutionize knowledge sharing
- AR Cloud is key to successful knowledge sharing applications
- Exciting opportunities in the area of AR + AI