Industrial AR –
Pilots, Results and Challenges

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VTT Technical Research Centre of Finland

- The largest research institute in Northern Europe
- Provides high-end technology solutions and innovation services to international customers

Figures

- > 2400 employees
- Annual turnover > 250 M€

Funding

- 1/3 industry
- 1/3 government
- 1/3 public sector (EU, Tekes)
AR Research at VTT

Pioneering work
- Research topic started in 2001
- First in the world with various AR applications
- Today team of 25 people based in Espoo & Tampere
- AR/MR core technology & high-end applications
- Human factors, usability, user experience

Proprietary technology
- ALVAR SDK (A Library for Virtual and Augmented Reality)
- Marker, multimarker, 2D template and 3D point cloud tracking
- See [www.vtt.fi/multimedia](http://www.vtt.fi/multimedia)

Applications, incl.
- Games, Entertainment
- Print media, Advertising
- Interior design, Furniture, Rendering
- Virtual Worlds Collaboration, Telepresence
- Architecture, Engineering & Construction (AEC)
- Industrial Applications, Facility Management
Assembly, Training

Case Valtra
- Finnish tractor company
- Hydraulic block, 200 pcs, AR pipeline from STEP model
- User interfaces for PC monitor, data glasses & mobile phone

User study
- 60 students, 30 using AR, 30 paper manuals
- Performance with AR was faster, and 6 times less errors

Current system
- Unity authoring tool
- Markerless tracking
- Assembly -> maintenance

Challenges
- Configurability
- Sub-assemblies
- Context sensitivity
Maintenance, Operation

Case ABB

- AR visualization of IoT information
- Maintenance tasks, safety elements
- User interface on HoloLens & tablet
- Most typical AR industrial application today

Challenges

- Context sensitivity
- Non-sequential functionality
- 3D content creation can be laborious
Tacit Knowledge

Case Konecranes
- Thousands of maintenance workers around the world
- Majority of equipment by other manufacturers
- Experienced workers retiring, need to collect tacit knowledge
- Solution: augmented social media
- First implementation: virtual post-it notes

Challenges
- Object detection and identification
- Enterprise SoMe platform, integration with current maintenance systems
- User interfaces, visualization
- Acceptance, motivation, fun
- Social aspects
Equipment without Connectivity

Case KONE
- Maintenance of elevator control unit, life cycle may be > 50 years
- Computer Vision to interpret state of equipment, based on digits, LEDs
- Maintenance instructions obtained from service manual & shown to user
- Optional 3D AR instructions

Challenges
- Dedicated CV solutions required
- Reliability, lighting conditions etc.
Remote Assistance

Case Ponsse
- Finnish forest machinery manufacturer
- AR instructions from expert to remote user (in woods)

Challenges - solutions
- Limited bandwidth – transmit only coordinates, annotations
- No bandwidth – enable training at hotel room
- Recording of training material for wider use
Facility Asset Management

Case Bioruukki
- AR visualization of factory asset information
- IoT, process data, simulation data, alerts

Case Digitalo
- AR visualization of BIM and IoT data
- Integration with Granlund Manager (Facility Management System, FMS)
- Two-way interaction, feedback to FMS

Challenges
- Covering the whole factory/building
- Several floors, hundreds of rooms
- Handling and updating of point clouds
- Moving elements, difficult areas
- Varying lighting conditions etc.
Construction and Renovation

Case Skanska

- Skanska offices construction in Helsinki 2010
- AR visualization of construction plans (4D BIM)
- Construction elements shown on time line
- Client/server solution for mobile devices

Challenges

- Size of 3D BIM models – rendering, transmission
- 3D tracking – constantly changing and messy construction sites
- Markers & SLAM as practical approach

Case Fira

- Plumbing renovation (bathroom, kitchen)
- Relaxed requirements and easier scale
- 3D plans and 2D drawings associated to BIM
- Also, photos for later as-built inspections
ALVAR SDK

A Library for Virtual and Augmented Reality
β Computer vision based camera tracking for AR

ALVAR Desktop
β Windows / Linux – marker based – *Open Sourced*
β Users incl. Google, NASA, MIT, Vuzix, ROS etc.

ALVAR Mobile
β Marker, multimarker, 2D image and 3D point cloud tracking
β Generality, works from close range to wide areas
β ALVAR for Unity, enabling easy content authoring
β Point Cloud Tool for optimizing performance
β HoloLens support, tracking of predefined targets
β Platforms: iOS, Android, UWP, Windows, Mac

Challenges
β Easy adoption, robustness, most demanding applications
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