Augmented Reality e-maintenance modelling

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Context and problematic

- Wind turbine are off-shore
  - ~1 hour for accessing a wind farm.
  - Accessibility depends on weather conditions.
  => **Little time** to perform maintenance.
- Expert can’t always be **physically** on site.
- Expert may not be allowed to be part of the crew.

Need to **improve communication**
Steps of work

AR State of the Art → AR Framework study and choice → AR displayer study and choice → Demonstrator development

AR maintenance modeling → AR maintenance Development → AR maintenance Test
Definition of Augmented Reality

Augmented reality (AR) is defined by (Azuma 1997) as:
1. Combines real and virtual
2. Interactive in real time
3. Registered in 3-D
Definition of Augmented Reality: how it works?

- Principle for augmented reality vision-based tracking (Azuma 1997)
  - A camera gets the scene
  - Based on the scene, camera pose is computed (position and orientation).
  - When cam pose is known, the virtual object is added in the scene.
  - Real and virtual objects are mixed before displaying the result.

![Diagram showing the process of augmented reality](image)
Definition of Augmented Reality

Augmented reality application examples

Ikea Marketing

Volswagen MARTA project Maintenance

Metro Paris application Entertainment

Weather cast Not AR, this is Augmented Virtuality
Projects with Augmented Reality and Maintenance

**MARTA** Volkswagen Mobile Augmented Reality Technical Assistance (with metaio framework) Sept. 2013
[MARTA 1] / [MARTA 2]

**eKurzinfo** Audi (with metaio framework) Oct. 2013
[eKurzinfo]

Festo and **Industry 4.0** – production systems of the future
[Festo]

**Mitsubishi Electric meViewAR** on Epson Moverio display (with metaio framework)
[Mitsubishi 1] / [Mitsubishi 2]

**ARMRO** bitstars Augmented Reality Maintenance Repair Operation
[ARMRO] / [bitstars]

**KARMA** (Knowledge-based Augmented Reality for Maintenance Assistance) First project with AR and maintenance.
[KARMA]
Augmented Reality demonstrator blower maintenance

Demo done with
- Unity
- Vuforia SDK
Problematic

How the expert can quickly create Augmented Reality content for the operator, without development capacities?

How can we accelerate AR Player development on current device and future ones?
Augmented Reality maintenance modelling

1. UML Model
   - Entity
   - External Actions
   - Process

2. Export

3. Standard Resources
   - AR UML
   - XMI File
   - Standard

4. 3D CAO model

AR Player
- Smart Glasses or tablet
Augmented Reality maintenance modelling

- An AR maintenance is represented by a list of **Action** performed on **Entity** of the system.
  - For example: **Pull up the blower**.

- An **Action** is a simple **Animation** played on one of the **Entity** of the system to maintain.
  - The Action **Pull up** means an animation starting from position \((x, y, z) = (0,0,0)\) to position \((0,0,-50)\) in 300 msec.

- An **Action** may be composed of **Illustration** = an **Animation** on an **ExternalEntity**.

- An **ExternalEntity** is a virtual object that is not part of the system.
  - For example display a screwdriver to show which tool use for disassembling an element.
Augmented Reality maintenance modelling

- We can define template **Action** like Unscrew, Screw,… that are reusable for several maintenance operations.
Augmented Reality maintenance modelling

Can add plugin based on that standard in existing software
For example: maintenance creation in SolidWorks (CAO tool)
Can quickly develop AR Player on existing and future devices.
Maintenance configurations

• **Assisted maintenance**
  1. Operator shares his view with the expert and explain his issue.
  2. Expert augments the operator view in order to explain and assist him.
Maintenance configurations

- **Guided** maintenance
  1. Expert prepares the maintenance tasks in AR.
  2. Before leaving, operator loads the task he must perform from the DB.
  3. Once on site, he performs the maintenance actions.
Works progress

• State of the art of augmented reality.
• State of the art of Augmented Reality frameworks and devices.
  • We chose Metaio as framework and Moverio BT-200 as a smart glasses.
• Conference Mer Innovate in CESI Rouen the 21st of May.
• 2 demonstrators of augmented reality

AR Demonstrator with **marker** created with **ARToolKit**
(Alexis Barreau EXIA A2)

AR Demonstrator **markerless** created with **Vuforia** and **Unity3D**
(Gael Lago EXIA A3 and Olivier Massot ECIA A4)

• AR maintenance modelization v1
  (Dorian Boulc’h EXIA A4)
Perspectives

• Evolution of the AR maintenance modelling.
• Based on that model, development of the AR Player on the EPSON Moverio BT-200.

• Creating maintenance scenario.
• Testing the 2 maintenance configurations.
• Study the Gesture User Interface usage for smart glasses.
Augmented Reality for maintenance

Thank you
References


