Enel Augmented Reality helmet for remote assistance

EPRI Summit

D.Pestonesi
Enel GG R&D

Madrid, 28 April 2015
Agenda

1. Enel scenario
2. Enel Augmented Reality System
3. Improvement of AR System
4. Questions and Discussion
No.1 electricity company in Italy. Second largest utility in Europe by installed capacity

Presence in:
40 countries

Installed capacity:
99,000 MW

Annual output:
286 TWh

Electric grid length
1.9 mln Km

EBITDA:
17 Mld €

Customers:
61 million

Employees:
70,300

Investment Plan 2014-2018:
€26 Mld €

Data as of 31.12.20113
Money can no longer be earned by conventional power plants unless:

- O&M cost are strongly reduced
- New/expanded flexibility capability is created to provide services to the electric system
- Optimal operational efficiency is pursued even in cycling/part load conditions
Main R&D areas

- **Fuel flexibility**
  - Assessment of new, low cost, fuels for different contexts (e.g. petcoke in Spain, low grade coals in Italy and Russia)

- **Storage integration at PPs level**
  - Cost/benefit evaluation of Thermal and Liquid Air Energy Storage

- **Life assessment/management of PP systems**
  - Material ageing modeling (creep & fatigue interaction), new NDTs

- **Robotics and Augmented reality for O&M**
  - New customized technologies (i.e. automatic drones and instrumented helmet) able to support/assist O&M

- **Sensors & Diagnostic for O&M**
  - Wireless sensor networks, on line monitoring tools (e.g. lubricant oil quality, ammonia in fly ash, coal fineness)
  - O&M big data predictive analytics demonstration

- **Advanced automation & control**
  - CRTL that simulate transient behavior, forecast outcomes and optimize plant operation in real time

- **Waste heat recovery technologies**
  - Selection & feasibility

- **New components**
  - Plasma torches for direct coal start-up
  - Combustion system optimization
  - New materials & components design criteria
O&M optimization

The needs

Support the maintenance technician **cognitive and operative needs:**

- Bring knowledge and operative capability just close to hand (documentation, data, procedures)
- Use these capabilities at the right place in the right time.
- Remote assistance
- Reduce back Office activities (reporting)

**KPIs/Targets**

- System cost < 10k€
- Reduction of human errors
- Reduction of inspections time
- Expertise sharing overcoming geographical barriers
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Remote Assistance using Augmented Reality Systems

Technologies of Augmented Reality and Wearable Computing
Technological innovation in the industry:
Equip technicians with portable / wearable systems making it possible to operate in the plant with the ability to communicate easily and effectively with the rest of the staff.

Objectives
• Develop and Test of Mobile Augmented Reality technologies to be integrated into personal equipments of ENEL personnel during operation, diagnosis, maintenance activities.
This system is a portable system that allows one or more experts to assist the User in remote operations during maintenance activities.

The user equipment includes a:

- headset with microphone,
- mini camcorder and
- an embedded micro display
- cameras built into a flashlight

connected via transmission cable to a central reception and transmission of data powered by batteries.
Enel Augmented Reality System
The functionalities

Receiving visual and audio information in real time and on-site the User is able to perform complex tasks remotely guided by the expert.

• The developed system allows one or more expert operator to remotely communicate with and train an operator located in the power plant.

• The Expert sees what the operator is seeing and is able to guide the implementation of activities in a timely manner through precise audio communications, sending clear visual indications.

• In Field Operator may receive remote support audio / video through headsets and portable viewer, allowing him to receive over his field of view different types of information in real time such as graphic symbols and text and documents generated by the Expert desktop, and images from external cameras.
Remote camera selection: CAM1: head camera CAM2: hand camera

This value controls the shutter speed, and can be manually forced to “1” “2” o “3”. “A” will select auto exposure.

Save up to screenshots from the remote camera and recall them when needed. Click on the camera icon to capture image.

“LOW”, “MED” and “HIGH” will change the quality of the remote image and the bandwidth occupation.

Icons representing common tools. Click on any of these icons and they will be shown in the remote user display. This button enables sharing the user desktop with the remote user, who will see it on its own display.
Enel Augmented Reality System
O&M Feedback and New System Design

The use of the equipment by the O&M operators during the diagnostic activities on-site in a generation plant, makes possible to identify some limitations on the equipment ergonomics.

- Excessive weight
- Cables not making the operation easier
- Excessive equipment size
- Low quality of images

The analysis resulted with the release of a new version with a brand new technological design.
Enel Augmented Reality System

Improvements & Features

High quality images

Significant reduction of weight

Wireless Equipment

Light and Portable

ATEX certification in progress

Feature of Expert Application

- Visualization of images coming from selected camera (micro-camera, stethoscope camera)
- Media collection from all video sources
- Sharing desktop with operator on-site
- Visualization of monitoring data on communication quality

Features of Application for User on-site

- Showing on viewer the images coming from cameras
- Showing on viewer the images shared by expert operator remotely placed
- Collection of media data (images and videos)
- fruition of documents related to a specified plant component
Enel Augmented Reality System
New design

Operator In Field

Expert
Improvement of AR System
First Release vs Improved one

2013 - 2014

1. Helmet + Dedicated CPU (2.5 Kg)
2. Total Power: 17 Watt
3. OS Centra Unit

2015

1. Helmet 390 gm + Tablet
2. Total Power: 0.9 Watt
3. OS Tablet
Improvement of AR System
First Release vs Improved one

2013 - 2014

4. 3 Hours (Dual Battery)
5. VGA+ quality for helmet camera
6. High quality for portable camera

2015

4. 5 Hours (Single Battery)
5. Full HD quality for helmet camera
6. High quality for portable wireless camera
Improvement of AR System
Future development

• Assessment of industrial advanced solutions and integration
• Retrieve and use of documentation by utility workers while operating in the field via wearable computers.
• Ability to provide audio, text, numerical and color coded warning information to the workers using augmented reality in real time.

Smart Glasses

Gesture control armband
The idea of a Virtual Control Room

AR System
The smart interface for the technician

LAN Ethernet
IEEE 802.3

Wireless LAN
IEEE 802.11b

ERP

DMS

DCS
Questions and Discussion