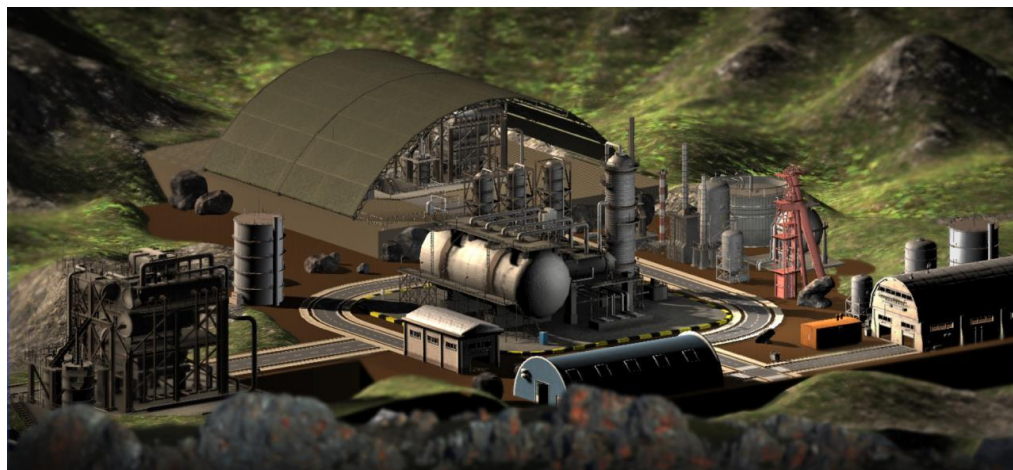# Training Platform for maintenance activities using Virtual Reality Technology

VR/AR/CV applications

Bay Zoltán Nonprofit Ltd. for Applied Research

Hungary

Szabolcs Szávai

Gergely Dobos, Róbert Soós, Zsombor Zsíros, Róbert Beleznai

Bay Zoltán Nonprofit Ltd. for Applied Research

- Date of foundation: 1993

- Non-profit Ltd. Since 2011.

- Owned by the government, but not funded by the government

- Number of personnel: ~ 190

- Income sources:
  - Industrial research and development projects, entrepreneurship, service activities (SMEs, large and multinational companies)
  - Domestic research and development projects (tenders)
  - International research projects (proposals, EU, NATO, TéT)
  - Public institutions (local authorities, ministries, hospitals, etc.)

- Revenue: 1.7 billion HUF (2017) – app. 5,4 mEUR

- Assets: 2,7 billion HUF (8.6 mEUR)

Bay Zoltán
(1900-1992)

Internal Organisation

- **Engineering Division (BAY-ENG)**

- **Intelligent Systems Division (BAY-SMART)**

- **Biotechnology Division (BAY-BIO)**

- **Knowledge Management Centre (BAY-TMK)**
  - International relations
  - Portfolio management
 - Innovation services
  - Technology transfer
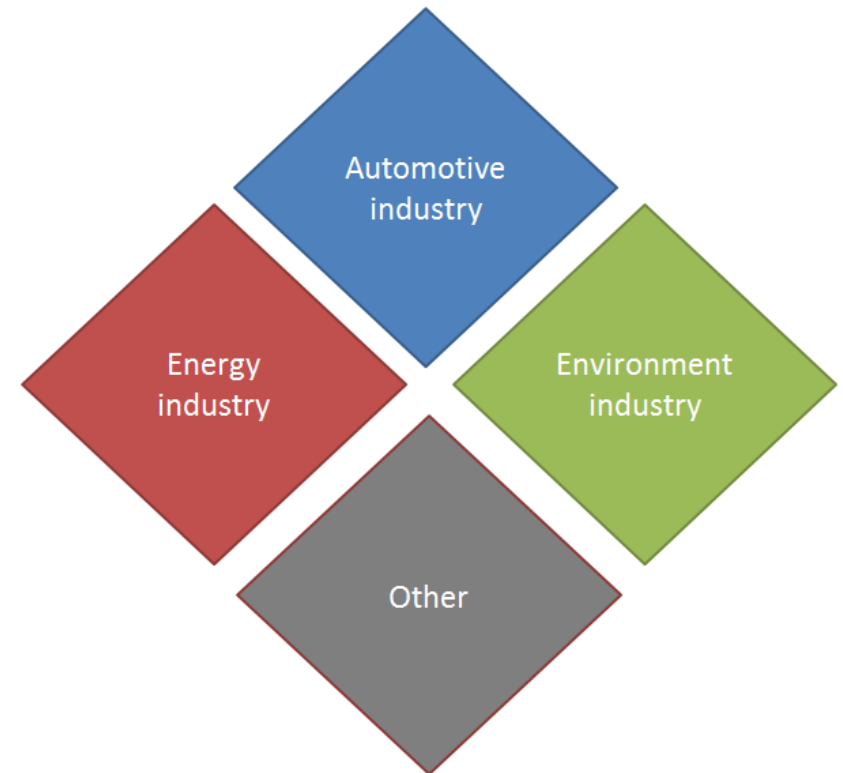
Main Fields Of Activities

- Material science and material technologies
- Product and technology design and reliability
- Engineering services supporting industrial and production processes
- Industrial safety, structural integrity
- Info communication
- Logistics
- Environmental protection
- Biotechnology

Business Structure
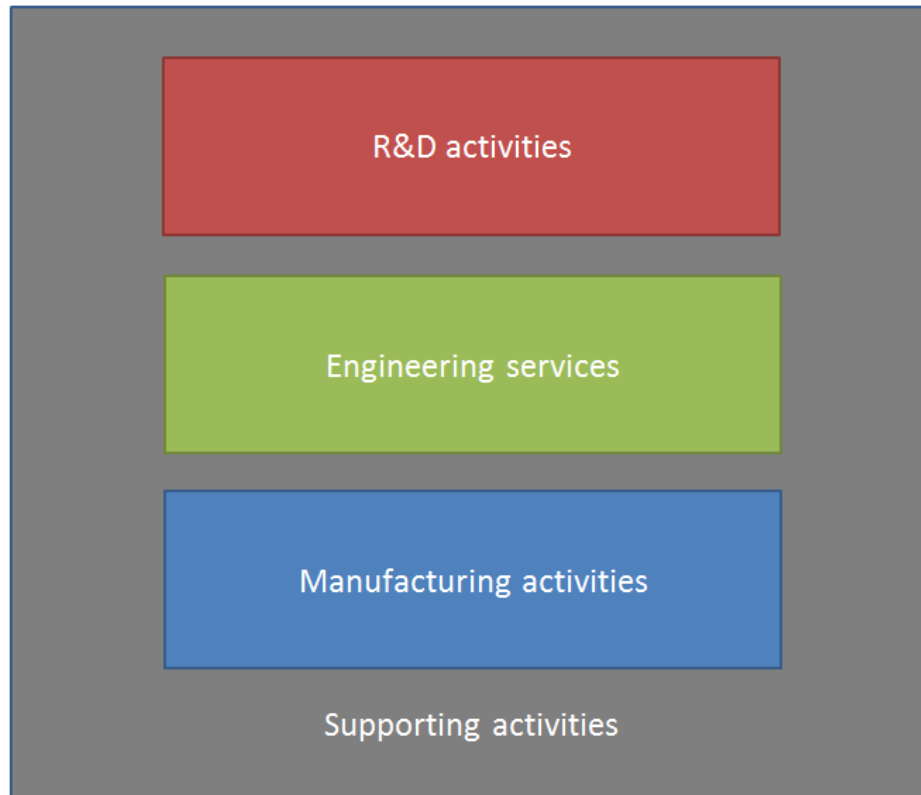
Industrial Focus

Introduction

- Ageing phenomenon of plant and personnel
- Lack of experienced and professional employees
- For personnel only the knowledge management and knowledge transfer is way to preserve the good practices and experiences from generation to generation
- Improvement of the reliable plant operation
- Assurance of the highest safety level
- Periodical training for personnel
- Good practice of safety aspects available for personnel
- "Lesson learnt" personnel courses

Introduction

- Operation or maintenance of plants can involve hazards for personnel (high temperature, chemical materials, etc.)
- Activities should be as short as possible and well-coordinated
- Important to avoid unexpected situations
- Requires experience and reliable knowledge of environment and work
- Practice of different scenarios
- Built expensive training areas are hardly available

- Interaction with different objects

- Prevent from being unnecessarily at danger (high temperature, radiation, etc.)

- User experiences the realistic environment

- Training the staff for the adequate actions

- Not interrupt the operation schedule of the plant

Maintenance Training

![bay logo] Bay Zoltán Alkalmazott Kutatási Közhasznú Nonprofit Kft.
Bay Zoltán Nonprofit Ltd. for Applied Research
www.bayzoltan.hu

# Maintenance Training

Maintenance Training - Dismantling
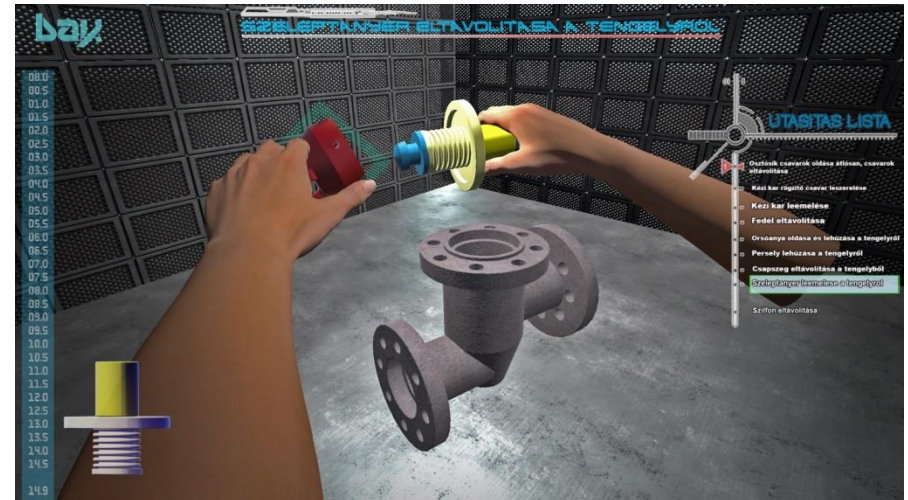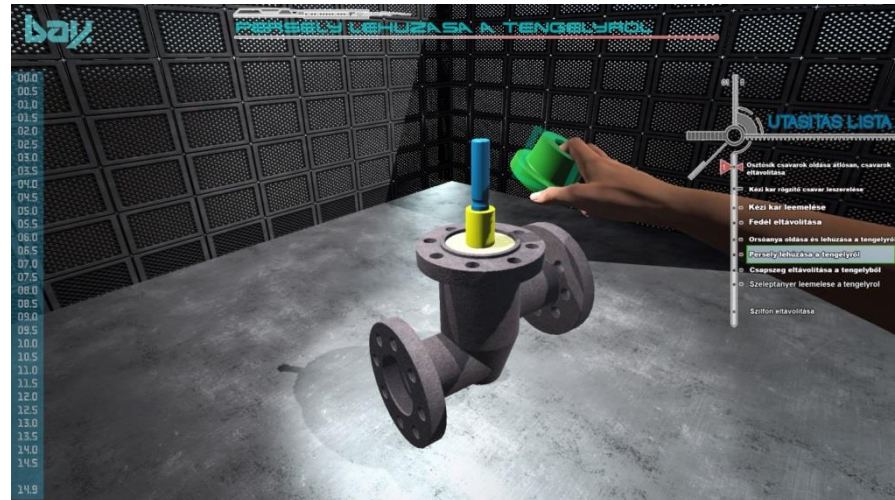
Visual Inspection

Unique Solution

- Complex multi-sensoric hardware and software system
- Detect the whole body motion of the user and provides high-level immersive experience
- User body controlled motion in arbitrary large virtual space
- Real-life interactions with different objects without physical controllers
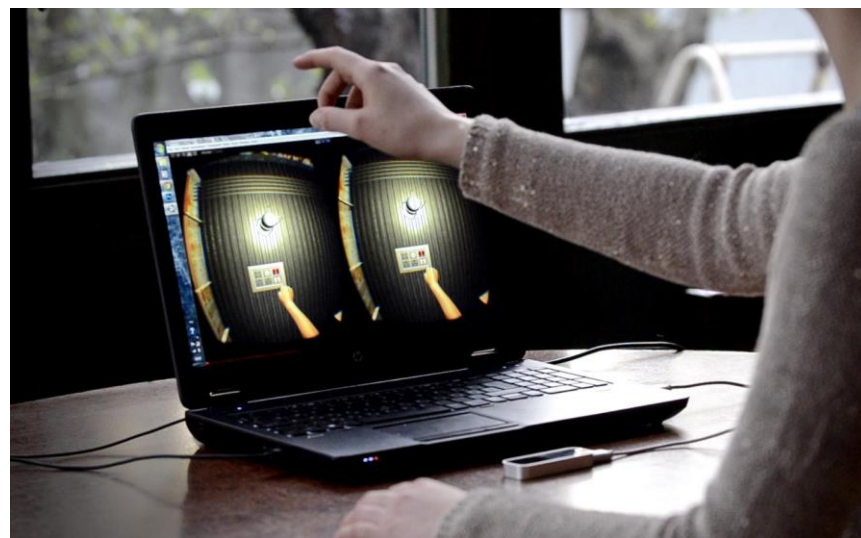
VR Platform Provides Possibilities To

- practice complex working processes in advance

- be prepared for unexpected situations

- receive knowledge of the area

in safety and without hazard.

VR Platform Can Be Applied For

- Increase the experience and knowledge of the personnel
- High value machines adequate operation training without imposing any risk on the real equipment state
- Human factor decrease, assurance of safer work and operation conditions
- Replace expensive training centres
- Organize cost-effective periodic trainings
- Provide safe and innovative education system
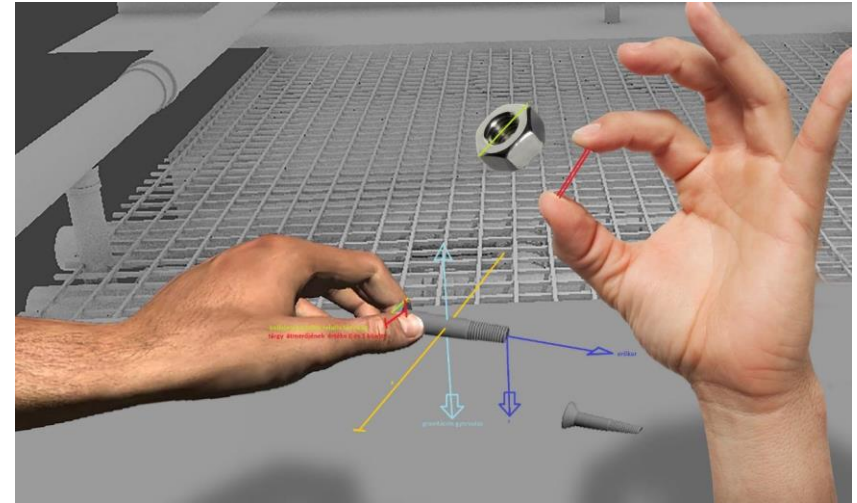
IT Business Award 2017

R&D Award

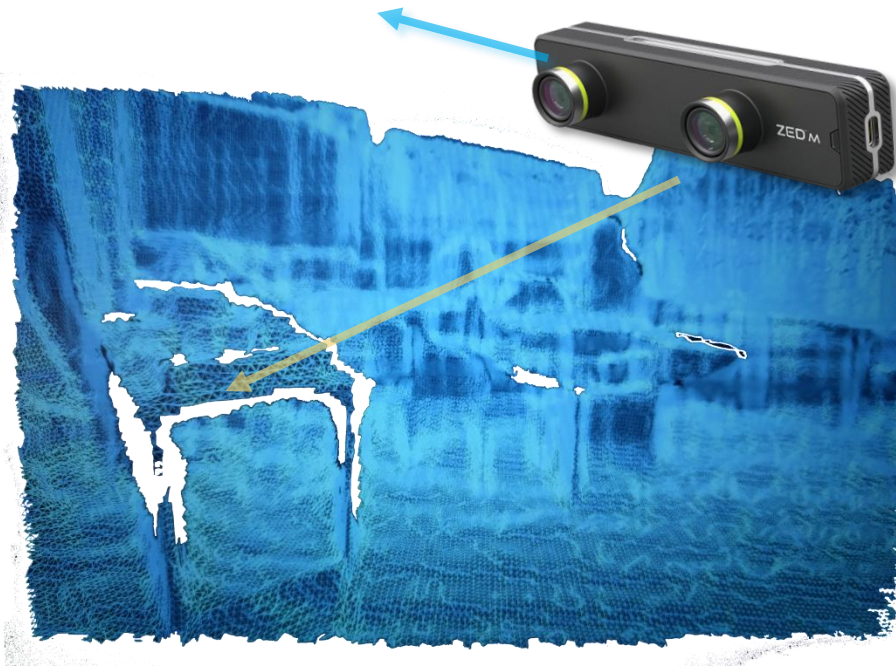**FISA2019 – 9th European Commission Conference on EURATOM Research and Training in Safety of Reactor Systems**

# Application of Augmented Reality and Computer Vision technology

- Indoor localisation
- On-demand localisation

→ Navigation system for field workers, firefighters

- Industry 4.0

→ Real-time documentation Remote operation

- Photogrammetry

→ VR space generation for training platform

- Object recognition

→ Identification of armatures, objects

Indoor localisation// Fusion of SLAM and other sensor to determine the indoor position

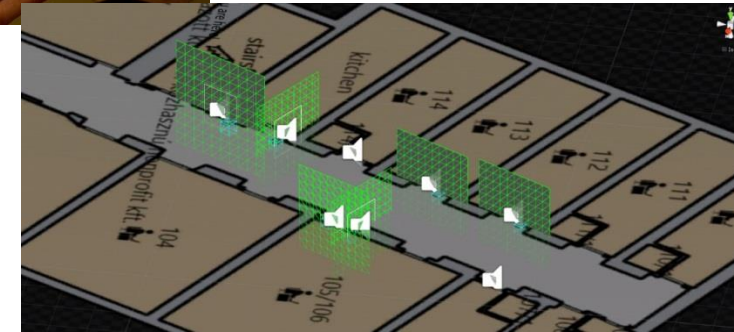# On-demand localisation // indoor localisation using camera of mobile phone

Our solution builds a spatial memory about the environment, like the human brain, and determines the position and orientation from the picture of a depth camera and other sensor data.
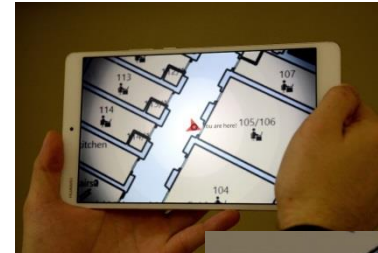
Feature point based localisation on Android tablet

- SLAM requires large computational capacity
- Development of mobile applications faces difficulties
- Searching for 2D natural feature points to determine the position and orientation of the device.

Industry 4.0

Object recognition using convolutional neural network for light switch

Pilot application to switch on/off the light using combination of AR display, convolutional neural network and smart object.

- Unlimited possibilities
- Any kind of interaction can be defined
- Many device can be controlled

Switch on   Switch off

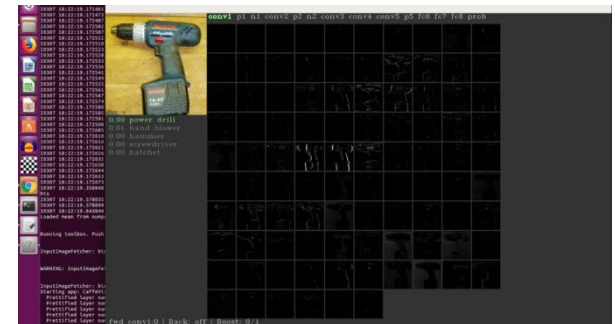Philips bulb with *WiFi* connection

Photogrammetry

- 2D photo series
  → 3D reconstruction
- Low poly model

- Textures
- Avoid modelling
- Fast creation of VR environment

# Object recognition // Object classification using convolutional neural networks
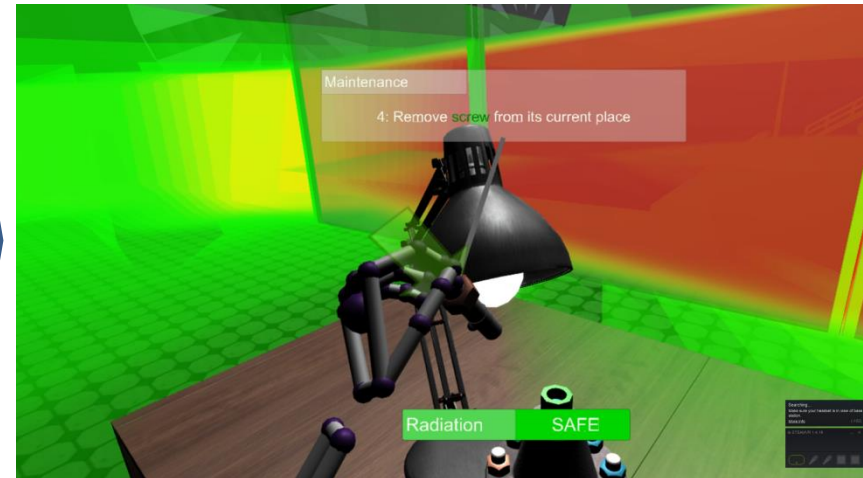
Contribution to Live Decom

- **Co-operation with IFE**
  - IFE: 3D radiation propagation model
  - BZN: VR based training platform for maintenance activity

- ➢ **Combination of the two systems**
  - VR training in radiation visualized environment
  - AR assistance to decrease the dose what the personnel can receive
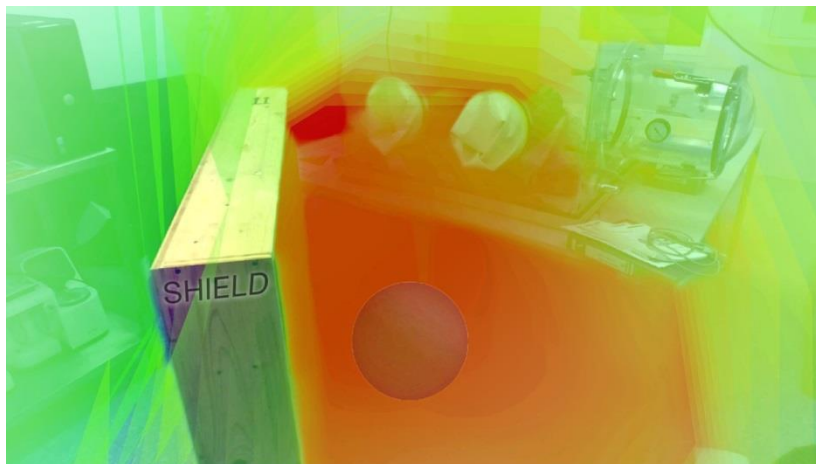
- **Further contribution**
  - Implementation of dose rate calculation
  - Assist the design process of shields (shape, thickness)
  - Testing AR and VR systems in real conditions

THANK YOU
FOR YOUR ATTENTION!