CONNEXIONs

Information Technologies Institute

MOTOROLA SOLUTIONS

CENTRIC
Centre of Excellence in Terrorism, Resilience, Intelligence and Organised Crime Research

NUROMEDIA

upf. Universitat Pompeu Fabra Barcelona

SIMAVI
Software Imagination & Vision

Hochschule für den öffentlichen Dienst in Bayern
Fachbereich Polizei

ENGINEERING

Liberté • Égalité • Fraternité
RÉPUBLIQUE FRANÇAISE

KEMEA

FORTH
INSTITUTE OF COMPUTER SCIENCE

universität wien

CONNEXIONs H2020 project: crime scene investigation and training through 3D reconstruction and VR

Dr. Theodora Tsikrika

Centre for Research and Technology – Hellas (CERTH)

Andrew Pomazanskyi – NUROMEDIA

Dr. Xenophon Zabulis – Foundation for Research and Technology – Hellas (FORTH)

This project has received funding from the European Union's Horizon 2020 research and innovation program under grant agreement No 786731

Fighting Crime & Terrorism

CONNEXIONs aims to equip Law Enforcement Agencies (LEAs)

with an **interconnected suite** of **advanced next-generation technologies**

for significantly improving their capabilities

to **gather intelligence**,

to **analyse evidence**,

and to **investigate crime and terrorism**

effectively and efficiently

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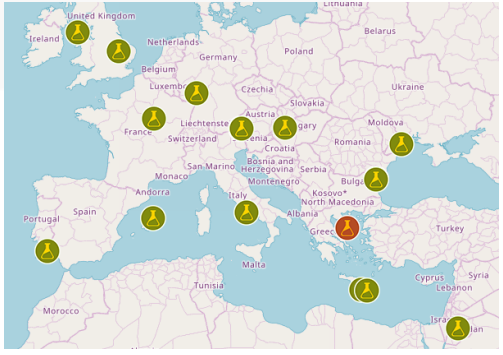
Fighting Crime & Terrorism (FCT)
Research & Innovation Action (RIA)

CONNEXIONS

17 partners

- **5** Research / Academic
  - Information Technologies Institute
  - CENTRIC – Centre of Excellence in Terrorism, Resilience, Intelligence and Organised Crime Research
  - Universitat Pompeu Fabra Barcelona
  - FORTH – Institute of Computer Science
  - universität wien
- **4** Industry / SMEs
  - Motorola Solutions
  - NUROMEDIA
  - SIMAVI – Software Imagination & Vision
  - ENGINEERING
- **8** LEAs
  - Hochschule für den öffentlichen Dienst in Bayern – Fachbereich Polizei
  - Liberté • Égalité • Fraternité – République Française
  - KEMEA

11 countries



START Sept 2018

FINISH Feb 2022

HORIZON 2020

€ 4 999 390

https://www.connexions-project.eu/

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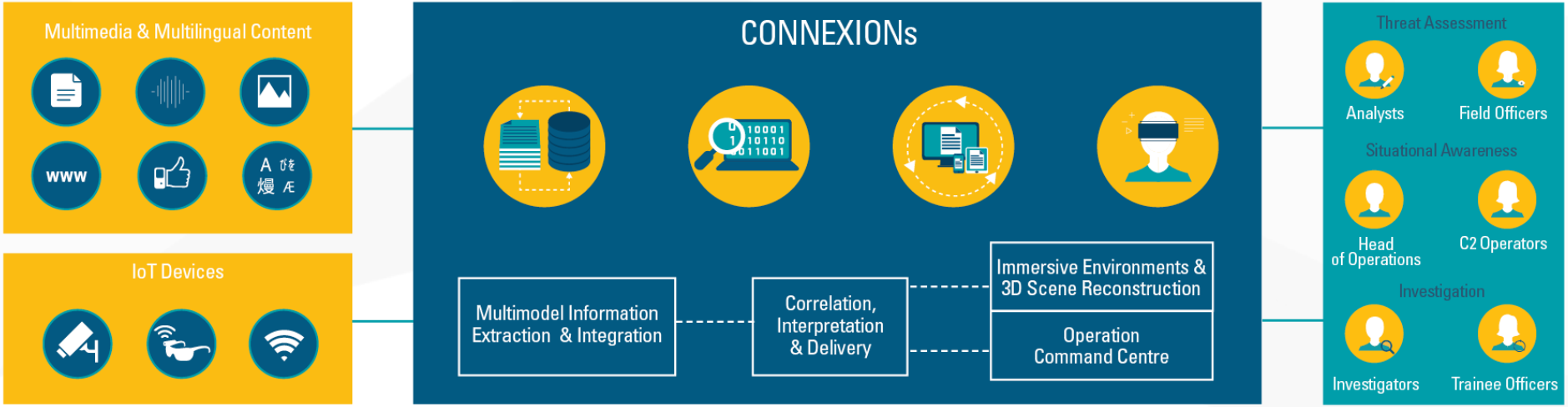
CONNEXIONs concept



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Lifecycle of LEAs' Operations

Pre-occurrence prediction & prevention	• 3D site reconstruction & VR applications for unit deployment planning • Intelligence gathering based on the discovery, collection, and analysis of online content • Threat assessment and early warnings provision
During-occurrence LEA operations	• Enhanced situational awareness and unit management in the Operation Command Centre • Video footage processing for object detection, face identification, abnormal activity detection • AR-based (near) real-time alerts to field officers • Continuous Web and social media monitoring • Multimodal analytics for threat assessment
Post-occurrence investigation	• 3D crime scene reconstruction • VR-based scene exploration & investigative hypotheses simulation • Summarisation and reporting services

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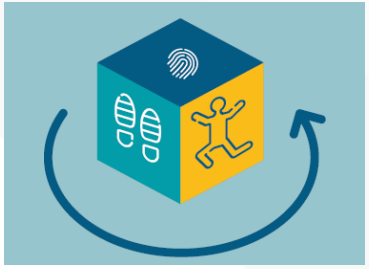
Pilot Use Cases

1. **Terrorist Threat to a Public Event**

2. **Human Trafficking**

3. **Improved Investigation and Training through 3D Crime Scene Reconstruction**



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Objectives

Legal & Ethical

Impact creation

Use case creation & end user requirements definition

Correlation, Interpretation & Delivery

Operation command centre for real-time management of LEAs operations

CONNEXIONs platform

Multimodal Information Extraction & Integration

Immersive Environments & 3D reconstruction

Field demonstrations, end-user evaluation and training

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Immersive Environments & 3D reconstruction

- Mission Planning
- Debriefing
- Crime Scene Investigation
- Training

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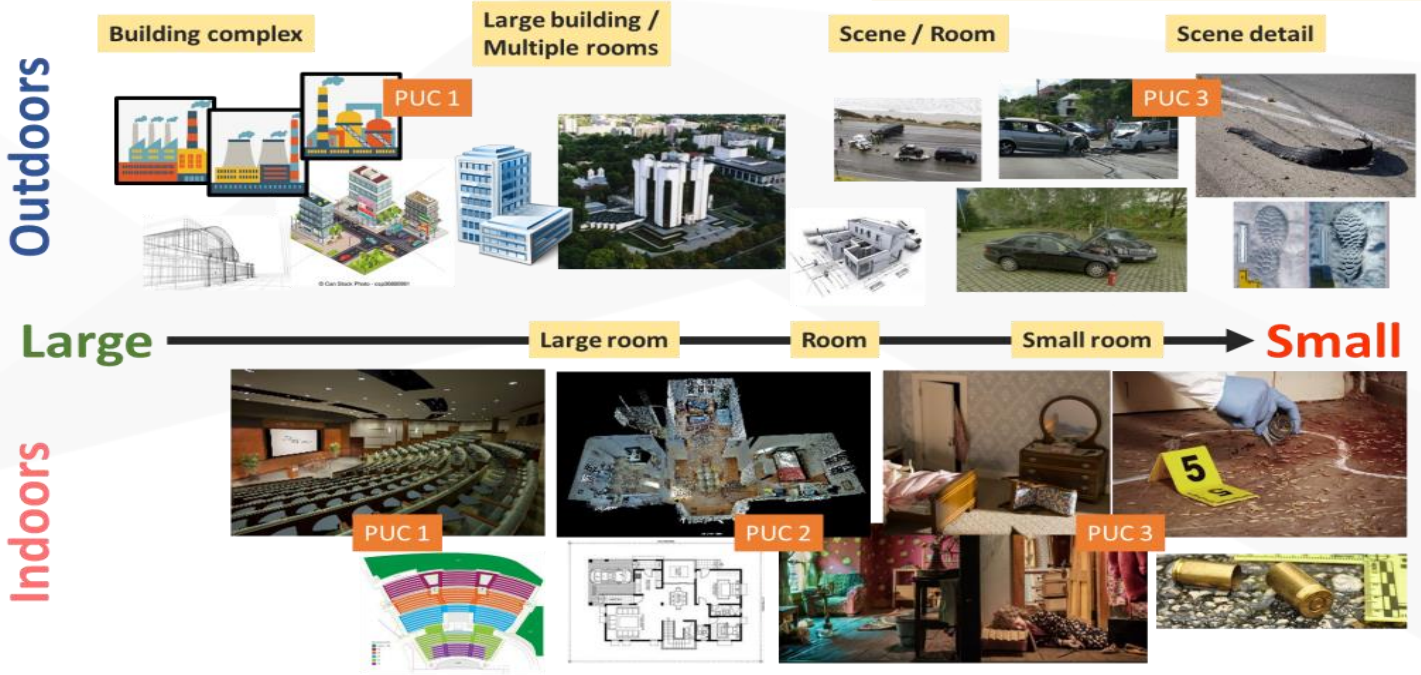
Immersive Environments & 3D reconstruction

3D reconstruction



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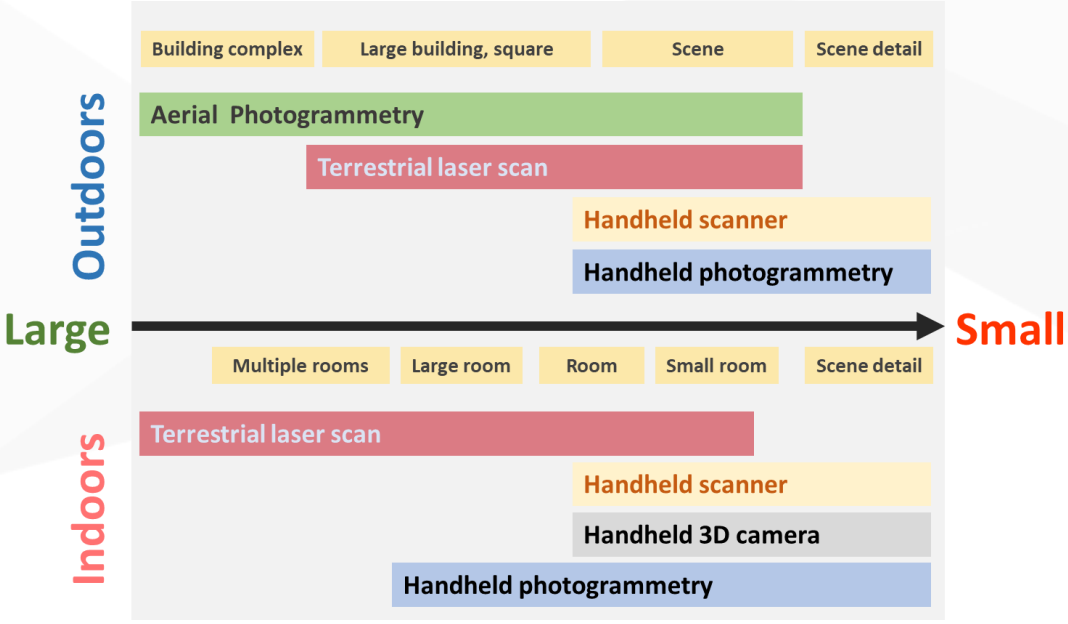
Immersive Environments & 3D reconstruction

3D reconstruction



- Proposed digitisation good practices
  - i. technical constraints
  - ii. ease of use
  - iii. level of automation
  - iv. cost
  - v. time duration of the scan

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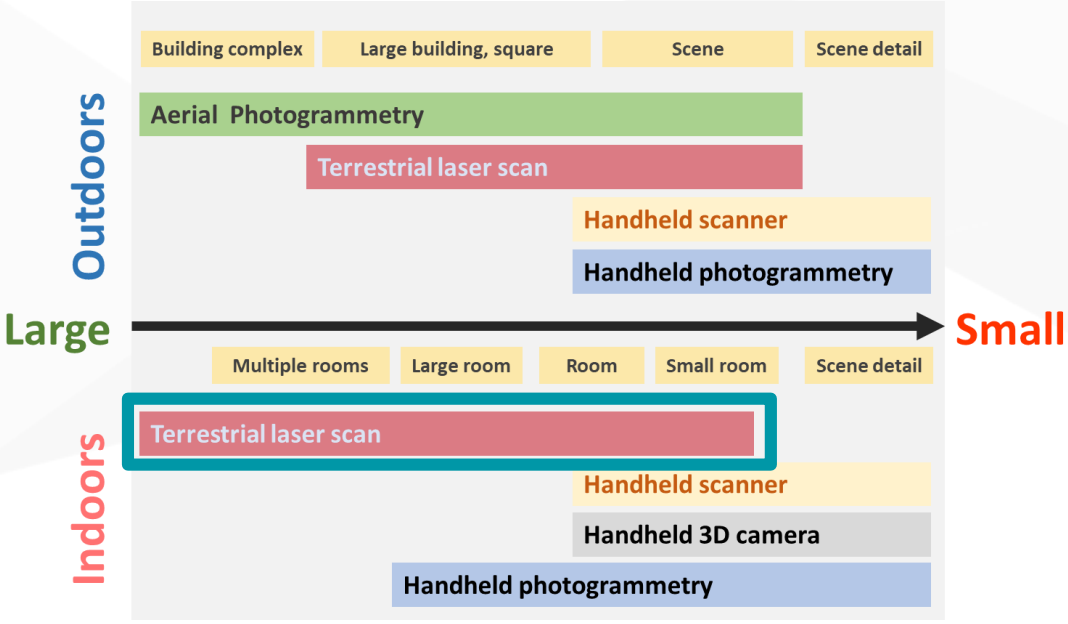
Immersive Environments & 3D reconstruction

3D reconstruction



+ accurate & robust
+ each scan takes place automatically
+ reasonable temporal duration
+ significant experience in the literature

- no real-time feedback; preparatory scans required
- occlusions give rise to requirement of several scans
- partial scans have to be combined at a later stage
- to increase automation, placement of markers needed
- indoors: limited by highly absorbent (dark) surfaces
- outdoors: may be hindered by bright sunlight
- may be less accurate in bad weather (rain, haze)
- high cost

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Immersive Environments & 3D reconstruction

3D reconstruction

Laser scans

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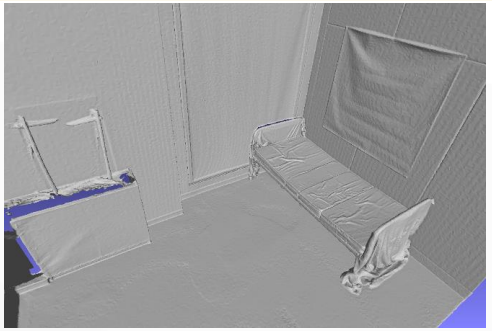
Immersive Environments & 3D reconstruction

3D reconstruction

Laser scans



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Immersive Environments & 3D reconstruction

3D reconstruction

Aerial photogrammetry

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Immersive Environments & 3D reconstruction

3D reconstruction

Photogrammetry

Scanner

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Immersive Environments & 3D reconstruction

3D reconstruction

- Scanning & 3D reconstruction
  - Proposed digitisation good practices
    - G. Galanakis, X. Zabulis, T. Evdemon, S. Fikenscher, S. Allertseder, T. Tsikrika, S. Vrochidis, "A study of 3D Digitisation Modalities for Crime Scene Investigation", Forensic Sciences, 2021; 1(2):56-85. doi:10.3390/forensicsci1020008. https://www.mdpi.com/2673-6756/1/2/8
  - Developed fusion of multiple reconstructions
  - Implemented geotagging of 3D reconstructed environments

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Immersive Environments & 3D reconstruction

Virtual Reality (VR)

- Optimised VR applications with customisation features
  - For Mission Planning
    - placement of virtual objects & field of view of placed cameras
  - For Debriefing
    - visualisation of GPS tracks & aligned video footage
  - **For Crime Scene Investigation**
    - **revisiting 3D reconstructed crime scenes**
  - For Training
    - addition of virtual objects
    - interaction with virtual objects
    - alignment of human models
    - Q&A with scoring system
    - heat map & visual analytics

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Immersive Environments & 3D reconstruction

Visual Assets Catalogue

- Identification of the catalogue requirements
- Design and development of the visual assets
  - manual design for the set of ”must haves”
  - further additions using scanning modality
- > 40 3D models created (incl. human models)

3D visual assets

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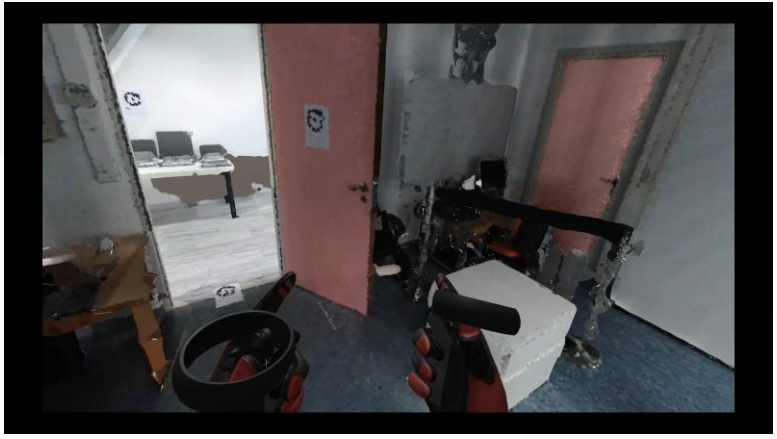

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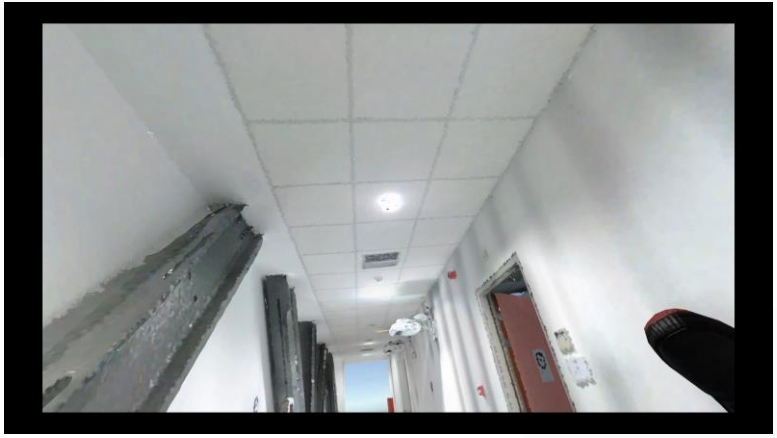

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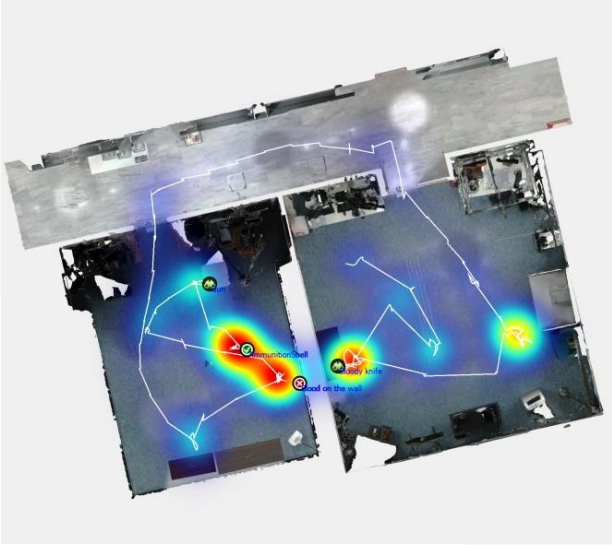

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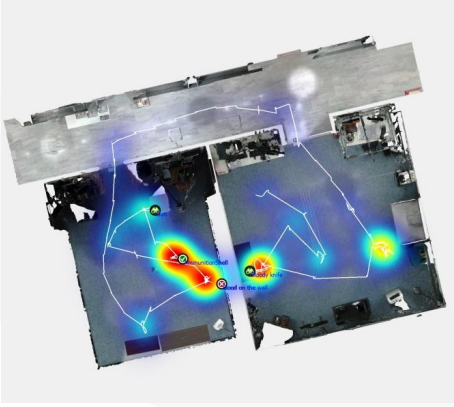
Immersive Environments & 3D reconstruction

Virtual Reality (VR)

- Optimised VR applications with customisation features
  - **For Training**
    - **heat map & visual analytics**
      - visualisation of person position within the environment throughout the training
      - indication of position, path, time spent
      - visualisation of the action sequence
      - logging of activities
        - traces found
        - questions answered – correct/wrong
        - time spent per action
      - detailed customisation possible:
        - intensity and blur allow to customise the focus on points of interest



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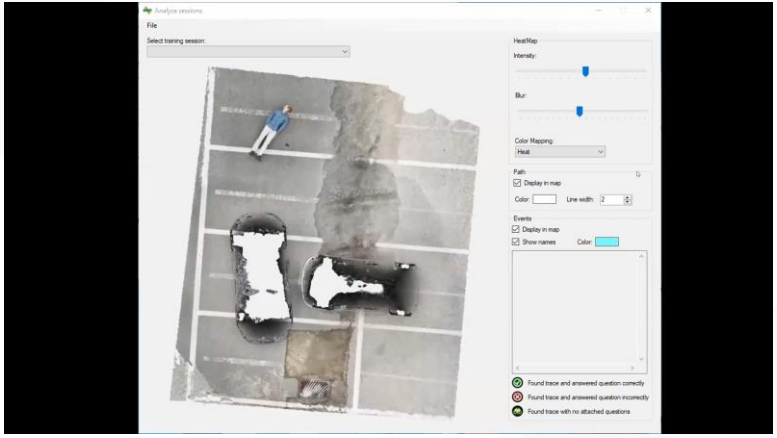

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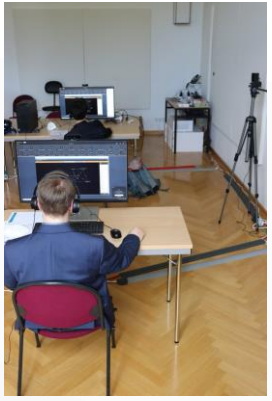
Field demonstrations & end-user evaluation

- Performed field demonstrations & evaluation and user validation

- Partners:
  - University of Applied Sciences for Public Service in Bavaria – Department of Policing
  - Munich Police Department

- Iterations: May 2021 & Jan 2022

- Overall feedback positive



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Thank you for your attention

Contact

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Online presence

https://www.connexions-project.eu/

https://twitter.com/CONNEXIONsEU

https://www.linkedin.com/groups/12170539/

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