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

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

17 partners
5 Research / Academic
4 Industry / SMEs
8 LEAs

11 countries

START Sept 2018
FINISH Feb 2022

€ 4 999 390

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

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CONNEXIONs concept

Multimedia & Multilingual Content

IoT Devices

CONNEXIONs

Multimodal Information Extraction & Integration

Correlation, Interpretation & Delivery

Immersive Environments & 3D Scene Reconstruction

Operation Command Centre

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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
Objectives

Use case creation & end user requirements definition

- Correlation, Interpretation & Delivery
- Immersive Environments & 3D reconstruction
- Operation command centre for real-time management of LEAs operations
- Multimodal Information Extraction & Integration

CONNEXIONs platform

Field demonstrations, end-user evaluation and training

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- Immersive Environments & 3D reconstruction

Legal & Ethical

Multimodal Information Extraction & Integration

Impact creation

Field demonstrations, end-user evaluation and training

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• Mission Planning
• Debriefing
• Crime Scene Investigation
• Training
• Mission Planning
• Debriefing
• Crime Scene Investigation
• Training
Proposed digitisation good practices

i. technical constraints

ii. ease of use

iii. level of automation

iv. cost

v. time duration of the scan
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

Laser scans

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Immersive Environments & 3D reconstruction

Laser scans

3D reconstruction

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Immersive Environments & 3D reconstruction

Aerial photogrammetry

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Immersive Environments & 3D reconstruction

Photogrammetry

Scanner

3D reconstruction
Scanning & 3D reconstruction

- Proposed digitisation good practices

- Developed fusion of multiple reconstructions

- Implemented geotagging of 3D reconstructed environments
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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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)
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Immune Environments & 3D reconstruction

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Immersive Environments & 3D reconstruction

- 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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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
Thank you for your attention

Contact

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Online presence

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https://www.linkedin.com/groups/12170539/
Thank You!