UMONS
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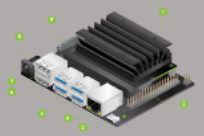
TRAIL TRUSTED AI LABS

TRAIL Seminar



Edge AI for Securing Railway sites

Mohamed Benkedadra & Sidi Ahmed Mahmoudi

UMONS
University of Mons

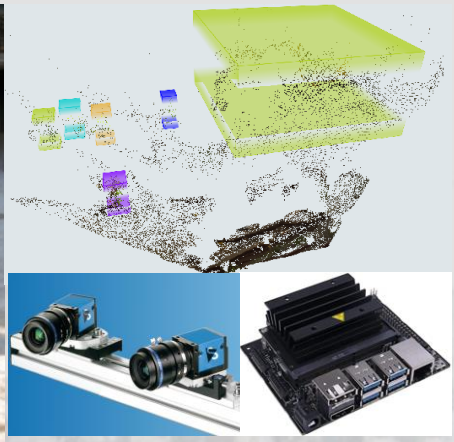
INFRABEL

ILIA UMONS

ISIA Lab

Context : PhD M. Benkedadra

Embedded/Explainable Deep learning for real time dangerous action detection/prediction



Advisors :

- Pr. Sidi Ahmed Mahmoudi
- Dr. Matei Mancas

ARIAC TRAIL

- **Objective 1 :** exploit 2D/3D images and videos captured from multiple cameras to train accurate models for dangerous action/situation detection and prediction.
- **Objective 2 :** Optimize and continuously deploy the models on Edge AI resources.
- **Applications :** generic/adaptive for appliaction on different situations :
  - Actions recognition/danger prediction in railway stations, construction sites, etc.
  - Process optimization/securing in the context of Industry 4.0

PLAN

I. Introduction

II. Hardware presentation

III. InfraSecure : Rule-based Approach for 3D Danger Detection

IV. Edge Deployed AI Solution

V. Experimental Results : Demos and Performance

VI. Conclusion

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Introduction

Infrabel wants to leverage **artificial intelligence to improve safety on construction sites**

ILIA and ISIA have a strong expertise in computer vision and artificial intelligence

Many Dangers Exist in a Construction site :

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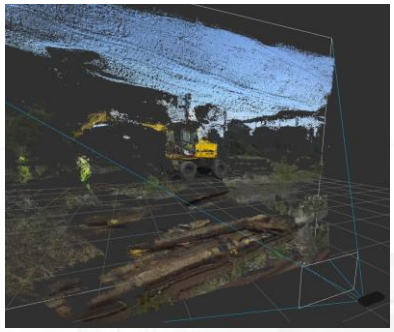
Hardware Presentation

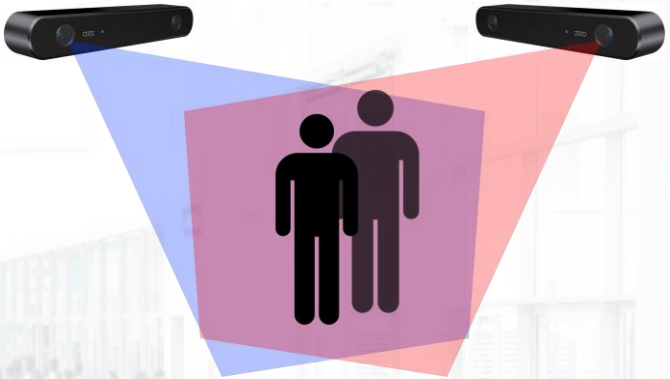
Zed 2 cameras

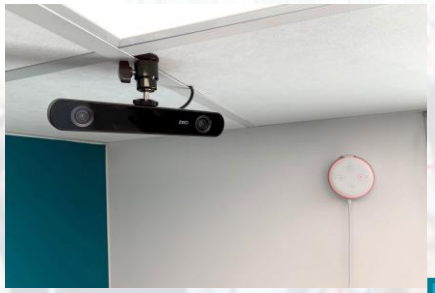
2D view

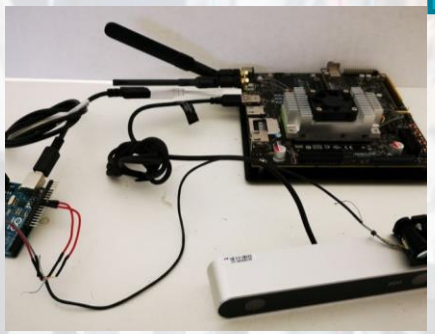
3D view

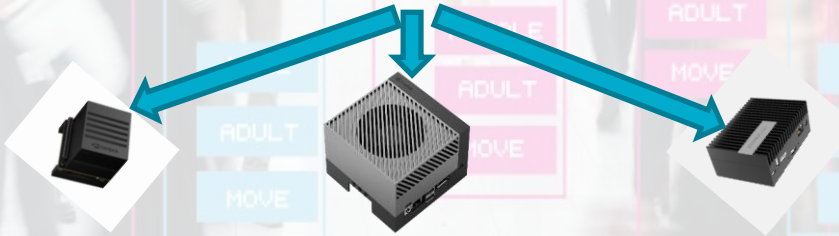


Multi Camera System
Double view









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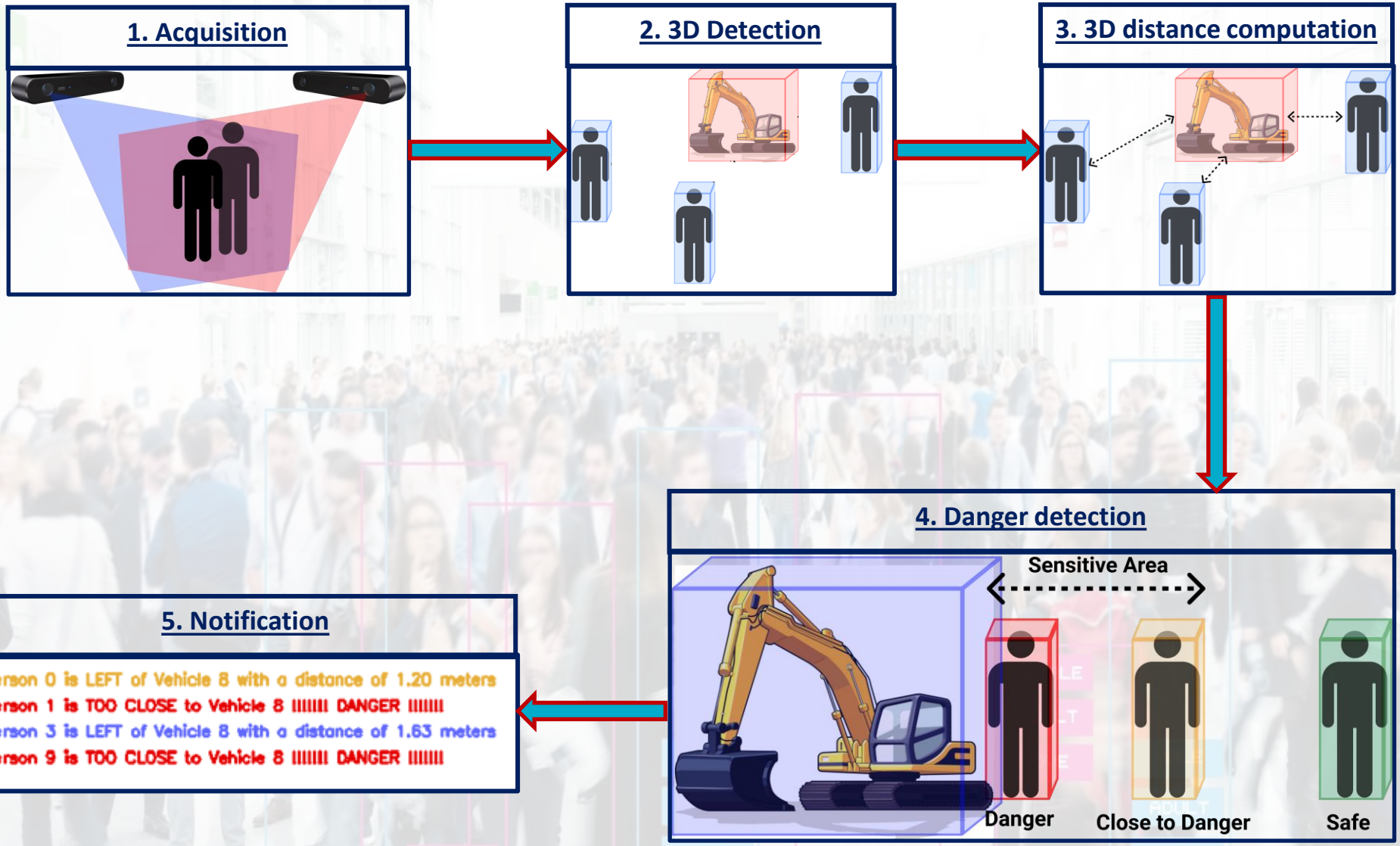
Rule-based Approach



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Required Hardware

InfraSecure Deployment Options

InfraSecure 2.0 : computation on Edge devices

- The rule-based and deep-based solutions of InfraSecure are **fully deployed on embedded resources « Edge AI »** with a **real time** treatment with the **Jetson Orin card** using one camera
- Tested successfully on laptops, tablets, and high performance servers

Laptop

Tablet

EDGE RESSOURCES & Servers

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InfraSecure Deployment Testing

Device	CPU	GPU	Memory	OS	Examples of Usage
[EDGE] NVIDIA Jetson Orin	12-core A78AE Armv8.2 64-bit 3MB L2 6MB L3	2048-core Ampere 64 Tensor Cores	64GB 256-bit LPDDR5 204.8GB/s	Jetpack 5.1	Embedded Systems Distributed Systems Compact Solutions
[EDGE] NVIDIA Jetson Xavier	8-core Carmel Armv8.2 64-bit 8MB L2 4MB L3	512-core Volta 64 Tensor cores	32GB 256-bit LPDDR4x 136.5GB/s	Jetpack 4.6	Embedded Systems Distributed Systems Compact Solutions
[LAPTOP] Lenovo T15g Gen2	Intel© i7-11850H 8 Cores x2.5GHz	GeForce RTX 3070 8GB Max-Q	16GB DDR4 3200MHz	Ubuntu 20.04	Smart Home Servers Workstations Gaming Systems
[TABLET] DT340T RUGGED 2-IN-1 TABLET	Intel® i5-8250U 4 Cores x1.6GHz	GeForce GTX 1050 4GB	8GB DDR4 2400MHz	Windows 10	Portable Solutions On-Site Testing

Laptop

Tablet

EDGE RESSOURCES & Servers

InfraSecure Deployment Testing

Frame rate Results for Testing

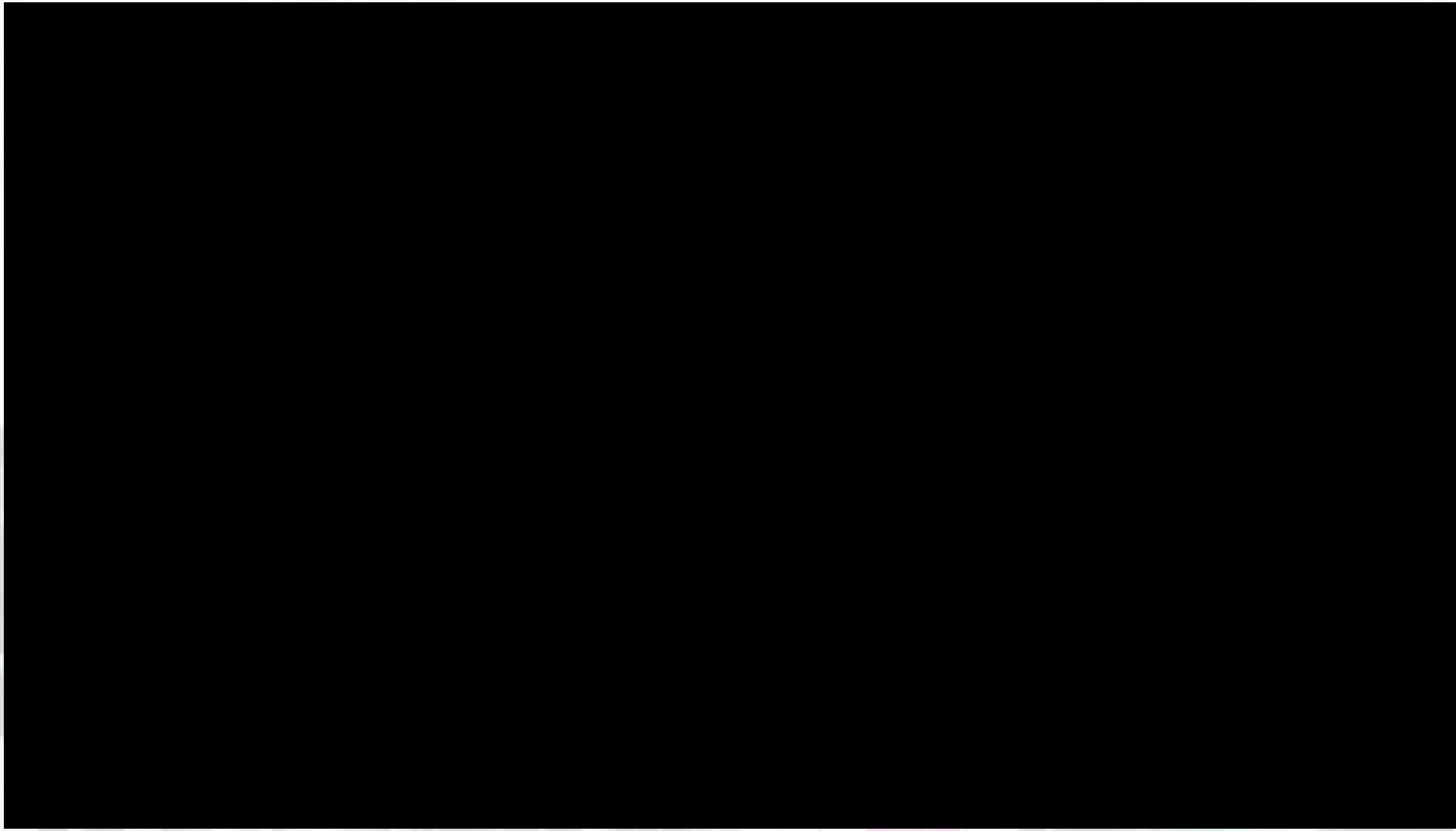
Device	Realtime (1 Cam)	Realtime (2 Cams)	Offline (1 SVO file)	Offline (2 SVO file)
[EDGE] NVIDIA Jetson Orin	30	14	18	8
[EDGE] NVIDIA Jetson Xavier	11	/	10	4
[LAPTOP] Lenovo T15g Gen2	20	10	15	8
[TABLET] DT340T RUGGED 2-IN-1	8	/	9	3

Laptop

Tablet

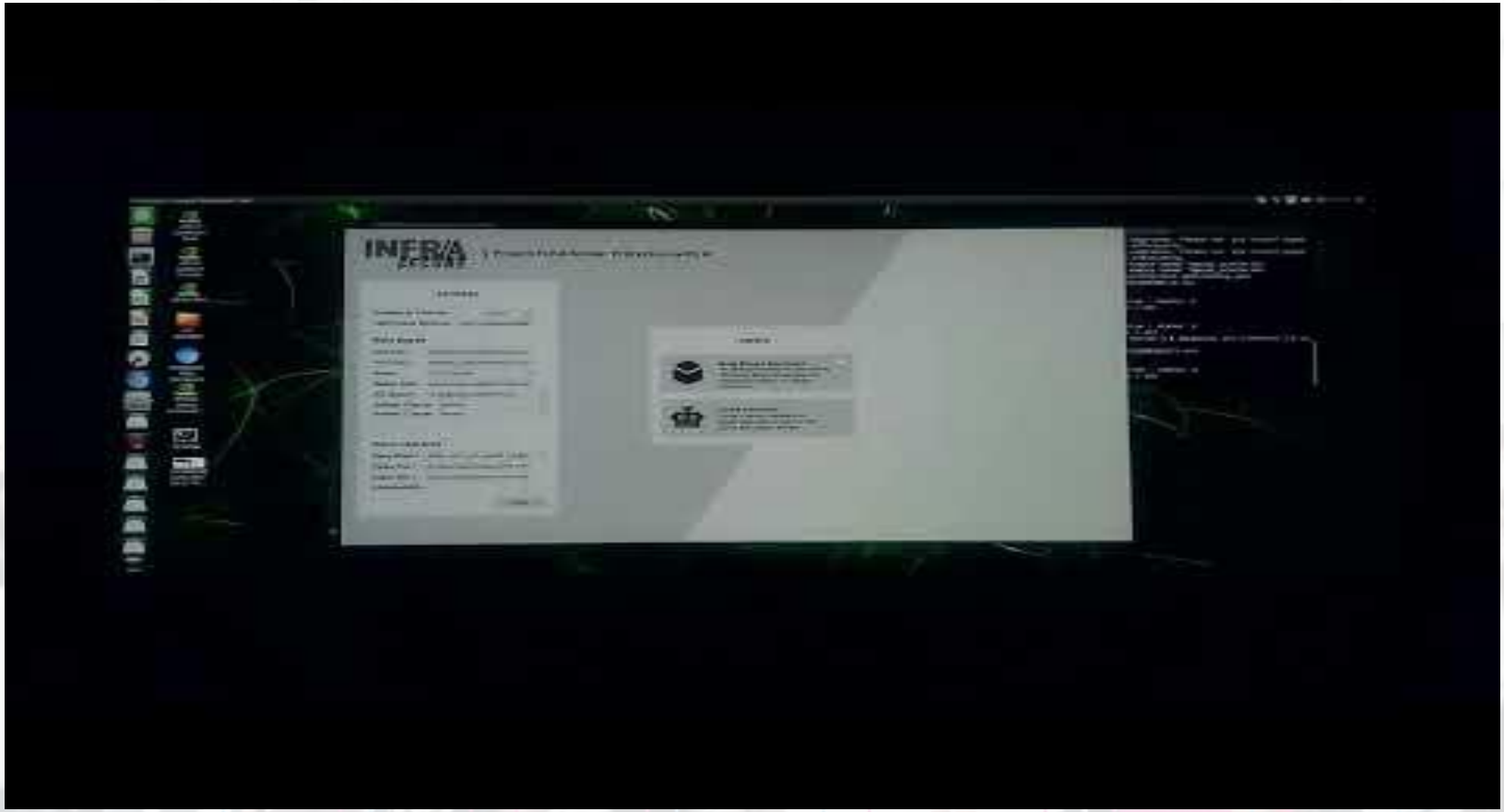
EDGE RESSOURCES & Servers

Infrasecure Demo



InfraSecure on Edge AI

DEPLOYMENT ON EDGE RESSOURCES



Conclusion

- Workers' safety using AI and Computer vision
- Danger detection : compute distance between 3D detected objects
- High accuracy of the provided solution : around 90%
- Infrasecure deployed on Edge AI : Jetson Xavier and Jetson Orin
- Models' compression : reduce memory size : **5x less**
- Models' compression : accelerate computation : **speedup of 2x**

Future Works

- Multiple camera fusion
- Continuous & multimodal learning

Questions