

DE LA RECHERCHE À L'INDUSTRIE

cea



CONTENT ENGINEERING & VISION LABORATORY

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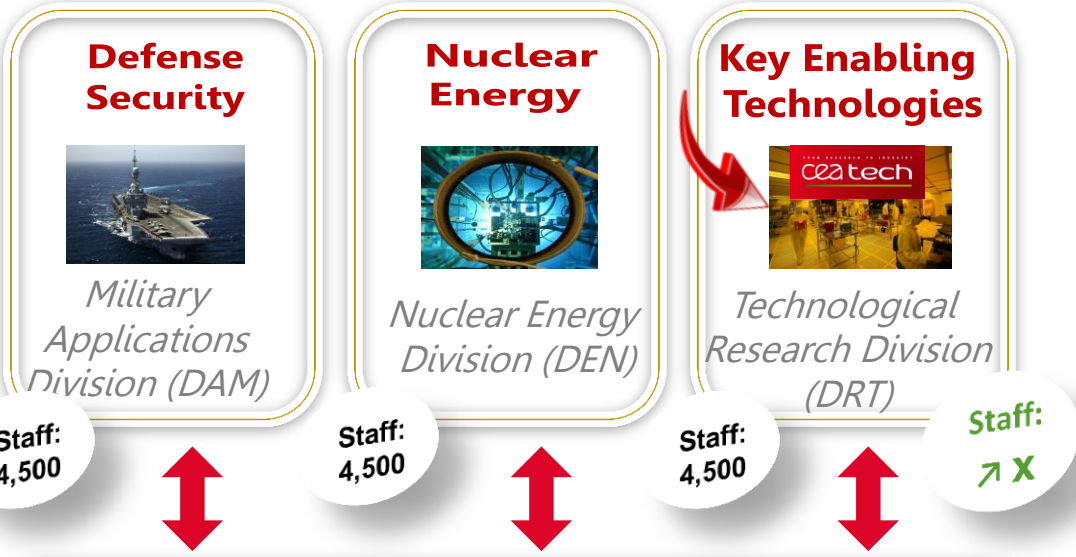
www.cea.fr



digiteo

list

Technologies



Science



- ➔ *Mission DAM : France's national **security independence***
- ➔ *Mission DEN : France's **energy independence***
- ➔ *Mission DRT : French business' **economic competitiveness***



Human resources **16,000**

10 Research centers

Budget: € 4,7 Bn

Scientific publications: **4,740**

4,674 Patent families in portfolio (2012)

701 Priority patents delivered

157 Innovative high-tech start-ups since 1972

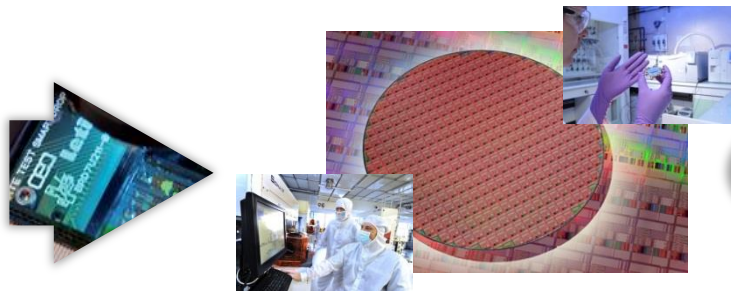
53 Joint research units

CEA TECH: A WIDE OFFER OF KEY ENABLING TECHNOLOGIES

leti

Laboratory of **E**lectronics and **I**nformation **T**echnologies

Staff: 1600, Budget: €300M

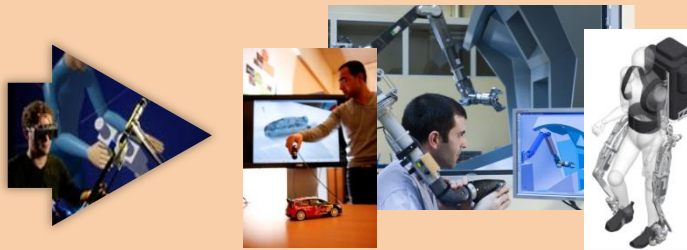


Micro-nanotechnologies and their
intégration in systems

list

Laboratory of **I**ntegrated **S**ystems and **T**echnologies

Staff: 700, Budget: €90M



Software-intensive systems
Advanced manufacturing

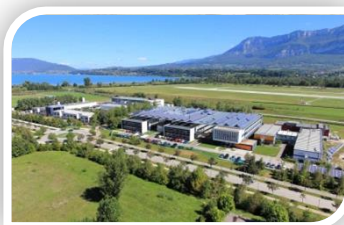
liten

Laboratory of **I**nnovation for new **T**echnologies for **E**nergy and **N**anomaterial

Staff: 1100, Budget: €170M

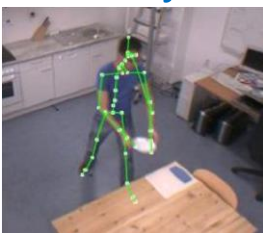


New energy technologies
and nanomaterials



Scene
Understanding

Detection/tracking
and activity analysis



3D Perception
&
Mobility

Localisation
Augmented Reality



Multimedia

Semantic Analysis
Text / Image



+80 researchers & engineers on projects
+ 15 PhD students

+50 publications / year
+30 active patents

3D Perception & Mobility

Real-time Localisation and Environment perception

- Augmented Reality
- Indoor/outdoor geo-localisation
- Industrial control



- Augmented Reality
- 3D Localisation & Mapping
- 3D Reconstruction
- 3D Control & Manufacturing
- Material Segmentation
- Scene Illumination Analysis
- Diminished Reality

- **Augmented Reality**
- 3D Localisation & Mapping
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AUGMENTED REALITY APPLICATIONS

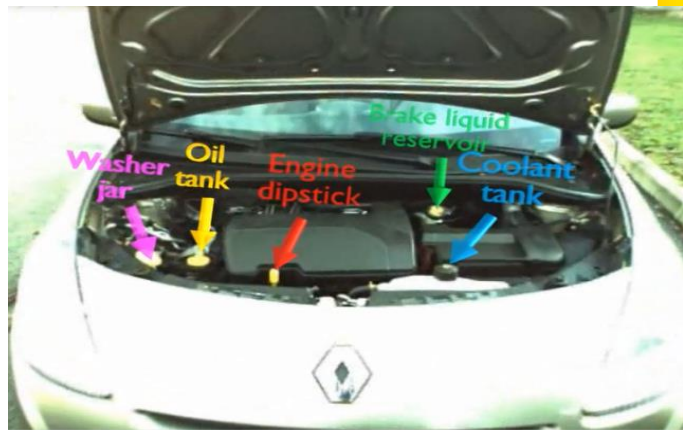


Marketing



Navigation

*Real Time
Visual
Registration
Technologies*



Training



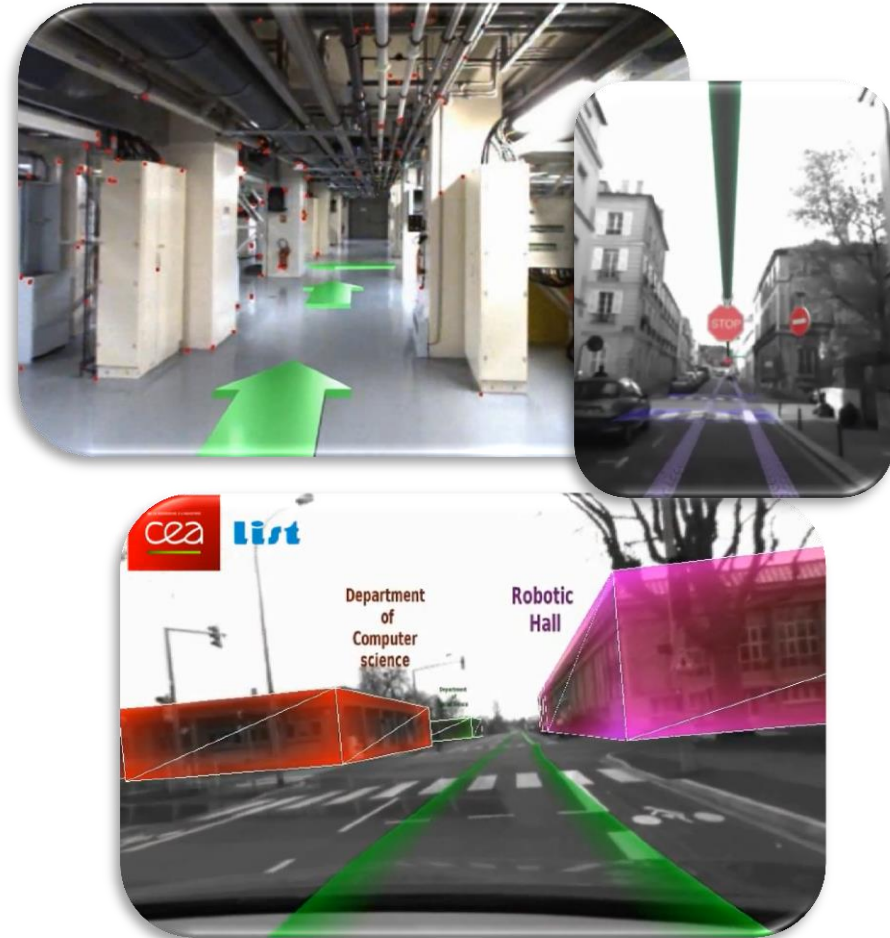
Industrial maintenance

AUGMENTED REALITY APPLICATIONS: 2 main kinds

Augmented Objects



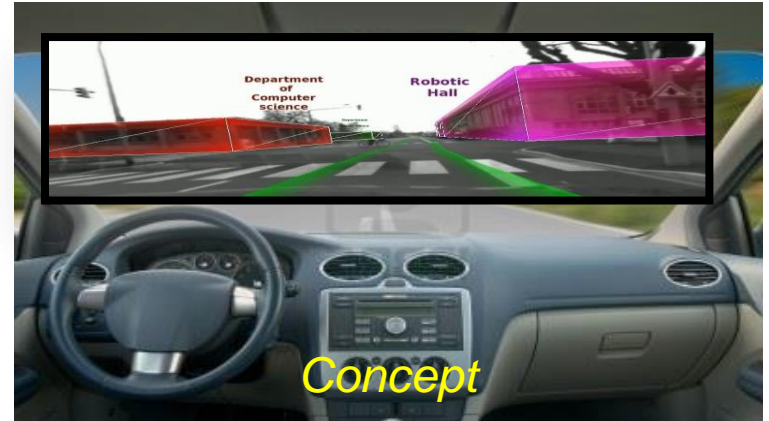
Augmented Environments



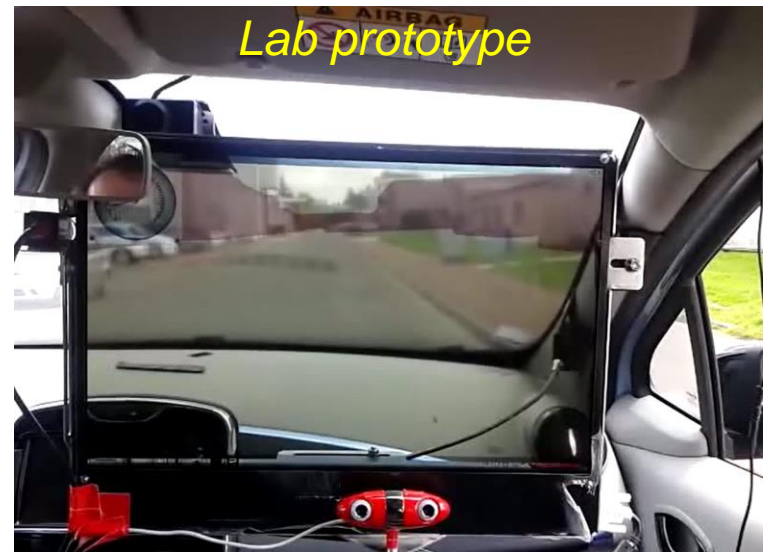
AUGMENTED REALITY & DISPLAYS



AR Glasses



Concept

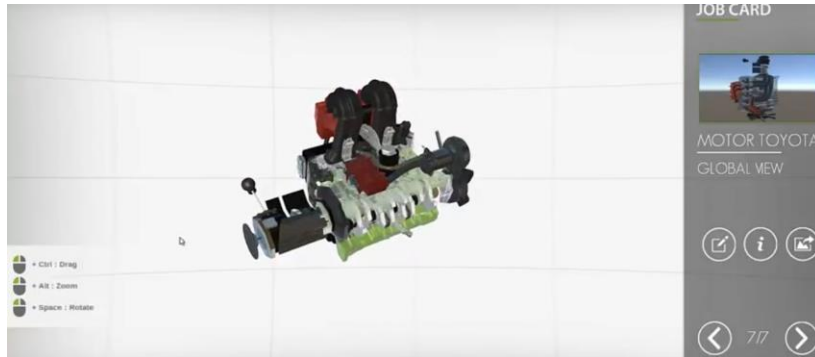


Lab prototype

HUD - Towards full windscreen

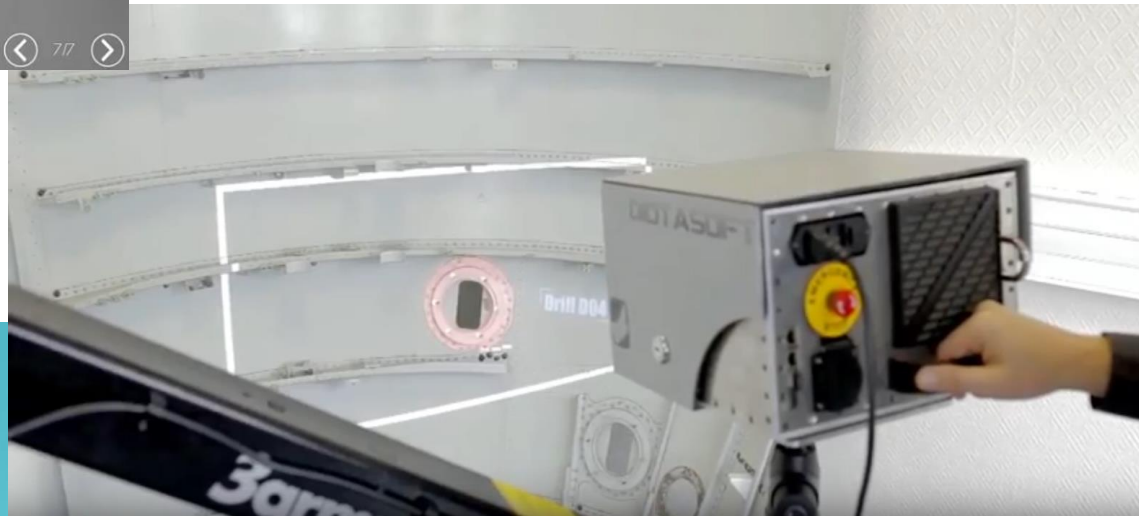


Transparent screens



AR software solution

Projective AR

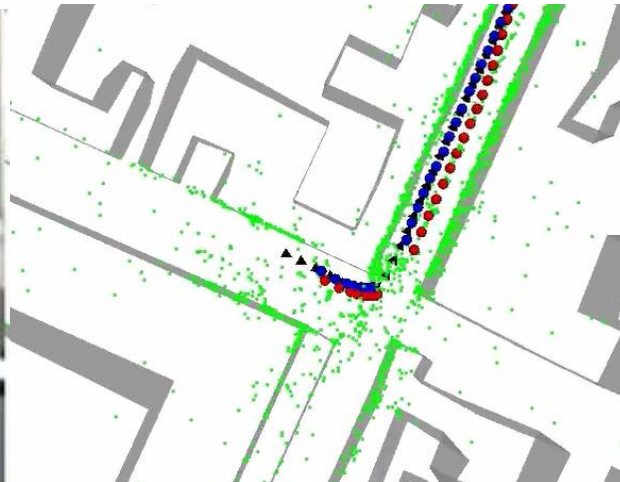
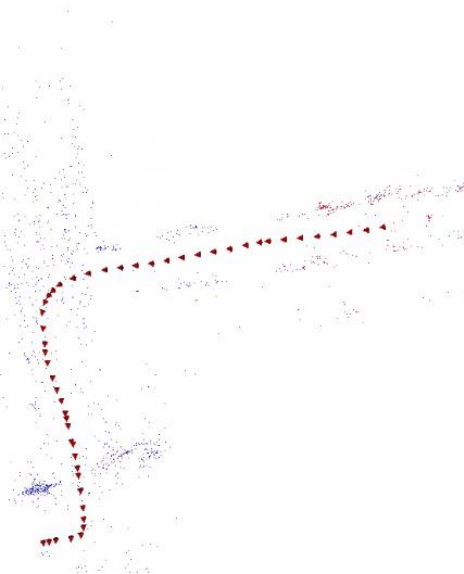


AR on tablet

- Augmented Reality
- **3D Localization & Mapping**
- 3D Reconstruction
- 3D Control & Manufacturing
- Material Segmentation
- Scene Illumination Analysis
- Diminished Reality

Indoor

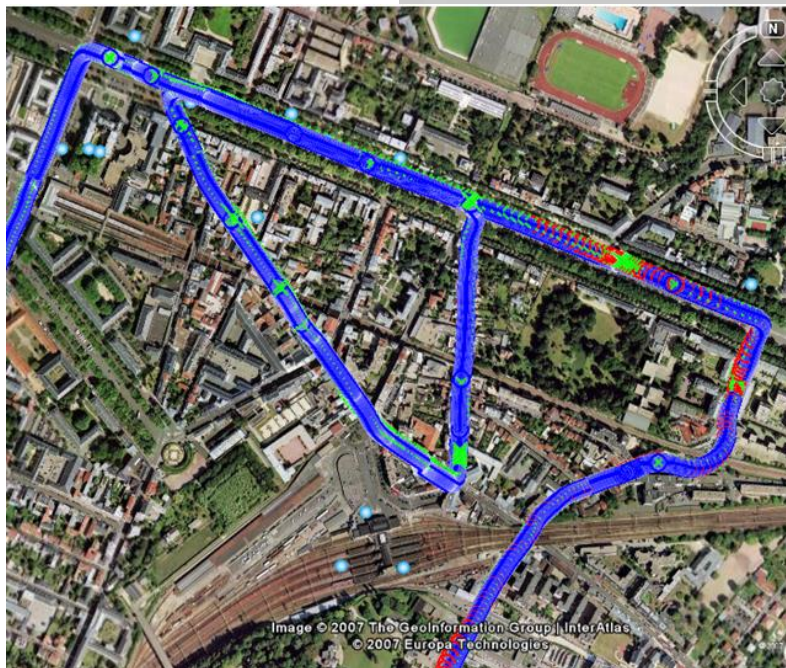
- Indoor Guidance
- Mobile Robots
- ...



Outdoor

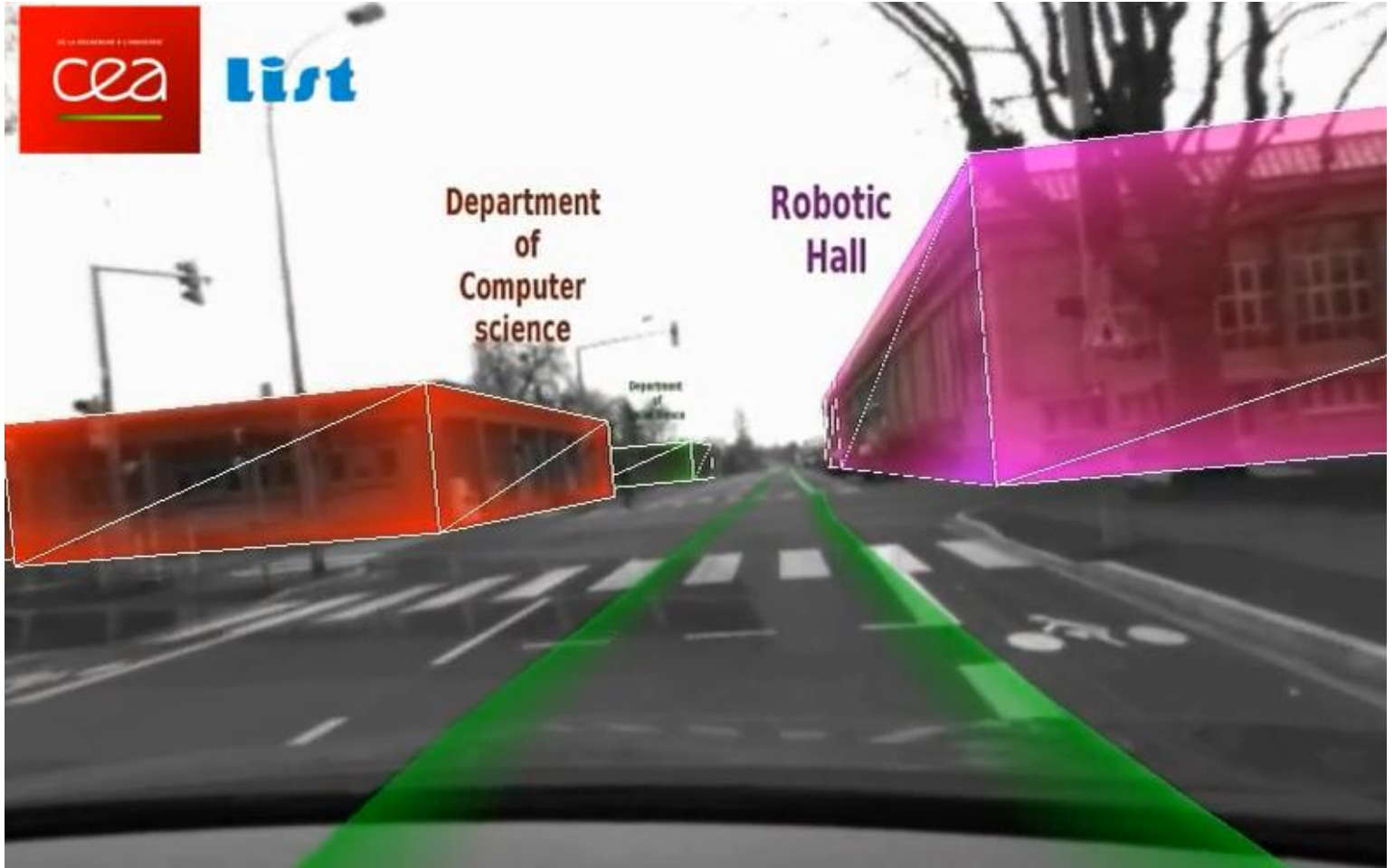
- Autonomous vehicles
- Pedestrian Guidance
- ...

LOCALIZATION BY MULTI-SENSOR FUSION



SENSORS

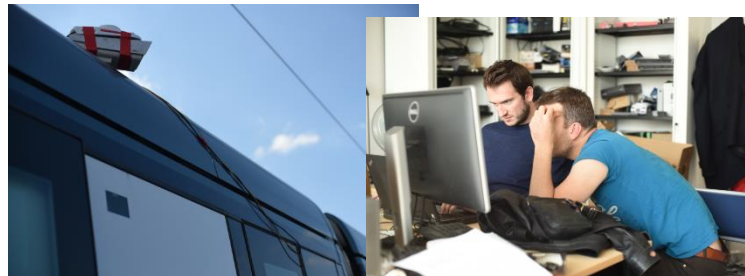
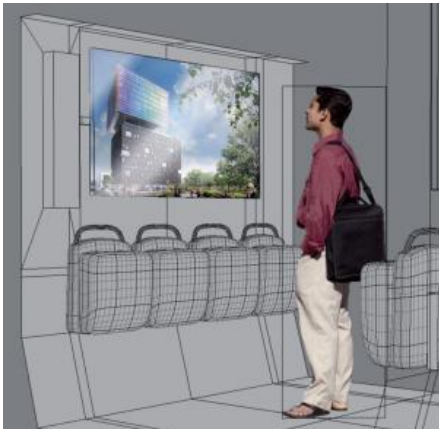
- **Camera:** *mono, stereo, RGB-D*
- GPS
- IMU
- Odometry
- Lidar



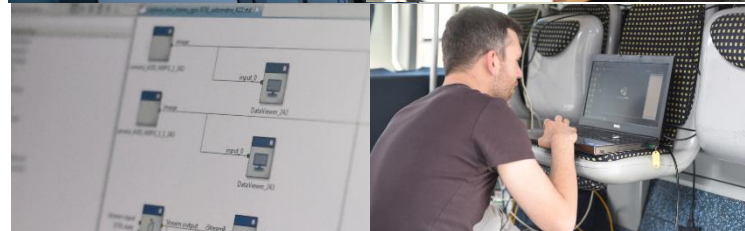
Augmented Reality in TRAMWAY

Prototype

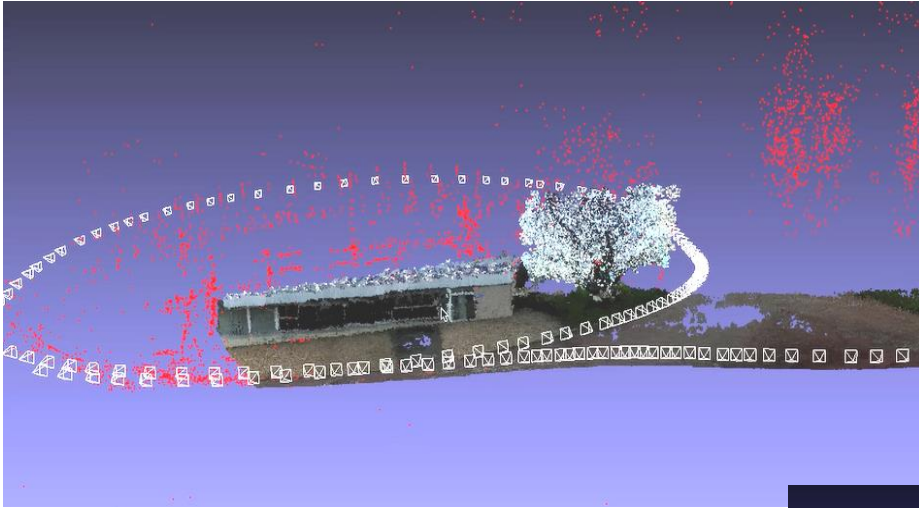
Concept



Realization

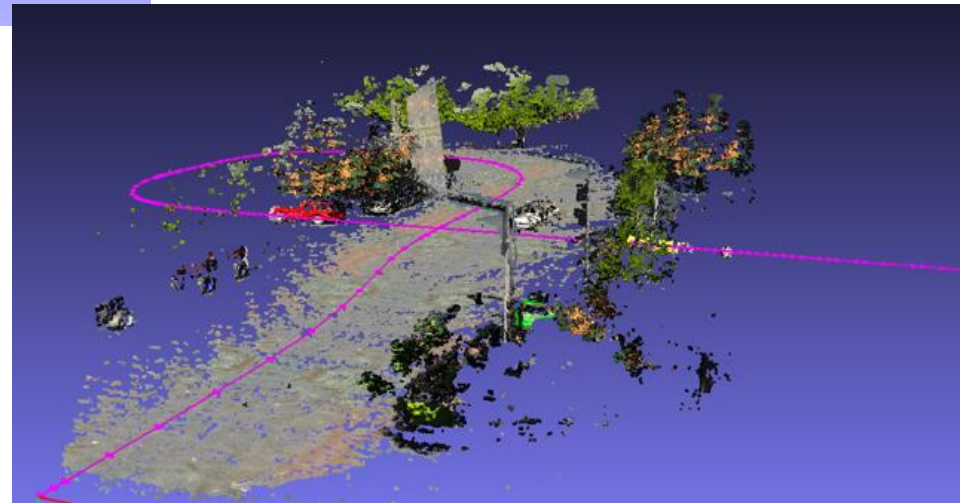


- Augmented Reality
- 3D Localisation & Mapping
- **3D Reconstruction**
- 3D Control & Manufacturing
- Material Segmentation
- Scene Illumination Analysis
- Diminished Reality

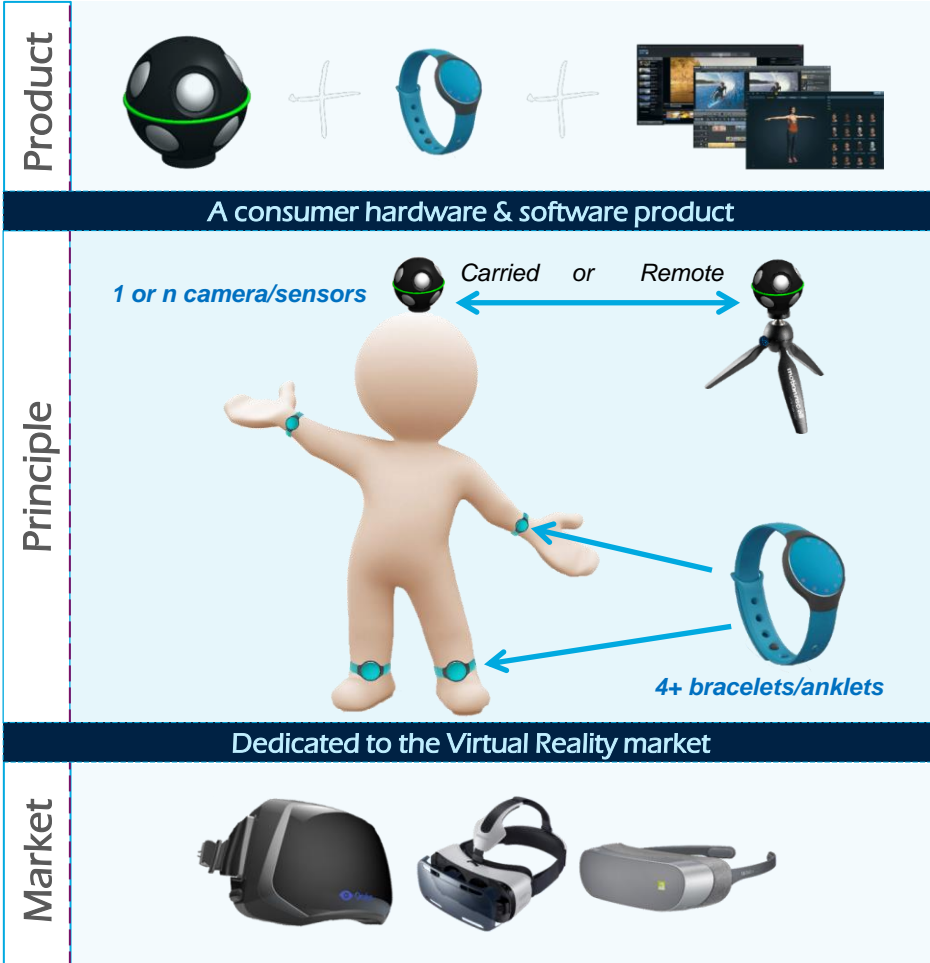


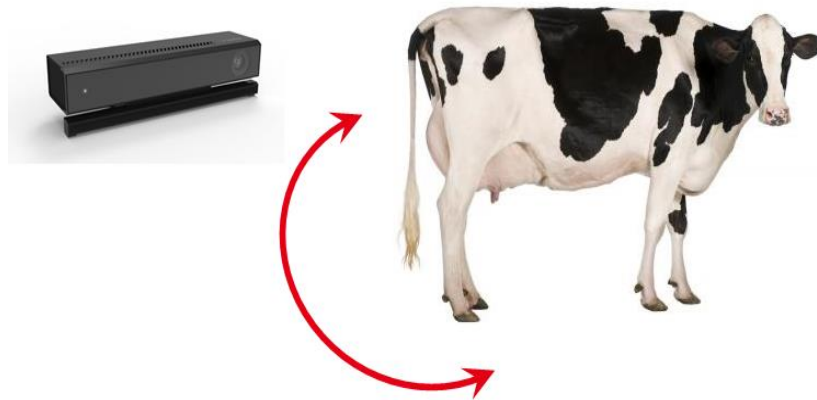
- *Low-cost or wearable systems for 3D Scene Modeling*

*Stereovision
Multicaméras
Sensor fusion*

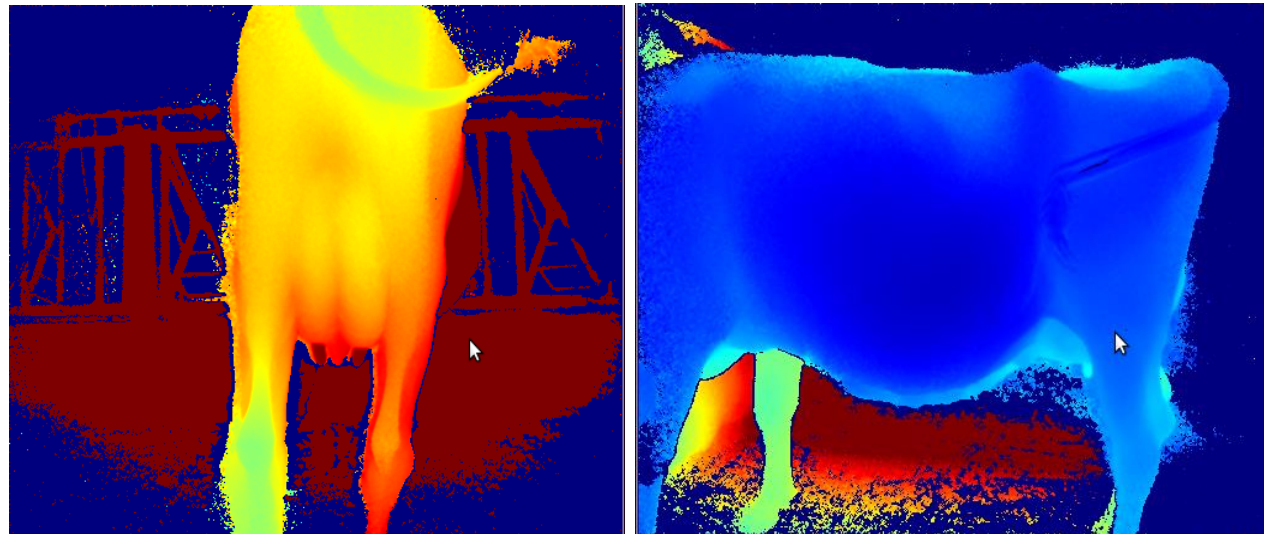


3D RECONSTRUCTION



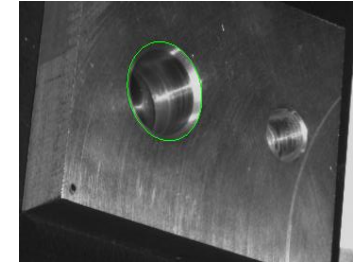
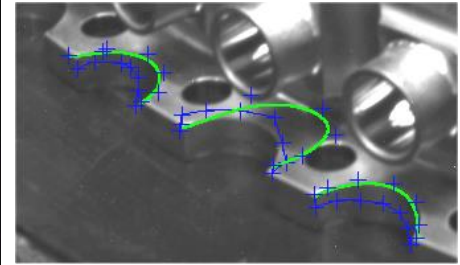
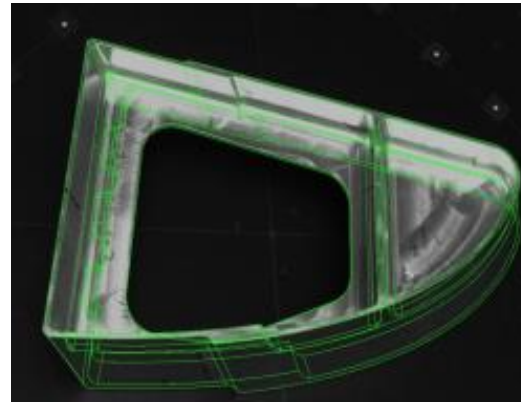
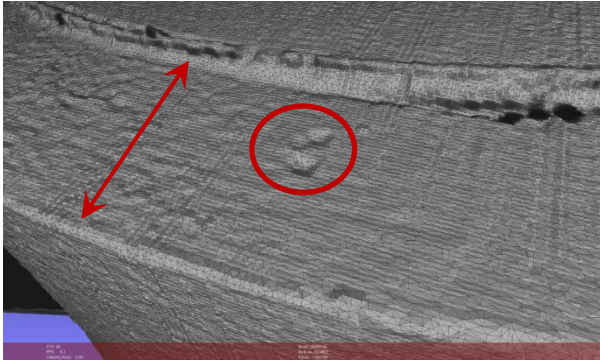


*Automatic
Physiological
Parameters
measures*



- Augmented Reality
- 3D Localisation & Mapping
- 3D Reconstruction
- **3D Control & Manufacturing**
- Material Segmentation
- Scene Illumination Analysis
- Diminished Reality

Defects Detection



Measured features :
→ holes, curved edges...



Automatic CAD Registration



Bin Picking





TRIDIMEO

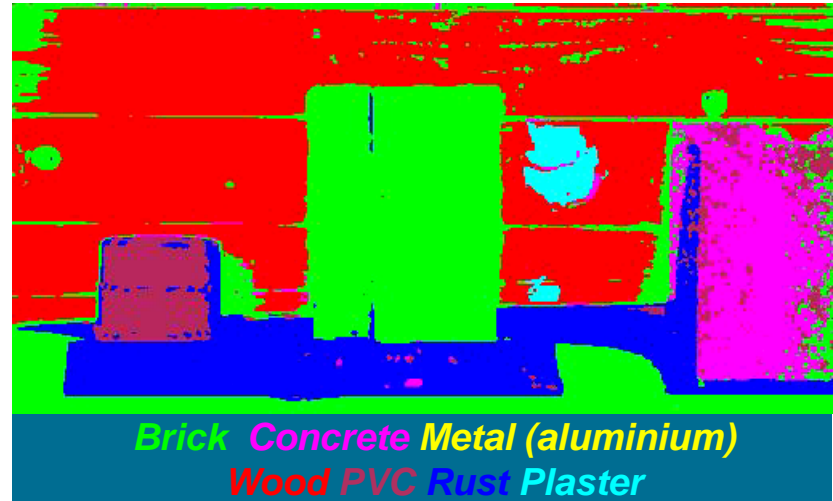
*3D Multispectral Real-Time Vision sensor
for
Robotics & Industries*

- **Fast & Accurate** 3D Vision solution:
 - Up to 4 3D-frames per second
 - Depth resolution up to 0.2 mm @ 40 cm
 - Robustness with reflecting objects
- **Multispectral data**
 - Useful for **material identification** applications,
 - **True Color Numerisation** (*independent from ambient light*)

- Augmented Reality
- 3D Localisation & Mapping
- 3D Reconstruction
- 3D Control & Manufacturing
- **Material Segmentation**
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- Diminished Reality

MATERIAL IDENTIFICATION

Multispectral cameras → better material **segmentation** in images



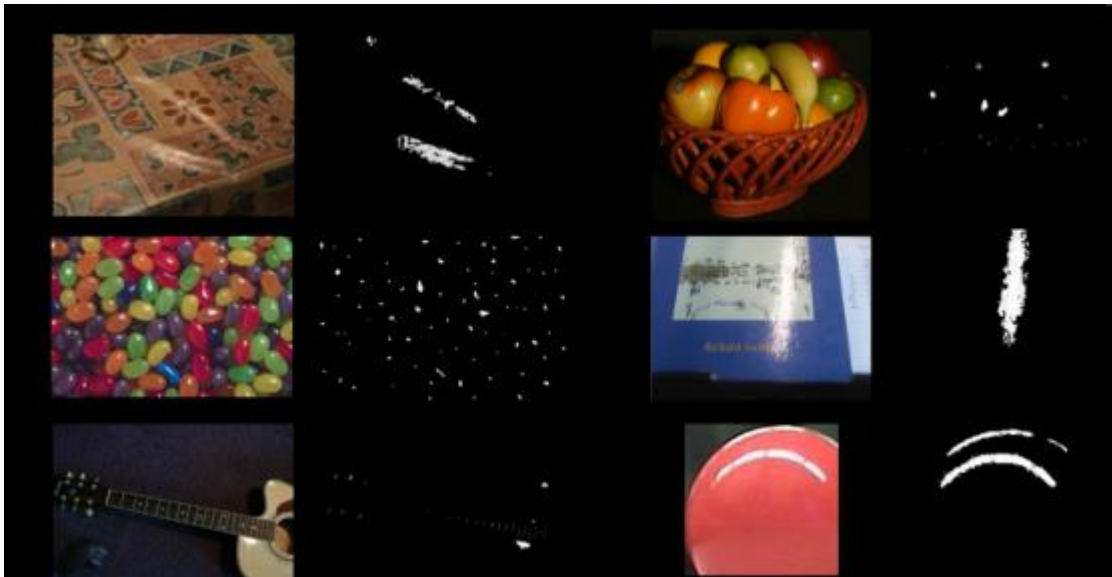
- Augmented Reality
- 3D Localisation & Mapping
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Shadows Detection

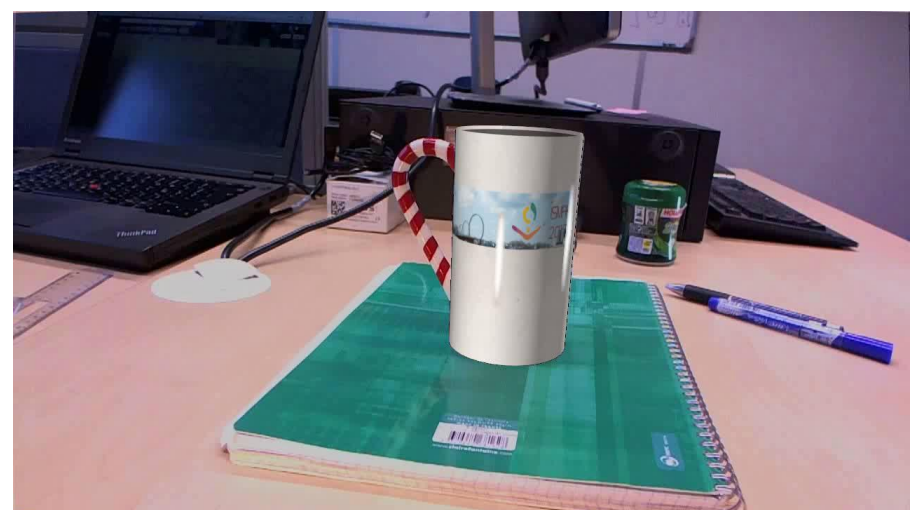
***Robustness**
to Light Changes*

***Realism**
of Scene Augmentations*



Specularities Segmentation

SCENE ILLUMINATION ANALYSIS



Input video

Retexturing

- Augmented Reality
- 3D Localisation & Mapping
- 3D Reconstruction
- 3D Control & Manufacturing
- Material Segmentation
- Scene Illumination Analysis
- **Diminished Reality**

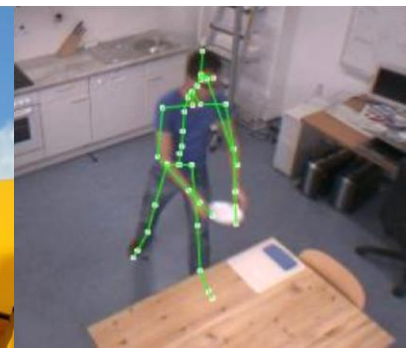
Toward a full concept...



Scene Understanding

Videoprotection & Video Assistance

- Infrastructure Security
- Driving assistance
- Smart Home / Smart building / Smart City

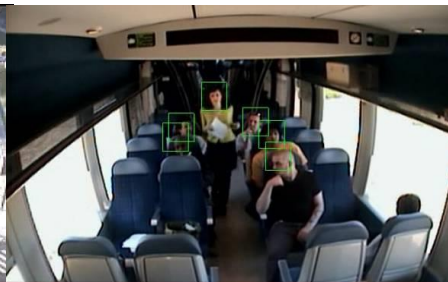


DETECTION, TRACKING, RECOGNITION

- Generic algorithms
- Various sensors (Visible, [IR](#), [IR/Visible](#), Fish-eye, PTZ...)
- Various Contexts (indoor, outdoor, broadcast)
- Fixed or Embedded



Urban



Transportation



Infrastructure



Automotive



Building

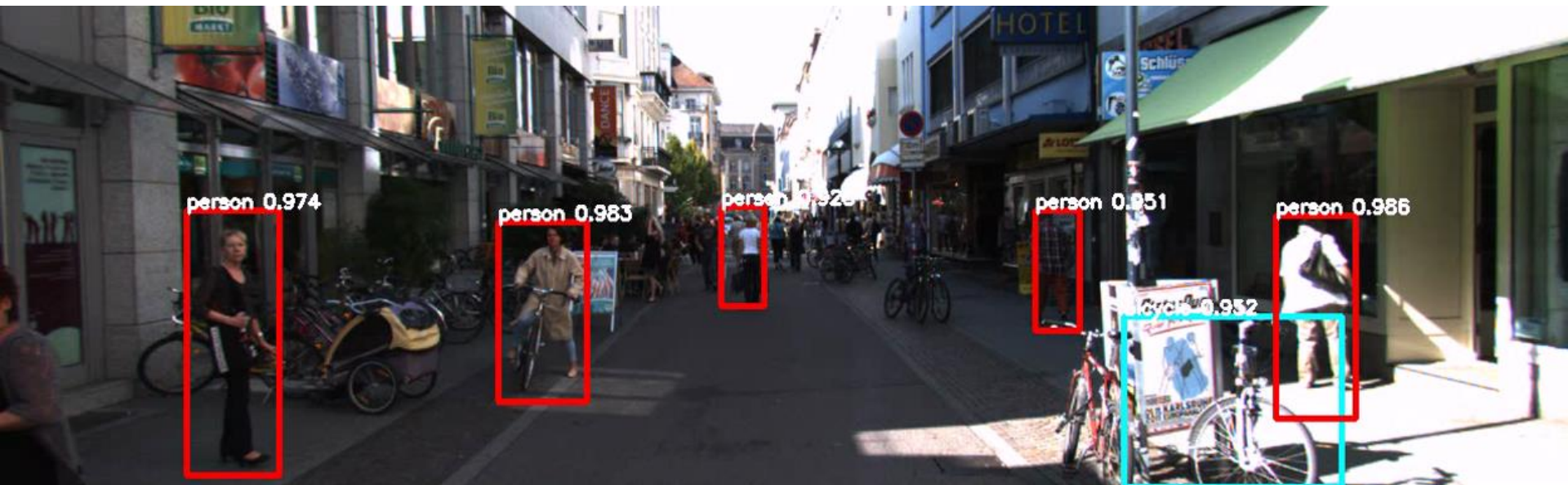


Manufacturing



Smart Home

DEEP LEARNING MULTI-CLASS AND PRECISION



Challenge KITTI : Automatic 3D Analysis of Vehicles

- (1) Vehicle detection
- (2) Type recognition
- (3) Fine pose estimation
- (4) 3D location
- (5) Visibility of parts

CEA APPROACH : DEEP MANTA

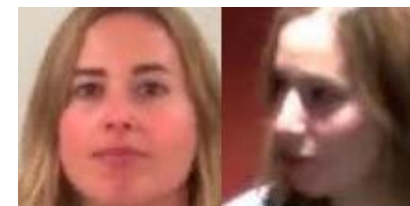
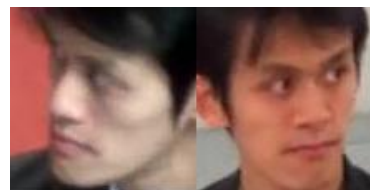
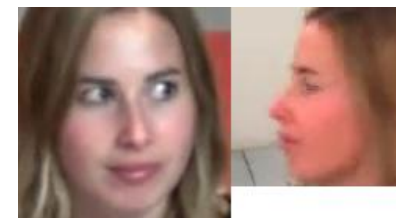
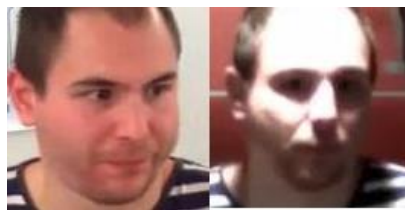
- 1st on detection and orientation estimation
- Close to Real time (3 Hz on VGA)
- Accuracy +30% vs Sota, similar to stereo approach



REAL TIME FACE DETECTION



FACE VERIFICATION: Examples of match pairs



Deep Learning for Face Recognition (2016)

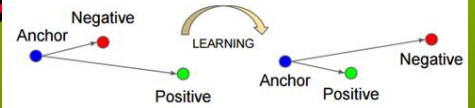
Face detection & alignment

Deep Multi-Task Multi-Scale Cascaded Neural Network



Feature extraction

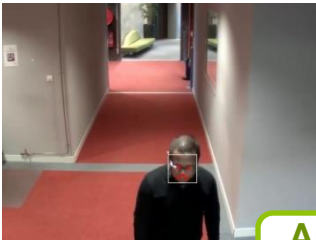
• Deep Metric Learning from Triplet Network



Video query



...

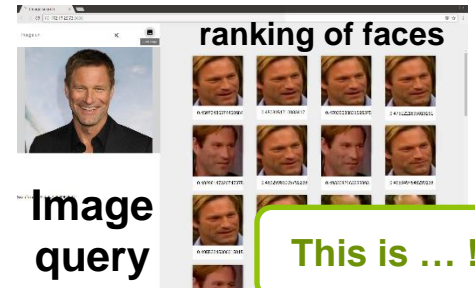


Authorized access!

Face Recognition

- **Verification:** is that face of a given people?
- **Retrieval:** similar faces ranked according to learned metric

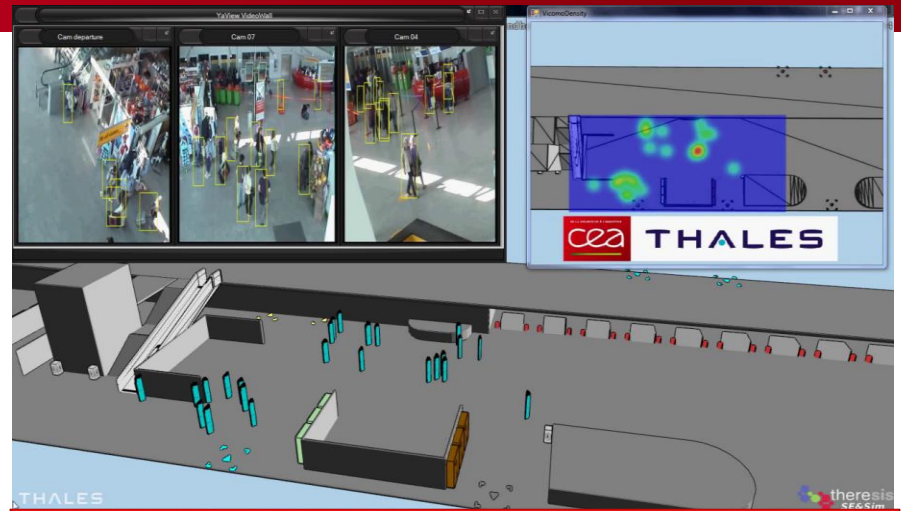
face features (1792-dim) projected in 3-D space



SECURITY: VIDEOPROTECTION



Real-time Analytics

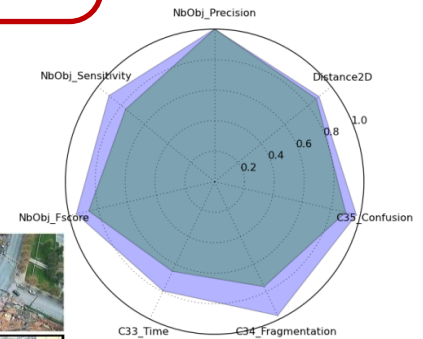
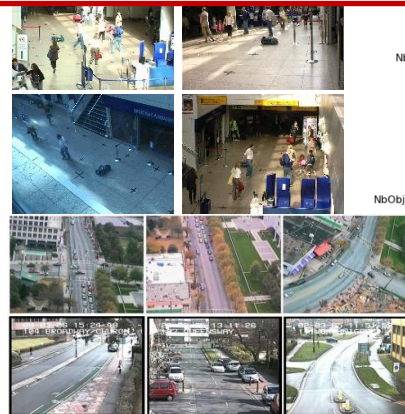


Camera Network & 3D Display



Behaviour Analysis

Operated in VisionLab



Perf Evaluation

SAFETY: PEDESTRIAN DETECTION



ARCURE
be secure

BLAXTAIR : Embedded Vision System
to enhance safety in critical industrial contexts

2004-2007

Thesis
Collaborative
Projects

2009

Arcure creation
Joint Lab
CEA/Arcure

2010

1st prototype
BLAXTAIR



2012

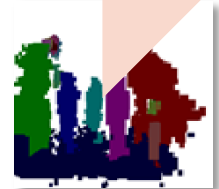
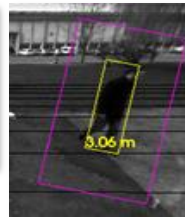
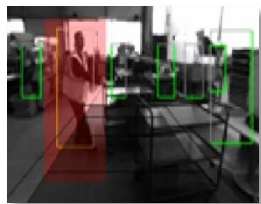
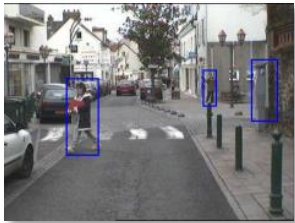
Vehicle
Rotation
Large Zone

2014

Close FOV
Variable
Posture

2015-2016

Non-planar ground
Obstacle
segmentation



TECHNOLOGY POSITIONNING

- Robust 2D/3D analysis :
TP= 99 %, FA= 1/jour
- Learning on specific image database :
24 000 positives > 1 million negatives
- Real time: 15 Hz (2 cœurs ARM)
- 5 patents



VISION SYSTEM FOR PEOPLE DETECTION



Robotics



Vehicle & Cobotics

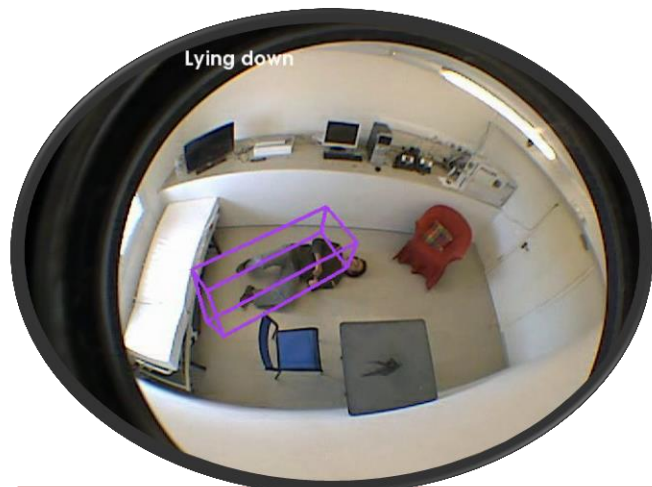


Obstacle Detection
Lidar/ IR bareer

People Classification
Blaxtair / IR Video



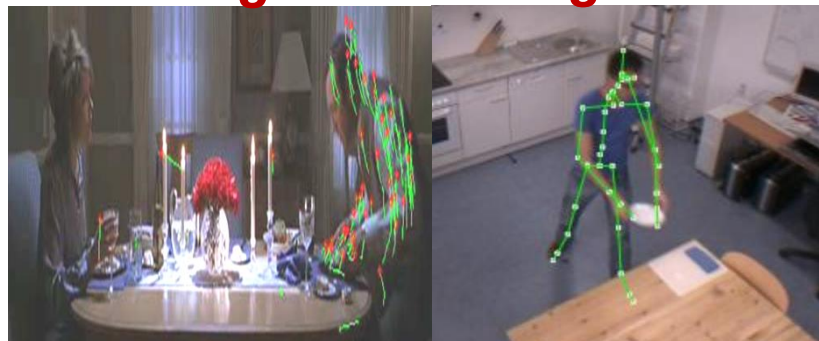
AMBIANT LIVING



Vulnerable people

Eating

Setting the table



Activity Recognition

Applications

- Safety
- Security
- Energy
- Comfort
- IHM



Platform MobileMii

Sensor fusion

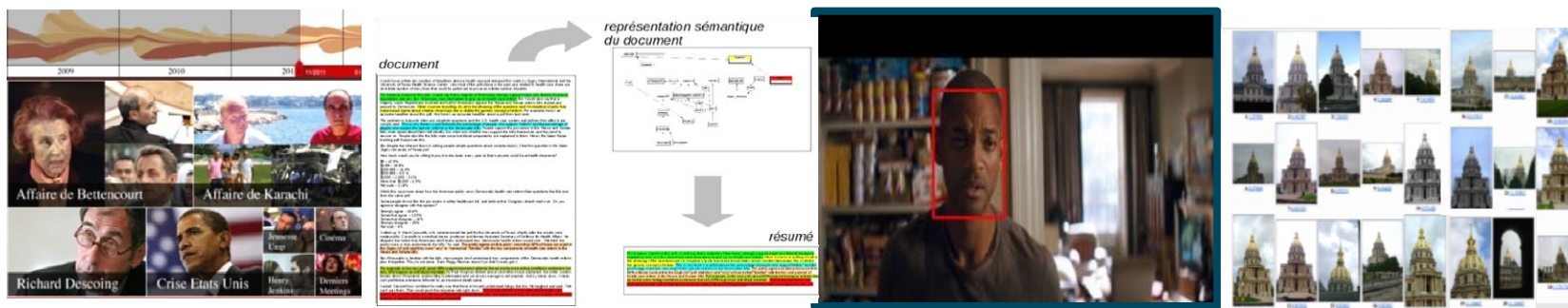
- Camera
- IR detector
- Home sensing

TV Control

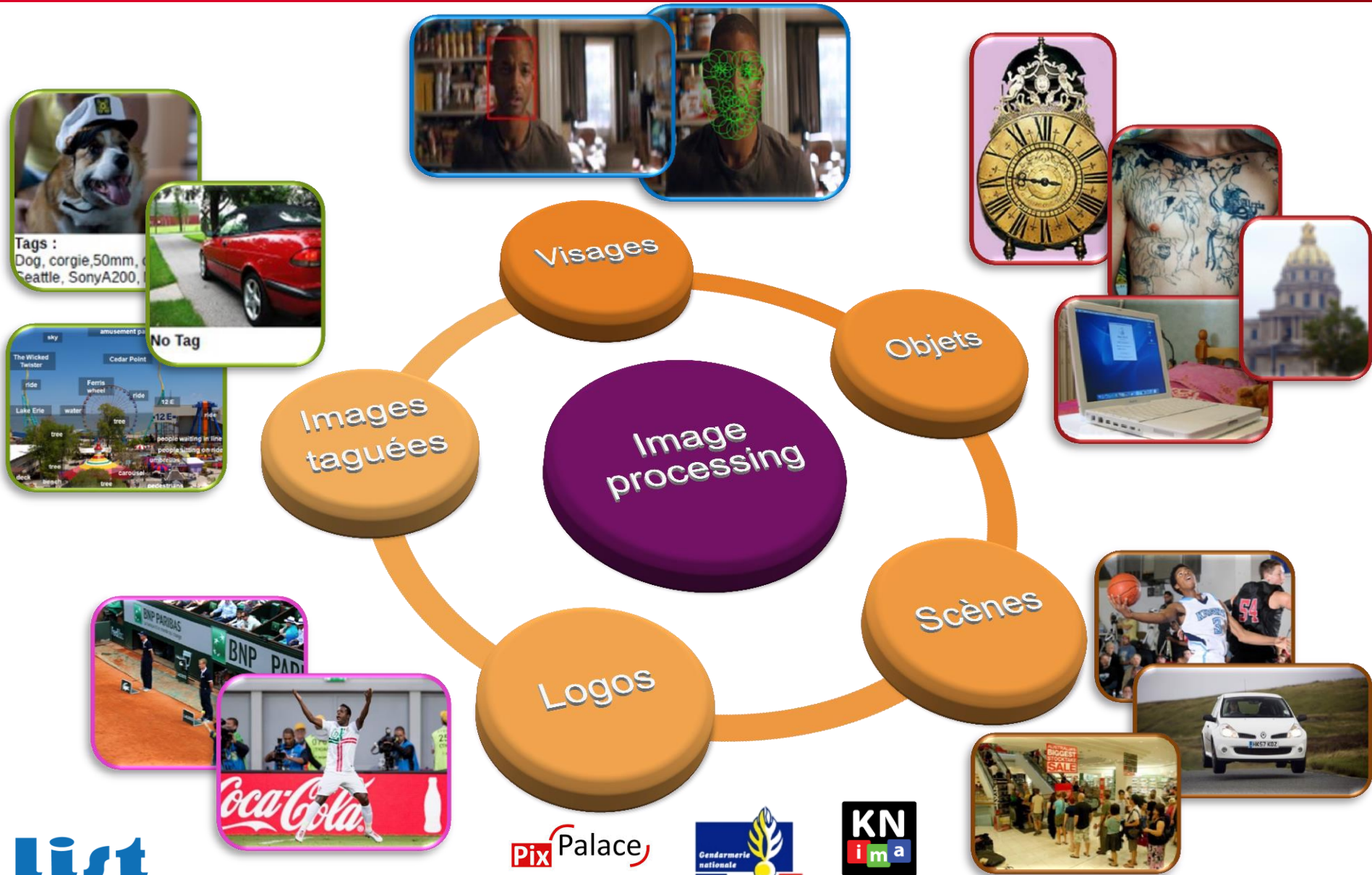
Multimedia

Semantic Analysis of Text, Image, Video

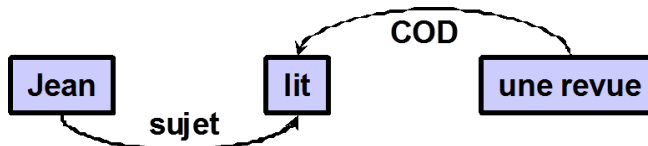
- Extraction
- Synthesis
- Retrieval



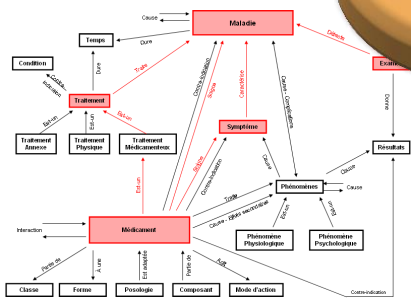
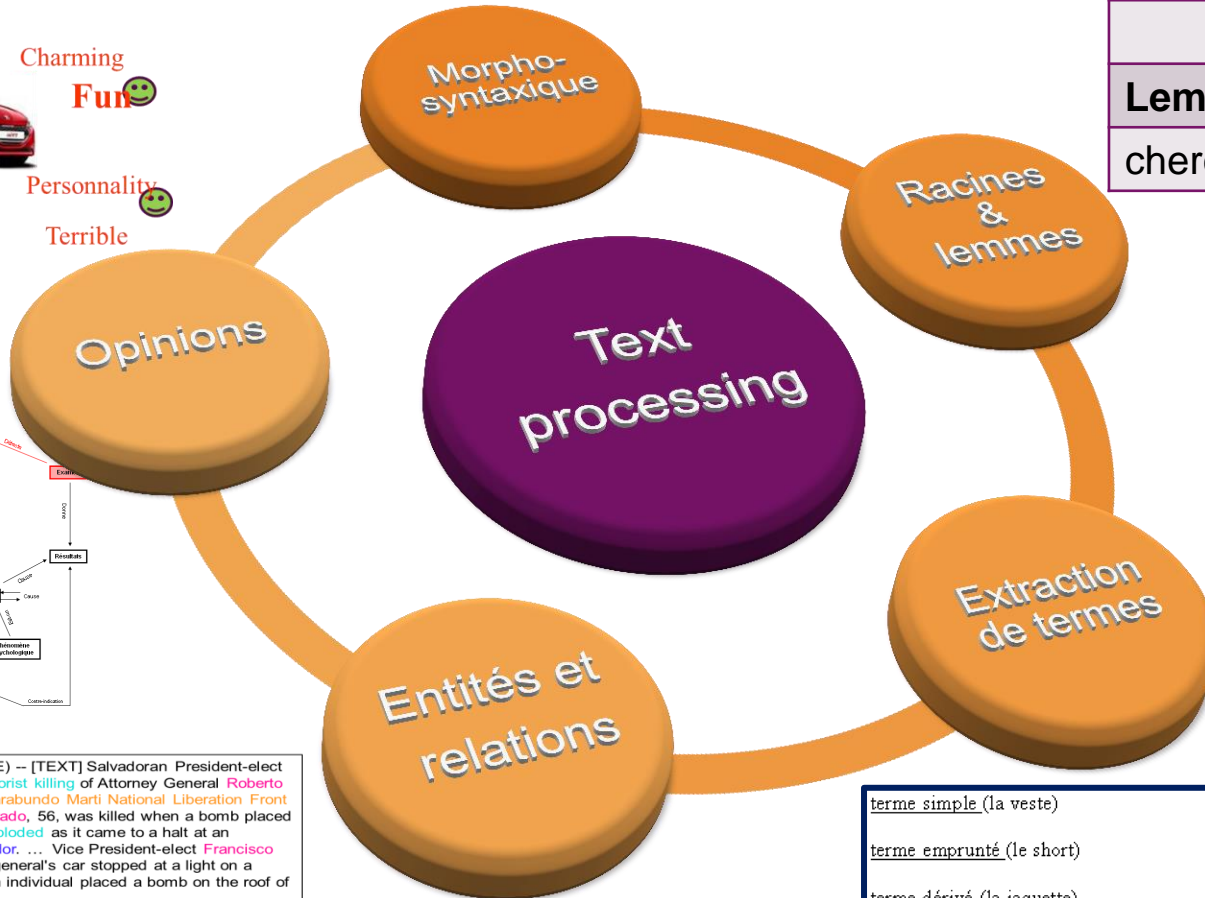
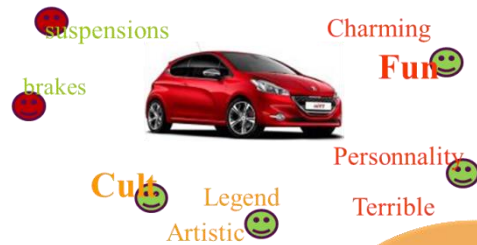
EXTRACTION D'INFORMATION : IMAGES



cea EXTRACTION D'INFORMATION : TEXTES



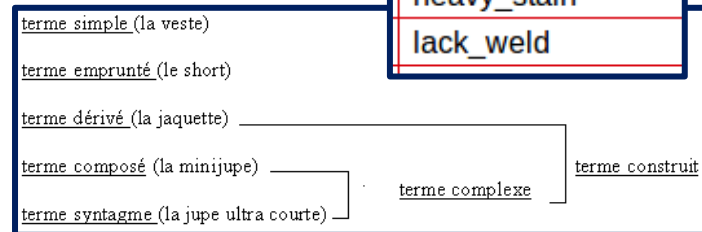
Cherchons	
Lemme	Racine
chercher	cherch



Document

San Salvador, 19 Apr 89 (ACAN-EFE) -- [TEXT] Salvadoran President-elect Alfredo Cristiani condemned the terrorist killing of Attorney General Roberto Garcia Alvarado and accused the Farabundo Marti National Liberation Front (FMLN) of the crime. ... Garcia Alvarado, 56, was killed when a bomb placed by urban guerrillas on his vehicle exploded as it came to a halt at an intersection in downtown San Salvador. ... Vice President-elect Francisco Merino said that when the attorney general's car stopped at a light on a street in downtown San Salvador, an individual placed a bomb on the roof of the armored vehicle. ...

Defect
weld_spatter
slag
heavy_stain
lack_weld





CEA List/LVIC

70 researchers
15 PhD students

3D Perception

- Augmented Reality
- 3D Localization

Scene Understanding

- Surveillance systems
- Assistance systems

Multimedia fusion

- Information retrieval
- Synthesis



We are recruiting !

*Our lab recruits non permanent researchers & engineers
almost throughout whole the year*

Main research domains:

- ➔ Computer Vision
- ➔ Deep Learning
- ➔ Sensor Fusion (mainly Vision/IMU)

(Common minimal skill: C++)

Main Contact: lvic-jobs@cea.fr

Other contacts:

- 3D Perception & Mobility: regis.vinciguerra@cea.fr
- Scene Understanding: quoc-cuong.pham@cea.fr
- Multimedia fusion: bertrand.delezoide@cea.fr