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Use Cases in five domains

(Digital Industry, Digital Farming, Transport and Smart Mobility, Healthcare and Digital Life) were selected involving 14 use cases in total.

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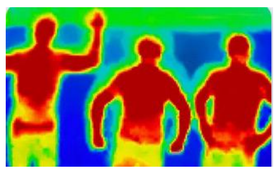
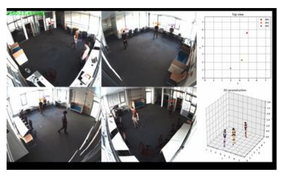
Objectives

Integrate (HW/SW), Develop application, validate and evaluate the applicability of the neuromorphic technologies for various application`domains, which are essential for the future of European competitiveness.
A short overview of the use cases addressed by Digital Industry, Digital Farming, Transport and Smart Mobility domains is given here.

Digital Industry

Partners:
IFAG, EESY, TUD, FHG, HEI





Use Case 1.1

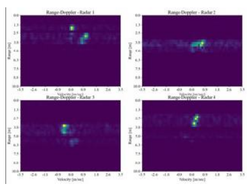
Indoor Positioning, Recognition and People Counting

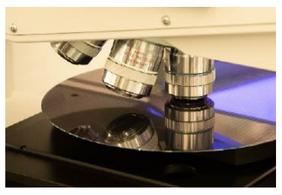
Description: Indoor positioning recognition and people counting for smart laboratory/factory applications (e.g., robot co-working)

Challenges:
- Real time computation
- Scaling to handle input of multiple sensors

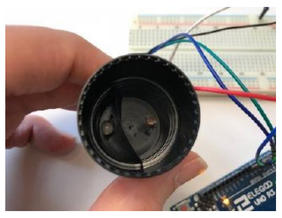
Positioning vs State of the Art: Existing solutions are too slow to fulfill the safety requirement of a smart factory/laboratory

Development Status:
- Datasets gathered with radar and thermal camera
- Basic demonstration setup was created
- Reference implementation with Google TPU completed
- Algorithm development started





Partners:
IFAG



Use Case 1.2

Color Classification at the Edge for Quality Control

Description: Integration of simple neuronal networks for color classification into color sensor nodes for real time control and monitoring devices at the edge

Challenges:
- Size of the AI solution
- Energy consumption and cost of the overall solution

Positioning vs State of the Art:
- Existing solutions are too big, consume too much energy and are too costly to be integrated into color sensors

Development Status:
- Datasets prepared and basic demonstration setup created
- Software system implemented
- Algorithm development started

Digital Farming

Partners:
Bordeaux-INP, CEA and STGNB

Use Case 2.1

Autonomous Weeding System

Description:
- Crops and weeds detection
- Intra-row weeding
- Mechanically: alternative to chemical weeding
- Autonomous: limiting human intervention

Challenges:
- Computation in real-time
- High precision needed to differentiate crops and weeds

Positioning vs State of the Art: To date, for most crops, only inter-row mechanized/autonomous weeding solutions exists

Development Status:
- Use case extended for plant development monitoring and phenotyping using an autonomous fixed multispectral camera adapted to field conditions
- Datasets gathered: Three temporal series of multispectral (RGB + infrared) acquired on vine plant development
- Software and algorithm development started

Partners:
CCTI, Italagro, TPRO-Tech., CEA, STGNB

Use Case 2.2

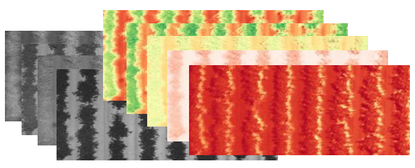
Tomato pests and diseases forecast

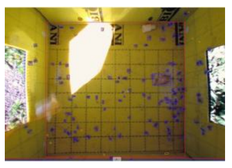
Description: Pest and disease detection model for the tomato agriculture industry.

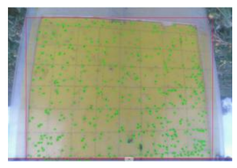
Challenges:
- Collecting enough and good quality data
- Time-series analysis for forecasting
- Model selection and development for edge devices

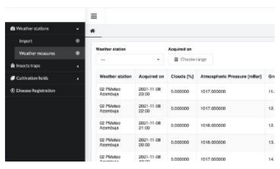
Positioning vs State of the Art:
- State-of-the-art solutions do not resort to image analysis with ANNs, which produce many false positive events.

Development Status:
- Datasets gathered and first version of analytics platform
- AI model to identify insects on trap images
- First version of algorithms for analyzing the growing of plants









Transport and Smart Mobility

Partners:
Thales, CEA, STGNB

Use Case 3.1

Drones/USV

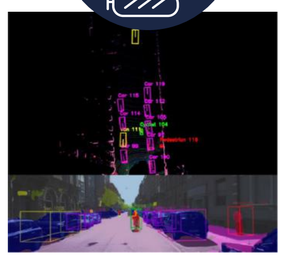
Description:
Detection, classification and segmentation of high-altitude images using either ANN, SNN or hybrid technology

Challenges:
- Real time computation
- High resolution inputs
- Power consumption

Positioning vs State of the Art:
Existing solutions are not compatible with drone constraints

Development Status:
- Development of hybrid accelerator board started
- SNN module with an FPGA developed
- Preparing integration of CEA accelerator
- Started implementation of the overall demonstrator

Transport and Smart Mobility



Partners:
Bordeaux-INP, CEA and STGNB

Use Case 3.3

3D Object Detection and Classification of Road Users based on LiDAR and camera

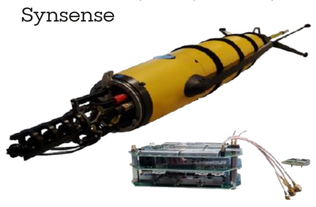
Description:
Object detection on lidar point clouds that will be fused with camera semantic image data implemented on ANDANTE Platform

Challenges:
- Real time computation with received sensor data (bandwidth bottlenecks)
- Scaling to handle input of multiple sensors

Positioning vs State of the Art: No fusion of both sensors/sensor data yet done on neuromorphic hardware

Development Status:
- First fusion concept implemented and data sets gathered
- Software architecture defined and implementation started
- Adaptation of system architecture due to changes of platform 4.1
- Preparing integration of ANDANTE hardware

Partners:
ALSEAMAR, CEA, STGNB, Synsense



Use Case 3.2

Underwater Acoustic Signal Classification

Description: The ocean soundscape is a continuously changing mosaic of sounds that originate from various sources. This is of primary interest to recognize in real time the components of the soundscape.

Challenges:
- Real time computation
- Low power

Positioning vs State of the Art:
- Long-term monitoring
- Real time communication with shore

Development Status:
- Data labelization, dataset growth
- Basic demonstration system created
- Study on marine mammals classification
- Preparing integration of CEA and SynSense Hardware
- First tests of transfer learning based on MobileNet v1

Partners:
BR&T-E, Gradiant, TVES, CARTO

Use Case 3.4

Robust Autonomous Landing

Description:
Four critical functionalities are considered: 1) image-based runway relative localization for navigation, 2) image registration for navigation, 3) foreign object detection on runway, 4) robust communications.

Challenges:
- Adaptation of large networks to efficient hardware without sacrificing performance levels
- Learning on the edge

Positioning vs State of the Art: Many smaller aircraft cannot permit energy cost of large number of conventional AI algorithms in standard hardware, which on the other hand, are necessary to enable autonomous operations.

Development Status:
- SWAP (size, weight and power) requirements and PKI defined
- Basic demonstrations setup realized in laboratory
- First version of algorithms trained and implemented
- Preparing integration of ANDANTE hardware into demonstrator system

ANDANTE

AI for New Devices And Technologies at the Edge

andante-ai.edu linkedin.com/company/andante-ai mario.diaznava@st.com (coordinator)

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