



The AMANDA project has received funding from the European Union's Horizon 2020 Research and Innovation programme under grant agreement No. 825464

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NEWSLETTER No.6

September 2022

AutonoMous self-powered
miniAturized iNtelligent
sensor for environmental
sensing and asset tracking
in smArt IoT environments



AMANDA
The world in your hands



Dear reader,

We are pleased to announce the publication of our project newsletter's sixth and final issue! The AMANDA journey is coming to an end. After three years and nine months, it is indeed time to close this chapter, and we are happy to share with you the final results which we have been working on since the start of the project in January 2019.

Looking back on the past 45 months, it was undoubtedly an intensive period of collaborative research and work between all members of the Consortium. To balance the impacts of the COVID-19 pandemic, project was extended for additional nine months. But it was worth it. Despite health and all other difficulties on this journey, we proudly announce that we achieved most of what was planned initially. Our objectives were quite ambitious from the very start of the project. Although this is our last newsletter, it is certainly not the end of AMANDA Consortium's joint collaboration. All partners will remain actively engaged with the dissemination activities by attending various events (conferences, fair trade exhibitions, meetings, etc.) and further scientific publications. If you are interested in using the AMANDA - Autonomous Smart Sensing Card or want to learn more, do not hesitate to contact us at amanda@amanda-project.eu. We kindly invite you to follow us, learn more on our social media profiles ([LinkedIn](#), [Twitter](#), [YouTube](#)), and visit the [AMANDA website](#).

AMANDA partners

The Team Behind AMANDA

The AMANDA project team consists of eight partners coming from six European countries: CERTH (Greece), ZHAW, MICRODUL (Switzerland), IMEC (The Netherlands), E-PEAS (Belgium), LIGHTRICITY, ILIKA (UK), and PENTA (Croatia). CERTH is the project coordinator.



CERTH
CENTRE FOR
RESEARCH & TECHNOLOGY
HELLAS

MICRODUL
Customized Swiss Microelectronics



e-peas
SEMICONDUCTORS



lightricity

imec

ilika

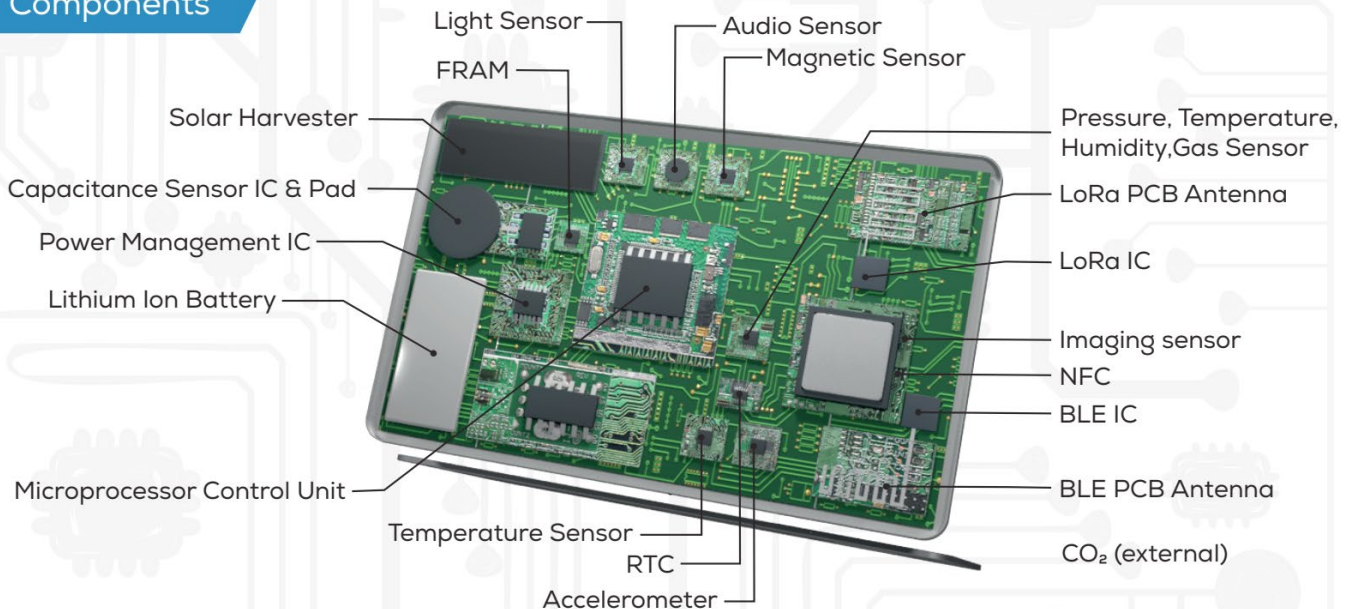
penta
ID SYSTEMS

AMANDA'S MAIN OBJECTIVES AND ACCOMPLISHMENTS

AMANDA has developed a **unique ASSC with the size, feel and look of a credit card, ideal for easy deployment in buildings (smart living environments) or as wearables (bikes, valuable assets, people).**

AMANDA project covers the triangle of experimentation, development and standardisation to optimise the materials behaviour, connectivity, miniaturisation, power consumption, security, intelligence, design and cost. The AMANDA Consortium has overcome the existing technological challenges and has achieved the development of a user-friendly wearable platform not only for indoor & outdoor environmental sensing but also for asset- or even people- tracking. A combination of newly developed, optimised, existing innovative off-the-shelf or close-to-commercialisation sensor technologies have been selected and integrated into the ASSC, including air quality, temperature, humidity and image sensing, as well as long-range tracing (positioning), innovative PVs, all packed in under 3mm thickness will introduce technical breakthroughs that will boost further miniaturisation, offer increased sensitivity, small footprint and ultra-low power consumption.

Components



Multiple sensors interact with each other, their output is fused with the use of the **Data Fusion software component** in order to provide additional functionality and to minimise the energy requirements for data processing.

AMANDA explored various IoT-compatible **low-power wireless technologies** and protocols for both short- and long-range communication. These technologies include LoRa, for long-range communication, BLE for short-range communication and NFC for both ultra-short-range communication and for fast charging of the energy storage device. Furthermore, **security by design mechanisms**, both in terms of hardware and software, have been employed to provide for low-vulnerability of the ASSC, encryption, intrusion detection/intrusion prevention, and overall enhanced cyber-secure operation.

Low-power algorithms have been developed to offer **edge intelligence** at the hardware level in support of decisional autonomy under the anticipated environmental monitoring and tracking services. Furthermore, using predictive algorithms, the ASSC can adapt to any changing environment and adjust its measurement and reporting rate accordingly.

AMANDA'S MAIN OBJECTIVES AND ACCOMPLISHMENTS

AMANDA's Main Objectives

Objective 1	To design and develop a maintenance-free, miniaturised and adaptable Autonomous Smart Sensing Card (ASSC) for multipurpose environmental sensing and asset tracking in smart living and working applications; indoor, outdoor and wearable versions of the ASSC are anticipated
Objective 2	To apply high aspect ratio architectures and miniaturisation-oriented design in terms of the overall size reduction to achieve up to 3mm thickness depending on sensors employed
Objective 3	To ensure maintenance-free (energy autonomy) functionalities exploring energy harvesting and storage concepts for powering microsensors nodes
Objective 4	To apply multi-layer optimisation strategies for ultra-low power processing/management
Objective 5	To develop and integrate advanced miniaturised multi-sensing technology that will contribute significantly to the realisation of next generation autonomous analytical instruments for distributed environmental sensing, asset and people tracking and monitoring
Objective 6	To enrich wireless connectivity capabilities in support of cyber-secure mesh communication as well as ultra-low power localisation and tracking
Objective 7	To incorporate build-in ASSC processing capabilities for sensor/data fusion and low power edge intelligence in support of IoT-related services
Objective 8	To validate the proposed ASSC in laboratory conditions under variable application scenarios

AMANDA Use Cases and Scenarios

In 2020, further research underwent on the original six use cases and was subsequently consolidated into three primary use cases, UC1, UC2 and UC3. The use case scenarios have been further consolidated on M42 into three final scenarios, FS01, FS02, FS03, based on end user requirements, system requirements, the technical excellence of each scenario, as well as the scientific innovation and exploitation potential of each scenario. All three use cases display the potential of a multi-sensor autonomous card.

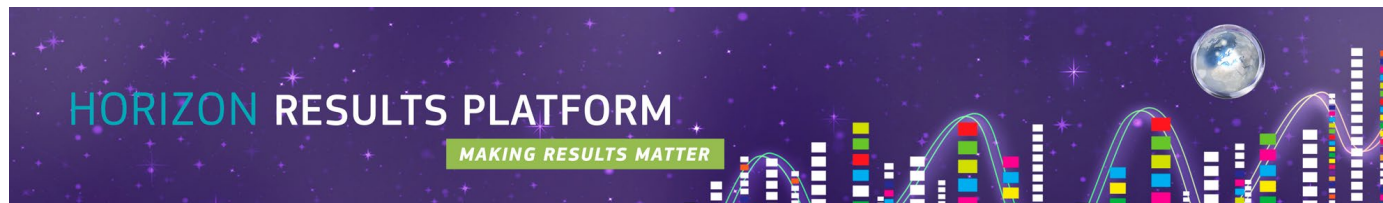
Use Case	Scenario
UC1 Environment monitoring and reporting	FS01 Work environment and thermal comfort monitoring
UC2 Asset tracking and occupancy monitoring	FS02 Parking lot occupancy monitoring
UC3 Mitigating the effects of the pandemic	FS03 Crowd counting for social distancing



AMANDA'S MAIN OBJECTIVES AND ACCOMPLISHMENTS

Key Exploitable Results on the Horizon Results Platform

During the project, the AMANDA team listed six Key Exploitable Results (KERs as termed by the EU) and published them on the Horizon Results Platform. For more details about each result, please follow the [link](#) to the Horizon Results Platform:



1. AMANDA – Autonomous Smart Sensing Card (ASSC)

A maintenance-free, miniaturised and easily deployable Autonomous Smart Sensing Card - ASSC for environmental sensing and for asset and people tracking/monitoring in smart living and working environments.



We need

- Business partners - SMEs, Entrepreneurs, Large Corporations
- Expanding to more markets /finding new customers
- Collaboration



8 contributors



Sectors

- Research and innovation



Result Maturity

3 - R&D Technology Development (TRL 3-5)

SUSTAINABLE
DEVELOPMENT
GOALS



2. Ultra-Low Power Capacitive Sensor for AMANDA ASSC

The integrated circuit MS8892 is an ultra-low-power capacitive sensor specially designed for human body detection and as a wake-up source for ultra-low-power systems.

3. Ultra-Low Power Temperature Sensor for AMANDA ASSC

The MS1089 temperature sensor uses no active current between measurements, which means that only standby current flows. The standby current for the MS1089 is less than 5nA, making it ideal for autonomous applications.

4. Data Fusion Engine for AMANDA ASSC

The AMANDA data fusion engine is a multi-purpose and lightweight data fusion & optimisation engine, designed and developed to support the low-power and intelligent capabilities of the AMANDA ASSC.

5. Edge Intelligence for AMANDA ASSC

A State-of-the-Art Edge Intelligence engine, developed for low-power embedded systems

6. Cybersecurity for AMANDA ASSC

The AMANDA cybersecurity component is based on several security pillars. Each pillar offers a different security level, contributing in the formation of a more robust and secure embedded system.

AMANDA'S MAIN OBJECTIVES AND ACCOMPLISHMENTS

Unique Value Proposition Why choose AMANDA?

AUTONOMY	ASSC is self-powered even in a low-light indoor environment
WEARABILITY	ASSC is lightweight with a small footprint and thickness
SELF-LEARNING	The card adapts intelligently to its deployed environment
POWER CONSUMPTION	Each component is powered down when not in use
MULTISENSING	ASSC incorporates all of the measurements coming from various sensors to get a better estimation of the dynamical system
MAINTENANCE - FREE	10 years of maintenance-free lifetime

AMANDA Autonomous Smart Sensing Card

ONE CARD - A WORLD OF FEATURES AND SOLUTIONS!



Discover the new
AMANDA leaflet!

The AMANDA Consortium is glad to announce that a new version of the project leaflet has been published. This version includes all progress made so far during the project execution, focusing on the device components, final use case list and unique value proposition of the Autonomous Smart Sensing Card. The AMANDA leaflet is available for download [here](#).

“A sensing solution for smart cities.” It is an article on the AMANDA project published in the 5 May issue of New Electronics, the electronic industry’s leading magazine and a central hub for design engineers and design management.

The AMANDA project develops an Autonomous Smart Sensing Card (ASSC) with the exact dimensions of a credit card and a height of only 3mm. The ASSC’s compact size, self-sustainability and wide variety of sensors allow it to be used in many different environments and applications, and its integrated intelligence provides the flexibility to adapt it to new requirements.

Check out the whole article in [New Electronics](#) and learn how the AMANDA Autonomous Smart Sensing Card (ASSC) could impact the world we live in.

newelectronics

Electronics Internet of Things Sensors Wireless Technology

A sensing solution for smart cities

Features | 5 min read

The AMANDA project looks to advance sensing capabilities to more smart applications, as Dr. Charis Kouzinopoulos explains.



Technology is vital to solve many of the challenges that society faces today. Whether it is fighting climate change or feeding a growing global population, technology offers some of the best chances of finding a solution.

THIRD AMANDA WEBINAR Continuous Occupancy Monitoring in a Parking Lot

The third episode of our AMANDA webinar series was held on Tuesday, 19 April 2022, focusing on applying the Autonomous Smart Sensing Card to detect vehicles and continuous occupancy monitoring in the parking area.

This free webinar provided an overview of AMANDA activities, main hardware and software components, as well as showcased the use cases and scenarios that make optimal use of all the functionalities of the AMANDA card in its three versions – indoor, outdoor and wearable. The central part of the webinar was dedicated to custom AI methods for low-power systems and the application of the AMANDA card for continuous occupancy monitoring in a parking lot.

If you missed the 3rd AMANDA webinar, we are pleased to provide you with a recording that is available [here](#).



Join our third webinar!

AMANDA AUTONOMOUS SMART SENSING CARD (ASSC)

19 April 2022 | 15:00 (CET time)



Duration: 30 min

ASSC for smart cities, smart homes and intelligent working environments

Custom AI methods for low power systems

Continuous occupancy monitoring in a parking lot

SPEAKERS



Dr. Charis Kouzinopoulos
Postdoctoral Researcher
CERTH (ITI)



Dr. Denis Pasero
Product Commercialisation
Manager, ILIKA



Alexios Papaioannou
Research Associate
CERTH (ITI)



Oskar Vujicic
Project Manager
PENTA

REGISTER NOW!

https://zoom.us/webinar/register/WN_O32W9Es3S2a2o8xlknu2dQ



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THE THIRD AND FINAL EXTERNAL ADVISORY BOARD MEETING

The AMANDA Consortium is supported by an External Advisory Board (EAB) that consists of four experts. Once a year, the EAB comes together to discuss past and newly planned project activities and support the project by giving valuable advice and new ideas.

The third and the final External Advisory Board meeting was held online on 21 September 2022, and the following members participated: Angelos Papadopoulos (Kleemann Hellas), Professor Des Gibson (The University of the West of Scotland), Associate Professor Ioannis Papaefstathiou (Aristotle University of Thessaloniki).



The experts expressed satisfaction with the innovations resulting from the project, as well as the cooperation between SMEs and the research institutes. They believe that the collaboration will be successful even after the end of the project, especially if the Consortium continues with solid and clear dissemination and exploitation activities as planned. They confirmed that the technology is awe-inspiring. It is a product in multiple markets.

INSIGHTS FROM THE EIGHTH AND FINAL PLENARY MEETING

On the 5th and 6th of July 2022, the AMANDA Consortium held its 8th plenary meeting, which was also the last plenary meeting. This time, after more than two years of remote collaboration due to COVID-19 restrictions, the plenary meeting was organised as a hybrid event, and it took place in Pula (Croatia), hosted by PENTA d.o.o., but also online.

During the meeting, all partners presented the work performed during the past months, reflected on their progress across all WPs and scheduled the next steps toward the project's final phase. A lively discussion on validation and evaluation of the Autonomous Smart Sensing Card (ASSC) was held, and the exploitation plan update for commercial exploitation beyond the project lifetime was also agreed upon.

On the first day, Penta organised a walking tour around the city, and on the second day, attendees had the opportunity to enjoy Istria's beautiful nature and explore the National park Brijuni, the unspoiled beauty of the amazing Adriatic islands.



MECO & CPSIoT 2022

MECO & CPSIoT 2022 is an International Scientific Forum aimed to present and discuss the leading achievements in the modelling, analysis, design, validation and application of embedded computing systems, as well as in the broader sense of complete computer systems with applications and related fields. MECO is one of the most referenced conferences in Embedded Computing, Cyber-physical Systems and the Internet of Things.

Chrisa Oikonomou from CERTH attended (online), presenting the paper “[An Encryption Scheme using Dynamic Keys and Stream Ciphers for Embedded Devices](#)”. That paper is related to all of the scenarios of the Amanda Project.



Embedded world 2022: Using New Memory Technologies to Reduce the Energy Requirements of LPWAN Nodes



Every year, experienced developers come together in Nuremberg to share their knowledge and help others turn ideas and innovations into real products. The international embedded community met for the 20th time in the exhibition halls in Nuremberg and again impressively demonstrated that it is rightly the leading exhibition of the international embedded community.

On 23 June 2022, ZHAW (Marcel Meli, Stefan Kunz) had a [presentation](#) at Embedded World Conference related to energy harvesting and new memory types and energy harvesting.

Sensors Converge 2022

Another successful event is behind us. Did you have a chance to visit the Sensors Converge exhibition held from 27-29 June 2022 in San Jose McEnery Convention Center (CA)?

ILIKA, the AMANDA project partner, participated in the event that reunited the sensors and electronics industry. At their booth you could learn about ILIKA's solid-state batteries, their innovation and production process. Also, you could get acquainted with the AMANDA project, and the current status and activities. Sensors Expo & Conference started 36 years ago with a focus on sensor technology. Over the years, it has expanded and diversified to include the electronics technologies and embedded systems that work hand-in-hand with sensors, as well as new and emerging application areas such as IoT, Connectivity, Autonomous, and more.



Intertraffic Amsterdam 2022

Participation at Intertraffic Amsterdam is a commercial priority for anybody who is active in the global mobility sector. At this year's exhibition that took place from 29 March to 1 April 2022 in the RAI Amsterdam exhibition and convention centre, PENTA, the AMANDA project partner, was present in hall 12, which was intended for intelligent parking solutions and micro-mobility.



The exhibition was an excellent success. It gave us the great opportunity to present the use of the AMANDA card and the possibility of application in parking solutions and synergy with the EU project Smart Eco Parking. At Penta's booth, visitors could check the latest equipment and solutions like Smart Eco Parking, PARKELA barriers, Go2Bike – bike sharing system, and Go2Charge – EV charging solution.

Intertraffic Amsterdam is more than an exhibition. Place where you can discover new trends, best practices, the latest developments and solutions to challenges in the traffic industry during four action-packed days.

Swiss Medtech Day 2022

Swiss Medtech Day is the leading conference of the Swiss medical technology industry – attracting over 600 industry representatives yearly.

This live event was held in Bern, Switzerland, on 14 June 2022 and was dedicated to the topic of "Digital Health Technology". The event included a series of 5 deep-dive sessions but also offered unique networking opportunities with talks, an innovation zone and 1:1 matchmaking sessions.



MICRODUL, a partner of the AMANDA project, participated in the conference as a partner of Swiss Medtech, and prepared a short presentation of the AMANDA. In the AMANDA project, Microdul developed novel, low-power miniaturised sensors – the MS1089 temperature sensor and the MS8892 capacitive sensor. The MS1089 temperature sensor uses no active current between measurements, which means that only standby current flows. The standby current for the MS1089 is less than 5nA, making it ideal for autonomous applications. The integrated circuit MS8892 is an ultra-low-power capacitive sensor specially designed for human body detection and as a wake-up source for ultra-low-power systems. It can be used in various applications.

PARTICIPATION IN EXTERNAL EVENTS

InnoTrans 2022

PENTA, the AMANDA project partner, participated as an exhibitor at the thirteenth edition of InnoTrans that took place on the Berlin Exhibition Grounds from 20 to 23 September 2022.

InnoTrans is the world's leading trade fair for transport technology and takes place every two years in Berlin. A total of 57.3 per cent of visitors came from abroad. The high rate confirms InnoTrans' status as the world's leading trade fair. Trade visitors were primarily interested in rail transport technology, infrastructure and the 3.5-kilometre track and outdoor exhibition area. This was followed by the new Mobility+ exhibition area, a platform for services and products relating to Mobility complementary to public transport. PENTA participated as an exhibitor and showcased BusCARD, CityPASS, Go2Bike and Go2Charge solutions that create smarter Mobility, but also several EU projects, including the AMANDA.



AMANDA Project at a Glance

Title and Acronym	AutonoMous self powered mini A turised i N telligent sensor for environmental sensing and D asset tracking in sm A rt IoT environments
Call	H2020-ICT-2018-20
Type of Action	RIA
Grant Agreement No.	825464
Duration	45 months (Start Date: 2 January 2019)
Requested EU Contribution	3,999,625.00 EUR
Project Coordinator	Centre for Research & Technology Hellas (CERTH)

The AMANDA Consortium



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