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Autonomous self powered miniaturized intelligent sensor for environmental sensing and asset tracking in smart IoT environments

AMANDA

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Deliverable

D6.1 AMANDA Testing and Qualification Roadmap

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List of definitions & abbreviations

Abbreviation	Definition
ACK	Acknowledge
AOI	Automated Optical Inspection
ASSC	Autonomous Smart Sensing Card
BLE	Bluetooth Low Energy
BoL	Beginning of life
BOM	Bill Of Material
BSDL	Boundary Scan Description Language
CO2	Carbon dioxide
CPU	Central processing unit
DoD	Depth of Discharge
DUT	Device Under Test
EoL	End of Life
ESD	Electrostatic Discharge
FRAM	Ferroelectric Random-Access Memory
IC	Integrated Circuit
ICT	In-circuit test
KPI	Key Performance Indicator
LDO	Low Dropout Regulator
MCU	Microcontroller Unit
MPPT	Maximum Power Point Tracking
MVI	manual visual inspection
OCR	Optical Character Recognition
ODR	Output Data Rate
OTP	One Time Programmable memory
PCB	Printed Circuit Board
PMIC	Power Management Integrated Circuit
PPM	Part Per Million
PV	Photo Voltaic
RAM	Random Access Memory
RSSI	Received Signal Strength Indicator

RTC	Real Time Clock
RTH	Relative Humidity
SC	Scenario
SNR	Signal to Noise Ratio
SPI	Serial Peripheral Interface
TAP	Test Access Port
TCK	Test Clock
TMS	Test Mode Select
UART	Universal Asynchronous Receiver/Transmitter
VOC	Volatile Organic Compounds

Executive Summary

This Deliverable describes the testing and qualification roadmap for the AMANDA system. It is the first report of **WP6 - ASSC Validation in Laboratory Environment and Evaluation** where evaluation of the system is performed. The content of the report is as follows:

- After a short introduction to the project and the technical validation topic in Section 1, follows the customer view on the system reliability versus the price

The output of this Deliverable will be used as an input in **Tasks T6.2 - Lab Environment Validation** and **T6.3 - Overall Evaluation, Lessons Learnt and Improvements** for validating the execution of the tests.

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1 Introduction

1.1 Overall technical objectives

The AMANDA project aims to develop a unique ASSC with the size, feel and look of a credit card. It can be ideal for easy deployments in buildings and smart living environments or as a wearable, on valuable assets or on people. The project covers both experimentation and development. The platform is meant to be used in different use cases and operational scenarios. A combination of technologies, both developed by the project's Partners and utilising existing off-the-shelf components is selected and integrated into the ASSC. Innovative sensors from IMEC and Microdul, PVs from Lightricity, a PMIC from EPEAS and batteries from Ilika, as well as necessary off-the-shelf components all packed in under a 3mm thickness. One of the project objectives is to overcome technical challenges related to low-power requirements and extensive miniaturization. The project outcomes will offer a smart card technology with integrated sensors, small footprint and ultra-low-power consumption.

1.2 Purpose, context, and scope of the Deliverable

This Deliverable is part of **WP6 - ASSC Validation in Laboratory Environment and Evaluation** which focuses on evaluation and quality checks of the developed system. This is the first Deliverable of WP6, and focuses on tests' planning and validation metrics. The performance evaluation will be reported in **Deliverables D6.2 - Characterisation/test reports of individual components in lab environment, D6.3 - Characterization/test reports of integrated AMANDA platform in lab environment** and **D6.4 - Report on Evaluation Results, Lessons Learned and Improvements**. The purpose of the Deliverable is to build the test and qualification roadmap of the AMANDA card in order to evaluate the system performance and ensure its compliance with the initial specifications and expected KPIs.

1.3 Customer view on the system reliability vs price

The market today offers a wide range of autonomous devices while multi-sensor devices also exist. However, devices that are both autonomous and multisensory are rare. Such devices find their application in all aspects of human activity, for example in the field of air quality control or the application in the field of smart cities. The ASSC also has potential in mitigating the effects of current and future pandemics. A possible implementation is in the area of contact tracing, in order to monitor the position and transportation conditions of medical equipment. The ASSC can be used as a standalone end-user autonomous multi-sensor device or integrated into more complex user applications. An example as a product intended for the end-user is its use as a personal autonomous multi-sensor device connected to a smartphone. At any time, it can deliver useful information about the area conditions to its owner. An example of the use of the ASSC as a product integrated into a user solution is the occupancy detection of a parking spot. Vehicle arrival and departure detection is just one part of a much more complex traffic management system in the area of smart cities solution. The criteria that the card needs to meet are long lasting performance and accuracy of measurements.
Regarding the accuracy of the measurement, it is important to state that the developed system is not or should not be a measuring instrument with laboratory measurement accuracy. Devices on the market meet the accuracy of +/- 2% in temperature measurement, 1.5% deviation in the field of air pressure measurement or +/- 5% in the area of humidity measurement [1], [2]. Satisfactory accuracy for OCR cameras is greater than 95% [3] while vehicle presence sensors in the parking lot satisfy a measurement accuracy is 96% [4].
The ASSC should meet existing market standards in the areas of timeliness of notification and accuracy of the measurement. The ASSC has a comparative advantage over existing products on the market in its declared to operate autonomously for 10 years. Furthermore, a significant advantage of a multi-sensor card is the ability to measure several parameters simultaneously. Multi-sensing, data fusion and edge intelligence also give the card a considerable advantage

over single-sensor systems on the market. Innovative solutions implemented in the ASSC will provide a significant market advantage over other similar devices.
The price of the system should not be the deciding factor for the willingness of end-user to buy the ASSC. The AMANDA's system provides functionalities that are innovative in the market. For an example, the current price of a vehicle presence sensor in a parking space, technically satisfactory product, a market-competitive product, averages €100 [5]. In addition to its advantages of functionality and innovation, the ASSC will undoubtedly be priced competitive in the market.
The ASSC provides new functionalities, provides extended autonomy and can be easily integrated into existing solutions. With its properties and predicted market price, it is an attractive and outstanding product that can find a wide application.

2 Summary

The development of a system like AMANDA is a complex task. The project activities defined the usage of the device, reported in **Deliverable D1.4 - AMANDA Operational Scenarios Definition**. From that information, the essential parameters were extracted, and the architecture of the ASSC was introduced, as reported in **Deliverable D1.7 - Architecture design of the AMANDA system delivered (for both breadboard and integrated/miniaturised system).** Further on, parameters of the off-the-shelf components, as reported in **Deliverables D2.2 - Initial Report on commercial AMANDA Sensors** and **D4.1 - Hardware and firmware implementation of the wireless solutions** and developed in the project components, reported in Deliverables **D2.1 - Report on AMANDA Sensors Development** and **D3.2 - PV Energy Harvester Proof-of-concept prototype, D3.3 - PV Energy Harvester Proof-of-concept prototype, D3.4 - Report on Power management electronics** and **D3.5 - Report on Rechargeable Storage Element** have been evaluated. The next logical step is to consider the evaluation of the integrated system. WP6 activity refers to the test of the whole ASSC system. In this Deliverable, the focus is placed on defining parameters of the component provided by the project Partners, defining test procedures and defining metrics according to which the system will be evaluated.
The information and metrics defined in this report will be used during the activity executed as an input for Tasks T6.2 and T6.3.

3 References

[1] “https://www.warioweather.com/,” [Online].

[2] “http: //www.fao.org/3/X0490E/x0490e00.htm#Contents,” [Online].

[3] “http: //www.bosch-connectivity.com/products/connected-mobility/parking-lot-sensor,” [Online].

[4] “https://www.parkdroid.com,” [Online].

[5] “https://www.tattile.com/vision-solutions/vega-basic/,” [Online].