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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

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Authors List

| | Leading Author (Editor) | | | | |
|------------|-------------------------|----------|---------------------|-------------------------------------|--|
| Surname | | Initials | Beneficiary Name | Contact email | |
| Kou | zinopoulos | CS | CERTH | kouzinopoulos@iti.gr | |
| Co-authors | | | | | |
| # | Surname | Initials | Beneficiary Name | Contact email | |
| 1 | Bellanger | МВ | Lightricity | mathieu.bellanger@lightricity.co.uk | |
| 2 | Bembnowicz | PI | IMEC-NL | pawel.bembnowicz@imec.nl | |
| 3 | Kanlis | AK | CERTH | alexkanlis@iti.gr | |
| 4 | Karanassos | DK | CERTH | dkaranassos@iti.gr | |
| 5 | Kauer | MK | Lightricity | matthias.kauer@lightricity.co.uk | |
| 6 | Sideridis | PS | CERTH | sideridis@iti.gr | |
| 7 | Van de Wiel | RW | IMEC-NL | rik.vandewiel@imec.nl | |
| 8 | Van Hal | RH | IMEC-NL | roy.vanhal@imec-nl.nl | |

Reviewers List

| | List of Reviewers | | | | |
|---|---|----|-------|-------------------------|--|
| # | # Surname Initials Beneficiary Name Contact email | | | | |
| 1 | Brütsch | МВ | ZHAW | manuel.bruetsch@zhaw.ch | |
| 2 | Meli | MM | ZHAW | marcel.meli@zhaw.ch | |
| 3 | Vujičić | OV | PENTA | oskar.vujicic@penta.hr | |

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List of definitions & abbreviations

| Abbreviation | Definition | |
|--|---|--|
| ASSC | Autonomous Smart Sensing Card | |
| DG RTD | European Commission's Directorate-General for Research and Innovation | |
| DMP | Data Management Plan | |
| GDPR | General Data Protection Regulation | |
| H2020 | Horizon 2020 | |
| IIoT Industrial Internet of Things | | |
| IPR | Intellectual Property Rights | |
| LEPPI | Legal, Ethical, Privacy and Policy Issues | |
| MCU | Microcontroller Unit | |
| ORDP | Open Research Data Pilot | |
| PMIC Power Management Integrated Circuit | | |
| PV | Photo Voltaic Radio Frequency | |
| RF | | |
| RIA Research and Innovation Action | | |

Executive summary

This Deliverable provides a general description related to data management, ethics and standardisation which is applied in the project and focuses on data collected from various activities of the project up to M36. The document consists of the following Sections:

- Section 1 provides information about the project scope, the goals of this report and the Legal, Ethical, Privacy and Policy Issues (LEPPI) manager nomination
- Section 2 describes the needs, reasons and methods of AMANDA's data management, together with the implementation of the data management plan during M1-M36 of the project and can be used to track data collected for the project's duration
- Section 3 details ethical aspects of the project

This version includes updated information on data handling and ethics for the AMANDA project during the first 36 months of the project. Further information is provided with reference to the implementation of the initial plan detailed in **Deliverable D8.3 - Data management plan and ethics v1**, as well as **Deliverable D8.5 - Data management plan and ethics v2**. Moreover, the Data Management Portal integration is presented and its technical details analysed. Lastly, the latest data sets created within the AMANDA project are presented and have been uploaded to the data management platform.

Table of Contents

| 1. | Intr | oductio | n | 8 |
|----|---------|-----------|--|----|
| | 1.1. | Overall | l technical objectives | 8 |
| | 1.2. | Purpos | se, context and scope of this Deliverable | 9 |
| | 1.3. | Appoin | ntment of a LEPPI manager | 11 |
| 2. | Dat | a manag | gement plan | 12 |
| | 2.1. | Proced | lures of data collection | 12 |
| | 2.1. | .1. D | Data collection process | 13 |
| | 2.1. | .2. D | Data collection description | 13 |
| | 2.1. | .3. S | Specification of the required components data collection | 14 |
| | 2.2. | Data st | torage and back-up | 14 |
| | 2.3. | Data do | ocumentation | 15 |
| | 2.4. | Data re | etention and archiving | 33 |
| | 2.5. | Data M | Nanagement Portal | 33 |
| | | | cerns of the AMANDA project | |
| 4. | Con | nclusions | s and future work | 42 |
| Bi | bliogra | aphy | | 43 |
| | | | | |

List of Figures

| Figure 1 Data management timeline | 9 |
|--|------|
| Figure 2 The data roadmap [2] | . 10 |
| Figure 3 Open access to research data automation | . 34 |
| Figure 4 AMANDA GitHub repository | . 35 |
| Figure 5 GitHub liked to Zenodo | . 35 |
| Figure 6 The DOI Zenodo of an example AMANDA dataset | . 35 |
| Figure 7 Edit field of Zenodo for metadata | . 36 |
| Figure 8 Basic information fields | . 37 |
| Figure 9 License and Funding field | . 38 |
| | |

List of Tables

| Table 1 LEPPI nomination | 11 |
|---|----|
| Table 2 Data acquisition details | 14 |
| Table 3 Data storage and data backup information | 15 |
| Table 4 "DS.CERTH.01.LIS3DH_Accelerometer_10k_resistor" documentation | 16 |
| Table 5 "DS.CERTH.02.OPT3001_Light_sensor_10k_resistor" documentation | 18 |
| Table 6 "DS.CERTH.03.SPH_MIC_1k_resistor" documentation | 19 |
| Table 7 "DS.IMEC.01.CO2" documentation | 20 |
| Table 8 "DS.MICRODUL.01.MS1089_SupplyCurrents" | 21 |
| Table 9 "DS.MICRODUL.02.MS1089_TemperatureData" | 22 |
| Table 10 "DS.MICRODUL.03.MS8892_SupplyCurrents" | 23 |
| Table 11 "DS.MICRODUL.04.MS8892_CapacitanceData" | 24 |
| Table 12 "DS.CERTH. 04.LIS3MDL_SupplyCurrents" | 25 |
| Table 13 "DS.CERTH.05.OPT3001_light_sensor_SupplyCurrents" | |
| Table 14 "DS.CERTH.06.STM32L496_TPS6220x_SupplyCurrents" | 27 |
| Table 15 "DS.CERTH.07.STM32L496_ST1PS02DQTR _SupplyCurrents" | 28 |
| Table 16 "DS.CERTH.08.STM32L496_NUCELO_SupplyCurrents" | |
| Table 17 "DS.ZHAW.01.Energy_measurements" | 31 |
| Table 18 "DS.ZHAW.02.Energy_measurements_SiP" | 32 |
| Table 19 "DS.IMEC.02.CO2" | |
| Table 20 Suggested retention time with respect to type of data | 33 |
| Table 21 Basic information fields | 37 |
| Table 22 License and Funding field | 38 |
| Table 23 Other Fields that can be specified on Zenodo | 39 |

1. Introduction

1.1. Overall technical objectives

AMANDA is an ambitious project that develops a unique ASSC with the size, feel and look of a credit card. It can be ideal for easy deployments in buildings (smart living environments), as a wearable, for infrastructure monitoring and to mitigate issues related to current and future epidemics. The project covers the triangle of experimentation, development and standardization to optimize the materials behaviour, connectivity, miniaturization, power consumption, security, intelligence, design and cost. AMANDA's partners have the expertise and combination of world-class manufacturing infrastructures and know-how. They are using micro- and nano-technology, new composites, innovative architectures and advanced software. AMANDA's vision is to overcome the existing technological challenges and achieve the development of a user-friendly wearable platform not only for indoor and outdoor environmental sensing, but also for asset- or even people- tracking. A combination of developed and existing off-the-shelf technologies have been selected and are in the process of integration into the ASSC. Innovative PVs (Lightricity PV), PMIC (EPEAS) and batteries (Ilika's solid-state battery), all packed in under a 3mm thickness. The project introduces technical breakthroughs that further boost miniaturisation, offers increased sensitivity, small footprint and ultra-low power consumption with a maintenance-free lifetime of more than 10 years.

The project execution requires tight cooperation between the partners. This leads to the generation of a significant amount of information, including datasheets, specifications, measurement and reporting data as well as other types of data. The Data Management Plan (DMP) is in place to ensure that all information is categorised and stored in a safe way and can be accessed at any time by authorised users and, in case of public data, by the scientific community. All work done within the AMANDA project aims to incorporate the high standards set by the European Commission. To that end, the consortium put their efforts to make the research data FAIR [1]: Findable, Accessible, Interoperable and Reusable to ensure it is soundly managed.

The FAIR principles indicate different ways to handle data and their respective metadata. This serves as an important factor that leads to knowledge discovery and innovation, while enables easier data and knowledge integration and reuse. As detailed in [1], the FAIR principles are:

- To be Findable
 - o (meta)data are assigned a globally unique and persistent identifier
 - o data are described with rich metadata
 - o metadata clearly and explicitly include the identifier of the data it describes
 - (meta)data are registered or indexed in a searchable resource
- To be Accessible
 - (meta)data are retrievable by their identifier using a standardized communications protocol
 - o the protocol is open, free, and universally implementable
 - the protocol allows for an authentication and authorization procedure, where necessary
 - o metadata are accessible, even when the data are no longer available
- To be Interoperable
 - (meta)data use a formal, accessible, shared, and broadly applicable language for knowledge representation.
 - o (meta)data use vocabularies that follow FAIR principles
 - o (meta)data include qualified references to other (meta)data
- To be Reusable:
 - meta(data) are richly described with a plurality of accurate and relevant attributes
 - o (meta)data are released with a clear and accessible data usage license

- (meta)data are associated with detailed provenance
- (meta)data meet domain-relevant community standards

This document is an updated version of **Deliverable D8.3 - Data management plan and ethics v1** and **Deliverable D8.5 - Data management plan and ethics v2**, submitted on M6 and M18 respectively, which set the basis on which the consortium worked on handling the scientific data produced throughout the duration of the project. In this context, **Deliverable D8.6 - Data management plan and ethics v3** entails the relevant updates, implementations and tools developed by the consortium. The changes introduced in this document include:

- Updates to the outline of the document and modification of the respective Tables and Figures in order to provide the proper relevant information and details as they were explored during the period of M18 - M36
- The newer/relevant data sets that have been created during the period of M18-M36 are detailed as they are, or in some cases will be, shared via AMANDA's data management platform
- Further documentation, Figures and Tables were provided to argue the validity of the project's strategic data handling

An overview of the data management plan's timeline is provided in Figure 1. Between M18 and M36, the DMP was finalised based on the latest developments for the AMANDA ASSC and the result is reflected in this document. During the same period, the Data Management Portal was updated, as detailed in Section 2.5 and different datasets of the project were collected, as discussed in Section 2.3.

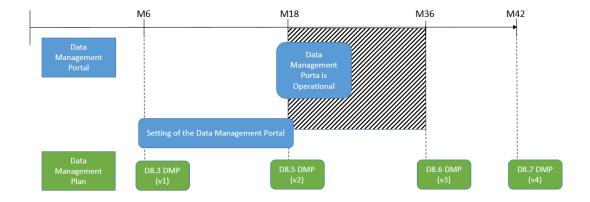


Figure 1 Data management timeline

1.2. Purpose, context and scope of this Deliverable

This document relates to data management and ethic plans within the AMANDA project. The DMP is a living document and will evolve during the lifespan of the project. As the project progresses, it will be updated as needed whenever significant changes arise, such as dataset updates or evaluation results. The reason is that there is a need for handling potentially sensitive data in a discreet way. The data lifecycle of the AMANDA project follows a six-stage process, based on the methodology of [2], as presented in Figure 2 and detailed below:

- **Planning.** The strategizing on how data will be managed, the creation of a data management plan, and being aware of data policies that apply to the work
- Collecting. The data acquisition. It refers to two groups of techniques: documentation and data organization. Documentation can include metadata, and protocols, as well

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as documentation files and data dictionaries. Organization strategies for data management include file organization, file naming, how to document conventions, and the use of databases

- Analysing. Involves data analysis. It includes understanding the difference between managing raw and analysed data, as well as performing data quality management
- Publishing. The data-sharing stage of data's lifecycle
- Preserving. Data preservation examines the data to retain and how long to retain it, how to prepare data for the long term, and outsourcing data preservation to data repositories
- **Reusing**. Data reuse is the last stage of data management and the one that completes the data cycle

Subsequent updates to this document are foreseen on M42 with the release of **Deliverable D8.7 - Data management plan & ethics v4**. The document describes the process applied by the Consortium to ensure a quality data management and high ethical standards. It enables clear tracking of data collected, not only during the project execution but also after its conclusion.

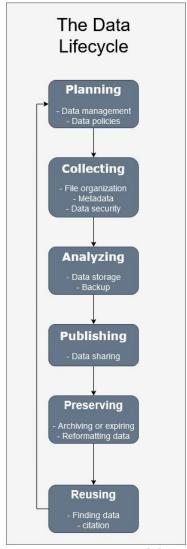


Figure 2 The data roadmap [2]

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1.3. Appointment of a LEPPI manager

There is a need to appoint a LEPPI manager. The LEPPI manager is responsible for the coordination of all activities related to legal, ethical, privacy and policy issues that may arise during the development and validation phases of the project. In case of issues related to law, ethics and privacy, the LEPPI manager will cooperate and advise the following decisions making bodies: Plenary Board, Quality Control Board and Ethics Helpdesk. Table 1 shows the assigned LEPPI manager, chosen by the project partners.

| Partner short name - company | Name | Email |
|------------------------------|-----------------|-----------------------|
| IMEC | Rik van de Wiel | Rik.vandeWiel@imec.nl |

Table 1 LEPPI nomination

Rik van de Wiel is a senior employee at IMEC. He has been working as an R&D manager in the field of connected health solutions for eight years. Rik van de Wiel contributed to many data collection trials, including a number of trials in which medical devices were evaluated.

December 2021 ¹¹ CERTH

2. Data management plan

A DMP is a key element of proper data management in a RIA project. The plan describes the life cycle for the data generated, collected and processed. A DMP should include information on:

- The data to be collected, processed and/or generated
- The methodology and standards that will be applied
- The dissemination level of the data
- The way data will be curated and preserved, including after the end of the project's duration

The European Commission is running a flexible pilot under Horizon 2020 called the Open Research Data Pilot (ORDP). The ORDP aims to improve and maximize access to and reuse of research data generated by Horizon 2020 projects and takes into account the need to balance openness and protection of scientific information, commercialization and Intellectual Property Rights (IPR), privacy concerns, security as well as data management and preservation questions. The AMANDA project is part of the ORDP and this Deliverable provides insights regarding the data management, ethics and standardization which are applied within the project and focuses on the data collected up to M18 of the project. The project involves the generation and collection of technical data in different phases, as part of the following Tasks:

- Under Task T2.2 Evaluation and Adaptation of off-the-shelf sensors, off-the-shelf sensors have been evaluated for inclusion to the project. Data produced as part of the evaluation include sensor readings
- Under Task T2.4 Data fusion optimization engine, the output of the data fusion optimisation engine is collected and used in the design (WP3) and validation phase (WP5) of the project
- The entire energy profile of the AMANDA card as it goes through different modes was captured as part of Task T2.5 - Prototypes finalisation and setting-up sets of multiple sensors & Evaluate sensor and multi-sensor energy requirements
- Measurements on the interfacing of the power electronics with the system's MCU was performed under Task T3.4 - Power electronics interfacing with the main system microcontroller
- Under Tasks T4.2 Cybersecurity by design implementation, T4.3 Edge intelligence and User Interfacing and T4.4 - Accurate localisation and tracking tool, the output of the cybersecurity, edge intelligence and positioning algorithms respectively are captured to assist in the integration of the software components with the system's firmware and to enable their optimisation
- The output of sub-Task T5.1.5 on the testing of the basic firmware routines are stored to aid in the optional hardware and firmware redesign step under sub-Task T5.1.6.
 The output of the main firmware routines of the system are recorded under sub-Task T5.1.7
- The results of the validation activities of Tasks T6.2 Lab Environment Validation and T6.3 - Overall Evaluation, Lessons Learnt and Improvements are stored for future reference and to assist in the extraction of a set of conclusions that support the exploitation process of the project and underline key improvements and additions that optimise the system and increase the targeted spectrum of applications

2.1. Procedures of data collection

This Section summarises the active efforts of the AMANDA consortium to ensure that technical data generated and collected during the lifetime of the project are findable, openly accessible, interoperable and reusable.

December 2021 12 CERTH

2.1.1. Data collection process

The data collection description characterises, in plain text and for each data collection, the types of research data that are and will be collected during the study. It also describes how information is and will be collected and why it is needed. This gives a general overview that can be used to fine tune the data management if required. The following research data types are possible (but not limited to):

- Observational data. Captured in real time, typically cannot be reproduced exactly.
 Examples of observational data include sensor readings, sensory (human) observations, survey results, images
- **Experimental data.** Generated from a lab environment and equipment, can often be reproduced but may be expensive to do so
- Simulation data. From models, can typically be reproduced if the input data is known.
 Examples: output of data fusion algorithms, training datasets of edge Intelligence algorithms
- **Derived or compiled data.** Theoretical search, data mining or statistical analysis, can be reproduced if the analysis is documented

The data collector can complete the matrix containing the detailed information of the data collection in the study based upon the following check list:

- Responsible Partner. Indicates the Consortium Partner responsible for the data collection
- **Data type**. Describes the type of collected data, including text, arithmetic values, images, models, audio and video files, simulated data
- **Data collection**. Explains the methodology of the data collection: how the data is and will be collected and from which components
- **Data format**. The format in which the data is stored, including text and CSV files, compressed and uncompressed images as well as raw binary data
- **Estimated size**. An estimation of the size for each collected data file
- Software. Indicates the tool or software needed to create/process/visualize the generated data
- **Comments**. Does the data have a specific character in terms of reproducibility, confidentiality and others? What does this mean for the management of the data?

2.1.2. Data collection description

This Section describes the context and type of collected data. Table 2 describes:

- Dataset name. It also incorporates the data collector, versioning per collector and details on the way the data was generated. For example, the name "DS.CERTH.01.LIS3DH_Accelerometer_10k_resistor" reflects the fact that the dataset was created by CERTH, it was the first generated dataset by CERTH, it was produced using an LIS3DH accelerometer and the measurement was taken with the integration of a 10k resistor
- Dataset status. It includes information regarding whether it's a new dataset or an
 updated version of an existing one, the month they are made available and if the
 dataset is public or confidential

In order to ensure the reproducibility of the results generated, the publicly available data files can be accessed via different software tools, including LibreOffice Calc, Microsoft Excel spreadsheet or MATLAB.

| # | Dataset name | Status |
|---|---|--------------|
| 1 | DS.CERTH.01.LIS3DH_Accelerometer_10k_resistor | M15 - Public |

December 2021 ¹³ CERTH

| 2 | DS.CERTH.02.OPT3001_Light_sensor_10k_resistor | M15 - Public |
|----|--|--------------------------|
| 3 | DS.CERTH.03.SPH_MIC_1k_resistor | M15 - Public |
| 4 | DS.IMEC.01.CO ₂ | M18 - Confidential |
| 5 | DS.MICRODUL.01.MS1089_SupplyCurrents | New - M34 - Confidential |
| 6 | DS.MICRODUL.02.MS1089_TemperatureData | New - M34 - Confidential |
| 7 | DS.MICRODUL.03.MS8892_SupplyCurrents | New - M34 - Confidential |
| 8 | DS.MICRODUL.04.MS8892_CapacitanceData | New - M34 - Confidential |
| 9 | DS.CERTH.04.LIS3MDL_SupplyCurrents | New - M34 - Public |
| 10 | DS.CERTH.05.OPT3001_Light_sensor_SupplyCur- | New - M34 - Public |
| 10 | rents_under_different_illumination_levels | New - M34 - Public |
| 11 | DS.CERTH.06.STM32L496_TPS6220x_SupplyCurrents | New - M34 - Public |
| 12 | DS.CERTH.07.STM32L496_ST1PS02DQTR _SuppllyCur- | New - M34 - Public |
| 12 | rents | New - M34 - Public |
| 13 | DS.CERTH.08.STM32L496_NUCELO_SupplyCurrents | New - M34 - Public |
| 14 | DS.ZHAW.01.Energy_measurements | New - M34 - Public |
| 15 | DS.ZHAW.02.Energy_measurements_SiP | New - M34 - Public |
| 16 | DS.IMEC.02.CO2 | New - M34 - Confidential |

Table 2 Data acquisition details

2.1.3. Specification of the required components data collection

Component data was collected as part of **WP1 - System Specifications, Requirements and Use Cases**. This includes data from components being developed as part of the AMANDA project:

- Temperature sensor
- Capacitive sensor
- Imaging sensor
- Solid-state battery
- Energy harvester
- PMIC

Data was also gathered from State-of-the-Art analysis, data from the evaluation of off-the-shelf electronic components such as RF chipsets and modules, additional sensors including accelerometer, Volatile Organic Compound, humidity, light as well as other peripherals like timers, displays and memory ICs. Each technological Partner within the Consortium has contributed to the required data based on its current expertise and on technology scouting e.g. literature survey of patents and datasheets. The collected data was compiled into CSV documents that comprised various Tables of relevant technical specification parameters, especially the electrical and mechanical data, graphs about the power consumption profiles and electronic block diagrams. The purpose of such documents is to share the same level of information between all partners, regardless of the individual level of expertise, in order to mutually understand the current status of each respective technology and put these into perspective with the intermediate and final project specification targets. As such, it can be considered as an internal technical project roadmap. Finally, it is also a comprehensive comparison tool for assessing the various sensors, RF and loads that are integrated into the ASSC.

2.2. Data storage and back-up

It is the responsibility of the partners to ensure that the data is regularly backed-up and stored securely for the lifetime of the project and beyond. These services have been implemented both for confidential as well as for publicly available data. The following types are distinguished:

December 2021 14 CERTH

- Hosting service (GitHub) with a web-based graphical interface that provides access control and several collaboration features, such as a wiki and basic task management tools, to make public data easily accessed
- Hosting service (GitLab) with a web-based graphical interface that provides access control and several collaboration features, such as a wiki and basic task management tools, for internal co-operation
- A general-purpose open-access repository developed under the European OpenAIRE program and operated by CERN integration (Zenodo)

Backup indicates the location of the backups and the responsible partner. The data in this study are stored and backed up as described in Table 3.

| Ref. nr. | Responsible Partner | Data type | Storage medium and location | Backup location and backup frequency |
|-------------|------------------------|-----------------------|-----------------------------|--------------------------------------|
| 1 | CERTH | Confidential datasets | GitLab | Automated service backup |
| 2 | CERTH | Public datasets | Zenodo | Automated service backup |

Table 3 Data storage and data backup information

2.3. Data documentation

The data processed is documented and labelled for immediate usage and future reference. The labelling consists of two parts:

- File naming. Files have naming conventions for each data type. There are many conventions for file naming. The well documented practical guidance from Purdue University [3] is followed. Naming convention is very helpful in case of manual and automatic search
- Metadata. Files have metadata that describes the data stored in the file. Metadata have a description what the data contains and what each value represents. The reason to use metadata is, that it can be found easily when looking for information

Wherever possible, existing community standards should be identified and reused. An example of commonly used generic metadata can be found at Dublin Core Metadata Initiative [4]. The data processed in the study have been documented according to the standards with the data type as described in Table 4.

| DS.CERTH.01.LIS3DH_Accelerometer_10k_resistor | | |
|---|--|--|
| Data identification | | |
| Source | LIS3DH accelerometer sensor | |
| Description | This dataset was gathered in order to establish the baseline on acceleration metrics. It consists of the acceleration forces on three different axis (x,y,z) together with the respective timestamps of each measurement. These measurements were collected during the evaluation of the sensor for Deliverable D2.2 | |

December 2021 ¹⁵ CERTH

| Partners activities and responsibilities | | |
|--|--|--|
| Partner owner of the device | The device is owned by CERTH, where the | |
| Dorthor in charge of data collection | data collection was performed | |
| Partner in charge of data collection Partner in charge of data analysis | CERTH | |
| Partner in charge of data storage | CERTH | |
| raither in charge of data storage | The data was collected within the activities | |
| WPs and tasks | of WP2 and more specifically within the activities of Task T2.2 | |
| Standards | | |
| Info about metadata (production and storage dates, place) and documentation? | The dataset is accompanied with a detailed documentation of its contents. Indicative metadata include: • Upload type • A Digital Object Identifier • Publication date • Access rights • References • Contributors | |
| Standards, format, estimated volume of data | CSV data format. This dataset's size is 16kB | |
| Data sharing and exploitation | | |
| Dissemination level | Public | |
| Data access policy | The full dataset is openly available through the AMANDA Data Management Portal | |
| Data sharing, re-use and distribution (How?) | The full dataset is openly available through the AMANDA Data Management Portal | |
| Data exploitation (purpose/use of the data analysis) | The collected data serves as the baseline for the orientation and activity detection of the ASSC. Moreover, this dataset could be useful in the benchmarking of different implementations of any 3-axis MEMS accelerometer to ensure their optimal performance | |
| Embargo periods (if any) | None | |
| Archiving and preservation (including storage and backup) | | |
| Data storage (including backup): Where? For how long? | The data will be available through the AMANDA Data Management Portal for the duration of the project's lifetime | |

Table 4 "DS.CERTH.01.LIS3DH_Accelerometer_10k_resistor" documentation

| DS.CERTH.02.OPT3001_Light_sensor_10k_resistor | | |
|---|----------------------|--|
| Data identification | | |
| Source | OPT3001 light sensor | |

| Description | This dataset was gathered in order to establish the baseline on the brightness of the ambient light over time. It consists of the intensity of light as visible by the human eye, in lux, together with the respective timestamps of each measurement. These measurements were collected during the evaluation of the sensor for Deliverable D2.2 | |
|--|---|--|
| Partners activities and responsibilities | | |
| Partner owner of the device | The device is owned by CERTH, where the data collection was performed | |
| Partner in charge of data collection | CERTH | |
| Partner in charge of data analysis | CERTH | |
| Partner in charge of data storage | CERTH | |
| WPs and tasks | The data was collected within the activities of WP2 and more specifically within the activities of T2.2 | |
| Standards | | |
| Info about metadata (production and storage dates, place) and documentation? | The dataset is accompanied with a detailed documentation of its contents. Indicative metadata include: • Upload type • A Digital Object Identifier • Publication date • Access rights • References • Contributors | |
| Standards, format, estimated volume of data | CSV data format. This dataset's size is 15kB | |
| Data sharing and exploitation | | |
| Dissemination level | Public | |
| Data access policy | The full dataset is openly available through the AMANDA Data Management Portal | |
| Data sharing, re-use and distribution | The full dataset is openly available through the AMANDA Data Management Portal | |
| Data exploitation (purpose/use of the data analysis) | The collected data serves as the baseline for the brightness of the ambient light over time of the ASSC. Moreover, this dataset could be useful in the benchmarking of dif- ferent implementations of any ambient light sensor to ensure their optimal perfor- mance | |
| Embargo periods (if any) | None | |
| | | |
| Archiving and preservation (including storage and backup) | | |

| I NOW IONG? | The data will be available through the |
|-------------|--|
| | AMANDA Data Management Portal for the |
| | duration of the project's lifetime |

Table 5 "DS.CERTH.02.OPT3001_Light_sensor_10k_resistor" documentation

| DS.CERTH.03.SPH_MIC_1k_resistor | | |
|--|--|--|
| Data identification | | |
| Source | SPH0645LM4H microphone sensor | |
| Description | This dataset was gathered in order to establish the baseline on the spectrum frequency over time. It consists of the soundwave amplitude together with the respective timestamps of each measurement. These measurements were collected during the evaluation of the sensor for Deliverable D2.2 | |
| Partners activities and responsibilities | | |
| Partner owner of the device | The device is owned by CERTH, where the data collection was performed | |
| Partner in charge of data collection | CERTH | |
| Partner in charge of data analysis | CERTH | |
| Partner in charge of data storage | CERTH | |
| WPs and tasks | The data was be collected within the activities of WP2 and more specifically within the activities of T2.2 | |
| Standards | | |
| Info about metadata (production and storage dates, place) and documentation? | The dataset is accompanied with a detailed documentation of its contents. Indicative metadata include: • Upload type • A Digital Object Identifier • Publication date • Access rights • References • Contributors | |
| Standards, format, estimated volume of data | CSV data format. This dataset's size is 15kB | |
| Data sharing and exploitation | | |
| Dissemination level | Public | |
| Data access policy | The full dataset is openly available through the AMANDA Data Management Portal | |
| Data sharing, re-use and distribution | The full dataset is openly available through the AMANDA Data Management Portal | |
| Data exploitation (purpose/use of the data analysis) | The collected data serves as the baseline for the spectrum frequency over time of the | |

| | ASSC. Moreover, this dataset could be useful in the benchmarking of different implementations of any I ² S MEMS microphone to ensure their optimal performance | |
|---|---|--|
| Embargo periods (if any) | None | |
| Archiving and preservation (including storage and backup) | | |
| Data storage (including backup): Where? For how long? | The data will be available through the AMANDA Data Management Portal for the duration of the project's lifetime | |

Table 6 "DS.CERTH.03.SPH_MIC_1k_resistor" documentation

| DS.IMEC.01.CO2 | | |
|--|--|--|
| Data identification | | |
| Source | The CO ₂ transducer is prepared from commercially available ITO on glass electrodes, covered with an ionic liquid based electrolyte layer | |
| Description | Using the IMEC gas setup, a series of CO ₂ steps of ~2000 ppm were switched on and off in a 5 minute cycle. At the 1h07m mark, the diluting gas for the setup was changed from pure nitrogen to compressed dry air, while at ~2h this was switched back to nitrogen | |
| Partners activities and responsibilities | | |
| Partner owner of the device | The device is owned by IMEC, where the data collection was performed | |
| Partner in charge of data collection | IMEC | |
| Partner in charge of data analysis | IMEC | |
| Partner in charge of data storage | IMEC/CERTH | |
| WPs and tasks | The data were collected within the activities of WP2 and more specifically within the activities of T2.2 | |
| Standards | | |
| Info about metadata (production and storage dates, place) and documentation? | In the file detail, a verbal description of the experiment is provided | |
| Standards, format, estimated volume of data | The data format is xlsx, an MS Excel file. The estimated volume of data is approximately 140kB | |
| Data sharing and exploitation | | |
| Dissemination level | Confidential | |
| Data access policy | The data is research measurement. It should remain confidential | |

| Data sharing, re-use and distribution | The created dataset is shared through the Data Management Portal only for members of the Consortium and the European Commission | |
|---|--|--|
| Data exploitation (purpose/use of the data analysis) | The results show a fast response of both the real (Re) and imaginary (Im) parts of the measured impedance (Z) to changes in the CO ₂ concentration in the absence or presence of oxygen. Previous sensors based on Pt on Si showed (reversible) deactivation when exposed to oxygen | |
| Embargo periods (if any) | End of the project | |
| Archiving and preservation (including storage and backup) | | |
| Data storage (including backup): Where? For how long? | All information belongs to the AMANDA consortium. All data will respect the partner policies | |

Table 7 "DS.IMEC.01.CO2" documentation

| DS.MICRODUL.01.MS1089_SupplyCurrents | | |
|--|---|--|
| Data identification | | |
| Source | Microdul MS1089 solid-state temperature sensor | |
| Description | Supply current measurement in prototype package, in a lab environment. The supply current of the temperature sensor is measured during the start-up phase, the idle phase and the measurement phase | |
| Partners activities and responsibilities | | |
| Partner owner of the device | The device is owned by Microdul, where the data collection was performed | |
| Partner in charge of data collection | Microdul | |
| Partner in charge of data analysis | Microdul | |
| Partner in charge of data storage | Microdul | |
| WPs and tasks | The data was collected within the activities of WP2 and more specifically within the activities of task T2.1 | |
| Standards | | |
| Info about metadata (production and storage dates, place) and documentation? | The measurement setup and the conditions (voltage, timing, etc.) are described in the data file(s) itself | |
| Standards, format, estimated volume of data | The data format is in CSV. The estimated data size is a few MB | |
| Data sharing and exploitation | | |
| Dissemination level | Confidential | |

| Data access policy | The data is research measurement. It should remain Confidential | |
|---|---|--|
| Data sharing, re-use and distribution | The created dataset is available only for members of the Consortium. The data can be used to derive simulation models for the energy simulation tool developed in Task T1.4 | |
| Data exploitation (purpose/use of the data analysis) | The data is used for evaluation and comparison with the specified power consumption figures, and for modelling the power consumption in the AMANDA ASSC | |
| Embargo periods (if any) | None | |
| Archiving and preservation (including storage and backup) | | |
| Data storage (including backup): Where? For how long? | The data will be stored beyond the lifetime of the project | |

Table 8 "DS.MICRODUL.01.MS1089_SupplyCurrents"

| DS.MICRODUL.02.MS1089_TemperatureData | | |
|--|--|--|
| Data identification | | |
| Source | Microdul MS1089 solid-state temperature sensor | |
| Description | Temperature data obtained from the sensor in prototype package, in a lab environment. The temperature data of the sensor in a calibrated state is obtained over the full temperature range | |
| Partners activities and responsibilities | | |
| Partner owner of the device | The device is owned by Microdul, where the data collection was performed | |
| Partner in charge of data collection | Microdul | |
| Partner in charge of data analysis | Microdul | |
| Partner in charge of data storage | Microdul | |
| WPs and tasks | The data are going to be collected within the activities of WP2 and more specifically within the activities of Task T2.1 | |
| Standards | | |
| Info about metadata (production and storage dates, place) and documentation? | The measurement setup and the conditions (voltage, temperature, etc.) are described in the data file(s) itself | |
| Standards, format, estimated volume of data | The data format is in CSV. The estimated data size maximum a few MB | |
| Data sharing and exploitation | | |
| Dissemination level | Confidential | |

| Data access policy | The data is research measurement. It should remain Confidential | |
|---|---|--|
| Data sharing, re-use and distribution | The created dataset is available only for members of the Consortium | |
| Data exploitation (purpose/use of the data analysis) | The data is used for evaluation, and for comparison with the specified accuracy figures | |
| Embargo periods (if any) | None | |
| Archiving and preservation (including storage and backup) | | |
| Data storage (including backup): Where? | The data will be stored beyond the lifetime | |
| For how long? | of the project | |

Table 9 "DS.MICRODUL.02.MS1089_TemperatureData"

| DS.MICRODUL.03.MS8892_SupplyCurrents | | |
|--|---|--|
| Data identification | | |
| Source | Microdul MS8892 ultra-low power capacitive sensor and touch switch for human body detection and system wake-up with absolute & relative switching threshold | |
| Description | Supply current measurement in final QFN16 package, in a lab environment. The supply current of the capacitive sensor is measured as average current consumption in the different operating modes and sampling rates and both with internal and external clock source. The dynamic current consumption during the measurement phase is also measured and reported. | |
| Partners activities and responsibilities | | |
| Partner owner of the device | The device is owned by Microdul, where the data collection was performed | |
| Partner in charge of data collection | Microdul | |
| Partner in charge of data analysis | Microdul | |
| Partner in charge of data storage | Microdul | |
| WPs and tasks | The data was collected within the activities of WP2 and more specifically within the activities of task T2.1 | |
| Standards | | |
| Info about metadata (production and storage dates, place) and documentation? | The measurement setup and the conditions (voltage, timing, etc.) are described in the data file(s) itself | |
| Standards, format, estimated volume of data | The data format is in CSV. The estimated data size is a few MB | |
| Data sharing and exploitation | | |

December 2021 22 CERTH

| Dissemination level | Confidential | |
|---|---|--|
| Data access policy | The data is research measurement. It should | |
| | remain Confidential | |
| | The created dataset is available only for | |
| | members of the Consortium. The data can | |
| Data sharing, re-use and distribution | be used to derive simulation models for the | |
| | energy simulation tool developed in Task | |
| | T1.4 | |
| | The data is used for evaluation and compar- | |
| Data exploitation (purpose/use of the data | ison with the specified power consumption | |
| analysis) | figures, and for modelling the power con- | |
| | sumption in the AMANDA ASSC | |
| Embargo periods (if any) | None | |
| | | |
| Archiving and preservation (including storage and backup) | | |
| Data storage (including backup): Where? | The data will be stored beyond the lifetime | |
| For how long? | of the project | |

Table 10 "DS.MICRODUL.03.MS8892_SupplyCurrents"

| DS.MICRODUL.04.MS8892_CapacitanceData | | |
|--|---|--|
| Data identification | | |
| Source | Microdul MS8892 ultra-low power capacitive sensor and touch switch for human body detection and system wake-up with absolute & relative switching threshold | |
| Description | Capacitance measurement in the final QFN16 package, in a lab environment. The capacitance (by means of a variable charge) is simulated by a programmable voltage source. The linearity of the measurement over the capacitance range will be evaluated. | |
| Partners activities and responsibilities | | |
| Partner owner of the device | The device is owned by Microdul, where the data collection was performed | |
| Partner in charge of data collection | Microdul | |
| Partner in charge of data analysis | Microdul | |
| Partner in charge of data storage | Microdul | |
| WPs and tasks | The data were collected within the activities of WP2 and more specifically within the activities of Task T2.1 | |
| Standards | | |
| Info about metadata (production and storage dates, place) and documentation? | The measurement setup and the conditions (voltage, temperature, etc.) are described in the data file(s) itself | |

December 2021 23 CERTH

| Standards, format, estimated volume of | The data format is in CSV. The estimated |
|---|---|
| data | data size maximum a few MB |
| Data sharing and exploitation | |
| Dissemination level | Confidential |
| Data access policy | The data is research measurement. It should |
| | remain Confidential |
| Data sharing, re-use and distribution | The created dataset is available only for |
| Butta sharing, re use and distribution | members of the Consortium |
| Data exploitation (purpose/use of the data | The data is used for evaluation, and for com- |
| analysis) | parison with the specified accuracy figures |
| Embargo periods (if any) | None |
| Archiving and preservation (including storage and backup) | |
| Data storage (including backup): Where? | The data will be stored beyond the lifetime |
| For how long? | of the project |

Table 11 "DS.MICRODUL.04.MS8892_CapacitanceData"

| DS.CERTH. 04.LIS3MDL_SupplyCurrents | | |
|--|---|--|
| Data identification | | |
| Source | LIS3MDL magnetometer sensor | |
| Description | This dataset was gathered in order to evaluate the current consumption of the magnetic sensor in different operational modes. It consists of the average supply current for the Data rates of 10,20,40 and 80Hz. These measurements were collected during the evaluation of the sensor for Deliverable D2.6 | |
| Partners activities and responsibilities | | |
| Partner owner of the device | The device is owned by CERTH, where the data collection was performed | |
| Partner in charge of data collection | CERTH | |
| Partner in charge of data analysis | CERTH | |
| Partner in charge of data storage | CERTH | |
| WPs and tasks | The data was collected within the activities of WP2 and more specifically within the activities of Task T2.5 | |
| Standards | | |
| Info about metadata (production and storage dates, place) and documentation? | The dataset is accompanied with a detailed documentation of its contents. Indicative metadata include: • Upload type • A Digital Object Identifier • Publication date • Access rights | |

| | . Defenses | |
|---|--|--|
| | References | |
| | Contributors | |
| Standards, format, estimated volume of | CSV data format. This dataset's size is a few | |
| data | kB | |
| | | |
| Data sharing and exploitation | | |
| Dissemination level | Public | |
| B. L | The full dataset is openly available through | |
| Data access policy | the AMANDA Data Management Portal | |
| Data sharing, re-use and distribution | The full dataset is openly available through | |
| (How?) | the AMANDA Data Management Portal | |
| (110111) | The collected data serves as the baseline for | |
| | | |
| | the energy requirements of the ASSC. More- | |
| Data exploitation (purpose/use of the data | over, this data is used for evaluation and | |
| analysis) | comparison with the specified power con- | |
| | sumption figures, and for modelling the | |
| | power consumption in the AMANDA ASSC | |
| Embargo periods (if any) | None | |
| Archiving and procognation (including stores | | |
| Archiving and preservation (including storage and backup) | | |
| Data storage (including backup): Where? For how long? | The data will be available through the | |
| | AMANDA Data Management Portal for the | |
| | duration of the project's lifetime | |
| | and an arrange of the control of the | |

Table 12 "DS.CERTH. 04.LIS3MDL_SupplyCurrents"

| DS.CERTH.05.OPT3001_light_sensor_SupplyCurrents | | |
|---|--|--|
| Data identification | | |
| Source | OPT3001 Light sensor | |
| Description | This dataset was gathered in order to evaluate the current consumption of the Light sensor under different illumination levels. It consists of the average supply current for the lux range of 300-8000lux. These measurements were collected during the evaluation of the sensor for Deliverable D2.6 | |
| Partners activities and responsibilities | | |
| Partner owner of the device | The device is owned by CERTH, where the data collection was performed | |
| Partner in charge of data collection | CERTH | |
| Partner in charge of data analysis | CERTH | |
| Partner in charge of data storage | CERTH | |
| WPs and tasks | The data was collected within the activities of WP2 and more specifically within the activities of Task T2.5 | |
| Standards | | |

| Info about metadata (production and storage dates, place) and documentation? | The dataset is accompanied with a detailed documentation of its contents. Indicative metadata include: • Upload type • A Digital Object Identifier • Publication date • Access rights • References • Contributors | |
|--|---|--|
| Standards, format, estimated volume of | CSV data format. This dataset's size is a few | |
| data | kB | |
| Data sharing and exploitation | | |
| Dissemination level | Public | |
| Data access policy | The full dataset is openly available through the AMANDA Data Management Portal | |
| Data sharing, re-use and distribution (How?) | The full dataset is openly available through the AMANDA Data Management Portal | |
| Data exploitation (purpose/use of the data analysis) | The collected data serves as the baseline for the energy requirements of the ASSC. Moreover, this data is used for evaluation and comparison with the specified power consumption figures, and for modelling the power consumption in the AMANDA ASSC | |
| Embargo periods (if any) | None | |
| Archiving and preservation (including storage and backup) | | |
| Data storage (including backup): Where? For how long? | The data will be available through the AMANDA Data Management Portal for the duration of the project's lifetime | |

Table 13 "DS.CERTH.05.OPT3001_light_sensor_SupplyCurrents"

| DS.CERTH.06.STM32L496_TPS6220x_SupplyCurrents | |
|---|--|
| Data identification | |
| Source | STM32L496 Microcontroller |
| Description | This dataset was gathered in order to evaluate the current consumption of the Microcontroller with TPS6220x, as an external switching power supply, in different operational modes. It consists of the average supply current for the clock frequency range of 100KHz - 80MHz. These measurements were collected during the evaluation of the microcontroller for Deliverable D3.6 |
| Partners activities and responsibilities | |

| Partner owner of the device | The device is owned by CERTH, where the data collection was performed | |
|--|--|--|
| Partner in charge of data collection | CERTH | |
| Partner in charge of data analysis | CERTH | |
| Partner in charge of data storage | CERTH | |
| WPs and tasks | The data was collected within the activities of WP2 and more specifically within the activities of Task T2.5 | |
| Standards | | |
| Info about metadata (production and storage dates, place) and documentation? | The dataset is accompanied with a detailed documentation of its contents. Indicative metadata include: • Upload type • A Digital Object Identifier • Publication date • Access rights • References • Contributors | |
| Standards, format, estimated volume of data | CSV data format. This dataset's size is a few kB | |
| Data sharing and exploitation | | |
| Dissemination level | Public | |
| Data access policy | The full dataset is openly available through the AMANDA Data Management Portal | |
| Data sharing, re-use and distribution (How?) | The full dataset is openly available through the AMANDA Data Management Portal | |
| Data exploitation (purpose/use of the data analysis) | The collected data serves as the baseline for the energy requirements of the ASSC. More- over, this data is used for evaluation and comparison with the specified power con- sumption figures, and for modelling the power consumption in the AMANDA ASSC | |
| Embargo periods (if any) | None | |
| Archiving and preservation (including storage and backup) | | |
| Data storage (including backup): Where? For how long? | The data will be available through the AMANDA Data Management Portal for the duration of the project's lifetime | |

Table 14 "DS.CERTH.06.STM32L496_TPS6220x_SupplyCurrents"

| DS.CERTH.07.STM32L496_ST1PS02DQTR _SupplyCurrents | |
|---|--|
| Data identification | |
| Source | STM32L496 Microcontroller |
| | This dataset was gathered in order to evalu- |
| Description | ate the current consumption of the Micro- controller with ST1PS02DQTR, as an external |

| | switching power supply, in different operational modes. It consists of the average supply current for the clock frequency range of 100KHz - 80MHz. These measurements were collected during the evaluation of the microcontroller for Deliverable D3.6 | | |
|--|--|--|--|
| Partners activities and responsibilities | | | |
| Partner owner of the device | The device is owned by CERTH, where the data collection was performed | | |
| Partner in charge of data collection | CERTH | | |
| Partner in charge of data analysis | CERTH | | |
| Partner in charge of data storage | CERTH | | |
| WPs and tasks | The data was collected within the activities of WP3 and more specifically within the activities of Task T3.4 | | |
| Standards | | | |
| Info about metadata (production and storage dates, place) and documentation? | The dataset is accompanied with a detailed documentation of its contents. Indicative metadata include: • Upload type • A Digital Object Identifier • Publication date • Access rights • References • Contributors | | |
| Standards, format, estimated volume of data | CSV data format. This dataset's size is a few kB | | |
| Data sharing and exploitation | | | |
| Dissemination level | Public | | |
| Data access policy | The full dataset is openly available through the AMANDA Data Management Portal | | |
| Data sharing, re-use and distribution (How?) | The full dataset is openly available through the AMANDA Data Management Portal | | |
| Data exploitation (purpose/use of the data analysis) | The collected data serves as the baseline for the energy requirements of the ASSC. Moreover, this data is used for evaluation and comparison with the specified power consumption figures, and for modelling the power consumption in the AMANDA ASSC | | |
| Embargo periods (if any) | None | | |
| Archiving and preservation (including storage and backup) | | | |
| Data storage (including backup): Where? For how long? | The data will be available through the AMANDA Data Management Portal for the duration of the project's lifetime | | |

duration of the project's lifetime

Table 15 "DS.CERTH.07.STM32L496_ST1PS02DQTR _SupplyCurrents"

| DS.CERTH.08.STM32L496_NUCELO_SupplyCurrents | | | |
|---|--|--|--|
| Data identification | | | |
| Source | STM32L496 Microcontroller | | |
| Description | This dataset was gathered in order to evaluate the current consumption of the Microcontroller in different operational modes. It consists of the average supply current for the clock frequency range of 100KHz-80MHz. These measurements were collected during the evaluation of the microcontroller for Deliverable D3.6 | | |
| Partners activities and responsibilities | | | |
| Partner owner of the device | The device is owned by CERTH, where the data collection was performed | | |
| Partner in charge of data collection | CERTH | | |
| Partner in charge of data analysis | CERTH | | |
| Partner in charge of data storage | CERTH | | |
| The data was collected within the of WP3 and more specifically with tivities of Task T3.4 | | | |
| Standards | | | |
| Info about metadata (production and storage dates, place) and documentation? | The dataset is accompanied with a detailed documentation of its contents. Indicative metadata include: • Upload type • A Digital Object Identifier • Publication date • Access rights • References • Contributors | | |
| Standards, format, estimated volume of data | CSV data format. This dataset's size is a few kB | | |
| Data sharing and exploitation | | | |
| Dissemination level | Public | | |
| Data access policy | The full dataset is openly available through the AMANDA Data Management Portal | | |
| Data sharing, re-use and distribution | The full dataset is openly available through | | |
| (How?) | the AMANDA Data Management Portal | | |
| Data exploitation (purpose/use of the data analysis) | The collected data serves as the baseline for the energy requirements of the ASSC. More- over, this data is used for evaluation and comparison with the specified power con- sumption figures, and for modelling the power consumption in the AMANDA ASSC | | |
| Embargo periods (if any) | None | | |

| Archiving and preservation (including storage and backup) | | | |
|---|---|--|--|
| Data storage (including backup): Where? For how long? | The data will be available through the AMANDA Data Management Portal for the duration of the project's lifetime | | |

Table 16 "DS.CERTH.08.STM32L496_NUCELO_SupplyCurrents"

| ZHAW.01.Energy_measurements | | | |
|---|--|--|--|
| Data identification | | | |
| Data set description | Energy measurement with one LoRa transmission and BLE in advertising mode. Advertisement interval of 40ms. LoRa: SF12, 9 Bytes user payload | | |
| Source (e.g. which device?)) | The dataset will be collected from the RSL10 development board with the Semtech SX1261 LoRa shield | | |
| Partners activities and responsibilities | | | |
| Partner owner of the device | ZHAW | | |
| Partner in charge of data collection | ZHAW | | |
| Partner in charge of data analysis | ZHAW | | |
| Partner in charge of data storage | ZHAW | | |
| WPs and tasks | The data was collected within the activities of WP4 and more specifically within the activities of Task T4.1 | | |
| Standards | | | |
| Info about metadata (Production and storage dates, place) and documentation? | Indicative metadata which include measurement of energy | | |
| Standards, Format, Estimated volume of data | The data format has not been defined yet. This data will be measured with a Power Analyzer and analyzed with different tools. | | |
| Data exploitation and sharing | | | |
| Data exploitation (purpose/use of the data analysis) | Measuring if the card will work with the planned battery. With this measurement the development team can change the transmission interval | | |
| Data access policy / Dissemination level (Confidential, only for members of the Con- sortium and the Commission Service / Pub- lic | Confidential, only for members of the Consortium and the Commission Service. The data set should only be used during the development phase of the project | | |
| Data sharing, re-use and distribution (How?) | The full dataset is openly available through the AMANDA Data Management Portal | | |
| Embargo periods (if any) | None | | |
| Archiving and preservation (including storage and backup) | | | |

| Data storage (including backup): where? For how long? | All information belongs to the AMANDA consortium. All data will respect the partner |
|---|---|
| O | policies |

Table 17 "DS.ZHAW.01.Energy_measurements"

| ZHAW.02.Energy_measurements_SiP | | | | |
|--|--|--|--|--|
| Data identification | Data identification | | | |
| Data set description | Energy measurement with one LoRa transmission and BLE in advertising mode. Advertisement interval of 40ms. LoRa: SF12, 9 Bytes user payload | | | |
| Source (e.g. which device?)) | The dataset will be collected from the RSL10 System in Package (SiP) development board with the Semtech SX1261 LoRa shield | | | |
| Partners activities and responsibilities | | | | |
| Partner owner of the device | ZHAW | | | |
| Partner in charge of data collection | ZHAW | | | |
| Partner in charge of data analysis | ZHAW | | | |
| Partner in charge of data storage | ZHAW | | | |
| WPs and tasks | The data was collected within the activities of WP4 and more specifically within the activities of Task T4.1 | | | |
| Standards | | | | |
| Info about metadata (Production and storage dates, place) and documentation? | Indicative metadata which include measurement of energy | | | |
| Standards, Format, Estimated volume of data | The data format has not been defined yet. This data will be measured with a Power Analyzer and analyzed with different tools | | | |
| Data exploitation and sharing | | | | |
| Data exploitation (purpose/use of the data analysis) | Measuring if the card will work with the planned battery. With this measurement the development team can change the transmission interval | | | |
| Data access policy / Dissemination level (Confidential, only for members of the Consortium and the Commission Service / Public | Confidential, only for members of the Consortium and the Commission Service The data set should only be used during the development phase of the project | | | |
| Data sharing, re-use and distribution (How?) | The full dataset is openly available through the AMANDA Data Management Portal | | | |
| Embargo periods (if any) | None | | | |
| Archiving and preservation (including storage and backup) | | | | |
| Data storage (including backup): where? For how long? | All information belongs to the AMANDA consortium. All data will respect the partner policies | | | |

Table 18 "DS.ZHAW.02.Energy_measurements_SiP"

| DS.IMEC.02.CO2 | | | | |
|---|---|--|--|--|
| Data identification | | | | |
| Data set description | Data to test the workings of an ITO based CO ₂ sensor | | | |
| Source (e.g. which device?)) | The dataset is collected with Bio-Logic SP- 300 potentiostat measuring an IMEC-devel- oped sensor | | | |
| Partners activities and responsibilities | | | | |
| Partner owner of the device | IMEC | | | |
| Partner in charge of data collection | IMEC | | | |
| Partner in charge of data analysis | IMEC | | | |
| Partner in charge of data storage | IMEC | | | |
| WPs and tasks | Collected in context of WP2 (Sensor development and multi-sensorial optimisation) Task 2.1 (Sensor development and evaluation); and WP6 (ASSC Validation in Laboratory Environment and Evaluation), Task 6.2 Lab Environment Validation | | | |
| Standards | Standards | | | |
| Info about metadata (Production and storage dates, place) and documentation? | Data includes gas profiles that the sensor has been exposed to, including date of evaluation in the lab | | | |
| Standards, Format, Estimated volume of data | 176 data points for a measurement of approximately 45 minutes. Each data point consists of a timestamp (relative to start of test), absolute and imaginary impedance, absolute impedance and phase angle | | | |
| Data exploitation and sharing | | | | |
| Data exploitation (purpose/use of the data analysis) | Benchmarking of sample performance: a standard CO2 exposure test and exposure to humidity variations | | | |
| Data access policy / Dissemination level (Confidential, only for members of the Con- sortium and the Commission Service / Pub- lic | The data may become public, and will be used as dataset for publication about the sensor principle and possible applications | | | |
| Data sharing, re-use and distribution (How?) | The full dataset is confidential until May 2022 and then will be available through the AMANDA Data Management Portal | | | |
| Embargo periods (if any) | Data should not be public before it is accepted for publication in journal approximately May 2022. Until then data can be used for internal consortium needs | | | |

| Archiving and preservation (including storage and backup) | | |
|---|---|--|
| Data storage (including backup): where? For how long? | All information belongs to the AMANDA consortium. All data will respect the partner policies. Data will be stored at IMEC for 5 years | |

Table 19 "DS.IMEC.02.CO2"

2.4. Data retention and archiving

This Section describes how long the data will be stored for this study, what data can be archived and what safeguards are setup for the data archiving. Examples of safeguards are limited access, anonymisation, scrambling and deleting parts of data.

The data processed in this study should have the defined retention period for each data type. The default retention period is set to the end of the AMANDA project activities. However, the retention time should be adjusted to significance of collected data. Table 20 shows the suggested retention time with regards different type of data. Nevertheless, the experiment designer should have decisive voice about retention period. Moreover, the files can be archived or deleted directly after processing.

| Nr. | Data type | Suggested retention period |
|-----|---------------------------------|----------------------------------|
| 1 | Non-anonymised raw measurements | Delete subsequent to project end |
| 2 | Anonymised raw measurements | 5 years or more |
| 3 | Project reports | 5 years or more |

Table 20 Suggested retention time with respect to type of data

2.5. Data Management Portal

In AMANDA, the focus is on the development and operation monitoring of environment, air quality and asset tracking. Two different types of data are collected within the AMANDA project:

- Scientific/technology data from the development side
- Private information, gathered by the consortium, that derives from human participation

The project involves carrying out the data collection and a set of validation tests to assess the technology and effectiveness of the proposed framework in real life conditions. The various models designed in the AMANDA project are anonymised and are provided to the public as open models using the Open Model Initiative (OMI). They are already available to interested parties that could provide adaptations and contribute to the evolution of AMANDA models after the end of the project. Hence, it becomes apparent that the majority of research data generated by the project is and will continue to be open. In this context, a detailed data management plan was delivered in M6, as reported in **Deliverable D8.3 - Data management plan & ethics v1** and was subsequently updated in **Deliverable D8.2 - Project progress report** on M10 and in **Deliverable D8.5 - Data management plan & ethics v2** on M18. The plan fully describes the procedures for ensuring that the data management process complies with national and EU legislation. The consortium's approach is in full compliance with the EU legislative and regulatory framework for data protection based on the uniform approach of the EC Directive 95/46/EC3, and the national legislative and regulatory framework for data protection of each project member country.

December 2021 33 CERTH

In that spirit, an automated way to make the relevant data publicly available was developed. The first component is a dedicated "open access to research data" repository on a self-hosted Gitlab solution. As a next step, this repository is exclusively mirrored to an open-access depository on the Github platform (https://github.com/amanda-project/ORDP-repository). The last component of this automation is the Zenodo¹ platform. The aforementioned Github account is integrated with a Zenodo account that makes all the data publicly available and provides a DOI for each item in order for other interested parties to cite them easily. This mechanism is illustrated in Figure 3 below.

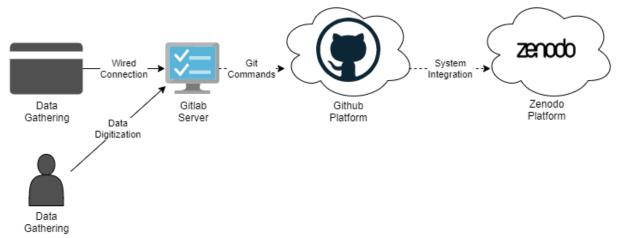
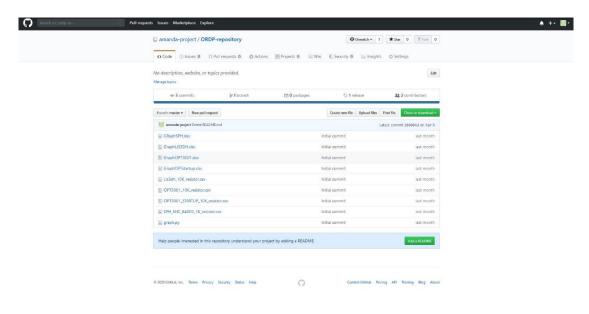


Figure 3 Open access to research data automation

Specifically, there are certain actions that need to be followed in order to enable AMANDA's repository on GitHub to be citable and have a DOI assigned via the general-purpose open-access repository Zenodo. The first step in providing a DOI, to datasets and other submitted data which lacks one, is to select the repository of GitHub that will be integrated with Zenodo. An overview of AMANDA's current GitHub repository is given in Figure 4.



¹ Zenodo is a general-purpose open-access repository developed under the European OpenAIRE program and operated by CERN. It allows researchers to deposit data sets, research software, reports, and any other research related digital artifacts. For each submission, a persistent digital object identifier (DOI) is minted, which makes the stored items easily citable.

December 2021 34 CERTH

Figure 4 AMANDA GitHub repository

As the project progresses, the repository will be updated and finalised during the last part of the project. Moreover, the GitHub account needs to be linked to Zenodo.

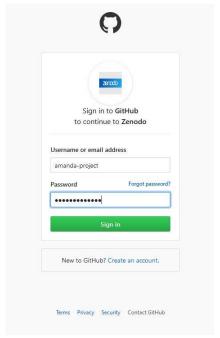


Figure 5 GitHub liked to Zenodo

Furthermore, a new release needs to be created within the GitHub project and Zenodo takes care of the automation that deposits the files and assigns a DOI to the relative data. As a result, AMANDA project's data sets, research software, reports, and any other research related digital artifacts are and will be stored together with their persistent DOI which makes them easily citable. The Zenodo DOI of an example AMANDA dataset can be seen in Figure 6 below.

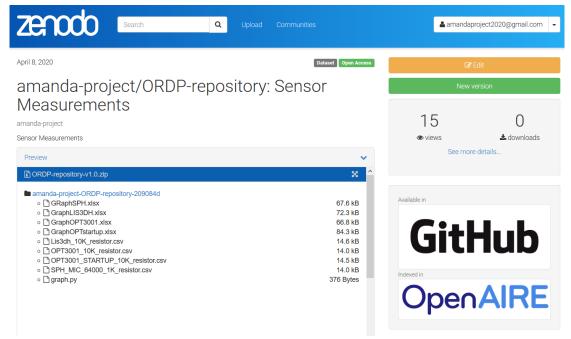


Figure 6 The DOI Zenodo of an example AMANDA dataset

December 2021 35 CERTH

The opportunity offered by this automation for AMANDA is to:

- Manage the datasets which are and will be collected within the project's actions
- Be flexible in terms of the parts of datasets that are made publicly available
- Facilitate the management of the data produced for the purposes of the AMANDA Project
- Provide a web-based implementation that enables its users to easily access and effectively manage the various data sets created throughout the development of the Proiect
- Provide a short description for each data set

The Zenodo platform offers the possibility to edit the metadata on the record. This feature enables edits for almost all of a record's metadata. From the upload type fields, it becomes evident that several different type of files such as publications, datasets, images, software's source code and others can be uploaded. This is demonstrated in Figure 7 below.

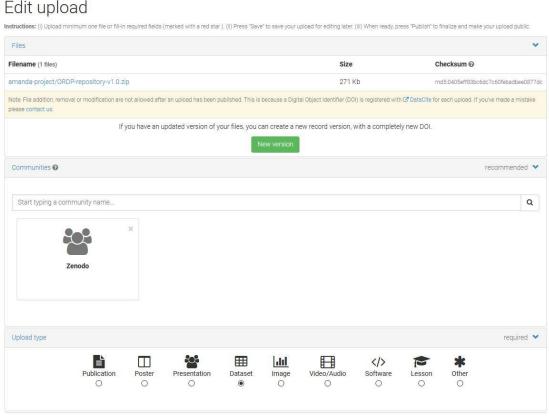


Figure 7 Edit field of Zenodo for metadata

A summary of the basic information that accompanies the file such as the digital object identifier, publication date, title, author, description, version, language, key words and additional notes are illustrated in Figure 8.

December 2021 36 CERTH

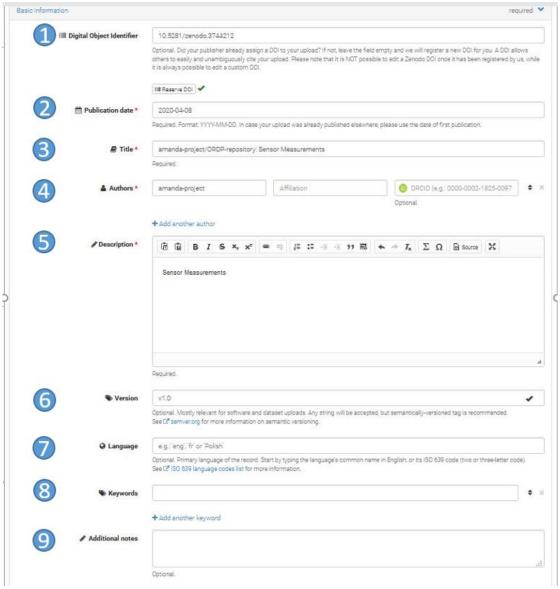


Figure 8 Basic information fields

| Number | Field | Significance | Description |
|--------|---|--------------|---|
| 1 | Digital object iden- tifier Optional | | Identifier of the DOI |
| 2 | Publication date | Required | Date of first publication in case of up- load file already published |
| 3 | Title | Required | Title of the upload file |
| 4 | Authors | Required | Author of the upload file |
| 5 | Description | Required | Description of the upload file |
| 6 | Version | Optional | Version of the upload file |
| 7 | Language | Optional | Primary language of the report |
| 8 | Keywords | Optional | Describe what the content about |
| 9 | Additional notes | Optional | Extra description for the upload file |

Table 21 Basic information fields

December 2021 37 CERTH

The level of accessibility to the metadata can be chosen from the license tab. In addition, there is a field with regards to the grants that have funded the research, as shown in Figure 9.

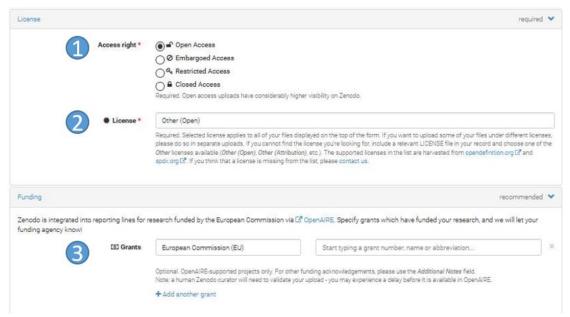


Figure 9 License and Funding field

| Number | Field | Significance | Description |
|--------|--------------|--------------|--|
| 1 | Access right | Required | Accessibility of upload files |
| 2 | License | Required | License applies for the files |
| 3 | Grants | Optional | The grants that have funded the research |

Table 22 License and Funding field

| Number | Field | Significance | Description |
|--------|------------------------------------|--------------|---|
| 1 | Related/alter- nate identifiers | Recommended | Specify identifiers of related publications and datasets |
| 2 | Contributors | Optional | Names of contributors that help to create the upload file |
| 3 | References | Optional | References for the upload file |
| 4 | Journal | Optional | If the upload file has been published in journal fill out the basic information of journal such as title, volume, issue, pages |
| 5 | Conference | Optional | If the upload file has been published in conference fill out the basic information of conference such as title, acronym, dates, place, website, session, part |
| 6 | Book/re- port/chapter | Optional | If the upload file has been published in book form, fill out the basic information |

December 2021 38 CERTH

| | | | of the book such as publisher, place, ISBM, book title, pages |
|---|----------|----------|--|
| 7 | Thesis | Optional | If the upload file has been published as thesis, fill out the basic information of thesis such as awarding university, supervisors |
| 8 | Subjects | Optional | Add subject from a taxonomy or controlled vocabulary with term and the identifier |

Table 23 Other Fields that can be specified on Zenodo

All metadata is stored internally in JSON-format according to a pre-defined JSON schema. They can be exported in several standard formats such as MARCXML, Dublin Core, and DataCite Metadata Schema (according to the OpenAIRE Guidelines).

December 2021 39 CERTH

3. Ethical concerns of the AMANDA project

The AMANDA consortium confirms that each partner checks with their national legislation/practice and their local ethics committee. That provides guidelines on data protection and privacy issues, in terms of both data protection and research procedures in relation to any of the proposed public engagement and potential volunteer research activities. Any procedures for electronic data protection and privacy conforms to Directive (EU) 2016/680 and Regulation (EU) 2016/679 on the protection of personal data and its enactments in the national legislations.

The process of adhering to the applicable regulations begins with a thorough investigation of the EU and national research projects' ethical guidelines as well as the examination of the directives regarding privacy and protection of personal data and free movement of data issues. The legislation with which the AMANDA consortium must conform includes:

- The Universal Declaration of Human Rights
- The Convention 108 for the Protection of Individuals with regard to Automatic Processing of Personal Data
- The Directive 95/46/EC & Directive 2002/58/EC of the European parliament regarding issues with privacy and protection of personal data and the free movement of such data
- Other European and national regulations related to privacy

The AMANDA project expects the development of a set of qualitative information collecting activities. In particular, interviews and questionnaires were planned, within Task 1.3. The double nature of consent appears again as both personal data and potentially sensitive information might be collected. Therefore, two issues become crucial from an ethical perspective: The confidentiality of the information and the anonymisation of personal data. The Code of Ethics of the International Sociological Association reminds researchers that "The security, anonymity and privacy of research subjects and informants should be respected rigorously" [5]. The sources of personal information obtained by researchers should be kept confidential, unless the informants have asked or agreed to be cited. Should informants be easily identifiable, researchers should remind them explicitly of the consequences that may follow from the publication of the research data and outcomes" [5]. From this article it is possible to extract some general rules that investigators must apply when designing and conducting their research:

- Information gathered from the participants should be kept confidential, unless specific consent to be cited is given by the participant.
- Information gathered should be anonymised and used only for the purpose for which it was collected.
- Participants must be informed when the investigator believes that some of the information shared may make them identifiable and the potential consequences.
- Participants must be given, in a clear and transparent manner, the opportunity to withdraw at any time and especially after being informed of their potential identification and potential the consequences.

In case the collected data contains personal information, data protection principles and legal requirements extracted from Regulation 2016/679 should be taken into consideration. In particular the investigator needs to put in practice organizational and technical measures directed to "minimising the processing of personal data, pseudonymising personal data as soon as possible, transparency with regard to the functions and processing of personal data, enabling the data subject to monitor the data processing" [6].

In case the collected data contains personal information, the responsible partner of the AMANDA project should apply the following rules:

• Information collected from the participants should be anonymised. Responsible partners of the Consortium prepares a summary, of the conducted research's results. The

December 2021 40 CERTH

raw information is kept in local resources by the partners under their own responsibility and according to the data protection policies of their own organisations. Partners should pay special attention to the respect of the minimisation principle following article 89 (1) of Regulation 2016/679.

- Each task leader collects the summaries and send them to the Ethics Helpdesk. The
 Ethics Helpdesk reviews that no personal or sensitive information is contained in the
 summary, unless the participant has given specific consent. If needed, the Ethics
 Helpdesk can consult LEPPI during the process. The summary can be shared within the
 Consortium once this point is verified.
- The investigator must obtain specific consent from all the participants prior to their involvement in the different activities.
- The task leader of each of the activities proposes to the Ethics Helpdesk a text containing the specific information concerning the activity. The Ethics Helpdesk validates the specific Informed Consent Form before it is used with any participants. Informed consent must be obtained, in written form.
- Oral informed consent is highly discouraged. Although oral consent is legally valid, the
 data controller must be able to "demonstrate that the data subject has consented to
 processing of his or her personal data" (Regulation 2016/679, article 7.1). Therefore,
 investigators should only use this procedure when there is no other possibility and
 after having consulted with the Ethics Helpdesk. The Ethical Body evaluates the situation, bearing in mind the potential value of the information that could be obtained
 from the participant.

Duly signed Informed Consent forms, both written and electronic or proof of the oral consent, should be kept by the controller for a five years period to be available for auditing by the Ethics Helpdesk or any competent authority.

Miniaturizing the electronic system is going to be safe and non-intrusive. The project goals are technical. Most of the collected datasets are going to describe electronic system behaviour e.g. power consumption, voltage stability, radio connectivity performance and others. The measurements, which are not related to the technical evaluation of the system, are foreseen to be related to environmental conditions. An investigated subject is exposed to the measured conditions. There is no intention to directly gather measurement from bodies of living creatures. Thus, there is no interaction between the electronic system and the body of the subject. The project does not have the aim to perform human trials. However, experiments where the device is placed in the room where people are present is considered. The project is not in the scope of Utilisation of Genetic Resources the Access and Benefit Sharing (ABS).

December 2021 41 CERTH

4. Conclusions and future work

This Deliverable details the data management and ethics of the project. Section 2 provides insight on the way the AMANDA Data Management Plan was created and implemented. This Section can later be used to track all the generated data in the project. It therefore satisfies the need of reusability of the generated data required by directive 2013/37/EU. Furthermore, the data which is generated during the project is mostly related to the performance of the electronic hardware. Also, this Section includes the description and systematisation of the data originated from the project. The data management approach presented in this report mostly consists of labelling and describing the generated data. In this way the data can be tracked during and after the project's execution.

During this project, no human trials are planned. However, data collection in form of questionnaires was conducted. Personal or sensitive data was labelled as such. Then, it was stored, analysed and used anonymously. The individuals were informed comprehensively about the intended use of the information collected from them. Participants provided their permission for data collection for a scientific purpose, with their active approval in form of a written consent. There is a potential for field tests, if time permits and lab testing is successful. These tests include the deployment of prototypes at the location of end users for a preliminary evaluation of the ASSC. However, this decision will be made towards the end of the project.

For each data set, ethical issues are considered separately in Section 3. The ethical aspect of each dataset is evaluated in the data description.

The data management plan & ethics document is an iterative report which will be finalised on M42 as part of **Deliverable D8.7 - Data management plan & ethics v4**. As a combined set of reports, it will document the progress of data generation, handling and storage.

December 2021 42 CERTH

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December 2021 43 CERTH