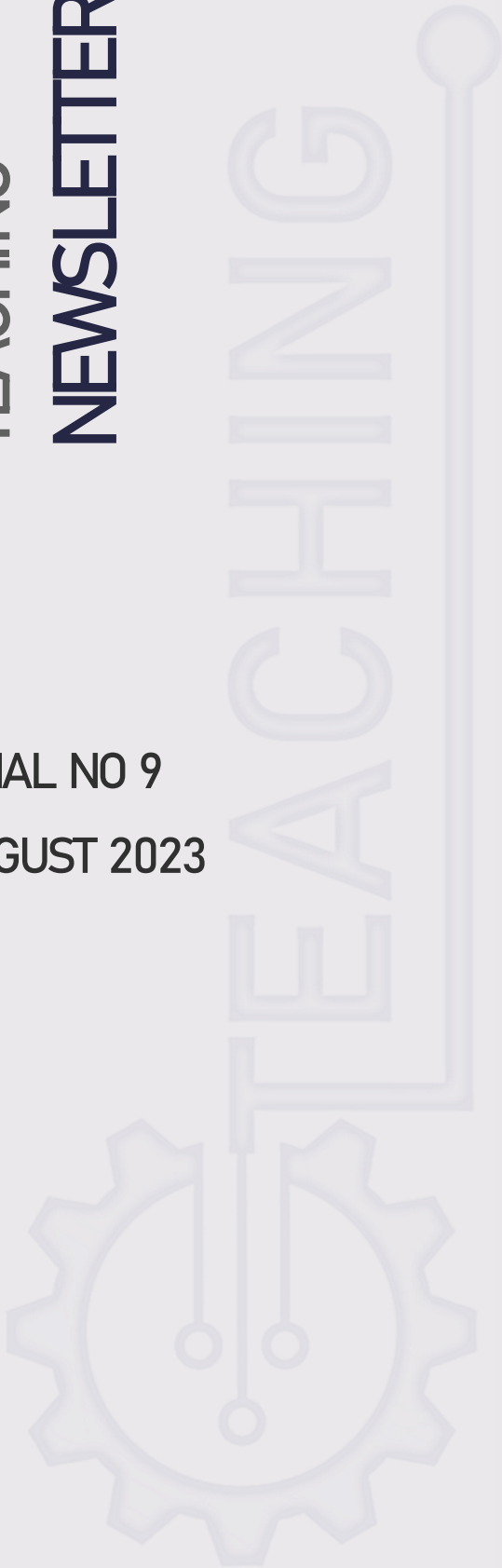


TEACHING NEWSLETTER

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TEACHING is an EU-funded project that designs a computing platform and the associated software toolkit supporting the development and deployment of autonomous, adaptive, and dependable CPSoS applications, allowing them to exploit sustainable human feedback to drive, optimize and personalize the provisioning of their services.





This issue provides a grasp of the main project developments during April 2023 – June 2023. It also provides facts on the results achieved, as well as links to the latest dissemination activities.

During the reference project period, TEACHING partners have implemented main technical action items, focusing on the tasks related to AI for human monitoring, AI models for human-centric personalization and Dependable AI models. Moreover due to the project closure, one of the final stages was the code wrapping for the demo pilots.

Regarding dissemination activities, TEACHING consortium have met virtually for the final consortium meeting in May 2023, while the Hackathon meeting has been organized successfully by our academic partners with the great participation of university students. The Hackathon took place on June 30th, 2023, as a key dissemination activity at the end of the 4 years project and has run in parallel in four different locations (Athens, Graz, Pisa, Bologna) and lasted an entire day.

TEACHING partners have submitted successfully the last five deliverables of the project by the M42 (June 2023). Publications proceedings have finalized as we were reaching at the end of the project. Also, deliverable D6.5 (“Final Dissemination and Exploitation Report”) was delivered and presents the reports from the performed actions within the dissemination, communication, and exploitation aspects during the project lifetime.

Public deliverables will be uploaded in our [TEACHING website](#) along with all the updated information and dissemination material such as Newsletters, Publications, Journals, etc.

TEACHING
HIGHLIGHTS
M40 – M42

WHAT HAS BEEN DONE?

The last leg of the project found WP1 wrapping the code for the demo pilots. Using the input collected from the simulations for both Avionics and Automotive use case scenarios, we evaluated the TEACHING platform's capacity to support complex data workflow involving ML/DL components and interaction between systems. The latter is of particular interest since the platform supported federated learning scenarios where heterogeneity and synchronization challenges were seamlessly tackled. Furthermore, some final modifications in the project repository took place so as to better organize it and make the platform more user friendly for prospective adopters. WP1 concluded its business with the event of the project Hackathon that it supported actively. Regarding the main output of WP1, the platform source code, there are ongoing discussions regarding its continuous support beyond the project's duration and scope. Concluding, apart from the tangible outcomes, the work in WP1 benefited its members offering new knowledge, ideas and experiences that will multiply the value to be added in our new ventures.



WP2 being officially over by the end of M36, and some effort from the participating partners has been devoted to supporting the exploitation of the platform tools developed so far within WP2 tasks, thus contributing to the experimental activities as well as completing the overall WP2 validation via the project use cases. The TEACHING platform developed by this WP includes tools for exploiting accelerated devices like GPUs and FPGAs for AI and stream processing, mechanisms for efficient and scalable networking, distributed federated learning and service orchestration. These allow to implement federated learning schemes as well as more generic distributed computation and communication patterns that tie together a multitude of Cyber-Physical Systems into an organized CPSoS. The platform tools are now used by both the flight management experiment and the experiment on autonomous driving with used.

The achievements and activities of WP3 of the TEACHING Project in the last time period have included the successful preparation and organization of a TEACHING Workshop at the international SafeComp conference in September 2023 in Toulouse. This event provided an excellent platform for researchers and experts to exchange ideas and insights on improving system dependability and also of AI-based systems. As part of our commitment to knowledge dissemination, TUG represented the TEACHING project at the ARTISAN Summer School in Vienna, where we shared our WP3 outcomes on dependability engineering concepts. The engagement sparked fruitful discussions and inspired young minds to dive deeper into this field (*I can also send you some pics related to this event*). The WP3 teams also finalized the dependability concepts reporting for the final deliverable, which represents the collective efforts of our dedicated team members. The comprehensive document captures the essence of our findings and recommendations for building robust systems. Furthermore, the TEACHING project team invested significant resources in refining and perfecting test environments and engage with students at the scientific partner sides



via utilizing these test environments in various lectures to impart hands-on knowledge to students and also via the TEACHING hackathon. Other highlights of this quarter was the submission of an invited paper to the DECSOS workshop. The paper aimed to trigger expert discussions on critical aspects of dependability engineering of AI-based systems, fostering a collaborative approach to tackling industry challenges. Looking ahead beyond the TEACHING project time period, WP3 partners remains dedicated to exploring new avenues and novel approaches in dependability engineering. Stay connected and be part of our journey in creating a safer and more dependable future.



During the last three months of TEACHING, the WP4 team has been working hard on the final stages of the project, focusing on the tasks related to AI for human monitoring, AI models for human-centric personalization and Dependable AI models. We have made significant progress in both scientific and technological aspects, as well as in the validation of the TEACHING AI toolkit in the automotive and avionics use cases. We have also contributed to several scientific publications

and events, showcasing our results and achievements. More specifically, we developed a comprehensive framework for learning from a federation of resource-constrained edge devices, continually, in the context of human state monitoring (HSM). We also performed extensive studies on the data collected from the automotive study #1 and collaborated with WP5 for the design and execution of the automotive study #2, which decisively contributed in meeting the project's objectives. We furthermore enhanced the reinforcement learning (RL) module of the AlaaS for human-centric personalization, implementing a federated A2C algorithm and comparing different algorithms such as PPO and A2C. We also integrated the personalization module into the AI-Toolkit and tested it in the final automotive scenario using the simulator at AVL's premises. For the avionics use case, we developed a synthetic dataset of anomaly traces and developed a detection model. On the side of Dependable AI, we collaborated to define a safety-critical use case based on TEACHING automotive use case, following the reference standards, and contributing to the standardization activities. All of these aspects are fully reported in the final WP4 deliverable, titled "Report on the final release of the AlaaS system". The scientific contributions have been disseminated by proceedings papers in major AI conferences, including ESANN, with the acceptance of several papers, ICASSP 2023, where we have presented two papers at the 1st workshop on Ambient AI. The work on dependable AI has been accepted for presentation at a DECSoS workshop within the SAFECOMP 2023 conference.

Finally, the WP4 team played an important role in organizing and running the project hackathon on June 30th 2023, which took place in four different locations: Athens, Graz, Pisa, Bologna. The hackathon aimed to develop a TEACHING application using the open platform developed within the project and run it on different hardware architectures (arm64 and amd64).

WP5 achieved a major milestone, completing two experimental use cases in the avionics and automotive domains. The TEACHING platform supports anomaly detection and pilot-approved decision-making in the avionics domain. However, the exploitation faces delays due to stringent safety restrictions. Simultaneously, the automotive sector utilized the same platform to improve understanding of human behavior targeting optimization of vehicle controls and personalization of human models.

Use Cases

The collected data is analyzed to enhance paths towards industrial applications while enhancing safety and performance. The target is an achievement of optimal machine-to-human interaction based on an improved understanding of human psychophysiological factors. That implies the detection of the human state for training and modelling purposes (as achieved by the performed use cases) and integration of those models into a test environment (be it a controlled avionics environment or driving simulator) with an intent for later inclusion of those models in real industrial settings.

TEACHING Dissemination and Communication

Within the reference period, the TEACHING partners continue to effectively disseminate the project results and continuously raise awareness. One of the main scopes of the TEACHING partners is to contribute and support communication activities of the project, in order to achieve all the dissemination goals due to the project closure.

In addition, website and social media analytics continue to be used to monitor website visibility and audience engagement throughout the project's duration.

Moreover, within the aforementioned period, the last consortium meeting of the TEACHING project took place on the 23rd of May, 2023. The meeting was very productive since we discussed all work packages activity reports, together with the actions full field so far and the next final steps to come. Also, technical discussions such as integration, demo preparations, use cases along with pilot outcomes and communication/dissemination approaches with the final action points have been presented. Finally, exploitation and standardization activities, have been discussed within the meeting while the main purpose was to focus on the results achieved and the KPIs from the proposal.

Furthermore, within the scope of the EU2020 project TEACHING "A computing Toolkit for building Efficient Autonomous appliCations leveraging Humanistic INtelliGence" we run a Hackathon on June 30th, 2023, as a key dissemination activity at the end of the 4 years project. The distributed Hackathon took place in parallel in four different locations (Athens, Graz, Pisa, Bologna) and lasted an entire day from 9:00 to 18:00 (UTC+2). It saw the participation of 57 people including the organizers, several PhD, master and bachelor students at different



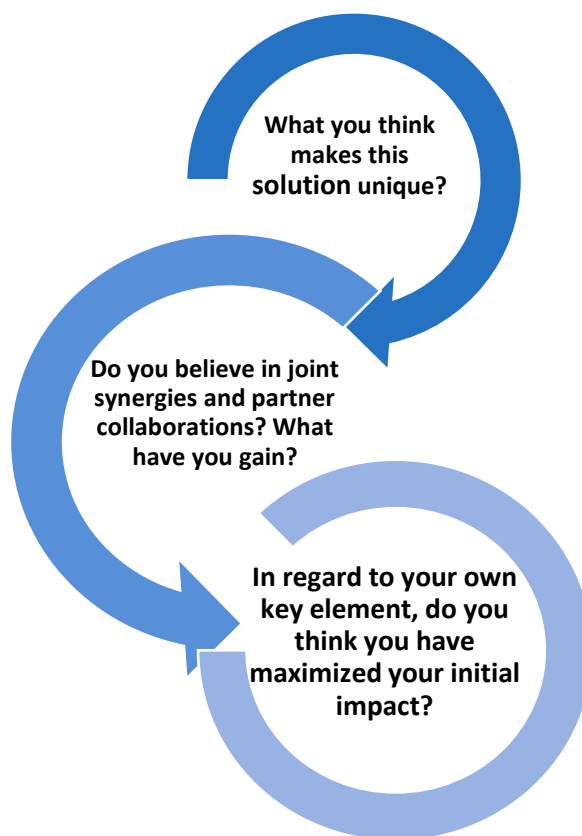
universities and specialization courses. The main objective of the Hackathon was to develop a TEACHING application using the open platform developed within the scope of the EU TEACHING project.

The TEACHING platform allows to streamline the development of distributed AI-enabled applications with a Human-centered design. During the Hackathon, the participants were required to use the platform to build their own applications. A Raspberry PI 3B+ with a camera module was given to each team with a starting dev-kit to simplify the integration of a custom object recognition module. A minimal introduction to the platform and the dev-kit was also given during the day. The Hackathon was successfully concluded with the award of the prize for the best team after a 3' minute pitch from each of them.

Finally, publications proceedings were finalized reaching the end of the project, and also the Deliverable 6.5 (Final Dissemination and Exploitation Report) was delivered, presenting the reports from the performed actions within the dissemination, communication, and exploitation aspects during the project lifetime. Thus, metrics, Key Performance Indicators (KPIs), existing strategies, knowledge facilitation, and results were analysed in detail.

TEACHING - Partners' Interviews

Due to the project closure, partners have met together virtually and shared their feelings and experiences that have gained within TEACHING implementation. We wanted to show this feedback in our last newsletter, so we have placed some valuable answers about our partners. Interviewing sessions has been made to academic but also to industrial partners of TEACHING consortium.



To exploit the result industrially/commercially it is important to focus on the distinctive values and performance of the platform vis-à-vis the competitors. What do you think makes this solution unique?

"The AI-Toolkit solution stands out due to its groundbreaking approach that fosters flexible and federated learning from resource-constrained edge devices, ensuring real-time adaptability and scalability. Unlike competitors, our platform is easily deployable and places a strong emphasis on human-centric personalization, tailoring AI models to individual user needs, leading to unparalleled user experiences".

**University
of Pisa**



"In terms of functional features: The support of multiple hardware boards. In terms of intangibles, it is the engineering solutions that were applied and the overall quality of the implementation that tackles multiple non-functional requirements in a way that the investigated current art doesn't".

**Harokopio
University**



"The dependability engineering concepts are focused on 3 diverse application areas and evaluated for applicability in 2 different domains. Currently no agreed concepts are rolled out industry-wide therefore the TEACHING building blocks have the chance to get adapted in standardisation groups via TEACHING project members. On the other hand, fundamental concepts have also been prepared with dedicated testing environments which make them applicable for inclusion into training and teaching activities with industrial experts and students, enhancing the awareness of the concepts".

**Graz University
of Technology**



"The ability to leverage humanistic intelligence to optimise the performance of CPSoS hence offering an opportunity for improved trust and acceptance of the offered solutions. It is only through acceptance and increased usage that the users can experience real benefits. Those benefits are further maximized by effective interaction between humans and machines, something that is offered by the TEACHING solution".

**AVL List GmbH
(AVL)**



Regarding your own key element, do you think you have maximized your initial impact?

"We believe that we have maximized our initial impact with our key element. Throughout the project, we focused on strategically aligning our efforts to ensure the best possible outcomes. By leveraging our expertise and resources effectively, we were able to achieve significant milestones and deliver valuable results."

**University
of Pisa**



"HUA was involved with a variable intensity to all project processes at all times, adapting the solutions to each new brought challenge and requirement. The starting set of requirements and specifications was continuously revised also considering the current state of the art. As such, if not the skills, then the process itself led us to the maximization of our initial impact."

**Harokopio
University**



"Our key building blocks we developed have been elaborated throughout the project life and enhanced by application in industrial environment of the TEACHING partner. Additionally we could establish some liaison with other projects and scientific partners of the TEACHING consortium. We have achieved combined master thesis and several master and project works, also enhanced our lecture concepts and training frameworks with TEACHING project outcomes and thus ensured a more up to date training. These trainings will be exploited via the TUG LifeLongLearning network and will also establish a solid basis for future research projects, student thesis, and industry cooperations."

**Graz University
of Technology**



"The TEACHING outcomes have already opened up new exploratory avenues in terms of understanding the human factors that form the basis for trust in technology. Consequently, the potential impact (which has also been partially estimated and quantified in the automotive use case) has been maximised as new exploitation avenues have been opened up."

**AVL List GmbH
(AVL)**



Do you believe in joint synergies and partner collaborations? What have you gain through this EU project implementation?

"Throughout the project, despite the initial difficulties related to the pandemic, we have always believed in the great value of collaboration between different partners. This EU project has provided us with valuable insights, expertise, and fruitful networking opportunities. Working together has accelerated progress and enriched our knowledge base, leading to impactful outcomes. In my view, the interactions between partners in WP4 exemplify successful project collaboration".

University of Pisa



"Through the project collaborations we got to learn of research areas and engineering approaches that we weren't aware of. We got involved in numerous research publications which improved our CVs but also provided us a perspective of science that is necessary to pursue new and bigger societal challenges. On this basis, we started three PhDs and our new R&D development plans were funded in at least one case (SOPRANO HorizonEurope Project)."

Harokopio University



"TUG is highly committed to joint activities and partner collaborations. Through the TEACHING project we found industrial partners in Italy for future cooperation's and scientific partners for future project proposals. In fact, a follow-up proposal has been submitted to follow up on the TEACHING project outcomes and findings, industrial cooab."

Graz University of Technology



"Yes, it is no longer possible to progress on one's own. The knowledge pool and skill gaps for implementing modern technologies are such that it takes cooperative efforts to deliver impactful solutions with decent acceptance levels."

AVL List GmbH (AVL)



TEACHING Deliverables

TEACHING consortium has successfully submitted all the final deliverables by the end of the project cycle. The project has already ended on the 30th of June 2023. Public deliverables once will be accepted, will be also available on the TEACHING website.

- D3.3: Final Report on Engineering Methods and Architecture Patterns of Dependable CPSoS; Public, M42, TUG.
- D4.3: Report on Final release of the AlaaS system; Public, M42, UNIPI.
- D5.4: Use case evaluation report; Public, M42, AVL
- D6.5: Final dissemination and exploitation report; Public, M42, ITML
- D6.6: TEACHING contribution to standards report; Confidential, M42, AIT.

TEACHING Publications

The TEACHING project also had an active performance via journal and conference paper publication, by presenting the research work carried out in the frame of the project. By the project closure and in order to achieve valuable scientific results and KPIs, partners have participated in online conferences, workshops and submitted more final papers.

The total number has reached 72 scientific articles in total (journals, conference proceedings, special sessions). The list of project publications is provided on the [TEACHING website](#), while most of the accepted and released articles are located in ZENODO and OpenAIRE. Those communities will be updated accordingly once the new publications are accepted.



TEACHING Consortium



Key Facts

Project Coordinator: Dr. Davide Bacciu

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Start: 1-1-2020

Duration: 36 months

Participating organisations: 11

Number of countries: 6

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