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.

WHAT HAS BEEN DONE?

Over the past six-months, the consortium continued developing the TEACHING concept and methodologies, with extremely promising results. In this regard, the project has succeeded at a large extent both from technical and non-technical perspectives. In particular, the effect of the human-in-the-loop concept in the CPSoS' operation, which is at the core of the humanistic intelligence concept of the project, has been elaborated more in detail. Sharing of basic safety aspects, considering the state-of-art of safety standards, including methodologies suitable for complex system architectures like autonomous driving systems, have been broadly progressing and still, there are much more to come.

With respect to WP1, UNIPI and HUA have been exploring the tight interaction between the AI components of TEACHING's autonomous applications. Additionally, partners have worked towards identifying an abstract model of the TEACHING application, with the information sources needed to run it and the mechanisms to support and ease the work of the application developer, in particular from the perspective of the AI models design and management. Furthermore, MM has elaborated on the Functional Safety ISO26262 and Operational Safety ISO PAS 21448 approaches by introducing the definition of functional safety as the main requirement to reach CPSoS-dependability. In parallel, fail-safe/fail-operational (top level) requirements have been analyzed and defined. Moreover, some methodological approaches, such as workflow and system model language have been used to describe the safety concept based on ISO26262. On the other hand, partners from I&M performed a study of the available solutions in terms of hypervisors and Real Time Operating Systems for high performance SoC. This has been useful for the definition of the use cases in WP5. Finally, specifications regarding the safety and security requirements for both use cases have been provided while TRT partners have also presented the challenges related to integrating AI in such domains where explainability and embeddability are prime concerns.

WP1

WP2

Investigating suitable hardware resources for prototyping a novel computing framework for high-speed streaming on edge resources has been started by UNIPI in the scope of WP2. The selection is based on the discovery of the usability of embedded systems equipped with ARM multicores and NVIDIA GPUs (Jetson Nano) and FPGAs (Terasic Han Pilot Platform). Currently, the research unit is working on the design of a new run-time system for

stream processing on small multicores and co-processors, able to take advantage of data parallelism provided by GPUs (leveraging the physically shared memory with CPU) and pipeline parallelism on reconfigurable hardware. The next steps of this work computations to be executed using this framework will be pre-processing ones (e.g., sampling, filtering, aggregation at the edge) and suitable ML/AI models will be identified also in cooperation with WP4 tasks.

Over the last months, TRT has ported the Flight Management System application to a Cortex A53/A72 with Linux platform, relying on raspberry Pi 3 & 4. Such a port should be directly usable once the I&M's iMx8 based platform is available. In addition, TRT started to implement the hardware monitoring features with a port of the METrICS environment to a ARMv8/Linux target, implying the development of a Linux driver to configure the hardware counters (requires privilege mode), a library to provide the probes, and a collector process gathering metrics being collected as traces to be forwarded to the AI algorithms.

The TEACHING partners also keep pace with research activities related to dependability and secure CPSoS (WP3). Defining risk assessment metrics and procedures for AI models as well as methods to characterize and, possibly, protect the safe operational regime of AI models are the utmost important attributes of WP3. The ultimate objective of this activity is to define a regulatory scheme and accepted standard for the inclusion of AI components into highly dependable and safety certified CPSoS. In this context, UNIPI has been collaborating with the WP3 partners to design dependable engineering schemes supporting the integration of AI-based components with safety-critical architecture. HUA experimented with the concept of the AI model performance degradation in online training scenarios. Assuming that such a model is autonomously navigating the vehicle, it is prone to such a degradation and even catastrophic forgetting. HUA's work on identifying the conditions under which such a degradation happens and either mitigate or predict the problem.

To safeguard the dependability of an AI-based system partners of MM are working on creating a "new" safety case based on SOTIF and ISO 26262 merged standards. With the aim to analyze the dependable CPSoS solution in a structured way, MM is developing a procedure for Functional Safety Assessment based on these standards. First steps in this direction have been taken; an item definition template has been shared with partners, to collect proper information on the system under safety analysis. Further activities, like a checklist for SOTIF and ISO26262 on the development phase and the merging of SOTIF and ISO26262 workflow, are still ongoing.

Finally, while assuring inter-WP cooperation, I&M has participated in the definition of the architectural concept providing insight on the possible hardware solutions about dependability regarding both automotive and avionics use cases.

Regarding the WP4 activities, UNIPI, in cooperation with other partners, has conducted a survey on the state-of-the-art on Human State Monitoring highlighting topics from various tasks, such as type of sensor, datasets and algorithms used for predicting the human state. The survey has a strong focus on the applicability of Machine Learning algorithms and techniques to detect the physiological state of a subject from the biological signals that can be collected from non-invasive sensors. Apart from this, the design of an architecture for the AI-as-a-service system for federated learning has been jointly structured, allowing an easy-design distributed application that take

advantage of federated learning. Moreover, HUA modeled an approach on enhancing the vehicle's control system based on driver's state and by using an open-source simulator for autonomous driving (CARLA) started an experiment on the aspects of modifying the driving functionality of the vehicle controllers. We have modified the behavior agent of CARLA so that it automatically chooses between the preset modes based on the driver's stress levels (still simulated with keystrokes). We are working on training a Reinforcement Learning agent using CARLA's camera sensors and/or longitudinal, lateral proximity sensors. MM has analyzed the architectural solution proposed within TEACHING project, with a specified focus on the dependability of AI and DNN based systems. MM's aim is to try to define a methodology to establish a link between dependability evaluation and functional safety integrity level definition. Moreover, MM has proposed some requirements for AI dependable systems design. Based on the state of the art for dependability for AI and DNN, a study for the definition of some attributes and their possible evaluation metrics, to describe a dependable AI-based system, is ongoing.

TEACHING develops tools and technologies targeting dependable and highly secured autonomous CPSoS applications, where humans are in close interaction with the system and are directly experiencing consequences of the interactions. Autonomous Driving and Aviation domains are chosen to demonstrate the selected proof-of-concept. A series of project-wide targeted workshops has taken place in recent months focusing on the detailed definition of TEACHING use cases. Considering the disparity of the two industrial domains (automotive and aviation), which are providing the two Use Cases, the target is to find constructive overlaps for the future execution of TEACHING technologies in a demonstrable fashion. Hence, the discussion goes beyond the specific needs of the proposed supply chains and considers integration aimed at sustainable exploitation.

Succinctly, the workshops have generated a set of Use Case requirements and specifications as well as a constructive mapping of those onto the TEACHING hardware platform. This process of mapping the needs of the project to its implementation involves project-wide, cross-WP discussions and helps streamline the technical developments towards sustainable impact creation.

TEACHING MEETINGS & EVENTS

Only one general meeting has been held since the Kick-off the project. Currently, the partners are preparing the second consortium meeting, which will be held on 16-17 of November 2020. This virtual meeting will allow partners to review and discuss the project status, the performed work and will examine the crucial action points to be executed for the next six months.

Although regular dissemination, communication and exploitation activities of Horizon 2020-funded projects have been severely hampered by the Coronavirus outbreak, our team has been leveraging the participation in online events to increase the exposure of partner activities within TEACHING and the benefits that the TEACHING platform will offer. Some highlighted events are presented below.

Our partners from Technische Universität Graz (TUG) have participated in the EuroSPI² 2020 in Düsseldorf by leading a panel discussion with international experts from industry and academia on integrating AI-based systems into Autonomous Vehicles.

New ideas and emerging results on behalf of our project have been recently presented to AI researchers and safety experts by Dr. Georg Macher (TUG) during the WAISE2020 workshop. During this event, the interdisciplinary discourse with the expert colloquium raised awareness for the TEACHING project and helped establish requests for TEACHING outcomes and future cooperation possibilities.

The TEACHING project also had an active performance in two well-known conferences by presenting the research work carried out in the frame of the project. The list of the presented articles is listed below:

The International Joint Conference on Neural Networks

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- Claudio Gallicchio, Alessio Micheli "Ring Reservoir Neural Networks for Graphs" International Joint Conference on Neural Networks (IJCNN) WCCI July, 2020
- Daniele Di Sarli, Claudio Gallicchio, Alessio Micheli "Gated Echo State Networks: A preliminary study" International Conference on Innovations in Intelligent SysTems and Applications (INISTA) August 2020
- Claudio Gallicchio "Sparsity in Reservoir Computing Neural Networks" International Conference on INnovations in Intelligent SysTems and Applications (INISTA) August 2020

TEACHING TUTORIALS

The TEACHING concept with a focus on humanistic intelligence was presented in a course at the postgraduate programme of the Department of Informatics and Telematics, at HUA. Given the circumstances, the course was conducted online. The presentation emphasized on the automotive use case scenario and the TEACHING personalization component. In addition to this one thesis work on the topic of autonomous driving while considering human comfort has assigned. Additionally, in July, 2020 during the International Joint Conference on Neural Networks (IJCNN) WCCI 2020, a short tutorial course was given by Claudio Gallicchio about "Deep Randomized Neural Networks".

Università di Pisa · Harokopio University · Consiglio Nazionale delle Ricerche · AVL · i&m Ideas&Motion · Magneti Marelli · Thales · TU Graz · Infineon · ITML

Key Facts

Project Coordinator: Dr. Davide Bacciu
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Start: 1-1-2020
Duration: 36 months
Participating organisations: 10
Number of countries: 5

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