HUBCAP
Digital Innovation HUBs and Collaborative Platform for Cyber-Physical Systems

Newsletter 5 March 2022

HUBCAP Newsletter: Special Feature 1/2

Join the HUBCAP DIHs!

HUBCAP brings together Digital Innovation Hubs to support SMEs embracing digital innovation. Our focus is on model-based technologies and solutions to design and develop Cyber-Physical Systems (CPSs).

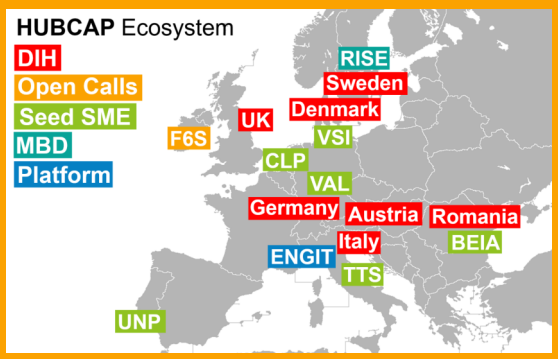
HUBCAP is developing an open, cloud-based **Collaboration Platform**. This innovation portal enables businesses to contribute and access digital assets needed to undertake Model-Based Design (MBD) for building Cyber-Physical System solutions on the scale required for SMEs. Assets include both models and services, and they are made available to allow businesses to manage their investment in MBD technology and to promote experimentation.

The **HUBCAP** Collaboration Platform offers access to the HUBCAP innovation community of DIHs and SMEs, to catalogues of models and tools for model-based design, and to a variety of innovation support services from DIHs. Visit the Collaboration Platform homepage at https://hubcap-portal.eng.it/welcome/ to get an overview of its offerings. The full contents is available to registered users.

We are now inviting other Digital Innovation Hubs to join our network and contribute to the platform. If you are interested to present your DIH and your services on the platform, to connect with other hubs across Europe, learn about how SME apply model-based design tools in their CPS designs, or want to enable the SMEs in your ecosystem to learn about MBD technologies and get hands-on experience with modelling software and existing models in our HUBCAP Sandbox Middleware, sign up to join the HUBCAP DIH network. Simply click on for further questions contact our HUBCAP service center at info@hubcap.eu

In this HUBCAP newsletter special feature we invite you to become a HUBCAP DIH, as well as present the outcomes of our first set of experiment calls!

Look out for the follow up special feature (2/2) where we present further outcomes from our first EXPERIMENT calls!



Become a HUBCAP DIH Today!

Join our growing network of DIHs!

- Help support SMEs in MBD of CPS!

READ MORE hubcap.eu

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First Experiment Success

With the close of our first projects which enabled SMEs to experiment with MBD methods and tools for CPSs we are proud to announce the outcomes covering a variety of domains including aviation, smart devices, healthcare and more! If you'd like to find out more contact info@hubcap.eu.

ACDSAT

Accidents occurring during the ground handling of aircraft cause over $10 billion in damage per year. Collisions with tooling, vehicles, and other aircraft contribute to massive repair costs, downtime, and flight scheduling delays. The goal of this experiment between **Evitado Technologies GmbH** and **Mototok International GmbH** was to apply technologies from the self-driving car industry and recent advancements in LiDAR perception to the tug machine handling of aircraft.

The experiment started with a simulation of various LiDAR types covering different scenarios experienced when towing aircraft to determine the best sensor for the solution. The amount of coverage of a chosen aircraft and its surroundings was analyzed. This exploration of coverage was important to determine what the collision detection aspect of the Evitado system is able to see when a LiDAR is integrated into the Mototok tug (Figure 1). This analysis was conducted using Gazebo and a version of the simulator was uploaded to the HUBCAP sandbox.

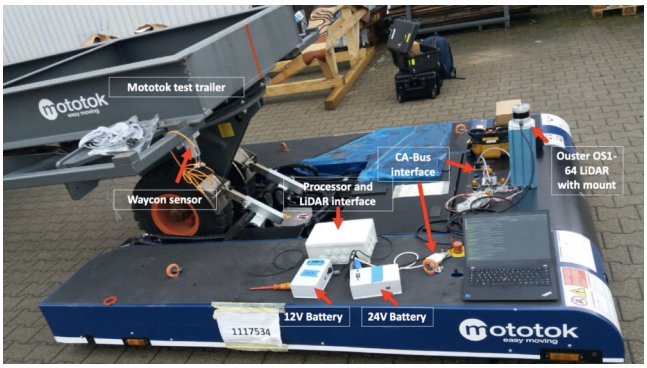

Figure 1 - Evitado & Mototok LiDAR system.

A LiDAR was chosen to integrate and test with a Mototok tug. The LiDAR was integrated into Evitado's proprietary tracking algorithm.

The Evitado system was closer integrated with the tug's CAN -Bus system in order to communicate system status, driving speed and detected steering angle of the tug relative to the aircraft. Testing was conducted by moving the Mototok tug with a test trailer in order to calculate the error between calculated and true steering angle as well as tracking delay.

The experiment resulted in over 100 Gb of collected real world movement data. The steering angle tracking testing detected mean error of steering angle tracking of less than 2° with a delay of less than 0.5 seconds in more than 75% of the movements conducted, with a max mean error less than 3.5° and 0.605 seconds of delay.

"The HUBCAP project and subsequent funding gave the opportunity to validate our simulation tool that allows the evaluation of LiDAR sensors in different situations. It opened the door for further cooperation with our consortium partner to explore our technology in their tugs. Ultimately we believe that this project will open the door to future economic development for both companies" - ACDSAT Team

Safe2Go

The **goal** of the **SAFE2GO** experiment was to incorporate novel MBD tools into the hardware and software development practices of an e-scooter sharing platform BOOST to ensure **safety requirements** to be strictly met at any time and in any conditions of e-scooter use.

At the same time, Developair (a HUBCAP SME asset) offers MDB tools for verification of requirements and automatic test generation, enabling the **optimization** of the software development life cycle. The architecture and safety requirements of the BOOST use case (of KMB company) have been specified using MBD tools provided by Developair. New features have been implemented: that make the tool more powerful and versatile. Then, those requirements were verified to detect errors and inconsistencies between them.

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First Experiment Success (cont.)

Moving from informal requirements to fully formalized ones allows to automatically detect problems early during the requirement specification phase, avoiding those errors propagating to the implementation (see Figure 2).
After that, black-box functional tests were generated automatically from those requirements to test that the code was doing what the requirements specified. The generated tests are compatible with a popular testing framework (i.e., Unity).

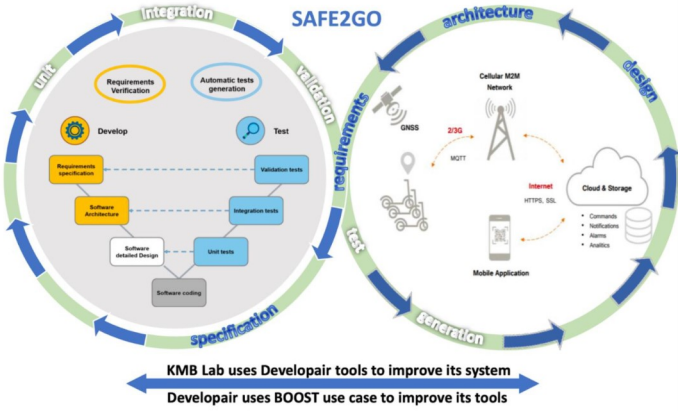


Figure 2 - SAFE2GO MBD safety practices.

It allows for using standard tools, e.g., for measuring the code coverage of those tests. Given that now the tests can be generated from the specification and are ready even before the implementation, testing starts before in the process (following TDD).
Finally, a connector to the platform where the tests are going to be executed, in this case the Unity framework, was developed.

"Hubcap has provided the framework from the most general to the most concrete contribution: know part of the European MBD and CPS community, their products and challenges; allow to look for a complementary partner and meet in depth its company and product" - Safe2GO Team

WHY-PRED

"Should I fertilise today or not?" - the answer to this question on smaller farms is often based on the subjective experience of the farmer (see Figure 3).

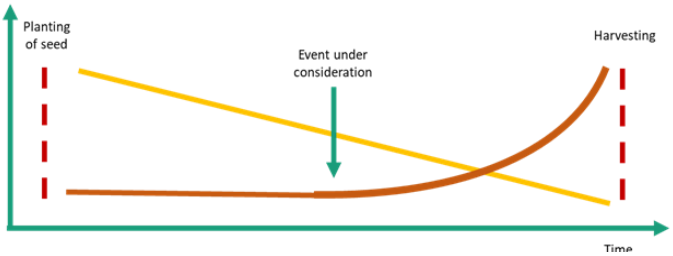
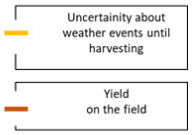


Figure 3 - WHY-PRED concept.



On the one hand, a wrong decision has monetary effects - unnecessarily used fertiliser generates costs and requires working time. However, fertiliser that is not used also has negative effects, such as a lower crop yield. With falling food prices, too low a profitability can pose livelihood problems for the farmer. From a more holistic point of view, over fertilization also unnecessarily pollutes the environment - with sodium or phosphorus. Increasingly dynamic weather patterns due to climate change also present SMEs with the challenge that historical empirical values about the weather can no longer be extrapolated. WHY-PRED investigated the extent to which these challenges can be resolved, and the farmer supported through data-based approaches, while at the same time minimising the environmental impact.

Available process models for wheat cultivation were evaluated and adapted to a specific application for the Hedwigshof farm. The models were calibrated to Karlsruhe and enriched with historical data. The aim was to show the farmer the impact on crop yield of the decision "Should I fertilise today?" This enables a cost-optimal fertilisation that simultaneously minimises the environmental impact.

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First Experiment Success (cont.)

With the help of the funding, the SME could be accompanied on its way to becoming a digital farm. In addition, available academic models were examined for possible applications in the day-to-day operations of a small farm and their limits were evaluated. With the experience gained, a decision support system can be developed that makes Agriculture 4.0 also accessible for SMEs.

"The HUBCAP project enabled us to do the groundwork for developing a decision support system for small and medium sized farming companies. Thanks to the funding we have been enabled to look into this really interesting topic" (David Lumpp, Agricultural engineer @DatenBerg)

ITwinBuild

The partners implemented a large Model-Based Design (MBD) CPS "SmartPerson@SmartHome" as a hierarchy of smart objects having their own data sources and KPIs to run AI-driven calculation of system status in real & future time. The complete CPS model of the system "Smart Human @ Smart Home" was implemented, all planned indicators were defined and entered into the knowledgebase.

The major difference between indicators and data sources for data import or sensors for data collection in real time, is that indicator processors in the Digital Twins allow calculating the state of each new indicator using its latest value considering multiple properties of each physical process it represents.

In total, considering the two main monitoring objects Human and Home for the user's health and its life conditions, we defined 108 new indicators each with 3 optional states and configured the rules for evaluation of the Digital Health Twin homeostasis using the combinations of indicators and their objects. As a result, after tuning the targets for each indicator and adding calculations of the object states, a full-fledged operational CPS model was obtained in accordance with the experiment objectives.

"The funding let us combine expertise, novel CPS/IoT/AI technology PharosN to develop practical health monitoring solution within 5 months. " - ITwinBuild Team