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A Software Engineering Approach to Digital Twin Architecture: The HUMAN at home project and Twin Cooperation of roBOT and human project case studies

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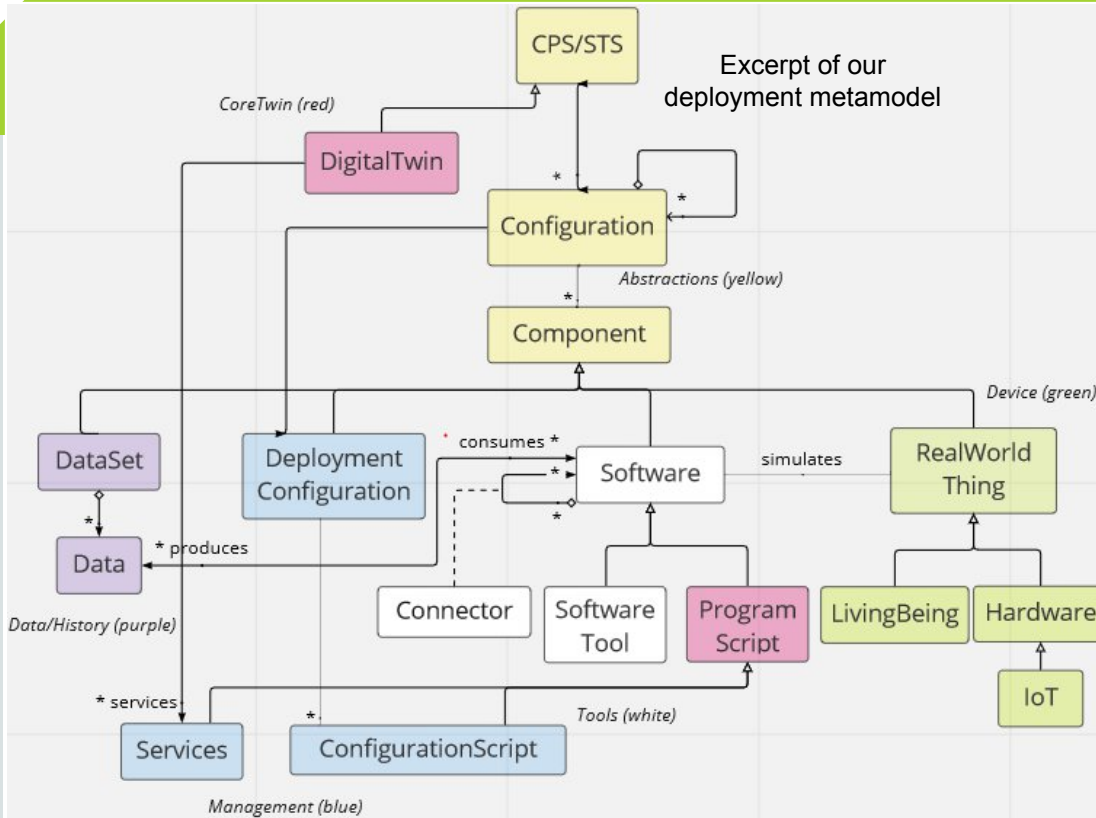
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A Software Engineering Approach to Digital Twin Architecture

The HUman at home project and Twin Cooperation of roBot and human project case studies



Motivation – Digital twin (DT), Internet of Things and Artificial Intelligence are key emerging technologies in Industry 4.0. However, concrete and operational models are still to be designed to manage the deployment of DTs [1]. Our proposed metamodel is a first step towards a model-driven approach for DT deployment. It is derived from our previous work on ADLs [2, 3].

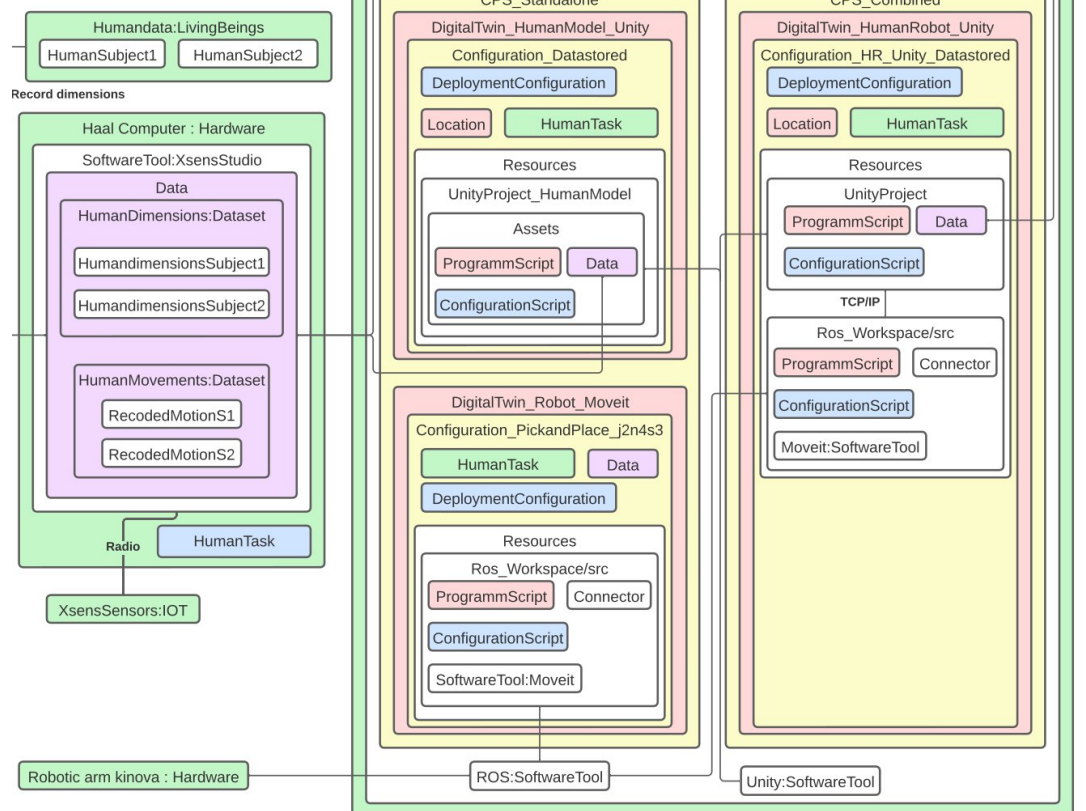
Objective – Develop a metamodel that supports concrete operational descriptions of digital twins; Validate in two human-robot interaction case studies: a robotic arm and a home automation application.

Robotic arm application

In the robotic arm case study, DTs of the interacting human and robot are used for motion planning in pick-and-place tasks.

Our deployment metamodel can describe the combination of software and hardware used, including: ROS, Unity, Kinect, Xsens body suit, Kinova j2n4s300 robotic arm, etc.

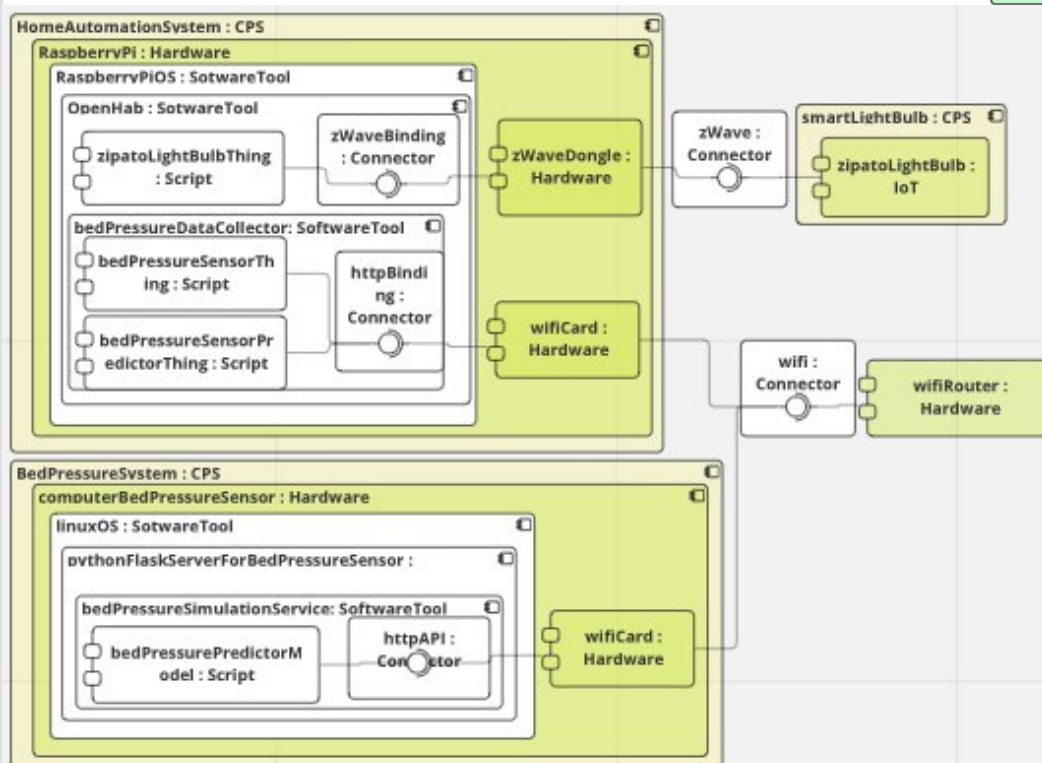
The transformation of this model into executable deployment descriptors is being studied.



Home automation application

In the home automation case study, DTs are used to handle and predict the interactions between a smart appartement and its inhabitants. The validation of our metamodel is here twofold:

- ▶ modeling of CPS architectures including DTs of sensors/actuators and AI models,
- ▶ full implementation as executable deployment descriptors of the modeled elements using Ansible scripts.



References

- [1] Fei Tao, Meng Zhang, and Andrew Yeh Chris Nee. Digital twin driven smart manufacturing. Academic Press, 2019.
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- [3] Paul Perrotin, Nicolas Belloir, Salah Sadou, David Hairion, Antoine Beugnard. HoS-ML: Socio-Technical System ADL Dedicated to Human Vulnerability Identification. 26th International Conference on Engineering of Complex Computer Systems, Mar 2022, Hiroshima, Japan.

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