Summary BSc Thesis

Title: Addressing Integration issues during the design and development of a Synthetic Prototype Environment for industry 4.0: A model-based systems engineering approach.

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Assignment Overview
During this assignment, a framework was developed to solve the integration issues that occurred between separately developed components during the development process of a Synthetic Prototype Environment.

Synthetic Prototype Environment
A Synthetic Prototype Environment is a product that helps companies visualize the consequences of a new configuration of production assets in real-time, enabling them to make informed decisions throughout the development of their production environment.

The Synthetic Prototype Environment consists of tangible scaled version of a production environment where a company can monitor their production environment, prototype new production environment setups and implement these prototypes.
The Synthetic Prototype Environment provides immediate insight about prototypes by simulating the production setup in real-time to speed up the decision-making process.

Figure 1 The Synthetic Prototype Environment that connects virtual and real (Damgrave & Lutters, 2020)

Problem
In the past, many designers have developed separate components of such a Synthetic Prototype Environment. However, the design and development of these components were never coordinated, leading to:

- Missing or incompatible interfaces between components.
- Redundant, duplicate, or conflicting functionalities.

To solve these integration issues, a broader view should be taken during development. Connections between components of the SPE should be defined and visualized throughout the development lifecycle.

Solution
To help future designers define and visualize the connections between the components of the SPE, a framework was developed using a model-based systems engineering approach (MBSE). This framework consists of:

1. A set of requirements for the SPE that all components must adhere to.
2. A flexible methodology to define interfaces between SPE components.

Evaluation

A case study was conducted where the framework was used to develop a prototype for a part of the SPE. The connection with a real production environment, data visualization, and predictive capabilities were not implemented. This case study shows potential for the framework to solve the integration issues. The developed framework provides future designers with both the structure and tools to further the development of the Synthetic Prototype Environment.

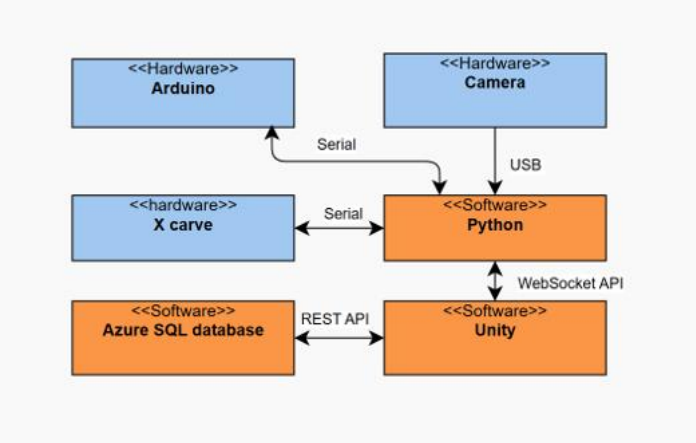

Figure 3 Case study: defined component interfaces

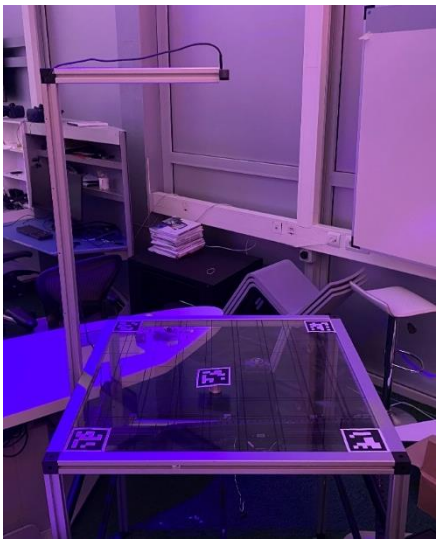

Figure 2 Case study: Prototye design

Future Research

Future research should expand on the limitations of this study and should focus on:

- Evaluating and refining this framework during design and development.
- Implementing the missing functionality of the prototype from the case study.
- Applying the proposed framework to develop and integrate SPE components.

Bibliography

Damgrave, R. G. J., & Lutters, E. (2020). Synthetic prototype environment for industry 4.0 testbeds. *Procedia CIRP*, *91*, 516–521. https://doi.org/10.1016/J.PROCIR.2020.02.208