A STORAGE SOLUTION FOR THE SYNTHETIC PROTOTYPE ENVIRONMENT

S.C. Wieles

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Public Summary

In the last decade, production environments in industry have made large developments. The so-called Fourth Industrial Revolution has led to an increase in data collection in production environments, transforming these environments into Smart Factories. Production facilities are connected to the Internet of Things, which offers advantages in several fields, e.g., customization management, resource management, or maintenance design [1]–[3]. This development in industry has led to the need for new ways to interact with data.

The Synthetic Prototype Environment, or SPE, is a device which assists different stakeholders in industry with collaborating. This interactive prototyping environment can assist during the development of a production environment by allowing multiple stakeholders to interact with a scaled, interactive, and adaptable representation of this environment. This concept is implemented in the form of a table, on which 3D-printed scale models move around. The models can be moved by hand, or by a computer-controlled magnet, which is mounted under the table.

Several other interfaces can be used to convey additional information to the stakeholders. A projector can display additional data on the table itself, external monitors can be used to control the SPE, or virtual or augmented reality devices can help stakeholders to gain new perspectives on the presented data. Another possibility is linking two different SPEs, which offers potential for distance collaboration.

Three phases during the development of a production environment are recognised: the Digital Master, Digital Prototype and Digital Twin phase [4]. When used as a Digital Master, no connection between a digital and a real environment is made. The SPE is used to configure and modify a new environment, while additional information layers like projection or AR can be used to display the effects of these modifications on the environment.

When used as a Digital Twin, the SPE is used to monitor and control a real environment. Using sensors connected to different production facilities, the current state of a production environment can be displayed. The connection between the

real and virtual environment is bidirectional, meaning the SPE can be used to make changes to the real environment. An example of this is controlling Automated Guided Vehicles (AGVs).

When used as a Digital Prototype, the connection to the real environment is monodirectional. The scaled environment is fed by data from the real environment. Changes made to the scaled environment are not directly implemented in the real environment, allowing stakeholders to modify the environment based on data captured in the real environment.

All of these functions are dependent on a shared information backbone. While different interfaces can offer additional perspectives or separate simulations, they are based on the same data. In order to support further development of the SPE, it therefore makes sense to start with improving this information backbone.

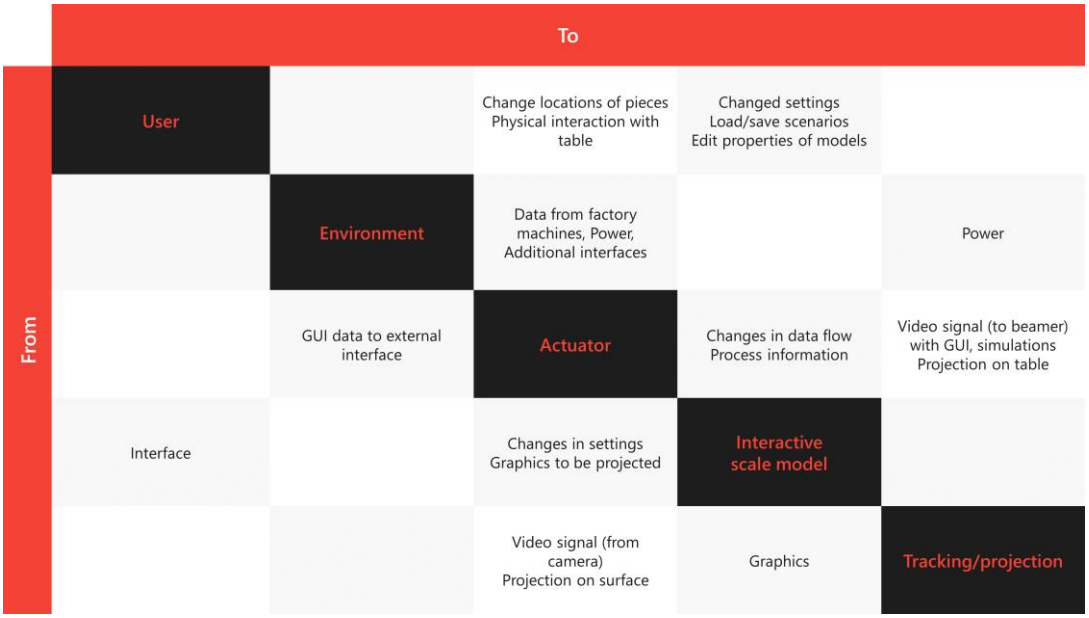

Figure 1: The modular N2 diagram, which displays the in- and outputs between subsystems.

A systems engineering approach was selected for the development of the prototype, in order to gain a clear overview of the desired functions, and establishing a framework on which future developments can be based. The SPE as a whole is divided into three different subsystems: the actuator, which physically moves the models on the table, the interactive scale model which includes the interface as well as the information backbone, and a tracking/projection module. The interfaces between users, the environment, and the subsystems can be seen in Figure 1. By isolating these subsystems, a clear overview of the functions and requirements of each part of the SPE has been gained. In Figure 2, an overview of the different functions can be seen.

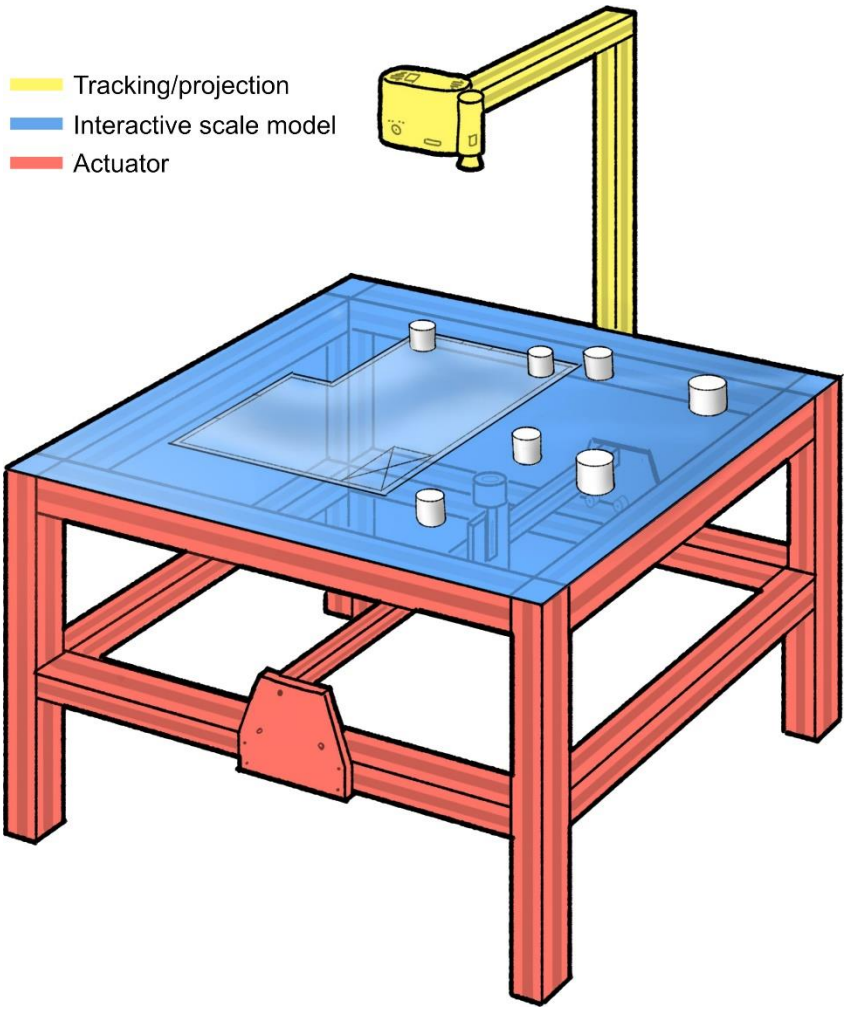

Figure 2: Visual representation of the three subsystems.

A data framework was created in this assignment which fulfils some of the requirements of the interactive scale model. Saving and loading different scenes is now possible, but the main change is that changes on the SPE are now loaded from an Azure SQL-server. Any change made in the software of the SPE is now mirrored in a SQL database, which can be accessed easily by different devices, opening up possibilities for future development.

References

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