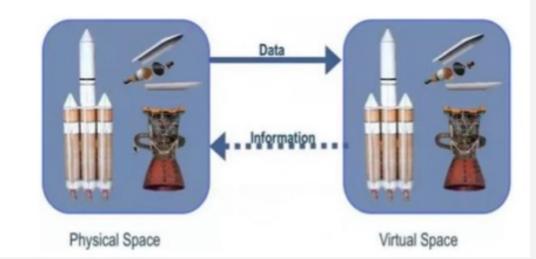# Creating a virtual laboratory with a digital twin
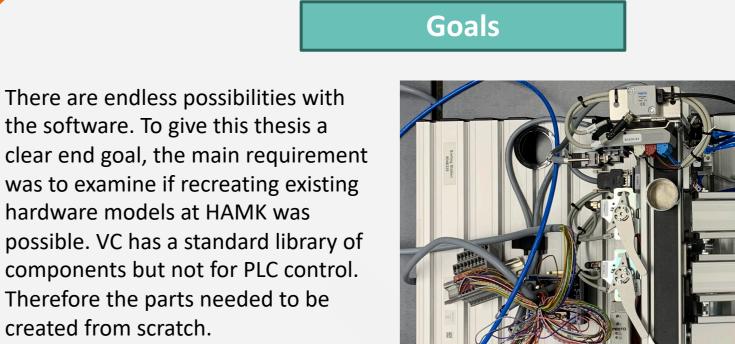
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Master of Elektromechanical Engineering Technology – Automation Engineering Technology

Situation

HAMK (Häme University of Applied Sciences) wants the ability to teach practical classes online and the option for students to practice at home with digital twins. Digital twins (DT) are a popular research topic and are used more and more for industrial applications.
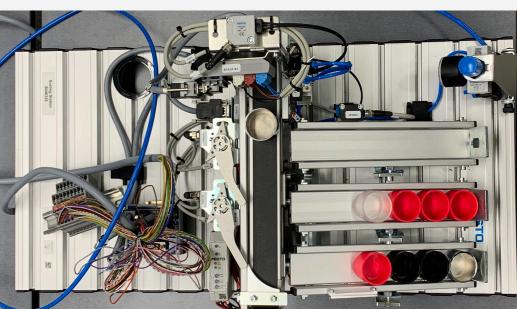

Figure 1 Three dimension DT mode [1, p.2406]

This thesis investigates the possibilities of recreating hardware products with the digital twin and the ability to control the DT with a PLC. The chosen software is Visual Components (VC).

Figure 2 Visual Components logo

Goals

There are endless possibilities with the software. To give this thesis a clear end goal, the main requirement was to examine if recreating existing hardware models at HAMK was possible. VC has a standard library of components but not for PLC control. Therefore the parts needed to be created from scratch.

Figure 3 Example Festo model at HAMK

The following functionalities of VC were used besides the modelling of components:
* Robot programming
* Process flow simulates industrial processes and gathers statistics such as production feed, idle time of a machine,…

Figure 4 Production feed graphs

Results and conclusion

With a combination of the created models, it is possible to recreate the existing hardware models. Besides the main goal reached, understanding the software opens up endless possibilities. HAMK will use the included manual in the thesis to teach students how to create their models.

Figure 8 shows an example of a robot doing a weld on a product placed on a work positioner. This is to show the possibilities with the software.
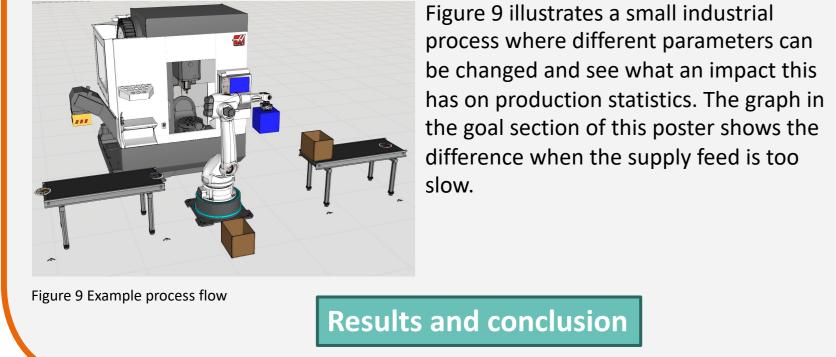

Figure 8 Example robot programming

Figure 9 illustrates a small industrial process where different parameters can be changed and see what an impact this has on production statistics. The graph in the goal section of this poster shows the difference when the supply feed is too slow.
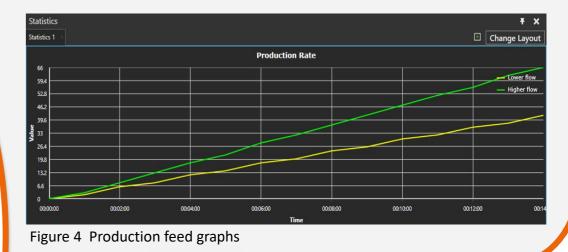

Figure 9 Example process flow

Method

Figure 5 shows a sensor and two actuator CAD models, but nothing will move or measure anything without a python script or joints.
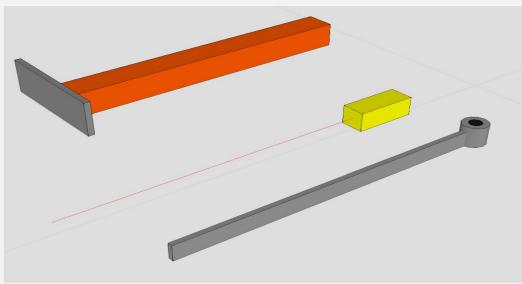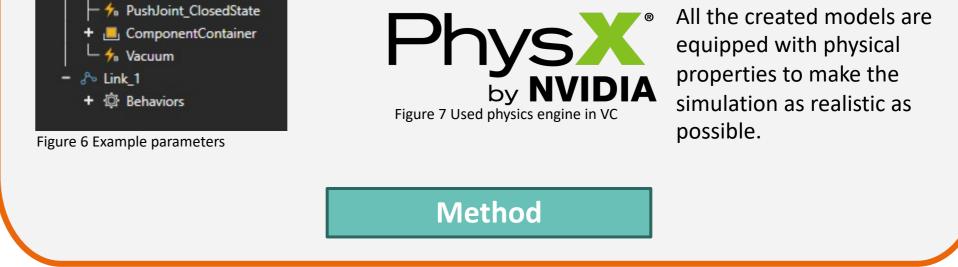

Figure 5 CAD models of a sensor and actuators

The modelling of any component is done with these steps:
1. Import/draw a 3D CAD design
2. Explode the model and add possible joints
3. Add properties/behaviours
4. Program the python script

Figure 6 Example parameters

Figure 7 Used physics engine in VC

All the created models are equipped with physical properties to make the simulation as realistic as possible.

Supervisors / Co-supervisors / Advisors

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[1] F. Tao, H. Zhang, A. Liu, and A. Y. C. Nee, 'Digital Twin in Industry: State-of-the-Art', *IEEE Trans. Ind. Inform.*, vol. 15, no. 4, pp. 2405–2415, Apr. 2019, doi: 10.1109/TII.2018.2873186.

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