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Development and Implementation of an Industry 4 Laboratory Flexible Assembly Cell

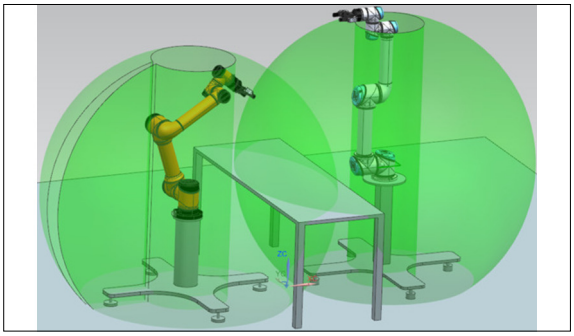

Figure 1: CAD model of a simple robotic assembly cell with the working area (green).
Own presentment

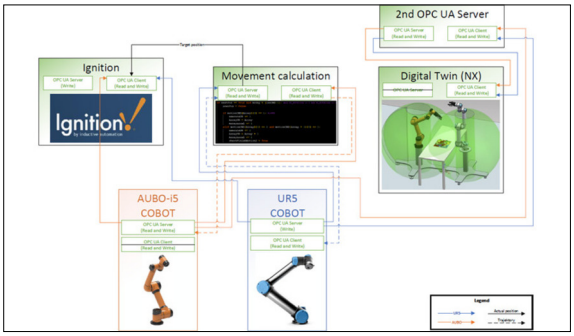

Figure 2: Connection diagram of all devices and software tools needed for the flexible assembly cell.
Own presentment

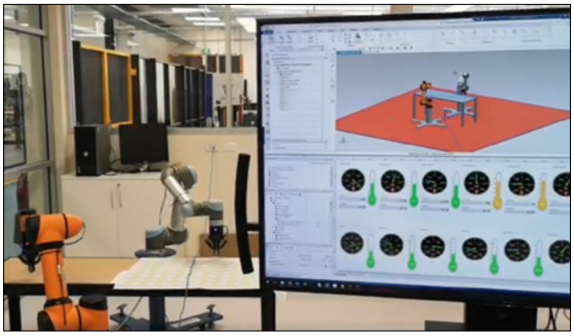

Figure 3: Physical assembly cell (left) with digital twin (top, right) and monitoring are in Ignition (bottom, right).
Own presentment

Problem: Globalisation forces companies to lower their prices. In order for companies to remain competitive in high-salary countries, production must be automated. Other than mass-production, small quantities or highly individualized products are currently more difficult to automate and therefore costly.
The goal of this project is to develop an assembly cell, which includes controlling two robots simultaneously and setting up a Digital Twin as well as an Industry 4.0 system. An extended goal of this setup is the ability to adjust the assembly procedure in real-time depending on the product.

Approach: Advantages of this setup are that two robots are faster in assembling, and the production does not need to pause if one robot fails, because the setup of two or more robots is redundant. Furthermore, with Industry 4, the whole system is connected and can be used in future projects to improve it even more.
To achieve that goal, a robotic assembly cell is set up (Figure 1) with two collaborative robots from different manufacturers, which have a shared area and a table where the assembly is done. A digital twin of this environment is set up, which is a 3D copy of the physical model and mimics the movement. Finally, everything is connected through a network called Ignition (Figure 2). It is named after the software which is running on that server and is used to monitor and collect any data in that network. A motion software is programmed to control both robots simultaneously through the network.

Result: The whole setup could successfully be connected through OPC UA in the ignition network. Both robots are controlled with one script and the digital twin, as well as Ignition can be accessed from any place, even outside of the Uni network (Figure 3). This allows the production line to be monitored from any place and enables an overview of a whole factory without the need to be there. The result is a strong groundwork for future projects. The outcome of this work was presented at the 2020 IEEE International Conference on Industrial Engineering and Engineering Management.
There are many different possibilities for future projects to improve this system. The most important one is to develop the “flexible” script further. In the future, other features can be added like image recognition to identify the parts or analyzing the data from Ignition to predict complications.