PLC-Based Automation Systems in SMART Manufacturing

Abstract: SMART Manufacturing refers to the digitization of manufacturing methods to realize the opportunities offered by digital transformation, industrial internet, automation, and machine learning. Future Factories is investigating SMART Manufacturing implementations in real-world applications by utilizing data-driven digital manufacturing systems in a virtual environment. Continuous interfaces are established within the virtual environment through interaction with a digital twin representing the manufacturing cell, allowing manufacturing systems to reliably predict and respond to real-world dynamics of live manufacturing cells.

Introduction

Modern manufacturing systems are becoming increasingly convoluted, but digital twinning provides a reliable method of approaching dynamic, complex engineering problems that constantly arise in the manufacturing industry.

Although PLC-based automation systems are already a standard industry practice in the manufacturing sector, the advantages provided by PLC technology in device management and system networking make them the ideal foundation for controlling the manufacturing cell via a digital twin.

Manufacturing cells generally also have a Human Machine Interface (HMI) outside the cell for operators to interact with the manufacturing cell. The HMI device can't perform logic, but it can read data and logic sent from the PLC and display it to the operator.

My research this summer focused on developing PLC programs to increase cycle-time efficiency, adding functionality to the HMI, integrating the HMI into the PLC network, and reconfiguring the manufacturing cell safety program.

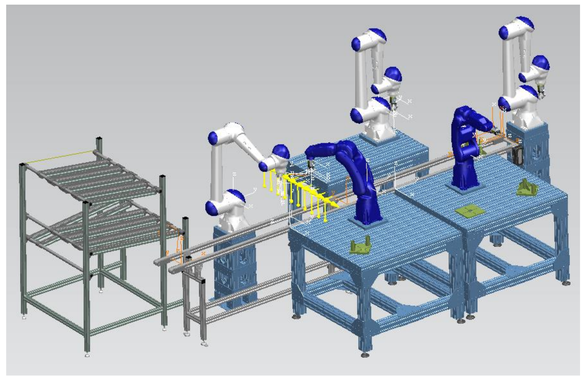


Figure 1: Virtual Model of Manufacturing Cell at Future Factories

Demonstration Elements

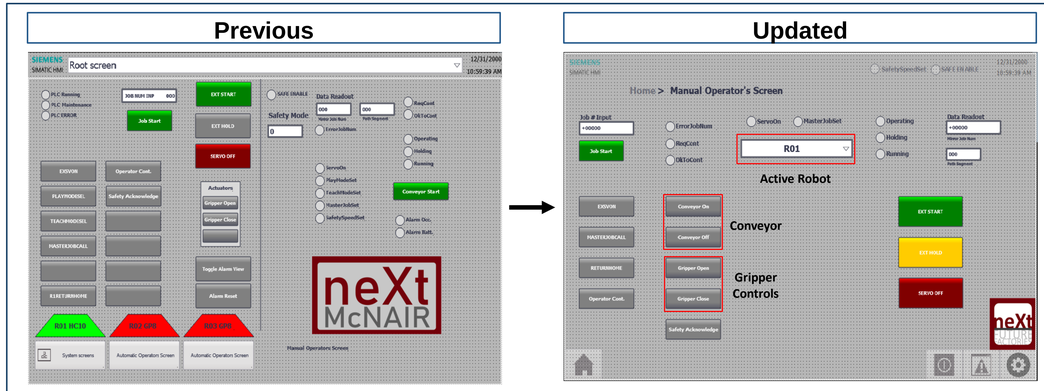


Figure 2: Reconfiguration of HMI Manual Operator's Screen

The Manual Operator's screen on the HMI is used for performing specific functions in the manufacturing cell through interacting with the HMI. The previous version of the Manual Operator's screen had a separate screen for controlling each robot. The back-end code was then reworked so that the updated version has a single screen for all robots, and the "Active Robot" is selected from the drop-down menu. Adding additional robots to the system is no longer an arduous process since it can be added to the "Active Robot" program rather than requiring an entirely new screen with its own individually programmed HMI button controls.

The safety program of the cell was also reconfigured to integrate the built-in Alarm View from Siemens TIA Portal. Emergency-Stops are buttons that that cut power from the system when triggered, or if some other conditional has been met. To continue operation in the cell after the E-Stop is triggered, the operator must press the "Acknowledge" button.

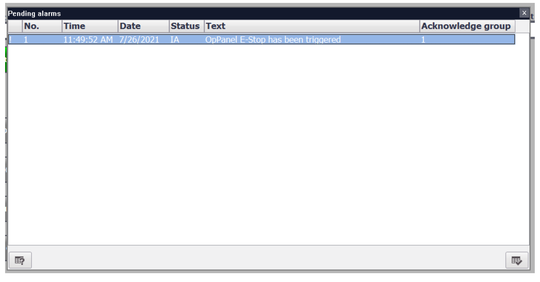
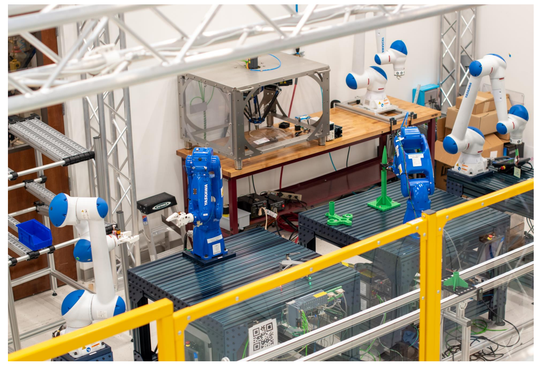


Figure 3: HMI Alarm View

Conclusion

For the future, I will be working in Process Simulate to create additional robot path segments that will eventually be combined to create a variety of different robot operations. I will also be developing an Automatic Operator's Screen that can run complete robot operations from the HMI.



Acknowledgements

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