Master's Thesis Engineering Technology

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Automated Recuperation and Stock Refilling in an Industry 4.0 Training Production Line

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Situation & Problem

Industry 4.0 is the current automation and data exchange trend in manufacturing. It focuses on automation, efficiency, connectivity and data gathering. The smart innovative factory (SIF) 400 by SMC International Training simulates a smart production line to inspire and teach the key concepts of Industry 4.0. It integrates the order management, production, storage and shipment of goods.

The SIF-400 is a modular system, consisting of 13 stations, from which 12 form a connected production line. The last, physically separated station, is used to disassemble the end-products back to the raw materials, in order to achieve reusability. Currently, the recuperation of end-products and the refilling of raw materials have to be done manually by an operator, which is time and labour consuming.

SIF-400

Figure 1. Overview of the SIF-400 [1, p. 1]

Objectives

The main task consists in the integration of an existing automated guided vehicle (AGV) as an automated and efficient transport solution. The implementation should meet two objectives:

- Automated recuperation of finished goods
- Automated stock refilling of raw materials

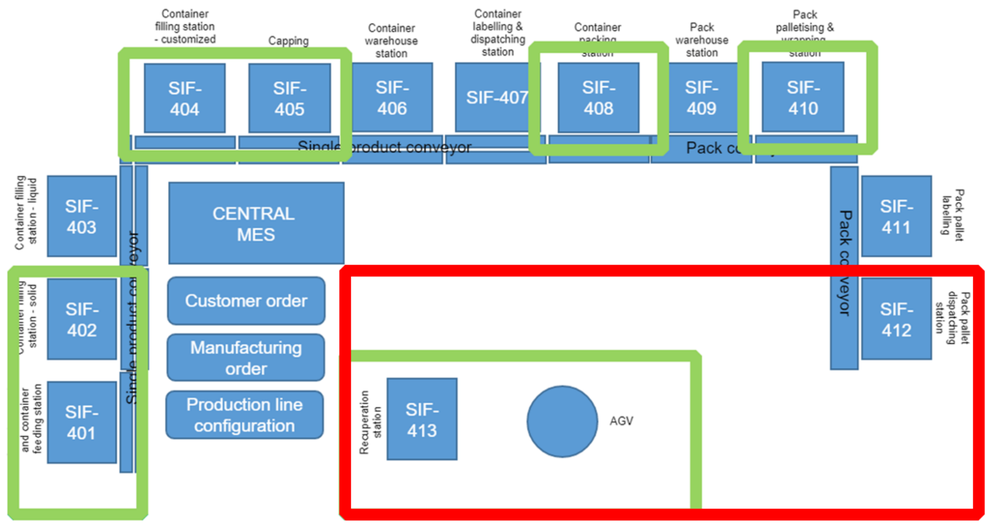

Figure 2. Schematic view of the SIF-400 with highlighted objectives

Control Service

The implemented central control service forms the logical unit of the system. Based on the communication with the different resources, the AGV's navigation and the operators' notifications are managed. Consequently, a labor-effective transport solution is obtained.

The logical flow is implemented by means of two parallel threads: the *query filler* and the *query handler.* The former is in charge of creating *tasks*, whereas the latter is responsible for the execution of them. *Tasks* are created based on the critical stock levels and include a sorted list of *steps*, defining the required actions. These actions, executed in the *query handler*, are defined as the movement of the AGV to a specific location or the triggering of the mobile signalling application.

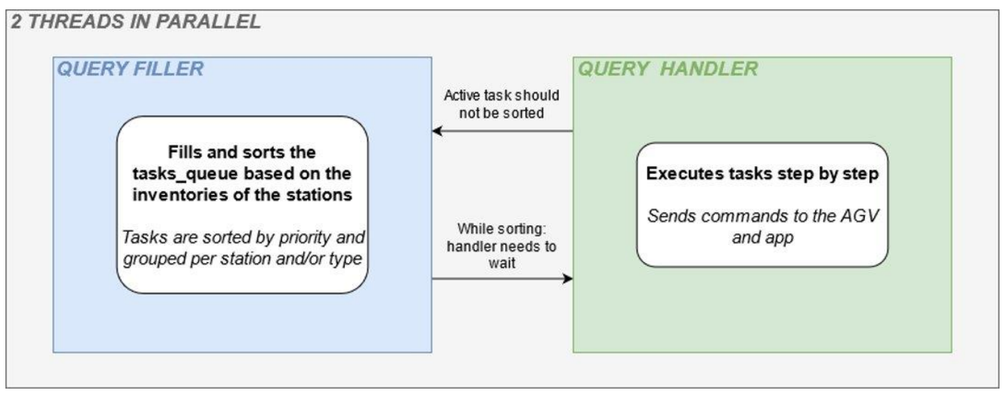

Figure 3. Schematic view of the logic implementation

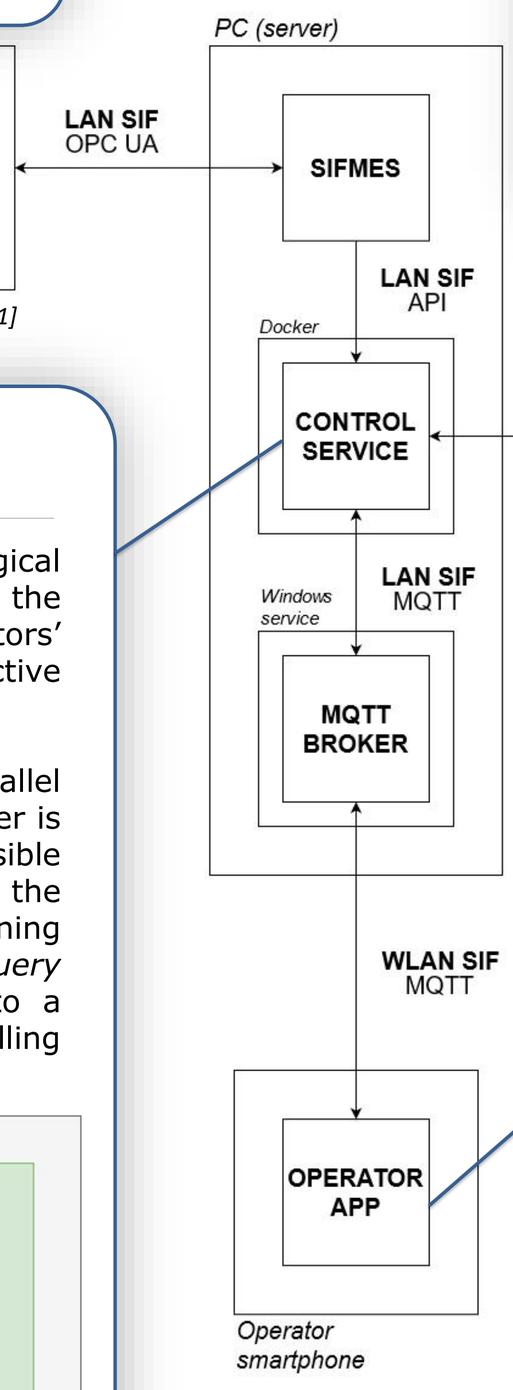

Figure 5. Schematic view of the resulting infrastructure

Mobile Application

The developed cross-platform mobile signalling application forms the user interface of the system. It includes different views, representing the states of the application, in combination with the associated action buttons.

The transfer view contains the item to be transferred, as well as the source and destination modules. In addition, the emergency stop, implemented in the idle view, enables the deactivation of the AGV in case of emergency. Finally, a progress bar represents the remaining battery level of the AGV.

Figure 4. Example of the transfer view of the mobile application

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[1] SMC International Training, "SIF-400 - Photo Gallery," SMC International Training, 2021. [Online]. Available: https://www.smctraining.com/en/webpage/indexpage/1210. [Accessed 21 05 2021].