Design of a modular, flexible, collaborative workspace for electrical cabinet production

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DIMOFAC (DIgital MOdular FACtories) is a project funded by the European Commission. 30 partners, among them the Swiss Smart Factory and Schaltag, are developing a flexible and modular, modern workspace. This thesis contributes a proof-of-concept for a cobotic application.

Motivation

Modular Factories can reconfigure independent components to achieve efficient production outputs. Modularity enables a faster, easier, and dynamic customization of standardized products. The integration of new technologies can support the industry to attain Modular Factories. New technologies aim to provide a more productive operation and allow the worker to focus on more added-value activities. Nevertheless, the implementation does not always run as desired, and efficiency is not achieved. A well-designed integration process, a clear definition of the requirements, and efficient knowledge transfer usually help accomplish a more appropriate technology deployment.

Objective

Collaborative Robots (Cobots) are a flexible, human-centered, modular technology that allows workers to be more efficient. Cobots are designed to avoid human injury. These safety features reduce the need of physical protective barriers and allow the human to move the Cobot by hand. This simplifies Cobot relocation to various tasks, like palletizing, fastening, and tracing. Still, the need for skilled workers, standardization, and complexity of manual tasks present challenges for successfully integrating Cobots into the manufacturing floor. This thesis proposes a strategy based on „Lean Cobotics“ to deploy Cobots in industrial production by developing a proof-of-concept for a cobotic application.

Figure 1 : Prototype set-up with a Fanc CRX-10iAL Cobot.

Methodology

The identified need in Schaltag‘s production was to measure the linearity of incoming metal frames (±1mm). Due to the dimensions and the increased demand, this task becomes a labor-intensive and non-value-adding process. A Cobotic application was designed to let the robot make the measurement automatically by tracing the frame‘s perimeter. In a first step, the robotic simulation software RoboDK was used to prove the kinematic feasibility of a Cobotic application. Using CAD of tools and components, different robots and setups were considered to select the best solution. Then, a prototype was built to concretize the proof-of-concept. A Fanuc CRX-10ia Cobot with a Robotiq FT300 force/torque sensor were used to control the force applied by the robot on the frame and measure its trajectory.

Results

The simulations proved that it is feasible to implement the proposed scenario with a Cobot. The data collected during the experiments showed that the prototype achieved a precise measurement. The proposed strategy encourages that with a clear definition of the requirements, trained workers, and a well-defined implementation strategy, Cobots can be used in production and perform various industrial tasks contributing to the realization of Modular Factories.

Outlook

The DIMOFAC project will continue until the year 2023. Schaltag AG is planning to integrate a Fanuc CRX-10iaL Cobot. The results of the integration will provide further information to improve the proposed strategy.

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