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Robotic Automation of Car Seat Reloading Workstation

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INTRODUCTION

Automation is transforming modern manufacturing by enhancing efficiency, precision, and safety. This project focuses on replacing manual labor with a robotic workstation for reloading car seats at Hyundai Transys s.r.o. The goal is to improve production speed, product quality, and workplace safety while reducing costs.

Operators manually inspect and adjust car seats before attaching labels and transferring them between conveyors. This process is time-consuming, prone to inconsistencies, and requires physical effort.

To address these challenges, an automated workstation was designed using an industrial robot. The selected system integrates seamlessly into the production line, ensuring synchronized operation with high precision and reliability.

MATERIALS, METHODS & IMPLEMENTATION

A digital twin of the workstation was created in Roboguide to simulate real-world conditions. The robot's movements, end effector positioning, and safety features were tested to optimize performance before physical implementation.

Key Components of the workstation included:

- Robot: FANUC M-20iA/35M
- Control System: FANUC R-30iB
- PLC: Siemens CPU 319-3 PN/DP
- End Effector: Custom-designed gripper
- Simulation Software: FANUC Roboguide

Fig.1. – Original workspace.

RESULTS

The Roboguide simulation environment was used to model and optimize the robotic workstation. The HandlingPRO module facilitated the simulation of material handling tasks, while Fanuc’s robotic models were integrated with additional components such as cameras, sensors, and conveyor belts. A virtual model of the industrial workstation was created, including precise positioning of the robotic arm, end effector, and surrounding components. Dynamic collision control was implemented to enhance safety, preventing collisions and ensuring controlled movement within a designated workspace. The robot's motion paths were programmed with available linear, joint, and circular movements to optimize task efficiency. Digital input/output configurations allowed seamless communication with the PLC, ensuring accurate process control. Error detection and recovery mechanisms were also integrated. The system automates the handling and transfer of car seats by synchronizing robot actions with PLC signals. The robot detects product presence, picks up and places seats, and coordinates with conveyor belt operations. Safety and efficiency checks were embedded into the workflow. Potential improvements include integrating a storage bin to manage workflow fluctuations, adapting the system for diverse product handling, and expanding automation across multiple production stages. These advancements would enhance efficiency, flexibility, and cost-effectiveness in real-world applications.

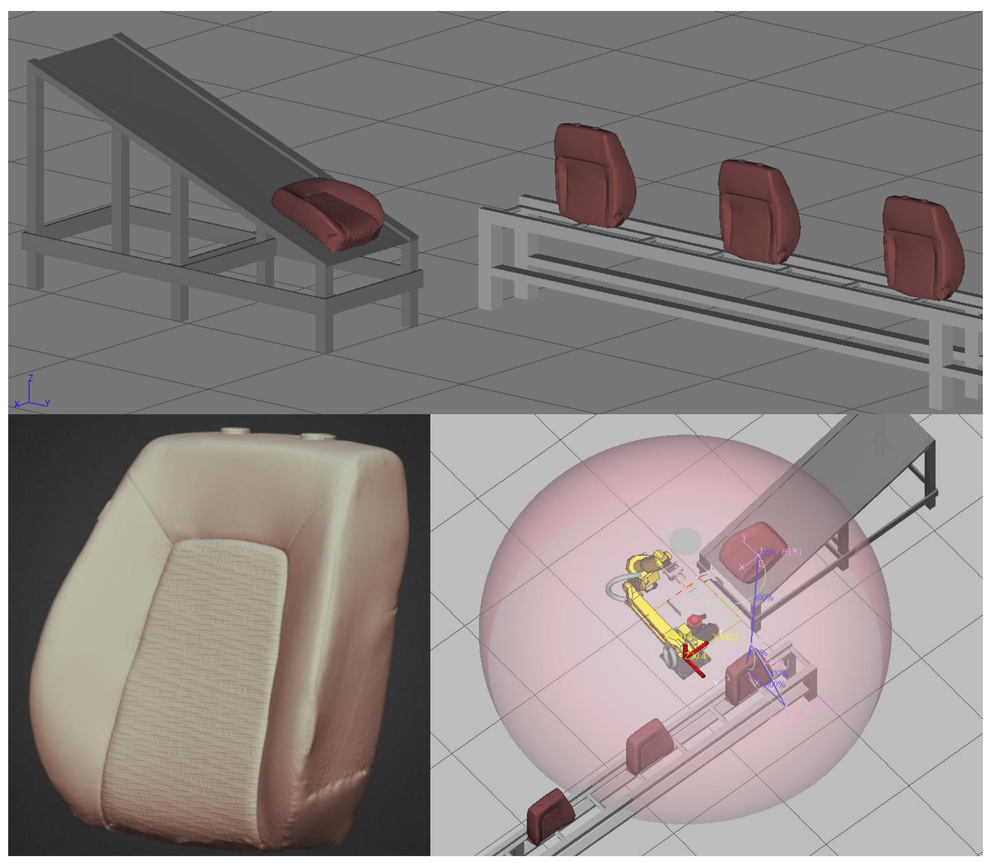

Fig.2. – A virtual model.

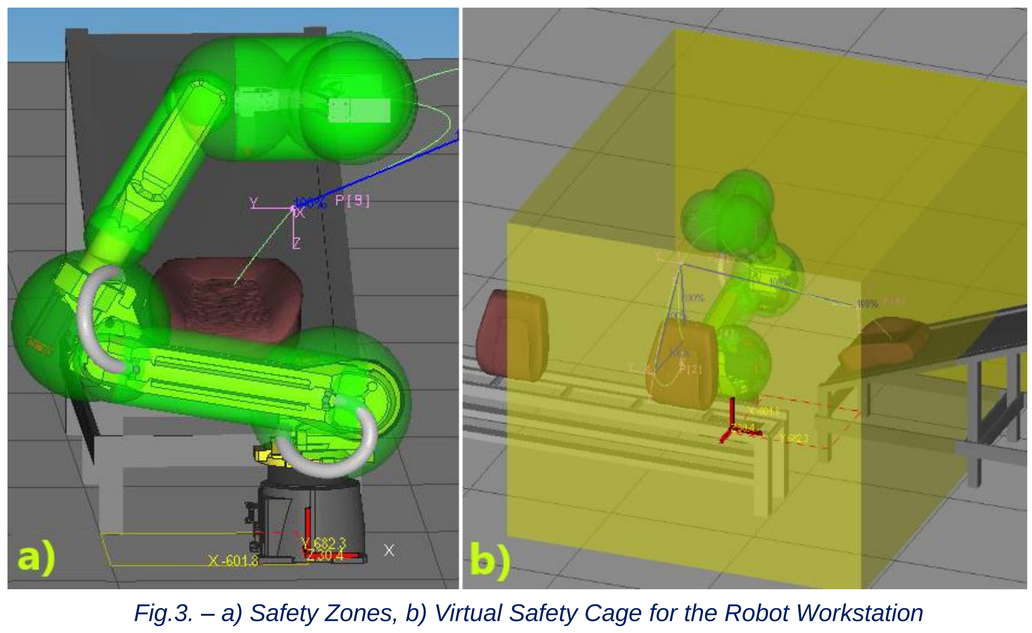

Fig.3. – a) Safety Zones, b) Virtual Safety Cage for the Robot Workstation

CONCLUSION

An autonomous robotic system was designed to replace manual labor at Hyundai Transys s.r.o.'s car seat reloading workstation. The project involved analyzing the production process, selecting a robotic arm, PLC system, and sensors, and establishing an efficient communication environment. Using Roboguide, the workspace was simulated, and the robot’s movements were programmed, allowing for performance testing and optimization before real-world implementation. The result is a fully functional robotic twin that enhances efficiency and has the potential to improve Hyundai Transys' production competitiveness.

By expanding the system in the future to automate multiple production processes and enabling real-time communication between them, we could improve speed, quality, and safety. This approach would also reduce costs and create new opportunities for efficient, modern problem-solving in production environments.

ACKNOWLEDGEMENTS

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