AI-BASED INTELLIGENT ROBOTIC SYSTEM –
A CASE STUDY

This material presents an educational module based on a case study that illustrates the application of artificial intelligence in an industrial robotics environment through an analysis of the packaging process at a roof tile manufacturing plant. In the system under examination, robotic arms perform palletizing tasks, placing products and intermediate materials onto pallets. Although the process is largely automated, material replenishment still requires frequent human intervention, which interrupts the production process and causes efficiency losses and safety risks, thus creating a complex operational and safety problem. The solution is based on the development of an AI-powered monitoring and control system, which involves analyzing the logistics workflow, identifying critical interaction points between humans and robots, and defining system requirements. The planned system integrates an industrial camera and an edge computing device, enabling real-time detection of human presence within the robot's workspace. Particular attention is paid to optimal camera placement, full coverage of the workspace, and seamless integration with the existing robot controller via digital communication interfaces. As part of the implementation, the AI-based vision system continuously processes image data and assesses the safety status of the workspace. Upon detecting a human presence, the system immediately sends a stop or disable signal to the robot controller, preventing unsafe operation. The system is tested under various conditions, including different lighting conditions and partial obstructions, ensuring reliable and robust detection performance. The integration of artificial intelligence enables real-time monitoring and significantly improves both operational safety and process continuity.

The result of the application is a functional and validated safety-enhancing solution capable of reducing unnecessary human intervention and minimizing the risk of accidents in the robotized workspace. At the same time, the approach improves production efficiency by reducing downtime and ensuring uninterrupted operation. The presented concept also lays the groundwork for further developments, including integration with safety-rated control systems, expansion with additional sensors, and the application of advanced artificial intelligence models, ultimately supporting the transition toward more autonomous and intelligent industrial robotic systems.

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