

Module name: Safe human detection in a collaborative work cell

- **Main functionalities:**

Solution for creating safe collaborative working cell for robots and human workers performing tasks such as assembly together. Target is to provide flexible and adaptive way to create dynamic safety areas based on information from a laser scanner or a safety camera system. **Technical specifications:**

Description of hardware components and connections for this module are shown on Fig 1. Sick S300 safety scanner and Pilz SafetyEYE camera system are utilized for monitoring workspace from two perspectives. SafetyEYE detects working environment from above of robot providing a map of floor area. S300 scanner scans pathway in front of robot vertically. Robot is Kuka KR6 R900 SIXX with KR C V8.3 software, Kuka Safe Operation option is mandatory for this module to work.

Kuka Work Visual software is utilized for configuring robot controller and defining IO for safety camera and laser scanner on robot side. Sick CD and Pilz PSS software are used for configuring laser scanner and camera system areas and IO's.

Sick S300 laser scanner has connection to robot controller digital safety inputs. Corresponding inputs need configuring with Work Visual as safety inputs. Work visual is used for setting up SafetyEYE as Ethernet safety device with corresponding description files provided by Pilz. Price for Sick S300 is about 5000 € and 15 000 € for SafetyEYE. Work Visual comes free with Kuka robots.

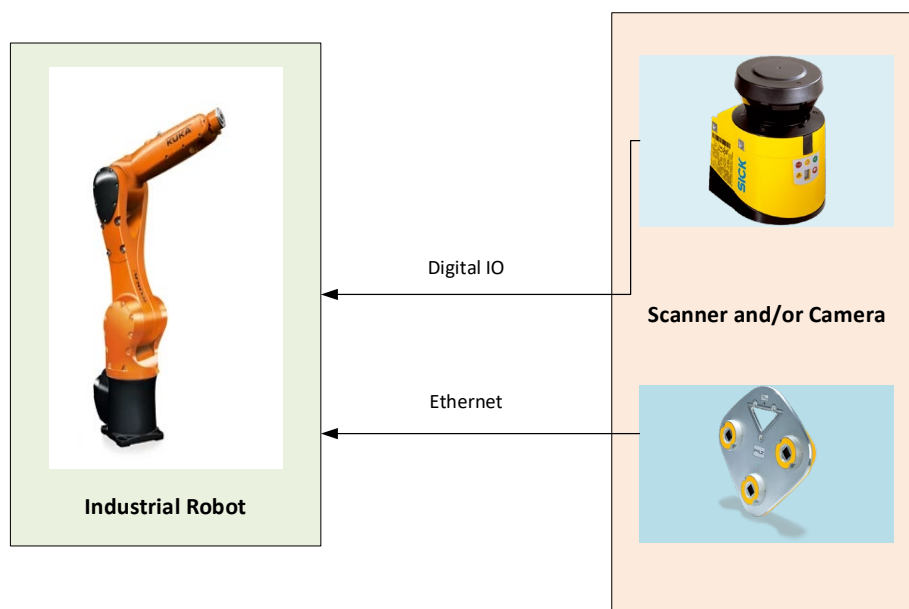


Fig 1. Module Hardware components and connections

- **Preliminary software configurations:**

Before this module can be used 1) Laser scanner and safety camera need to be connected to power source and to robot controller IO's, 2) Laser scanner and safety camera need to be

physically placed and their safety areas and IO's need to be configured with corresponding software.

- **Inputs and Outputs**

Data is transferred from laser scanner as digital message to robot controller. Data from safety camera is transferred to robot via Ethernet connection. Fig 2. explains these connections more in depth. Inputs of this module are data of environment and proximity from laser scanner and safety camera. Outputs of this module are stop and slow down commands for robot controller.

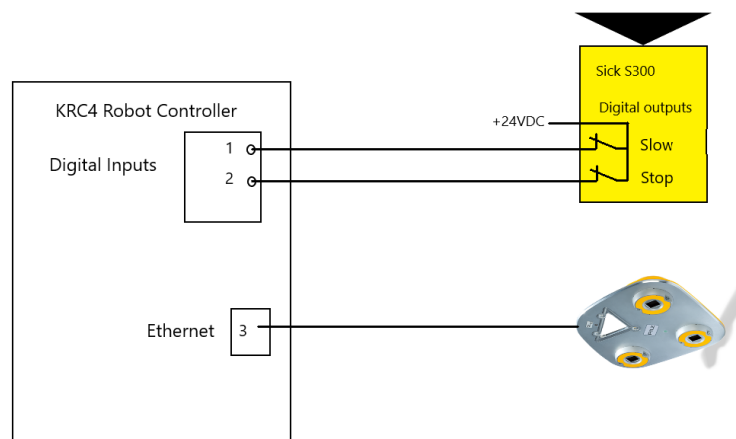


Fig 2. Input and Output configuration of this module

- **Interface specification:**

The end-user does not interact with this module directly. Module controls robot by stop or slow down commands.

- **Formats and standards used:**

ISO 10218, ISO 12100

- **Availability:**

This module is currently under development. First version is available at the beginning of year 2020.

- **Application scenarios:**

This module has applications with integrators and companies who are building applications where robots and human workers work together.

- **Offered for internal / external use**

This module as a concept will be available for internal and external use.