Robotics: Safety without protective barriers

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Visible lines denote the safe zone. Should a person enters the zone, a robot will stop its work and a warning may be signaled. Credit: © Fraunhofer IFF

The modern working world is no longer conceivable without robots. They assist humans in manufacturing, laboratories or medicine. In the future, a new projection and camera-based system will prevent collisions between robots and humans working together.

A robot carefully lifts and positions a heavy component while a worker welds light-weight aluminum components to a machine right next to it. Although such scenarios are visions of the future at present, they will soon be part of the everyday work routine if industry has its way. Humans and robots will team up, especially on assembly jobs, and collaboratively employ their particular capabilities: Steel assistants could bring their power, durability and speed to bear and humans their dexterity and motor skills. At present, automated helpers are usually

enclosed by protective barriers. Industrial safety regulations permit contact between people and robots only under certain conditions since the risk of injury to humans is too great. In order to allow their collaboration after all, new technologies will have to define workplaces and safe zones, which humans may not enter. A robot will stop or slow down whenever a safe zone is entered. In the ViERforES project supported by the Federal Ministry of Education and Research, researchers at the Fraunhofer Institute for Factory Operation and Automation IFF have developed a novel solution that monitors workplaces highly flexibly.

This safety system employs conventional projectors and cameras, which are normally mounted on the ceiling. One distinctive feature of the system is its projection of monitored safe zones directly onto a floor or wall. Projected beams produce visible lines in the work area. Thus, humans recognize the safe zone right away and know how close they may get to a robot. The camera immediately detects any intrusion in the safe zone by an individual – the projected lines are disrupted. The robot decelerates at once. Optical and acoustic warning signals can additionally be generated. Another distinctive feature is the variability of marked areas' position and size and the capability to give them any shape – for instance, a circle, a rectangle or any freeform. "Since we employ common standard components, our system can be installed cost effectively. The projector and camera are calibrated and synchronized to one another," says Dr. Norbert Elkmann, Robotic Systems Business Unit Manager at the Fraunhofer IFF. When a larger area needs to be monitored, the system can be extended as desired by additional projectors and cameras.

The monitoring system operates with modulated light. "The advantage of this is its reliability even under the effects of external light, e.g. sunlight and shadow. Present purely camera-based space monitoring systems operate independently of external light only to a limited extent," explains

Elkmann. In addition, the experts can combine this system with robot controls and thus dynamically modify danger and safe zones. If, for example, a robot only works to the left of its workspace at times, the maximum robot workspace would not have to be monitored.

Elkmann and his team have filed a patent for their system. A prototype already exists. The potential applications of the projection and camera-based system are not merely limited to safe human-robot interaction. Other spaces in which safety is relevant, e.g. public buildings, can be monitored. The system can also be used wherever safe zones ought not to be perceptible – by projecting invisible light.

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