Technical Article

Rise of the Industrial Robots. Overcoming the Challenges of Safe Robot-Human-Interaction in Factory Automation

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“I’ll be back.”

That’s probably the most famous sentence ever uttered by a robot. At the same time, it’s probably also not the best promotion for robotics as the Terminator does everything but act like a friendly human. Luckily, “The Terminator” is just science fiction, and Arnie even saves mankind in the second movie. But let’s switch from entertainment to business and take a look at how humans can benefit from the interaction with different types of robots involved in factory automation and still feel safe when working with them. After all, by 2018 around 1.3 million industrial robots will be introduced to factories around the world with the highest concentration working in factories in Europe, according to the International Federation of Robotics.

The industry looks at industrial robots in the following five areas:

Categories of Industrial Robots

Before we get to examples of robot-human-interaction, let’s look at the first three categories of robots that are being used today in factory automation.

- **Industrial robots** handle tasks like welding, palletizing and lifting. They are fixed to the floor, ceiling or wall. A control unit located inside a control cabinet controls the robot. An example for the interaction of an industrial robot and a human is the following: After the work step of an industrial robot on a product, a human picks up the product and therefore needs to enter the working area of the robot.
- **Logistics robots** are used in warehouses, wherein a robot fetches goods and brings them to a packing station or the robot is transporting goods from one building of a company site to another. These robots move within a particular environment and need a lot of sensors for localization and mapping – as well as sensors to prevent collisions.
- **Collaborative robots** are meant to interact directly with humans. The difference to industrial robots is that the robot and the human work on the same object at the same time. One example is that the collaborative robot holds an object over the work desk of an operator so that he can move and turn the object arbitrarily for visual inspection and maybe necessary fine-tuning tasks. Collaborative robots are most often fixed to a table, and like industrial robots, are controlled by a control unit.

Challenges of Human-robot-interaction

Since humans will always be around, the big problem of human-robot interaction is how to keep this interaction safe for us humans. How can collisions or accidents be prevented, while still working side by side? The challenges can be quite different for each robot type.

An **industrial robot** is designed to perform tasks quickly and accurately. The motors inside a robot arm receive a signal and execute it. Typically, a robot arm has no features with which to sense its environment. It will just execute commands and move into programmed positions, no matter if there is an object in its way. Thus, to prevent accidents, industrial robots normally operate in a protected environment. One common setup is to place light barriers around the robot arm. The outputs of the light barriers connect to the control cabinet, which will detect whether the light barrier is crossed and shut down the robot arm. Another setup is to place a fence around the robot arm and monitor the lock of the fence door.

Logistics Robots

Often operate in environments where humans may be around. Therefore, the robot not only needs sensors for location and mapping but as well sensors to detect people. For this sensing technologies like ultrasonic, infrared or LIDAR can be used. In addition to the sensors meant to prevent collisions, there is also a backup sensor. If the robot bumps into an object, a switch inside mechanically opens, turning the robot off until an operator can put it into operation mode again. This is necessary to ensure that the robot stops in case the electronic sensors inside fail.

The most complex interaction occurs between a human and a **collaborative robot**. It must be ensured that in case of a collision between a robot arm and a human – or any object – integrated sensors in the robot arm turn the robot off immediately. If one sensor or the electronic circuit following it fails, the robot also turns off. Therefore, robot manufacturers must implement redundancy into the robot system to quickly detect and prevent any possible collision.

Hopefully, this blog could terminate your concerns of robot-human-interaction, and you're ready for the rise of the robots. If you want to read more about robotics in factory automation, just wait, because "I'll be back."

FRANKA Demonstration at Electronica

TI is demonstrating the FRANKA EMIKA industrial robot arm at electronica, providing a glimpse into the future where robots will take the more simplistic tasks performed by business people, but in an industrial setting. Here's a YouTube video of the robot that uses TI integrated circuits and another video of Greg Peake showing off the robot arm at electronica:

FRANKA presents TI products for Industrial Connected Robots

Additional Resources

- Read more about how robots are enabling new levels of factory automation
- Stay up to date on videos, blog posts and news related to TI at electronica.
- Learn more about TI and industrial robotics and automated machinery.
- Get started with these TI reference designs:
  - Multi-Protocol Industrial Ethernet Detection w/PRU-ICSS for Industrial Automation Reference Design.
  - Real-time Ethernet Tracer with PRU-ICSS Reference Design.
  - Multi-Protocol Digital Position Encoder Master Interface Reference Design With AM437x on PRU-ICSS.
  - EtherCAT(R) Master Reference Design for Sitara AM57x Processor Gb Ethernet and PRU-ICSS.
- Check out the latest content for Industry 4.0.

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