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Humans and Robots:
A Unified Workplace

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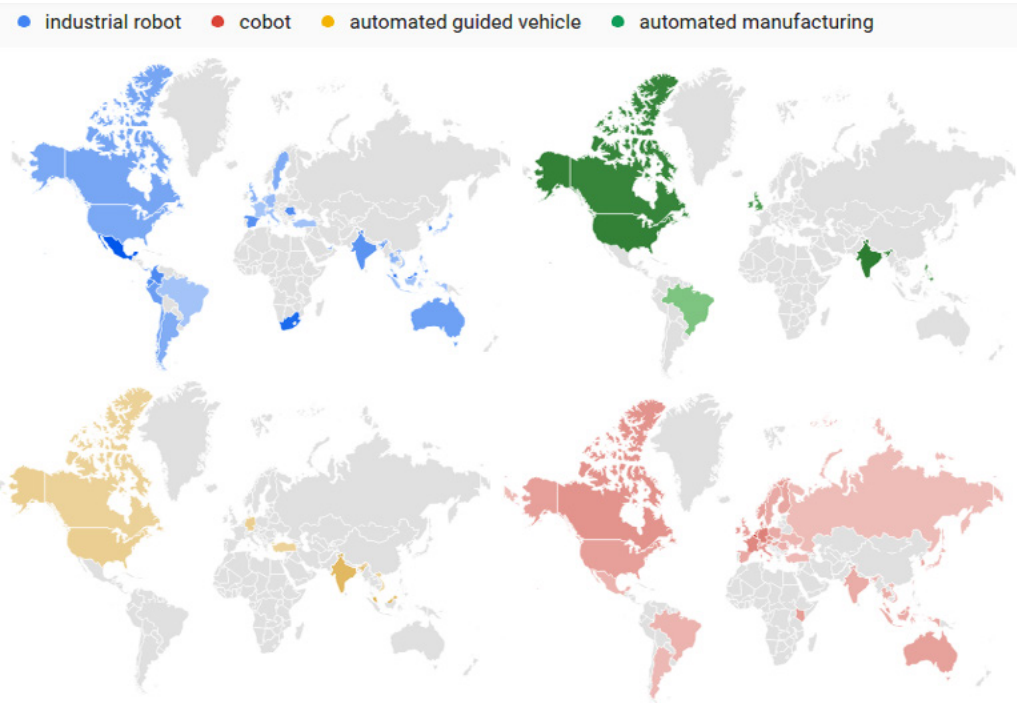
Introduction

To the human mind, trust is an integral part of a working relationship. A worker who is mindful of their surroundings, ensures that protocols are followed, ensures safety of their co-workers and wins the respect and cooperation of everyone. The introduction of robots into workplaces initially resulted in accidents that lowered the sense of physical and psychological safety that workers felt. Modern industrial robots however, have evolved with the use of accurate sensors and algorithms that enable robots to be aware of their surroundings. Such measures have gradually brought back the element of trust that is essential when man and machine work in unison.

Industries across the world have witnessed an increased interest in such collaborative robots (cobots). This document presents a brief perspective of how industrial robots equipped with durable sensors, enable the implementation of an efficient, compliant and safe work environment.



Google Trends 2010 to 2020, depicting the growing interest in robotics and automation.

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Safety from hazards

Safety from hazards

The Occupational Safety and Health Administration (OSHA) 1910.145, the Hazard Communication Standard and American National Standards Institute (ANSI) Z535 specify workplace guidelines that have helped ensure safety of workers. A small subset of such hazards that have avoided using robots are:

Chemicals

In the United States (U.S.) healthcare industry alone, eight million workers are exposed to hazardous chemicals each year. Chemicals may be inhaled, absorbed via the skin/eyes or ingested, leading to health complications like cancer, cardiovascular disease, rashes, reproductive issues and pulmonary complications. The National Institute for Occupational Safety and Health (NIOSH) highlights such chemical hazards that may be present as:

Gases: Corrosive, oxidizing, toxic or pressurized.
Liquids: Acids, solvents, flammable, volatile organic compounds, iso-cyanides and radioactive liquids.

Studies have shown that 54% of chemical accidents are caused by carelessness. Robots designed with explosion-proof parts (where fumes can ignite when exposed to sparks) and precise sensors can safely handle a variety of chemical processing tasks. Some examples:

Spray-gun painting: Remotely controlled robots have helped workers achieve painting jobs four times faster than normal, hence avoiding exposure and retaining jobs.
Healthcare: Robots not only keep the work-area clean and sterile, they also automate the preparation of intravenous fluid bags and syringes, helping workers avoid exposure to cytotoxic and oncology drugs.

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Inhaling particles and fumes

Particulate matter that workers breathe in often goes unnoticed until years later, when serious complications develop. Workers in some factories where robots were introduced, were reported to have lower lead levels in their blood. Robots that are sealed against chemicals and particles, equipped with sensors that are not affected by vapor or smoke are ideal for such situations. Some are:

Lead acid battery assembly: Airborne lead particles.
Automotive airbag assembly: Volatile inflator propellants.
Bag palletizing food-grains: Explosive dust environments.
Powder painting: Atomized paint.
Grinding/milling: Airborne particles.
Servicing/lubrication: Toxic fumes.

“This is the goal: robots as colleagues, not competitors, and robots working with people, not in place of them.”

— **Melonee Wise**
CEO, Fetch Robotics

External environments

Refueling: Automated refueling in industries like rail, road, aviation, marine, drilling and excavation, helps human operators avoid exposure to flammable liquid, harsh weather, contamination, manual errors and collisions. The robot utilizes machine vision and sensors to guide the fuel nozzle to the filler neck.

Pipeline maintenance: Certain underground pipeline maintenance tasks that could ordinarily be performed only by unearthing it, can now be performed by mobile robots that travel through the pipeline to perform maintenance and inspections. These robots are capable of repairing cast iron pipes and sealing joints in natural gas pipelines.

Autonomous vehicles: Dealing with harsh conditions like snow, fog, heat, freezing cold, dry and wet weather 24/7, is a perfect use-case for robots equipped with LiDAR sensors rated at IP67 (IP is Ingress Protection, where "6", indicates dust-tightness and "7" indicates water-tightness). The resistance of the sensors to ambient light and environmental noise make it ideal for airborne mapping, mining, autonomous cars etc.

Extreme temperature

Steel manufacturing: Molten slag in steel smelting furnaces can reach temperatures of 1650°C. Even the robots that automate the process of furnace tapping (removing slag) require heat resistant suits.

Deep freezers: Robot arms used for palletizing, can work at -30°C without a heating system or protective suits.

Fire-fighting: Mobile robots equipped with thermal insulation and water-spray-cooling, are remotely controlled to douse flames in areas where the field of flame can reach 700°C.

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Compliance with safety standards

Compliance with safety standards

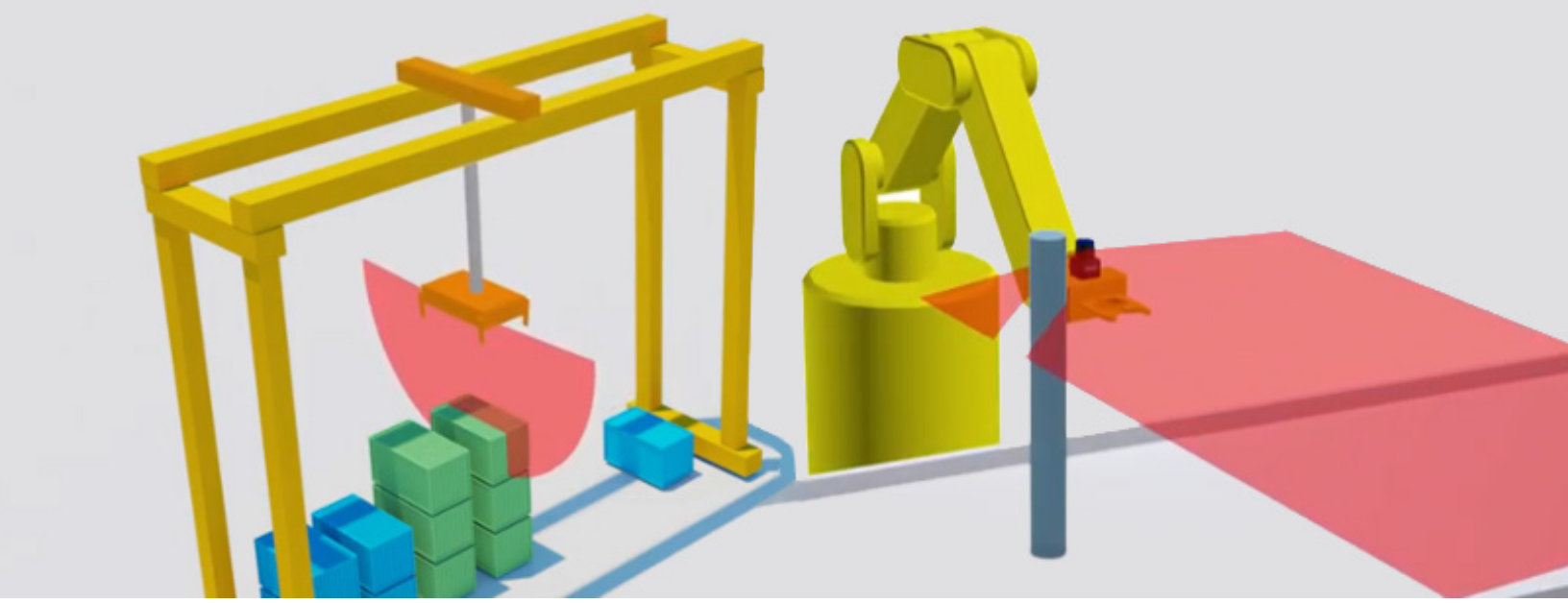
Machine tending

Tending is the process of overseeing a machine's activities and moving materials in and out of the machine's workspace. Such work is dangerous and requires high consistency. The use of robots for tending, also helps comply with some sections of ISO 12100 (safety of machinery).

Automated storage: Stacker cranes or vertical transport lifts perform loading and unloading operations with accurate positioning, hence avoiding product damage. Sensors and anti-collision software enable robots to work in close proximity, thus decreasing part cycle time.

Hokuyo Laser Scanner
Distance data output models

Eye for Robot Arms
It can detect the position of work pieces



Assembly/manufacturing: Robots also tend to machines during welding, milling, grinding, injection molding and in presses. It reduces machining errors and minimizes waste.

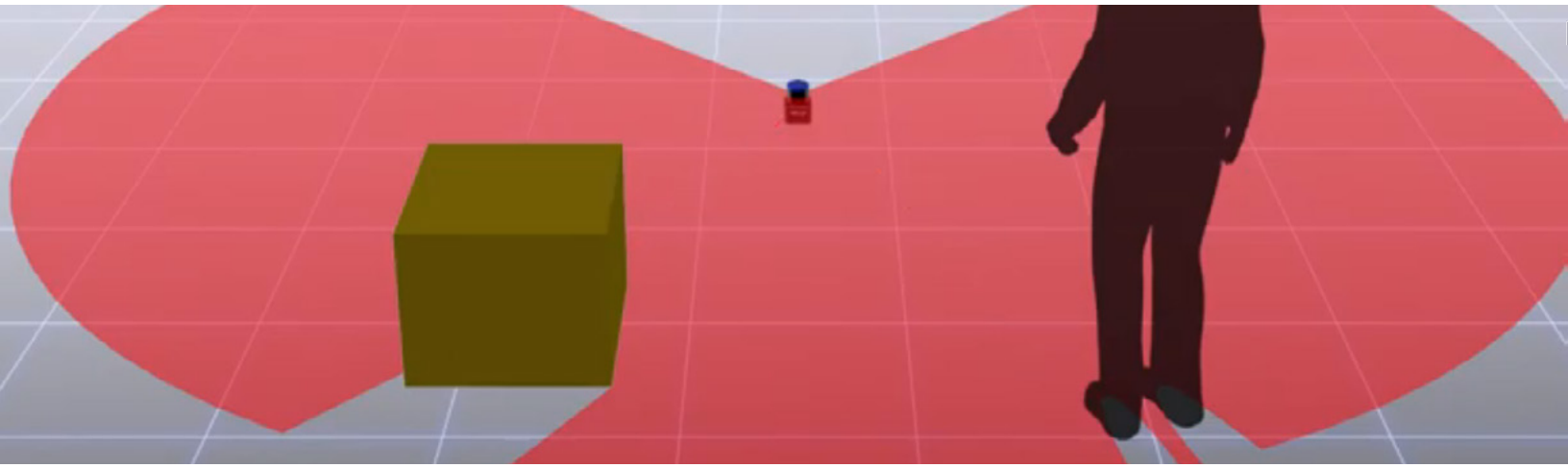
Adherence to facility standards

Cleanroom robots: In electronic assemblies and the pharmaceutical industry, cleanrooms require controlled levels of particulate matter and moisture (ISO 14644). Specialized robot arms utilize vacuums to remove particles and prevent electrostatic discharge from damaging electronics, using grounded end-effectors (ANSI S20.20).

Hygiene: Cutting and deboning of meat is performed using food-grade parts and coatings. This ensures better throughput, lesser contamination (CAC/RCP 58-2005), improves shelf life and keeps workers away from sharp cutting tools.

Inspections: Robots (crawlers and drones) can detect leakages, cracks, corrosion and perform non-destructive testing using thermography, radiography, ultrasonic testing in remote locations, tanks, underground pipelines (USC 60108), confined spaces, offshore oil platforms (RP 2SIM) and chimneys, thus assisting in frequent data gathering that allows predictive maintenance and root cause analysis. Sensors and machine learning algorithms in robots inspecting nuclear reactors (IP 65001), can identify cracks and other compromises in the integrity of the reactor.

Security/safety: Robots equipped with LiDAR can assess human risk behavior models and adjust collaborative operating modes (ISO/TS 15066) .



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Advantages

Advantages

Reduced manual labor

The use of cobots compliant with ISO/TS 15066 and RIA TR 15.606 guidelines have been shown to reduce operator loads by up to 60% in assembly lines. Cobots can be hand-guided, to learn motion that can be repeatedly performed, while stopping on contact with humans. They can apply the right pressure at the right angle when performing tasks, enabling precision, reducing production time and material waste. Glass-making industries reported reducing an entire eight-hour shift once a cobot was introduced.

Automated Guided Vehicles (AGV's) equipped with safety laser scanners can accurately perform repetitive movement of ship containers, pallets, paper, steel, plastic and other materials from warehouses to processing lines or shipping docks.

Reduced injuries

Musculo-skeletal: Over-exertion and micro task exertion results in hernia, sprains, swelling, carpal tunnel injuries and pinched nerves. According to the U.S. Bureau of Labor statistics, workers aged between 45 to 64, presented with incidence rates of 30 cases per 10000 workers in 2018, with twelve days away from work being the median.

Bodily harm: Un-managed insomnia and fatigue are serious risks that machine loading robots help avoid. They prevent falls and injuries from risky tasks like reaching for items stacked very high. Noise and vibrations are another source of harm that is avoided with the use of robots.

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Adaptability

Adaptability

Social acceptance

Emotion: Various studies have shown that people attribute feelings, intentions, a personality and even gender to the actions of a robot. When a packaging robot was built with a digital display that simulated the "eyes" of the robot, the operators related to it in a more human-like manner. The eye motion helped them assess the robot's status and offered cues to the intent of action of the robot, which made them feel safe while working near the robot. Staff members also wished the robot had a speech channel for social and operative conversations.

Urgency: In demanding environments, workers viewed robots as a burden and a disruption to their social environment if robots did not recognize and adapt well to tasks. People in less demanding environments perceived robots more positively. Accurate, reliable sensors and algorithms thus play a crucial role in social acceptance of robots in a co-working environment.

Smoother transition of roles

An MIT study showed that firms which introduced robots faster, incorporated more people into their payroll than firms which adopted robots slowly. However, the fear of losing a job and negative perceptions toward automation, are an ever-present reality that arises from a lack of comprehension of the reason for automation and the benefits it brings to both the company and to employee health. As in any business transformation phase, transparency in communication is key. One method of soliciting cooperation, is to involve employees in the decision-making process by asking what parts of their jobs are so repetitive or monotonous that they would wish it could be done by a robot, while they could move on to safer, higher level supervisory and intellectually stimulating tasks.

Conclusion

While the ISO 10218 and other such standards offer helpful safety guidelines and information to assist in reducing hazards associated with robots, the real automation heroes behind-the-scenes are the sensors and algorithms that provide a reliable, accurate and fail-safe recognition of the environment, enabling the robots to work collaboratively with humans.

Hokuyo-USA brings you a wide range of smart sensors for autonomous robotics. Get in touch with us to learn how our smart sensing solutions can maintain the highest levels of safety and improve efficiency within your working environment.

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