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Imagine the Impact™

How Today's Robots Keep Humans Out of Harm's Way

COVID's impact on the workforce has business leaders thinking about augmenting their human capital. Jobs that are high risk, due to potential infection from disease or general safety issues, are increasingly harder to staff. Employers must find alternative solutions to do jobs that put humans in harm's way. Robots are a profitable and credible alternative that the commercial medical and defense industries are already using.

"Today's robots allow us to remove people from hazardous situations and keep them safe," says Dave Shane, Technical Program Manager and Business Development Lead for Boston Engineering's Advanced Systems Group.

"In the past, people accepted certain risks and considered them unavoidable. Now, technology has evolved enough to eliminate many hazards, allowing human operators to supervise from afar."

Why now? Recent engineering and technological breakthroughs have spawned a new generation of robots featuring components that are exponentially more advanced than their predecessors. In the last 20 years, roboticists have made impressive progress in areas such as:

- Sensors: Light detection and ranging (LiDAR) technology uses lasers to create 3D maps of environments so robots can navigate independently. Machine vision leverages cameras and algorithms to perceive obstacles robots encounter on their journeys.

- Actuators and control: A robot's motion often requires an electric motor and a gearbox. While this setup is straightforward, the advancement of actuators themselves and the control schemes that operate them enable smoother and higher-fidelity motion.

- Artificial intelligence (AI): Processing power and AI have matured in parallel to achieve incredible capabilities. Machine learning, a type of AI, can make sense of the massive amounts of data that robots collect through their advanced sensors. This enables robots to recognize faces and speech, predict user behavior, and avoid physical obstacles in their paths.

Robotic systems are becoming increasingly sophisticated, with the ability to complete a wide range of physical movements delicately and precisely. These innovations reduce risks in operating rooms and inherently dangerous environments such as areas affected by natural disasters and battlefields.

Commercial

The ability of robots to complete repetitive tasks efficiently and consistently has fueled widespread adoption in industrial and commercial settings. The International Federation of Robotics reports that 2.7 million industrial robots are already operating in factories worldwide.

In addition to boosting productivity, robots can take over the types of jobs that put people in precarious situations, such as cleaning nuclear waste or entering flooded mines.

Construction, a notoriously dangerous industry, has an abundance of occupational hazards. According to the Occupational Safety and Health Administration, excavation and trenching are among the most perilous construction operations. Digging trenches requires handling heavy equipment that could tip over and carries the risk of trenches caving in and crushing workers. Self-driving excavators remove the need for people to enter these treacherous locations.

Additionally, robots can go to inaccessible places to perform tasks while humans monitor the jobs remotely from safe locations. “We work on many inspection-type robots,” says Mike Rufo, Director of Boston Engineering’s Advanced Systems Group. “They help people avoid climbing into high-risk, hazardous, or confined spaces.”

For example, Rufo and his team are developing a range of advanced robotic platforms. This includes inspection robots that use vacuum suction or magnetic adhesion to crawl on or inside naval or commercial vessels and equipment. Gaining access to wind turbine blades or ship hulls is often difficult and unsafe. A robot can negotiate awkward geometries and slippery surfaces to get the job done without putting people in jeopardy

Additionally, Discover magazine reports that robots have assisted with search-and-rescue missions after the World Trade Center attacks, Hurricanes Katrina and Harvey, the Fukushima Daiichi nuclear disaster, and the eruption of Hawaii’s Kilauea volcano.

When disasters are unavoidable, robots can gather information so people can make the safest possible decisions (e.g., determining whether to evacuate). To this end, Boston Engineering is developing a jellyfish-inspired robot that provides oceanographic data for early hurricane detection (among other things). While other oceanographic sensors (e.g., buoy-based systems) can float away from their locations, the robotic jellyfish uses electromechanical swimming to stay in place.

Defense

Military personnel have dangerous jobs, both on and off the battlefield. Robots can perform many high-risk tasks to diminish these threats.

For example, when a ship pulls into port, military (or law enforcement) professionals must do a thorough inspection to make sure bad actors have not smuggled weapons or drugs onto the ship or placed explosives below the waterline. This job is physically challenging and dangerous, especially when divers are trying to reach places like ship hulls and under piers, where they must contend with the ocean’s changing currents and murky waters.

Boston Engineering developed an autonomous underwater vehicle called the BIOSwimmer™ for the U.S. Navy and Department of Homeland Security to explore these difficult-to-reach locations to gather intelligence. This robot maneuvers like a biological fish to complete ship-hull surveillance missions and collect data from confined underwater areas without putting divers at risk.

On the battlefield, robotic systems assist soldiers with combat support transportation, surveillance, reconnaissance, search-and-rescue missions, and situational awareness. These robots include unmanned aerial vehicles (or drones), ground robots, and self-driving tanks and vehicles.

Organizations can outfit wearable devices known as powered exoskeletons with robotic components, sensors, and actuators to assist wearers and increase their mobility while carrying heavy loads or transporting heavy objects. In collaboration with the U.S. military, industry, and academia, Boston Engineering is at the forefront of testing these systems and observing their utility in extending endurance and reducing fatigue and musculoskeletal injury.

All of these robotic technologies serve to protect soldiers’ lives so they can continue protecting our nation.

Medical

Health and safety are integral to any medical setting, but many tasks and interactions threaten healthcare workers’ lives. Robots mitigate these risks by reducing people’s exposure to pathogens, raising the quality of patient care, and providing valuable data that inform public health policies.

For example, while surgery may be absolutely necessary to save a life, the procedure itself can have an adverse impact. Even the most brilliant and talented surgeons are only human and can make mistakes.

Robotic-assisted surgery, which products such as the da Vinci surgical system make possible, empowers surgeons to perform complex procedures with extraordinary precision and accuracy. Parent company Intuitive reports that the da Vinci system features technology to magnify the surgical area 10 times larger than what the human eye can see, along with instruments that move like a human hand but with a greater range of motion. In traditional surgery, a slip of the hand can have harmful consequences. By lowering the potential for human error, robotic surgery improves the level of care.

With the evolution of robotic systems, clinicians can also deliver medical care remotely. Surgeons can use devices such as the da Vinci system to perform procedures on patients in a different location. Enabling physicians to treat people in rural and remote places makes healthcare more accessible.

"When highly skilled experts can supervise the robotic procedure from afar, it expands the reach of healthcare into danger zones and creates a more equitable delivery of expertise," says Mark Smithers, Co-Founder and CTO of Boston Engineering.

The COVID-19 pandemic highlights the risk that infectious disease patients present to healthcare workers. Off-loading some of their work to robots—such as sanitizing rooms, collecting and analyzing samples, and distributing medicine—reduces workers' exposure to the coronavirus, illness-causing bacteria, and other pathogens.

"Robots automate complex manual operations," says Paul O'Connor, Director of Boston Engineering's Medical Development division. "This can eliminate tasks, enabling healthcare organizations to repurpose and retrain talent and deliver a higher level of care."

Beyond patient care, robots and automated testing platforms such as the Biobot provide efficient wastewater surveillance. When it detects unusual amounts of pathogens or substances such as addictive drugs, Biobot alerts public health officials so they can support their communities during an epidemic or pandemic.

Unlimited Possibilities for a Safer World

In recent years, we have seen great progress in robotics development, and this is just the beginning. Advanced sensors, faster processing speeds, increased connectivity, and innovative designs create more opportunities for robots to keep humans safe and healthy.

"We will develop whatever we can conceive and believe," Smithers says. "Nothing is out of the realm of possibility. We're already starting to see robotics take off one step at a time, and in 50 years, robots will be ubiquitous at work and even in our homes."

Today's robots are already saving lives by keeping people out of dangerous situations. Tomorrow's robots will extend that capability by managing even more situations to improve and save lives.

Contact Boston Engineering to learn how we can partner with your organization to keep people out of harm's way.

Boston Engineering Corporation | 300 Bear Hill Road Waltham, MA 02451

boston-engineering.com | info@boston-engineering.com