FUTURE OF ROBOTICS:

INDUSTRIES WHERE IT IS MAKING A DIFFERENCE

molex

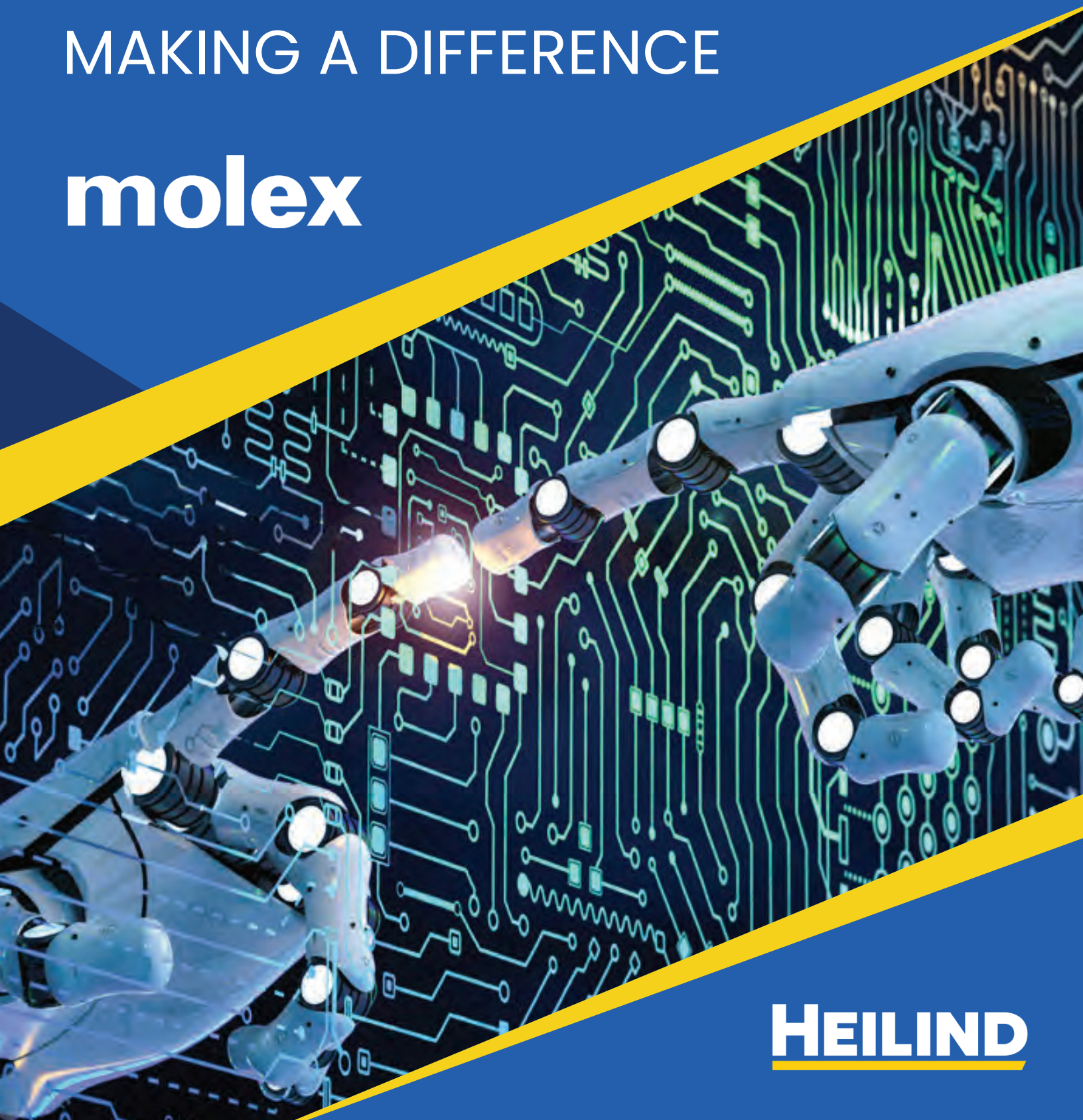

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TABLE OF
CONTENTS

Introduction 3
Ruggedized Connectors for Industrial Robotics 4
Power Management Optimization for Home Robots 5
Miniaturized Landscape of Medical Robots 6
Autonomous Vehicles Integrate Robotics and 5G/6G Connectivity 7
Data Connectivity Modernizes Data Centers and Hyperscalers 8
Looking Ahead: Molex and Technological Advancement 9

INTRODUCTION

Robotics has become an integral part of everyday lives with its continuous innovation and research in most existing markets. For these machines to become smarter and react to external stimuli in real time, it is important to leverage emerging technologies like artificial intelligence (AI), edge computing, and advanced wireless connectivity.

As robots have transitioned from being designed and programmed for static environments to dynamic, ever-changing ones, this shift has enabled closer collaboration between robots and humans. The adaptability to dynamic settings comes from incorporating AI and machine learning capabilities into robotic systems that can analyze patterns and optimize their behavior.

For example, humans can perform initial tasks, while robots can handle high-precision work that would take humans much longer to complete. This synergy fully utilizes the unique capabilities of both humans and robots. Through AI, machines can learn from their environments, experiences, and interactions to fine-tune their tasks and predict future conditions.

Robotics systems have expanded into diverse industries, such as medical electronics, automotive, data centers and connectivity, and home and consumer robotics. As robotic systems and connected devices evolve, they will reshape how these industries operate by assuming more responsibilities, making tough decisions, and driving innovation as co-creators. Next-generation robotic systems are here, and their adoption will forever change human workflows.

This eBook explores the increasing challenges adopters face in using robotic systems across sectors, and different approaches to addressing them in the modern era. Solutions range from high-speed real-time data transmission modules to miniaturized, robust connectors and power management technologies.

RUGGEDIZED CONNECTORS FOR INDUSTRIAL ROBOTICS

The industrial robotics market presents the richest application that involves automation of various processes. These systems excel at performing continuous, high-accuracy tasks in harsh environments and at scales difficult for humans to reach. While these advancements have massively transformed the use of robots to bring efficiency, several unsolved problems prevent their large-scale adoption.

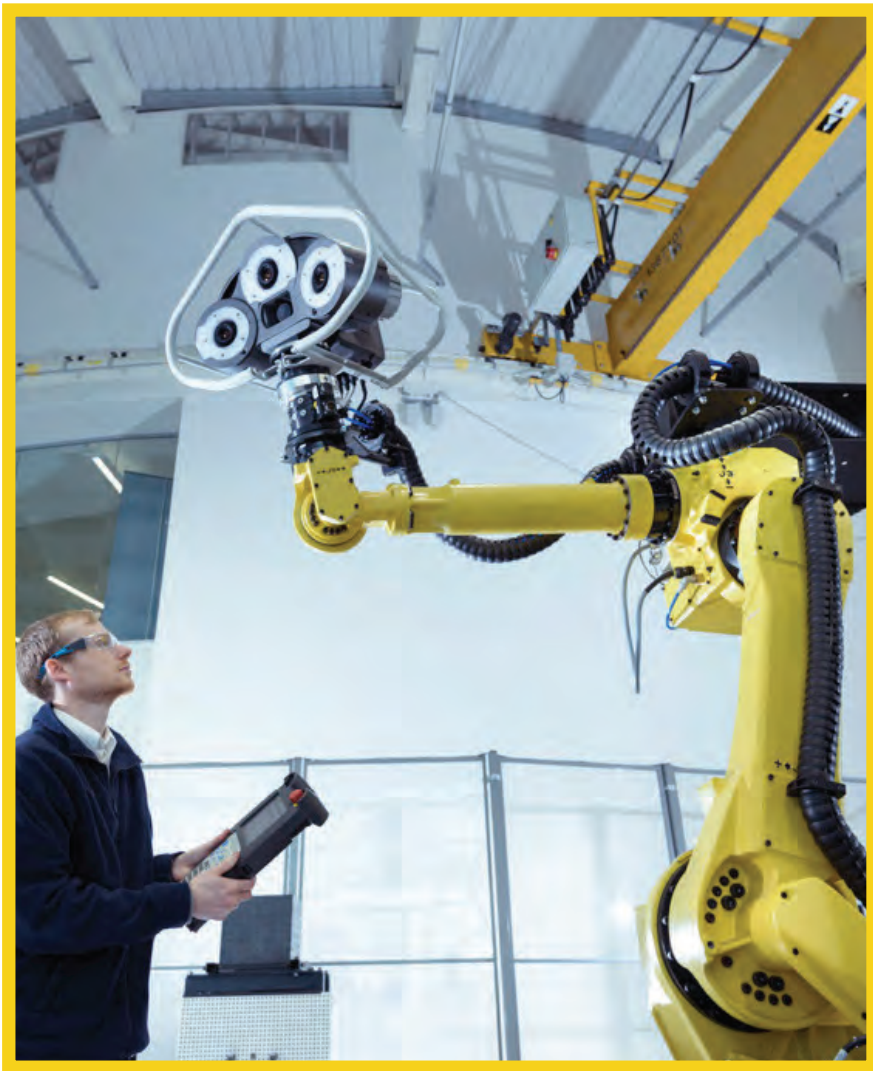
Problem

Imagine an offshore oil and gas plant where robotic equipment is deployed to automate processes, but is exposed to extreme marine environments. The sensor and actuator connectors in the machines perform multiple functions, from assembly and installation to improving maintainability. For constant operation, they need to withstand high humidity and temperature variation without degradation and loss of functionality. As a result, the connectors need to be ruggedized for reliable power, signal, and data connections in such settings.

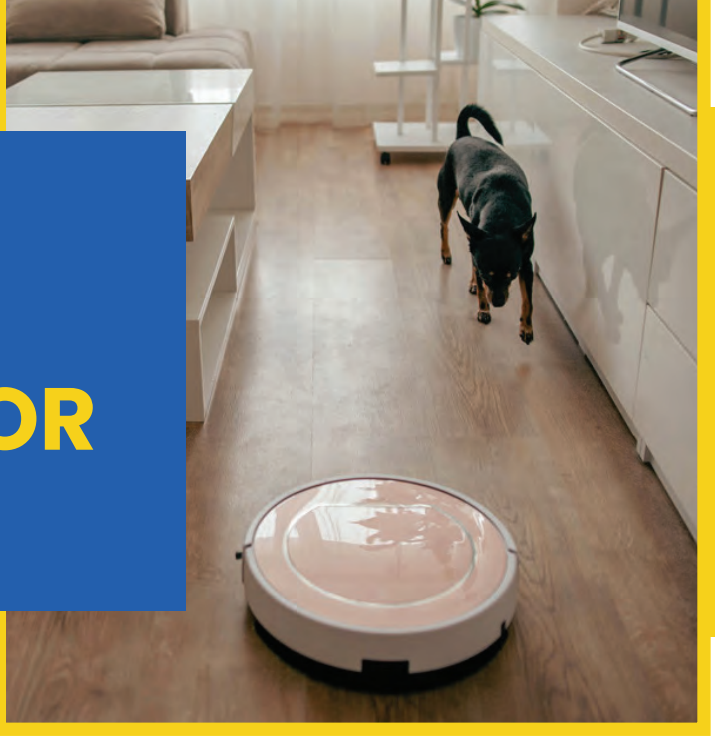
Solution

Molex designs flexible connectivity solutions in the form of connectors and industrial cordsets. These micro-change industrial network infrastructure solutions are available in many form factors, including the standard M12. They come with anti-vibration features to maintain high performance. With their IP67/68 rating for protection, the systems are designed for use in harsh weather conditions.

Molex high-quality connectors allow fast and simple replacement of encoders, switches, and other I/O devices in industrial robotics. These connectors are available in 2- through 5-, 8-, and 12-pole IEC-compliant configurations. In particular, the M12 harsh-duty receptacles offer sealed connections with better electromagnetic interference (EMI) and radio frequency interference (RFI) shielding in high-vibration systems.



POWER MANAGEMENT OPTIMIZATION FOR HOME ROBOTS



In the consumer space, home robots have brought a new level of convenience to our lives, improving efficiency in day-to-day tasks. But these systems have a complex and power-intensive structure that comes with advanced AI capabilities, from real-time mapping of the environment to sensing and adapting to it.

Over several years, home robotic systems have transformed from a smart vacuum cleaner to the current development of humanoid robots. They go beyond simply automating processes to bringing interaction between smart home devices.

Problem

Consider an intelligent robotic vacuum cleaner that is tasked to operate in complex surroundings with varying floor surfaces and tight corners. While its design has sensors, motors, and processors for high performance, it is crucial to integrate power management modules.

The power demands fluctuate throughout the task completion cycle due to the changing intensity of operations, such as high power consumption during vacuuming carpets versus lower usage while cleaning hard floors. In the case of poor allocation of power, battery degradation can also become a problem. To ensure these issues are addressed, the power structure needs to be divided across navigation, data processing, and tasks. Advanced power strategies must be designed to maximize operational efficiency.

Solution

One solution to the above challenges is the battery energy storage system that reserves energy during low-demand periods, such as when solar panels generate surplus power. This is then delivered from onboard storage systems only when high-energy activities are required.

Molex has extensive experience in developing power and energy management solutions through its interconnects and busbars. The UL-certified devices ensure safe operations in high-power and harsh environment applications, as is the case for home robotics. Molex acknowledges that these solutions form the backbone of home robotic applications and offers a portfolio of high-performance busbars, connectors, and cable assemblies.

MINIATURIZED LANDSCAPE OF MEDICAL ROBOTS

Robots in medicine come in various shapes and forms, ranging from compact surgical robots to automated robotic arms. All of these operate with high precision and control, leaving no margin for error. Manufacturers in medical robotics aim to create devices that integrate intelligent capabilities into a compact form factor. This creates demand for miniaturized, reliable, and robust connectors in various design options.

Problem

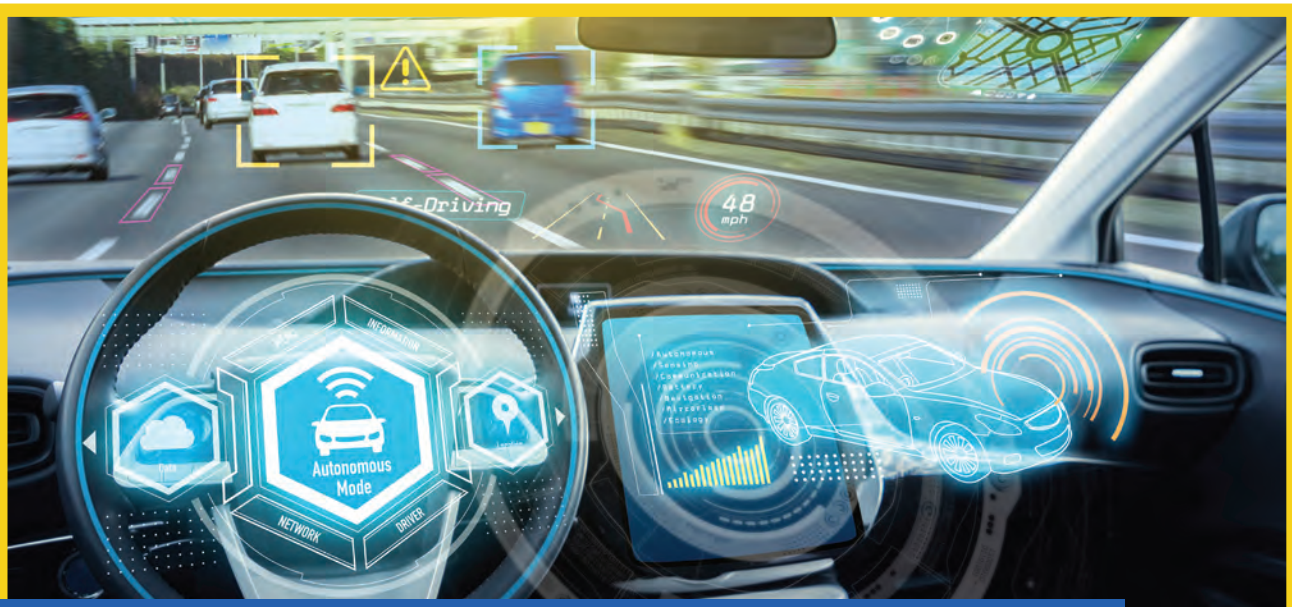
In the case of surgical robots that collect data through attached cameras, the network requires reliable power, signal, and data connectors. These connectors must handle the complex requirements of large current power delivery and extreme operating temperatures, along with high electrical reliability and design flexibility.

For connecting and disconnecting tools, there needs to be easy mating and strong design to prevent damage to the connector housing during blind mating. Because of the sensitive nature of these robotic arms, the connectors need to be robust in design to operate in a wide range of settings.

Solution

The small structure of Molex Board-to-Board and Board-to-FPC connectors solves these challenges. They provide several design options, such as micro/fine-pitch plugs and receptacles that support various voltage, current, and temperature ranges. Such connectors are well-positioned to solve the ever-changing demands of medical robotic systems.

Connectors with a nail structure provide wide alignment for easier mating. Particularly, the metal-power-armor nail provides housing protection for currents up to 3A, while the cover nail prevents damage from currents up to 5A. Even the short body and nail structure of stacking connectors prevent housing damage during the mating process.



AUTONOMOUS VEHICLES INTEGRATE ROBOTICS AND 5G/6G CONNECTIVITY

Vehicle design depends on four key areas: connectivity, autonomous driving, in-vehicle experience, and electrification. These connected vehicles are envisioned to drive, communicate, and connect with their surroundings by relying on multiple sensors, such as LiDAR, cameras, and depth sensors. Achieving this functionality necessitates the complex integration of robotic systems to create a comprehensive view of the environment.

Problem

For autonomous vehicles with thousands of sensors, there are huge amounts of data collected at the source. These systems must be able to perceive their surroundings and react in real time. This demands two key innovations–optimized AI models and low latency communication for better performance in high-speed environments. With 5G networks reducing data transmission delays to milliseconds among various devices and servers, 6G is on the horizon, promising even faster data transfers.

Solution

Molex, a Heilind supplier, is developing a range of engineering solutions and components for 5G-enabled systems, including interconnect and connectors. These 5G connectors offer a significant advantage by combining RF and non-RF connectors in a single unit. The ability of these connectors to replace multiple coaxial cables when used with an FPC cable addresses the potential space constraints within compact vehicular architecture.

The Molex 5G connector supports various applications, such as 5G mmWave, sub-6 GHz, and 4G/LTE. It has improved signal integrity (SI) performance that is important for high-frequency applications. To serve integrators, the company builds custom component design through its collaborative approach to system design, helping companies scale their 5G infrastructure to high volume.

DATA CONNECTIVITY MODERNIZES DATA CENTERS AND HYPERSCALERS

Gartner predicts that by the end of 2025, half of cloud data centers will have advanced robots with AI and machine learning capabilities that will improve operating efficiency by 30 percent. There are four areas for robots to revolutionize the traditional data centers and hyperscalers: server upgrades and maintenance, monitoring, data security and connectivity, and AI in cloud operations. The most common use of these robots would be in automating cloud data center operations and processes.

Problem

As processes become automated, high-speed data transmission between servers and storage devices in the hyperscaler infrastructure remains crucial. Due to the growing volume of data storage at these data centers, further optimization is essential for mission-critical industries, such as security and military. Therefore, they must integrate reliable data transmission infrastructure that provides high speed and secure long-distance data transmission capabilities.

Solution

High-speed optical transceivers solve current data center networking issues. Market reports suggest the growing importance and demand for optical transceivers in the data center industry, which range from 100G optical transceivers to a mass supply of 400G optical transceivers. These networking devices have enabled the development of high-speed networks in hyperscalers.

The increase in data bandwidth due to the adoption of heavy media applications like streaming videos and social networking necessitates 400G optical modules that create a seamless path for future data center expansion. Molex designs optical devices to meet high-quality standards, delivering superior optical, electrical, and EMI performance for network strength. The company offers a range of optical solutions, from cages to connectors and cable assemblies.

LOOKING AHEAD: MOLEX AND TECHNOLOGICAL ADVANCEMENT

Robotic systems are making a major difference in various industries, such as medical electronics, industrial and warehouse automation, automotive, data centers and connectivity, and home consumer devices. By integrating key technology enablers like AI, edge computing, and wireless connectivity, adopters can solve complex challenges in designing these machines.

Molex delivers solutions ranging from connectors to power management modules and assembly devices. As an enabler of evolving technology, Molex products maintain the robustness, responsiveness, and interconnectedness of robotic systems, supporting everything from high-precision medical procedures to advanced autonomous vehicular systems.

Robotic machines are becoming an increasingly integral part of our daily lives, taking on tasks such as vacuuming the floors to providing cooking assistance. They will handle repetitive tasks and accelerate processes that usually take hours for humans to complete. By augmenting human capabilities, robotics will enhance precision, efficiency, and decision-making in a wide range of tasks.

CONNECTING THE FUTURE OF INDUSTRIAL AUTOMATION

Embarking on the forefront of industrial automation, Molex's comprehensive suite of cutting-edge products are meticulously engineered to revolutionize manufacturing landscapes worldwide. Get ready for the future of industrial automation with Heilind's vast inventory of Molex products, supply chain expertise, and renowned customer service. Explore our product solutions.

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