



[Blog] The Evolution of Semi-humanoid Robots: Powering a Human-Robot Collaborative Future

2024-09-25 | [The Evolution of Semi-humanoid Robots: Powering a Human-Robot Collaborative Future](#)

Through depictions like *Star Wars*' C-3PO or Pixar's WALL-E, robots are the big screen and in books have fascinated people around the world. Although these fictional characters go on missions for more advanced than current robots, they have inspired scores of inventors and entrepreneurs to move toward their lofty goal.

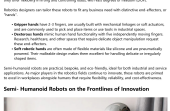
Most people are already familiar with specialized robots, such as vacuum robots or service delivery robots like [Puka Robotics' Bullseye Pro](#) moving about buildings and homes. However, many are less familiar with general-purpose semi-humanoid and humanoid robots. Yet leaders in the robotics and technology fields believe these human-like robots are on the precipice of achieving similar worldwide prevalence in businesses and homes.

The three types of robots we mentioned above have important distinctions that company decision-makers and buyers of the household must understand when gauging their evolution and roles:

- **Specialized Robots:** Task-specific robots, like vacuum, mechanical arm, and delivery robots, excel in their designed roles and are the most cost-effective but lack the versatility to conduct other actions or accomplish different jobs.
- **Semi-humanoid Robots:** These robots mimic some human traits but use wheels for faster movement and smoother navigation on flat surfaces, balancing flexibility and affordability.
- **Humanoid Robots:** Capable of mimicking various human traits and skills, and executing assignments requiring fine motor skills, these bipedal robots replicate more human abilities than semi-humanoid robots but come with greater engineering complexity, including cost.

Each type of automation has its role in the state of robotics, with specialized robots providing targeted solutions, semi-humanoids offering flexibility and effectiveness, and humanoids shining in advanced settings. As semi-humanoid robots evolve, companies are advancing AI to create collaborative workplaces where specialized robots, semi-humanoids, and humans work together effectively.

Understanding Semi-Humanoid Robots: Bridging the Gap



The rise of semi-humanoid robots reflects their growing maturity in both science and business. Companies invest in these general-purpose robots because their engineering is more straightforward, they can achieve ROI more quickly, and they have distinct navigational advantages over bipedal humanoid robots.

Powered semi-humanoids outperform bipedal robots on flat terrain, achieving higher speeds and maintaining better balance due to their wheels' constant contact with the floor or ground. These wheeled robots can continue to function upon a one-wheel malfunction, and they consume less energy than bipedal designs, which require complex gait control.

Semi-humanoid robots also feature a height-adjustable design for handling tasks at varying heights—something bipedal robots can't do. With construction-chassis and different arm-types, they offer flexibility in lifting and controlling loads with vast degrees of freedom (DOF).

Robotics designers customize these robots to fit any business need with distinctive end-effectors, or "hands".

- **Gripper hands:** Have 2-3 fingers, are usually built with mechanical fingers or soft actuators, and are commonly used to pick and place items or use tools in industrial spaces.
- **Centered hands:** Mimic human hand functionality with the independently moving fingers. Research, healthcare, and other spaces that require delicate object manipulation require these end-effectors.
- **Soft robotic hands:** are often made of flexible materials like silicone and are pneumatically powered. Their malleable design makes them excellent for handling delicate or irregularly shaped items.

Semi-humanoid robots are practical, versatile, and eco-friendly, ideal for both industrial and service applications. As major players in the robotics fields continue to innovate, these robots are poised to create workplaces alongside humans that require flexibility, reliability, and cost effectiveness.

Semi-Humanoid Robots on the Frontlines of Innovation



Semi-humanoid robots are well-suited for "brownfield" environments—spaces designed for humans and "greenfield" sites built for automation. Brownfield environments are relatively unobstructed and cost-prohibitive, most industries center around brownfield spaces.

Restaurants, hotels, healthcare facilities, entertainment venues, warehouses, and factories drive demand for semi-humanoid robots for an array of different reasons and scales of use. Since many workplaces have level floor spaces and accessible infrastructure like ramps and elevators, semi-humanoid robots are the superior choice to accommodate these situations.

Brownfield sites, which may be both indoor and outdoor, benefit from the quick mobility of semi-humanoid robots, which are adaptable for loading and unloading goods, to roll backlogs, and predefine paths.

While major corporations like Toyota have developed semi-humanoid robots, many start-ups like Puka Robotics, the industry leader in service robotics, have also driven significant advancements. Puka Robotics has unveiled its semi-humanoid robot, the [PUBU D1](#), which exemplifies the apex of robotics progress. With 40-degree shoulder mobility, 180-degree mobility, a linear speed of 2 mph, and 75 kg lifting precision, the PUBU D1 is built for any brownfield scenario.

Despite breakthroughs like the PUBU D1 and others, mass adoption lags due to business uncertainty regarding how to incorporate these robots into their workflows best. It falls on robotics industry leaders to demonstrate effective integration strategies to encourage broader use of semi-humanoid automation in commercial and industrial systems.

Real-World Benefits and Considerations of Semi-humanoid Robots



The humanoid-robot market (which includes semi-humanoid robots) is projected to grow from \$100.15 billion in 2024 to USD 344 billion by 2030 with a CAGR of 36.2%. These semi-humanoid robots, equipped with the latest cameras, sensors, and software, are increasingly enhancing industries through human-robotics.

Currently, robotics companies have completed semi-humanoid robots leverage servers can grow two times in six seconds and safely handle high-temperature drinks like coffee. Attended robots are becoming common in hotels, dealing with check-ins, key card distribution, and customer service, addressing labor shortages and ensuring consistent service quality.

In healthcare, semi-humanoid robots can support elderly exercise programs and enable remote care through telemedicine and more. Warehouses and factories are pioneering using semi-humanoid robots for lift loads and detect malfunctions to prevent equipment incidents and increase output. Commercial sites like shopping malls are starting to deploy these robots for tasks like staff employee assistance with restocking or providing customers with navigational information. These robots again help companies differentiate themselves from their rivals to keep their competitive edge.

Other technology enterprises have created semi-humanoid robots that can entertain, open doors, and patrol for security, demonstrating their versatility in residential and commercial spaces. Their refined motor skills and speech capabilities can even allow them to conduct lectures or perform on stage, captivating audiences and increasing performance accuracy on stage and concert halls.

These innovative examples and others help us envision a future where these semi-humanoid robots regularly perform these tasks, and wouldn't be out of place in our day-to-day lives.

However, the road to widespread adoption also involves overcoming challenges. A 2020 study of Japan's *Team-Hotel* revealed limitations in fully-robotic reception due to inadequate emotional and linguistic capabilities, leading to customer dissatisfaction. The hotel reduced its robots and lifted human responsibilities, highlighting the need to balance human and robotic roles.

The Human-Robot Collaboration (HRC) model at *Team-Hotel* demonstrates the importance of balancing well-trained staff with suitable robots for optimal service.

Robotics companies like [Puka Robotics](#) are advancing HRC with their quality fleet of specialized service and cleaning robots in tandem with their latest semi-humanoid robot, the PUBU D1. These robotics companies intend to show businesses how pairing specialized robots and semi-humanoid robots into workplaces to work alongside employees is the optimal solution for most long-standing challenges.

Calculated Human-Robot Collaboration (HRC) is the Name of the Game



While many industries have started introducing semi-humanoid robots into their workflows, the most strategic enterprises are taking digital transformation a step further: They are developing specialized robotic workflows that foster a more profound and practical Human-Robot Collaboration.

In the hospitality sector, hotels use specialized cleaning robots alongside semi-humanoid robots and staff. These cleaning robots handle floor maintenance, complementing the semi-humanoid robots that assist with other commands and virtual consultations. While robots manage routine duties, hotel employees focus on personalized services such as greeting guests, providing information, and resolving issues. Integrating robots and human staff maximizes the guest experience by making it more seamless and relaxed.

Hospitals are embracing HRC to meet the rising demand for patient care coupled with labor shortages. Specialized robots, such as surgical arms, assist with procedures, while dedicated robots care for disaster spread. Semi-humanoid robots further support by transporting medical supplies, keeping patients company, and alerting staff if a patient falls. These robots help ease the burden on healthcare providers by managing routine tasks and elevating overall care competency.

In retail settings like shopping malls, HRC boosts customer satisfaction. Specialized robots take care of floor maintenance, shopping cart refilling, and mapping busy areas, while attended semi-humanoid robots help customers by directing them, answering questions, and carrying small bags. This automation allows human staff to concentrate on steering customers, managing customer service, and handling complex sales issues. Properly balanced HRC streamlines operations and lets employees focus on higher-value responsibilities, elevating the shopping experience.

In logistics, HRC promises growth in versatility. Semi-humanoid robots work alongside human employees and autonomous mobile robots (AMRs) that handle hazardous areas and loads. AMRs handle heavy, awkward, or irregular items across large warehouses or exteriors. This framework amplifies the productivity and safety of e-commerce warehouses, with semi-humanoid robots complementing the AMR's functions.

The manufacturing industry benefits from the dynamic collaboration of semi-humanoid robots, specialized robots, and humans. Specialized robots assume mundane precision duties like welding, and industrial cleaning robots like [Puka Robotics' B17](#) keep large-scale buildings, pipes, and tools. Semi-humanoid robots assist with handling various tasks and loading and unloading crates. HRC enables human workers to focus on complex duties such as quality control and process management, resulting in greater efficiency and employee satisfaction.

The popularization of Human-Robot Collaboration (HRC) is evolving industries by combining semi-humanoid robots with human workers. This integration in hospitality, logistics, manufacturing, healthcare, and retail streamlines workflows and strengthens each company's competitive edge. Robots manage routine and dangerous tasks, freeing up humans to handle more emotional and specialized roles. This combination of human ingenuity and technological durability boosts real-world performance and enhances customer and employee experiences, setting the stage for tremendous success and rapid ROI.

What's Next on the Horizon?



The widespread adoption of wheeled semi-humanoid robots in commercial and industrial sectors via Human-Robot Collaboration also depends on balancing aesthetics, functionality, and reliability.

While customers appreciate human-like traits in robots, overly realistic designs can trigger discomfort due to the "uncanny valley" effect. For example, *Isabella*, a hyper-realistic robot from *Disney's AULU*, impressed many people with its realism but was discomforted as eerie and gave them "glitchy" feelings" by some users.

In commercial settings, testing robot appearances is crucial for ensuring positive HRC. Though aesthetics matter less in industrial environments, robots still need to look appealing when interacting with visiting VIPs.

Despite these considerations, functionality is paramount. Robots must reliably handle routine engagements, offering employees, in focus on more complex tasks. In factories and warehouses, where conditions can be hazardous, robots must have long battery life and high reliability to prevent productivity disruptions and ensure safety.

In high-end industries like hospitality and retail, while employees remain essential for personalized services, robots are still needed to handle repetitive simple commands correctly. With informal decision-makers who discern which high-quality robotic solutions best match their demands and others to scale up the quantity appropriately can better serve their customers and help employees take on more meaningful roles.

The future of semi-humanoid robots depends on accurate research and setting achievable goals for both robotics manufacturers and enterprises that deploy them. AI advancements, such as Google's *PaLM-2* and the Large Language Models (LLMs) used in [Puka Robotics'](#) products, enable robots to better understand and interact with their environments, which gives businesses more confidence in their deployment.

These innovations bring semi-humanoid robots from science fiction to reality, with embedded intelligence intensifying their adaptability and nuanced interactions.

Conclusion



As AI and machine learning drive the accelerated integration of semi-humanoid robots in commercial and industrial sectors, these robots will systematically enhance customer service levels, efficiency, and cost effectiveness.

Despite high upfront costs and current limitations, ongoing advancements and expanded Human-Robot Collaboration with specialized robots promise to overcome these challenges, maximizing ROI.

HRC flourishes in various industries, involving semi-humanoid robots, specialized robots, and employees. As versatile robots to handle complex duties, adapt to diverse environments, and interact naturally, improving operations in brownfield environments like retail, logistics, and healthcare.

Innovations in HRC will provide consistent, effective, and empathetic support, helping businesses meet evolving demands and remain competitive. As semi-humanoid robots become more common, they will enable industries from logistics to healthcare and beyond, galvanizing widespread collaboration and prosperity.

[Follow us](#) to learn more about how robots can help solve persistent industry challenges.

Puka Robotics, a global service robotics leader, is transforming industries in the commercial and industrial spheres with cutting-edge technology and over 1,000 patents. Their delivery, cleaning, industrial, and semi-humanoid robots boost efficiency and customer satisfaction in over 60 countries and regions, with over 10,000 units shipped.

Works Cited

1. BBC News. "Service Robots: A Real Future?" *Humanoid Robot Ready for Real Future*. BBC News. 11 Sep. 2023. [www.bbc.com/news/technology-66181818](#). Accessed 11 Sept. 2024.
2. BBC News. "The AI Humanoid Robot in the Japanese Style." *BBC News*. 14 Aug. 2023. [www.bbc.com/news/technology-66181818](#). Accessed 11 Sept. 2024.
3. Global Data. "Market is Expected to Grow Substantially Over the Next Five Years as the Segments of Industrial and Commercial Robots." *Industrial Robot Sales Expected to Grow Substantially Over the Next Five Years*. Global Data. 14 Sept. 2024. [www.globaldata.com](#).
4. The Information Group. "Puka Robotics' Bullseye Pro: A New Standard for Service Robots." *The Information Group*. 14 Sept. 2024. [www.theinformationgroup.com](#).
5. The Information Group. "Puka Robotics' Bullseye Pro: A New Standard for Service Robots." *The Information Group*. 14 Sept. 2024. [www.theinformationgroup.com](#).
6. The Information Group. "Puka Robotics' Bullseye Pro: A New Standard for Service Robots." *The Information Group*. 14 Sept. 2024. [www.theinformationgroup.com](#).
7. The Information Group. "Puka Robotics' Bullseye Pro: A New Standard for Service Robots." *The Information Group*. 14 Sept. 2024. [www.theinformationgroup.com](#).
8. The Information Group. "Puka Robotics' Bullseye Pro: A New Standard for Service Robots." *The Information Group*. 14 Sept. 2024. [www.theinformationgroup.com](#).
9. The Information Group. "Puka Robotics' Bullseye Pro: A New Standard for Service Robots." *The Information Group*. 14 Sept. 2024. [www.theinformationgroup.com](#).
10. The Information Group. "Puka Robotics' Bullseye Pro: A New Standard for Service Robots." *The Information Group*. 14 Sept. 2024. [www.theinformationgroup.com](#).
11. The Information Group. "Puka Robotics' Bullseye Pro: A New Standard for Service Robots." *The Information Group*. 14 Sept. 2024. [www.theinformationgroup.com](#).
12. The Information Group. "Puka Robotics' Bullseye Pro: A New Standard for Service Robots." *The Information Group*. 14 Sept. 2024. [www.theinformationgroup.com](#).
13. The Information Group. "Puka Robotics' Bullseye Pro: A New Standard for Service Robots." *The Information Group*. 14 Sept. 2024. [www.theinformationgroup.com](#).
14. The Information Group. "Puka Robotics' Bullseye Pro: A New Standard for Service Robots." *The Information Group*. 14 Sept. 2024. [www.theinformationgroup.com](#).
15. The Information Group. "Puka Robotics' Bullseye Pro: A New Standard for Service Robots." *The Information Group*. 14 Sept. 2024. [www.theinformationgroup.com](#).
16. The Information Group. "Puka Robotics' Bullseye Pro: A New Standard for Service Robots." *The Information Group*. 14 Sept. 2024. [www.theinformationgroup.com](#).
17. The Information Group. "Puka Robotics' Bullseye Pro: A New Standard for Service Robots." *The Information Group*. 14 Sept. 2024. [www.theinformationgroup.com](#).
18. The Information Group. "Puka Robotics' Bullseye Pro: A New Standard for Service Robots." *The Information Group*. 14 Sept. 2024. [www.theinformationgroup.com](#).
19. The Information Group. "Puka Robotics' Bullseye Pro: A New Standard for Service Robots." *The Information Group*. 14 Sept. 2024. [www.theinformationgroup.com](#).
20. The Information Group. "Puka Robotics' Bullseye Pro: A New Standard for Service Robots." *The Information Group*. 14 Sept. 2024. [www.theinformationgroup.com](#).