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Robotics in Real Estate

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ABSTRACT

The real estate industry is standing on the precipice of a profound transformation. The integration of robotics and automation promises to revolutionize everything from property construction and maintenance to security and facility management. Real estate often depends on the practical work of constructing, inspecting, operating, and maintaining buildings. Robotics can improve each of these stages. The value of robotics lies not merely in automating a repetitive task. It also lies in generating dependable, timely information about a property. From the initial breaking of ground on construction sites to the ongoing management of properties and the final stages of the sales process, robots are becoming increasingly embedded into every facet of the real estate lifecycle. Used thoughtfully, robotics technologies can help real estate companies deliver projects more reliably, protect workers, manage properties more efficiently, and create more responsive buildings. This paper examines the applications, benefits, and challenges associated with the adoption of robotics across the real estate sector.

KEYWORDS: *robots, robotics, real estate, realtor, property.*

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INTRODUCTION

The real estate industry, historically characterized by labor-intensive practices and analog management, is undergoing a profound transformation driven by robotics and automation. In 2024 alone, the International Federation of Robotics (IFR) reported the sale of nearly 200,000 professional service robots globally. This growth encompasses domains highly relevant to real estate, including transportation and logistics. However, integrating autonomous systems into the built environment presents distinct challenges compared to deploying them on controlled manufacturing floors [1].

Robotics is shifting from factory automation to physical AI machines that can perceive space, navigate semi-structured environments, and perform repetitive tasks consistently.

It is reshaping the real-estate life cycle from development through long-term asset operation. A robot is typically equipped with cameras, thermal sensors, LiDAR, or other instruments and can document conditions in places that are difficult, dangerous, or costly for people to access. The marketing and sales processes in real estate have also been transformed by the advent of robotics and AI technologies. AI algorithms can analyze consumer behavior and preferences, enabling real estate professionals to tailor their marketing strategies more effectively. In the next few years, many real estate companies will be actively using these technologies to enhance inspections, automate operations, improve safety, and reimagine client interaction. From construction to leasing, maintenance to analytics, robotics and AI are turbocharging real estate's future [2].

WHAT IS A ROBOT?

The word "robot" was coined by Czechriter Karel Čapek in his play in 1920. Isaac Asimov coined the term "robotics" in 1942 and came up with three rules to guide the behavior of robots and later added the zeroth law [1]:

- Law 0: A robot may not injure humanity or through inaction, allow humanity to come to harm.
- Law 1: Robots must never harm human beings,
- Law 2: Robots must follow instructions from humans without violating rule 1,

- Law3: Robots must protect themselves without violating the other rules.

Robots are becoming increasingly prevalent in almost every industry, from healthcare to manufacturing.

Although there are many types of robots designed for different environments and for different purposes/applications, they all share four basic similarities [2]:

1. All robots have some form of mechanical construction designed to achieve a particular task;
2. They have electrical components which power and control the machinery;
3. All robots must be able to sense its surroundings; a robot may have light sensors (eyes), touch and pressure sensors (hands), chemical sensors (nose), hearing and sonar sensors (ears), etc.
4. All robots contain some level of computer programming code.

Programs are the core essence of a robot since they provide intelligence. There are three different types of robotic programs: remote control, artificial intelligence, and hybrid. Some robots are programmed to faithfully carry out specific actions over and over again (repetitive actions) without variation and with a high degree of accuracy.

Robotics is an interdisciplinary field that involves the design, construction, operation, and use of robots. It is a branch of engineering and computer sciences that includes the design and use of machines that are capable of performing programmed tasks without human involvement. The field develops machines that can efficiently carry out various tasks, can automate tasks, and do various jobs that a human might not be able to do. Robots could someday be our drivers, companions, collaborators, teachers, specialists, and exploration pioneers [3]. Figure 1 shows a cloud word for robots [4], while Figure 2 shows a typical robot [5].

ROBOTICS IN REAL ESTATE

Real estate is often understood as a business of locations, buildings, and personal relationships. Yet its daily work is deeply physical: sites must be measured, façades examined, spaces cleaned, equipment checked, materials moved, and people kept safe. Robotics brings programmable sensing, mobility, and manipulation into these activities.

The technology includes aerial drones, autonomous mobile robots, robotic arms, inspection crawlers, and collaborative machines that assist people rather than replace them outright. Robotics can influence real estate before a building is occupied. Drones can survey land, capture site imagery, and compare construction progress across time. Ground robots and robotic arms can assist with specialized construction tasks such as drywall work, drilling, lifting, concrete-related work, welding, painting, and material handling [1]. Figure 3 shows a representation of robotics in real estate [6].

The integration of robotics and AI into real estate is not merely a trend; it represents a fundamental shift in how properties are managed, marketed, and experienced by tenants. As these technologies continue to advance, they will play an increasingly vital role in enhancing efficiency, improving tenant satisfaction, and ensuring security within properties [7].

APPLICATIONS OF ROBOTICS IN REAL ESTATE

Research has identified five primary applications for robotic inspection in the built environment: maintenance inspection, construction-quality inspection, construction-progress monitoring, as-built modeling, and safety inspection. Robotics has applications across the full real-estate value chain: it can survey and monitor construction sites, inspect difficult building components, clean and maintain occupied properties, support security teams, and convert physical observations into useful operating data. Common applications of robotics in real estate include the following [1,2]:

- *Property Inspection*: One of the most immediate applications of robotics in real estate is property inspection. Manual inspections can be time-consuming, costly, variable in quality, and sometimes unsafe; it can also expose people to risk when the work involves heights, confined spaces, damaged structures, or inaccessible building components. Roofs, façades, high windows, ventilation ducts, mechanical rooms, confined spaces, and damaged structures can be difficult or hazardous to examine manually. Drones, wheeled robots, wall-climbing devices, and crawlers can carry cameras and other sensors to collect visual, thermal, acoustic, or spatial data. Aerial robots can examine building exteriors and roofs without routinely sending a person to height, while ground or crawler robots may inspect ducts, pipes, or other confined components. Data from robotic inspections, for example, can inform work orders, maintenance plans, capital budgets, and communication with occupants.
- *Property Management*: Robotics is reshaping how properties are managed and maintained once they are occupied. The field of facility management is experiencing a wave of automation with the

introduction of autonomous cleaning robots, robotic security patrols, and automated landscaping systems. Once a property is occupied, facilities management assumes responsibility for its upkeep, security, and cleanliness. Autonomous Mobile Robots (AMRs) are increasingly deployed in these roles to address labor shortages and improve service consistency. Crucially, robotics is facilitating a shift from reactive to proactive property maintenance. Figure 4 shows a robotic arm that carries a model home foreshadowing automation in property management [8].

- *Human–robot Collaboration*: The most productive operating model is usually human–robot collaboration. A robot can complete an overnight floor-cleaning route or collect routine readings, while a facilities professional responds to unusual conditions, validates the findings, communicates with tenants, and performs repair work requiring dexterity or judgment. This division of labor may make service more consistent while preserving the human presence that tenants expect. In multifamily, office, industrial, hospitality, and mixed-use properties, robots can therefore contribute to experience and reliability as well as labor efficiency. Figure 5 shows human-robot collaboration [9].
- *Construction Projects:* Beyond inspection, AI-enabled robots are directly performing construction tasks. The first benefit of robotics appears before a building is occupied. Construction projects involve repetitive, physically demanding, and detail-sensitive activities, including surveying, material handling, concrete work, bricklaying, welding, finishing, and quality checks. Robotics should not be understood as a complete substitute for construction professionals. Instead, it reallocates work: machines can perform repetitive or hazardous tasks, while architects, engineers, tradespeople, and site managers apply judgment to design decisions, exceptions, and coordination. This division of labor can be particularly valuable in complex developments, where small deviations in quality or schedule can compound into substantial costs. After construction, AI continues to add value to a building's operational life through energy management, security applications and enabling "smart buildings."
- *Building Maintenance*: Robots efficiently handle routine inspections, janitorial duties, and minor repair tasks, significantly reducing downtime, enhancing service quality, and lowering ongoing maintenance costs. They can detect issues early, proactively maintaining property conditions. Real estate owners and managers must look seriously into robotics to support maintenance operations in their properties. Robotic systems are adding tremendous value when it comes to building maintenance. Specially designed systems are being used to automate inspections—for example, robots equipped with thermal cameras, vibration sensors, and gas detectors can patrol buildings and identify potential issues before they become serious. Robotics are also being used to ensure consistent cleaning standards and handle basic maintenance tasks. Security and monitoring are other areas in which autonomous systems can assist humans. Machines can provide continuous monitoring of environmental conditions such as temperature and air quality while providing round-the-clock surveillance.

BENEFITS

Robotics can make construction more consistent, reduce exposure to hazardous inspection work, improve the efficiency of property operations, strengthen preventive maintenance, and support more sustainable building performance. Other benefits of robotics in real estate include the following [1,7]:

- *Automation*: Robotics plays a crucial role in automating physical tasks within properties. Manual inspection is often subjective, time-consuming, and dangerous when it involves confined spaces or elevated heights. The real estate industry, traditionally characterized by manual processes and human oversight, is now embracing automation to enhance productivity and streamline operations. Robotic systems, particularly Unmanned Aerial Vehicles (UAVs) and Unmanned Ground Vehicles (UGVs), have emerged as critical tools for these tasks. By automating data collection, these robots reduce human error and increase the frequency at which inspections can be safely conducted. Automation and robotics can aid in reducing errors and increasing the efficiency of inspection tasks.
- *Operational Efficiency*: Integrating robotic solutions can dramatically decrease operational expenses by automating repetitive tasks and improving resource efficiency. These operational savings directly boost net operating income (NOI) and increase overall property valuations.
- *Customer Engagement*: This level of customization increases the likelihood of engagement and conversion. Moreover, virtual reality (VR) and augmented reality (AR) technologies powered by AI are revolutionizing property showings. Prospective buyers can take

virtual tours of properties from the comfort of their homes, experiencing immersive environments that showcase the features of a property without the need for physical visits. This not only broadens the reach of marketing efforts but also caters to the growing demand for convenience among buyers.

- *Security*: Security is a paramount concern in real estate, whether for residential complexes or commercial properties. Traditional security cameras produce a flood of footage that is impractical for humans to monitor in real time. AI computer vision now can analyze video feeds for threats or issues. The integration of robotics and AI into security systems offers enhanced surveillance capabilities that traditional methods cannot match. AI-powered cameras equipped with facial recognition technology can monitor access points in real-time, identifying individuals who may pose a security risk or tracking unauthorized entries.
- *Sustainability:* Robotics can support sustainability goals. Precise construction and automated quality checks may reduce material errors and rework. During operations, robots can help monitor building conditions and reveal maintenance needs that affect energy performance, such as defects in exterior envelopes or difficult-to-access mechanical systems. The broader integration of robotics, artificial intelligence, and building technologies is associated with efforts to improve resource efficiency, environmental quality, and the responsiveness of the built environment.

CHALLENGES

In spite of the clear advantages, the widespread adoption of robotics in real estate is not without challenges. At the forefront of these challenges are the technological limitations inherent in current robotic systems. Real estate environments are dynamic, unstructured, and highly complex. The technology can require upfront investment, staff training, changes to building layouts, reliable connectivity, privacy safeguards, and effective integration with existing operating systems. Other challenges of robotics in real estate include the following [1,7]:

- *High Costs*: Economic factors present another formidable barrier. One significant issue is the initial cost of implementing these technologies. The initial capital expenditure required to procure, deploy, and integrate advanced robotics is substantial. High-quality robots equipped with sophisticated sensors and AI capabilities command premium prices. For many real estate developers, property managers, and facility management companies, the return on investment (ROI) remains uncertain or difficult to quantify in the short term. While robots can reduce long-term labor costs, the immediate financial burden, coupled with ongoing expenses for maintenance, software updates, and specialized technical support, deters widespread adoption. The economic equation is particularly challenging for smaller companies or properties with tight profit margins, leading to a digital divide where only well-capitalized entities can afford to innovate.
- *Data Privacy*: A major concern revolves around data privacy and security. The use of AI often involves collecting vast amounts of data from tenants and properties, raising questions about how this information is stored, used, and protected.
- *Constraints*: Robotics is not universally economical or suitable. Buildings vary substantially in layout, surfaces, access, connectivity, and operating conditions, making navigation and standardization difficult. A robot may require charging infrastructure, reliable wireless coverage, compatible façades or floor plans, operator training, maintenance support, and integration with existing workflows. For this reason, the strongest adoption strategy is incremental.
- *Regulation:* The regulatory landscape surrounding robotics in real estate is also largely uncharted and fragmented. As robots take on more active roles in public and semi-public spaces, questions regarding liability, safety standards, and data privacy become increasingly pressing. If a security robot accidentally injures a tenant or damages property, determining fault between the manufacturer, the property owner, and the software developer is legally complex. The absence of comprehensive, unified regulatory frameworks creates uncertainty, making stakeholders hesitant to fully commit to robotic solutions.
- *Organizational Culture*: The cultural and organizational challenges of integrating robotics cannot be overstated. The real estate sector is inherently people-centric, relying heavily on human interaction, negotiation, and personalized service. There is a pervasive fear that automation will lead to widespread job displacement, particularly for facility management, security, and maintenance personnel. This apprehension can foster resistance from employees and labor unions, hindering the implementation process.

The successful deployment of robotics requires a shift in organizational mindset and the acquisition of new skill sets.

- *Fear of Job Displacement:* Robots often tend to make many people uneasy. Robots tend to spark fears that they could overtake human jobs. There is a fear that over-reliance on technology could lead to job displacement within the industry, as automation takes over tasks traditionally performed by human workers. This concern must be addressed to ensure a smooth transition to a more technology-driven real estate industry. Rather than simply replacing human jobs, robots can augment human capabilities, allowing employees to transition to more skilled, strategic roles.

FUTURE OF ROBOTICS IN REAL ESTATE

Looking ahead, several trends indicate how robotics and AI will continue to evolve within the real estate sector. One notable trend is the increasing use of predictive analytics powered by machine learning algorithms. It is clear that robotics and AI will be at the forefront of shaping the future landscape of real estate. As the built environment continues to automate, the most successful real estate organizations will be those that view robotics not merely as a capital purchase, but as a catalyst for redesigning their operational processes and physical spaces. The industry is evolving toward the creation of fully autonomous smart buildings that self-monitor, self-regulate, and seamlessly integrate into broader, interconnected urban ecosystems. Looking ahead, the future vision for real estate is one of collaboration, where humans and robots work in tandem [1], as illustrated in Figure 5 [9]. The convergence of physical AI capabilities, substantial venture capital investment, and sophisticated orchestration platforms is creating the foundation for a transformational breakthrough in robotics applications. Figure 6 shows the involvement of humanoid robots in the future of work [9].

CONCLUSION

Robotics is fundamentally reshaping the real estate industry value chain, from design and construction to operations and usage patterns. The application of robotics in real estate is no longer a distant possibility; it is a measurable reality actively reshaping how buildings are constructed, inspected, and managed. However, the industry must navigate significant barriers before robotics can achieve ubiquitous adoption. Construction sites require advanced safety protocols to manage human-robot interaction in unpredictable environments. The greatest contribution of robotics is not the simple replacement of people with machines. Instead, robotics can shift people away from hazardous, repetitive, and low-information work toward oversight, skilled repair, tenant service, and decision-making.

By embracing these technologies, stakeholders can unlock efficiencies, improve safety, and deliver enhanced experiences for tenants and occupants Stakeholders who embrace these changes will not only gain a competitive edge but also contribute to a more efficient, responsive, and tenant-centric industry that meets the evolving needs of modern society. As the industry continues to evolve, harnessing the power of robotics and automation will be essential for staying competitive and meeting the demands of tomorrow's real estate landscape. More information on robotics in real estate can be found in the following related journals:

- Robotica
- Robotics
- Robitics and Autonomous
- Robotics and Computer-Integrated Manufacturing,
- Advanced Robotics
- Autonomous Robots
- Automation in Construction
- Journal of Robotics
- Journal of Robotic Systems
- Journal of Robotic Surgery
- Journal of Robotics and Mechatronics
- Journal of Intelligent & Robotic Systems
- Journal of Mechanisms and Robotics-Transactions of the ASME
- Journal of Automation, Mobile Robotics and Intelligent Systems
- Journal of Future Robot Life
- IEEE Robotics and Automation Letters
- IEEE Transactions on Robotics
- International Journal of Robotics Research
- International Journal of Social Robotics
- International Journal of Humanoid Robotics
- International Journal of Advanced Robotic Systems
- Science Robotics
- Soft Robotics

- Journalism
- Journalism and Media

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Figure 1 A cloud word for robots [4].

Figure 2 A typical robot [5].

Figure 3 A representation of robotics in real estate [6].

Figure 4 A robotic arm that carries a model home [8].

Figure 5 Human and robot work in collaboration [9] .

Figure 6 Involvement of humanoid robots in the future of work [9].