A Condensed Overview of Robotics with Artificial Intelligence

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Abstract. Both positive and negative experiences are common in robotics. The twenty-first century has entered the era of robotics. The promise of fresh possibilities has long been associated with robots. In the modern world, robots are becoming more and more prevalent in many facets of society, including transportation, healthcare, construction, food production, and supply chain management. A significant technical achievement, modern robotics is now a significant component of science, ranging from medical research to other scientific domains. The robot is handling challenging and accurate duties with ease and without getting hurt. In the modern world, robots are increasingly serving as the main representation of human interaction.

This article gives an overview of the dynamic intersection of artificial intelligence and robotics and how it impacts dynamics of society. We look at the new fields of management and economics study that look at the intricate impacts of these cutting-edge technology. We provide conclusions on the effects of automation, robotics, and artificial intelligence on organisational design and business strategy by utilising the many approaches used by scholars in this field. We advise organisational and strategy researchers to become more involved and attentive in these areas and identify promising avenues for future research endeavours.

Keywords: Collaboration in Robotics, Human Cooperation, Manufacturing, and Transportation, Artificial intelligence

1 Introduction

The cutting-edge sciences of robotics and artificial intelligence (AI) have the potential to completely transform a number of aspects of society and the economy. The integration of AI with robotics has enabled robots to observe, reason, and act in complex environments autonomously, leading to the development of advanced robotic systems in industries such as logistics, manufacturing, and healthcare. Furthermore, new avenues for research and development in areas like human-robot interaction, social robotics, and cognitive robotics have been made possible by the convergence of AI and robotics [1-11].

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As a result, more and more academic research has been done to examine the latest advancements, challenges, and potential applications. With a focus on research directions, technical breakthroughs, and real-world applications, our goal in this review article is to provide a comprehensive overview of the status of artificial intelligence in robotics. We also intend to discuss the ethical, societal, and economic ramifications of this quickly developing field. With this assessment, we hope to clarify the opportunities and difficulties related to this cutting-edge technology and further awareness of the state of AI in robotics today and in the future.

Computer science, electrical engineering, mechanical engineering, and other disciplines are all included in the engineering and scientific subject of robotics [12]. These robots are utilised in sensitive scenarios even though they may be utilised for any work. Human-faced robots are probably capable of understanding, talking, walking, and above all performing human-like activities. The novelist Isaac Asimov claimed to have coined the term "robotics" in a 1940s short fiction [13]. In addition, he discussed three guiding principles for robots in his story.

Robotics is an interdisciplinary area of computer engineering and sciences [14]. They can even carry out extremely repetitious operations that are difficult for humans to complete, including venturing into space or navigating hazardous situations. In dangerous circumstances, people can be replaced by robots in production operations. However, until the 20th century, the usefulness and potential applications of robots did not much improve. Throughout history, robotics has frequently been observed to behave and carry out activities in a similar way to humans. In the fields of science, technology, engineering, and mathematics, robotics is frequently employed as a teaching tool [15].

Science, technology, and engineering all include robotics. During antiquity and the Middle Ages, the primary purpose of robots was amusement [16]. However, the modern robot has altered social structures and made safe working conditions possible. Additionally, the national defense and space exploration landscapes have transformed as a result of NASA and the military implementing advanced robotics. The growth of robotic laborers has provided significant benefits to the sector because compared to humans; robots are much more efficient and never grow weary. Because they can operate in hazardous situations, robots are incredibly useful to people. The robot can perform repetitive operations and handle large and poisonous substances with ease. Robots save factories time and money by preventing numerous accidents.

Mechanical, electrical, computer, software, and information engineering are all included in the field of robotics. Robotics creates devices that can replace humans and behave like humans. In order to prevent issues for industry personnel, robots were first designed to carry out hazardous duties. Additionally, robots are used in tasks that are too risky, unclean, or boring for people to perform. Robots are frequently utilized in assembly, production, transportation, mining, packing and packaging, space and earth exploration, and surgery. [16]

In addition, it can assist in extinguishing fires, be crucial in combat, be used by the military, collaborate with workers in manufacturing facilities, produce items like cars, operate in hazardous environments and rescue lives, and support emergency searches. Robots play a huge role in rescue operations. Furthermore, robots play a crucial part in the mass manufacturing of consumer and industrial goods, security, laboratory research, and weapons [17]. In our life, robots are a marvelous invention. We observe that robots are used in our day-to-day jobs. It follows that robots play an equally significant role in our lives.

Furthermore, certain occupations, like space flight and undersea exploration, are exceedingly dangerous and damaging to humans. Robots can be utilized for risky jobs like bomb disposal. In these situations, using robots significantly lowers the number of workplace accidents [18-20]. A robot can operate flawlessly for twenty-four hours a day, seven days a week, and in a short amount of time by itself with numerous humans, but it also works nonstop all year round [22].

Already, robotics is leading the competition in large-scale production. Many prosperous European industrial sectors would not be able to compete with their current European base operations without robotics. By using robotics, many industries have already managed to thrive [23]. Expanding robots is becoming more important for Europe's small manufacturing sector, which is the hub of the continent's production and job prospects.

Utilizing new technologies, farmers are doing anything from using robots to gather crops. Auxiliary surgical robotics has advanced, benefiting the medical sector as well as the trash disposal industry, where those robots are currently being utilized to clean up their mess[24].

1.1 Classification of Robots

Robots with preprogrammed codes: Pre-programmed robots do basic, boring tasks in a controlled setting and to outperform humans in terms of duration, speed, and efficiency.

A robot that resembles a human: Robots that mimic human behavior are called humanoid robots. Usually, these robots carry out actions that humans would do, like sprinting, jumping, and carrying goods.

Self-governing robot: Robots that are autonomous function without human intervention. Typically, these robots are made to carry out activities in an unsupervised, open environment without the need for human intervention.

Teleported robot: An individual at a safe distance can use a wireless network to direct a teleportation robot, which is a semi-autonomous machine. These robots typically work in challenging environments with unpredictable weather and topography.

Augmenting robot: Robots designed to augment human talents either restore or enhance those that have been lost. By making people stronger and faster than robots, augmentation can completely redefine humankind. Royalty used to be the primary audience for robots. For their own profit, inventors like Leonardo da Vinci and Al-Jazari sought to develop early humanoid automata and programmable automaton bands [10]. Al-Jazari put together a human-looking floating band that played a range of tunes and rhythms. It has the ability to stand, move its neck and arms, and open its mouth. The first attempt at using a robot for modern industrial application was made in 1961 when George Devil, an inventor, installed his creation, Unmet, in a general motors' factory in Trent, New Jersey[25-30].

1.2 Algorithms Applied to Automation

Deep Reinforcement Learning (DRL): The objective of this type of machine learning algorithm is to see an agent interacting with its environment and learning to make decisions depending on input. Because deep reinforcement learning enables robots to learn from errors, adjust to changing circumstances, and make decisions immediately, it is very beneficial to robotics. DRL may need a lot of computing power and have slow convergence rates. [31]

Computer Vision: Computer vision algorithms are applied in robotics to enable robots to sense and understand visual information from their environment. Semantic segmentation, object detection, and image recognition are frequently employed techniques that facilitate visual perception. However, computer vision techniques can be computationally demanding, necessitating large CPU power and memory resources.

Supervised Learning: In a machine learning process known as supervised learning, where inputs and outputs are connected, an agent learns from labelled data. Robotics makes extensive use of supervised learning to complete tasks like object identification, mapping, and localisation. It can attain excellent accuracy when trained on big tagged datasets and is thought to be rather easy to implement. On the other hand, the amount and calibre of available labelled data may limit supervised learning and hinder its ability to generalise to new, unexperienced data.

Evolutionary Algorithms: Inspired by natural selection, evolutionary algorithms are used in robotics for motion planning, optimization, and parameter adjustment, among other tasks. They are especially useful in situations where the solution space is complex and poorly defined. Evolutionary algorithms are renowned for their capacity to manage multi-objective optimization and their resilience in chaotic situations. Nevertheless, it can take a lot of assessments for them to converge on a workable answer.

Deep Learning: A sort of deep learning technique used in robotics to carry out tasks including perception, control, and planning. Because of their outstanding performance in domains like image and audio recognition, they are helpful for tasks like grasping, manipulation and object detection. However, deep learning techniques may be computationally taxing and often need a lot of labelled data to train on.

Simultaneous Localization and Mapping (SLAM): For navigation and mapping reasons, robotics practitioners frequently employ the SLAM algorithm. It enables robots to track their own position within the environment and create maps of their surroundings at the same time. For tasks like autonomous navigation and exploration, SLAM is essential. For precise mapping and localization, it can require complex sensor configurations and be computationally taxing.[31-35]

2 Different aspect of application of robots in today's scenario

Robots are becoming a dependable tool in our everyday job and are assisting us in many ways in our daily lives. Robots are employed extensively in a variety of sectors, including the food manufacturing and medical fields, although not replacing chefs and physicians. Nowadays, robots are used in nearly every industry because of their accuracy and human benefit. Many occupations in fields like business, farming, entertainment, etc., also need precision ,hard work and repetitive work. Because they are accurate, intelligent, and don't cause disruptions as people do, robots are more suitable in certain situations than humans.[36]

The following are a few examples of robotics applications that make our life easier:

Safety: Robotics companies are currently trying to connect human safety experts with robot guards. Among the most well-known businesses in the industry is Nightscape in the US, which offers autonomous security robots that can provide human security officers with useful information in real time. These robots are capable of helping with crimes including running, injury, fraud, theft, domestic abuse, and armed robbery. In the army, robots play a variety of duties. These robots can be deployed like drones to keep an eye on entire cities or even enemy camps. Robots for search and rescue are quite useful in times of conflict. In hazardous chemical, biological, radioactive, and nuclear situations, they are capable of searching, tracking, and rescuing.

Medical Care: Healthcare has undergone significant transformation thanks to robots; these days, nurses and doctors are assisted by robots in operating rooms and clinical settings, which enhance patient care. Robotic systems have many benefits when utilized in surgery, including great precision, less infection risk, improved vision, good control, and much more. In addition to serving as a prosthetic limb and giving patients rehabilitation, the robot can assist medical professionals in carrying out procedures with more accuracy[37]. The Da Vinci robots, which assist surgeons in performing intricate surgery, are one of the example of this.

Space Investigation: As robotics advances, it is now more common to send robots rather than humans on space missions. Almost all scientific information about the conditions of Mars, Venus, Titan, Jupiter, and other planets comes from robotic explorations before humans even stepped foot on the moon. Numerous objects in space pose a serious risk to astronauts [38]. It is not possible for humans to visit Mars for an entire day in order to gather soil samples or fix spacecraft outside of outer space! In this scenario, humans can be replaced by robots, but human death is not a possibility. Robots and autonomous vehicles are frequently used by institutions like NASA to perform tasks in which humans are incapable of doing it. An autonomous robot that travels to Mars is the Mars Rover, for example.

Armed forces: The armed forces also use military robots. A nation's army plays a critical role in upholding law and order and defending the nation from outside aggression. These days, the robot is employed by the military as a Medicare agent to support friendly forces, as well as a drone to observe the enemy and even as a weapon to strike the opposing forces. A few well-known military robots are the Modular Advanced Armed Robotic System, equipped with grenade launchers and tear gas to disorient adversaries. A tactical combat robot, the DOGO can spy on enemy movement with its camera and carry a 9-millimeter weapon for emergencies. Therefore, it can be concluded that the military uses robots extensively.

Farming: Human civilization is based on agriculture, which has been our primary source of sustenance from the dawn of agricultural civilization. The weather has a major impact on agricultural work [39]. Good soil, weather, and other conditions are necessary for agricultural activity. Additionally, agricultural labor involves physical labor that wears a person out. Farmers waste a lot of time on repetitive chores in agriculture, but robots can efficiently complete duties like planting seeds, controlling weeds, harvesting, and other tasks that humans cannot. Harvesting is a popular task for robots, which saves farmers time and increases their financial independence. Eco robotics is one type of robot used on a farm to pull weeds. With the help of its advanced camera system, it can locate and spray weeds. It is run entirely on solar energy. Thus, robots can help us enhance agriculture.

3 Conclusion

Though some sector pose ethical questions, robotics and artificial intelligence have the ability to completely transform civilization. These include issues of abuse, autonomy, biases, transparency, and the effect on the workplace and interpersonal relationships. To address these obstacles, ethical considerations like as bias identification and mitigation, transparency and human oversight, and machine ethics that are consistent with human values should all be incorporated into the design process. Initiatives for education and awareness should be combined with legislation and regulations to govern the moral use of robotics and artificial intelligence. Ethicists, technologists, and legislators should work closely together to establish these initiatives.

Among all the technological improvements in the last ten years, robotics advancements have been the most significant. observed several uses for robots throughout various industries. These days, robots are employed in the armed forces, as well as in the kitchen, medical assistance, security, and customer service departments! As artificial intelligence advances, robots are becoming increasingly intelligent. Numerous monotonous, annoying, or dangerous tasks are programmed into robots. In conclusion, humans can collaborate with robots to tackle a multitude of problems across several sectors.

In conclusion, each algorithm utilised in robotics artificial intelligence has pros and cons of its own. Computer vision provides visual perception skills, supervised learning is helpful for tasks involving labelled data, reinforcement learning is great for adaptive decision-making, evolutionary algorithms are effective for optimisation, deep learning is powerful for perception and control, and SLAM is crucial for mapping and navigation. The task requirements, data availability, computational resources, and desired robot autonomy degree all influence the choice of the best algorithm.

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