

AI Powered Robotics: Review of Technologies and Applications

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Abstract: *Artificial Intelligence (AI) has revolutionized the field of robotics, enabling unprecedented advancements in autonomy, adaptability, and efficiency. This paper provides a comprehensive review of AI-powered robotics, focusing on the underlying technologies and their diverse applications across industries. Key AI techniques, including machine learning, deep learning, computer vision, and natural language processing, are examined in the context of robotics. The integration of AI with robotic systems has led to innovations in manufacturing, healthcare, autonomous vehicles, agriculture, and service industries. Additionally, the paper explores the challenges associated with AI-driven robotics, such as ethical concerns, safety considerations, and computational constraints. By analyzing recent developments and future trends, this study aims to highlight the transformative impact of AI-powered robotics and identify areas for further research and improvement.*

Keywords: Artificial Intelligence, Robotics, Machine Learning, Automation, AI Applications, Software aspects of robotics

1. Introduction

The integration of Artificial Intelligence (AI) in robotics has transformed the capabilities of robotic systems, enabling them to perform complex tasks with greater autonomy, precision, and adaptability. AI-powered robotics combines advanced machine learning algorithms, computer vision, and natural language processing with robotic hardware to enhance automation across various industries. From manufacturing and healthcare to agriculture and autonomous vehicles, AI-driven robots are redefining traditional workflows and improving efficiency. The rapid evolution of AI technologies, including deep learning, reinforcement learning, and neural networks, has significantly expanded the functional scope of robotics. Intelligent robots can now analyze vast amounts of data, make real-time decisions, and interact seamlessly with humans and their environment. These advancements have led to breakthroughs in autonomous navigation, human-robot collaboration, and robotic dexterity.

"Artificial Intelligence (AI) Enabled Robotics" sounds like an intriguing subject, doesn't it? Yes, without a doubt. "The science and engineering of making intelligent machines, especially intelligent computer programs," says John McCarthy, the father of artificial intelligence. Although AI and robots are used for very different things, their combination is very powerful in many ways. Robotics serves as the body and artificial intelligence as the brain, enabling robots to perform a number of tasks, based on the AI used. The three types of artificial intelligence (AI) are as follows: Weak or narrow AI Strong or general AI Artificial intelligence with superpowers

2. Analysis

1) Robotics

The planning, construction, operation, and application of robots as well as computer systems for their control, sensory

feedback, and information processing are the subjects of the "Robotics" subfield of mechanical, electrical, and computer science.

2) Artificial Intelligence

It is a knowledge to generating machines smart systems to like as computers for solving the problems that used to be solved only by beings.

3) Three Laws of Robotics

- A robot can't hurt a person in any way or let a person's body get hurt again.
- A robot must abide by citizenry orders, unless doing so would violate the primary Law.
- As long as intrinsic protection does not conflict with the primary or second laws, a robot must safeguard its own existence.

3. Literature Survey

The field of robotics has the potential to undergo a paradigm shift as a result of the significant technological advancement known as artificial intelligence. In current years, there has been a growing interest in incorporating AI methods into robotic systems so that the system can bring out tasks on their own and adjust to changing situations.

For robots to learn from data and make decisions based on patterns and experiences, machine learning methods like supervised, unsupervised, and reinforcement learning have been expansively used. NLP methods have been used in social robots, personal assistance robots, and service robots to make it easier for them to connect with people in a more natural and instinctive way. Deep learning, which involves training artificial neural networks with large amounts of data, has demonstrated remarkable performance in many robotics' tasks, including object recognition, speech recognition, and motion planning. Ethical considerations regarding the application of AI to robotics have received

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important devotion, in addition to advancements in technology. To ensure the responsible and ethical deployment of AI-powered robots in various fields, ethical issues such as safety, transparency, accountability, and bias in decision-making must be addressed. AI for robotics has made rapid progress, but there are still obstacles to overcome, such as the inability of AI algorithms to deal with dynamic and uncertain surroundings and safety, robustness, and interpretability problems.

4. Proposed Idea

The computer vision provided by artificial intelligence enables robots to plan, logic, and analyze their actions based on the type of AI used. Over machine learning, robots are learned to perform from humans which is a part of processer and AI. Due to the fact that it liberates humans and enables them to perform tasks in which they surpass, artificial intelligence is useful to civilization. Without the need for human intervention, AI is capable of smoothly carrying out complex and all-encompassing human labour. This has reduced operational costs and therefore cost of manpower significantly.

1) Idea Subtitle

a) Software

In order to operate our robot, we must first configure the hardware and software. We have the option to switch the language if we so choose. English and French chatbots are currently the most effective and practical. We use "Blender," a free and open-source 3D creation suite, to create our files. Modeling, rigging, simulation, rendering, compositing, motive tracking, video editing, and 2D animation pipeline are all supported. Next, "Netfabb is a connected software for additive manufacturing, design, and simulation (to adjust our STLs)." It provides a comprehensive toolkit that minimizes build errors and optimizes workflows. It creates models that utilize additive manufacturing, converts import models from a variety of CAD programs, and optimizes the number of parts that can fit. Next, based on our printer necessities, we will share our STLs. A robust, user-friendly, and quick cross-platform program called KISSlicer converts STL files into G-code files that are ready for printing. It generates excellent G-code paths for outstanding prints by incorporating numerous sophisticated slicing features. Lastly, the software program "Instep" converts a variety of file formats, including STL, into STEP format. Allowing mesh surfaces to be exported as geometry or faceted geometry to be used as surface meshes facilitates interaction between FE and CAD meshes. A number of tools offer feedback regarding the data, planar combination, facet normal switching, and hole closure for the Surface/CAD meshes.

b) 3D Printing Technology

3D printing, also known as Additive Manufacturing is developing robotics by enabling rapid prototyping, custom component fabrication, and lightweight structural designs.

One of the rapidly growing technological advancements is 3D printing. It was mentioned how 3D printers that use robotic arms are advanced. Industrial robots are a important new use for 3D printing. The ability of 3D printing to

quickly and expensively style various parts with complicated geometries is legendary. Large-scale objects can be produced through robotic additive manufacturing when 3D printing and robots work together. A robotic 3D printer that has a multi-axis robotic arm can move in different directions and print at different angles.

c) AI Involved

AI is a very helpful tool in robotic assembly applications. During operation, it assistances a robot in autonomously learning which paths are appropriate for particular developments. Robotic packaging makes use of AI to package more rapidly, correctly, and expensively. The robots used in hotels and retail establishments use their natural language processing skills to cooperate with customers in a more humane way. They learn more the more they can engage with their customers. Certain open-source robotic systems with AI capabilities are for sale. In this manner, users can instruct their robots to perform specific tasks based on their necessities.

2) Components of a Robot

The following materials are used to build robots:

- Power Supply: The power sources for the robots are solar power, batteries, hydraulic power, or pneumatic power.
- Actuators: They are devices that transform energy into motion. This enables the robot to react to its surroundings.
- Electric Motors (AC/DC): Rotational movement requires the use of AC/DC electric motors.
- Pneumatic Air Muscles: When air is drawn into the pneumatic air muscles, they contract by nearly 40%.
- Muscle Wires: When an electric current is run through them, they contract by 5%.
- Piezo Motors and Ultrasonic Motors: The best motors for industrial robots are piezo and ultrasonic.
- Sensors: They serve as the robots' window. Sensors, like people, receive information from their environment. In order to determine the depth of their surroundings, robots are outfitted with vision sensors. The mechanical characteristics of touch are replicated by a tactile sensor.

3) Tasks of Computer Vision

- OCR - Optical Character Reader, or OCR, is a computer program that works with scanners to turn scanned documents into editable text.
- Face Detection - This feature, which is included in many modern cameras, allows one to read a person's face and capture the ideal expression on camera. On the right match, it will enable the user to access the software.
- Object Recognition - They are found in cameras, supermarkets, and luxury vehicles like Volvo, GM, and BMW.
- Position Estimating - Position estimation is the process of determining an object's location in relation to the camera, such as the location of a tumour in a person's body.
- In addition to the research, biped robots are being created to carry out human duties like personal care, which should prepare them to help the elderly and sick.

4) Domains of Computer Vision in Applications

- Agriculture using biometrics
- Security
- Forensics
- Surveillance
- Examining industrial quality
- Recognition of faces
- The study of gestures security in the retail sector
- Medical imagery
- Process management
- Satellite monitoring
- Robotics
- Medical care

5. Applications of Robotics

In a variety of fields, robotics has made a contribution, such as

- Industries - Robots can handle materials, cut, weld, colour coat, drill, polish, and other tasks
- Military - During a war, autonomous robots can reach dangerous areas and areas off the map.
- DRDO- The Défense Research and Development Organization (DRDO) created a robot called Daksh that is designed to carefully destroy lethal objects.
- Medicine: The robots can perform complex surgeries, including brain tumours, and hundreds of clinical tests at once, enabling them to help people who are permanently disabled.
- Exploration- Among these are the underwater drones used for ocean exploration and the robot rock climbers used for space exploration.
- Entertainment- Disney's engineers have developed a lot of entertainment robots because they can work without getting tired.

6. Conclusion

Humans are essential to the majority of AI systems, either as inputs to analyze the behaviour of the system or as outputs to provide the necessary information. Robotics is unique in that it creates physical systems that, at least for autonomous robots, can see and act in the real world without the assistance of humans. In order to build human-centered robots, humans must be brought back into the loop and the system must be able to communicate with, comprehend, and learn from humans while also making sure that humans are aware of their limitations. It also brings up a number of ethical issues that have been mentioned and debated.

It similarly brings up a number of moral issues that have been mentioned and debated. As a consequence, human-centered AI and robotics present a variety of problems and demand the integration of numerous technologies. It also highlights how the use of robots to help people is a socio-technological shift in our societies rather than just a technical problem in many ways. People who deal with social processes, public awareness, and political and legal decisions should pay particular attention to how this technology is used and how accessible it is.

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