Application And Development of Robotics in Industrial Automation

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Abstract. Robotics plays an important role in industrial automation, and its application areas cover manufacturing, logistics and warehousing, as well as agriculture and other fields, with the continuous development of artificial intelligence and machine learning, robotics technology presents more and more broad prospects for development, this paper will explore the application and development of robotics in industrial automation, and analyse its future development trends.

Keywords: Robotics; industrial automation; manufacturing.

1. Introduction

with the continuous progress of science and technology, robotics has become an important part of industrial automation, the emergence of robots not only improves the production efficiency, reduces the cost, but also changes the traditional production mode, this paper will discuss the application areas and development trends of robotics in industrial automation, in order to provide references for the research and practice in related fields.

2. Importance of robotics in industrial automation

The importance of robotics in industrial automation is self-evident, they can not only improve productivity, reduce costs, but also improve product quality and safety, robots can work continuously without rest, greatly improving production efficiency, the accuracy and consistency of the robot makes product quality can be guaranteed, reducing the errors introduced by human operation, in addition, the use of robots can also reduce labour costs, especially in repetitive and dangerous work environments, the presence of robots can effectively reduce the incidence of workplace accidents, improve the safety of the workplace. In addition, the use of robots can also reduce labour costs, especially in the high repetitive and dangerous work environment, the emergence of robots can effectively reduce the incidence of industrial accidents, improve the safety of the workplace, it can be seen that the importance of robotics in industrial automation is reflected in the overall improvement of production efficiency, product quality and employee safety, and it is an indispensable and important part of modern industry. [1] The importance of robotics in industrial automation can be seen in its overall improvement of production efficiency and product quality and employee safety, which has become an integral part of modern industry.

3. Areas of application of robotics

3.1. Manufacturing

In the manufacturing industry, the application of robotics has become a key means of improving production efficiency and product quality. Robots can perform a variety of highly repetitive and precision-required tasks in the manufacturing process, such as welding, assembling, machining, etc., and their accuracy and consistency are far beyond the level of human operation, thus ensuring product consistency and quality stability. The use of robots can realise the construction of automated

production lines, which greatly reduces manpower input and improves productivity and production speed; the application of robots in manufacturing can also deal with high-risk operating environments, such as high temperature, high pressure, toxic and other scenarios, which reduces the safety risk of employees.

With the continuous development of science and technology, the application of robotics in the manufacturing industry is also evolving, for example, intelligent robots can achieve autonomous navigation and autonomous decision-making through perception technology and artificial intelligence technology, so as to flexibly respond to a variety of situations on the production line, improving the flexibility and adaptability of the production line. In addition, the development of 3D printing technology also makes the manufacture of some complex parts can be realised by robots, greatly reducing the product development cycle and production costs [2] .

3.2. Logistics and warehousing

In the field of logistics and warehousing, the application of robotics is rapidly changing the traditional way of operation, bringing huge efficiency gains and cost savings to the logistics industry. Automated warehouse management systems utilise robots for storage, picking and sorting of goods, greatly improving the efficiency and accuracy of warehouse operations. Robots can move flexibly between narrow shelves and accurately remove or place goods from shelves by means of advanced technologies such as LiDAR and visual recognition, thus enabling fast and accurate goods handling. Logistics robots play an important role in cargo handling, for example, technologies such as AGV (Automated Guided Vehicle) and robot arms are widely used for cargo handling and loading in warehouses, replacing traditional manual handling and substantially improving handling efficiency and reducing errors in the handling process.

With the continuous development of artificial intelligence and machine learning technology, robotics in the field of logistics and warehousing is also evolving. Intelligent logistics robots are able to achieve more intelligent handling and sorting operations by learning and optimising path planning, further improving the efficiency and accuracy of logistics operations. In addition, with the Internet of Things technology, logistics robots can achieve a seamless connection with the warehouse management system, real-time sharing of data and information, so as to achieve more efficient warehouse management and logistics distribution [3] .

3.3. Agriculture

The agricultural field is an emerging field for the application of robotics technology, which has great potential to improve agricultural production efficiency, reduce labour intensity, and improve the quality of agricultural products, etc. The application of agricultural robots in planting and harvesting has become an important part of modern agriculture, for example, automated seeding robots, intelligent spraying robots, and orchard picking robots, etc., which can reduce manpower input, improve operational efficiency and thus reduce production costs. The development of intelligent farm management systems has also promoted the modernisation and transformation of the agricultural sector. Through sensors, cameras and other perception technologies, agricultural robots can monitor real-time information such as soil moisture, crop growth status, and pest and disease conditions, and carry out intelligent farm management based on real-time data, such as automatic irrigation, precise fertiliser application, and targeted weed control, etc., so as to target and improve the yield and quality of crops. Robotics is also widely used in sub-production areas such as animal husbandry and fisheries. For example, intelligent feed feeding robots can accurately control the amount of feed put in to improve the efficiency of livestock and poultry farming; water quality monitoring robots for aquaculture can monitor water quality parameters in real time to ensure that the aquaculture environment is excellent and to improve the efficiency of aquaculture.

4. Trends in robotics

4.1. The role of artificial intelligence and machine learning in robotics

Artificial Intelligence (AI) and Machine Learning (ML) play a crucial role in robotics, driving intelligence and autonomy in robots, and Machine Learning enables robots to learn from large amounts of data and continuously optimise their own behaviour and decision-making. By training algorithms, robots can progressively improve their performance in different tasks to better adapt to different environments and task requirements. Artificial intelligence technologies provide robots with intelligent perception and decision-making capabilities, such as visual recognition technologies that enable robots to recognise and understand objects and scenes in their surroundings, so as to carry out operations such as navigation, obstacle avoidance, or item grasping, and natural language processing technologies that enable robots to understand and respond to human language commands, thus improving their interactivity and communication efficiency with humans. Reinforcement learning technology enables robots to continuously learn and optimise their behavioural strategies through interaction with the environment to achieve autonomous decision-making and autonomous learning.AI and ML technologies also advance the ability of robots to work collaboratively and cooperatively, where multiple robots can work together to complete complex tasks by sharing data and communicating with each other, improving productivity and flexibility, for example, in the manufacturing industry where multiple robots can work together to assemble and process products, increasing the overall efficiency and capacity of production lines[4] .

4.2. Improvements in sensory technology

Improvements in perception technologies play a crucial role in robotics, they enable robots to sense and understand their surroundings more accurately, leading to more efficient operations and smarter decision making.Improvements in visual recognition technologies enable robots to recognise and understand surrounding objects and scenes with greater precision.Through technologies such as deep learning and convolutional neural networks, robots can from image or video data accurately identify the type, shape, colour and other characteristics of objects to achieve efficient perception of complex environments, while the improvement of LiDAR and sonar technology improves the spatial perception ability of robots, LiDAR technology can accurately measure the distance and position of surrounding objects to achieve high-precision environment map construction and obstacle avoidance, and sonar technology can achieve obstacle detection and positioning in complex environments, which is It is suitable for some special scenarios, such as underwater detection and navigation. The improvement of perception technology also includes the optimisation of other sensor technologies, such as infrared sensors, ultrasonic sensors, etc. These sensors can detect information that is difficult to reach by visual recognition, such as temperature, humidity, gas concentration, etc., to provide robots with a more comprehensive perception of the environment [5] .

4.3. Development of collaborative robots

Collaborative robots are robotic systems that are able to work with humans and complete tasks together, and their development marks an important shift in robotics from traditional industrial robots that perform tasks in a fixed manner to a new type of robotic system that is able to work with humans and share space and tasks.Collaborative robots have improved productivity and flexibility, and by working together with humans, collaborative Robots can take advantage of human intelligence and creativity to achieve more complex and flexible task execution, thus improving the overall efficiency and adaptability of the production line, collaborative robots also improve the working environment and safety of human-robot collaboration, the traditional industrial robots usually need to work in a fixed safety fence to prevent harm to humans, while collaborative robots through the use of a variety of sensor technology and smart algorithms Collaborative robots are able to work in safe coexistence with humans, greatly reducing the reliance on safety fences and improving human-robot collaboration and safety in the workplace.

5. Conclusion

The application and development of robotics in industrial automation has become an important engine to promote industrial progress, with the continuous progress of artificial intelligence and machine learning, robots will become more intelligent, flexible and adaptable, and the emergence of collaborative robots will change the face of the workplace, improve productivity and safety, looking forward to the development of robotics in the future, to bring more innovations and changes to the industry to Realise the common progress of man and machine.

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