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A REVIEW ON THE EMERGING DEVELOPMENTS IN AI: ROBOTICS

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Abstract: **The development of intelligent robots is a complex process that requires careful consideration of various factors. The key to creating a successful intelligent robot is to define its purpose, select the right hardware, develop robust software, implement machine learning algorithms, ensure safety, test extensively, and continuously improve its capabilities. By following these suggestions, developers can create intelligent robots that can perform a range of tasks, learn from their environment, and adapt to new situations. Intelligent robots have the potential to revolutionize various industries by improving efficiency, safety, and productivity. Intelligent robots also can operate in hazardous environments where human workers would be at risk, such as in nuclear power plants, oil refineries, and other industrial settings. The review provides guidance, updates, and issues in the development of the intelligent robot.**

Keywords: **Intelligent robot, Machine learning, Artificial intelligence, Computer vision, Human-robot interaction, Neural networks, Natural language processing, Navigation, Decision-making, Soft robotics.**

I. INTRODUCTION

Robotic equipment has been playing a central role since the proposal of smart manufacturing. The development of intelligent robots is a complex process that requires careful consideration of various factors. The key to creating a successful intelligent robot is to define its purpose, select the right hardware, develop robust software, implement machine learning algorithms, ensure safety, test extensively, and continuously improve its capabilities. By following these suggestions, developers can create intelligent robots that can perform a range of tasks, learn from their environment, and adapt to new situations[1]. Intelligent robots have the potential to revolutionize various industries by improving efficiency, safety, and productivity. As technology continues to advance, the development of intelligent robots will undoubtedly continue to be an exciting and rewarding journey. The development of intelligent robots is a rapidly growing field that combines artificial intelligence, machine learning, and robotics to create machines that can perform complex tasks and interact with humans more naturally. The history of intelligent robots can be traced back to the mid-20th century when the first programmable robots were created. However, it wasn't until the advent of microprocessors and the development of computer vision technology in the 1980s that the development of intelligent robots truly took off. Today, intelligent robots are used in a wide range of industries, from manufacturing and logistics to healthcare and education[2]. As the field of robotics continues to evolve, researchers and engineers are constantly developing new technologies and techniques to create robots that are more intelligent, efficient, and adaptable. Some of the key challenges in developing intelligent robots include improving their perception and decision-making abilities, as well as ensuring their safety and security when interacting with humans. This paper summarizes the status of the development of the intelligent robot, current issues, and current development[3].

II. LITERATURE SURVEY

Intelligent robots are an emerging technology that has the potential to revolutionize various industries such as manufacturing, healthcare, and agriculture. The development of intelligent robots requires a multidisciplinary approach that encompasses various fields such as robotics, artificial intelligence, machine learning, and control systems. The development of intelligent robots has been a topic of interest for researchers in the field of robotics for many years. Researchers have explored various methods to create robots that can perceive, learn, and adapt to their environment. Here is a literature review of the development of intelligent robots, including some examples from previous researchers. In this literature review, we will examine previous research on the development of intelligent robots and provide relevant references. One of the key challenges in the development of intelligent robots is the

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ability to sense and perceive the environment. In a study conducted by a visual sensor-based navigation system was developed for a mobile robot. The system utilized a stereo camera and image processing algorithms to generate a 3D model of the environment [4]. The robot was able to navigate autonomously in both indoor and outdoor environments. Another important aspect of intelligent robots is their ability to learn from their environment and adapt to changing conditions. In a study conducted by, a machine learning-based approach was used to develop an intelligent robot for autonomous navigation. The robot was trained using a neural network to recognize and classify objects in its environment. The robot was able to adapt to changing conditions and successfully navigate through different environments. The development of intelligent robots also requires the integration of various control systems[5]. In a study conducted by, a hierarchical control system was developed for an intelligent robot. The system utilized a high-level controller to plan the robot's movements and a low-level controller to execute the movements[6]. The system was able to achieve smooth and accurate movements in various tasks, including grasping and placing objects. Perception and Sensing: Perception is one of the critical components of intelligent robots, and researchers have focused on developing methods to enhance a robot's sensing capabilities. For example, researchers at MIT developed a robot named "Cheetah" that uses sensors to detect and avoid obstacles while running at high speeds. Through general Architecture, we can understand the process of obstacle avoidance for an intelligent robot in Fig1.

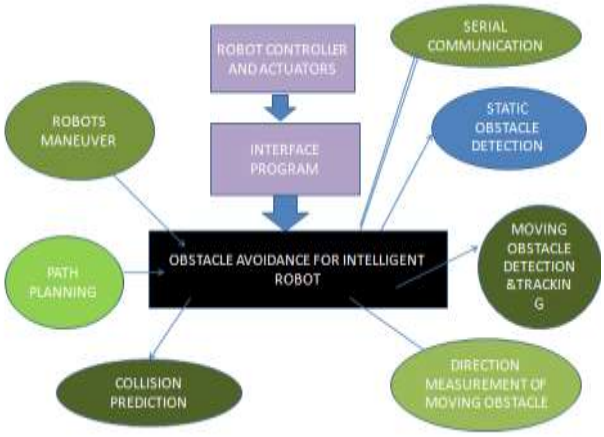

Fig 1. General Architecture of Intelligent Robot

Machine Learning: Machine learning algorithms play a vital role in enabling intelligent robots to learn from their environment and improve their performance over time. Researchers have explored various machine learning techniques, including supervised learning, unsupervised learning, and reinforcement learning. For example, a team of researchers at Stanford University used reinforcement learning to develop a robot that could learn to flip pancakes[7].Human-Robot Interaction: The development of intelligent robots has also led to research on human-robot interaction. Researchers have explored ways to make robots more intuitive and responsive to human needs. For example, a team of researchers at the University of Michigan developed a robot that uses natural language processing and machine learning to understand and respond to human speech. Robot Design: The design of intelligent robots is critical to their functionality and performance. Recent work has focused on developing robots with improved design features, such as modular construction light weight materials and flexible structures [8].Robot Control: Robot control is another critical aspect of intelligent robots. Recent work has focused on developing algorithms and techniques for robot control, such as the use of deep reinforcement learning and bio-inspired control Robot Perception: Robot perception involves the use of sensors and algorithms to enable robots to perceive their environment. Recent work in this area includes the development of algorithms for object recognition and localization and the use of 3D sensors for robot navigation. Supervised learning requires a supervisor or teacher who teaches the machine. If the dependent datasets were well labelled a supervised learning algorithm can be used to train the machine. In other words, we already have a set of data associated with the precise output, which has been used to train the machine learning framework to identify the possible relationship between the input and output variables. Thus, a supervised machine learning framework involves developing an optimal mathematical framework that applies the data set that contains the required output and input variables. For example, if a dataset contains numerous images of cats and dogs, the machine can be trained one by one with the features presented in each image like shapes, color, and texture. For instance, if the image is having the feature of more muscular and proportionate body parts with a circular facial structure, it is labeled as a dog. If the image file is having the feature of an angular face, smoother and fine fur, and a slender body, it is labeled as a cat. When the computational framework is employed to identify a cat from the stored dataset, it utilizes the data points learned from past training and classifies the specific images.

III. CURRENT STATUS IN THE DEVELOPMENT OF INTELLIGENT ROBOTS AT THE NATIONAL AND INTERNATIONAL LEVEL:

As of my knowledge cut-off date of 2021, the development of intelligent robots has made significant progress, but there is still a long way to go. Some of the recent advancements in the field include: Machine learning and deep learning techniques have improved the ability of robots to recognize and understand the environment around them. Robots are becoming more capable of performing complex tasks that

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require dexterity, precision, and adaptability. Collaborative robots, or co-bots, are increasingly being used in manufacturing and other industries to work alongside humans, improving productivity and safety. Natural language processing (NLP) and computer vision technologies are being integrated into robots, allowing them to communicate with humans and perceive their surroundings more effectively. There are still many challenges to overcome before we can create truly intelligent robots that can function autonomously in complex environments[9].Some of these challenges include improving machine perception and reasoning, developing more advanced AI algorithms, and ensuring that robots are safe and ethical in their interactions with humans. The development of intelligent robots is a rapidly evolving field, and there is so much to look forward into coming years There has been significant progress in the development of intelligent robots in recent years, particularly in the areas of machine learning and artificial intelligence. Here are a few examples of current research in this field. Boston Dynamics' Spot robot: This quadrupedal robot can navigate difficult terrain and perform a variety of tasks, such as carrying objects, opening doors, and even dancing. It uses a combination of sensors, cameras, and machine-learning algorithms to achieve its goals. Soft- robots: Researchers are developing robots made from soft materials, such as silicone, that can mimic the movements of living organisms. These robots have potential applications in areas such as medical robotics and search and rescue missions. Deep learning for robot perception[10]. Deep learning algorithms are being used to improve robots' ability to perceive their environment and recognize objects. For example, researchers at Google have developed a robot that can identify and sort objects using a combination of cameras and deep learning algorithms. Robot-human collaboration: Researchers are working on ways to enable robots to work alongside humans in a variety of settings. For example, a team at MIT is developing a robot that can assist with cooking tasks in the kitchen, such as chopping vegetables and washing dishes, while taking into account the preferences and abilities of the human user. Overall, recent work in the development of intelligent robots has focused on designing robots with improved features and developing algorithms and techniques for robot control, perception, learning, and human-robot interaction. These advancements hold significant promise for the future of robotics and have the potential to revolutionize many industries, including manufacturing, healthcare, and transportation[11].

IV. CURRENTISSUES IN THE DEVELOPMENT OF INTELLIGENT ROBOT AT THE NATIONAL AND INTERNATIONAL LEVEL

One current issue in the development of intelligent robots is the ability to make them more adaptable to changing environments and situations. Another challenge is the intelligence (AI) algorithms that can enable robots to make more complex decisions and development of more advanced artificial learning from their experiences[12]. This includes the ability to recognize and interpret sensory information, understand human language, and interact with humans and other robots more naturally and intuitively. Another important issue is the ethical and societal implications of the increasing use of robots in various domains, such as healthcare, manufacturing, and service industries. Overall, the development of intelligent robots requires not only advances in technology but also careful consideration of the ethical and societal implications of their use[13].

V. LEADING TECHNOLOGIES FOR THE DEVELOPMENT OF INTELLIGENT ROBOT

Intelligent robots are advanced machines that can perceive their environment, reason about it, and take action to achieve specific goals. They use a variety of technologies to achieve these capabilities, including:

5.1 Artificial intelligence (AI): AI allows robots to learn from data and experience, and make decisions based on that learning. Deep learning, machine learning, and reinforcement learning are some of the key AI techniques used in intelligent robots[14].

5.2 Computer vision: Computer vision enables robots to interpret and see their environment using sensors and cameras. It allows them to recognize objects, people, and other visual cues and respond accordingly. Here can see an example of an intelligent robot with a computer [15].

Visioning in Fig 2. A four-wheel robot with sensors and a camera

Fig 2. Picture of a Four-wheel Robot with sensors and a camera (example of an intelligent robot with computer visioning)

5.3 Natural language processing (NLP): NLP helps robots to understand and respond to human language. It allows them to interact with humans more naturally and intuitively[16]

5.4 Sensors: Sensors enable robots to sense and measure their environment. They can include cameras, microphones,

sonar, LIDAR, and other types of sensors that provide information about the robot's surroundings[17].

5.5 Actuators: Actuators are the mechanisms that enable robots to move and interact with their environment. They can include motors, grippers, and other types of devices that allow the robot to manipulate objects and perform tasks[18].

5.6 Cloud computing: Cloud computing allows robots to access and use large amounts of data and computational power over the internet. This enables them to perform more complex tasks and improve their performance over time[19].

5.7 Internet of Things (IoT): IoT enables robots to connect with other devices and systems, such as smart homes and factories. This allows them to operate more seamlessly and efficiently within their environment.

5.8 RFID controller: An RFID control system can be a useful component in an intelligent robot. RFID stands for Radio Frequency Identification, which is a technology that uses radio waves to track and identify objects. An RFID system typically consists of an RFID reader and one or more RFID tags. In the context of an intelligent robot, an RFID control system can be used to identify and track objects or components within the robot or its environment[21].

VI. SUGGESTIONS

Here are some suggestions for the development of an intelligent robot:

Define the robot's purpose: Before starting the development process, it's essential to define the robot's purpose and the tasks it will perform. This will help to focus the development efforts and ensure that the robot is designed to meet specific needs.

Choose the right hardware: The hardware used to build the robot will determine its capabilities. Selecting the right sensors, processors, and other components is critical to the robot's ability to function as intended.

Develop robust software: The robot's software is just as important as its hardware. To create an intelligent robot, you will need to develop software that can process data from sensors, learn from its environment, and make decisions based on that data.

Implement machine learning algorithms: Machine learning algorithms can help the robot learn from its experiences and improve its performance over time. You can use supervised learning, unsupervised learning, and reinforcement learning to enable the robot to adapt to new situations.

Ensure safety: Safety is a critical consideration in the development of intelligent robots. You will need to implement safety protocols and design features that prevent the robot from causing harm to people or property.

Continuously improve: Intelligent robots should be designed with the capability to learn and improve over time. You should continue to refine the robot's software and hardware to optimize its performance and enhance its capabilities.

VII. CONCLUSION

In conclusion, the development of intelligent robots is a complex and challenging process that requires careful consideration of multiple factors. To create a truly intelligent robot, developers must focus on selecting the right hardware, developing robust software, implementing machine learning algorithms, ensuring safety, testing extensively, and continuously improving the robot's capabilities. While challenging, the benefits of intelligent robots are vast, including increased efficiency, improved safety, and enhanced productivity in a range of industries. As technology continues to evolve, the potential for intelligent robots to transform the way we live and work is immense, and the development of such robots will undoubtedly be an exciting and rewarding journey.

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