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AI enabled robotics

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Abstract
Robotics is a branch of AI, a combination of Electrical Engineering, Mechanical Engineering, and Computer Science that produces machines so called robots. Robots are used as a substitute for human actions.
Aspects of robotics: The robots have mechanical construction, form, or shape designed to perform a particular task. They contain electrical components which power and manage the machinery. They contain some level of computer program that determines what, when and how a robot does something. The input to an AI program is in symbols and rule. They need general purpose computers to work on.

Keywords: Robotics, AI, integration of technology, future of robotics, software aspects of robotics

1. Introduction
The topic, 'Artificial Intelligence (AI) Enabled Robotics' sounds interesting, right? Yes, absolutely. According to John McCarthy, the father of Artificial Intelligence, it is "The science and engineering of making intelligent machines, especially intelligent computer programs". AI and Robotics serve very different purposes but the combination of AI and Robotics are very powerful in many aspects. AI acts as the brain and robotics acts as the body which enable robots to perform.
Several tasks according to the AI used. Following are the three sorts of Artificial Intelligence (AI):
- Narrow or weak AI
- General or strong AI
- Artificial super-intelligence

2. Analysis
2.1 Robotics
'Robotics' is the branch of mechanical engineering, electrical engineering, and computer science that deals with the planning, construction, operation, and application of robots as well as computer systems for their control, sensory feedback, and information processing.

2.1.2 Artificial intelligence
It is a science of creating machines smart algorithms to like computers to solve problems that used to be solved only by humans.

2.1.3 Three laws of robotics
1. A robot must not harm a person’s being in any way or, allow a person’s being to return to harm.
2. A robot must obey the orders given by citizenry except where such orders would clash with the primary Law.
3. A robot must protect its own existence as long intrinsically protection does not conflict with the primary or Second Laws.
4. Components used
   - Power supply
   - Electric motors (DC/AC)
   - Sensors
   - Controller

3. Literature survey
Many businesses use chatbots to promote their products and make payments. They are

efficient in offering outstanding customer service. Many chatbots use data from huge databases. But, they could not comprehend particular phrases. Chatbots will match human conversation this year. For instance, AI-driven chatbots can recall some parts of a conversation with a client and make a customized conversation using them. Artificial intelligence has many possibilities. It is one among the foremost important technologies in Industry 4.0 and automation, agriculture, aerospace, construction, logistics, robotics, and connected mobility.

4. Proposed idea

Artificial intelligence (AI) acts as a brain that gives robots a computer vision to plan, sense, and calculates their action counting on the sort of AI used. Through machine learning, robots learn to perform their tasks from humans which may be a part of computer programming and AI. Artificial intelligence is a boon to humanity given the fact that it liberates humans and allows them to perform tasks in which they excel.AI can perform all-encompassing human labor and onerous tasks easily without the need of human beings. This has reduced operational costs and therefore cost of manpower substantially. It eliminates the necessity for humans to perform tedious tasks.

4.1 Idea subtitle

4.1.1 Software

Initially, we need to set up hardware and software to control our Robot. If we want to change the language, we can change it. At this time the most efficient worky chatbot is English and French. To create our files, 'Blender' is the free and open-source 3D creation suite. It supports the entirety of 3D pipeline modelling, rigging, simulation, rendering, compositing and motive tracking, video editing, and 2D animation pipeline. Next 'Netfabb (to adjust our STLs) is a connected software for additive manufacturing, design and simulation'. It offers a complete toolset that streamlines workflows and reduce build errors. It converts the import models from many different CAD applications, create models that take advantage of additive manufacturing and maximize the number of parts we can fit into each build. Next, to slice our STLs (depending on our printer requirement) KISSlicer (Keep It Simple Slicer) is a powerful, easy-to-use, and fast cross-platform app that slices STL files into printer-ready G-code files. It incorporates many advanced slicing features, generating high-quality G-code paths for exceptional prints. Finally, 'Instep' is a software application that converts from various file formats including STL into STEP format. Interaction between FE meshes and CAD meshes is enabled by allowing the surfaces of meshes to be exported as geometry or faceted geometry to be used as surface meshes. For the Surface/CAD meshes, several tools provide feedback about the data, planar combination, facet normal switching, and hole closure. For the FE meshes, tools provide feedback of the data, surface extraction, removal of surface or volume meshes, and removal of unused vertices.

An open-source programming framework for robotics whose development began in the late 2000s at Stanford University. ROS is an important development in the field of robotics which has been dramatically growing in popularity all over the world. It applies to a wide number of robotic systems including industries and flying robots. To better understand ROS and its benefits let us consider robotic projects which were developed before ROS existing. The kinds of commercially available robotics are commonly associated with beer factories and have been a move into different industries and have historically were involved in software control systems. Each system was different. Building robots is traditionally been difficult because robot developers in essence had to reinvent the real in each project. ROS changes this by creating a framework for developing robotics software that facilitates and even encourages the sharing and reuse of good ideas about how to control robots. For one thing, different robots were designed for different tasks in different environments. ROS has maximized the utility of having open-source robotics software by addressing many of the common problems developers face. Challenges such as coordinate system transformations, motion planning, communications, sensor integration can be solved by ROS. A programmer only has to download the appropriate software packages. ROS provides a library of reusable code packages that are free. This makes robot development much easier, faster, and reliable. ROS also provides a run time environment that supports real-time communications between system elements. ROS provides some conventions useful for creating and using ROS supported curved in a repeatable and reliable way. There are also ROS development tools that are helpful in monitoring and visualizing the robots.

4.1.2 3D printing technology

3d printing is one of the mushrooming developments in the world of technology. The innovation of 3D printers that utilize robotic arms was touched on. This is a serious new application of 3D printing in industrial robots. 3D printing is legendary for the power to style different parts with complex geometries in a quick and cost-effective way. When robots and 3D printing unite, robotic additive manufacturing can create large-scale objects. With a multi-axis robotic arm, a robotic 3D printer can move in various directions and 3D print at different angles.

4.1.3 AI involved

In robotic assembly applications, AI is a very useful tool. It helps a robot to learn on its own, which paths are suitable for certain processes while it's in operation. Robotic packaging uses forms of AI for quicker, lower cost, and accurate packaging. The Robots which are being used in retail stores and hotels leverage natural language processing abilities to communicate with customers in a more humanly. The more, they can interact with their customers, the more they learn.Some robotic systems are being sold as open-source systems with AI capability. In this way, users can teach their robots to do a particular task depending on their needs.

4.1.4 Robot locomotion

Locomotion is the mechanism that makes a robot capable of moving in its environment. There are various types of locomotion

- Legged
- Wheeled
- Combination of Legged and Wheeled Locomotion
- Tracked slip/skid

4.1.5 Legged locomotion

This type of locomotion consumes more power while demonstrating walk, jump, trot, hop, climb up or down, etc. It requires more number of motors to accomplish a movement. It is suited for rough as well as smooth terrain where irregular or too smooth surface makes it consume more power for wheeled locomotion. It is a little difficult to implement because of stability issues. It comes with a variety of one, two, four, and six legs. If a robot has multiple legs then leg coordination is necessary for locomotion.

The total number of possible gaits (a periodic sequence of lift and release events for each of the total legs) a robot can travel depends upon the number of its legs.

If a robot has k legs, then the number of possible events $N = (2k-1)!$.

In case of a two-legged robot ($k = 2$), the number of possible events is $N = (2k-1)! = (2*2-1)! = 3! = 6$.

Hence there are six possible different events

- Lifting the left leg
- Releasing the Left leg
- Lifting the Right leg
- Releasing the Right leg
- Lifting both the legs together
- Releasing both the legs together

In the case of $k = 6$ legs, there are 39916800 possible events. Hence the complexity of robots is directly proportional to the number of legs.

5. Components of a robot

Robots are build with the following:

- Power supply - The robots are powered by batteries, solar power, hydraulic, or pneumatic power sources.
- Actuators - They convert energy into movement. This allows robot to respond to its surrounding environment.
- Electric motors (AC/DC) - They are required for rotational movement.
- Pneumatic Air Muscles - They contract almost 40% when air is sucked in them.
- Muscle Wires - They contract by 5% when the electric current is passed through them.
- Piezo Motors and Ultrasonic Motors - Best for industrial robots.
- Sensors - It acts as a window for the robots. Sensors take input from the outside world much like human beings. Robots are equipped with vision sensors to be to compute the depth in the environment. A tactile sensor imitates the mechanical properties of touch receptors of human fingertips.

6. Tasks of computer vision

- OCR - Within the domain of computers, Optical Character Reader, a software to convert scanned documents into editable text, which accompanies a scanner.
- Face Detection - Many state-of-the-art cameras accompany this feature, which enables one to read the face and take the image of that perfect expression. It will let a user access the software on the correct match.
- Object Recognition - They are installed in supermarkets, cameras, high-end cars like BMW, GM, and Volvo.
- Estimating Position - It is estimating a position of an object concerning the camera as in a position of a tumour in a human's body.
- Biped robots are normally composed of rigid bodies linked by simple kinematic connections. The segments of the human body are not rigid and this difference between humans and robot produces many discrepancies in their equilibrium. The lack of compliance systems in biped robots may transfer high loads to the entire structure due to the impact of the robot's feet on the ground. Biped robots are now used as research tools in several scientific areas. Researchers study the human body structure and behaviour to build humanoid robots. On the opposite side, the plan to stimulate the human body results in a far better understanding of it.
- Besides the research, biped robots are being developed to perform human tasks like personal assistance, through which they ought to be ready to assist the sick and elderly, and dirty or dangerous jobs. Humanoid robots, especially those with AI algorithms, might be useful for future dangerous and/or distant space exploration missions, without needing need to turn back around again and return to earth once the mission is completed

7. Application domains of computer vision

- Agriculture
- Autonomous vehicles
- Biometrics
- Character recognition
- Forensics, security, and surveillance
- Industrial quality inspection
- Face recognition
- Gesture analysis
- Retail and retail security
- Medical imagery
- Pollution monitoring
- Process control
- Remote sensing
- Robotics
- Healthcare

8. Applications of robotics

Robotics has been contributory in the various domains such as -

- Industries - Robots are capable for handling material, cutting, welding, colour coating, drilling, polishing, etc.
- Military - Autonomous robots can reach off the map and dangerous zones during the war. A robot named Daksh, developed by Defense Research and Development Organization (DRDO), is in function to demolish deadly objects cautiously.
- Medicine - The robots have the ability to carry out hundreds of clinical tests simultaneously, amending permanently disabled people, and it also perform complex surgeries such as brain tumours.
- Exploration - The robot rock climbers used for space exploration, underwater drones used for ocean exploration are to name a few.
- Entertainment - Disney's engineers have created many robots for filming because the robots can perform without getting tired.

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