Robotic System and Artificial Intelligence

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Abstract: The invention of computers or machines, their capability to perform various tasks went on growing exponentially. Humans have developed the power of computer systems in terms of their diverse working domains, their increasing speed, and reducing size with respect to time. A branch of Computer Science named *Artificial Intelligence* pursues creating the computers or machines as intelligent as human beings. Artificial Intelligence is a way of making a computer, a computer-controlled robot, or a software think intelligently, in the similar manner the intelligent humans think.AI is accomplished by studying how human brain thinks, and how humans learn, decide, and work while trying to solve a problem, and then using the outcomes of this study as a basis of developing intelligent software and systems.

Index Terms: Introduction-History, Definition, Laws of Robotics; Types Of Robots-Mobile, Rolling, Walking, Stationary, Autonomous, Remote Control Robots; Components of Robots-Structure, Power source, Actuation, Manipulation, Locomotion; Applications-Rob surgery, Robots in Danger Zones, AIBO….The robot pup, Humanoid robots; Advantages And disadvantages; Conclusion.

Keywords: Types And Components of Robotics, Applications.

1 Introduction

Artificial Intelligence (AI) is a general term that implies the use of a computer to model and/or replicate intelligent behavior. Research in AI focuses on the development and analysis of algorithms that learn and/or perform intelligent behavior with minimal human intervention. These techniques have been and continue to be applied to a broad range of problems that arise in robotics,e-commerce, medical diagnosis, gaming, mathematics, and military planning and logistics, to name a few. Several research groups fall under the general umbrella of AI in the department, but are disciplines in their own right, including: robotics, natural language processing (NLP), computer vision, computational biology, and e-commerce. Specifically, research is being conducted in estimation theory, mobility mechanisms, multi-agent negotiation, natural language interfaces, machine learning, active computer vision, probabilistic language models for use in spacelanguageinterfaces and the modeling and integration of visual, haptic, auditory and motor information

History of Robotics

The term 'robot' got prominence way back in the 1950s when Karl Capek in his play Rossum's Universal Robots denoted the birth of a superior race that had intelligence similar to that of humans.

Later on Isaac Asimov introduced his laws of robots and finally Eric Ellenberger, who is considered as the father of robotics, introduced real time robots to the world.

Meaning of Robotics

Robotics means the study and application of robot technology.

Robotics is a branch of engineering that involves conception, design, manufacture, and operation of machines assigned for specific high precision and repetitive tasks

Definition of a robot

"A reprogrammable, multifunctional manipulator designed to move material, parts, tools, or specialized devices through various programmed motions for the performance of a variety of tasks"

"Robots are the artificial agents acting in real world environment."

Laws of Robotics

Popular science fiction writer Isaac Asimov created the Three Laws of Robotics:

1. A robot must not injure a human being or, through inaction, allow a human being to come to harm.
2. A robot must always obey orders given to it by a human being, except where it would conflict with the first law.
3. A robot must protect its own existence, except where it would conflict with the first or second law.

Aspects of Robotics

- The robots have **mechanical construction**, form, or shape designed to accomplish a particular task.
- They have **electrical components** which power and control the machinery.
- They contain some level of **computer program** that determines what, when and how a robot does something.

Difference in Robot System and Other AI Program

- Here is the difference between the two −

AI Programs	Robots
They usually operate in computer-stimulated worlds.	They operate in real physical world
The input to an AI program is in symbols and rules.	Inputs to robots is analog signal in the form of speech waveform or images
They need general purpose computers to operate on.	They need special hardware with sensors and effectors.

2 Robotics -Types of Robots

- Mobile Robots
- Rolling Robots
- Walking Robots
- Stationary Robots
- Autonomous Robots
- Remote-control Robots

Ask a number of people to describe a robot and most of them will answer they look like a human. Interestingly a robot that looks like a human is probably the most difficult robot to make. It is usually a waste of time and not the most sensible thing to model a robot after a human being. A robot needs to be above all functional and designed with qualities that suits its primary tasks. It depends on the task at hand whether the robot is big, small, able to move or nailed to the ground. Each and every task means different qualities, form and function a robot needs to be designed with the task in mind.

2.1 Mobile Robots

Mobile robots are able to move, usually they perform task such as search areas. A prime example is the Mars Explorer, specifically designed to roam the mars surface.
Mobile robots are a great help to such collapsed building for survivors Mobile robots are used for task where people cannot go. Either because it is too dangerous of because people cannot reach the area that needs to be searched.

2.2 Rolling Robots:

Rolling robots have wheels to move around. These are the type of robots that can quickly and easily search move around. However they are only useful in flat areas, rocky terrains give them a hard time. Flat terrains are their territory.

2.3 Walking Robots:

Robots on legs are usually brought in when the terrain is rocky and difficult to enter with Wheels. Robots have a hard time shifting balance and keep them from tumbling. That's why most robots with have at least 4 of them, usually they have 6 legs or more. Even when they lift one or more legs they still keep their balance. Development of legged robots is often modeled after insects or crawfish.

2.4 Stationary Robots

Robots are not only used to explore areas or imitate a human being. Most robots perform repeating tasks without ever moving an inch. Most robots are 'working' in industry settings. Especially dull and repeating tasks are suitable for robots.
A robot never grows tired, it will perform its duty day and night without ever complaining. In case the tasks at hand are done, the robots will be reprogrammed to perform other tasks..

2.5 Autonomous Robots

Autonomous robots are self supporting or in other words self contained. In a way they rely on their own 'brains'.
Autonomous robots run a program that give them the opportunity to decide on the action to perform depending on their surroundings. At times these robots even learn new behavior. They start out with a short routine and adapt this routine to be more successful at the task they perform. The most successful routine will be repeated as such their behavior is shaped. Autonomous robots can learn to walk or avoid obstacles they find in their way. Think about a six legged robot, at first the legs move ad random, after a little while the robot adjust its program and performs a pattern which enables it to move in a direction. An autonomous robot is despite its autonomous not a very clever or intelligent unit. The memory and brain capacity is usually limited , an autonomous robot can be compared to an insect in that respect. In case a robot needs to perform more complicated yet undetermined tasks an autonomous robot is not the right choice. Complicated tasks are still best performed by human beings with real brainpower.

2.6 Remote control Robots

A person can guide a robot by remote control. A person can perform difficult and usually dangerous tasks without

being at the spot where the tasks are performed. To detonate a bomb it is safer to send the robot to the danger area.

Biology

Robots are often modeled after nature. A lot of BEAM robots look remarkably like insects. Insects are easy to build in mechanical form. Not just the mechanics are in inspiration also the limited behavior can easily be programmed in a limited amount of memory and processing power.

Electronics

Like all robots they also contain electronics. Without electronic circuits the engines cannot be controlled. Lots of Beam Robots also use solar power as their main source of energy.

Aesthetics

A BEAM Robot should look nice and attractive. BEAM robots have no printed circuits with some parts but an appealing and original appearance.

Mechanics

In contrast with expensive big robots BEAM robots are cheap, simple, built out of recycled material and running on solar energy.

3 Components of ROBOTS

- Structure
- Power source
- Actuation
- Manipulation
- Robot Locomotion

3.1 Structure

The structure of a robot is usually mostly mechanical and can be called a kinematic chain.
The chain is formed of links (its bones), actuators (its muscles), and joints which can allow one or more degree`es of freedom.

3.2 Power source

- Suitable power supply is needed to run the motors and associated circuitry
- Typical power requirement ranges from 3V to 24V DC
- 220V AC supply must be modified to suit the needs of our machine
- Batteries can also be used to run robots

- **Robots are driven by different motors:-**

o DC Motors
o Stepper Motors
o Servo Motors

3.3 Actuation

Actuators are the "muscles" of a robot, the parts which convert stored energy into movement.
The most popular actuators are electric motors.

3.4 Manipulation

- Robots which must work in the real world require some way to manipulate objects; pick up, modify, destroy, or otherwise have an effect. Thus the 'hands' of a robot are often referred to as end effectors, while the arm is referred to as a manipulator.
- Some manipulators are:

o Mechanical Grippers
o Vacuum Grippers
o General purpose effectors

3.5 Robot Locomotion

- It is concerned with the motion of the robot.

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

3.5.1 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 a wheeled locomotion. It is little difficult to implement because of stability issues.

- It comes with the 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 case of k=6 legs, there are 39916800 possible events. Hence the complexity of robots is directly proportional to the number of legs.

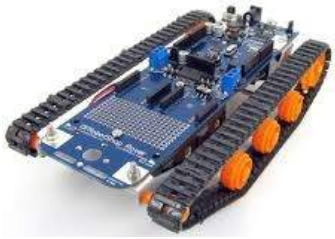
3.5.2 Wheeled Locomotion

It requires fewer number of motors to accomplish a movement. It is little easy to implement as there are less stability issues in case of more number of wheels. It is power efficient as compared to legged locomotion.

- **Standard wheel** − Rotates around the wheel axle and around the contact
- **Castor wheel** − Rotates around the wheel axle and the offset steering joint.
- **Swedish 45° and Swedish 90° wheels** − Omni-wheel, rotates around the contact point, around the wheel axle, and around the rollers.
- **Ball or spherical wheel** – Omni directional wheel, technically difficult to implement.

3.5.3 Slip/Skid Locomotion

In this type, the vehicles use tracks as in a tank. The robot is steered by moving the tracks with different speeds in the same or opposite direction. It offers stability because of large contact area of track and ground.



4 Robotics Applications

4.1 Rob surgery

Robots are increasingly being used during certain types of microsurgery. This lets surgeons perform delicate procedures that would otherwise be too fine for human hands.

The surgeon can control a surgery from a terminal in a room or at times several miles away from the patient while robots go on with their job. Assisted with tactile/feedback sensors, the surgeon can 'feel' the tissues underneath the robot instruments.

4.2. Robots in danger zones

Robots form an important part of landmines and bomb detection squads in many countries.

Besides such land combining operations, the robots go deep down the earth's crust where temperatures are unbearable and also search for buried treasures in the deepest of oceans and sometimes work in nuclear reactors. The very purpose of deploying robots is to shield humans from hazards.

- **Industries** − Robots are used for handling material, cutting, welding, color coating, drilling, polishing, etc.
- **Military** − Autonomous robots can reach inaccessible and hazardous zones during war. A robot named *Daksh*, developed by Defense Research and Development Organization (DRDO), is in function to destroy life-threatening objects safely.
- **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 hundreds of robots for movie making.

4.3 AIBO----the robot pup

When one thinks about robots, AIBO is the name that comes across everyone's mind. AIBO can express emotions of happiness, sadness, anger, surprise, etc. and definitively makes a wonderful companion.

This robot pup responds to your voice commands with flashing lights and sounds. The newer versions promise more interaction and far better responses with the sensors corresponding to the senses of humans and animals.

4.4 Humanoid robots

When it comes to human resemblance, one can just marvel at Honda's ASIMO and Sony's SDR-3X and now the more advanced SDR-4X. These humanoid robots walk on two feet with amazing grace, replicating the walking movements of humans.

Sony's SDR-4X has advanced features such as the ability to remember faces and recognize emotions from facial features in addition to improved voice and speech recognition and technology.

5 Advantages and disadvantages of robotics

5.1 Advantages

- ☐ You can send them to very dangerous places
- ☐ You can make them do you're job for you
- ☐ They are more accurate than humans Eg no shaking when in a very important surgery, puts every screw in fabricating a car etc.
- ☐ Can do jobs 24/7
- ☐ Can guard without being tired just keep doing the same thing 24/7
- ☐ No need of nutrients
- ☐ You can programme them to make them do exactly what you want them to do
- ☐ They can not harm you unless they are programmed
- ☐ can work with out doubts Eg when you think "what do i do now"?
- ☐ They can lift very heavy things

5.2 Disadvantages

- ☐ You need to get people trained to fix them if anything wrong happens
- ☐ Need a very intelligent crew
- ☐ They can ruin peoples lives Eg Take their job away from them
- ☐ They are very expensive to make
- ☐ You need the right materials to make them, that could be very rare
- ☐ If you make a very amazing robot with amazing quality and it brakes, it might be very hard to fix
- ☐ They can be very hard to programmes.
- ☐ They can reproduce but it could cost money for the materials
- ☐ You need highly trained people to make them
- ☐ They can not recharge themselves

Problems With Robotics

Yes there are problems. As with any machine, robots can even cause disaster. They are powerful machines that we allow to control certain things. When something goes wrong, terrible things can happen. Luckily, this is rare because robotic systems are designed with many safety features that limit the harm they can do.

There's also the problem of evil people using robots for evil purposes. This is true today with other forms of technology such as weapons, and biological material. Of course, robots could be used in future wars.

This could be good or bad. If humans perform their aggressive acts by sending machines out to fight other machines, that would be better than sending humans out to fight other humans. Teams of robots could be used to defend a country against attacks while limiting human casualties. Could future wars really just be a video game that drives robots?

Either way, human nature is the flawed component that's here to stay.

The Impact Of Robotics On Society

Since robots are used mainly in manufacturing, we see their impact in the products we use every day. Usually this results in a cheaper product. Robots are also used in cases where it can do a better job than a human such as surgery where high precision is a benefit. And, robots are used in exploration in dangerous places such as in volcanos which allows us to learn without endangering ourselves.

6 Conclusion

Today we find most robots working for people in industries, factories, `warehouses, and laboratories. Robots are useful in many ways.

For instance, it boosts economy because businesses need to be efficient to keep up with the industry competition.

Therefore, having robots helps business owners to be competitive, because robots can do jobs better and faster than humans can, e.g. robot can built, assemble a car. Yet robots cannot perform every job; today robots roles include assisting research and industry.

Finally, as the technology improves, there will be new ways to use robots which will bring new hopes and new potentials.

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