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Can Robots are Changing the World: A Review

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Abstract – *Robots are rapidly developing from factory to robot-companions. The forthcoming of robots, as our companions, is highly dependent on their capabilities to understand, interpret and represent the environment in an efficient and consistent style, in a human compatible manner. The work presented here is oriented in this direction. It proposes a hierarchical probabilistic concept-oriented representation of space that is based on typical household objects and structural elements such as doors and walls. The primary aids of this work are in the areas of representation and conceptualization for mobile robots. The outcome of all these efforts is a hierarchical probabilistic concept-oriented representation of space. Such a representation would be useful for permitting robots to be acquainted of their environments and yet compatible with their human users. The robot would be artistic with a capacity to reason about spatial semantics and act in a semantically and potentially socially intelligent manner. From an application point-of-view, this makes an influence towards bringing robots into our homes, as our companions. From a scientific standpoint, this contributes in extending the state-of-the-art in mobile robotics by attempting to bridge the gap between the situated world (Robotics, in its current state) and the purely symbolic world (traditional AI).*

Key Words: Robotics, rd2, mobile robotics

1. INTRODUCTION

Robotics is a technology which is used to develop machines that can be a replacement for humans and replicate human actions[1]. Robots are physical agents that perform tasks by manipulating the physical world. For this, they are equipped with effectors such as legs, wheels, joints and grippers. Effectors have a single purpose to assert physical forces on the environment. Robots are also equipped with sensors, that allows them to perceive their environment[2]. Present day robotics employees a diverse set of sensors, including cameras and lasers to measure the environment, and gyroscopes and accelerometers to measure the robot's own motion.

Most of today's robots are categories into three primary categories

- Manipulators
- Mobile robots
- Mobile manipulators

Manipulators:

These are devices which are used to work without any direct contact. Manipulator motion usually involves a chain of controllable joints. These are by far the most common type of industrial robots.

Mobile robots:

Mobile robots move according to their environment using wheels, legs or similar mechanisms. They have been used for many working processes like delivering food in hospitals, shifting loads and other similar tasks.

Mobile manipulator:

This device is nowadays a massively used term to refer to robotic manipulator arm and reduce their disadvantages

Artificial intelligence and robotics have long period of interaction. The invention of robotics and Artificial intelligence('50). The field of robotics is closely related to that of AI, although definitional issues abound. 'Giving AI motor capability' seems a reasonable definition, but most people would not regard a cruise missile as a robot even though the navigation and control techniques draw heavily on robotics research. AI and robotics are likely to continue and to creep into our lives without really noticed by us.

Real robots must cope with environment that are partially observable, stochastic, dynamic, and continuous. Robotics brings together many of the concepts, including probabilistic state estimation, perception, planning, unsupervised learning, and reinforcement learning.

Robot hardware:

The agent architecture is divided into

- Sensors
- Effectors
- Processors

The success of real robots depends a least as much on the design of sensors and effectors that are fitting for the task.[3]

Sensors:

Sensors are the perpetual interface between robot and environment.

There are different sensors to choose from and we will identify the characteristics of few sensors

- **Light sensors:** A Light sensor is used to detect light and create a voltage difference.
- **Sound Sensor:** this sensor (generally a microphone) detects sound and returns a voltage proportional to the sound level.
- **Temperature Sensor:** Tiny temperature sensor ICs provide voltage difference for a change in temperature.
- **Contact Sensor:** These sensors are mostly used for obstacle avoidance robots.
- **Proximity Sensor:** This is a type of sensor which can detect the presence of a nearby object within a given distance, without any physical contact.
- **Distance Sensor:** Most proximity sensors can also be used as distance sensors, or commonly known as Range Sensors; IR transceivers and Ultrasonic Sensors are best suited for distance measurement
- **Pressure Sensors:** Pressure sensor measures pressure.
- **Tilt Sensors:** Tilt sensors measure tilt of an object.
- **Effectors:**

Effectors are the means by which robots move and change the shape of their bodies.

Two basic ways of using effectors:

- to move the robot around =>locomotion
- to move other object around =>manipulation

These divide robotics into two mostly separate categories:

- mobile robotics
- manipulator robotics

Robotic perception:

Researchers have advanced technology that enables a robot to syndicate data from both sound and vision to create combined, determined perception. In the process, they have taken the field to a new level

Robot perception is a protruding research field in AI and Robotics. Current robotic systems have been partial by visual perception systems. In fact, robots have to use other kinds of sensors such as laser range finder, sonar, and so on in order to avoid the difficulties of vision in dynamic and formless environments. A robotic agent acting in the real world must deal with rich and formless environments that are occupied by moving and interacting objects, by other agents (either robots or people), and so on. To correctly move and act, a robot must be able to comprehend the perceptions of the environment. Understanding, from an AI perspective, includes the cohort of a high-level, declarative explanation of the professed world. Developing such a description requires both bottom-up, data driven developments that associate typical knowledge representation structures with the data coming out of a vision system, and top-down processes in which high-level, symbolic information is working to drive and extra refine the interpretation of the scene. To achieve its tasks, a robot must be endowed with discerning reasoning competences, in order to understand, categorize, track and do in advance the behaviour of the neighbouring objects and agents. Such abilities require rich inner depictions of the environment firmly protected to the input signals coming from the sensors. In other words, the connotation of the symbols of the robot reasoning system must be anchored in sensorimotor mechanisms. On the one side, the robot vision community advanced the problem of the representation of scenes mainly in terms of 2D/3D reconstruction of shapes and of regaining of their motion parameters, possibly in the presence of noise and occlusions, in order to control the motion of the robots. This tactic is known as visual robot system. On the other side, the AI community developed rich and expressive formalisms for image understanding and for representation of processes, actions, movements and, in general, of dynamic situations, as mentioned in the preceding segment.

Machine learning in robot perception:

Machine learning plays a significant role in robot perception. This is mainly the case when the best internal representation is not known. One mutual approach is to map higher dimensional sensors streams into lower dimensional spaces using unsubstantiated machine learning methods. Such an approach is called low-dimensional embedding. Machine learning makes it possible to learn sensor and motion models from data, while at the same time discovering an appropriate internal representation.

Planning to move:

All a deliberation ultimately come down to deciding how to move effectors.

- Configuration space
- Cell decomposition methods
- Modified cost function
- Skeletonization methods

Configuration space:

A key concept for motion planning is a configuration: – a complete specification of the position of every point in the system

Cell decomposition methods:

It decomposes the free space into a finite number of contiguous regions, called cells. These regions have the important property that the path-planning problem within a single region can be solved by simple means. The path-planning problem then becomes a discrete graph search problem.

2. Robotics software architecture:

A procedure for structure algorithm is called a software architecture. Architecture includes languages and tools for writing programs, as well as an complete philosophy for how programs can be brought together.

- Subsumption architecture
- Three layered architecture
- Pipeline architecture

Subsumption architecture is a reactive robotic architecture heavily related with behaviour-based robotics which was very widespread in the 1980s and 90s. The term was familiarized by Rodney Brooks and colleagues in 1986. Subsumption has been widely influential in autonomous robotics and in real-time AI.

Three-Layer Architecture is a mixture reactive/deliberative robot architecture developed by Firebathed involves three layers: a reactive feedback control mechanism, a reactive plan execution mechanism, and a mechanism for performing time-consuming deliberative computations.

Another architecture for robots is known as the **Pipeline architecture.** Just like the subsumption architecture, the pipeline architecture executes multiple process in parallel. However, the specific modules in the architecture resembles those in the three-layered architecture

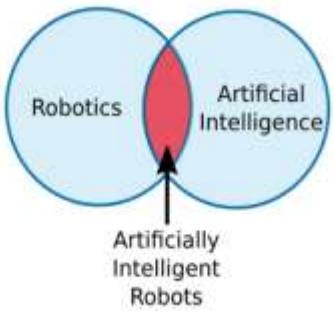

Fig-1: Robotics Software architecture

Application domain:

- Industry and agriculture
- Transportation
- Robotic cars
- Health care
- Hazardous environments
- Exploration
- Personal services
- Roomba
- Entertainment
- Human augmentation

Advantages of Robotics:

- Consistency [5]
- Improved Analytics
- Increased Employee Productivity
- Increased Customer Satisfaction
- Faster
- Reconciliation from Multiple Systems
- Versatility
- Better IT Support and Management

Disadvantages of Robotics:

- The robots need a supply of power [5]
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- The robots can take the place of many humans in the factories, this will lead to unemployment.
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- The robots cost much money in the maintenance & repair
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- The robots can store large amounts of data but the storage, access, retrieval is not as effective as the human brain, they can perform the repetitive tasks for long, but they do not get better with experience such as the humans do.

3. Can machines really think?

This category is about whether computers, robots, and software agents can literally be said to think. Humans think, chimps think, dogs think, cats and birds think. But do computers? Is your computer thinking now? Perhaps only specially programmed computers think? Or perhaps only computers with special hardware can think -- hardware that resembles the neurons of the brain, for example. If computers can be made to think, then does that mean that humans are a kind of robot and their brains a kind of computer -- a neurocomputer, say? One of the deeper issues here is that the term "thinking" is ambiguous in at least two ways: It can include being conscious of one's environment (surroundings), one's personal feelings and thoughts, etc., or it can mean cogitate, learn, plan, and solve problems, where

these latter terms pick out mental events that may or may not be conscious.

4. Can machines act intelligently?

Given that the 'human' machine can act intelligently, it is likely that other machines may act intelligent as well. However, that doesn't mean that every type of technology can support such intelligence. I find it for instance quite unlikely that digital computers (logic machines) can ever be intelligent and at least it would be an extremely inefficient way to produce intelligent behaviour

Alan Turing reduced the problem of defining intelligence to a simple question about discussion. He suggests that "if a machine can answer *any* question put to it, using the same words that an ordinary person would, then we may call that machine intelligent." A modern version of his trial design would use an online chat room, where one of the contributors is a real person and one of the participants is a computer program (or rather, artificial intelligence). The program passes the test if no one can tell which of the two participants is human. Turing notes that no one (except philosophers) ever asks the question "can people think?" He writes "instead of arguing continually over this point, it is usual to have a polite convention that everyone thinks." Turing's test extends this polite convention to machines: If a machine acts as intelligently as human being, then it is as intelligent as a human being.
But the question here is if the machine is *acting*, and just pretending to think. As I am not a computer programmer, I am not able to answer this question, but I do extend suggestion: that computers only do what they are *programmed* to do, and, therefore, are they the ones with intelligence, or are the programmers the ones who are intelligent?

Marvin Minsky writes that "if the nervous system obeys the laws of physics and chemistry, which we have every reason to suppose it does, then .... we ... ought to be able to reproduce the behaviour of the nervous system with some physical device." This argument is now associated with futurist Ray Kurzweil, who estimates that computer power will be enough for a complete brain simulation by the year 2029. Few disagree that a brain simulation is possible in theory, even critics of AI such as Hubert Dreyfus and John Searle. However, Searle points out that, in principle, *anything* can be simulated by a computer, and so any process at all can be considered "computation", if you're willing to stretch the definition to the breaking point. "What we wanted to know is what distinguishes the mind from thermostats and livers," he writes. Any argument that involves simply by copying a brain is an argument that admits that we know nothing about how intelligence works. "If we had to know how the brain worked to do AI, we wouldn't bother with AI," writes Searle.

1) Advantages of robots

- The people should know the importance of robots to help them to determine when to use and when to not use the robots, the robots can go to the planets, they can be used to explore the space, They can spy on the people in ways the people can't move and from views the humans can't reach.

- The robots can go far down into the unknown places where the humans would be crushed, they can give us the information that the humans can't get, they can work at places 24/7 without any salary and food, plus they don't get bored.[6]

- The robots can perform the tasks faster than the humans and much more consistently and accurately, they become more common each day, the robotic pets can help the patients with depression and they keep them active.

Fig-2: Robots

- Most of robots are automatic so, they can move without any human interference, they can entertain us, and they can help us in certain tasks, you can send them about the dangerous environment such as the deep sea or the war-zones.

- You can use the robots to produce the products in the factories such as assembling the cars, they can also be used to build the parts for many products such as the plane parts, the car parts and the construction supplies.

- The robots do anything which we need to be precise & accurate, New jobs are created because the people have to fix and design the robots, The robots can work without sleep. So, they can work 24hours/7days/365days.

- The robots can endure the hostile environment of the interplanetary space, they are made that the planetary atmospheres do not affect their physical state and

performance, they can replace the human beings in many areas of work, they can shoulder greater responsibilities and they can be programmed to manage themselves.

- The robots can be programmed to reach the Earth's nadir, they can be used to dig for the fuels, they can be used for mining purposes, they can be harnessed for exploring the depths of oceans, they can be used to overcome the limitations that humans have.
- The robots can be used in carrying out the repetitive & time-consuming tasks efficiently, they are used to do dangerous tasks, they can adjust their parameters like their speed & time, they can act quickly, unaffected by the factors that affect the humans.[6]
- The robots do not require to sleep or take breaks, they are able to function without stopping, when employed to carry out dangerous tasks, the risk to the human health & safety is reduced, they can work long time without service or maintenance and they can be more productive than the people.
- The robots cannot tremble or shake as the human hands do, they can have much smaller & versatile moving parts than the people, they have performed the medical surgeries because they can be faster and more precise than the people.
- The robots are designed to work in harsh environments like in space, without the air, underwater & in the fire, they can be used instead of the people when the human safety is a concern, they can come in any size, Whatever size needed for any task can be created.
- The robots can do the jobs that the people are unwilling to do, many robotic probes have been sent throughout the solar system to never return to Earth, they can be stronger than the people, the robots in the warfare eliminate putting more people at risk.

Disadvantages of robots:

- Robots need a supply of power, The people can lose jobs in factories, [7] They need the maintenance to keep them running, It costs a lot money to make or buy the robots, The software and the equipment that you need to use with the robot cost much.
- Robots can take the place of many humans in factories, So, the people have to find new jobs or be retrained, They can take the place of the humans in several situations, If the robots begin to replace the humans in every field, They will lead to unemployment.
- Robots cost much money in maintenance & repair, the programs need to be updated to suit the changing requirements, the machines need to be made smarter, in case of breakdown, the cost of repair may be very high, the procedures to restore lost code or data may be time-consuming & costly.
- The robots can store large amounts of data but the storage, access, retrieval is not as effective as the human brain, they can perform the repetitive tasks for a long time, but they do not get better with experience such as the humans do.
- The robots are not able to act any different from what they are programmed to do, With the heavy application of robots, the humans may become overly dependent on the machines, losing their mental capacities, If the control of robots goes in the wrong hands, robots may cause the destruction.
- The robots are not intelligent or sentient, they can never improve the results of their jobs outside of their predefined programming, they do not think, they do not have emotions or conscience, this limits how the robots can help & interact with people.

2) Different Branches Occupied in the Development of Robotics:

Robotics in contrast to other branches is a reasonably new domain of engineering. It is a multi-disciplinary domain.[8] the different branches occupied in the development of Robotics are:-

1. **Mechanical Engineering**: Deals with the machinery & structure of the Robots.
2. **Electrical Engineering**: Deals with the controlling & intelligence (sensing) of Robots.
3. **Computer Engineering**: Deals with the movement development and observation of Robots.

3) Classification of Robots:

Robots are categorized depending upon the circuits of the Robots and the variety of application it can perform. The robots are classified into three types:

- **Simple level Robots-** These are automatic machines which do not contain complex circuit. They are developed just to extend human potential. For Example- Washing Machine.
- **Middle level Robots**– These robots are programmed but can never be reprogrammed. These robots contain sensor-based circuit & can perform multiple tasks. For Example- Fully Automatic Washing Machine.
- **Complex level Robots-** These robots are programmed and can be reprogrammed as well.

They contain complex model-based circuit. For Example- Laptop or Computer.

4) Types of Robotics:

Robotics is an area of interest to human beings for more than one hundred years. On the other hand, our perception over robots is influenced by the media and international film industry (Hollywood). You may ask- what robotics is all about? In my views, a robot's distinctiveness transforms depending on the atmosphere it works in. [8] Some of these are as follows:-

Fig-3: Robots

1. **Outer Space** – Robotic arms that are under the control of a human being are employed to unload the docking cove of outer-space shuttles to launch satellites or to build a space station.

2. **The Intelligent Home** – Robotic systems can nowadays scrutinize home safety, ecological circumstances and energy consumption. Door & windows can be unlocked mechanically and electrical device such as lights and A/C can be pre-programmed to turn on. This helps residents to enjoy appliances irrespective of their mobility.

3. **Exploration** – Robots can enter the environments that are injurious to human beings. An illustration is observing the atmosphere within a volcano or investigating our deep marine life. NASA has utilized robotic probe for environmental study, ever since the early 60's.

4. **Military Robots** – Flying robot drones are brought into play for close watch in present time's modern armed force. In the future robotic airplane and automobiles could be employed to transmit petroleum, bullets, bombs, etc or clear minefields. [9]

5. **Farms** – Programmed robots are used by harvesters to cut and collect crops. Robotic milk farms are existing permitting workers to nourish and milk their cattle distantly.

6. **The Car Industry** – Robotic arms are used; these arms can execute numerous tasks in the car manufacturing & assembling procedure. They carry out jobs such as sorting, cutting, welding, lifting, painting and bending. Similar functions but on a minor scale are now being intended for the food industry to execute tasks like- the trimming, cutting and processing of different types of meats like- chicken, beef, fish, lamb, etc.

7. **Hospitals** – The development of a robotic suit is under construction that will allow nurses to raise patients without injuring their backbones. Scientists in Japan have crafted a power facilitated suit which will provide nurses the additional power that they need to lift patients.

8. **Disaster Areas** – Observation robots built-in with superior sensing and imaging gears. This robot can work in dangerous environments like urban site spoiled by earthquakes by inspecting floors, walls, and roofs for structural reality.

9. **Entertainment** – Interactive robots that shows behaviours and education capability. One such robot is owned by SONY which moves around freely, responds to all your commands, carries your luggage and even responds to your oral instructions.

This is not the end of Robotic world; there is many more applications of Robotics.

5) Applications of robotics:

Currently, robots perform several different jobs in numerous fields and the number of tasks delegated to robots is rising progressively. The best way to split robots into types is a partition by their application [10].

1. Industrial robots – These robots bring into play in an industrialized manufacturing atmosphere. Typically, these are articulated arms particularly created for applications like- material handling, painting, welding and others. If we evaluate merely by application, then this sort of robots can also consist of some automatically guided automobiles and other robots.

2. Domestic or household robots – Robots which are used at home. This sort of robots consists of numerous different gears for example- robotic pool cleaners, robotic sweepers, robotic vacuum cleaners, robotic sewer cleaners and other robots that can perform different household tasks. Also, a number of scrutiny and tele-presence robots can also be considered as domestic robots if brought into play in that sort of environment.

3. Medical robots – Robots employed in medicine and medicinal institutes. First & foremost surgical treatment robots. Also, several robotic directed automobiles and perhaps lifting supporters.

4. Service robots – Robots that cannot be classed into any other types by practice. These could be various data collecting robots, robots prepared to exhibit technologies, robots employed for research, etc.

5. Military robots – Robots brought into play in military & armed forces. This sort of robots consists of bomb discarding robots, various shipping robots, exploration drones. Often robots at the start produced for military and armed forces purposes can be employed in law enforcement, exploration and salvage and other associated fields.

6. Entertainment robots – These types of robots are employed for entertainment. This is an extremely wide-ranging category. It begins with model robots such as Robosapiens or the running photo frames and concludes with real heavy weights like articulated robot arms employed as movement simulators.

7. Space robots – I would like to distinct out robots employed in space as a split apart type. This type of robots would consist of the robots employed on Canadarm that was brought into play in space Shuttles, the International Space Station, together with Mars explorers and other robots employed in space exploration & other activities.

8. Hobby and competition robots – Robots that is created by students. Sumo-bots, Line followers, robots prepared merely for learning, fun and robots prepared for contests.

5. CONCLUSION

Today we find most robots working for people in industries, factories, warehouses, and laboratories. Robots are beneficial in many ways. For example, it boosts economy because businesses need to be efficient to keep up with the industry rivalry. Therefore, having robots helps business owners to be competitive, because robots can do works better and faster than humans can, e.g. robot can build, assemble a car. Yet robots cannot perform every job; today robots roles include assisting research and industry. Finally, as the technology advances, there will be new ways to use robots which will bring new hopes and new possibilities.

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