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Applications and Future scope of Robotics-A Review

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Abstract

Robotics is the confluence of engineering and science that includes mechanical engineering, electrical engineering, computer science also it is no more an emerging field as it has evolved so much in the last 10 years and it is nearing an apex point .It is an ever growing field and many avenues have opened up in recent past. The promise of robotics is easy to describe but hard for the mind to grasp. A robot is a mechanical or virtual intelligent agent that can perform tasks automatically or with guidance, typically by remote control. In practice a robot is usually an electro-mechanical machine that is guided by computer and electronic programming. Robots hold the promise of moving and transforming materials with the same ease as a computer program transforms data. But the grey spot remains wide when it comes to Research awareness in the field of Robotics and Automation. Sooner or later Robotics and automation will find its application in every facet of human life. The advancement in technology would bring a day of robots omnipresence. They will soon sneak everywhere from gadgets to apparels and to our very own bodies. Hence it is the responsibility of engineering community to disseminate the knowledge about the future scope and application of Robotics.

***Keywords:** Confluence, Research awareness, Omnipresence*

INTRODUCTION

What are Robots?

The term robot is derived from Czech word "robota" which means forced labor. Nobody has ever given a precise explanation of what a robot is, although each of those definitions more or less means the same. To make things simpler, "Robot is a combination of electronics, mechanics and programming which senses it's surrounding through its sensors processes the sensor information and does something in response". The response can be locomotion or manipulation, like turning on a LED, rotating a wheel, moving an arm, raising an alarm and so on. The branch of computer science and engineering which deals with robot design, construction, application and operation is called Robotics with applications in computer science, physics, engineering, defense and even many household devices.

DIFFERENCE BETWEEN ROBOTS AND EMBEDDED SYSTEMS

Embedded System: Embedded system is a combination of various electronic and mechanical parts which are designed to perform a particular task (or a set of few tasks) in real time with high efficiency and performance. These systems are used in various consumer electronics, medical systems, military applications, etc. Portable music player, cell phones are all examples of embedded systems which have a controller built in to perform specific activities.

Robots: Robots are theoretically different in that they are equipped with sensors to perceive their environment and actuators to perform particular tasks and can take intelligent decisions.

Although robots and embedded systems seem like two extremes of engineering world, the gap between them is reducing. We already know that washing machines can sense dirt in cloths and takes intelligent decisions. Air conditioners can sense outside temperature and adjust internal room temperature. These are intelligent embedded systems built inside another bigger system which perceives it environment through its sensors and takes corrective actions, thereby controlling the bigger system.

Applications:

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

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.

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.

Medical robots: Existing technologies are being combined in new ways to streamline the efficiency of healthcare operations. As a result, a wide range of robots is being developed to serve in a variety of roles within the medical environment. Robots specializing in human treatment include surgical robots and rehabilitation robots. The field of assistive and therapeutic robotic devices is also expanding rapidly. These include robots that help patients rehabilitate from serious conditions like strokes, empathic robots that assist in the care of older or physically/mentally challenged individuals, and industrial robots that take on a variety of routine tasks, such as sterilizing rooms and delivering medical supplies and equipment, including medications.

Below are six top uses for robots in the field of medicine today.

1. Telepresence: Physicians use robots to help them examine and treat patients in rural or remote locations, giving them a "telepresence" in the room. Specialists can be on call, via the robot, to answer questions and guide therapy from remote locations; the key features of these robotic devices include navigation capability within the Emergency Room(ER) and sophisticated cameras for the physical examination.

2. Surgical Assistants: These remote-controlled robots assist surgeons with performing operations, typically minimally invasive procedures. "The ability to manipulate a highly sophisticated robotic arm by operating controls, seated at a workstation out of the operating room, is the hallmark of surgical robots," Additional applications for these surgical-assistant robots are continually being developed, as more advanced 3DHD technology gives surgeons the spatial references needed for highly complex surgery, including more enhanced natural stereo visualization, combined with augmented reality.

3. Rehabilitation:

These play a crucial role in the recovery of people with disabilities, including improved mobility, strength, coordination, and quality of life. These robots can be programmed to adapt to the condition of each patient as they recover from strokes, traumatic brain or spinal cord injuries, or neurobehavioral or neuromuscular diseases such as multiple sclerosis. Virtual reality integrated with rehabilitation robots can also improve balance, walking, and other motor functions.

4. Medical:

Supplies, medications, and meals are delivered to patients and staff by these robots, thereby optimizing communication between doctors, hospital staff members, and patients. "Most of these machines have highly dedicated capabilities for self-navigation throughout the facility," states ManojSahi, a research analyst with Tractica, a market intelligence firm that specializes in technology. "There is, however, a need for highly advanced and cost-effective indoor navigation systems based on sensor fusion location technology in order to make the navigational capabilities of transportation robots more robust."

5. Sanitation:

With the increase in antibiotic-resistant bacteria and outbreaks of deadly infections like Ebola, more healthcare facilities are using robots to clean and disinfect surfaces. "Currently, the primary methods used for disinfection are UV light and hydrogen peroxide vapors," says Sahi. "These robots can disinfect a room of any bacteria and viruses within minutes."

Military robots: Robots brought into play in military & armed forces. This sort of robots consist 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.

The military has always been at the cutting edge of technology, so it should come as no surprise that the most advanced robots in the world are being built with military applications in mind. While the thought of autonomous machines carrying heavy armaments might make people a bit nervous, they have the potential to dramatically reduce loss of life, allowing soldiers to safely scout locations or breach enemy locations. Many of them are even designed for support purposes, rather than eliminating threats.

The MAARS (Modular Advanced Armed Robotic System) depicted in fig 1 fits a lot of firepower into its diminutive frame. Its modular design allows its controllers to outfit it with a variety of armaments, ranging from non lethal lasers (designed to blind foes) to tear gas and even a grenade launcher. The MAARS is a follow-up to an earlier model of robot called SWORDS, which saw deployment in Iraq a few years ago.

Figure 1: MAARS

Figure 2: Gladiator

Designed to assist the U.S. Marine Corps in various operations, the Gladiator depicted in fig 2 Tactical Unmanned Ground Vehicle looks like a small tank,

and can be outfitted with various modular tools and armaments depending on what the situation calls for. Although it tops out at 10 miles per hour, the Gladiator trades speed for toughness; it has an armored hull, and users can mount machine guns and grenade launchers directly onto its body.

The Chinese-developed Anbot depicted in fig 3 is an armed police robot designed by the country's National Defense University. Capable of reaching max speeds of 11 mph, the machine is intended to patrol areas and, in the case of danger, can deploy an "electrically charged riot control tool." Those worried about the Anbot's resemblance to a Dalek, take heart; no blue police boxes have yet been seen in its vicinity.

Figure 3: Anbot

Figure 4: Black Hornet

Another model of flying surveillance robot, the Black Hornet depicted in fig 4 is made by Prox Dynamics, and looks like a miniature helicopter. The machine

contains cameras that can stream live video to the user, allowing them to scout areas from a safe distance. Small, quiet, and helpful on the battlefield, the Black Hornet is like a Mission Impossible gadget in real life. The robot has already seen its share of action, too. Speaking with UAS Vision, British Major Adam Foden said that the military has already begun deploying the Black Hornet inside compounds in an effort to clear routes through enemy-held spaces. It's worked well thus far, and frequently transmits clear and concise images back to British forces.

RoboBeedepicted in fig 5 is a tiny robot capable of partially untethered flight, developed by a research robotics team at Harvard University. The culmination of twelve years of research, RoboBee solved two key technical challenges of micro-robotics. Engineers invented a process inspired by pop-up books that allowed them to build on a sub-millimeter scale precisely and efficiently. To achieve flight, they created artificial muscles capable of beating the wings 120 times per second.

The goal of the RoboBee project is to make a fully autonomous swarm of flying robots for applications such as search and rescue, surveillance and artificial pollination

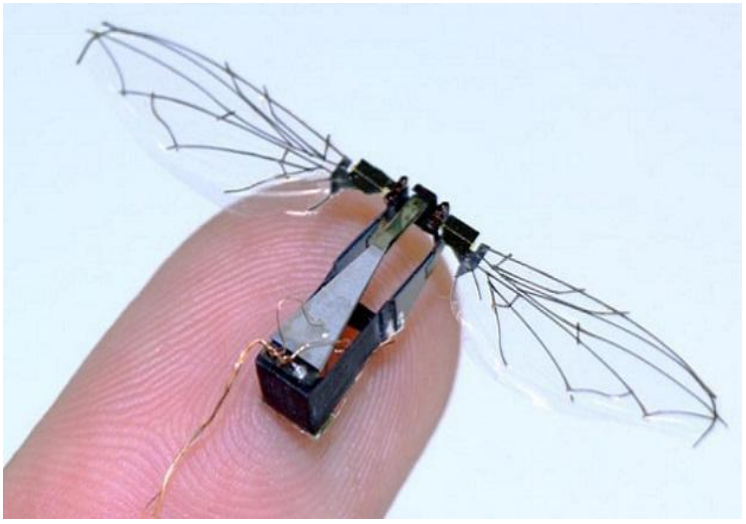

Figure 5: Robobee

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Entertainment robots: Entertainment Robots Entertainment robots perform many different tasks, like singing and dancing, but they all have one goal. To entertain humans these robots take the place of comedians, parents, or even pets. Entertainment robots can have conversations with people, serve sodas at restaurants, or even carry kids.

What do entertainment robots do? Entertainment robots are usually found in households, acting as toys for children. These toy robots can usually move around, like the Aibo, Robo-sapien or the QRIO. Entertainment robots are machines that are built to entertain (usually children) using several different features.

Figure 6: Robosapien

Robosapien depicted in fig 6 is a toy-like biomorphic robot designed by Mark Tilden and produced by WowWee toys. The Robosapien is preprogrammed with moves, and also can be controlled by an infrared remote control included with the toy, or by either a personal computer equipped with an infrared PDA.

The toy's remote control unit has a total of 21 different buttons. With the help of two shift buttons, a total of 67 different robot-executable commands are accessible.

QRIO ("Quest for cuRIOsity", originally named Sony Dream Robot or SDR) was a bipedal humanoid entertainment robot developed and marketed (but never sold) by Sony to follow up on the success of its AIBO entertainment robot. QRIO stood

approximately 0.6 m (2 feet) tall and weighed 7.3 kg (16 pounds). QRIO's slogan was "Makes life fun, makes you happy!"

Figure 7: QRIO

Figure 8: Aibo

AIBO (Artificial Intelligence Robot) depicted in fig 8is an iconic series of roboticpets designed and manufactured by Sony. Sony announced a prototype robot

in mid-1998. The first consumer model was introduced on May 11, 1999.New models were released every year until 2005. AIBOs were marketed for domestic use as "Entertainment Robots". They were also widely adopted by universities for educational purposes (e.g. Robocup) and research into robotics and human-robot interaction. AIBOs have been used in many movies, music videos and advertising campaigns as futuristic icons

Space Robots: Robots are most widely used in space research. It can easily work in harmful space where human being can't perform. A robotic spacecraft designed to make scientific research measurements is often called a space probe. Many space missions are more suited to teleroboticrather than crewed operation, due to lower cost and lower risk factors Robonaut is a joint DARPA–NASA project designed to create a humanoid robot which can function as an equivalent to humans during extra-vehicular activity (space walks) and exploration. The large goal of the Robonaut project is to build a robot with dexterity that exceeds that of a suited astronaut. Currently there are four different robonauts with others in development, this variety of robonauts allows for the study of different stages of mobility and tasking for each situation. All four versions of this robot use various locomotion methods. Some versions of the robot use the Segway HT for locomotion

Figure 9: Robonaut

Robonaut uses telepresence and various levels of robotic autonomy. While not all human range of motion and sensitivity has been duplicated, the robot's hand has

fourteen degrees of freedom and uses touch sensors at the tips of its fingers.

RASSOR: Pronounced "razor", RASSOR stands for Regolith Advanced Surface Systems Operations Robot. It is a lunar robot that will autonomously excavate soil when it is near completion, with its small tank like chassis with a Drum excavator and either side mounted on arms which can help the robot climb over obstacles that may be in its way. With these arms the robot can successfully right itself if it flips over and lift itself off the ground the clear its tracks of debris.

With the drums positioned vertically RASSOR stands at about 2.5 ft. tall and expected to weigh about 100 pounds. With a top speed of about 4 centimeters per second (nearly five times faster than the Curiosity rover on mars) the RASSOR will work 16 hours a day for many years. In its design NASA has moved away from its usual fragile and slow robot to design something more robust and hardy.

The 2 excavating drums are designed to slowly remove soil into a hopper that can hold 40 pounds of material. The little robot will then drive to a processing plant where the lunar soil could be chemically broken down and converted into rocket fuel, water or breathing air for astronauts working on the moon and even possibly mars. In-situ resource utilization of lunar soil for fuel could save the costs of launching a rocket as 90% of the rockets weight consists of propellants.

Underwater robotics:

Underwater robotics is a branch of robotics. Underwater robots depicted in fig 10 can be autonomous, or they can be remotely operated. This is an emerging science, which has become more popular with evolving technology. There are many applications of underwater robotics such as scientific exploration, military use, and hobbies.

Besides capability of swimming an underwater robot also has multi DOF manipulators and end effectors on these arms of various types to perform underwater tasks such as construction, salvage, rescue and repair. They can also help in collecting items that are deeply submerged inside the sea, used by the military and scientists mostly.

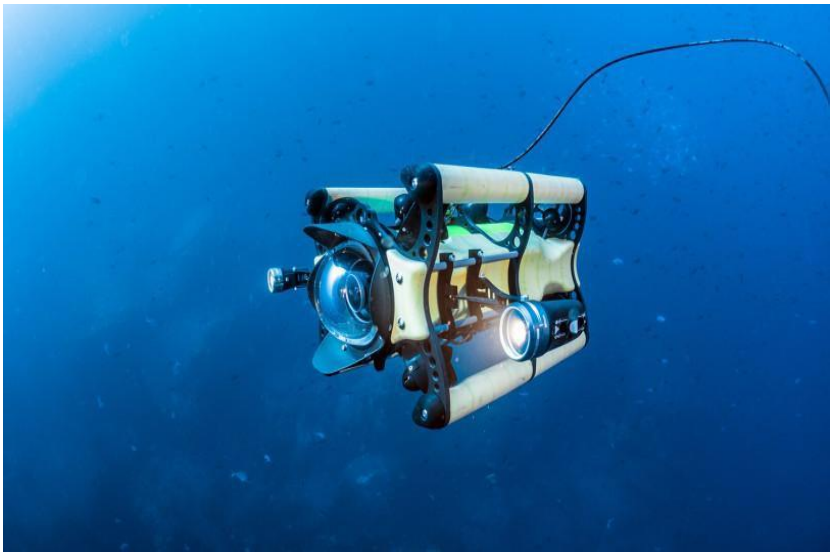

Figure 10: Under water Robots

Electric Mobility: Mobility as a term used in logistics usually refers to shipping, trucking, aviation, vehicle, and any transportation related states. Most cities around the world currently face three major transportation problems with the foremost problem being the traffic capacity overflow, meaning too many automobilesto address thisrobotics applications are also involved in electric mobility to transport goods economically and without polluting the environment.

Bio-inspired and Bio Mimicking Robots: Bio Mimicking robots or robots which are designed based on some animals and creatures are so fascinating and amazing that they are already being loved for their designs and the amazing work they offer.This research is aimed at developing a new class of biologically inspired robots that exhibit much greater robustness in performance in unstructured environments than today's robots.It is about learning concepts from nature and applying them to the design of real-world engineered systems.

More specifically, this field is about making robots that are inspired by biologicalsystems. Biomimicry and bio-inspired design are sometimes confused. Biomimicry is copying the nature while bio-inspired design is learning from nature and making a mechanism that is simpler and more effective than the system observed in nature.

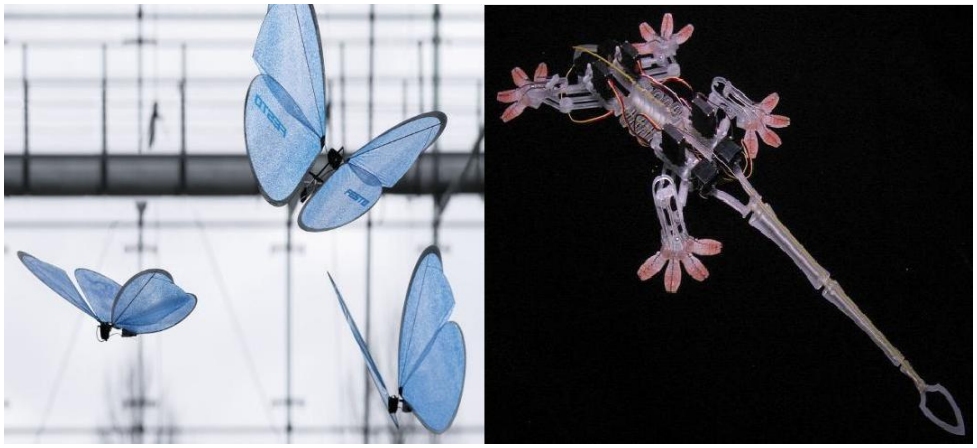

Figure 11: Bio Inspired Robots

Humanoid Robotics: A humanoid robot is a robot with its body shape built to resemble that of the human body. A humanoid design might be for functional purposes, such as interacting with human tools and environments, for experimental purposes, such as the study of bipedal locomotion, or for other purposes.

In general, humanoid robots have a torso, a head, two arms, and two legs, though some forms of humanoid robots may model only part of the body, for example, from the waist up. Some humanoid robots may also have heads designed to replicate human facial features such as eyes and mouths. Androids are humanoid robots built to aesthetically resemble humans. Japan , karelcapek invented the first humanoid robot.

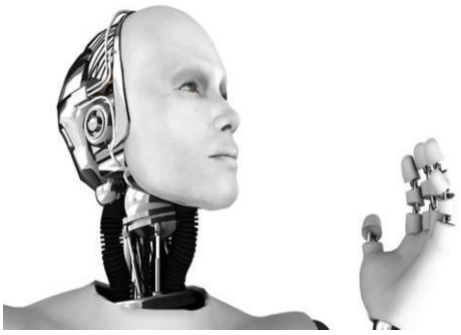

Figure 11: Humanoid Robot

FUTURE OF ROBOTICS

There is no denying that Robotic technologies are all set to change the way things are done in the industries in which they are being implemented. Entrepreneurs are voicing a similar sentiment and are clearly optimistic about the use of Robotics in various industrial segments. Robotics is mainly capturing industries like manufacturing, pharmaceutical, FMCG, packaging and inspection. A bit of Robotics would also be seen in the healthcare sector primarily in the form of assistive and skill development

technologies. The other promising sectors are defense and education. World had come across PC revolution and mobile revolution in the recent past now it is the time for inevitable robotics. Considering that the global players, like Google, FESTO and Tesla are investing in Robotics along with substantial increase in amateur robotic enthusiasts, Open source tools and platforms available for robotics, It is assured that significant development in this field will occur in another 5-10 years.

CONCLUSION

Robotics is fast entering into the industrial space, and many other utilities application it is but natural that a lot of employment and entrepreneurship opportunities are opening up for people who wish to enter this growing and exciting field. It is evident from the above provided details that the robots have proved time and again that they can do the impossible. Man's short stay in this planet is influenced by these machines created by the human brain. Hopefully in a few years these man-made machines or the so called "Brain child of mankind" will find its path along every walks of human life.

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