

UNIT 41 – UPSC - Awareness in the fields of Robotics

The field of robotics is the outcome of scientific research and development. Roboticists develop man-made motorised devices that can move by themselves, whose motion must be modelled, planned, sensed, actuated and controlled, and whose motion behaviour can be influenced by programming. A robot is a reprogrammable, multifunctional Machiavelli designed to move material, parts, tools or particular devices through adjustable programmed motions for the performance of many tasks (Robot Institute of America, 1979). Basically, Robotics deals with the design, construction, operation, and use of robots combined with computer systems for their control, sensory feedback, and information handling. The design of a given robotic system brings together doctrines of electronic engineering, mechanical engineering and computer science. Robots are developed by humans in the perfect image of the Human in the human mind. Robots are very useful to humans as these manmade machines traverse harmful terrain, perform surveillance missions, and perform remote surgery around the world. A robot consists of a repertoire of sensors and actuator together with a “Brain” (a Microprocessor) and communication capability.



History of Robots

The discipline of robotics emerged in the 20th century but the history of human-invented automation was developed in ancient time. Historical reports indicated that the ancient Greek engineer Hero of Alexandria, produced two texts, Pneumatica and Automata that affirm to the existence of hundreds of different kinds of “wonder” machines that can perform automated movement. During the 20th and 21st centuries, Robotics has advanced profoundly to include machines capable of assembling other machines and even robots that can be fallacious for human beings. The phrase robot was invented by a Czech novelist, Karel Capek in a 1920. Robotics was first used in Runaround, a short story published in 1942, by Isaac Asimov. Issac Asimov introduced his laws of robots and Eric Elenberger, who is considered as the father of robotics, introduced real-time robots to the world. Fundamentally, a robot is a re-programmable machine that is capable of movement in the accomplishment of a task. Robots use special coding that

differentiates them from other machines and machine tools. Robots have applications in many industries due to their robust resistance capabilities and accuracy function.

In 1954, the first programmable robot was developed by George Devol, who created the term Universal Automation. He shortens this to Unimation, which becomes the name of the first robot company (1962). In 1978, The Puma (Programmable Universal Machine for Assembly) robot was developed by Unimation with a General Motors design support. During 1980s, the robot industry had made tremendous progress. Many institutions introduce programs and courses in robotics. Robotics courses are spread across mechanical engineering, electrical engineering, and computer science departments. In 1995, there is embryonic applications in small robotics and mobile robots drove a second growth of start-up companies and research.

Attributes of robotic technology:

1. It is a specialized machine tools with flexibility that distinguishes them from fixed-purpose automation.
2. Robot technology is basically a mechanical arm that is bolted to the Floor, a machine, the ceiling, or, in some cases the wall Fitted with its mechanical hand, and taught to do Repetitive task in a controlled, ordered environment.
3. It has ability to move mechanical arm to perform work.
4. Robot interface with their work environment once a Mechanical hand has been attached to the robot's tool mounting Plate.

Types of robot:

1. Mobile robots
2. Rolling robots
3. Walking robots
4. Stationary Robots
5. Autonomous Robots
6. Remote-control Robots

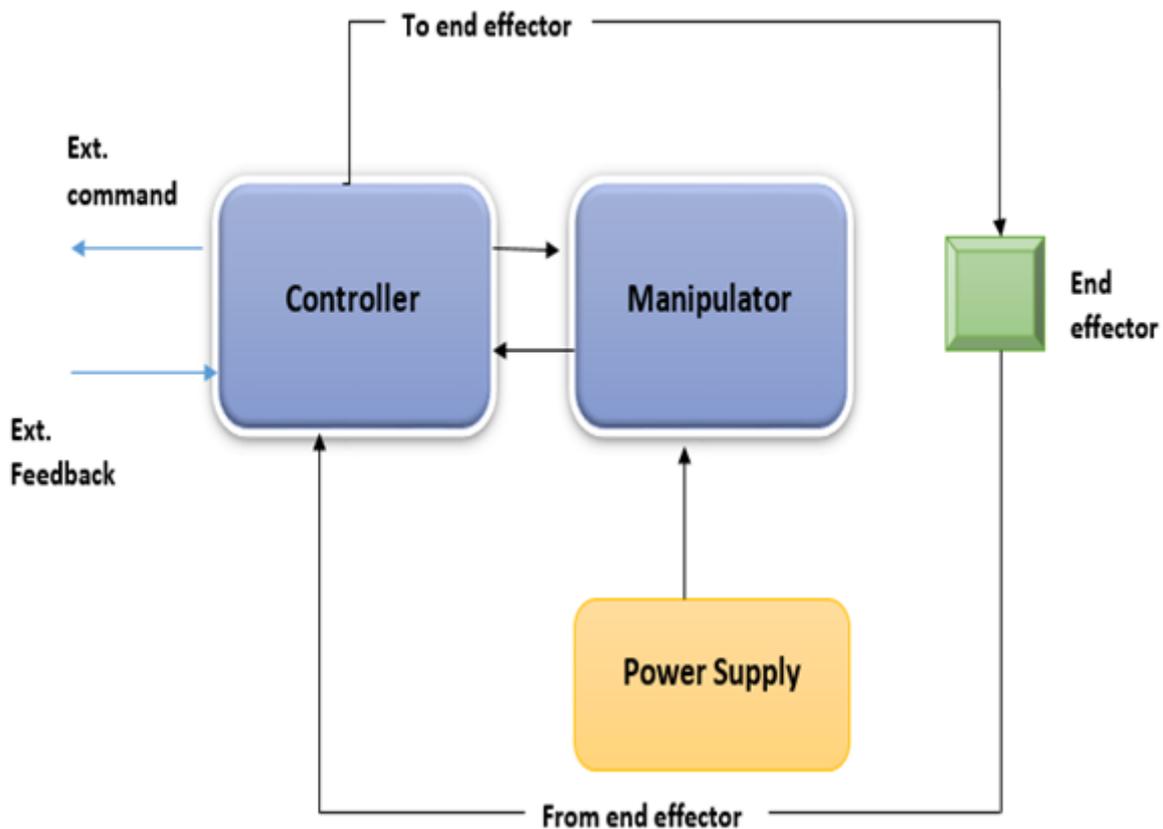
Typical knowledgebase for the design and operation of robotics systems:

- Dynamic system modelling and analysis
- Feedback control
- Sensors and signal conditioning
- Actuators (muscles) and power electronics
- Hardware/computer interfacing
- Computer programming

Major component of robot:

1. The manipulator, which is the robot's support comprises of Segments jointed together with axes capable of motion in various directions allowing the robot to perform work.
2. The end effector which is a gripper tool, a special device, or Fixture attached to the robot's arm, actually performs the Work.

3. Power supply provides and regulates the energy that is converted to motion by the robot actuator, and it may be either electric, pneumatic, or hydraulic.
4. The controller initiates, terminates, and coordinates the Motion of sequences of a robot. Also it accepts the necessary Inputs to the robot and provides the outputs to interface with the outside world.



Robots are highly beneficial for workers, industries and countries. If introduced properly, industrial robots can augment the quality of life by freeing workers from dirty, boring, hazardous and heavy labour. It is a fact that robots can cause unemployment by replacing human workers but robots also create jobs like robot technicians, salesmen, engineers, programmers and supervisors. The benefits of robots to industry include improved management control and productivity and consistently high quality products. Industrial robots can work vigorously night and day on an assembly line without a loss in performance. Subsequently, they can greatly reduce the costs of manufactured goods. As a result of these industrial benefits, nations that successfully use robots in their industries may enhance their economic status at global scale.

Robotics in India: India understands the importance of robotics in numerous fields. This will also open up the possibilities in the field of Research activities, Manufacturing, Academia, Space technology, Defence industries, Medical, and Agriculture industry. Table: timeline vision of robotics in India (Report of National Institute of Science and Technology Policy (NISTEP), 2030).

- By 2013-2014 – Agricultural robots
- By 2013 – 2017 - Robots that care for Elderly

- By 2013-2020 – Nano Robots
- By 2015 – To have one third of its fighting capacity provided by Robots
- By 2017 – Medical Robots performing low invasive surgery
- By 2017-2019 – Household Robots
- By 2035 – To have first completely autonomous Robot soldiers on the battlefield

Prospects in Robotics in India: Robotics offers numerous opportunities for both entrepreneurs and students. Industries across a range of sectors such as automotive, atomic energy, defence, space, metals, textiles and manufacturing use Robotic technologies very effusively. Robots are required everywhere to improve productivity. They are also being used in operation theatres and rehabilitation centres to enhance the quality of life. Developed countries like Japan and America are using robots for many functions.

Challenges of robotics in India: In India, Robotics field also pose many challenges. The major issue in using robotics for various functions in India is the high cost of adoption, availability of skilled talent and procurement of hardware components. As Robotics is a multidisciplinary field, acquiring and retaining quality talent is major issue.

Industrial Applications of Robots: Modern Robots are very useful for industrial field. Industrial robots are found in various locations such as the automobile and manufacturing industries. Robots cut and shape fabricated parts, assemble machinery and inspect manufactured parts. Robots perform task of load bricks, die cast, drill, fasten, forge, make glass, grind, heat treat, load/unload machines, machine parts, handle parts, measure, monitor radiation, run nuts, sort parts, clean parts, profile objects, perform quality control, rivet, sand blast, change tools and weld.

Robots in Medicine: Robots have great importance in the medical field where extreme precision and delicacy is essential, and the margin for error is very low. The main areas of robotics applications in medicine is in surgery. Because robots are able to perform major operations while only making small incisions, patients receive many benefits. Robots are used to perform heart surgery without opening patient's chests. In Prosthetics, Mechanical replacements for missing limbs and organs that can interact with the human organic system are a long-standing goal of the robotics community. Robotic devices can also provide help to people with severe restrictions on movement, in many cases allowing them at least some capability to move around or nearby their homes. Rehabilitation Robots can provide exercise platforms to help restore limb function and can monitor the condition of patients undergoing rehabilitation from the effects of injuries, stroke or other brain or nerve damage.

Application of Robots in Space: Robots can perform well in space arena where it is dangerous for humans to get to space, to be in space and to return from space. But is a major challenge for experts or engineers to fit robots operating reliably. It is easy for manipulator to restore parts, to fix the space ship and to direct the wholes space shuttle.

Underwater Robots: Robotic underwater travellers are used to reconnoitre and gather information about many aspects of marine environment. For example, robots are used for underwater cable inspection, and for telecommunications.

Application of Robots in Military and Security: Military robots are self-directed or remote-controlled devices designed for military applications. As it is well established that military is a dangerous job, but some of the tasks that soldiers are required to do are more dangerous than

others. Walking through minefields, deactivating unexploded bombs or clearing out hostile buildings are some of the most dangerous tasks a person is asked to perform in the line of duty. In military field, robots are also used to investigate hazardous and dangerous environments. In these environments robots are used for firefighting, for entering into risky areas and for removing of injured persons in natural disasters. Other major applications of robots in security is for inspection and search for dangerous materials. In this, robots prevent the harms to humans operating it in case of something explodes during the inspection. Robots are also used during war for mine removal and entering into risky areas where robots use guns as their manipulators.

Domestic robots: The domestic or household robot are available in different types and serves various purposes such as robotic movers, robotic vacuum cleaners, robotic pool cleaners, toys, and floor washing robots. Domestic robots of these types must be setup properly to perform their jobs.

Humanoid robots: A humanoid robot is a robot which has resemblance like human and it is based on that of the human body, allowing interaction with made-for-human tools or environments. In general, humanoid robots have a torso with a head, two arms and two legs, although some forms of humanoid robots may model only part of the body, for example, from the waist up.

To summarize, a robot is a programmable, self-controlled device which has electronic, electrical, or mechanical units. It is a machine that work as a living human. Though the notion of robot is very old, it was explored in the decade of 1920. Robotic technology has applications in numerous fields. It provides significant potential to improve the dilemma of the rescue workers by reducing exposures to hazardous conditions. A robotic device can explore the mine and provide valuable information to the teams to assist in planning and implementing search and rescue operations. It is established that robot technology is an applied science that is devoted to as combination of machine tool basics and computer applications.