INTRODUCTION

What is a robot?

- A robot is a machine that's responsible for performing some sort of task.
- For example my blender in my kitchen that performs the task of making me a smoothie.
- That's a machine that performs the task, a robot then?
- Maybe if my blender did all the shopping, bottle its own fruit and then made me a drink, then we can call it a blender robot

What is a robot?

- **A robot is a machine that's responsible for performing some sort of task.**
- **With some sensors to perceive the world around it.**
- **It will have some capability to make a decision.**
- **Finally, it will take action based on that decision or those decisions.**

Videos to watch

1) https://www.wired.com/video/watch/hardwired-so-what-is-a-robot-really

2) https://www.youtube.com/watch?v=nlrr5b1XWoY&t=301s

3) https://www.youtube.com/watch?v=x1Qu1YKZA0Y&t=70s

4) https://www.youtube.com/watch?v=XDeR1JYXSy0

5) https://www.youtube.com/watch?v=6iJu9-8pjcQ

6) https://www.youtube.com/watch?v=uoC2ZGRI8a8

Isaac Asimov's Laws of Robotics

First Law:

A robot may not injure a human being, or, through inaction,allow a human being to come to harm.

Second Law:

A robot must obey orders given it by human beings, except where such orders would conflict with the First Law.

Third Law:

A robot must protect its own existence as long as such protection does not conflict with the First or Second Law.

Classification of Robots

The following is the classification of robots according to the Japanese Industrial Robot Association (JIRA):

Class 1: Manual Handling Device: A device with multiple degrees of freedom, actuated by an operator

Class 2: Fixed Sequence Robot: A device that performs the successive stages of a task according to a predetermined, unchanging method, which is hard to modify

Class 3: Variable Sequence Robot: Same as in class 2, but easy to modify

Classification of Robots

Class 4: Playback Robot: A human operator performs the task manually by leading the robot, which records the motions for later playback; the robot repeats the same motions according to the recorded information

Class 5: Numerical Control Robot: The operator supplies the robot with a movement program rather than teaching it the task manually

Class 6: Intelligent Robot: A robot with the means to understand its environment and the ability to successfully complete a task despite changes in the surrounding conditions under which it is to be performed

Classification of Robots

The Robotics Institute of America (RIA) only considers classes 3–6 of the above as robots. The Association Francaise de Robotique (AFR) has the following classification

Type A: Handling devices with manual control to tele-robotics

Type B: Automatic handling devices with predetermined cycles

Type C: Programmable, servo controlled robots with continuous or point-to-point trajectories

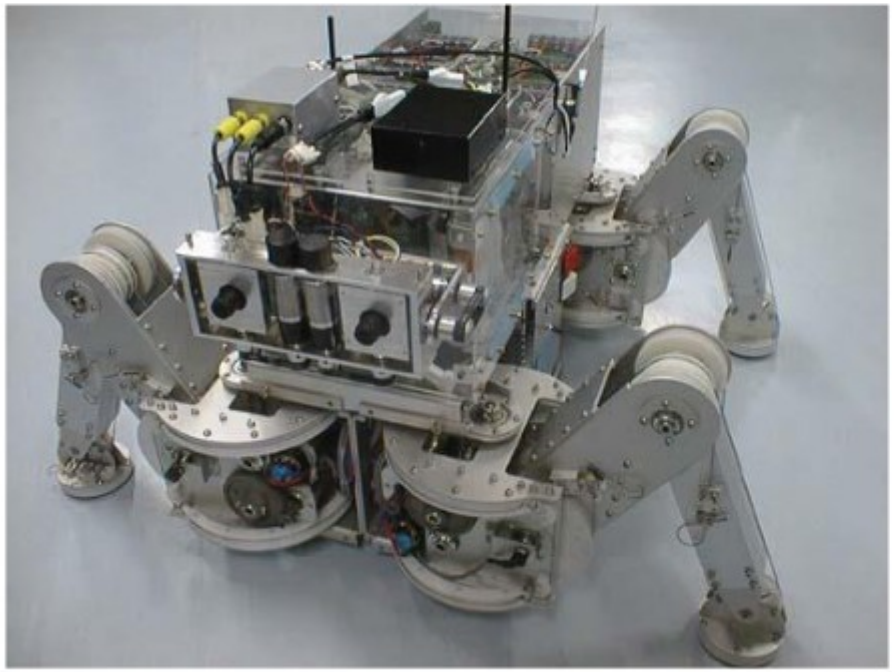
Type D: Same as C but with capability to acquire information from its environment

Examples of Robots

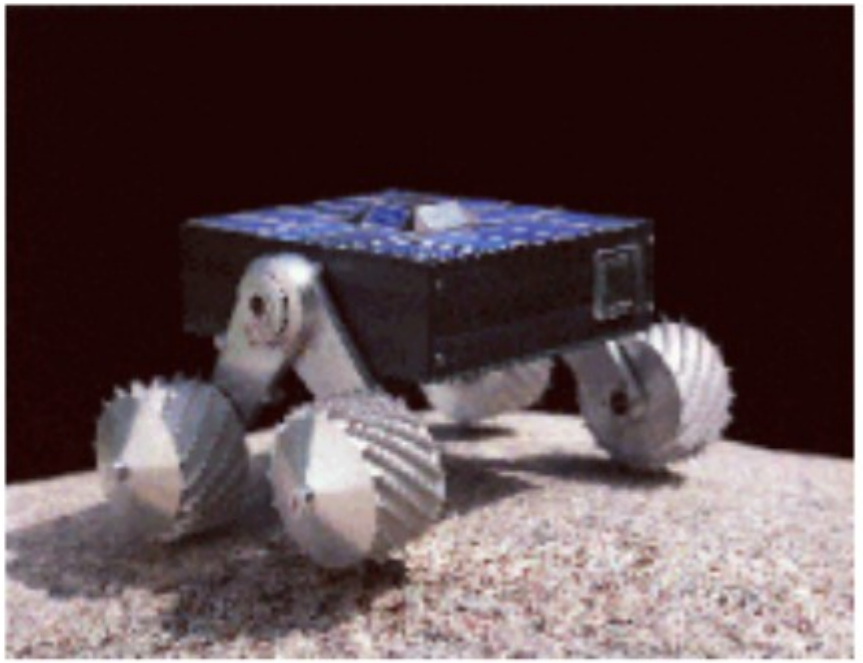
Manipulator

Examples of Robots

Legged Robot



Wheeled Robot



Examples of Robots

Autonomous Underwater Vehicle

Unmanned Aerial Vehicle

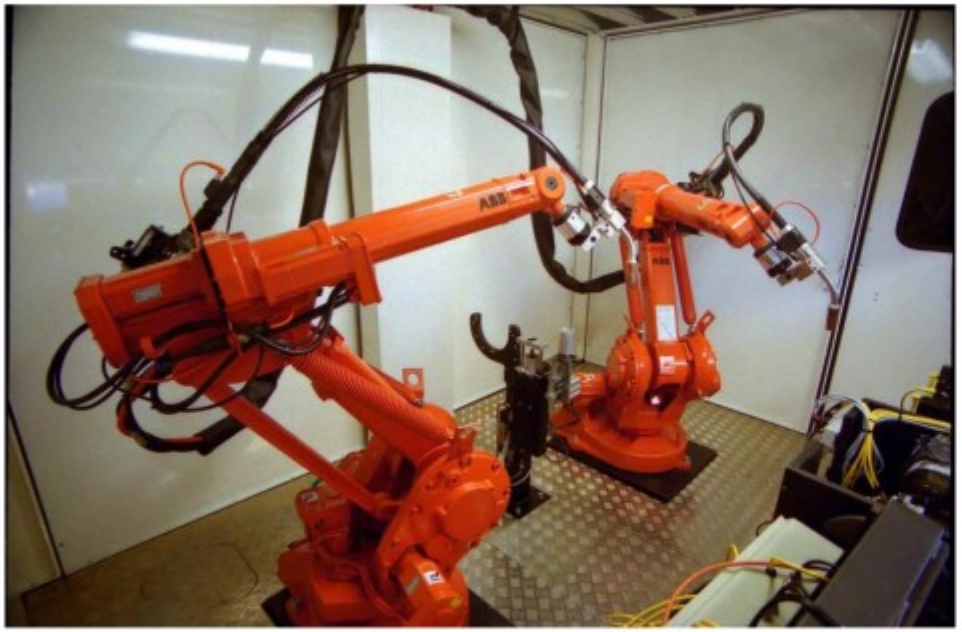
Examples of Robots

Decontaminating Robot

Cleaning the main circulating pump housing in the nuclear power plant

Jobs that are dangerous for humans

Examples of Robots



Welding Robot

Repetitive jobs that are boring, stressful, or labor-intensive for humans

Examples of Robots

The SCRUBMATE Robot

Manual tasks that human don’t want to do

Advantages and Disadvantages of Robots

- **Robotics and automation can, in many situations, increase productivity, safety, efficiency, quality, and consistency of products.**
- **Robots can work in hazardous environments such as radiation, darkness, hot and cold, ocean bottoms, space, and so on without the need for life support, comfort, or concern for safety.**
- **Robots need no environmental comfort like lighting, air conditioning, ventilation, and noise protection.**
- **Robots work continuously without tiring or fatigue or boredom. They do not get mad, do not have hangovers, and need no medical insurance or vacation.**

Advantages and Disadvantages of Robots

- **Robots have repeatable precision at all times unless something happens to them or unless they wear out.**
- **Robots can be much more accurate than humans. Typical linear accuracies are a few ten-thousandths of an inch. New wafer-handling robots have micro-inch accuracies.**
- **Robots can process multiple stimuli or tasks simultaneously. Humans can only process one active stimulus.**

Advantages and Disadvantages of Robots

- **Robots replace human workers, causing economic hardship, worker dissatisfaction and resentment, and the need for retraining the replaced workforce.**
- **Robots lack capability to respond in emergencies, unless the situation is predicted and the response is included in the system. Safety measures are needed to ensure that they do not injure operators and other machines that are working with them. This includes:**
  - Inappropriate or wrong responses
  - Lack of decision-making power
  - Loss of power
  - Damage to the robot and other devices
  - Injuries to humans

Advantages and Disadvantages of Robots

- **Robots, although superior in certain senses, have limited capabilities in:**
  - Cognition, creativity, decision-making, and understanding
  - Degrees of freedom and dexterity
  - Sensors and vision systems
  - Real-time response
- **Robots are costly due to:**
  - Initial cost of equipment and installation
  - Need for peripherals
  - Need for training
  - Need for programming

Robot Components

A robot, as a system, consists of the following elements, which are integrated together to

form a whole:

Manipulator or the rover: This is the main body of the robot which consists of the links, the joints, and other structural elements of the robot. Without other elements, the manipulator alone is not a robot

End effector: This part is connected to the last joint (hand) of a manipulator that generally handles objects, makes connections to other machines, or performs the required tasks.

Robot Components

Actuators: Actuators are the ‘‘muscles’’ of the manipulators. The controller sends signals to the actuators, which, in turn, move the robot joints and links. Common types are servomotors, stepper motors, pneumatic actuators, and hydraulic actuators.

Sensors: Sensors are used to collect information about the internal state of the robot or to communicate with the outside environment. similar to our major senses of sight, touch, hearing, taste, and speech, robots are equipped with external sensory devices such as a vision system, touch and tactile sensors, speech synthesizer, and the like that enable the robot to communicate with the outside world.

Robot Components

Controller: The controller is rather similar to our cerebellum although it does not have the power of the brain, it still controls your motions. The controller receives its data from the computer (the brain of the system), controls the motions of the actuators, and coordinates the motions with the sensory feedback information.

Processor: The processor is the brain of the robot. It calculates the motions of the robot’s joints, determines how much and how fast each joint must move to achieve the desired location and speeds, and oversees the coordinated actions of the controller and the sensors.

Robot Components

Software: Three groups of software programs are used in a robot.

One is the operating system that operates the processor.

The second is the robotic software that calculates the necessary motions of each joint based on the kinematic equations of the robot. This information is sent to the controller.

The third group is the collection of application-oriented routines and programs developed to use the robot or its peripherals for specific tasks such as assembly, machine loading, material handling, and vision routines.

References

- **Lecture on Introduction to Robotics by Prof. Dr. Syed Akhter Hossain Sir**

- **Saeed B. Niku – Introduction to Robotics Analysis, Control, Applications-Wiley (2010)**