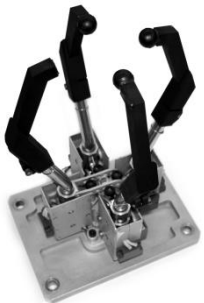


# ***Robot Construction: Review***



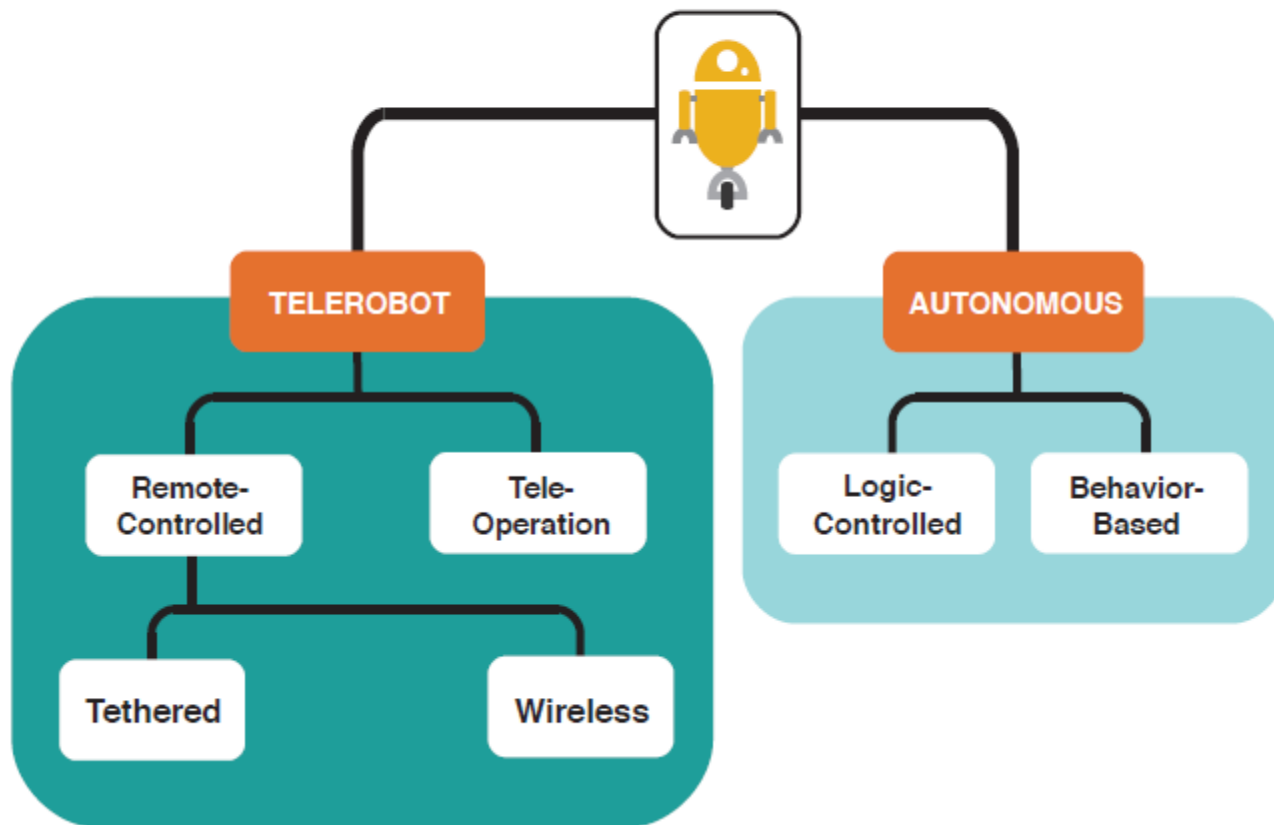
## **ACTUATORS**



# What is a robot? (Cont.)

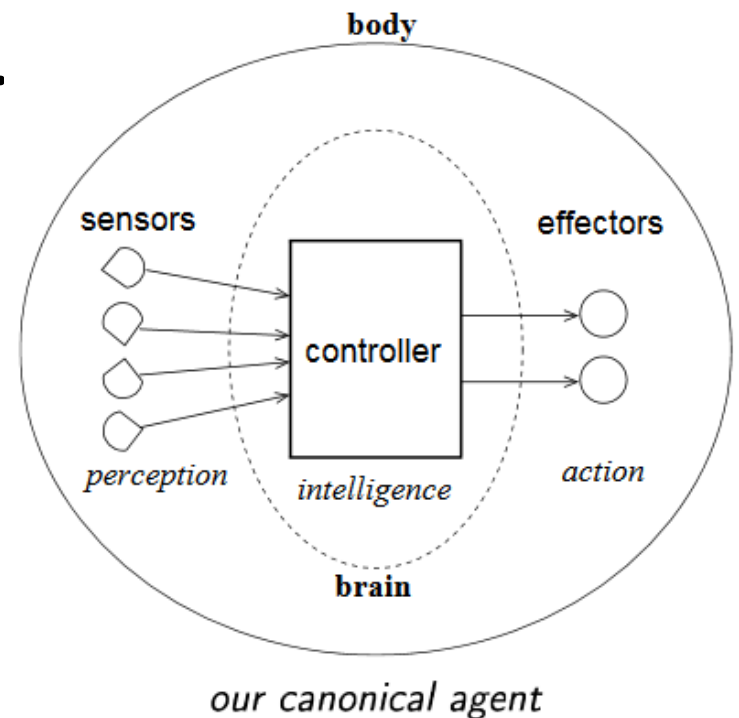
- Our definition of robot (for our purposes):
  - An autonomous agent, acting independently. Our environment is the real world.
  - The robot can sense its environment (including its own internal state) and act on it to achieve pre-defined goals.
- Robotics: The study of robots – their design, construction, capabilities and purpose.

## TWO BASIC CATEGORIES OF ROBOT OPERATION



# Our definition of a robot

- Robot = autonomous embodied agent
- Has a *body* and a *brain*
- Exists in the physical world (rather than the virtual or simulated world).
- Is a mechanical device



# Robot definition (cont.)

- Contains *sensors* to perceive its own state
- Contains *sensors* to perceive surrounding environment
- Has *effectors* that perform actions
- Has a *controller* that takes input from the sensors, makes *intelligent* decisions about actions to take, and performs these actions by sending commands to motor

# Robot State

- Refers to the description of the system at any point in time
- Internal state refers to the state of the robot
  - E.g., its battery is low
- External state refers to the state of the world
  - As the robot perceives it
    - E.g., it is wet on the ground

# Robot components

- All have five common components:
  - Control:
    - Human: Brain, central nervous system
    - Function: the brain makes decisions based on sensory input , nervous system sends signals to muscles
    - What is the equivalent in Robots?
      - Usually the brain is a computer of some kind, wires send signals
  - Effectors (body/structure):
    - Human: Bones and muscles - legs, arms, wrists, neck, etc.
    - Function: Allows movement
    - What is the equivalent in Robots?
      - Motors allow movement, wheels

# Robot components

- All have five common components (cont.):
  - Perception (sensors):
    - Humans: 5 senses detected by our body (what are they?)
      - Touch, Smell, Sight, Hearing, Taste
    - Robots: Touch sensor notifies robot of contact with another object, sound sensor allows robot to perceive audio.
  - Power source:
    - Humans: food and digestive system
    - Function: provide energy
    - Robots: usually batteries of some kind



# Robot components

## – Communications:

- Humans: voice, gesture, hearing
- Function: communication with outside world
- Robots: input/output functionality, expressions, wireless signals

# Effectors and Actuators

- Terms are often used interchangeably to mean: “whatever makes the robot take an action”
  - but they aren’t the same thing

# Effectors

- Any device that affects the environment
  - Either through direct impact or influence
  - Examples:
    - Wheels on a mobile robot
      - Or legs, wings, fins...
    - Whole body might push objects
    - Grippers on an assembly robot
    - Or welding gun, paint sprayer
    - Speaker, light, tracing-pen



# Effectors

- Specific categories:
  - Manipulators: Industrial robot arms, capable of picking and placing objects, mimicking human
  - Mobile/humanoid robots: effectors enables moving around

# Actuators



- The mechanisms that enables the effector to execute an action or movement.
  - In animals and humans:
    - muscles and tendons are the actuators
    - make the arms and legs and the backs do their jobs.
  - In robots:
    - Converts software commands into physical movements
      - Through electronic or hydraulic signals
    - Actuators include electric motors and various other technologies.
    - Connected via transmission:
      - System gears, brakes, valves, locks, springs...



# **PROGRAMMING FUNDAMENTALS**

# Creating a successful robot

- Creating a successful robot takes team effort
  - Between humans and robots
- Humans is responsible for:
  - identifying the task
  - planning out a solution
  - Explaining to the robot what he needs to do
    - To reach the goal
- Robot is responsible for:
  - Following the instructions it is given
  - Thereby carrying out the plan



# Creating a successful robot

- Humans and machines do not speak the same language
- Therefore, a special language needs to be created
  - To translate the necessary instructions from human to robot
    - Such as the NXT-G we are working with
  - These are called programming languages



# Programming Language

- Instructions written in programming languages are called programs
  - Created by the programmer
- The programmer needs to:
  - identify the task
  - plan a solution
  - Produce a program that the robot will understand
- The robot will run the program
  - And accomplish the task it was given
    - Assuming the program is correct

# Programming Language

- What are the challenges?
- The robot only follows the program
  - It does not think by itself
  - Only has the capabilities that the program gives it
  - The programmer is responsible for:
    - designing a solution
    - Programming the robot to follow it



# Lab time!

- Let's work with our robots!

