NYU TANDON SCHOOL OF ENGINEERING

Promoting robotic design and entrepreneurship experiences among students and teachers

Lesson 1: Introduction to Robotics

Document

Innovative Technology Experiences for Students and Teachers (ITEST), Professional Development Program, July 2017 - 19
Mechatronics, Controls, and Robotics Laboratory, Department of Mechanical and Aerospace Engineering, NYU Tandon School of Engineering

CONTENTS

ITEST: Outline and objective of the program

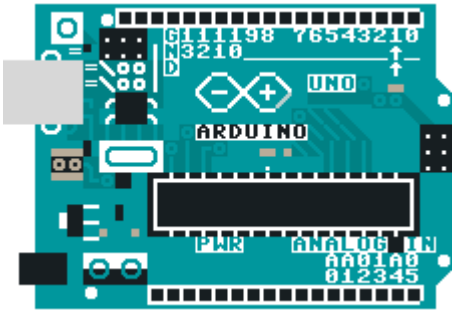
Content:

- History of robotics
- Components of a robot

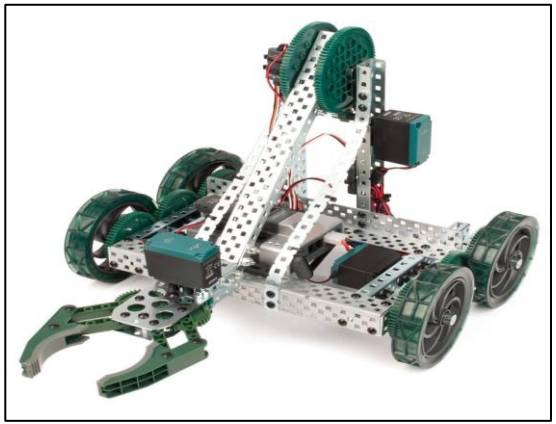
- **TASK/ACTIVITY:** Introduction to robots of MCRL NYU

BRIEF OUTLINE OF ITEST PROGRAM

- Conceptual and practical learning of basic robotics
- **Arduino** platform to program the robots
- Building a mobile robot with **VEX EDR** robotics kit



Arduino UNO



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OVERVIEW: ITEST SESSIONS

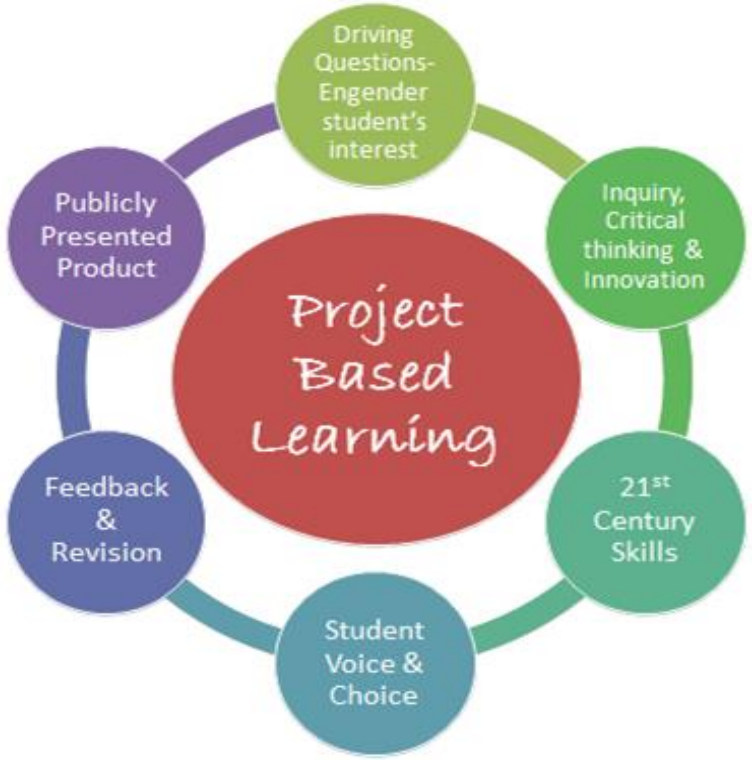
Lesson	Topic
1	Introduction to Robotics
2	Robots in the industry
3	Basic Concepts of Physics and study of Robot Chassis Construction
4	Basic electronics
5	Introduction to Arduino
6	Actuators
7	Robot dynamics
8	Programming in Arduino

OVERVIEW: ITEST SESSIONS

Lessons	Topic
9	Drive mechanism
10	3D printing and Makerspace
11	CAD Modelling and 3D printing
12	Advanced Arduino programming I
13	Advanced Arduino programming II
14	Advanced Arduino programming III
15	Sensors
16	Robot links and joints
17	Robot grippers
18	Robotics Challenge – Line follower robot

OBJECTIVE OF THE PROGRAM

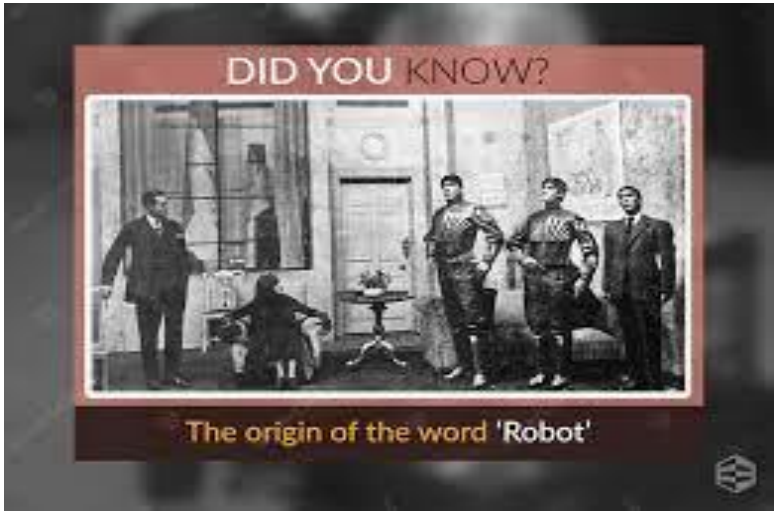
- Formulating robotics activities in a **PBL (Project Based Learning)** framework
- **Integration** of PBL with entrepreneurship
- Deepen teachers' **Technological, Pedagogical and Content Knowledge (TPACK)**
- Use robotics to expose participants to techniques and models of engineering design



FUNDAMENTALS OF ROBOTS

Robot term origin:

The term "**robot**" originated from a 1921 **Czech play** "Rossum's Universal Robots" (from Czech "**robota: work**") by Karel Čapek



Origin of robot

Definition from Robot Institute of America (RIA):

"A robot is a **reprogrammable**, **multifunctional manipulator** designed to move material, parts, tools, or specialized devices through variable programmed motions for the performance of a variety of tasks."

LAWS OF ROBOTICS

- The T**hree Laws of Robotics**, were developed by science-fiction writer **Isaac Asimov**, who sought to create an ethical system for humans and robots
- In his short story "Runaround" he coined the term “**Robota**” referring to an artificial human
- Asimov also added a fourth, or **zeroth law**, to precede the others

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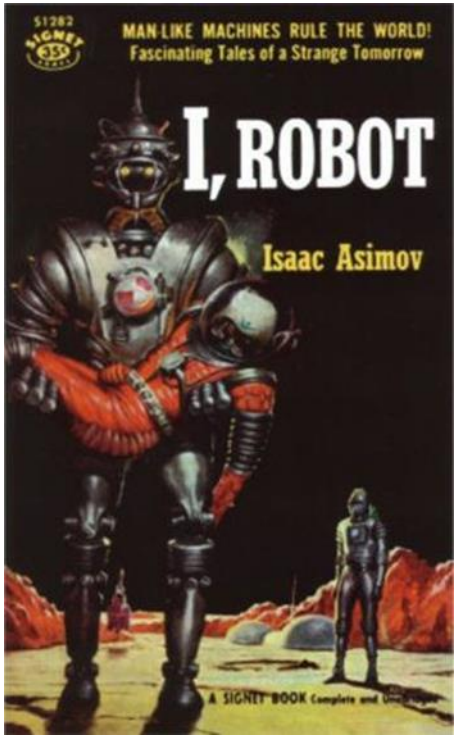

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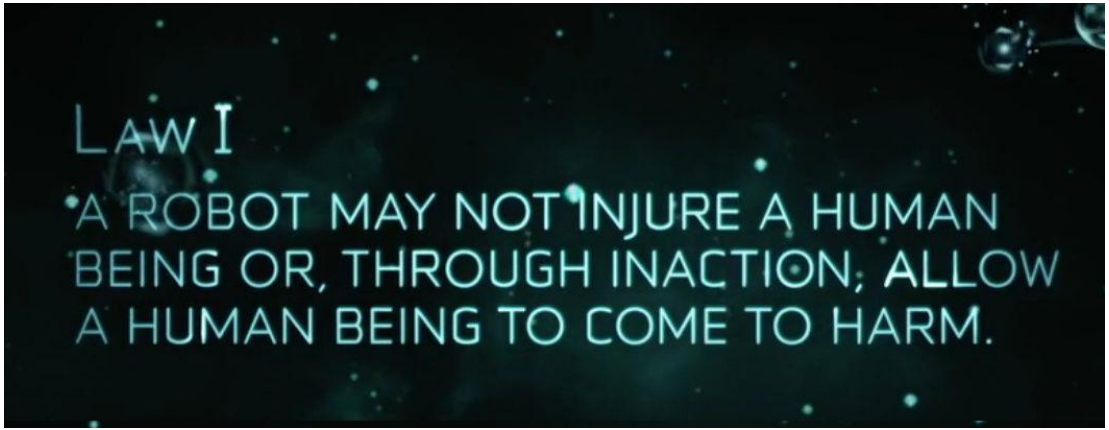
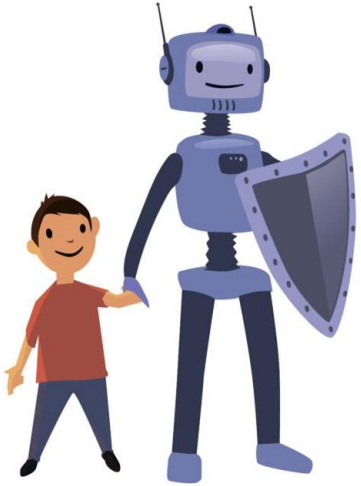
FIRST LAW OF ROBOTICS

Law One: A robot may not injure a human being, or, through inaction, allow a human being to come to harm, unless this would violate a higher order law.



Law One of Robotics



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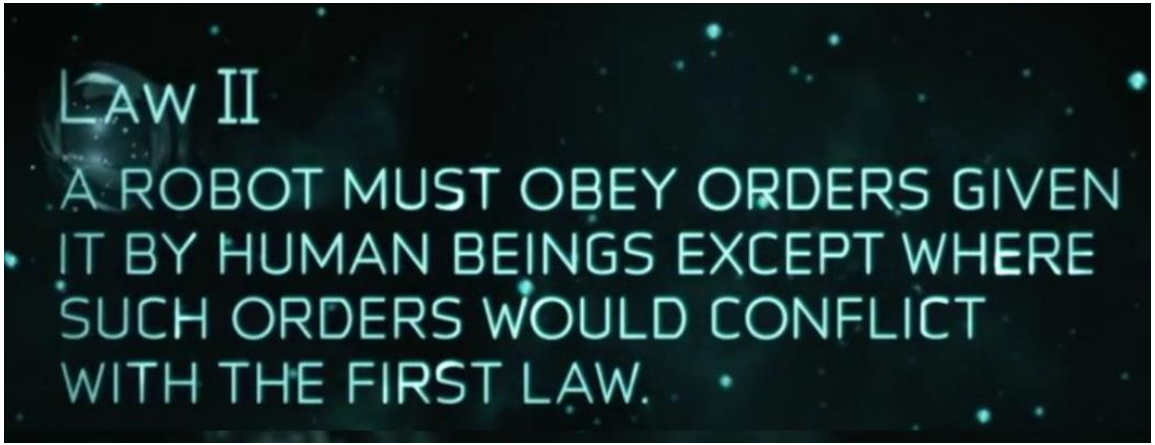
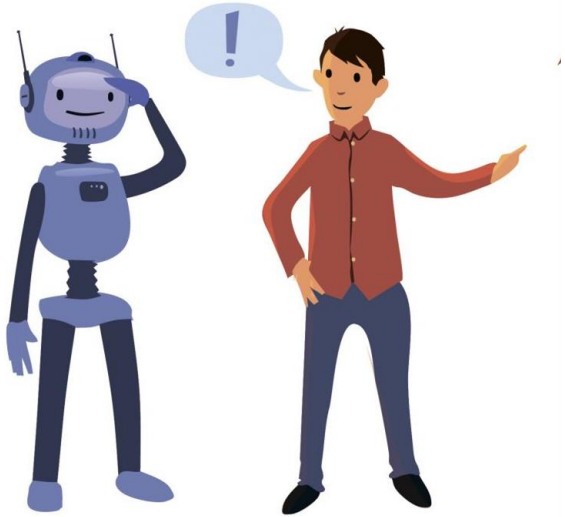
SECOND LAW OF ROBOTICS

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



Law Two of Robotics



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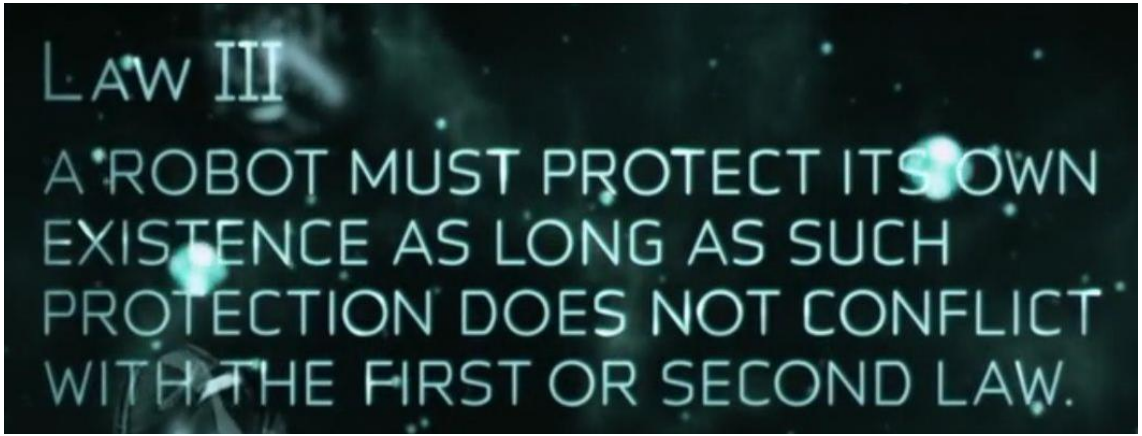
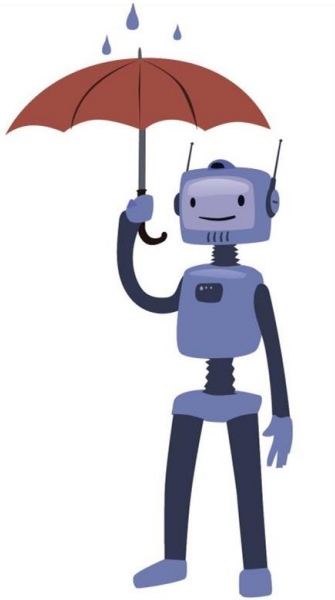
THIRD LAW OF ROBOTICS

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



Law Three of Robotics



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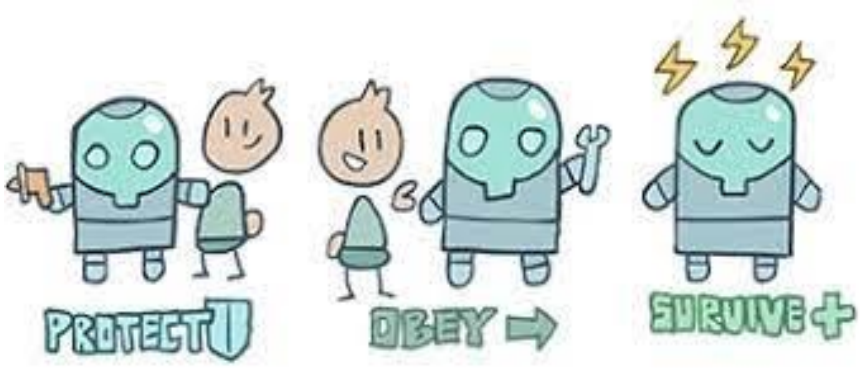
ZEROTH LAW OF ROBOTICS

Zeroth Law: A robot may not injure humanity, or, through inaction, allow humanity to come to harm.



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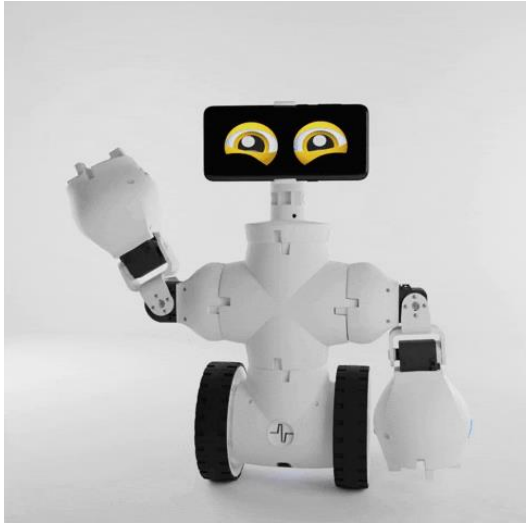
ACTIVITY - 1

- Have you ever come across a robot in your life?
- If yes, what kind of robot have you encountered?
- What was your involvement with it?
- Have you been a part of any robotics activity before?
- If yes, what did you learn from it?



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HISTORY OF ROBOTICS

The first industrial robot: UNIMATE

- The first programmable robot was designed by **George Devol,** who coined the term **Universal Automation** later shortened to **Unimation**, which becomes the name of the first robot company (**1962**)

- The first UNIMATE robot was installed at GM's Inland Fisher Guide Plant in Ewing Township, New Jersey

UNIMATE robot

NOTE: UNIMATE originally automated the manufacture of TV picture tubes

Source

HISTORY OF ROBOTICS

In **1978**: The **PUMA** (Programmable Universal Machine for Assembly) robot was developed by Unimation with support of **General Motors design.**

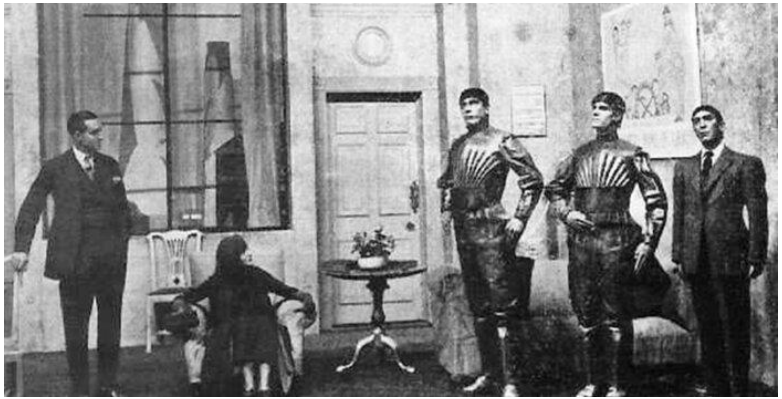
- Used since 1978 to **assemble automobile subcomponents** such as dash panels and lights

PUMA 560 Manipulator

HISTORY OF ROBOTICS

1980s: The robot industry entered a phase of rapid growth. Robotics has come a long way, from being a story to a reality

- Many institutions introduce programs and courses in robotics
- Robotics courses are spread across mechanical engineering, electrical engineering, and computer science departments



Introduction of term **ROBOT** as an artificial human in 1921

Humanoid robot Sophia

HISTORY OF ROBOTICS

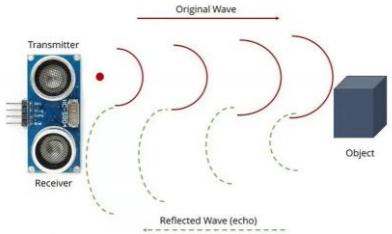
1995 - present:
Emerging applications in small robotics and mobile robots have driven a second growth of start-up companies and research.

Adept's **SCARA** robot

Cognex **In-Sight** robot

Barrett technology m**anipulator**

COMPONENTS OF A ROBOT



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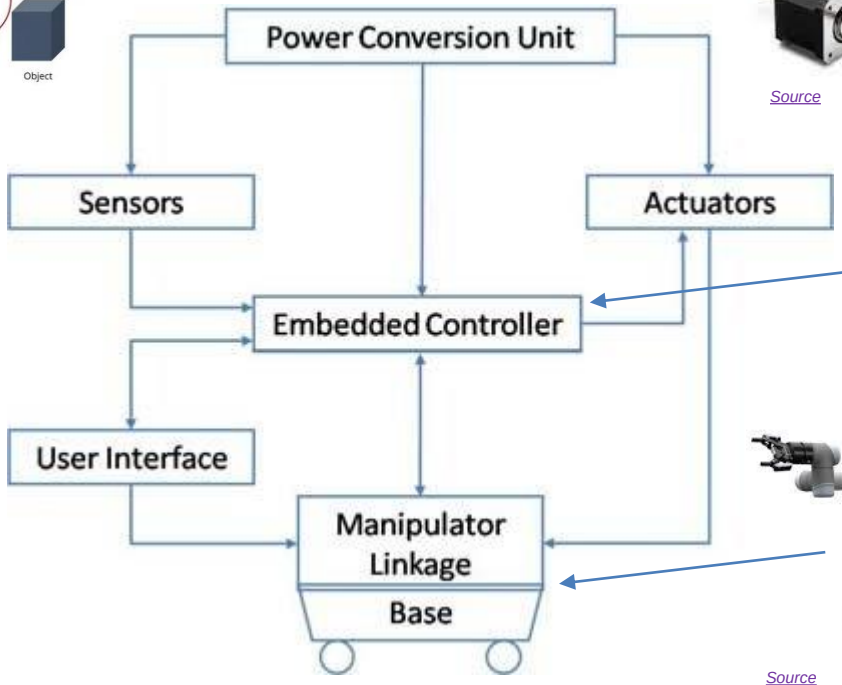

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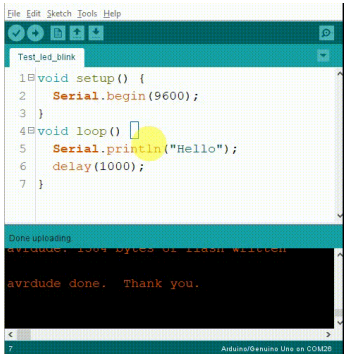

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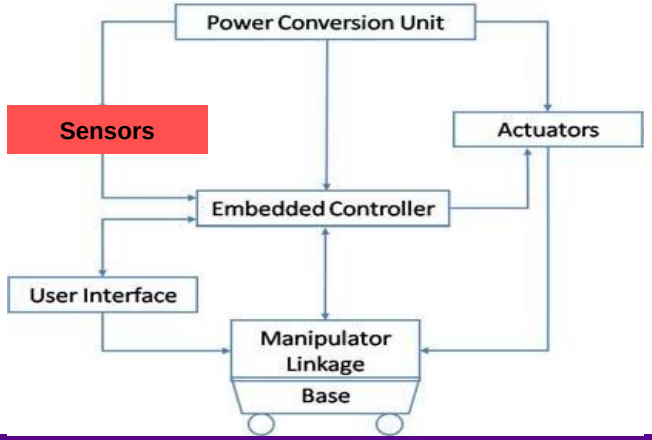
SENSORS

- Robots often need beyond **5 human senses** (e.g., **night vision**, detect tiny amounts of invisible **radiation**, measure small and fast movement)

- **Robot sensors**: **Measure robot configuration/condition** and its **environment** and send it to robot controller as electronic signals (e.g., position, pressure, presence of toxic gas)

Ultrasonic sensor

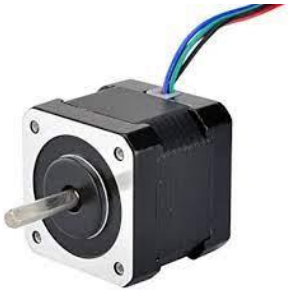


Flexiforce sensor

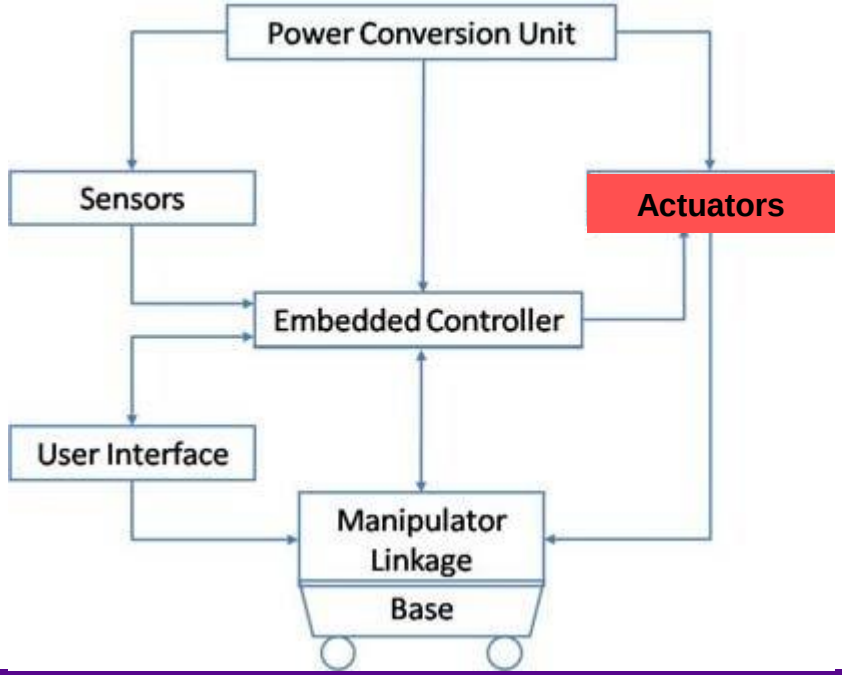
ACTUATORS

- **Actuator:** A device that produces a motion by **converting energy and signals going into the system to motion**
- The motion it produces can be either **rotary** or **linear**

DC motor



Stepper motor



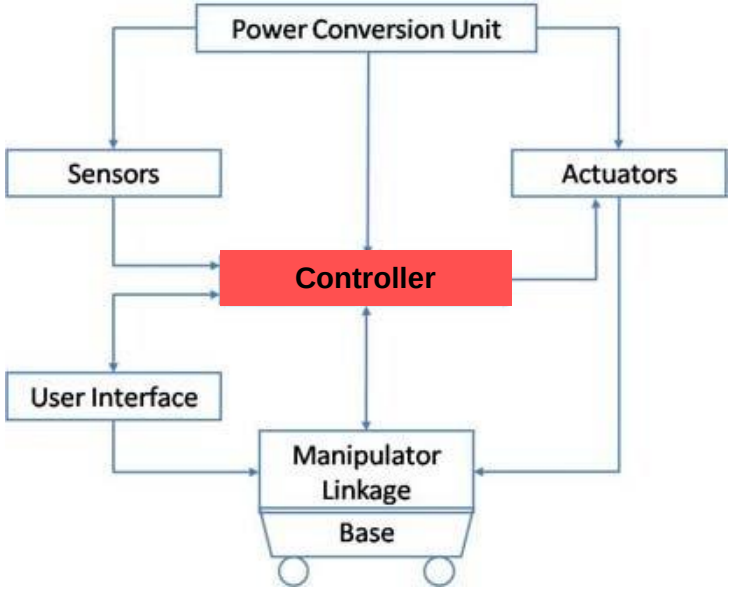
Servo motor

Pneumatic motor

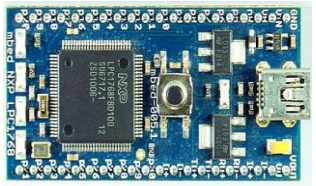
CONTROLLERS

- Controller is the "**brain**" of the robots
- Provide necessary intelligence to **control** the **manipulator/mobile robot**
- Process the sensory information and compute the **control commands** for the actuators to carry out specified tasks

Arduino UNO



Raspberry Pi 4



ARM cortex

ACTIVITY

- Showcasing the lab robots (45 min) of NYU MCRL lab

NYU MCRL lab

NYU TANDON SCHOOL OF ENGINEERING

Thank You!

Questions and Feedback?

Innovative Technology Experiences for Students and Teachers (ITEST), Professional Development Program, July 2017-19
Mechatronics, Controls, and Robotics Laboratory, Department of Mechanical and Aerospace Engineering, NYU Tandon School of Engineering