ESBootcamp Day 2: Mechatronics Homework Assignment

Thank you for attending the workshop! The questions listed below are designed to gauge your understanding in mechatronics fundamentals. Please feel free to collaborate with other newbies and don't hesitate to reach out to Vedang or Katie if you have any questions. Have fun!

Sensors and Actuators
Link: https://youtu.be/Gu_1S77XkiM
Watch the video linked above, and find one example of an actuator and one example of a sensor being used. (1 to 2 sentence max)
The telecentric camera is used as a sensor to 'see' the puzzle pieces and the robotic gantry is used to actuate this task.
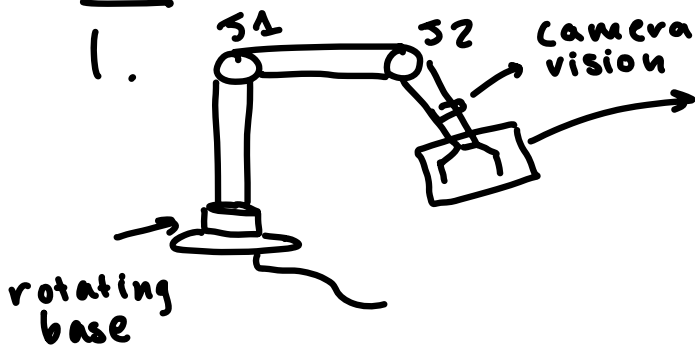
Design Challenges
1) Design a robotic arm for precision pick-and-place operations. The arm must be able to pick up light objects, move them to a target location, and place them with high accuracy. Propose a mechanical design, focusing on actuators and sensors you would include. Draw a block diagram of your proposed system.

2) Design a mechanical system for a conveyor belt that needs to move products along a production line. The system must allow precise control of speed and direction. Propose a design, considering the mechanical components and their integration with actuators and sensors. Draw a block diagram of the system.

Controls:
1) Open-Loop and Closed-Loop Systems
   a) Explain the difference between open and closed-loop systems.
   b) Give one practical example of each type of system.
   c) Draw a block diagram for an open loop and closed loop system and explain how each block plays a role in the overall system.
2) What is positive feedback in control systems?

3) You are tasked with designing a **closed-loop control system** for controlling the speed of a motor in an electric fan. The motor's speed can be measured using a sensor and the desired speed (setpoint) can be adjusted by the user.
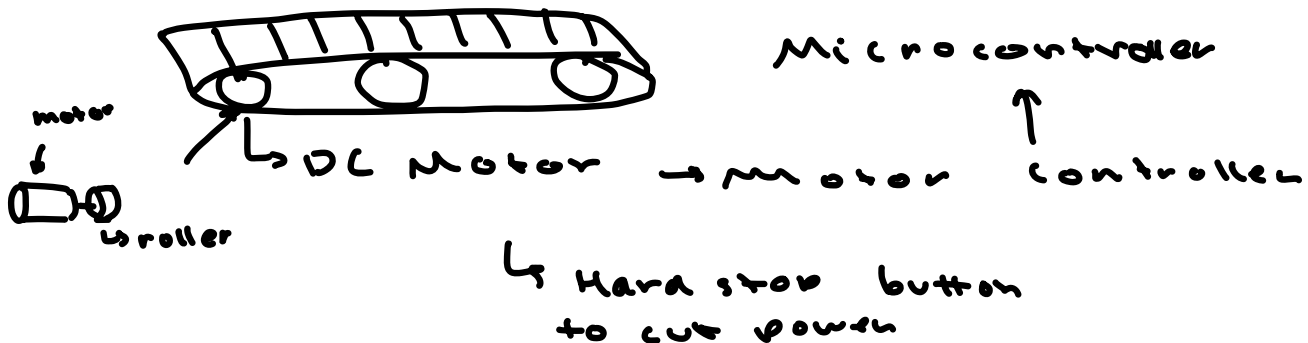
Pt 1

1.

Base

- servo motor

J1 + J2

- servo motor
- encoder

Claw

- Force sensor
- Camera / LIDAR
- stepper motor

2.

Microcontroller
↑
motor → motor controller

↳ DC Motor
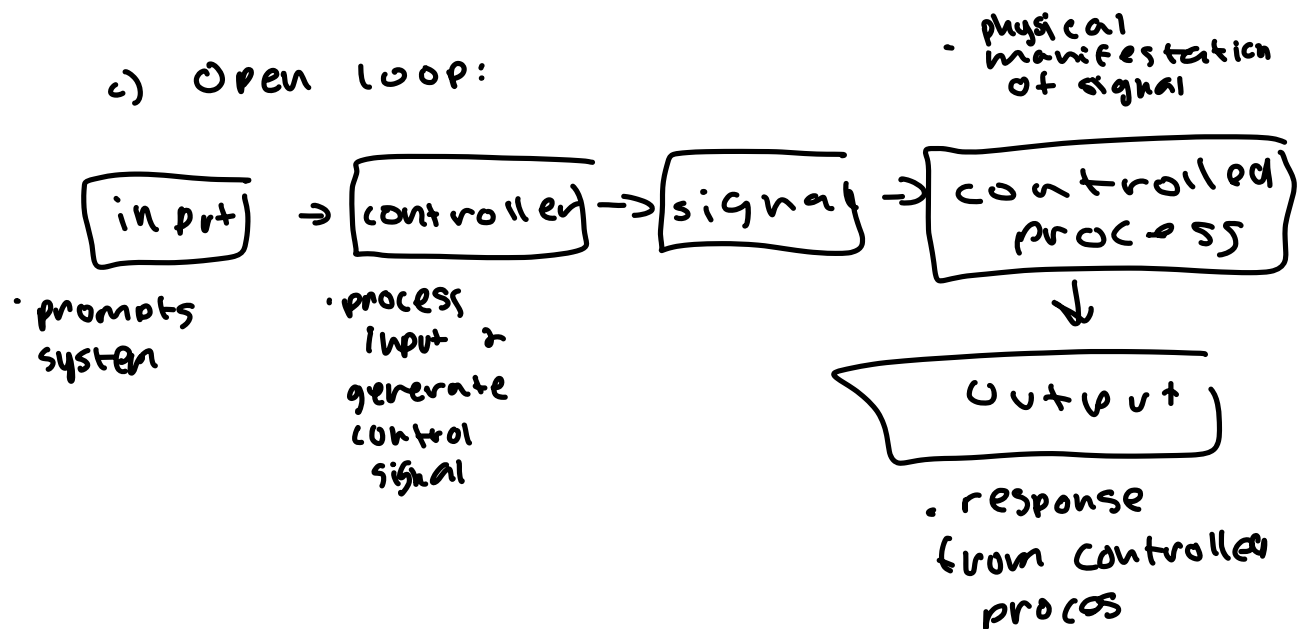
↳ Hard stop button to cut power

Pt 2

1 a) Open - loops do not use feedback to
adjust output whereas closed do
and can self correct.

b) Open ex: Toaster

Closed: Thermostat

c) Open loop:

- physical
manifestation
of signal

input → controller → signal → controlled process ↓ Output

- promots system
- process Input & generate control signal
- response from controlled procos

Closed Loop

error . compare signal from feedback w/ input

input prompt → ⊗ detection → controller · produce output signal → process · physical system controlled → output · produced result

feedback
output signal used by error
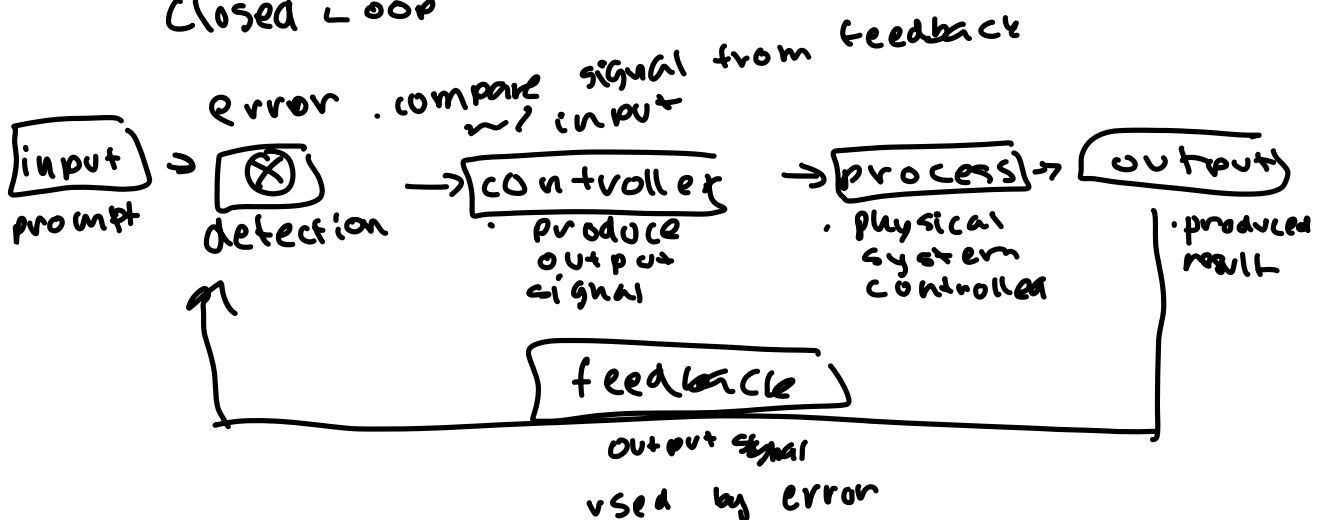
2. Positive feedback amplifies change of a variable from the initial point.

3.

Setpoint Input → PID → Fan & Motor → Speed Sensor

Feedback