uOttawa

# MCG 5353-EG00 - Robotics

**Group Project**

## Design and Development of a Robotic Sorting System for A Production Line

***Report Due:*** Wednesday, July 12, 2023 at 11:59pm (Cyro time zone).

**Important NOTES:**

- All groups should submit a soft copy of all related document for their final works
- No delays will be tolerated.
- Please indicate, clearly, your group members' names, student numbers, and **signatures of all members** on the project title page.

### 1. Objective

You are required to form a **group of 4 students** and, together, you will design a sorting station using a robotic arm in the Gazebo simulator. The sorting station will be a crucial part of a large-scale production line. As completed parts (e.g., bricks with different shapes and colors) enter the input conveyor, your robotic station must identify at least three distinct types of bricks, pick them from the conveyor surface, and place them onto designated areas for packing.

### 2. Suggested Resources

1. ROS Wiki: Documentation (https://wiki.ros.org/Documentation)
2. Gazebo Software and Documents (https://classic.gazebosim.org/tutorials)

### 3. Requirements

To successfully complete this group project, you must accomplish the following tasks:

1. Modeling the Robot and Embedding Motors and Sensors:
    a. Create or find a URDF or Xacro file for your desired robot (6 or 7 DOF) model, ensuring that the dimensions in the simulator match the real robot. Alternatively, use CAD software to generate your desired robot model.
    b. Attach motors to the joints and sensors to the links for the simulation of robot in Gazebo.
2. Workspace Design:
    a. Design the workspace in Gazebo, including a conveyor and any other necessary components for the sorting station.
    b. Justify your design choices and the selection of components in your final report.

3. Robot Control:
    a. Implement ROS controllers to control the robot's joints.
    b. Save the PID parameters in a YAML file for future runs.
    c. Create launch files that run all nodes and parameters, enabling a complete project launch.
4. Object Position Detection and Command Generation:
    a. Develop a node to obtain the positions of bricks from the Gazebo simulator.
    b. Generate commands for each controller to enable the robot to pick and place bricks in the simulation.
5. Extra Credit Options (Choose One):
    a. Option 1: Install a camera on the ceiling to capture top-down photos in the simulation. Implement image processing techniques to detect object positions and types instead of relying solely on available link positions published with Gazebo. (Up to 1.5x mark)
    b. Option 2: Utilize visual servoing techniques by placing a camera at the top of the robot's end effector. Use the camera to detect brick types and positions and guide the robot gripper to the objects. (Up to 2x mark)