



**Programming Autonomous Robots**  
**COSC3070 | Semester 1**  
**Final Project**

<b>Assessment Type</b>	Group Assessment.
<b>Demonstration</b>	Live demo in-class, May 23, 2025, from 2:30 – 4:00 pm
<b>Report Due Date</b>	23.59pm, May 25, 2025
<b>Weight</b>	45% of the final course mark
<b>Submission</b>	Online via Canvas. Submission instructions are provided on Canvas.
<b>Learning Outcomes</b>	This assignment contributes to CLOs: 1-3, 5

**Title: Autonomous Path Following and Obstacle Avoidance with mBot2 Neo**

### Project Overview

In today's world, autonomous robots are becoming essential tools in various industries, from self-driving cars navigating complex city streets to warehouse robots sorting packages and delivering them along intricate paths. One key aspect of these systems is the ability to follow a designated path, interpret visual signals, and safely avoid obstacles in real-time. This type of intelligence and adaptability is powered by a combination of autonomous robots, computer vision, and artificial intelligence (AI).

In this project, your mission is to program the robot to successfully navigate a maze-like environment by following a colored path (yellow or white), responding to visual traffic signs, and avoiding obstacles just like an AI-powered robot would in the real world.

The features to be implemented are described below and must be addressed throughout the course of your project.

### Project Goal

Design and program the mBot2 Neo robot to navigate a connected maze of multiple paths by:

1. Choosing and following one path color:
  - Decide whether your robot will follow the white path or the yellow path.
  - Program the robot to stay accurately on the chosen color throughout the maze.
2. Interpreting visual signs using the robot's camera or sensors:
  - Stop when a red stop sign is detected directly ahead.
  - Resume movement when a green sign appears in front of the robot.
3. Avoiding all other obstacles that may appear in its path:
  - The robot must detect and steer around unexpected objects or walls in its way.
  - Use appropriate sensors (e.g., ultrasonic) to perform obstacle avoidance smoothly without losing the path.
4. During demo, the maze will contain:
  - Interconnected paths with both white and yellow routes.
  - Stop and go signs will be placed at various intersections or straightaways.
  - Random obstacles will be placed along the chosen path during demo

### Success Criteria of your final implementation

To complete the project successfully, your robot must:

- Stay consistently on the selected path color.
- Stop immediately upon seeing a red stop sign.
- Resume motion only when the green sign is detected afterward.
- Avoid all non-sign obstacles without manual intervention.
- Complete a full run through the maze.

### Deliverables

1. Python Code of your implementation
2. A detailed project report (up to 15 pages, single column) explaining:
  - Your approach/algorithm to path following and obstacle avoidance.
  - How sign detection was implemented.
  - Challenges faced and how you overcame them.

### Creativity (Bonus Points)

- Add sound or LED signals for stop/go actions.
- Record and visualize the path taken by the robot using sensor data.

### Demonstration:

The final assessment of your project will be conducted live during the face-to-face tutorial on May 23, 2025 at 2:30pm.

### Project Report

You are required to write a report that:

- Describes deeply the methodology of your implementation.
- Evaluates your methodology. This presents a critical quantitative or qualitative evaluation of the algorithms and techniques used. This includes identifying strengths and weaknesses of the work. Also, you need to fully explain your choice to follow the path and avoid obstacle.

Your report should include but not limited to the following sections:

- ✓ Abstract
- ✓ Introduction
- ✓ Related Work
- ✓ Methodology
- ✓ Implementation
- ✓ Results, Evaluation & Discussion (assuming you did some tests to see how your robot is behaving)
- ✓ Conclusion

### Marking Rubric

The marks are divided as follows:

- **Report (20 pts)**
  - Description of Methodology: 5pts
  - Implementation: 5pts
  - Analysis and Critical Evaluation: 5pts
  - Overall Report Structure: 5pts
- **Demo (15 pts)**
  - Live demonstration showing that your robot can follow the path, react to signs and avoid obstacle.
- **Recorded Presentation: 5 pts**
- **Creativity: 5 pts**

The detailed breakdown of the marking rubrics is provided on the rubric linked on Canvas.

### Final Project Summary – COSC3070

1. **Goal:**  
Implement a self-driving algorithm for Path Following with Obstacle Avoidance using mBot2 Neo.
2. **What to submit by May 25, 2025:**
  - A detailed project report - pdf
  - Presentation slides - pdf
  - A pdf file with link to code repo and recorded group presentation
3. **How you will be marked (45pts total):**
  - Report (20 pts)
  - Live Demo (15 pts)
  - Recorded group presentation (5 pts)
  - Creativity ( 5 pts)