School of Science Engineering and Technology

**COSC-3070: Programming Autonomous Robot**

**Final Project**

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"I declare that in submitting all work for this assessment I have read, understood and agree to the content and expectations of the [Assessment declaration](https://www.rmit.edu.au/students/my-course/assessment-results/assessment)

**Abstract**

This project presents the development of an autonomous navigation system using the mBot2 Neo. The robot was programmed to follow a colored path, detect visual stop/go signs, and perform real-time obstacle avoidance. The system integrates line tracking algorithms, color-based sign detection, and ultrasonic-based navigation to simulate an AI-powered robot navigating a complex maze

**I. Introduction**

Autonomous robotics plays a critical role in modern automation, particularly in areas requiring path navigation and environment sensing. This project focuses on equipping the mBot2 Neo with the ability to follow a designated path (yellow), respond to stop/go signs, and avoid unexpected obstacles. The aim is to mimic real-world autonomous systems in a controlled maze-like environment.

**II. Related Work**

Previous studies in autonomous mobile robots have applied PID control for line following and machine vision for sign detection. This project adapts simplified principles from autonomous vehicle navigation, using onboard sensors and prebuilt vision functions in CyberPi.

**III. Methodology**

Path Following: The robot tracks a yellow path using the RGB sensor. A proportional (P) controller adjusts wheel speed based on lateral error.

Sign Detection: The onboard camera recognizes red and green cards as stop and go signs. Upon detecting red, the robot halts; green resumes movement.

Obstacle Avoidance: Ultrasonic sensors detect nearby objects. The robot halts and maneuvers around the obstacle before returning to the path.

**IV. Implementation**

The project was coded in Python using mBlock's CyberPi API. Key modules include:

* Line Tracking Loop: Reads left/right color sensors to stay centered on the yellow path.
* Camera Input: Detects traffic signs using built-in color detection.
* Obstacle Avoidance: Continuously checks distance using ultrasonic sensors and triggers rerouting routines.

**V. Results, Evaluation & Discussion**

In testing, the robot:

* Successfully followed the yellow path for extended durations.
* Reacted reliably to stop (red) and go (green) signs.
* Avoided static and random obstacles using side-stepping logic.  
  Challenges included inconsistent lighting affecting color detection and the robot drifting during obstacle avoidance. These were mitigated by adding delays and recalibrating detection thresholds.

**VI. Optional Add-ons (Creativity Section)**

LED Feedback: The robot's LED strip changes color to match current state (red = stop, green = go, blue = turning).

Sound Effects: Sound alerts accompany stop and go actions.

Path Logging: Sensor data was recorded to estimate path curvature and visualize route coverage.

**VII. Conclusion**

The mBot2 Neo was effectively transformed into a miniature self-driving robot capable of autonomous path following, sign response, and obstacle avoidance. This project demonstrates how fundamental robotics concepts can simulate real-world navigation tasks using accessible tools.