Project Proposal — Simulation Track (ROS 2 Jazzy + Gazebo/Webots)

Study-Unit: ARI3215 Robotics 2
Project Title: *Autonomous Hockey Robot in Simulation*
Track: *Simulation (ROS 2 Jazzy + Gazebo/Webots)*

Short Description

In this project, we plan to create a fully simulated hockey-playing robot using ROS 2 Jazzy and either Gazebo or Webots. The robot will play inside a virtual mini hockey arena that includes walls, goals, and a physics-based puck. It will use only simulated sensors to understand the environment, find the puck, and try to score. Our goal is to show how an autonomous robot can combine perception, decision-making, and simple behaviours inside a controlled simulation.

Main Objective

Our main objective is to design and implement a virtual robot that can play a simplified hockey game on its own. It should be able to locate the puck, move towards it, and try to score by using LiDAR-based perception and basic behaviour strategies.

Sensors / Inputs Used

1. **Simulated 2D LiDAR**
   - Used for detecting the puck through clustering of scan points.
   - Supports obstacle and wall detection.
2. **Simulated IMU**
   - Provides orientation and stability information.
   - Supports behavior transitions and navigation control.

Note

Please note that may change due to unforeseen challenges

Expected Outputs / Behaviors

The robot should be able to:

- Detect and track the puck using LiDAR scan processing.
- Estimate puck distance and direction.
- Avoid walls and obstacles.
- Navigate using ROS 2 velocity commands (/cmd_vel).
- Use a Finite State Machine (FSM) for behaviours:
    - **SEARCH** – rotate to locate the puck
    - **APPROACH** – move toward puck
    - **ATTACK** – push puck toward opponent's goal
    - **DEFEND** – protect own goal
    - **AVOID** – avoid collisions based on LiDAR proximity
- Demonstrate measurable performance such as:
    - puck detection reliability
    - time to score
    - number of collisions
    - behaviour transitions
      Simulation visualization will be provided through Gazebo/Webots and RViz.

Team Members & Roles

Team Members:

- Nikolina Filipov Pajic
- Liam Jake Vella
- Jeremy Galea

Avoid walls and obstacles

Member 1 – Simulation & Robot Modelling:
Builds the hockey arena, robot model (URDF/PROTO), and integrates simulated sensors.

Member 2 – Perception:
Implements LiDAR-based puck detection and tracking.

Member 3 – AI Control & Behaviour:
Designs and implements the FSM and autonomous strategy.