Experiment Round: Follow-the-Leader

1. Introduction

In this round, you will implement and deploy an autonomous Follow-the-Leader behaviour on the multiple VOLTA robots in a real-world environment. Your task is to enable the robots to track and follow a leader (another robot) using ArUCo marker-based tracking while maintaining a safe and stable distance using LiDARs.

2. Problem Statement

Participants must develop and deploy an ID-based tracking system on the VOLTA robot using ArUCo markers. The system should enable the robot to detect a predefined marker (attached to the leader) and follow it dynamically while adjusting speed and path based on the marker's movements. The leader will follow a predefined pattern or manually controlled, which will be declared during the competition. The follower robots must adapt to this movement in real-time.

3. Reference Material

- Navigation: https://emanual.robotis.com/docs/en/platform/turtlebot3/navigation
- LiDAR ROS2 Packages: https://github.com/ros-perception/laser_filters
- ArUco Markers: https://docs.opencv.org/4.x/d5/dae/tutorial_aruco_detection.html
- ROS-based Vision: https://github.com/ros-drivers/vision_opencv

4. Objectives

- **Leader Detection**: Implement a method to detect the leader using sensors such as LiDAR or a camera.
- **Distance Maintenance**: Ensure the robot follows the leader while maintaining a safe and **constant** distance.
- **Dynamic Path Adjustment**: Modify the robot's path in response to the leader's movements and avoid obstacles.
- **Collision Avoidance**: The follower robots should not collide with each other and should be able to avoid small obstacles while following the leader.

5. Evaluation Criteria

Criteria	Weightage (%)
Successful tracking in a configuration	30%
Smoothness and stability of motion	25%
Obstacle avoidance and dynamic path adjustment	20%
Real-time response to leader movement	15%
Code quality and documentation	10%

6. Submission Process

- **ROS Package**: A GitHub repository link with properly structured code.
- **Execution**: Real-time deployment of the codebase on the robot during experimental rounds.
- **Log Files**: Any recorded ROS bag files for evaluation.
- **Documentation**: A short report (1-2 pages) explaining the approach taken.

7. FAQ

Q: Can we use external sensors for better tracking?

A: Yes, but they must be compatible with ROS 1 and easily integrated with the VOLTA robot.

Q: What happens if the leader moves too fast?

A: Your system should handle speed variations, but extreme speeds may not be evaluated negatively if well justified.

Q: Can we use multiple markers instead of one?

A: Yes, but you must specify how your system handles multiple markers and their influence on tracking.