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Title: Object Following Robot Using YOLO and Proportional Control in ROS 2

1. Problem / Motivation / Domain

In real-world robotics, the ability of a robot to identify and follow a specific object plays a crucial role in applications like indoor delivery, surveillance, and personal assistance. Many robots operate in dynamic environments where predefined paths are not sufficient. To address this, visual perception and real-time decision-making are important. This project focuses on building a system that enables a robot to detect and follow a target object using deep learning and simple motion control techniques, implemented within the ROS 2 and Gazebo simulation environment.

2. Proposed Solution

The solution integrates a YOLO object detection model with a proportional control system. The robot uses its camera feed to detect an object using YOLO and calculates how far the object is from the center of the frame. Based on this offset, a proportional controller adjusts the robot's speed and direction so that it keeps the object centered and follows it at a steady distance. The project is implemented using standard ROS 2 packages and simulated entirely in Gazebo, with visualization support from RViz. The focus is on combining perception and control in a simple, functional way.

3. Application

This kind of object-following behavior is useful in a variety of domains. Service robots can use it to follow people for assistance, warehouse bots can trail objects for logistics, and mobile robots in surveillance settings can track moving targets. The project lays the foundation for more advanced behaviors like convoying, autonomous delivery, or even human-robot collaboration.

4. Control System and Environment

The robot will use an onboard camera as the sensor and a differential drive base for actuation. YOLO will process the camera feed to detect the chosen object class, and the robot will use a proportional control algorithm to calculate turning and forward motion. The simulation environment will be set up in Gazebo, using either a simple open world or a pre-existing warehouse environment. RViz will be used to visualize the robot's camera view and object detection in real time.

5. Path Planning

Though the main approach relies on reactive control, the project can optionally compare it with a planner-based fallback. If the object disappears temporarily, the robot can switch to a planner like DWB or Smac Hybrid-A* to navigate toward its last known location. This comparison will help assess when simple reactive control is enough, and when planner integration improves robustness.

6. Conclusion

This project demonstrates how deep learning and basic control strategies can be combined to create a robot that responds to its environment in real time. By using YOLO for object detection and proportional control for motion, the robot can follow a moving target with smooth, adaptive behavior. The setup is realistic yet manageable, providing valuable insight into integrating vision and control in modern robotics using ROS 2.