


Robotics Assignment

Peer Robotics

1. What do you think the best approach would be in path planning of a differential drive robot in a multi-robot environment? You can start with assuming two robots where each robot has the knowledge of another robot in the surrounding environment. Explain the approaches which you think might work and why any particular approach would be better than other approaches that you came across. The path replanning should be real-time in a way that the robot should not collide with the other robots in the surrounding area.
2. Develop a pallet detection & segmentation application in ROS2 for a manufacturing or warehousing environment. The solution should be optimized for deployment on edge devices like the NVIDIA Jetson AGX Orin, ensuring real-time performance suitable for mobile robotics applications.

Tasks:

1. Dataset Acquisition and Preparation:

- **Dataset Recommendation:** Use the link to access open source database for pallets in different scenarios {  Pallets }
- **Data Preparation:**
 - Annotate **pallets** & **ground** using existing annotation tools (ex. DINO)
 - Organize the dataset into training, validation, and test sets.
 - Apply data augmentation techniques (e.g., varying lighting conditions) to simulate real-world scenarios.

2. Object Detection and Semantic Segmentation:

- **Model Development:**
 - Implement an object detection model (e.g., **YOLOv11** etc.) to identify pallets.
 - Develop a semantic segmentation model to segment pallets and ground
 - Train and fine-tune the models using your prepared dataset.
- **Performance Evaluation:**
 - Assess the models using metrics like mAP for detection and IoU (Intersection over Union) for segmentation.
 - Ensure models perform robustly under varying environmental conditions.

3. ROS2 Node Development:

- **ROS2 Package:**
 - Develop a ROS2 package with nodes written in **Python, C++**, or **RUST**.
 - Nodes should:
 - Subscribe to image and depth topics from a simulated or real camera.
 - Perform object detection & segmentation

4. Edge Deployment Optimization (Optional) :

- **Model Optimization:**
 - Convert your models to formats suitable for edge deployment (e.g., **TensorRT, ONNX**).
 - Apply optimization techniques like quantization and pruning to enhance performance.
- **Docker Container:**
 - Dockerized the complete module that can natively run on different devices as long as Nvidia drivers are present.

5. Evaluation Criteria:

- We will run the module on AGX Orin and feed live camera data from zed 2i
- Performance will be measured based on pallet detection accuracy under varying conditions

Create complete assignment as a GitHub repository and share with the team