RAJ SURYA RAJENDRAN KATHIRVEL

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EDUCATION

Master of Science in Robotics — **Sep 2023 - May 2025**
University of Minnesota, Twin Cities — *Minneapolis, MN, USA*

Bachelor of Technology in Mechanical Engineering — **Aug 2019 – May 2023**
Indian Institute of Technology, Palakkad — *Palakkad, Kerala, India*

EXPERIENCE

Graduate Research Assistant — Jan 2024 – Present
Robotics Perception and Manipulation Lab — University of Minnesota, USA

- Developed an approach to represent objects' semantic information to improve robot scene understanding.
- Utilized SOTA deep learning models for segmentation and detection using PyTorch to validate the approach by performing mobile manipulation tasks using SPOT robot.

Robotics Engineering Intern — May 2024 – Aug 2024
Milwaukee Tool — Milwaukee, WI, USA

- Developed perception system in C++ and Python to estimate 6DoF pose of target object within 1mm accuracy using 3D point cloud and RGB image, utilizing the ROS framework for integration.
- Integrated RTK GNSS with dual antenna setup to accurately determine the position and heading of outdoor robot, enabling accurate mapping of obstacles and boundaries.
- Collaborated with a cross-functional team to deploy the system onto real robots, ensuring seamless integration and functionality.

Undergraduate Research Assistant — Aug 2021 – Jan 2022
Indian Institute of Technology, Palakkad — Palakkad, India

- Developed motion model of swerve drive robot and validated in simulation.
- Integrated the motion model, utilizing ROS framework, with mapping and localization algorithm for SLAM to enable autonomous navigation of the robot.

Robotics Intern — Jun 2021 – Jul 2021
UST — Trivandrum, India

- Developed different testing environments in simulation for autonomous ground vehicles to identify failure conditions of the localization algorithm.
- Analyzed failure cases and helped improve the localization of the robot.

PROJECTS

HRSNet - A fusion model of HRNet with RESNet using preactivated residual units

- Implemented HRNet using PyTorch for classification and detection tasks that produced comparable results with actual model.
- Introduced preactivated residual units that reduced overall loss and led to faster convergence when the model was deeper.
- Integrated residual connections between different stages of HRNet to improve the performance of the model.

Formation Control using Vision Tracking

- Developed a perception pipeline to segment different instances of robots using RGB image.
- Utilized camera intrinsics and projective geometry to accurately determine the 2D pose of the robot.
- Developed a controller to move the set of robots while adhering to geometric constraints between them.

Pick and Place using RRT Connect

- Implemented path planning for a mobile manipulator using RRT Connect to perform pick and place tasks.
- Implemented inverse kinematics for the control of arm motion.

Vision-Based Multi Drone Control
Silver Medal at the InterIIT TechMeet 11.0 nationwide competition

- Developed teleoperation module to control the drones using MSP Communication protocol
- Implemented 6D pose estimation of multiple drones using ArUco marker and RGB Camera.
- Implemented path planning to move the robot through given set points autonomously.
- Developed follower drone's algorithm to follow trajectory of the master drone.

SKILLS

Languages: Python, C++, MATLAB

Libraries/Frameworks: ROS, PyTorch, Tensorflow, Pandas, NumPy, Gazebo

Robots and Sensors: Spot, Nano drones, Turtlebot, xARM, outdoor AMR, LiDAR, RGBD Camera, IMU, GNSS

Other: Linux, Git, Azure DevOps, Rapid prototyping, CAD