Ravi Raj Kumar

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EDUCATION AND HONORS

Case Western Reserve University   Cleveland, Ohio, May 2025
Master of Science in Computer Science
- Coursework: Machine Learning, Computer Vision, Robotics, High Performant Systems for AI, Probabilistic Graphical Models, Analysis of Algorithms, Computer Networks.
- Observer: Statistical Natural Language Processing, Deep Gen Models, Quantum Computing, Reinforcement Learning, ML on Graphs.

TECHNICAL SKILLS

- Robotics: ROS 2, SLAM, Perception, Computer Vision, DSP, Motion Planning & Control, Path Planning, Optimization
- Machine Learning: PyTorch, Supervised, Unsupervised, Deep Reinforcement & Multi-Agent Reinforcement Learning
- Programming: C++, C, Python, Graph Theory, Concurrency, gdb, TDD, Linux, Git, Behavior Tree, Docker, MongoDB
- Libraries: sympy, OpenCV, LP solver, PyQt, Nav2, RTABMap, MoveIt, Slam-Toolbox, Unitree GOs, Isaac Lab
- Software Tools: MATLAB, Simulink, Unity Gym Env, Weights & Biases, Coppelia-Sim (V-Rep), LABVIEW, AMPL
- Simulation & Visualization: Isaac Gym, Gazebo, RViz
- Hardware: Nvidia Orin, Depth Camera, 2D LIDAR, Dynamixel Actuators, RaspberryPi, Odroid XU4

PROFESSIONAL EXPERIENCE

Tata Consultancy Services   Hyderabad, India [October 2019 - November 2023]
Machine Learning Engineer (Banking and Finance domain)
- Built robust and scalable end-to-end ML pipelines for a Bank Member Complaint Distribution System on cloud as-well-as on-prem with components like data ingestion, data validation, feature engineering, model training, prediction, and monitoring.
- Implemented data ingestion and data validation components in the pipelines for large-scale data sources like Hadoop, Snowflake, and MongoDB and validated the output artifacts for robustness.
- Leveraged advanced NLP tokenizers, such as BytePair Encoding (BPE) and SentencePiece for tokenization, trained and finetuned several transformer-based models like BERT, RoBERTa, and Longformer on tasks such as Complaint Categorization and Prioritization, Named Entity Recognition (NER) for automated information extraction, and Complaint Severity Prediction.
- Built CI/CD pipelines with Jenkins for automated ML workflows and integrated MLflow for experiment tracking, versioning, and model registry; deployed models using Docker and Kubernetes with Helm for streamlined, version-controlled production deployment.
- Implemented automated model validation and drift detection to ensure reliability, and leveraged Prometheus and Grafana with custom metrics and alerts for proactive performance and infrastructure monitoring, and efficient issue detection in production.

PROJECTS

Multi-Agent SLAM Navigation for Quadruped Robot Fleet
- Developed SLAM pipeline using ZED SDK & Visual-Inertial data for Unitree GO1 and RTABMap & LiDAR data for GO2.
- Developed autonomous navigation packages using frontier exploration and high-level control packages for GO2 SDK.
- Applied deskewing, voxel filtering, and point cloud clustering techniques to improve occupancy grid accuracy.

Multi-Robot Swarm Exploration and Mapping System
- Scalable ROS2 based robot swarm for autonomous exploration and navigation in a dynamic environment
- Used instance segmentation and stereo depth for dynamic semantic environmental mapping.
- Designed a custom semantic database management system for efficient task allocation for the swarm.
- Designed a user-friendly chatbot interface for swarm control.

3D Point Cloud Segmentation Using 2D Image Segmentation   [Github Link]
- Developed a novel 3D point cloud segmentation framework leveraging state-of-the-art 2D image segmentation models (OneFormer) and a voting-based approach to project 2D semantic and panoptic labels onto 3D point clouds
- Integrated RGB images, depth maps, and LiDAR data, accurately projecting 2D semantic labels onto 3D point clouds.
- Achieved 96.5% segmentation accuracy matching PointFormer, with reduced computational overhead, demonstrating system scalability.

Autonomous Racing Buggy
- Developed an autonomous driving system using ROS2, leveraging advanced perception and control techniques.
- Implemented LIDAR and camera for lane detection, obstacle avoidance, and traffic sign recognition.
- Trained YOLOv5s with INT8 quantization, achieving real-time inference at 7 Hz.
- Achieved a 1:42 track time with Ackermann-steering control.

Precision Motion Planning and Control for Franka Arm
- Implemented Cartesian path planning trajectories for Franka using MoveGroup API to strike a golf ball towards the hole.
- Developed ROS2 node to synchronize the ball & target detection from the vision pipeline with real-time trajectory generation.