Sumukh Porwal

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EDUCATION

Worcester Polytechnic Institute (WPI) | Worcester, MA
Master of Science in Mechatronics, Robotics and Automation Engineering   Aug 2024 - May 2026 (expected)
Relevant Courses: Motion Planning, Reinforcement Learning, Robot Control

Indian Institute of Technology Tirupati (IIT Tirupati) | Tirupati, India
Bachelor of Technology in Mechanical Engineering | **GPA:** 8.69/10   July 2020 - June 2024
Relevant Courses: Machine Learning, Modeling & Control of Mobile Robots & Manipulators, Attitude Estimation & Control

RELEVANT EXPERIENCE

SeiAnmai Technology Pvt. Ltd. | Robotics Intern | Delhi, India   **May 2023 – July 2023**
- Led a team of 6 to develop an autonomous robot with **95% navigation accuracy**, integrating ROS 2 and micro-ROS.
- Designed an ArUco marker detection system, achieving docking precision within **1 cm**.
- Enhanced real-time telepresence by implementing internet-based teleoperation with <**100 ms latency**.
- Optimized performance by refining control algorithms and leveraging Docker for seamless micro-ROS deployment.

BluJ Aero | Research Intern | Tirupati, India   **Jun 2022 – Aug 2022**
- Designed and performed **Finite Element Analysis** (**FEA**) on the bulkhead of an EVTOL aircraft, optimizing the load-bearing performance of the fuselage.
- Utilized **CATIA** for precise CAD modeling, creating the solid bulkhead and wing attachment models.
- Simulated the bulkhead's mechanical behavior using **Abaqus**, evaluating its response under various load cases and boundary conditions to ensure structural integrity.

PROJECTS

Learning-Based Collision & Clearance Estimator for Manipulators, WPI   **Nov 2024 – Present**
- Developed neural network-based heuristic, reducing collision-checking time by **50%** compared to PyBullet functions.
- Designing a dynamic clearance adjustment algorithm, enhancing planning efficiency in complex environments.
- Working to achieve compatibility with diverse planning algorithms, improving overall system scalability.

Deep Reinforcement Learning for TurtleBot3 Navigation, WPI   **Oct 2024 – Present**
- Implemented DDPG, PPO, TD3, & DQN algorithms achieving obstacle avoidance with **85% accuracy** in simulations.
- Built a ROS 2 & Gazebo environment using LiDAR for precise distance sensing and decision-making.
- Conducted performance benchmarking, revealing a **15% improvement** in path efficiency for PPO over others.

Perception-aware Model Predictive Control on Quadrotor, WPI   **Sept 2024 – Present**
- Integrated YOLACT architecture, achieving **95% accuracy** in real-time detection and tracking targets.
- Developed an NMPC using Acados, enabling **trajectory tracking with sub-1% error** in constrained environments.
- Simulated quadrotor dynamics in Gazebo for testing robustness under variable conditions.

Reachability-Guided RRT for Efficient Motion Planning, WPI   **Oct 2024**
- Engineered a Reachability-Guided RRT algorithm, reducing invalid growth attempts by **30%** in the environment.
- Implemented state propagation techniques to approximate reachable sets, ensuring better tree expansion efficiency.
- Enhanced motion planning accuracy for constrained systems by integrating nearest neighbor optimization.

Breakout using Deep Q-learning Network, WPI   **Sep 2024 - Oct 2024**
- Implemented a **Prioritized Double Deep Q-Network** (**DQN**) algorithm to optimize performance in the Breakout game, achieving a **reward of 309.54**.
- Leveraged OpenAI's Atari wrapper and reward clipping technique, boosting training efficiency & game performance.
- Utilized PyTorch to build and refine the model, ensuring effective learning through continuous training cycles.

Trigger Word Detection | IIT Tirupati   **Jun 2024 – Aug 2024**
- Designed a deep learning model to achieve **90% accuracy** in detecting the trigger word "activate" in audio streams.
- Synthesized and processed 10,000+ audio samples by combining audio samples of words and background noises to create a diverse and robust training dataset.
- Utilized a neural network architecture with 1D convolutional and dual GRU layers for real-time detection.

Semantic Image Segmentation for Autonomous Vehicles, IIT Tirupati   **May 2024 – Aug 2024**
- Achieved **90% segmentation accuracy** using U-Net CNN on CARLA self-driving datasets for navigation tasks.
- Delivered precise object detection by training on **100,000+ labeled samples**, enhancing autonomous driving safety.
- Evaluated model performance with detailed mask predictions, surpassing benchmarks by **5%**.

Face Recognition using Siamese Network, IIT Tirupati   **May 2024 - Jun 2024**
- Built a face recognition system with **99% accuracy**, using MTCNN and Inception ResNet architectures.
- Implemented triplet loss with **128-dimensional embeddings**, enabling robust face verification for similar datasets.
- Optimized training efficiency, reducing false positives by **17%** through advanced data augmentation techniques.

Navigation and Control of Cooperative Mobile Robots, IIT Tirupati   **Jan 2023 – May 2024**
- Designed omnidirectional robots, achieving **95% SLAM accuracy** with real-time laser sensor fusion.
- Developed collaborative navigation in linear and triangular formations, reducing task completion time by **25%**.
- Deployed ROS 2 and RPi modules, enhancing system efficiency and communication reliability.

Sentinel Drone, IIT Tirupati   **Sep 2022 - Feb 2023**
- Built a drone for fire and accident detection, reducing response time by **30%** using computer vision algorithms.
- Integrated ROS Noetic and Gazebo for simulation, ensuring seamless communication and system validation.
- Conducted hardware testing with nano drones, achieving stable navigation with PID control

Alexa-controlled Robotic Manipulator | IIT Tirupati   **Oct 2022 - Dec 2023**
- Developed a 3-DoF robotic manipulator simulation, enabling **100% autonomous task execution** via Alexa.
- Integrated ROS, Gazebo, and MoveIt for real-time control of simulation, ensuring seamless performance.
- Hardware implementation using Arduino UNO, successfully linking it to ROS for communication and control.

TECHNICAL SKILLS

Operating System: Windows, Linux
Programming Languages & Tools: Python, C, C++, MATLAB, Bash, LaTeX, Git, Docker, Singularity
Frameworks & Libraries: ROS 1 & 2, TensorFlow, Keras, PyTorch, OpenCV, OMPL, Acados
Embedded Systems: Raspberry Pi, Raspberry Pi Pico, Arduino, Jetson Orix NX
CAD & CAE Softwares: DS Solidworks, Fusion 360, PTC Creo, DS Abaqus, Ansys
Simulation & ROS Tools: Gazebo, RViz, MoveIt, Nav Stack, rqt