VARUN LAKSHMANAN

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EDUCATION

University of Maryland, College Park, MD   **GPA: 3.62/4.00**
Master of Engineering (M.Eng.) in Robotics   *August 2023 – May 2025*

Panimalar Institute of Technology, Chennai, India   **GPA: 8.8/10**
Bachelor of Engineering (B.E.) in Mechanical   *August 2018 – July 2022*

SKILLS

- **Programming Languages:** Python, C++, MATLAB.
- **Simulation and Frameworks:** ROS 2, Gazebo, MoveIt, LiDAR, Nvidia Issac Sim, Simulink, Unreal Engine.
- **Robotics Concepts:** Control Systems, Motion Planning, Human Robot Interaction, Robot Kinematics, Perception, Robot Learning, Robot Programming, State Estimation, Sensor Fusion, Robot Modeling, UAV.
- **Machine Learning and AI:** PyTorch, TensorFlow, OpenCV, Scikit-learn, NumPy, SciPy, MediaPipe, NLP, Computer Vision, LLM, Deep Learning, Reinforcement Learning.
- **Tools:** Linux, Jupyter Notebook, Git.
- **CAD Software:** AutoCAD, SolidWorks, Fusion 360, Creo Parametric.
- **Mathematical & Engineering Foundations:** Linear Algebra, Probability, Statistics, Calculus.

PROJECTS

Adaptive Text-to-Command Translation for Robot Navigation
- Engineered a robot navigation system using the **T5-Small language model** and a custom dataset of **24,581** instructions.
- Achieved **98%** accuracy in generating the correct battery sequences for navigation.
- Embedded **ROS 2** with an **LLM model** for real-time robot navigation and command execution.

Multi-Robot Navigation using Centralized and Decentralized Monte Carlo Tree Search
- Applied **Monte Carlo Tree Search (MCTS)** in centralized and decentralized setups, enabling four **TurtleBots** to navigate in **Gazebo** simulation environment with moving obstacles.
- Analyzed navigation efficiency, revealing that the decentralized approach improved the speed of reaching goals by **50%** compared to the centralized method.

Gesture-Based Control in Assistive Technology
- Created a **ROS 2** node to control TurtleBot3 using **machine learning**-based hand gesture classification.
- Enabled real-time **DexHand** manipulation in **RViz**, achieving **95%** accuracy in replicating human hand movements via webcam.

Intelligent Robot Navigation
- Enhanced obstacle avoidance in a **Gazebo simulation** by integrating a **Dueling Double DQN (deep reinforcement learning) model** into an existing Vanilla DQN architecture.
- Boosted navigation performance by **30%** compared to the vanilla DQN implementation.

Performance Analysis of RRT* Variants
- Implemented and evaluated **RRT** algorithm variants for TurtleBot3 navigation in a custom simulation environment.
- Refined movement accuracy with a **PID** controller, identifying **Q-RRT*** as the most effective approach.

Perception-Based Robot Navigation
- Collaborated with a team of four to program a real-world TurtleBot3 to autonomously navigate unknown environments using perception-based techniques such as **Horizon Detection, Homography, Object Detection and Optical Flow.**
- Achieved a **98% success rate** in obstacle avoidance and path optimization.

Alpha – Mobile Pick and Place Manipulator
- Designed and simulated a mobile robotic manipulator featuring four-finger claw using **SolidWorks** and **ROS 2** in **Gazebo**, integrating **forward and inverse kinematics**, an **open-loop control** system, and **teleoperation** capabilities.

CERTIFICATIONS

- **Machine Learning Specialization** - DeepLearning.AI and Stanford University (Coursera).
- **Python Programming** - Udemy.
- **Electric Vehicles** - TVS Training and Services.
- **AutoCAD** - Go Tech Solutions.
- **Introduction to Programming with IOT boards** - POSTECH.