NARENDHIRAN V

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EDUCATION

National Institute of Technology, Tiruchirappalli *May 2026 (expected)*
B.Tech.in Mechanical Engineering (*Minor in Computer Science*)
GPA: 3.73/4.0
Related courses: *Robot Learning (UdeM-IFT6163), Robotic Manipulation (MIT-6.4210), Robot Motion Planning (NPTEL), RL & DL Specialization (Coursera), Data Structures & Algorithms*

RESEARCH INTERESTS

I am broadly interested in Robotic Manipulation, Embodied AI and research that deals with long-horizon tasks with Deep-Reinforcement Learning methods.

PUBLICATIONS

In Preparation

[1] **Narendhiran Vijayakumar**, R. Li, and Z. Wang*, "Contrastive Latent-Action Retrieval with In-Context Memory for Robotic Manipulation," in *IEEE/RSJ International Conference on Intelligent Robots and Systems*, 2026.

[2] **Narendhiran Vijayakumar**, P. Ojha, G. Varma, and A. Thomas*, "Contract-Validated Option Selection with MoE RL for Long-Horizon Manipulation," *IEEE Robotics and Automation Letters*, 2025.

Under Review

[3] C. Perera, **Narendhiran Vijayakumar**, and A. Agape*, "Fuzzy Logic–GRU Framework for Real-Time Sit-to-Walk Joint Torque Estimation in Robotic Exoskeletons," *IEEE Neural Networks and Learning Systems*, 2025.

[4] **Narendhiran Vijayakumar*** and M. Sridevi, "AURASeg: Attention Guided Upsampling with Residual Boundary-Assistive Refinement for Drivable-Area Segmentation," *Springer Signal Image and Video Processing*, 2025.

[5] **Narendhiran Vijayakumar***, I. Ravikumar, and R. Sundhar, "Design and Structural Validation of a Micro-UAV with On-Board Dynamic Route Planning," in *Springer International Conference on Modern Research in Aerospace Engineering*, 2025.

AWARDS

Finalist, *Smart India Hackathon* - India's Largest Innovation Contest *2024*
Top 15, *SAE AeroTHON* - National UAS Design, Build and Fly Contest *2024*

SKILLS/HOBBIES

Programming Languages	Python, C++, MATLAB, LaTeX
Libraries	PyTorch, TensorFlow, Keras, OpenCV, Scikit-learn, MediaPipe
Tools	Git, Docker, Jupyter, LabelImg, Roboflow, Librosa, SciPy
Operating Systems	Raspberry Pi, Arduino, Linux
Hobbies	Football, Keyboard, Writing

RESEARCH EXPERIENCE

Embodied AI Intern [1] *May 2025 - Present*
Supervisors: Runhao Li, and Prof. Ziwei Wang NTU, Singapore

- Extended **Moto-VLA** with **InfoNCE contrastive learning** to learn latent-action embeddings; built a **FAISS** sub-trajectory index with **DTW alignment** and cosine-similarity scoring for retrieval.
- Developed an **in-context memory cache** that conditions on retrieved **latent-action trajectories**, enabling retrieval-augmented VLA control with improved generalization.

Task & Motion Planning Intern [2] *July 2025 - Present*
Supervisors: Prof. Girish Varma and Prof. Antony Thomas IIIT, Hyderabad

- Designed a **contract-validated visual HRL** framework for long-horizon manipulation tasks that combines a **multi-view scene vector** ϕ, a **Mixture-of-Experts** high-level **PPO-option policy**, and per-skill **SmolVLA** controllers on a custom **RLBench** dataset.
- Built a **vision-only validator** that checks at every decision step, enabling contract-sequenced planning, failure localization, recoveries, and overall debuggability and explainability.

Assistive Robotics Intern [3] *Jan 2025 - May 2025*
Supervisors: Dr. Chamalka Perera and Prof. Alpha Agape Monash University

- Developed a lightweight **Encoder–Decoder GRU** for real-time sit-to-walk torque prediction, matching attention-LSTM accuracy (RMSE, Spearman's ρ & MDA) while cutting inference latency by **10-25%**.
- Integrated a **Mamdani Fuzzy Inference** System into an **ONNX-powered C/C++** GRU runtime for deterministic, sub-**2 ms** torque control on robotic exoskeletons.
- Deployed an automated **C3D to BVH** conversion and 3D visualization pipeline using **exc3d** & **VPython** to render live hip/knee torque predictions in simulation.

Robotic Perception Intern [4] *Jun 2024 - Feb 2025*
Supervisors: Prof. Leena Vachhani and Prof. Sridevi M IIT, Bombay

- Developed **AURASeg**: a free-space drivable area segmentation model to enable autonomous navigation in resource-constrained indoor and outdoor environments.
- Designed **Attention Pyramid Upsampling Decoder (APUD)**, **Atrous Spatial Pyramid Pooling-Lite (ASPP-Lite)**, and **Residual Boundary Refinement Module (RBRM)** to improve multi-scale feature extraction.
- Validated on a custom Gazebo and **GMRP** datasets, demonstrating improvement in segmentation accuracy and boundary precision, outperforming **YOLOP** in **mIoU** and **F1-score**.

Undergraduate Student Researcher *Dec 2023 - May 2025*
Supervisor: Prof. Sridevi M NIT, Tiruchirappalli

- ***Pose Estimation and HCI in Bharatanatyam***:
  - Developed a pose evaluation framework for Bharatanatyam dance using a custom dataset and hann temporal alignment for real-time analysis.
  - Implemented an **LSTM**-based model with skeletal keypoint extraction and custom losses, building a **Streamlit** web app for real-time feedback using **Mediapipe** and **FFmpeg**.
- ***Object Oriented Detection on Aerial Drone Imagery***:
  - Implemented **YOLOv5-OBB** model on **FAIR1M** Aerial Drone dataset for oriented object detection.
  - Benchmarked performances using a novel **fIoU** metric against **RTMDet**, **DAFNe**, and other variants.

PROJECTS

Autonomos UAS [5] *Apr 2024 - Nov 2024*
SAE AeroTHON-24

- Led the development of an autonomous quadcopter, ranking in the **top 15** out of 100 nationwide.
- Integrated **UXRCE-DDS** for ROS 2 communication, deployed a custom **SSDMobileNet-v2** model converted to **NCNN** format, achieving 20ms/frame inference (6x faster) for real-time object detection
- Developed a dynamic replanning algorithm alternating **SWEEP** and **SERVICE** nearest-neighbour modes for responsive path updates.

PixelBot *Aug 2024 - Sep 2024*
Smart India Hackathon-24

- Developed a multimodal conversational image recognition chatbot for **segmentation**, **inpainting**, and **generation** using **LLaVA**, **SAM2**, and **GLIGEN** to process complex image-based queries.
- Built a robust architecture integrating **LSTM** for contextual memory and **YAKE** for keyword extraction.
- Achieved **2nd** in the first stage, validating the chatbot's performance for multimodal interactions.

Line-Following Parrot MAMBO *Jul 2024 - Aug 2024*
Mathworks Minidrone Competition

- Developed an image processing pipeline to detect paths using **channel filtering**, **binarization**, and **morphological erosion** for noise removal and feature extraction.
- Implemented a Stateflow-based path planner and **cascaded PID controllers** in **Simulink**, enabling **virtual point tracking (VTP)** and marker detection for autonomous navigation on a Parrot Mambo drone.

Occlusion Masking - Avoidance Algorithm *Mar 2024*
Independent Project

- Developed a Python script for robot navigation in 300x300 binary images, integrating tangent arc computation and masking techniques for obstacle avoidance.
- Enabled circular movement with adjustable radii and efficient path generation from a 90-degree starting angle.

EXTRACURRICULAR ACTIVITIES

Third Dimension Aeromodelling Club *Mar 2024 - Present*
Developed autonomous drones, led workshops and represented NIT Trichy. Technical Mentor

Maximus - Math & Physics Society *May 2025 - Present*
Designed induction pipeline, curated ML projects, and mentored juniors. Vice President

Synergy, Annual Mechanical Symposium *Nov 2023 - Present*
Organized robotics workshop, managing logistics, speakers, and audience setup. Head of Workshops

IGNITTE, Teaching Club *Mar 2023 - Jul 2024*
Led free JEE training, mentoring rural students with career guidance. Physics Manager

Pragyan, Techno-Managerial Festive *Sep 2023 - Jul 2024*
Directed public relations, overseeing communication strategies and event logistics. PR Coordinator

First Robotics *Jan 2024 - Feb 2024*
Engaged middle school students with robotics kits, encouraging STEM interest. Regional Volunteer