YATHARTH AHUJA

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EDUCATION

Robotics Institute, Carnegie Mellon University — **Pittsburgh, PA**
Master of Science in Robotic Systems Development | CGPA: 3.88/4.00 — May 2025

Capstone Project: [Sponsored by Koppers Inc.] Worked in a team to develop an industrial chemical-cleaning robot aimed towards enhancing economic output, safeguarding workers' health, and optimizing for client demands in the factory. [website][media]

- Implemented the perception pipeline using a **fine-tuned foundation model** to segment the chemical on a **custom dataset** for efficient cleaning and feedback, with an accuracy of **91% on testbed**, and **87% on factory** images.
- Localized using **probabilistic recursive filters** to fuse visual landmarks and encoder data at **1.3 m/s velocity**.
- Devised manipulation skills using **sampling-based planning** to clean **>80%** of the **detected creosote** on the testbed.
- Developed the autonomy module using **ROS2**, to complete the task in **<5 hrs** during factory operation, versus the >8 hrs for manual cleaning baseline where factory is in downtime, leading to **reduction in factory downtime by ~3 days per month**.
- Designed and presented to sponsors the system, cyber-physical architecture, and business case as per their requirements.

Delhi Technological University — **New Delhi, India**
Bachelor of Technology in Electrical Engineering | CGPA: 8.16/10.00 — August 2022

Bachelor Thesis: Neural Depth Reconstruction Based Visual SLAM Using ORB Feature Extraction [publication]

- **Captain** of the university's **Unmanned Ground Vehicle Robotics Team**, managing personnel and logistics. [website][media]
- Developed UGVs Minotaur (2019) and Centaur (2020), working on **embedded**, **controls** and **perception** systems. [media]
- Secured 5th Position in Cyber Security Challenge and 9th overall (out of 50+ teams) at **IGVC 2019**. Worked on **sensors** (**GPS-RTK**, **IMU**, **RF**, **US**, **LiDAR**), **control** and **vision** modules. [certificate]
- Among the 250 professionals selected for the **Google Research Week** 2023 in ML-CV Track. [certificate]
- **Smart India Hackathon 2020 Finalists**, representing university for devising a bio-marking device. [certificate][media][report]
- Selected for, and attended the **IEEE RAS Winter School 2021** at **UTS Sydney**, on full scholarship. [certificate]
- Secured semester Department **Rank 1** out of 260+ as a junior with an SGPA of **9.48.**
- Awarded **First Class with Distinction** owing to exceptional academic achievement.

PUBLICATIONS

Full list here.

S. Syed, **Y. Ahuja**, "ExpReS-VLA: Specializing Vision-Language-Action Models Through Experience Replay and Retrieval" [print]

Y. Ahuja et al., "Selective Lossy Image Compression for Autonomous Systems," XXIII STSIVA 2021 [print][media]

Y. Ahuja et al., "Neural Depth based Visual ORB-SLAM," Journal of Images & Graphics 2022 [print]

Y. Ahuja et al., "Hybrid Controller for a Dual-Axis Solar Tracker System," ICECCME 2021 [print][media]

WORK EXPERIENCE

Applied Scientist — February 2026 – Present
General Motors Robotics — *Mountain View, CA*

- Brought up the AI and Robotics lab across UR and FANUC cells, with sensing, teleoperation, safety rails and data logging.
- Developed a manipulation skill training stack, focusing on on-robot data collection, auto collection and self-improvement loops.
- Trained multimodal diffusion policies for grasp generation and ranking, using sim-based pretraining, IL based fine-tuning and RL based post fine-tuning.

Robotics and AI Engineer — June – December 2025
Maven Robotics — *Santa Clara, CA*

- Achieved **8 mm** and **1.25° yaw** accuracy by fusing stereo, IMU, and encoders via a custom C++/ROS2 EKF deployed on edge.
- Fine-tuned **YOLOv11-seg** with augmented data to **96.5 % mAP@50**; deployed ONNX-optimized inference on edge at **~12ms**.
- Explored **RL based skill learning**, trained a **MLP policy** conditioned on **proprioceptive inputs** in IsaacSim.

Graduate Research Assistant — August 2024 – June 2025
Momentum Robotics Lab, Robotics Institute | *Faculty Advisor: Prof. Jeffrey Ichnowski* — *Pittsburgh, PA*

- Implemented manipulation task recovery from **8 failure states** with avg. **73% success rate** using **VLM** for perception feedback.
- Enabling **real-time, on-device** policy adaptation for **OpenVLA** using dynamic LoRA, 4-bit fine-tuning, and experience replay with RAG to learn continuously.

Technical Assistant — February – May 2025
JP Morgan Chase & Co. AI Makerspace | *Supervisor: Greg Armstrong* — *Pittsburgh, PA*

- Implementing Visual Inertial SLAM and navigation on Pepper Robot. Assisting researchers in their work at the makerspace.

Image Analysis Intern [media] — May 2024 – August 2024
Glimpse Engineering Inc. | *Supervisor: Peter Attia PhD.* — *Somerville, MA*

- **Registered 2.5D CT scans** of Metal-Ion cells using **morphological operations** with a **deployment runtime of <1s**.
- Deployed robustly within **1^{o} error** across the dataset on the **main product pipeline** for consistent scan alignment.
- Developed a **parameter auto-tuner** using heuristic search to automate the pipeline, tested successfully on **9 unseen cell models.**
- Executed multiple **CI/CD GitHub Actions** development cycles, incorporating linting, style checks, and code restructuring to ensure **real-time compute** optimization with **CUDA** and **production-ready code** deployment.

Research and Development Engineer [media] January – December 2022
CollabLens | *Supervisor: Rahul Budhiraja* *Gurugram, India*

- As the **first engineer**, managed a team of 3 employees, **prototyping and deploying data acquisition pipelines**, enabling initial deployments and **driving $2M in funding**.
- Deployed **company's first pilot** - an **object character recognition station** using **foundation model APIs** with **>96% accuracy**.
- Registered multiple objects across multiple viewpoints **regional-convolution networks** at **>90% accuracy**.
- Implemented **masked regional-convolution networks** for material segmentation on collected dataset with **0.6 val precision**.
- Estimated robustly the **pose and odometry** of objects using **monocular stream** and **LiDAR array** at up to **8 m/s**.
- Designed systems for efficient compute allocation for **client-server deployments**, optimized for real-time performance at **30 fps.**

Research and Development Engineer [publication][media][report] April 2020 – September 2021
RuTAG Lab, Indian Institute of Technology | *Faculty Advisor: Prof. S. K. Saha* *New Delhi, India*

- **Led development** of a **novel vending cart solution** to solve the problem of **preserving farm produce for hawking vendors** using refrigeration and energy acquisition.
- Engineered the **hybrid controller** based **dual-axis solar tracker** and boosted power acquisition efficiency by **>25.1%** over the static model, **resulting in >8 hrs of refrigeration** in deployment.
- Presented the final system to the **Ministry of Rural Technology** officials, which led to a **product roll-out** by startup adoption.

Founder February - December 2022
medicIndex *New Delhi, India*

- Secured **funding** offers from Lemon Ideas and PedalStart; recognized among South Asia's Top startups at Innopreneurs 2022.
- Researched markets and developed a **platform** to **healthcare awareness** and democratizing **pharmaceutical information**.

Research Intern [repo] May 2022 – December 2022
RI, University of Technology Sydney | *Faculty Advisor: Prof. Shoudong Huang* *Remote*

- Designed a polar-coordinate LinearSLAM framework for 3D submap joining, optimized for sensor data from LiDAR.
- Developed a robust LinearSLAM formulation, enhancing 3D submap joining with a **2% RMSE** alignment error reduction.

Research Intern [repo] May 2022 – December 2022
RBCCPS, IISc Bangalore | *Faculty Advisor: Prof. P. Jagtap* *Bengaluru, India*

- Devised novel control barrier-function based safe control algorithm for the 12-state dynamics of a quadrotor.
- Deployed in ROS1 with Gazebo and RViz.

Project Intern June – August 2021
The Hi-Tech Robotic Systems Ltd. | *Supervisor: Mr. Puneet Tiwari* *Gurugram, India*

- Enhanced energy models Autonomous Ground Vehicle model in **Fleet Management System** simulations in OpenTCS to match with the factory data for deployment.
- Trained a **polynomial regression** model using real-world data around Shepherd's battery model backbone, achieving a **24% improvement** in energy estimation accuracy when compared to real-time data.
- Setup **Docker** images and shipped the updated containers for efficient implementation, while using **Java** for secure execution.

Research Associate [media] April 2020 – September 2021
Image Enhancement Laboratory, DTU | *Faculty Advisor: Prof. Rajiv Kapoor* *New Delhi, India*

- Engineered **high-frequency ultrasonic** pulsar circuit module for bio-image analysis, primarily in a dental context.
- Designed a 100kHz signal generator with voltage outputs of **±10V, ±25V, and ±50V**, leveraging a microcontroller for signal generation, TC6320 dual MOSFET for amplification, PMBD diode pair for rectification, and MUX for voltage level toggling.

RELEVANT SKILLS

SOFTWARE: Python, C++, Java, MATLAB, Julia, NumPy, Linux, Docker, Git, CI/CD, CUDA, Jira, PyLint, Conda
ML FRAMEWORKS: PyTorch, Tensorflow, AWS, WandB
ROBOTICS: ROS/ROS2, OpenCV, RViz, MuJoCo, Gazebo, MoveIt, Motion Planning, Trajectory Optimization, State Estimation
HARDWARE: Arduino, RaspberryPi, LiDAR, Jetson, ToF, GPS, IMU, RF, xArm, FE Panda, Husky, Solidworks, AutoCAD

RELEVANT PROJECTS

RL Policy Interpretation February - April 2025

- Optimize a **learned RL policy** by modeling it as an **explicit proxy** over **geometric primitives** to identify key dependencies.

Multimodal Odometry: Visual + LiDAR [report] September - November 2024

- Devised a novel **vision-lidar odometry** prediction model using intermediate **optical flow** representations and attention based encoding-decoding transformers to estimate relative pose changes.
- Compared against multiple baselines on the **KITTI odometry** dataset, across various modalities.
- Improved performance on **challenging sequences** by **0.05 ATE** and benchmarked on the TartanAir dataset.

Fruit Ninja Robot [media] January 2024 - May 2024

- Implemented a real-time Fruit Ninja simulation using a **FE-Panda 6-DOF** Robot Arm, custom end-effector, and ping-pong ball.
- Enhanced visual detection of an in-flight object at **~3 m/s** with a **fine-tuned YoloV8** model at a **94% accuracy** in testing.
- Planned the motion to strike the object in its path within **0.6 s** using **RRTconnect sampling-based planner**.

mono3Dbox [report] January - May 2024

- Improved state-of-the-art by **~0.01 mAP** (at Recall 40) for 2 classes in **KITTI 3D Object Detection** Challenge.
- Fine-tuned a **modified YoloV8** on the dataset using curriculum learning, leading to **effective training data use**.

Morphological RCT Drill Volume Estimation [repo] July 2021

- Estimated micro-CT volumes of RCT-drilled molar tooth structures. Developed a computer vision method for detecting irregular closed curves using **morphological filters** and **differential signal processing** for efficient computation.
- Delivered the solution for **clinical use** at the **Maulana Azad Institute of Dental Sciences (MAIDS), New Delhi**.

High FPS Live Video Streaming [repo] December 2021

- Built an Android application to stream Live Video at **over 60fps** transmitting through BLE connection.
- Video captured through raspivid on RPi3, converting frames to byte arrays and encoding the video data using **DCT compression** in order to achieve higher frame rate on the receiving **Android app interface**.

RELEVANT COURSES

- **SPRING 2025:** Advanced Deep Learning, Optimal Control and RL, Robot Localization and Mapping
- **FALL 2024:** Multimodal Machine Learning, Advanced Robotics Business, AI & Emerging Economies
- **SPRING 2024:** Visual Recognition and Learning, Robot Autonomy, Robot Business
- **FALL 2023:** Advanced Computer Vision, Manipulation Estimation and Control, Robot Mobility, Systems Engineering
- **UNDERGRADUATE (2018-22):** Signals and Systems, Control Theory, Programming Fundamentals, Numerical Optimization, Machine Learning, Computational Biology, Deep Learning, Computer Vision, Natural Language Processing, Digital Circuits and Microcontrollers, Digital Signals, Networks Analysis and Synthesis, Electronic Design, Electromechanical Machines, Engineering Graphics, Power Electronics, Instrumentation and Measurement

EXTRA-CURRICULAR ACTIVITIES

- Conferred with the **Academic Excellence Award** consecutively from 2010 to 2017 by Delhi Public School Dwarka.
- As a founding member of the **MRSD Newsletter**, worked to set up the editorial system and processes leading to the inaugural publication in Spring 2024, connecting with 600+ readers.
- National finalists at **Flipkart GRiD 2020** and the **ARTPARK Robotics Challenge** 2021.
- Member of the Departmental **Football team** and Vice-Captain of the Departmental **Cricket team**. **Won intra-university sports tournament** Arena 2019 for football, runners-up at football and cricket in Arena 2020.
- Represented university at various **National Level literary events** as a part of the Content Writing, Quizzing and Debating contingent.
- Volunteered as a part of the Content and Teaching team of **eVidyaloka NGO**, for combating the discontinuities in rural education during COVID-19.
- Honorary mention by **The Navbharat Times**, a national newspaper, for a commendable batting performance at a state-level inter-school cricket tournament, 2013.
- Represented the school at **district** level in Badminton (2014), swimming (2016) and Cricket (2013-2017).