

# ACHAL PATEL

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## SUMMARY OF SKILLS AND QUALIFICATIONS

**Tools:** Docker • Git • MATLAB/Simulink • Pytest • ESP-IDF • Hugging Face • Kaggle • Fusion360 • KiCad • Jira • Jenkins

**Programming:** C • C++ • Python • Java • VHDL • SystemVerilog • ARM Assembly • ReactJS • SQL • Bash

**Libraries:** PyTorch • TensorFlow • MediaPipe • OpenCV • YOLO • NumPy • Matplotlib • SciPy • Pandas • FreeRTOS

**Robotics:** Gymnasium • ROS2 • MoveIt2 • Nav2 • ros2\_canopen • ros2\_localization • ros2\_control • IssacLab • LeRobot

**Currently ongoing:** VLA (Visual Language Action models) • Bimanual Dexterity • MPC (Model Predictive Control) • SLAM

**Languages:** English (Spoken & Written) • French (Beginner A1 certified)

## WORK EXPERIENCE

### Aerospace Robotics Research Intern (CUARL — CRAWLR Project)

May 2025 – Dec 2025

Concordia University Aerospace Robotics Lab (CUARL)

Montreal, QC

- Implemented MoveIt2 for joint trajectory solving for articulated wheel legged rover. Created simulation env. in Gazebo for validating MoveIt2 with ros2\_canopen's VirtualCAN to pass real CAN messages and real motor drivers.
- Created Xbox joystick teleoperation package that sends twist commands to the solver, enabling realtime user control of the rover. Validated in Gazebo then real hardware test.
- Designed and implemented perception based position estimation system, initially prototyping offboard ArUco marker based tracking with a stationary camera, then migrating to an onboard ZED stereo camera, inferencing on a Jetson AGX Xavier running a Docker container, wirelessly streaming ros messages over network
- Enabled repeatable and measurable experimentation by delivering reliable position estimates for feedback critical for closed-loop control algorithms, alongside directly supporting researchers in collecting valid experimental data

### Validation Engineering and Semiconductor Design Intern

Sept 2024 – Dec 2024

Microchip Technology Inc.

Montreal, QC

- Validated hardware for 800G Ethernet PHYs with 112G PAM4 SerDes for high-speed data centers, designing test scenarios using Pytest to ensure IEEE standards compliance
- Gained deep knowledge in Error Detection, Ethernet Frames, MAC & PHY layers, particularly PCS encoding/decoding
- Received training on NASA's HPSC (High-Performance Spaceflight Computing) project, using SystemVerilog for hardware verification and fault-tolerant systems to mitigate SEUs (Single-Event Upsets)
- Gained expertise in large-scale projects, hardware design, fault injection, regression testing and Git & CI/CD on Jenkins.

### Undergraduate Teaching Assistant

May 2024 – Present

Concordia University

Montreal, QC

- SOEN/COMP 228 (System Hardware): Taught tutorial classes and project-oriented lab sessions, guiding students in building a 4-bit RISC CPU on a breadboard with logic gates, flip flops, timers, shift registers and a microcontroller.
- COEN 313 (Digital Systems Design II [FPGA]): Conducted lab sessions, teaching VHDL programming, from basic constructs to RT-level design, covering combinational and sequential circuits, FSMs, and FPGA basics.
- MIAE 215 (Programming for Mechanical and Industrial Engineers): Tutored student C++ and embedded programming for microcontrollers in tutorials and guided with an robotics project with in the lab sessions
- Developed websites to educate with curated videos, resources, notes, and exam tips to help students succeed.

## PROJECTS

### MIMIC Capstone — Autonomous Bimanual Mobile Robotics via Imitation Learning | Concordia-McGill Collab. Sept 2025 – Present

- Co-leading interdisciplinary capstone project in partnership with McGill Mobile Robotics Lab to work on imitation learning research on bimanual mobile robots and create low-cost teleoperation arms for industry-grade manipulators
- Built low-cost platform with Mecanum base and dual SO-101 arms for rapid VLA model experimentation, while simultaneously restoring Kinova MOVO bimanual mobile robot with Jaco arms for validation.
- Developing custom teleop leader arms for realtime EEF control for data collection using LeRobot framework for VLA models such as  $\pi_0$ , X-VLA, and NVIDIA Groot and other behavior cloning policies like ACT and diffusion
- Helped secured close to \$15,000 in funding for the Capstone Project from various sources and sponsors

### LeRobot — Intro to Imitation Learning | Personal

May 2025 – Aug 2025

- Explored imitation learning fundamentals, VLA models, and the Hugging Face robotics ecosystem to understand how robots learn from human demonstrations

- Set up and experimented with the LeRobot framework, learning data collection pipelines, behavior cloning, and Action Chunking Transformers (ACT) architecture for policy training, laying foundation for MIMIC capstone project

**RNA Folding Prediction — Custom Transformer Architecture** | Academic, COEN 432 Fall 2025

- Designed Hybrid architecture from scratch combining DeepResUNetSE (15.3M params with SE attention, residual blocks, dilated convolutions) and **custom Transformer** with learned fusion layer for 2D RNA contact map prediction.
- Achieved highest F1 score (0.75 single model, 0.768 ensemble) in class of PhD/Master's students, **winning the Kaggle Competition**, through hyperparameter optimization, solving 187:1 class imbalance and long-range dependencies

**Extended Kalman Filter — IMU/GNSS Sensor Fusion** | Academic, ELEC 473 Fall 2025

- Implemented Extended Kalman Filter from scratch in Python for real-time vehicle position estimation, fusing IMU and GNSS measurements to handle sensor noise and uncertainty propagation. Extracted vehicle trajectory from raw IMU/INS data and computed motion parameters, visualised with 3d matplotlib animations

**RoboWars 2025 — Autonomous Sumo Robots** | Personal, Competition Feb – Mar 2025

- Black Copy: Back with Vengeance:** Built this sumobot with brushless motors, FOC via VESCs, Time-of-Flight sensors for opponent detection, Teensy 4.0 microcontroller, and FSM architecture for autonomous operation
- Definitely Overkill:** Developed this Perception based sumobot with Jetson Orin Nano, Intel RealSense depth camera, YOLO-based opponent detection, and point cloud processing for enhanced awareness and strategic positioning

**Haptic Navigation Wearable for Visually Impaired** | MakeUofT 2025 Hackathon Feb 2025

- Built 24-hour hackathon wearable navigation system prototype integrating **Intel RealSense** depth, **YOLO World** for runtime-configurable object detection, **OpenAI Whisper** for voice commands, and haptic feedback motors for directional guidance, inferencing on Jetson Nano, enabling users to locate objects through vision-based navigation

**The IoT Automation Project** | Personal, IEEE Concordia Sep 2024 – Dec 2024

- Led team of 6 in transforming club workshop into smart lab with self-hosted IoT network using WiFi, Zigbee, MQTT, and Home Assistant, eliminating cloud dependencies. Developed custom IoT devices and sensors with ML object detection on CORAL TPU for automated lab routines, integrating voice control via Alexa and Node-RED automations

**Autonomous Hovering Drone** | Personal, IEEE Concordia July 2024 – Nov 2024

- Built custom drone with optical flow altitude hold, ArduPilot firmware, custom PID tuning, GPS mission planning for enhanced flight stability, and FPV support.

## PROFESSIONAL ASSOCIATIONS & VOLUNTEER WORK

**Vice President of Projects** June 2024 – Present

*IEEE Concordia student branch* Concordia University

- Lead multiple project teams from ideation to execution, mentoring students in programming, electronics, CAD, and embedded systems while managing recruitment, onboarding, and secured over \$11,000 in funding from all projects

**Engineering Workshops Instructor** October 2023 – Present

*Concordia University* Montreal, QC

- Delivered several Interactive workshops on **Intro to Robotics**, **Intro to 3D Modeling & Printing** with Fusion and **Intro to Microcontrollers** with ESP32, teaching beginners practical skills in design, programming and embedded systems.

## EDUCATION

**Concordia University** Montreal, QC

*Bachelor of Engineering – Computer Engineering Co-op* 2022 – 2026 (Expected)

- Relevant courses: Autonomy for Mobile Robots • Applied Machine Learning • Modern Control Theory • C++ OOP • Data structures and algorithms • Computer architecture and Software • Continuous & Discrete Time Signals and Systems

## AWARDS & COMPETITIONS

<b>Innovation Fund</b> , Concordia University – \$10,000	(Dec 2025)	<b>RoboWars</b>	(2024, 2025)
<b>National Champions</b> , Canadian Engineering Competition (CEC)	(Mar 2025)	<b>MakeUofT</b>	(2024, 2025)
<b>2nd Place</b> , Quebec Engineering Competition	(Jan 2025)	<b>ConUHacks VIII</b>	(Jan 2023)
<b>Winner</b> , Englympics 2024 — QEC Qualifiers	(Oct 2024)	<b>IEEEExtreme</b>	(Oct 2023)

## INTERESTS

Autonomous Robotics • Rocket Avionics • Embedded Programming • Drones (UAVs) • Cybersecurity • IoT Systems  
Movies • Photography and filmmaking • Personal Finance • Investing • Traveling • Gardening • Eng. Competitions