ACHAL PATEL

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SUMMARY OF SKILLS AND QUALIFICATIONS

Platforms: Fusion360 • MATLAB • Simulink • Hugging Face • LeRobot • Kaggle • Docker • Docker Compose • VS Code • Platform IO • ESP-IDF • KiCad • Jira • Jenkins • Linux
Programming: C • C++ • Python • Java • VHDL • SystemVerilog • ARM Assembly • ReactJS • Bash
Libraries: PyTorch • TensorFlow • MediaPipe • OpenCV • YOLO • NumPy • Matplotlib • SciPy • Pandas • Free RTOS
Others: ROS2 • MoveIt2 • Nav2 • ros2_canopen • ros2_localization • ros2_control • SQL • Git Bash • Pytest • ArUco
Currently ongoing: VLA (Visual Language Action models) • Bimanual Dexterity • MPC (Model Predictive Control) • SLAM
Languages: English, (Spoken & Written) • French (Beginner A1 certified)

WORK EXPERIENCE

Robotics Research Intern (CUARL — CRAWLR Rover) — May 2025 – Dec 2025

Concordia University Aerospace Robotics Lab (CUARL) — *Montreal, QC*

- Learned MoveIt2 for trajectory solving and planning for articulated wheel legged rover. Created simulator environment in ROS2 Gazebo with virtual motor controllers using ros2_canopen's virtual CAN to pass real CAN messages simulating real motors. Set up virtual CAN hardware and implemented inching motion solver using MoveIt2 for the massive codebase
- Created Xbox joystick teleoperation package that sends twist commands to the solver, enabling realtime user control of the robot. Validated in Gazebo simulation then hardware field tests
- Designed and implemented onboard position feedback system enabling closed-loop control for researchers: Initially attempted ArUco marker-based tracking with external camera off board stationary;
- migrated to onboard mounting ZED camera onboard for real-time inference on Jetson Xavier with Docker setup to run ros2 on old deprecated hardware. Implemented perception-based position estimation package using ZED SDK. This feedback system was key input for closed-loop controller algorithms used by researchers to collect experiment 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, and OSI model with focus on MAC & PHY layers, particularly PCS (Physical Coding Sublayer) for 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 project management, hardware design, fault injection, regression testing, Git with Bitbucket, CI/CD on Jenkins, and extensive Linux experience for deployment, testing, and system management

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 — Bimanual Mobile Robotics for Imitation Learning | *Concordia-McGill Collaboration* — 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 industry-grade teleoperation arm systems
- Built low-cost platform with Mecanum base and dual SO-101 arms for rapid VLA model experimentation, while simultaneously restoring Kinova MOVO industrial robot with Jaco arms for validation on high-end hardware
- Developing custom teleoperation systems for data collection using LeRobot framework and Vision-Language-Action models such as Pi0, X-VLA, and NVIDIA Groot and other behavior cloning policies from ACT to diffusion

- Secured upwards of $20,000 worth of funding for the undergraduate capstone project through various sources and sponsors

LeRobot — Intro to Imitation Learning | *Personal*   Summer 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 and implemented DeepResUNet-Transformer hybrid model architecture from scratch to predicting 2D RNA folding patterns, achieving highest F1 score in class of PhD and Master's students
- Built custom transformer attention mechanism and ResNet-U-Net encoder-decoder architecture in PyTorch, conducting extensive hyperparameter sweeps and training dynamics analysis to optimize for imbalanced base-pair prediction task

Extended Kalman Filter — IMU/GNSS Sensor Fusion | *Academic, ELEC 484*   Fall 2025
- Implemented Extended Kalman Filter from scratch in MATLAB 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, achieving accurate position estimation through proper state-space modeling and sensor fusion techniques

RoboWars 2025 — Autonomous Sumo Robots | *Competition*   Feb – Mar 2025
- **Back with Vengeance**: Built sumo robot with brushless motors controlled by VESCs, Time-of-Flight sensors for opponent detection, Teensy 4.0 microcontroller, and finite state machine architecture for autonomous operation
- **Definitely Overkill**: Developed advanced sumo robot with Jetson Orin Nano, Intel RealSense depth camera, YOLO-based opponent detection, and point cloud processing for enhanced situational awareness and strategic positioning

Haptic Navigation Wearable for Visually Impaired Users | *MakeUofT 2025 Hackathon*   Feb 2025
- Built wearable navigation system combining Intel RealSense depth sensing, YOLO v12 World for runtime-configurable object detection, OpenAI Whisper for voice commands, and haptic feedback motors for directional guidance. Integrated four AI/ML subsystems (vision, depth, speech, detection) on Jetson Nano with Arduino-controlled haptic motors, creating end-to-end prototype in 24-hour hackathon that enables users to locate objects through touch-based navigation

Autonomous Hovering Drone | *Personal, IEEE Concordia*   July 2024 – Nov 2024
- Built custom drone with autonomous hover capability using optical flow sensor for altitude hold, ArduPilot firmware, and custom PID tuning for stable flight. Integrated sensor filtering and flight control systems, implementing GPS-based mission planning and FPV head-tracking gimbal for enhanced flight stability and autonomous operation

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 optimized automations through Node-RED

PROFESSIONAL ASSOCIATIONS & VOLUNTEER WORK

Vice President of Projects   June 2024 – Present
IEEE Concordia student branch   *Concordia University*
- Lead project teams and manage initiatives engaging students from beginner to advanced levels; secured over $11,000 in funding from university, IEEE Montreal, and industry partners
- Project leadership: Autonomous Hovering Drone project and IoT Automation Project, mentoring students in programming, electronics, CAD, and embedded systems

Engineering Workshops Instructor   October 2023 – Present
Concordia University   *Montreal, QC*
- Created Several Interactive workshops on **Intro to Robotics**, **Intro to 3D Modeling & Printing with Fusion360** and **Intro to Microcontrollers with ESP32**, teaching beginner university students and CEGEP students 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

Innovation Fund, Concordia University – $10,000	(Dec 2025)	RoboWars	(2024, 2025)
National Champions, Canadian Engineering Competition (CEC)	(Mar 2025)	MakeUofT	(2024, 2025)
2nd Place, Quebec Engineering Competition	(Jan 2025)	ENGR 290 Hovercraft	(Apr 2024)
Winner, Englympics 2024 — QEC Qualifiers	(Oct 2024)	ConUHacks VIII	(Jan 2023)
		IEEExtreme	(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