Gavin Tranquilino

Mechatronics Engineering Student

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Education

University of Waterloo **June 2028**
Candidate for BASc in Mechatronics Engineering *Waterloo, ON*

- **Coursework**: Data Structures, Algorithms, Linear Algebra, Circuits, OOP, Microprocessors, Digital Logic (FPGA, PLC), Mechanics of Deformable Solids, Structure and Properties of Materials, Statistics, Ordinary Differential Equations

Experience

Humanoid Robotics Engineering Co-op May 2025 – Present
WATonomous *Waterloo, ON*

- Building **robotic arms** (6DoF) with tendon driven anthropomorphic hands (20DoF each), aiming for VR teleoperation.
- Developed software interface to bridge high-level **ROS2** commands to low-level embedded systems over a **CAN bus**.
- Containerized ROS2 system in **Docker**, mounting CAN transceivers to enable communication between subsystems.
- Designed **URDF** models to define the transform **TF tree** for **RL simulation** and training in **NVIDIA Isaac Sim**.
- Built visualization infrastructure connecting **Gazebo** simulations to **Foxglove** for real-time debugging and data analysis.
- Assembled **PCBs** with 0.5mm pitch **SMD components**, soldered by hand, reducing assembly costs by 30%

Robotics Undergraduate Research Assistant September 2024 – December 2024
University of Waterloo Engineering IDEAs Clinic *Waterloo, ON*

- Implemented **adaptive cruise control** on physical robots using **PID** controllers in **C++** and **Python** packages.
- Led a **ROS2** workshop for 100+ students, introducing fundamental concepts and streamlining **Docker** installations.
- Utilized **Docker** to enable robot development across all operating systems, streamlining the deployment of **ROS2** apps.

Undergraduate Research Assistant September 2024 – December 2024
University of Waterloo Engineering IDEAs Clinic *Waterloo, ON*

- Instrumented a wearable knee crutch, allowing force readings for gait analysis and material selection via **FEA**.
- Designed a digital CAD twin of an existing knee crutch in **SolidWorks**.
- Developed a **data acquisition** system using **I2C** and C++, converting a bathroom scale for real-time load measurements.
- Prototyped **3D-printed** mounts and knee platforms for strain gauges, ensuring user comfort.
- Built **Python** scripts for force distribution visualization in **Matplotlib**, with data logging for **gait analysis**.

Projects

Autonomous LiDAR Navigation for Mobile Robot

- Developed **C++ ROS2** nodes to convert **LiDAR** data into a **2D costmap** for obstacle detection and perception.
- Generated a **world model** from costmap and odometry data to represent the current environment.
- Implemented **A* algorithm** to compute obstacle-aware paths through the mapped environment.
- Applied **Pure Pursuit** to follow planned paths for smooth differential drive navigation.

Warehouse Autonomous Guided Vehicles (AGV)

- **Won TMMC Software Challenge** by developing autonomous warehouse robots using **TurtleBot 4** and **ROS2**.
- Generated a real-time costmap converting 2D **LiDAR** scans to **occupancy grids** with obstacle inflation for perception.
- Implemented **CV** stop sign detection using **YOLOv8** with bounding box distance estimation to stop at intersections.
- Designed **cascading PID controller** for wall-following and heading control with **IMU** feedback for warehouse traversal.
- Solved collision risks by implementing **LiDAR safety zones** with emergency stopping and backward movement protocols.

Self-Balancing Unicycle

- Built a simulator from scratch using **C++** and **CMake**, integrating **OpenGL** to create a custom physics environment.
- Developed a **CartPole**-inspired control system focused on wheel **torque control**.
- Implemented **cascading PID controllers** to control: balancing and achieving precise position tracking.

Technical Skills

Software/Languages: Python, C, C++, CMake, SSH, Bash, Gazebo, Foxglove, Linux, Ubuntu, JS, HTML, CSS, SQL, LaTeX
Libraries/Frameworks: ROS2, Docker, OpenCV, YOLOv8, Git, MediaPipe, Flask, Selenium, NumPy, OpenGL
Mechanical: SolidWorks, Fusion360, AutoCAD, GD&T, CAD, FEA, DFMA, 3D Printing, Machine Tools, Onshape
Electrical: I2C, SPI, UART, CAN Bus, Arduino, ESP-IDF, Soldering, Oscilloscope, LiDAR, PLC, LAD, VHDL, FPGA