# Camilo Artigas

Product Design | Robotics | Hardware

American Citizen and Aspiring Engineer

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## Skills

**Mechanical**: Solidworks (CSWA), Ansys, GD&T, DFMA, FEA, 3D CAD, Rapid Prototyping, Assembly/Disassembly, Machining, Engineering Drawings, AutoCAD, Iterative Design, Root Cause Analysis, Tolerance Analysis, Actuators
**Software**: Python, C++, Arduino, MATLAB, Git, HTML, Automation, Web Scraping, NumPy, Matplotlib
**Electrical**: Altium, Circuit Analysis/Design, Electrical Troubleshooting, Serial, PWM, Stepper and Servo Motors

## Experience

**Mechanical Design Intern** — **Sep. 2024 – Dec. 2024**
*Sheartak Tools Ltd.* — *Waterloo, ON*

- 3D modelled 10+ spiral cutterheads in SolidWorks, drafting technical drawings using GD&T and ensuring flawless manufacturing.
- Performed 6 cutterhead installations on planers and jointers in less than 7 hours, installing 50+ carbide blades per cutterhead while prioritizing safety at all times.
- Automated the migration of 500+ products to new website using Python, saving 30+ hours.
- Increased website engagement by 10% by launching an SEO campaign, optimizing 3000+ products' metadata.
- Earned the company 1000+ views by shooting and editing 4 installation videos, outlining best practices to customers.
- Optimized the installation time of 20+ customers by drafting 5 installation manuals.

**Mechanical Designer & Project Manager** — **Aug. 2024 – Present**
*Waterloo Aerial Robotics Group* — *Waterloo, ON*

- Lead the design of the drone's landing gear in SolidWorks for the 2025 competition, angling its legs to ensure concentricity with bucket for water retrieval; implementing depth limiters, anti-tipping bars and CF members.
- Optimized main drone assembly in PDM by implementing parametric modelling, allowing team members to change the parameters in real time, saving 10+ hours.
- Revamped an existing mount for an optical flow sensor, CV and IR camera, aligning them with the drone's direction of flight, saving weight and eliminating all vibrations.
- Manufactured aluminum 3+ parts for fixed-wing aircraft using mill and lathe, meeting all tolerances.

## Projects

**Cycloidal Actuator** | *SolidWorks, 3D Printing, DFMA, Python, Stepper Motors, Iterative Design* — **July 2024 - Present**

- Designed 130+ part assembly in SolidWorks, achieving a gear ratio of 23:1 with cycloidal speed reducer.
- Developed Python script that outputs instant visualization of the cycloid, reducing modelling time by 50%.
- 3D printed a backlash free functional prototype. Projected to machine all parts after testing torque.

**3-DOF Robotic Arm** | *SolidWorks, 3D Printing, DFMA, Python, Arduino, Servo Motors* — **Apr. 2024 - July 2024**

- 3D printed the robot with tight tolerances by iteratively designing it in SolidWorks and employing DFMA.
- Achieved smooth movement in the x, y and z axes by deriving the arm's inverse kinematics and implementing ramp libraries. This was facilitated by the use of 3 servo motors and 2 four-bar linkages.
- Established serial communication between Python GUI and Arduino IDE, achieving precise movement within workspace.

**Autonomous Plant Watering Robot** | *SolidWorks, 3D Printing, C++, Sensors* — **May 2024 – Aug. 2024**

- Reliably watered 6 plants in less than 1 minute by designing a 3D printed Peristaltic Pump with 20% occlusion.
- Converted rotational motion to linear by designing a 3D printed rack and pinion mechanism, lifting the hose.
- Achieved autonomy through the flawless integration of an ultrasonic sensor, motor encoders and C++ scripts.

## Education

**University of Waterloo** — **Sep. 2023 – Present**
*Candidate for a Bachelor of Applied Science in Mechatronics Engineering* — *Waterloo, ON*

**Relevant Coursework**: Dynamics, Mechanics II, Data Structures and Algorithms, Materials Science, Circuits I, Calculus II

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MECHATRONICS ENGINEERING STUDENT AT UWATERLOO

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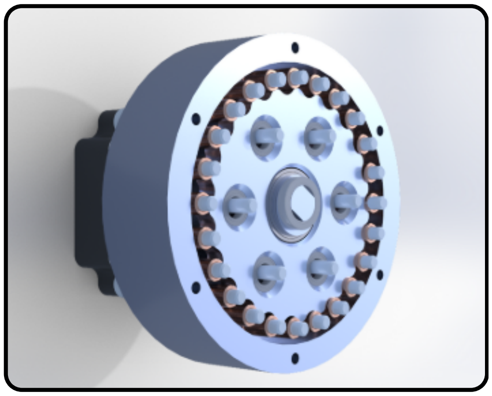
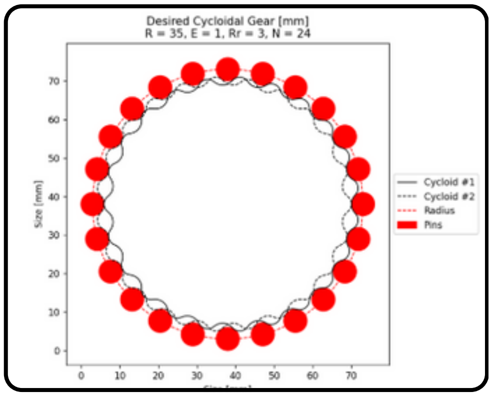
## CYCLOIDAL ACTUATOR



### WHAT?

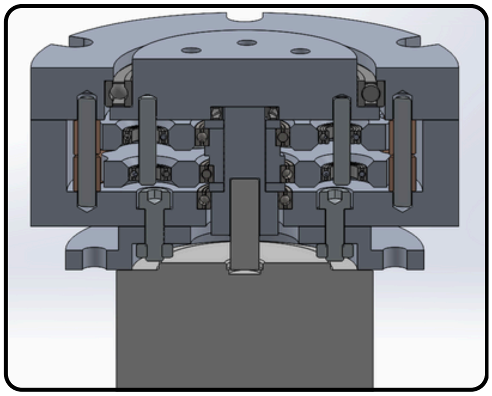
Design and manufacture a cycloidal actuator with the following goals:

- A reduction ratio (gear ratio) of 23:1.
- An efficiency above 85%.
- Ease integration with other systems.
- Robust and reliable design.
- Compact, light and compatible with a NEMA 23/17 motor.



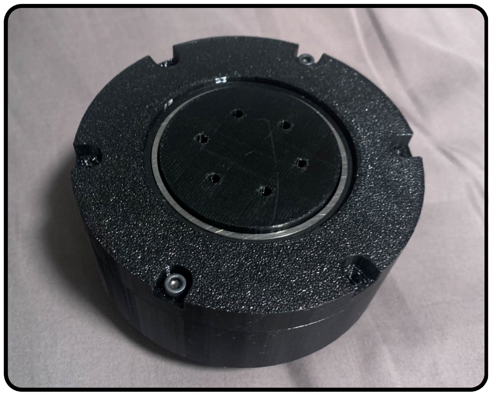

### HOW?

- Used SolidWorks to draft parametric models of the drive, exploring different configurations in the process.
- Developed a Python Matplotlib script that outputs a visualization of desired cycloidal gear and its pins given geometric inputs.
- Implemented design decisions based on academic research focused on efficiency and stress concentrations.



### WHY?

- I used SolidWorks' parametric design functionalities to be able to plug in parameters to get different designs. I explored designs where the torque is transmitted through an output disk or the casing.
- I used the Matplotlib script to create a quick visualization of a cycloidal disk of my choosing and parse the equations I would need in SolidWorks to generate the spline for the cycloidal gears. This made the process of settling on parameters easier and quicker.
- Decided to root decisions on proper research for better results.



### RESULTS

- 3D printed a functional model after applying tolerance analysis, projected to machine all parts after testing its maximum torque and efficiency.
- Prototype showed no backlash and integrates with a NEMA 23 motor.

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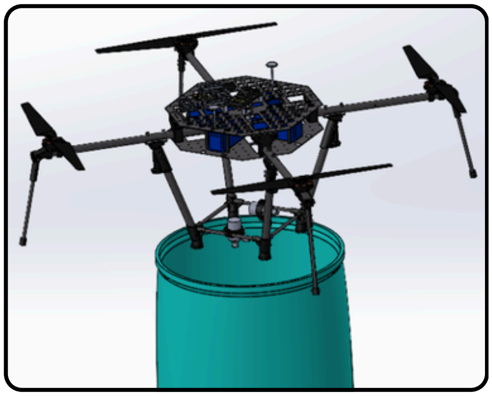
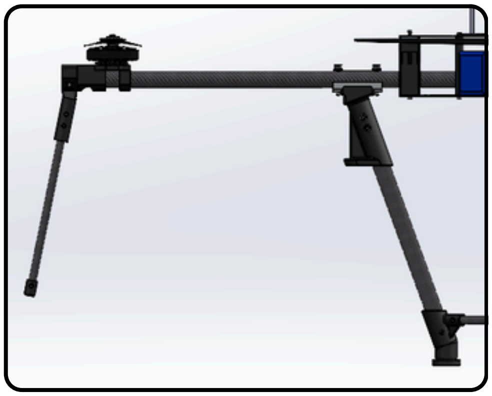
## ANGLED LANDING GEAR



### WHAT?

- Designed the drone's landing gear for the 2025 competition in SolidWorks, angling its legs to ensure concentricity with a bucket for water retrieval.
- The design was parametric and modular to allow for two different payload configurations.
- It integrated with already existing/machined components for cost and time efficiency.



### HOW?

- Used SolidWorks to create parametric models that can be accessed/modified by anyone in the team, promoting and ensuring collaboration.
- Key features include: angled top and bottom portions, carbon fiber members, anti-tipping bars and depth-limiters.
- Performed hand calculations to validate angles, structural strength and integrity.

### WHY?

- Using parametric modelling and collaborative platforms (PDM) is essential for a dynamic environment - such as WARG - to fully flesh out ideas and concepts.
- The angled landing gear forms concentricity between the drone and the bucket, the carbon fiber gives a stiff and reliable frame, the anti-tipping bars are for the drone to be able to "right" itself to its home position despite disurbances and the depth-limiters were implemented due to bucket measurements being vague.

### RESULTS

The landing gear has been fully manufactured, these are the results:

- It's sturdy without much tip at an angle of 20 deg with the vertical.
- Concentricity with the bucket is achieved by the angle. However, landing on the barrel was limited by the drone's PID tuning.
- The depth limiters function, they support the drone on the barrel.
- The anti-tipping bars saved the drone from tipping in 3/4 flights.

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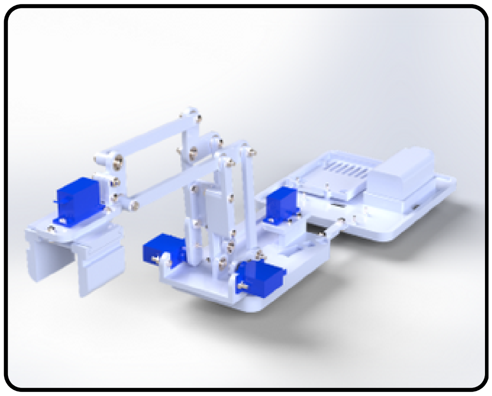
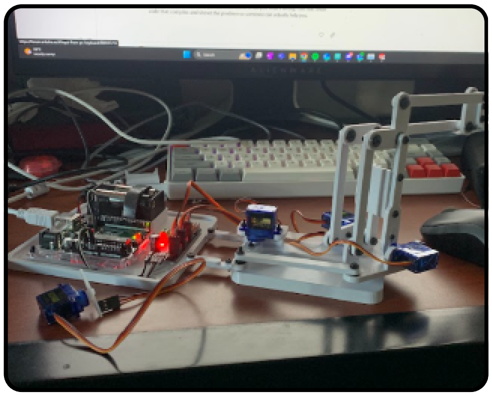
## 3-DOF ROBOTIC ARM



### WHAT?

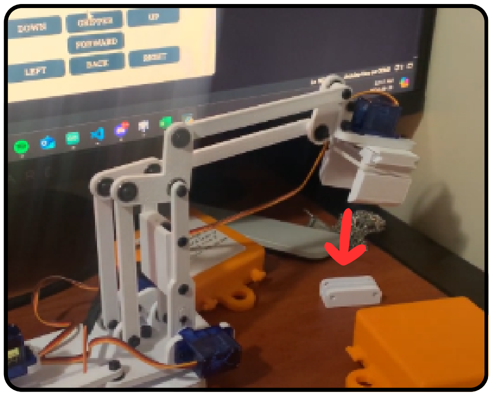
Design, manufacture and program a 3 DOF Robotic Arm that can perform a variety of tasks and meet the following requirements:

- Move its end effector in straight lines in the x, y and z axes.
- Be easy to control.
- Grip and move objects within its workspace.
- Keep its end effector parallel with the ground.



### HOW?

- Designed the robot and the base for the electronics in SolidWorks, which were 3D printed with tight tolerances.
- Employed servo motors and a servo motor driver for the motion of the robot, which were powered by a 6V battery.
- Used an Arduino board, which with a combination of inverse kinematics, C++ scripts and a Python GUI to control the robot.
- Ensured the parallelism of the end effector with the ground with four-bar linkages.



### WHY?

- I cadded the model in SolidWorks due to its use in the industry and versatility. I chose 3D printing due to its prototyping speed.
- I selected servo motors due to their straight forward position control and decided to drive them with a servo driver for consistent results.
- I decided to go with Arduino due to its vast documentation and I employed a Python GUI due to its modularity.
- I used four-bar linkages due to their ease of integration and effectiveness.

### RESULTS

- Due to GUI control, the robot was able to move in smooth straight lines to any point within its workspace and grip objects.
- With the four-bar linkages, the end effector remained parallel to the ground, facilitating object pick up.
- Demonstrated consistent and reliable results across the board.

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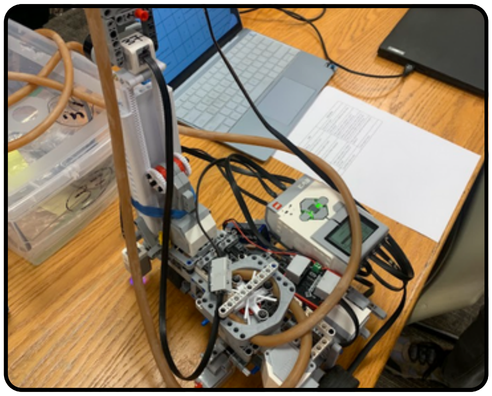
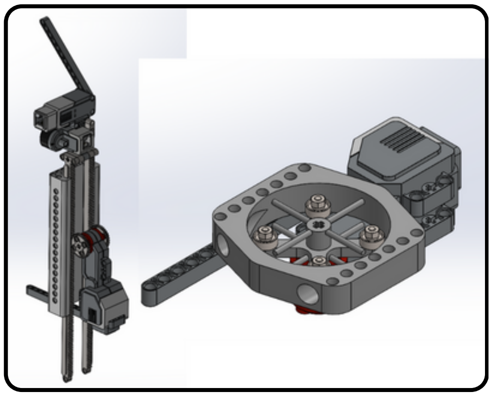
## AUTONOMOUS PLANT WATERING ROBOT



### WHAT?

For our programming course, we were tasked to create an autonomous lego EV3 system that would meet engineering specifications set by ourselves, we came up with the following:

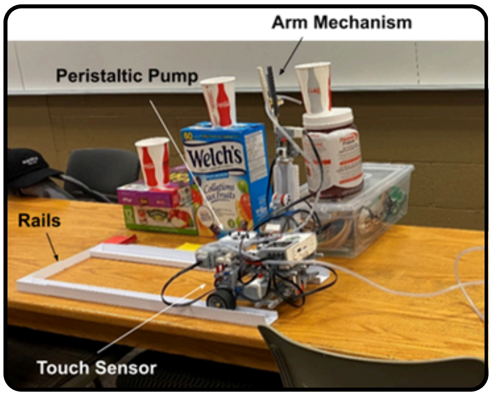
- Be able to reach plant pots that are more than 30 cm in height.
- Must deliver the right amount of water to 6 plants in a row.
- Must be able to detect height correctly with an ultrasonic sensor.



### HOW?

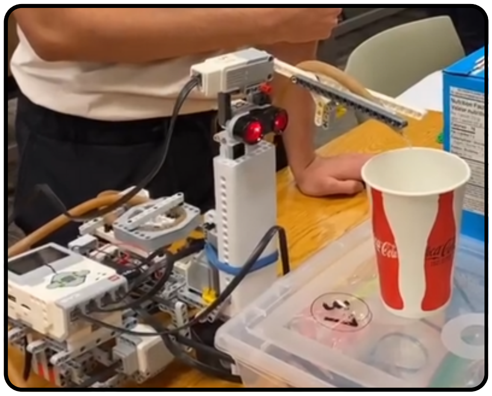
My duty was to find the mechanical solutions to the specifications, I implemented the following by using SolidWorks and 3D printing:

- A peristaltic pump with 20% occlusion, effectively squeezing the tubing to deliver water to each plant.
- A rack and pinion mechanism to lift and lower the ultrasonic sensor, which would also implemented a rotating arm for when the sensor reached the desired height.




### WHY?

- I decided on a peristaltic pump due to its reliability and ease of prototyping. I ended up going through 4 prototypes before getting reliable flow. The 20% occlusion rate was critical, as it provided a steady and powerful flow which was made possibly by our flexible and soft tubing.
- I used a rack and pinion mechanism due to its ease of integration to the EV3 environment.



### RESULTS

- The pump was able to consistently supply water to 3 different plants twice (6 times) and the rack and pinion mechanism was able to reliably elevate/lower the ultrasonic sensor throughout.
- The mechanical systems were able to properly respond to C++ scripts, in turn fully integrating with the sensors and encoders. This allowed the system to be fully autonomous.