PHOEBE LUO

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SKILLS

- Significant experience with **rapid prototyping** embedded systems over **5+ hackathons** using the following:
  - **Hardware:** Arduino, Raspberry Pi, ESP-32, breadboards, soldering, oscilloscope, sensors, motors
  - **CAD/Machining:** Solidworks, Inventor, 3D-printing, hand tools, drill press, lathes, CNC, Inventor CAM, GD&T
  - **Software:** C++, C, Python, Java, Git, Linux, OpenCV, FreeRTOS, Jupyter Notebook
  - **Communication Protocols:** UART, I2C, SPI, CAN

EXPERIENCE

Robot Designer & Programmer | *FIRST Robotics Competition Team 1241* Nov 2018 - Apr 2021

- Utilized **Inventor CAD** to design and create a **parametric model** of the robot drivetrain and gearboxes, ensuring design constraints and requirements such as robot top speed were met
- Integrated **SPI/I2C/CAN** based sensors through middleware to interface with third party drivers, and performed maintenance/debugging of components using **LabView** and **CAN analyzing** software
- Implemented **state machine** architecture with **Java** using **object oriented programming** principles for robot control, and integrated **autonomous routines, PID controllers, and motion profiles** to help achieve a scoring accuracy of 90%

Robotics Research Assistant | *The Hospital for Sick Children (SickKids)* May 2022 - Aug 2022

- Designed, prototyped, and iterated a new mechanism for an MRI-compatible robot that manipulated mock human tissue under strict design constraints using **Solidworks**, incorporating **DFM** and **DFA** principles
- Wrote **soft real time Python code** to develop a novel **beam steering** feature to correct for motion during MRI guided high-intensity focused ultrasound (HIFU) cancer treatments, achieving a final steering accuracy of ±2 mm
- Improved data processing time by 95% writing Python scripts in **Jupyter Notebook** to automate analysis of 1000+ files

PROJECTS

Canadian Engineering Competition (CEC) | *Product Design* Oct 2021 - Mar 2022

- Tackled real-life engineering problems at the regional, provincial, and national level (representing Ontario) for CEC, the most prestigious engineering competition in Canada with teams from over 43 top institutions participating
- Designed a **modular,** cost effective flood barrier by following a **user-centered design** process that informed decisions such as ensuring barriers were foldable, portable, and scalable to a larger market, which won **first place in Canada**

Anti Anti-Masker Mask | *Computer Vision, Firmware, Rapid Prototyping* Feb 2022

- Developed wearable solution to deter anti-maskers from the user's vicinity by using **OpenCV libraries** for face detection and a flywheel propelled dart shooter, winning 2nd place at MakeUofT out of 180+ participants
- Wrote implementation firmware in **C++** for the **Raspberry Pi GPIO** pins, including **PWM** control of BLDC motors, sensor polling through **I2C** protocol with a point LIDAR, and interfacing components through **serial** communication
- Actively redesigning software architecture with **FreeRTOS** to improve tracking speed and dart shooting frequency

Dumpling Dynamics | *C++, CAD, Rapid Prototyping, Machining* Sep 2021

- Invented a robot to automate the dumpling-making process from concept to prototype, using **Solidworks**, **3D printing**, and **machining** to prototype clamping mechanisms, and won out of 477 teams at HTN, Canada's biggest hackathon

Braille-iant | *C++, CAD, 3D Printing, Embedded Systems* May 2021

- Created a low-cost braille printer by **rapidly prototyping** a paper piercing mechanism with Inventor **CAD** and **3D printing**, which was awarded best hardware hack at TOHacks 2021 out of 700+ participants
- Developed **C++** code for an **Arduino** microcontroller, using **UART protocol** to run stepper and servo motors based on user input from a **Python GUI**

EDUCATION

University of Waterloo | *Candidate for Mechatronics Engineering, BASc - 3.9 GPA* Sep 2021 - Apr 2026 (expected)

INTERESTS

- Birds/Dogs
- Hackathons
- Anything Boston Dynamics does
- Food Reviewing and Cooking
- Minecraft

PORTFOLIO

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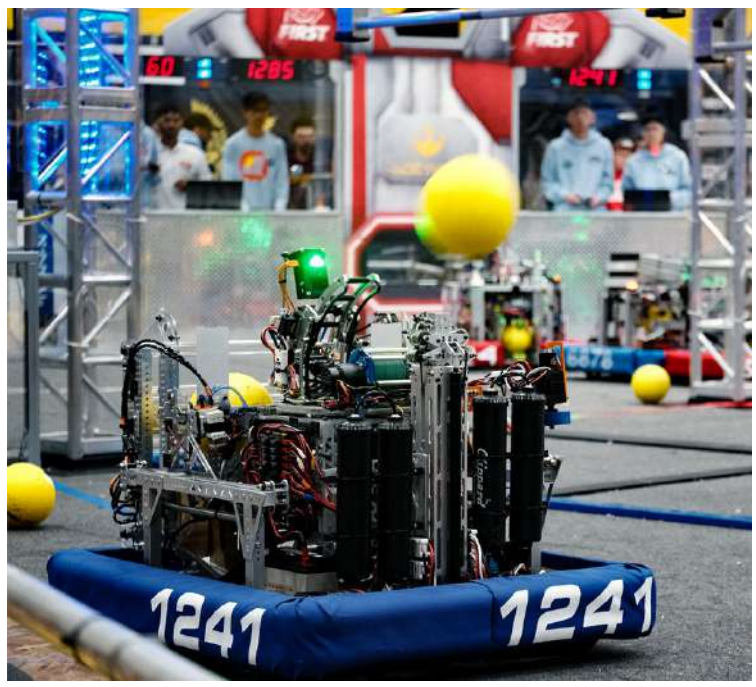
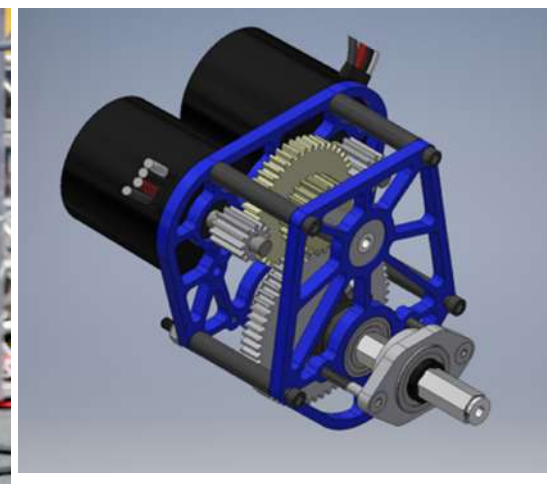
FIRST Robotics Competition





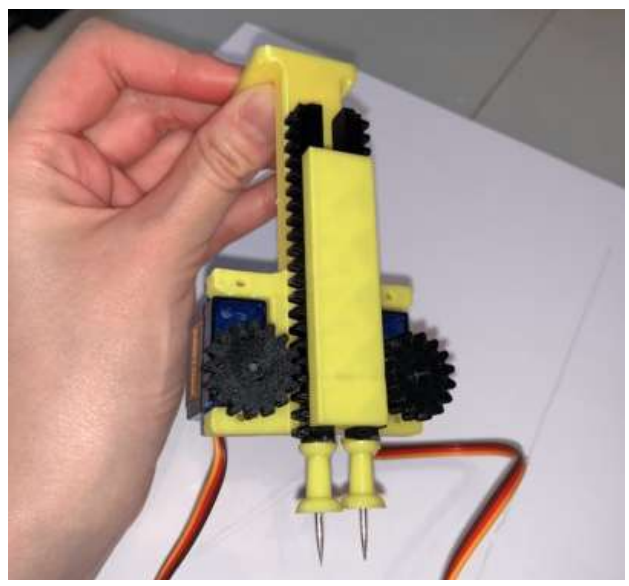
(Above) Gearbox CAD assembly, and the gearboxes in real life

(Left) Picture of the full robot shooting. The camera is actively tracking the target (the green light) and has shot the yellow ball.

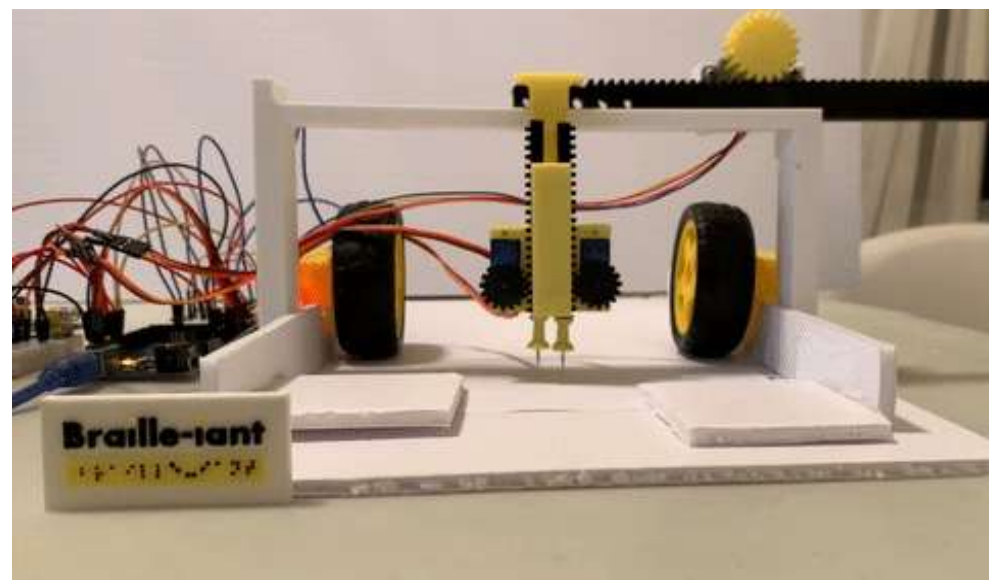
- As a designer and manufacturer on the team:
  - Used **Inventor** to design the chassis of the robot and the gearbox plates, performing **parametric modelling** to ensure the validity of my design and that it met requirements, and calculated gearbox ratios to source appropriate gears
  - Generated g-code using Inventor CAM software for CNC part fabrication, selecting settings that optimized time
  - Manufactured and assembled **10+** robot parts using **machine shop tools** including lathes, mills, and hand tools

- As the lead robot software developer:
  - Worked with **communication protocols (SPI, I2C, CAN)** to interface components (encoders, gyro, etc) with robot movements, and used **CAN analyzing** software for debugging problems throughout the competition season
  - Developed control software for the robot, for example designed and tuned **PID controllers** using **LabVIEW**, created **motion profiles** reduce shooting error, and wrote **autonomous routines** to ensure the robot scored the maximum number of points

Braille-iant



Close up of the final paper piercing mechanism design, which was designed, 3D printed, and assembled by me



Full image of Braille-iant midway through prinitng

- Built a low-cost world's cheapest braille printer for only $15 as a solution for making physical documents (receipts, contracts, doctors notes) more accessible to people who are visually impaired.
- **Rapidly prototyped** and **3D printed** the paper piercing mechanism in under 24 hours. The mechanism went through two iterations, the second design utilized 2 rack and pinion gears to convert a servo motor's rotational motion into linear motion
  - The paper piercing mechanism was designed in **Inventor** and I incorporated **DFM** and **DFA** principles to ensure feasibility
- Developed and integrated a **Python GUI** and **C++ Arduino** sketch to communicate via **UART** protocol, allowing the printer to receive user input and then drive stepper and servo motors to print the corresponding Braille output
- Used a breadboard to connect all the components, including servos, stepper motors, DC motors, and the motor controllers
- Braille-iant was awarded Best Hardware Hack out of 700+ participants and is seen working here