

# Sharon Cai

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## Skills

**Programming Languages:** Python, C/C++, SQL, Javascript/Typescript, HTML/CSS, MATLAB, Verilog/VHDL, Java  
**Frameworks & Tools:** React, RESTful APIs, Git, Jira, VS Code, Linux, Windows, RTOS, NumPy, Pandas, Matplotlib  
**Software & Design:** OOP, Autodesk Inventor, SolidWorks, CATIA, Figma, COMSOL, Wireshark, MS Dynamics 365

## Experience

**Embedded Software Engineer** | *Aversan* May 2024 – August 2024

- Led development of a **MicroPython-based** preliminary testbench for the mission-critical Water Drop Control Unit (WDCU) on aerial firefighter project (DO-160/178/254 environment), simulating system **discrete I/O**, key component behaviour, **real-time state transitions**, and **fault cases** via web UI with server-sent events.
- Modelled WDCU doors, tanks, and probe subsystems for testbench using deterministic **state machines** with **fault injection** (stuck-open/close, level freezes, probe errors); added drivers for Digital-to-Analog Convertor (**DAC**) and **I/O expander** to broaden I/O coverage and accelerate **software-hardware integration**.
- Contributed **C/C++** code for WDCU board bring-up application and **communication protocol** testing (**UART**, **I2C**, **SPI**) for both primary and display **microcontrollers**; configuring peripherals in **CubeMX (.ioc)** and supporting HAL-level tests for system-level validation across early hardware prototypes.
- Built a Tkinter-based **Python GUI** for verification testing, enabling **dynamic test case management**, result filtering, and structured logging for streamlined interaction with test frameworks.

**Mechanical Design Engineer** | *Alstom/Bombardier* May 2022 – May 2023

- Supported re-design, **rapid prototyping**, and continuous improvement activities for the Citadis Spirit LRV product line, focusing on mechanical subsystems and **component-level optimization** across multiple vehicles.
- Investigated** 200+ mechanical design issues raised on production line, **documented root causes**, and **proposed solutions** during Change Control Board meetings to prevent recurrence and ensure timely delivery of vehicles.
- Created, revised, and reviewed **3D models** and **2D engineering drawings** for various train subsystems and components using **CATIA**, ensuring compliance with geometric dimensioning and tolerancing (**GD&T**) **standards**.
- Performed calculations and simulation analysis related to component **structural integrity**, **kinematic interference**, and **load bearing capacity** to validate component performance under operating conditions.

**Microsoft Dynamics 365 Analyst** | *Digital Embrace* May 2021 – August 2021

- Worked in **Agile Scrum (Azure DevOps)** dev cycles to build scripts for **D365 reports**, execute cross-environment **data migrations**, and write **SQL** queries for large datasets; supported system testing and client coordination.

## Projects

**Capstone: Magnetically Actuated Soft Continuum Robot for ENT Surgery** | *Soft Robotics, Mechatronic Systems*

- Designed and fabricated a **soft continuum robot** body using medical grade silicone reinforced with a nitinol wire backbone for structural resilience, and engineered a magnetized tip embedded with NdFeB particles aligned to enable **torque-based steering** via **tri-axial electromagnetic actuation**.
- Programmed a real-time **Python-based GUI** for coordinating robot extension and directional magnetic steering, interfacing with an **Arduino** microcontroller to coordinate stepper motor movement and coil actuation.
- Developed embedded control logic for motor timing, **PWM coil activation**, and **H-bridge switching**, ensuring reliable actuation of linear and magnetic actuation subsystems via low-latency **serial communication**.
- Integrated **mechanical, electrical, and software subsystems** into a complete continuum robot platform and validated system performance through benchtop testing in **3D-printed** sinus phantoms and anatomical models, confirming design **verification thresholds** for range of motion, geometric compatibility, and actuation precision.

**Novel Catheter for Reduction of CAUTIs** | *Engineering Design, Project Scoping, Technical Writing, Health Economics*

- Designed a **sensor-integrated** catheter system to **detect and monitor** early indicators of Catheter-Associated UTIs (CAUTIs), by monitoring pH, temperature, and infection biomarkers, aimed at reducing hospital-acquired infections.
- Defined the project's need statement, objectives, constraints, and evaluation metrics, developing a detailed **technical design proposal** using **medical device design principles**, communicating with technical & non-technical audiences.
- Applied principles of **engineering economics** to model feasibility and cost-effectiveness of implementation, targeting a 25-35% reduction in CAUTI rate and projecting cost avoidance of about \$3300 per 1000 catheter-days.

**Interview Buddy** | *Full Stack, Python, Django, JavaScript, jQuery AJAX, RESTful API, OpenCV, ML, NLP*

- Built a **full-stack AI interview assistant** that analyzes recorded responses using **computer vision**, speech analysis, and text similarity techniques, providing users with feedback on tone, eye contact, articulation, and content relevance.
- Developed a responsive frontend interface using **HTML/CSS/JavaScript** and **Media Capture and Streams API**, enabling users to generate interview questions, record video responses, and download session footage for review.
- Engineered a **Python-based Django backend** that handled real-time video uploads via **jQuery AJAX**, used **OpenCV** for eye contact analysis, extracted audio features using **Praat**, transcribed speech with **Google Cloud Speech-to-Text API**, and applied **NLP** techniques via **scikit-learn** to assess response relevance.

## Education

**McMaster University**

**September 2019 – May 2025**

*Biomedical Engineering, Mechatronics Engineering (B.Eng.BME)*

Relevant Courses: Data Structures & Algorithms, Operating Systems, Embedded System Design, Real Time Systems & Control Apps