

# Calvin Li

## Engineering Portfolio

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## 1 Automated Water Dispenser System

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*Role: Mechanical Design & Systems Integration*

### Project Overview

Engineered a fully automated, touchless hydration station designed to improve office hygiene and accessibility. The system integrates a high-flow 12V DC pump with an APDS-9960 IR proximity sensor to deliver hands-free operation. The device features a custom T-shaped chassis designed for stability and splash resistance, accommodating standard 16.9oz reservoirs while isolating sensitive electronics from liquid exposure[cite: 92, 117].

### Key Technical Achievements

- **Dual-Voltage Power Architecture:** Designed a unified power system using a single 12V source to drive the high-torque DC pump, while integrating an L298N motor driver's onboard voltage regulator to supply a stable 5V logic level to the Arduino Uno and sensors[cite: 95, 230].
- **Embedded Control Logic:** Developed C++ firmware implementing a finite state machine. The system includes a 15-second auto-shutoff safety timer to prevent overflow, an emergency interrupt button that disables the sensor for 5 seconds, and real-time LCD status updates ("Dispensing," "Paused," "Ready") [cite: 126, 199, 220].
- **Engineering Problem Solving (Sensor Integration):** Diagnosed a critical failure in the initial prototype where the acrylic housing panel reflected IR signals, causing false triggers. Redesigned the chassis to flush-mount the sensor, eliminating interference and restoring 100% detection reliability [cite: 142, 143, 144].
- **Performance Validation:** Conducted rigorous testing over 20 trials, achieving a consistent sensor response time of < 0.5 seconds and a verified average flow rate of 16.558 mL/s [cite: 131, 247].

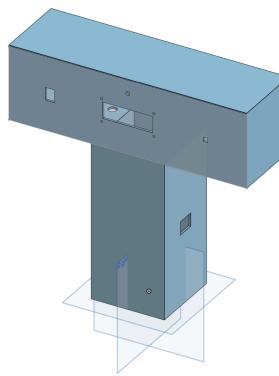


Figure 1: CAD Assembly: T-Shaped Housing Design



Figure 2: Final Prototype with LCD & Sensor Integration

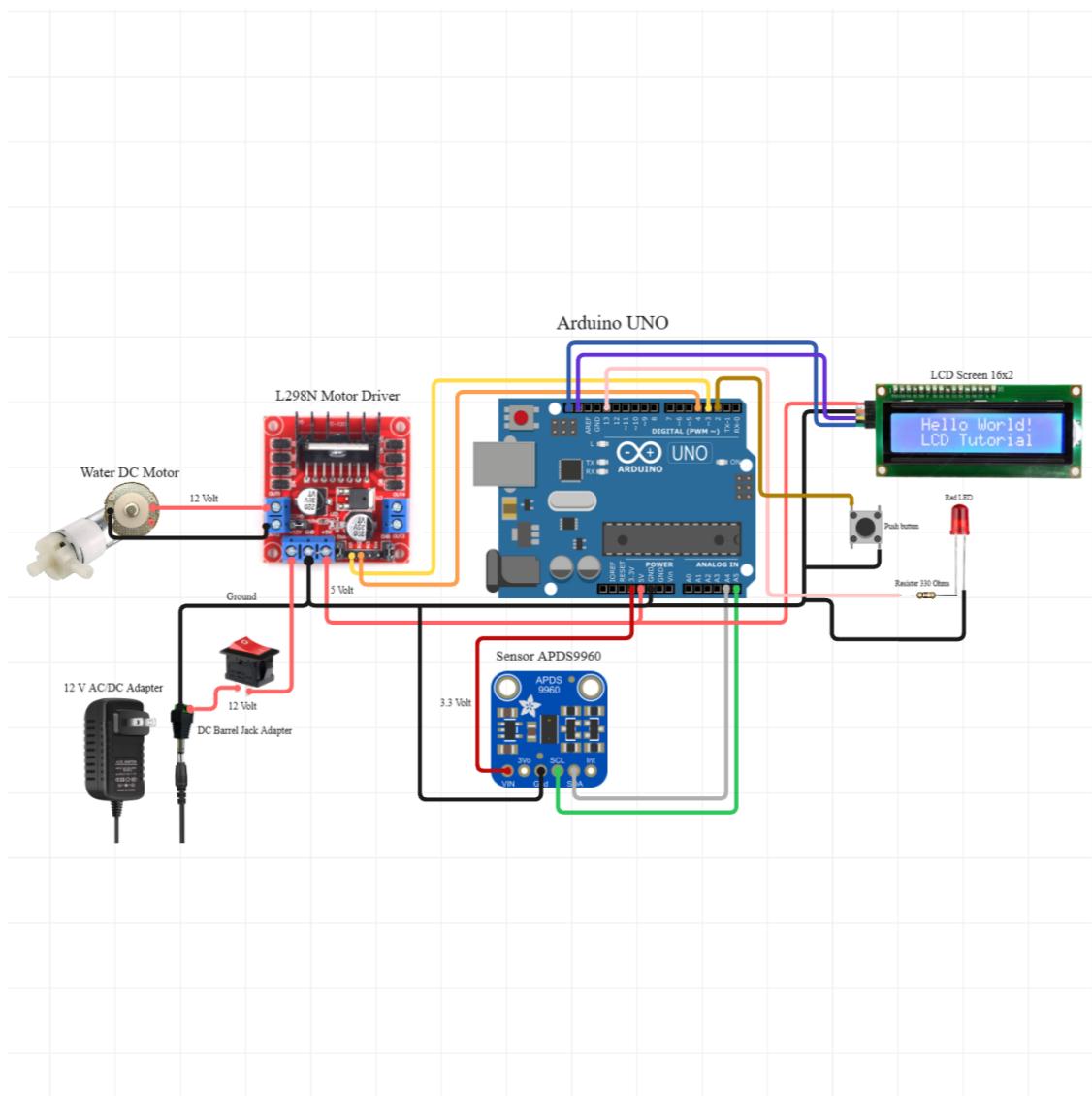


Figure 3: Wiring Schematic: Interfacing 12V pump load with 5V Arduino logic.

## 2 Room Temperature Monitoring Box

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*Role: Individual Design & Prototyping*

### Project Overview

Developed a standalone environmental monitoring unit capable of detecting ambient thermal fluctuations and providing immediate user feedback. The device monitors a "comfort zone" of 70°F - 75°F, utilizing a TMP36 analog sensor to trigger visual (LED) and audio (piezo buzzer) alarms when temperature thresholds are breached[cite: 318, 328].

### Key Technical Achievements

- **Circuit Design & Analysis:** Constructed a 9V-powered sensing circuit, utilizing Kirchhoff's Voltage Law (KVL) to calculate optimal current-limiting resistors ( $1k\Omega$  for Green LED,  $220\Omega$  for Red LED) to maximize brightness while protecting components.
- **Signal Processing Algorithm:** Wrote C++ firmware to process analog signals (0-1023 ADC values), converting voltage readings into precise Celsius and Fahrenheit temperature data for display on a  $16 \times 2$  LCD screen[cite: 418, 419].
- **Enclosure Fabrication:** modeled and fabricated a custom ABS enclosure ( $118 \times 146\text{mm}$ ) with precise tolerance cutouts for the LCD module and USB interface, employing twist-nut wire management for internal circuit reliability[cite: 339, 341].



Figure 4: Enclosure CAD Model

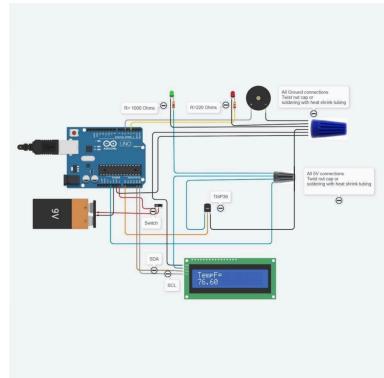


Figure 5: Circuit Wiring Diagram

## 3 Technical Skills

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- **Software & Programming:** C++ (Arduino IDE), CAD Modeling (SolidWorks/Onshape), LaTeX, Microsoft Office Suite.
- **Hardware & Fabrication:** Circuit Design & Analysis (KVL), Laser Cutting, Soldering, Rapid Prototyping, Sensor Integration (IR, Thermal, Ultrasonic), 12V/5V Power Systems, Finite State Machine Logic.