FRANK ZHAO

Green Card

HARDWARE + EMBEDDED FIRMWARE ENGINEER

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Senior hardware engineer with experience across the full product development lifecycle, from electrical design and embedded firmware to test automation and manufacturing support. Technical expertise spans battery and power electronics, machine vision, optics and camera sensors, RF, and reverse engineering.

CORE EXPERTISE

Hardware Schematic design, PCB layout, electronic prototyping, mechanical CAD.
Embedded C/C++, Python, C#; RTOS; platforms from 8-bit 8051 MCUs to modern ARM SoCs.
Battery + power electronics Li-ion batteries, BMS, power distribution, precharge, motor drivers, safety testing.
Camera sensors + optics + machine vision ; Interfaces + protocols + RF ; Fabrication + manufacturing

PROFESSIONAL EXPERIENCE

Senior Hardware Engineer 2014 – Oct 2026
Sony Interactive Entertainment / PlayStation San Mateo, CA

- Reimplemented the complete PlayStation wireless headset firmware from product specifications, adding DSP capability while achieving a smaller memory footprint than the previous ODM implementation. Worked on **all PlayStation wireless headsets** released between 2015 and 2020.
- Developed headset factory-automation tools and software for game developers to load custom EQ profiles over USB and later wirelessly; supported factory DSP tuning and manufacturing partners.
- Prepared products for battery safety certification: developed test procedures and conducted internal testing before submission to a UL certification laboratory.
- Developed latency instrumentation for **PlayStation Now** and **PlayStation Portal** network game streaming, and **PSVR**, including controller-triggered input and photodiode-based detection of screen response.
- Developed firmware for a VR eye-tracking platform combining four MIPI camera streams into USB 3.0; built IR illumination flex circuitry, frame-synchronized LED control, and an illumination-adjustment algorithm.
- Developed a single-shot camera calibration board and algorithm, enabling VR headset camera calibration with one board placed at a single location.
- Created camera tests and algorithms for MTF, lens axis, and noise characterization; used measured parameters to simulate camera behavior in Unreal Engine scenes for eye-tracking research.
- Conducted experimental research on holographic beam steering, including building a high-speed sampling instrument to characterize MEMS mirror dynamics.
- Conducted engineering interviews, maintained third-party partnerships, and trained colleagues across engineering, QA, and IT.
- Additional products: **DualShock 4 Back Button Attachment**, **PS One Classic**, and **Accessibility Controller**.

PATENTS + PUBLISHED APPLICATIONS | SONY / PLAYSTATION

US20260065509A1 — Varied density grid camera calibration chart
US12695990B2 — Eye tracking validation using robot eye system
US12592051B2 — Optimization of eye capture conditions for each user and use case
US12280508B2 — Reproducing fast eye movement using imaging of robot with limited actuator speed
US10850838B2 — UAV battery form factor and insertion/ejection methodologies
US10210905B2 — Remote controlled object macro and autopilot system
US20240073520A1 — Dual camera tracking system
US11833428B2 — Positional haptics via head-mounted peripheral
Two additional patent applications pending.

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ADDITIONAL ENGINEERING EXPERIENCE (CONTINUED)

Combat robotics | Electronics + firmware
Gigabyte / Robotic Death Company; independent community contributions

- Design anti-spark precharge power switches, compact radio receivers with integrated motor drivers, and motor encoders with noise-immune interfaces for combat robots.
- Contribute open-source radio firmware for safety features, motor-controller configuration, and telemetry; build custom firmware and publish electronics guides. Member of the BattleBots team behind Gigabyte.

Deputy Electrical Lead 2016 – 2017
rLoop | SpaceX Hyperloop Competition

- Designed battery modules for EV sized battery pack, the BMS, power-distribution circuitry, and a linear-actuator control board; modules integrated copper interconnects and temperature sensing.
- Trained recruits, reviewed resumes; Reviewed teammates' planned work to identify safety hazards and recommend precautions before they began.
- Team won the Innovation Award at the first SpaceX Hyperloop Competition.

ENGINEERING LEADERSHIP + COMMUNITY

Robotics mentor | Piedmont Pioneers / Piedmont Highlanders 2019 – Present
Mentor FIRST robotics teams, teaching engineering and fabrication skills to middle school and high school students, and ensuring their safety and inspiring creative problem solving.

Community teaching + repair
Makerspace volunteer at South San Francisco Public Library (2017–2019); Taught robotics, 3D printing, how to check email, etc. Helped residents diagnose and repair household items at Fixit Clinic.

Cross-disciplinary technical teaching | PlayStation R&D
Introduced the team's first 3D printer; taught 3D printing and soldering across engineering, QA, and IT.

SELECTED INDEPENDENT PROJECTS

My independent engineering projects reflect commercial-grade design sophistication and technical complexity. I also enjoy documenting and publishing my work, including technical writing, photography, and illustrations. Live hardware demonstrations available upon request.

USB + Bluetooth man-in-the-middle (2014) https://eleccelerator.com/usbxlater-2nd-proto/
Reverse-engineered DualShock 4 USB and Bluetooth traffic and built a custom electronics and firmware bridge for a PS4, keyboard, and mouse. Extended the ST USB stack for hub support and BTstack for controller communication. This project lead to PlayStation recruiting me.

Alpha-Fairy : Wireless camera control (2022) https://eleccelerator.com/alpha-fairy-wireless-camera-remote/
Wi-Fi camera remote control, as part of an open-source photography tool portfolio.

Hot-Wand : RF Soldering Iron (2026) https://eleccelerator.com/hot-wand/
RF soldering iron station similar to / compatible with a Metcal soldering station.

OpenMV Polar-Scope for Astrophotography (2019) https://eleccelerator.com/openmv-polar-scope/
Digital polaris alignment scope for astrophotography using OpenMV and Wi-Fi.

EDUCATION

UNIVERSITY OF WATERLOO — BASc (Hons.), Electrical Engineering — 2013