

ENGINEERING PORTFOLIO

Grace O. Zongo

Embedded Systems & Power Electronics

Firmware running in Antarctica. A 2nd-place competition electric boat. An 8-bit CPU built from scratch. Real systems, real results.

32 → 7 mA sleep mode

2nd Place PEP 2024

Antarctica deployment

grace.o.zongo@gmail.com · zongr-ce.github.io · linkedin.com/in/grace-ozongo



B.S. Electrical Engineering

UW–Madison · Expected May 2027

TOOLBOX

Skills & Education

LANGUAGES

- C / C++
- Python
- VHDL / Verilog
- MATLAB

HARDWARE

- PCB Design (KiCad, Altium)
- FPGA (Quartus)
- Oscilloscope / DMM
- Soldering & Bring-up

EDUCATION

University of Wisconsin–Madison

B.S. Electrical Engineering

Sept 2024 – Present · Expected May 2027

Madison College

Associate Degree · Liberal Arts Transfer (STEM)

2022 – 2024 · Dean's List, Perfect Honors (5 semesters)

PROTOCOLS

- USART / UART
- I²C / SPI
- CAN Bus
- GPIO / ISR / Timers

TOOLS

- Git / GitHub
- Linux / Bash CLI
- VS Code
- Doxygen

SELECTED AWARDS

Karen Roberts Leadership Award (2024)

Highest recognition for MATC student leaders

Student Tutor of the Year (2023)

Int'l Student Volunteer of the Year (2024)

100+ volunteer hours in one year

Automatic Weather Station · Antarctica

A data logger for climate research built to replace very expensive commercial units. Custom ATmega2560 PCB reads PRTs, a 215AX barometer, HMP155A humidity, SR50A snow depth, a radiometer, and an RM Young wind sensor; data goes out over an Iridium satellite modem.

- **Low-power sleep mode:** powers down sensor translators and the Iridium modem between cycles; an RTC alarm on an interrupt pin wakes the board every 10 minutes.
- **Modular state machine:** restructured around sensors and the modem, so adding a new sensor is a self-contained change.
- **Unified sampling:** one timer gates a 2–4 s window while a second, externally clocked timer counts sensor pulses (wind & barometer).
- **C++ sensor drivers** with Doxygen docs; NAND-flash local logging in progress.

32 → 7 mA

idle current, ≈78% lower

1 year

autonomous Antarctic operation

10 → 1.5 min

active time per cycle

ATmega2560

Iridium telemetry

WAMC 2026 presentation

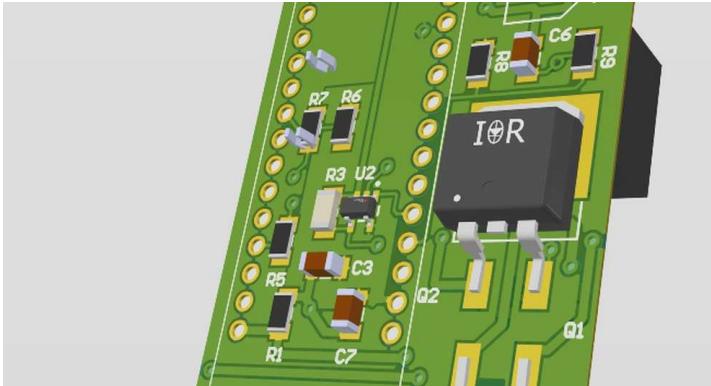
NSF-supported

Bare-metal C++

AWS hardware, deployment-ready enclosure

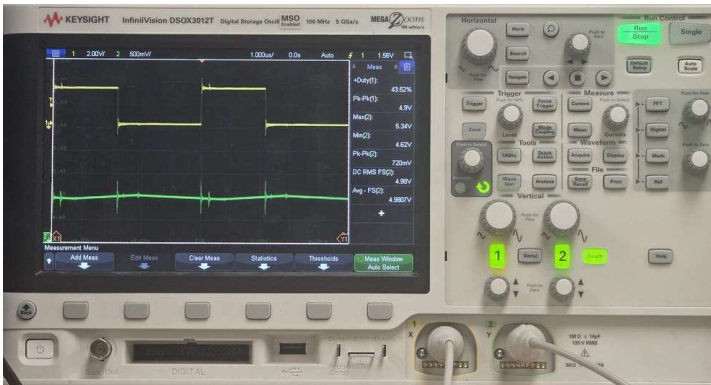


Digitally Controlled Buck Converter



Synchronous DC-DC buck converter with a UART-programmable output. Designed, simulated, built, and debugged end to end.

- **Bare-metal C** on **STM32G431KB** at 170 MHz; every peripheral configured by direct register writes.
- **200 kHz PWM** into an IR2104 half-bridge driving synchronous IRLZ44N MOSFETs.
- **10 kHz PID loop** with anti-windup, soft-start ramp, and a latching 3.2 A overcurrent fault.
- **ADC + DMA feedback**; INA180A2 current sense across a 20 mΩ shunt.
- **Live UART tuning**: setpoint and PID gains adjustable without reflashing.



Altium 3D render · regulated 5 V output on the bench

1.8–10 V

programmable output

200 kHz

switching frequency

10 kHz

digital control loop

Altium PCB

LTspice verified

Bench-debugged bring-up

TEAM PROJECT • PEP COMPETITION

Electric Boat • Battery & Propulsion

Dual-battery propulsion system for a competition boat, built with a team and validated on the water.

- **Two custom 6s8p 18650 packs**, spot-welded, vibration-wrapped, and sealed in waterproof enclosures.
- **JK-BMS** for balancing, monitoring, current limiting, and short-circuit protection.
- **Dual 1 kW Blue Robotics T500 thrusters**, one per battery.
- **Differential-thrust steering** eliminated the rudder entirely.
- **Load-tested at ~50 A** with minimal temperature rise; no active cooling needed.

2.5 h

runtime at ~8 knots

~20 mi

estimated range

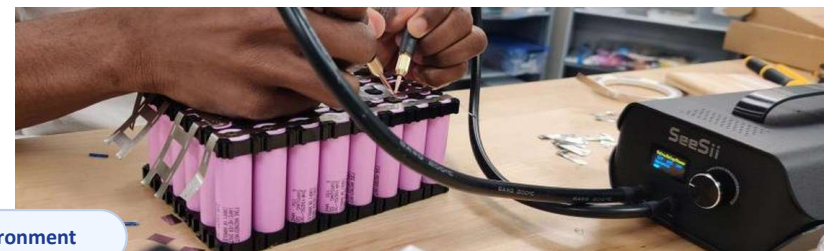
2× 1 kW

thrust, twin T500s

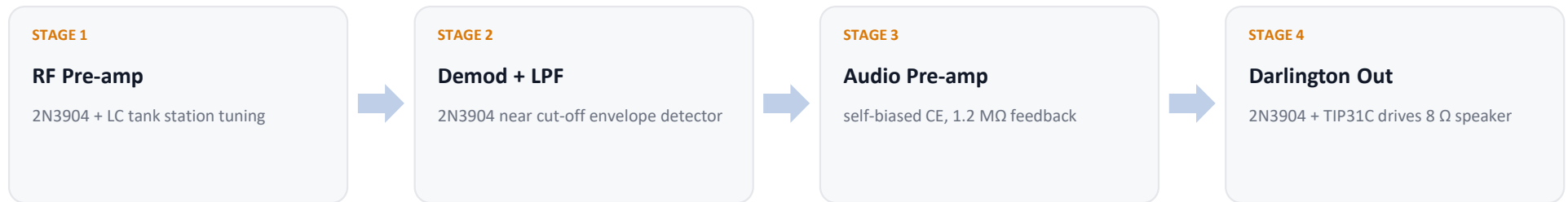
🏆 **2nd Place • PEP 2024 (Displacement Hull)**

Li-ion pack build

Marine environment



AM Radio Receiver · Discrete 4-Stage Design



- **Full receive chain** from antenna to speaker on a custom Altium PCB.
- **Verified in LTspice:** operating point confirmed for all five transistors; transient run shows clean demodulated audio.
- **Ground pour removed around the LC tank** to keep noise out of the tuned circuit.
- **DPDT switch** selects AM input or a 3.5 mm microphone jack.

~330 mW

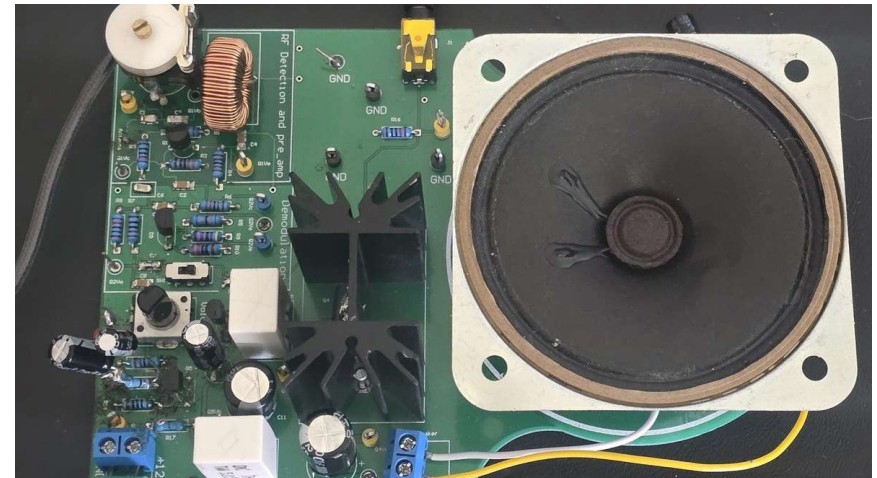
into the 8 Ω speaker

530–1700 kHz

AM band coverage

~\$47

full BOM



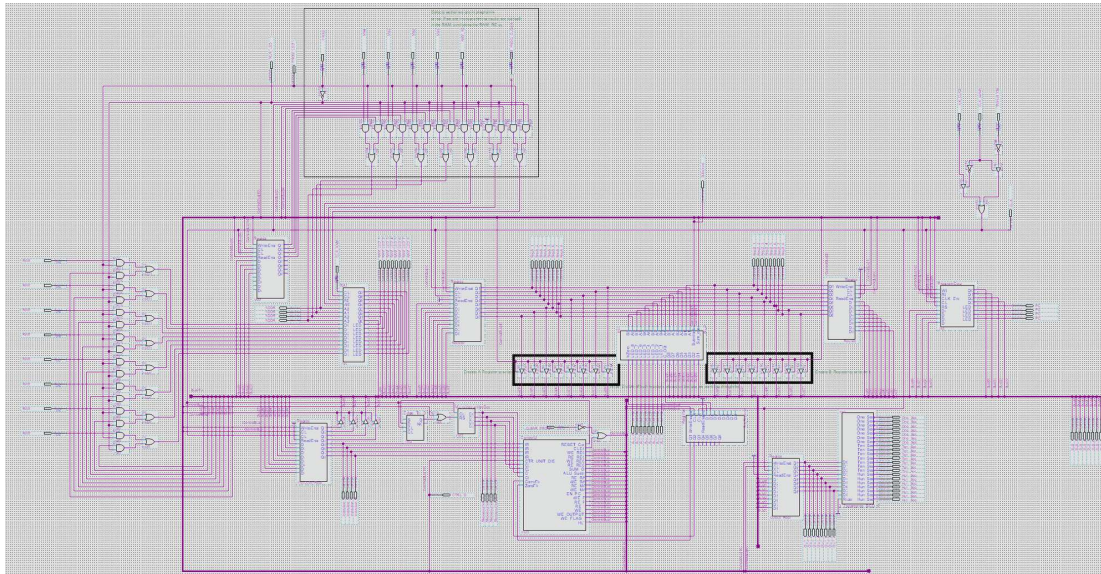
Populated receiver board with speaker

Altium PCB

LTspice verified

12 V supply

8-Bit CPU · From FPGA to PCB



Datapath + control unit, block-diagram design in Intel Quartus

PHASE 1 · FPGA

- Program counter, registers, RAM, ALU, and control logic.
- Custom instruction set; execution verified with testbenches and waveform analysis.

PHASE 2 · PCB

- Register, RAM, and 4-bit decoder boards designed and brought up on a custom PCB.
- Power and routing constraints that never show up in simulation.

~15 kHz

stable clock after fixing timing violations

100%

implemented instructions executed on
FPGA

Intel Quartus

Custom ISA

Hardware bring-up

More Hardware Projects



Reflex Game · ECE 315

- Multi-sheet Altium PCB around a XIAO RP2350.
- 12-LED chain, buzzer driver with flyback protection.
- Voltage supervisor + watchdog beyond the MCU's own POR.



555 Timer Clock Module

- Monostable, astable, bistable modes on one board.
- Manual trigger up to ~10 kHz astable clock.
- KiCad PCB; scope-verified frequency and duty cycle.



Occupancy / Motion Sensor

- Low-cost presence sensing for energy-efficient automation.
- Sensor + signal conditioning on a compact custom PCB.
- Validated detection across test scenarios.

WORK & LEADERSHIP

Experience

AWS Student Intern • Embedded Systems

Apr 2024 – Present

Space Science & Engineering Center (SSEC), UW–Madison

Antarctic AWS firmware: 32 → 7 mA sleep mode, C++ sensor drivers, adaptive sampling, USART/I²C links to the satellite modem. Co-author, WAMC 2026.

Design Engineer Intern

May 2025 – Dec 2025

Alpha Controls & Services • Middleton, WI

HVAC controls: electrical schematics and wiring diagrams from submittals, material takeoffs, cost estimates, intro DDC programming.

Low Voltage Team

Dec 2024 – Present

Badger Solar Racing • UW–Madison

CAN integration between vehicle modules; Altium PCB design for the control board and brake system.

Electrical Engineering Intern

Jun 2022 – Aug 2022

Bemis Manufacturing Company • Madison, WI

Prototype concept for a smart health-monitoring bidet seat; feature selection with a Pugh matrix.

GET IN TOUCH

Let's connect!

Email grace.o.zongo@gmail.com

Portfolio zongr-ce.github.io

LinkedIn linkedin.com/in/grace-ozongo

GitHub github.com/zongr-ce



Scan for the full portfolio