Nuno Soares Brandão

Aerospace Engineer · Full-stack, IoT, Embedded & AI

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"Be the change you want to see in the world"

Experience

Personal Technical Enrichment

Lisbon, Portugal

Full-Stack Developer, Systems Architect & AI-augmented workflows

September 2024 - Present

A break to regain sanity and enrich my technical knowledge. Focused on bridging hardware-software gaps using cloud infrastructure to allow users to control/monitor devices from remote locations. Implementing state-of-the-art Web Applications for backend and frontend services. Exploring and leveraging AI-augmented workflows and AI agents. During this period I built:

- **Personal Portfolio WebApp:**
  - Developed and deployed a personal portfolio as a full TanStack Start SSR application on Cloudflare Workers.
  - You can check my portfolio for a better overview (and also for a deep engineering analysis of the technical stack used) on the projects I built.
- **Aeroponics IoT Device + Web Infrastructure:**
  - Architected and built my **Aqua Farmers** personal project. A device + web platform for precise Aeroponics (cultivating plants in an air or mist environment), implementing a real-time Digital Twin paradigm for cloud state sync.
  - This project has two separate codebases, one is a monorepo comprising all the web-infrastructure apps and packages, the other is a FreeRTOS (CMake based compilation) that was architectured with 5 different layers (Application, Communication, Data, Hardware and Orchestration) for a clear separation of concerns.
  - Designed (and built) the device that has an ESP32s3 (dual-core) MCU running FreeRTOS firmware. The firmware uses I2C, one wire, and analog signals to read/control sensors/actuators, and WebSockets (migrated from MQTT) to communicate with the cloud.
  - Designed the synchronization of state between the device and cloud, with a Cloudflare-native edge backend composed of Cloudflare Workers, Cloudflare Durable Objects, Cloudflare Hyperdrive, and Cloudflare R2.
  - Exposed system state through a reactive dashboard built with TanStack Start (React) that allows the user to control the device.
- **Automatic Trading Platforms (two architectural iterations):**
  - *v1 — Distributed multi-tenant trading bot* (Python · Quart · Celery · Redis · MySQL · Docker · Nginx). Ingests HTTP requests from another script that performs the analysis and triggers actions. Fans out into a deliberately mismatched **dual-queue Celery architecture**, allowing for separation of concurrent and non-concurrent ops.
  - *v2 — Event-driven research-and-execution platform* (TypeScript · NATS JetStream · TimescaleDB · Fastify · TanStack Start UI · FastAPI · LightGBM · DuckDB · Web Workers · Docker). Architected **five independent peer services** that communicate solely via the NATS message broker. This app allows the user to create strategies and deep backtest them in the past, to train an ML model over the strategy results, and to set automated orchestrators for strategies that executes actions on the broker on my behalf.
- **Smart Locker Discovery Service (IoT):**
  - Developed a Smart Locker Discovery Service as part of an IoT technical challenge.
  - Implemented Modbus RTU/RS-485 communication with heuristic O(N log N) grid mapping.
  - Designed hardware substitution detection mechanisms.
  - Exposed functionality via a FastAPI REST interface and containerised the system using Docker.
- **Desktop Tools (Python):**
  - Built an ESP32 OTA Manager with reactive firmware and partition orchestration capabilities.
  - Developed a Test Executor for automated ESP-IDF hardware testing pipelines.

Thales EDISOFT - Embedded Systems Engineer

Oeiras, Portugal

Triton-X Project

February 2022 - September 2024

- **System architecture:**
  - Manufacturing of a custom system with 16 MCUs connected to provide a testing infrastructure for the Triton-X satellite Digital Main Board (DMB), Remote Terminal Element (RTE) and Power Conversion Unit (PCU) boards.
  - Manufacturing of the harness needed for each board to interact with the system.
  - Developped a testing library (an API written in C) to be used by the test developpers. This library would communicate with the system MCU's with the purpose of creating an abstraction layer, allowing an easy and straightforward way for the testers to interact with the satellite boards.
  - Created and maintained virtual machines for the project use and deliver to client.
- **Embedded systems:**
  - Development of a codebase (FreeRTOS) that allows compile time configuration and real-time configuration (via TCP) of the MCU functionality as needed. This codebase was used to flash 6 SAM V71 Xplained Ultra MCU's. The devices would receive messages from a C code (running on a PC) and parse them to low-level communication protocols (CAN, SPI, UART) to send to the satellite mainboard.
  - Development of a single codebase (using esp-idf RTOS) that allows compile time configuration. This codebase was used to flash 10 esp32s2 MCU's. The devices would work either as a DAC or an ADC:
    * DAC: MCUs received TCP messages and set specific pins to desired voltages using PWM modulation followed by a low-pass filter.
    * ADC: MCUs received TCP messages to activate readings on certain pins and periodically sent the read voltages via TCP.
- **Network architecture and analysis:**
  - Built a local network and connected the devices, assigning a static IP to each device.
  - Managed an IP table for all the devices in the lab.
- **Batch, bash, and Python scripting:**
  - Developed several auxiliary tools to allow for an easy and straightforward usage of the testing system infrastructure.
- **Software testing:**
  - Developed tests for the software of the DMB of the satellite.

Técnico Solar Boat (TSB) - Electrical Systems

Lisbon, Portugal

Design of a Photovoltaic System

September 2017 - April 2019

- **Project Overview:**
  - Técnico Solar Boat (TSB) is a project initiated by students at Instituto Superior Técnico (IST) to compete in Monaco Solar and Electrical Boat Annual Challenge.
  - The team followed strict technical regulations to participate in the competition, promoting innovative and sustainable marine technologies.
- **Technical Contributions:**
  - Designed and elected the solar panels, charge controllers, and battery systems to meet project needs.
  - Documented the design process for future teams and competition submissions.
  - Worked with interdisciplinary teams to align the electrical system with mechanical and naval designs.

Education

Masters Degree in Aerospace Engineering

Lisbon, Portugal

Instituto Superior Técnico (IST)

Sept. 2015 - Dez. 2022

- 1^{st} Cycle: Grade Average 15.40/20 (Diploma of Merit in 2016/2017)
  Developed deep knowledge on concepts related to Mathematic analysis, Quemistry, Physics, Aerodynamics, Computer Science, Programming, Digital Systems, Eletronics, Eletromagnetism and Eletromecanic Systems.
- 2^{nd} Cycle: Grade Average 15.05/20
  Masters focused on Systems and Control, with courses on Telecommunications, Antennas, Robotics, Artificial Inteligence, Avionic Systems, Systems Programming and Control of Real time systems.
- Master's Dissertation: Grade 18/20 - **Thesis Link**
  Developed a patch antenna array to be used as a part of a Radar System simulated in a 3D environment, with the objective of inferring a map of the surroundings and position the Radar within that map using a SLAM algorithm.

Faculdade de Farmácia da Universidade de Lisboa *Lisbon, Portugal*

Masters Degree in Pharmaceutical Sciences *Sept. 2014 - July 2015*

Finished 1^{st}Year. Studied Human Anatomy, Celular Biology, Quimics, Histology and Embriology;

High School - Science and Technology *Cascais, Portugal*

Escola Secundária de Cascais *Sept. 2011 - July 2014*

- Grade Average: 16.5/20.
- Key Achievements: Mathematics Exam - 19.3/20, Physics and Chemestry - 18.5/20

Self-Driven Activities

For more details about me, my profile, technical capabilities and to see more details of what I've built, please check my personal portfolio website (link in the CV header).