ALEXEI KHACHATRIAN

Embedded Systems Engineer • ESP32, Raspberry Pi, Custom Hardware

Yerevan, Armenia • alexey.khachatryan@gmail.com • +374 98 888 142 khachatryan.dev • github.com/alkhachatryan • linkedin.com/in/alexei-khachatrian

SUMMARY

Embedded systems engineer with strong systems background — 10+ years across backend and distributed systems combined with hands-on hardware work. Author of DTLP (a custom 8-channel optical laser data transmission protocol on dual ESP32 boards) and MeshLink (an ESP-NOW mesh sensor network with custom packet framing, hop limits, and ring-buffer deduplication). Comfortable across ESP32 and Raspberry Pi, with the full surrounding hardware stack: temperature, pressure, light, motion, gas, and other environmental and presence sensors; motor drivers; displays; relays; and multiple radio links (Wi-Fi, ESP-NOW, LoRa / LoRaWAN, Bluetooth). Currently designing my first custom PCB for the DTLP machine. Soldering and bench-prototype assembly are a regular part of my workflow. Also brings full backend and cloud experience for IoT systems that need a server side. Pursuing a PhD in Computer Science (expected 2029).

EMBEDDED & HARDWARE PROJECTS

DTLP — Data Transmission Laser Protocol

github.com/data-transmission-laser-protocol

Custom bidirectional laser-based communication protocol I designed and implemented on dual ESP32 boards. Eight parallel laser channels per machine yield ~8 kbit/s throughput by transmitting one byte (8 bits) in parallel per millisecond. Built on ESP-IDF with FreeRTOS task pinning to core 1, custom handshake (all-channels-high for 100 ms), bit-level synchronization, optional XOR encryption and LZ4 compression, and a TFT status display. Hardware design includes NPN transistor low-side switching to drive 5 V lasers from 3.3 V GPIOs, careful handling of strapping pins, and an aiming mode for physical alignment.

Stack: ESP32, ESP-IDF, FreeRTOS, C/C++, PlatformIO, ILI9341 SPI display.

MeshLink — ESP-NOW Sensor Mesh + FastAPI Dashboard

Open-source • ESP32 firmware + Python server

Wireless sensor mesh I designed end-to-end. ESP32 nodes broadcast environmental readings (currently barometric pressure) every 3 seconds over ESP-NOW on a shared channel. Each node validates a 16-bit network token, enforces a max-hops limit, and deduplicates packets via a 64-entry ring cache keyed on (origin_node_id, msg_id) before rebroadcasting — nodes without sensors run in relay-only mode. A Python FastAPI server reads parsed serial output from a gateway node, maintains a 3-hour rolling time-series per node, and pushes live snapshot / reading / status / alias events to a browser dashboard over Server-Sent Events. Planned extensions: in-mesh relay modules to switch lights, TVs, and other devices on/off; motion sensors to log movement and drive automations such as motion-triggered lights and media in each room.

Stack: ESP32, ESP-NOW, environmental sensors over I2C, packed C structs for the wire format, PlatformIO, Python, FastAPI, SSE.

HomeSauron — ESP32 Camera Surveillance System

Open-source • ESP32-CAM (AI-Thinker) + Laravel aggregator

Full-stack home surveillance system I built end-to-end. ESP32-CAM AI-Thinker nodes capture and stream JPEG frames over the local network; a Laravel aggregator pulls the MJPEG streams, re-publishes frames to Redis pub/sub for live viewing, batches them into MP4 files via ffmpeg, and self-heals dropped camera processes. Cameras are tracked by hostname so that Wi-Fi-driven IP changes resolve automatically. The embedded side covers the AI-Thinker hardware, JPEG capture pipeline, and network streaming under tight resource constraints.

Stack: ESP32-CAM (AI-Thinker), MJPEG over Wi-Fi, Laravel 11, PostgreSQL, Redis, ffmpeg, Docker, Google Drive API.

EMBEDDED & HARDWARE SKILLS

Platforms: ESP32 (WROOM-32U, AI-Thinker ESP32-CAM, NodeMCU-32S and similar), Raspberry Pi

Frameworks: ESP-IDF, PlatformIO, CMake

RTOS: FreeRTOS — task pinning to specific cores, custom stack sizing, watchdog management

Radio / Wireless: Wi-Fi, ESP-NOW, ESP-MESH, LoRa, LoRaWAN, Bluetooth, custom optical (laser) protocols

Sensors: Temperature, pressure, humidity, light, motion, gas, and other environmental and presence sensors over I2C / SPI / 1-Wire

Actuators & Drivers: DC and stepper motors with corresponding driver ICs, transistor-based switching (NPN low-side drivers), relay modules

Displays: SPI TFT displays and similar

Hardware Work: Soldering and bench-prototype assembly, breadboarding, currently designing my first custom PCB for the DTLP machine, GPIO design, strapping-pin handling, wiring design

Protocol Design: Handshake design, bit-parallel framing, signal inversion handling, end-of-transmission markers, mesh deduplication, optional XOR encryption and LZ4 compression

Languages: C / C++ (embedded), Python (host-side tooling and dashboards), Bash

SUPPORTING BACKEND & CLOUD

Strong full-stack background that complements embedded work — useful for any IoT system that needs a server side. 10+ years of backend, cloud (AWS / GCP), and operations experience, plus distributed team leadership. See full experience section below.

PROFESSIONAL EXPERIENCE

Senior Software Development Engineer

NGA — Next Generation Advanced *Dec 2023 — Present*

- Building automation software for emergency-services platforms deployed internationally, primarily in the US.
- Operating one of our platforms at approximately 600 requests/second and architecting the path to 1000 RPS; backend systems where reliability and latency are non-negotiable.

Python Developer

Wildbox.ru *Mar 2023 — Dec 2023*

- Built analytics features for a Wildberries-marketplace platform on a ~2 PB PostgreSQL dataset.
- Worked on query performance, ingestion, and feature development under heavy data volume.

Lead Software Development Engineer

Akvelon, Inc. *Mar 2022 — Mar 2023*

- Led a developer team building an information-security SaaS B2B product.
- Ran one-week sprints, daily stand-ups with client and team, code reviews, and CI/CD pipelines.
- Architected and operated infrastructure across Azure, GCP, and AWS in parallel.

Senior Software Development Engineer

2amigos Consulting Group *Aug 2020 — Mar 2022*

- Delivered backend systems across financial, messaging, and accounting verticals.
- Worked across multiple stacks and teams; collaborated closely with DevOps, frontend, and QA.

Lead Software Development Engineer

iNexxus *Oct 2017 — Mar 2020*

- Built Virtual Publicist (virtualpublicist.com) from scratch as the lead engineer — a music-industry PR platform on Laravel + PostgreSQL + Redis + ElasticSearch, deployed on a dedicated Hetzner CentOS server with AWS SES / SQS, scaled to a multi-million-row contact dataset before release.

- Recruited and led a team of two frontend engineers, one backend engineer, and a QA over three years; coordinated cross-functionally with designers, content writers, and marketing.
- Operated two dedicated CentOS Linux servers hosting 50+ WordPress sites for clients and volunteers.
- Owned security: penetration testing and exploit testing across our infrastructure and client sites.

Freelance Backend Lead (side work)
Self-employed *Apr 2017 — Aug 2020*

- Led a distributed backend team across Spain, Russia, Ukraine, Armenia, and Israel for an Israeli–American e-commerce project.
- Acted as lead developer setting architecture, code standards, and delivery cadence.

Web Developer
Web Foundation *Aug 2016 — Apr 2017*

- Built sites and platforms across WordPress / WooCommerce, CodeIgniter, CakePHP, Magento 1.9 and 2.0, and custom PHP / JS stacks.

Web Developer
Ayrosa — Digital Marketing Agency *Jun 2016 — Aug 2016*

- Built a Yii2-based personal account system for users of an online store on SimplaCMS; handled backend, frontend, server, and hosting.

RESEARCH

PhD Researcher — Bioinformatics Lab Collaboration
European University of Armenia / Bioinformatics Group (Armenia) *Mar 2025 — Present*

Applied research at the intersection of computer science and bioinformatics. Building Python-based automation tools for molecular and protein analysis, including: (1) an aggregator that pulls data from major protein banks (e.g. RCSB PDB) into a unified internal dataset; (2) an AI-driven recommendation system that infers a researcher's interests from their browsing behavior across our protein catalogue and surfaces related entries; (3) a drug-design automation pipeline that takes a candidate molecule from a pharmaceutical lab and simulates its interaction against every human protein in multiple binding positions to predict whether it would help or damage the target. Heavy compute workloads run on the Aznavour supercomputer.

EDUCATION

PhD in Computer Science (in progress)
European University of Armenia *2024 — 2029*

Research focus: software automation. Applied work at the intersection of computer science and bioinformatics — automation tools for molecular and protein analysis, including protein-bank data aggregation, AI-driven research recommendation, and drug-interaction simulation on the Aznavour supercomputer.

MSc in Computer Science
European University of Armenia *2021 — 2023*

BSc in Computer Science
European University of Armenia *2011 — 2017*

CERTIFICATIONS & OPEN SOURCE

- **Laravel Certified Developer** — Laravel.com (2021)
- **TestDome PHP — Gold** (Top 10% Worldwide, 2018)
- Active open-source contributor since 2017 — author and maintainer of embedded and security libraries across the Electr0Hub, data-transmission-laser-protocol, and krypt0ra GitHub organizations.

LANGUAGES

English (professional), Russian (native), Armenian (native).