İshak Alkuş

Senior Embedded Systems Engineer & IoT Specialist

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About Me

Senior Embedded Systems Engineer with **10+ years of hands-on experience** specializing in IoT solutions, firmware development, and HVDC systems. Proven track record of delivering **50+ commercial deployments** across smart home, industrial IoT, and environmental monitoring sectors. My background spans wireless communications, low-power design, and leading technical teams on complex embedded projects.

Key Expertise: Firmware Development | IoT Architecture | Battery Management Systems | Wireless Communications | Project Leadership | Industrial HAL Development | Full-Stack IoT Applications

Core Technical Skills

Programming Languages: C, C#, Python, JavaScript (partial), TypeScript (partial)

Microcontrollers: STM32, ESP32, PIC, nRF Series

Wireless Protocols: LoRaWAN, WiFi, BLE, NB-IoT, ESP-NOW

Communication Protocols: ModBus RTU/TCP, RS485, UART, I2C, SPI, CAN, HTTP, MQTT, WebSocket

Development Environments: VS Code, STM32CubeIDE, Keil µVision, Segger Embedded Studio

Operating Systems: FreeRTOS, Zephyr, Linux (Embedded), Bare-metal programming

PCB Design: Eagle (Primary), KiCad, Altium Designer

Web Technologies: React, Node.js, Flask, REST APIs, WebSocket

DevOps & Deployment: Docker, systemd, Raspberry Pi, Git, Linux system administration

Test Equipment: JTAG/SWD Debuggers, Oscilloscopes, Logic Analyzers, Power Analyzers

Professional Experience

Senior Embedded Systems Engineer | CRATUS - Remote

2022 - Present

LOMA AI Hardware Abstraction Layer

Architected and developed a production-grade Hardware Abstraction Layer (HAL) for industrial IoT edge computing that bridges low-level Modbus control boards with modern cloud-based microgrid energy management systems, featuring a sophisticated three-tier abstraction architecture, service-oriented design, and bidirectional WebSocket integration.

- Abstracted 3,284 raw Modbus registers across multiple industrial control boards with three-tier mapping system (Protocol → Register → Service)
- Created service-oriented architecture with 12 service types and 111+ instances, achieving 100% register coverage
- Developed intelligent batching algorithm reducing read operations by 95% (100+ → 5-10 operations)
- Achieved 95% code reusability with dual-mode architecture supporting simulation and production hardware

- Reduced development time through modular design
- Built physics-based simulation with fault injection framework (8 fault types) for testing before applying to the real devices.
- Implemented bidirectional WebSocket client with automatic device registration and standalone mode
- Created automated Raspberry Pi deployment with systemd service integration and comprehensive health monitoring

ESP-NOW End-to-End Communication System

- Designed and implemented ESP-NOW communication end-to-end (UART to UART between devices)
- Developed custom firmware with ACK mechanism and heartbeat (live pair detection) beyond standard ESP-IDF features
- Implemented runtime pairing with smart pairing algorithm to avoid collisions and confusion

High-Speed UART to WebSocket Bridge

- Designed and implemented UART to WebSocket bridge with extremely high data rates using ESP32

Smart BESS Calculator Web Application

Developed full-stack web application with React, Node.js, and Python for Battery Energy Storage System planning.

- Integrated real data from public API endpoints for climate conditions, sunlight durations, and location data
- Built comprehensive survey system collecting building size, roof area, and electricity usage parameters
- Implemented recommendation engine for BESS components (batteries, inverters, solar panels)
- Calculated consumption, production, total profit, and ROI times for residential, commercial, and industrial systems

IoT Device Architecture & Firmware Development

- Developed 10+ different WiFi/BLE connected devices for smart home and industrial applications
- Created 30+ custom firmware libraries for sensors, communication modules, and peripheral integration
- Designed modular "Lego-style" IoT platform allowing mix-and-match connectivity (BLE, LoRaWAN, NB-IoT)
- Led cross-functional teams in complex embedded projects

Manufacturing & Testing Infrastructure

- Developed comprehensive manufacturing test software using C#, Python, and JavaScript
- Implemented Over-The-Air (OTA) update mechanisms for remote firmware deployment
- Created automated testing frameworks ensuring product quality and reliability

High Voltage DC Systems (HVDC)

1. Engineered BMS solutions for applications ranging from 24V small-scale to 800V high-voltage systems
2. Developed custom development bench for battery gauge SoC validation and testing
3. Integrated wireless connectivity, CAN, and RS485 communications into battery systems
4. Implemented modular, scalable management architectures for EV and energy storage applications

Embedded Systems Engineer | SKYSENS

2018 - 2021

LoRaWAN Network Solutions

- Developed 20+ different LoRaWAN device types for environmental and industrial monitoring

- Successfully deployed across 50+ business sites including BRİSA, Istanbul Airport, Kale Factories, and Vestel
- Achieved 20+ km communication range in rural environments
- Optimized power management to deliver 10+ years battery life using single AA-size LiSOCl2 batteries

Industrial Integration & Innovation

- Designed OTA programmable ModBus device integration for industrial control systems
- Developed specialized solutions for magnetic car park detection and wildfire monitoring
- Built manufacturing test suites and update systems using Python and C# for production scalability

Research Engineer | TÜBİTAK & İzmir Katip Çelebi University

2016 - 2018

- Led research project: "Robust Adaptive Controller Design and Applications with Guaranteed Online Stability"
- Designed and simulated adaptive control systems using MATLAB & Simulink
- Tested algorithms on drones, inverted pendulums, chaotic mixers, and robotic systems
- Published 2 peer-reviewed conference papers on adaptive control applications

Key Projects & Achievements

- **Firmware Library Architecture:** Developed 30+ reusable libraries with standardized APIs reducing development time by 50%
- **Industrial HAL System:** Abstracted 3,284+ Modbus registers enabling non-embedded engineers to interact with industrial hardware
- **Modular IoT Platform:** Created plug-and-play architecture reducing time-to-market by 60%
- **Large-Scale Sensor Networks:** Achieved 99.5% uptime across distributed LoRaWAN networks globally
- **HVDC System Integration:** Developed scalable BMS architecture supporting 24V to 800V systems
- **Ultra-Low-Power Design:** Pioneered 15-year battery life solutions, reducing power consumption by 70%

Leadership & Client Management

- Successfully managed 30+ embedded systems projects from concept to deployment
- Guided and trained multiple junior engineers and fresh graduates
- Direct technical consultation and support for complex IoT and Industrial implementations
- Successfully performed extensive client support and technical consultation for many clients throughout project lifecycles.
- Led interdisciplinary teams in complex technical projects

Industry Focus Areas

Smart Home & Building Automation • Environmental IoT & Monitoring Systems • Industrial IoT & Process Control • Battery Management & Energy Storage • Electric Vehicle Systems • Microgrid Energy Management • Agricultural Technology • Transportation & Infrastructure

Education

M. Eng. Electronics Engineering | Ege University | 2018-2020 (not completed due to COVID-19)

B.S. Electrical & Electronics Engineering | İzmir Katip Çelebi University | 2012-2016

Exchange Program - Telecommunications Engineering | Poznan University of Technology | 2014