

VARUN CUMBAMANGALAM

Senior IoT & Edge AI Engineer

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PROFESSIONAL SUMMARY

Senior IoT and Embedded Systems engineer with 7+ years delivering end-to-end products across healthcare, wearables, and fitness-tech. Core expertise spans edge AI deployment (EfficientNet-B0, ONNX Runtime, TFLite, INT8 quantization), real-time firmware (FreeRTOS, BLE/GATT, MQTT), embedded hardware (ESP32, Raspberry Pi 5/Zero 2W, STM32, nRF52), and AWS IoT cloud pipelines. Shipped ML models achieving 94.7% accuracy across 11 disease categories and 92% on-device accuracy at <50ms inference on Cortex-M. Led an 8-engineer cross-functional team delivering a regulatory-grade medical device platform. International experience across the US, UK, Belgium, and India.

TECHNICAL SKILLS

Embedded & Firmware

ESP32, STM32, Raspberry Pi 5/Zero 2W, nRF52, FreeRTOS, Arduino, PlatformIO

IoT & Protocols

BLE/GATT, MQTT, I2C, SPI, UART, AWS IoT Core, Wi-Fi, AES-256-GCM

Robotics & Control

ROS, SLAM, PID, Impedance Control, Path Planning, Simulink

ML & Edge AI

ONNX Runtime, DirectML, EfficientNet-B0, INT8 Quantization, TensorFlow Lite, Edge Impulse, PyTorch, OpenCV

Sensor Fusion & DSP

IMU, Strain Gauge, Load Cell, Kalman Filter, Real-Time DSP

Tools & Practices

Git, Docker, GitHub Actions, CI/CD, HIL Testing, SQLCipher, Agile/Scrum

CAD & Simulation

OnShape, SolidWorks, MATLAB/Simulink

Languages

Python, C/C++, MATLAB

PROFESSIONAL EXPERIENCE

Senior Engineer – Technical Lead | *OraLens Healthcare*

Bengaluru, India

May 2024 – Present

- Led 8-engineer cross-functional team building a cloud-connected medical device platform; established architecture patterns and code standards that passed regulatory review on first submission.
- Architected dual-hardware IoT system (ESP32 + Raspberry Pi 5 / Pi Zero 2W) with AES-256-GCM encrypted BLE provisioning, MQTT cloud sync to AWS IoT Core, and 72-hour SQLCipher offline buffer with SHA-256 deduplication — serving 500+ active patient sessions in production.
- Trained and deployed an EfficientNet-B0 disease classification model (ONNX Runtime + DirectML) achieving 94.7% test accuracy across 11 oral disease categories on a 78,000-image dataset; integrated into a screening pipeline that reduced clinician review time by 30%.
- Applied INT8 ONNX quantization to on-device inference, achieving 2-3x speedup over FP32 with <2% accuracy loss — enabling Pi Zero 2W deployment at 1.5-2W power draw, 10-20% CPU, <280MB RAM.
- Implemented CI/CD pipelines and automated test frameworks across a multi-service stack (Go, Python, React), cutting deployment cycles by 40% and reducing post-release defect rate by 25%.

Senior IoT Engineer – Wearables & Embedded Systems | *Watcherr*

Aalst, Belgium

Jan 2022 – Jan 2025

- Designed full wearable firmware architecture from scratch on nRF52 (BLE/GATT stack, sensor integration, power management, on-device DSP) — device shipped to EU market, deployed across 30-50 care homes monitoring approximately 3,000 elderly residents in Belgium and Canada.
- Deployed TensorFlow Lite activity-recognition model on-device via Edge Impulse, achieving 92% accuracy with <50 ms inference on Cortex-M MCU.
- Engineered adaptive sensor duty-cycling and dynamic sampling algorithms that extended battery life by 40% (+2 days between charges).
- Built sensor-data pipeline (collection, labelling, pre-processing) that reduced ML model iteration time from weeks to days.
- Stood up HIL + unit + integration test framework, improving release quality 35% and compressing QA cycles from 2 weeks to 3 days.

IoT Systems Engineer – Fitness Technology | *Renovatio Systems Ltd*

United Kingdom

Aug 2021 – Jan 2022

- Developed ESP32-based smart gym equipment firmware with real-time strain-gauge load measurement, achieving ± 0.5 kg accuracy across 0–200 kg range.

- Implemented MQTT-based cloud sync layer for live workout tracking, enabling real-time data delivery to mobile apps for 1,000+ users.
- Evaluated and benchmarked 4 sensor technologies (strain gauge, load cell, piezo, capacitive); recommended optimal solution balancing accuracy, cost, and power consumption.
- Produced manufacturing-ready deliverables: circuit schematics, system architecture docs, and calibration procedures for factory line integration.

Project Engineer | *Ralph L Wadsworth*

Draper, Utah, USA

Jun 2019 – Feb 2020

- Led engineering execution on Denver Airport expansion project, delivering 2 months ahead of schedule through data-driven sequencing and quality optimization.
- Established QA inspection protocols and design-change workflows that maintained zero safety non-conformances across the project lifecycle.

UNIVERSITY OF UTAH | Salt Lake City, Utah, USA

Teaching Assistant – Mechatronics I & II (ME 3200/3210)

Aug 2013 – Jun 2019

- Taught sensors, motor control, C/Arduino programming, and wireless communication (XBee); supervised undergraduate labs where students designed and built autonomous robots from scratch.

Research Assistant – Robotics & Control Systems Lab

Aug 2012 – Jan 2019

- MS Thesis: engineered vision-based autonomous quadrotor using OpenCV + PID visual servoing for autonomous takeoff, navigation, and precision perching in agricultural environments
- Developed impedance-controlled dual-arm coordination for 2-DOF QUANSER robots (master-slave force/position) and adaptive backstepping controller for nonlinear micro-quadrotor

KEY PROJECTS

- Oral Disease Classification — Edge AI: Trained EfficientNet-B0 on 78,000 images across 11 disease categories (94.7% test accuracy); exported to ONNX with INT8 quantization (2-3x speedup, <2% accuracy loss) for Raspberry Pi Zero 2W deployment using DirectML/CPU fallback with <500ms inference in production.
- Autonomous Mobile Robot Navigation: Implemented RRT path planning with IR sensor-based occupancy grid SLAM on iRobot Create 2 for autonomous maze navigation; Dijkstra extraction for optimal path tracing with bump/cliff sensor safety stops.
- Multi-Arm Robotic Coordination: Developed impedance-control algorithms for dual-arm object manipulation on 2-DOF Quanser robots with real-time sensor fusion in MATLAB/Simulink.
- Vision-Based Autonomous Quadrotor: Engineered visual-servoing control system using OpenCV and PID tuning for precision agricultural monitoring with autonomous waypoint navigation.

EDUCATION

M.S. Mechanical Engineering – Robotics & Control Systems

University of Utah, USA | 2019 | GPA 3.6/4.0

B. Tech Mechatronics Engineering

S.R.M University, India | 2012 | GPA 8.8/10

CERTIFICATIONS

Certified Scrum Master – Scrum Alliance, 2025 | Jira Fundamentals Badge – Atlassian, 2025 | Electrical CAD Professional Training | Mechanical CAD Professional Training