Ramu Roy

Embedded Systems Engineer

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Summary

Embedded systems engineer (B.Tech ECE, 2026, **RGUKT Srikakulam**, CGPA 8.3/10) who works end-to-end across the stack — from PCB/KiCad hardware design through ESP-IDF and STM32 firmware to custom embedded Linux. At Elipse I contribute to **eOS**, a Yocto/OpenEmbedded Linux distribution for Raspberry Pi 5 with A/B RAUC OTA, an MQTT service bus, a Rust per-room sensor framework, and an on-device Rust voice stack (wake-word, Whisper STT, Piper TTS). Previously, during a six-month engagement at Radiogeet, I built the ESP32-S3 firmware for an industrial UWB Anti-Collision System now deployed at **Tata Steel BlueScope**.

Education

2022 – 2026 Bachelor's in Electronics and Communication Engineering at **RGUKT Srikakulam**, Andhra Pradesh (CGPA: 8.3/10)

2020 – 2022 Pre-University Course at **RGUKT Srikakulam**, Andhra Pradesh (GPA: 9.63/10)

Work Experience

Embedded Systems Engineer, Elipse May 2026 – Present

– **eOS — Custom Linux Distribution on Raspberry Pi 5 (16 GB RAM)**
Contributing to a Yocto Project / OpenEmbedded-based custom embedded Linux operating system targeting Raspberry Pi 5, featuring an A/B RAUC OTA-update rootfs, MQTT-based service bus, SQLite persistence, and a Qt6/QML local UI.

– Author and extend Yocto recipes (.bb / .bbappend) across the meta-eos layer for new system services, ML model assets, configuration, and ACL policies; manage BitBake PR bumps, AUTOREV pinning, and IPK packaging for incremental on-device deployment.

– Work across the deployed Linux subsystem stack: systemd unit design and service lifecycle, D-Bus interface authoring (org.eos.Config1, org.eos.RoomCommands1, org.eos.RoomAggregates1), Mosquitto MQTT broker (TLS + ACL hardening), and SQLite schema migrations with concurrency tuning (busy_timeout) for multi-writer workloads.

– Design and build a generic Rust RoomAggregator framework for per-room sensor fusion (thermal, mmWave radar, air quality, ambient light, PIR motion) with calibration via D-Bus and SQLite-backed persistence.

– Build an on-device voice subsystem: a transfer-learning wake-word detector (Google speech_embedding backbone + PyTorch-trained head, ONNX export, tract pure-Rust runtime), multi-microphone best-source fusion across ESP32 satellites, Whisper STT, and Piper TTS with async-Rust barge-in interruption.

– **ESP32 Firmware (ESP-IDF)**

– Develop firmware for ESP32 sensor-satellite devices using ESP-IDF v5.2, including BLE-based provisioning with on-chip EC P-256 keypair generation, X.509 CSR exchange with the hub CA, and full NVS lifecycle management (factory reset, identity preservation across OTA flashes).

– Implement pin-keyed sensor MQTT topics for disambiguating same-role sensors across GPIOs, an SNTP-synced audio-chunk frame format for streaming microphone audio over the network, and fixes for sensor-task scheduler bugs (null-queue panic loops, digital-event drain races).

– **Build System & Tooling**
– Extend kas build orchestration and the in-house eos-build CLI with host-specific overlay support, on-demand firmware builds, and PR-bump automation across the Yocto layer.
– Own end-to-end deployment flow: cross-compilation, full WIC image builds, bmaptool SD-card flashing, and RAUC A/B verification.

Embedded Systems Engineer Intern, Radiogeet Sep 2025 – Mar 2026

– **Project: Industrial Anti-Collision System**
Developed an industrial Anti-Collision System for crane operations, deployed at **Tata Steel BlueScope**. The system performs real-time UWB-based proximity detection, executes zone-based safety logic, and triggers industrial outputs to prevent hazardous crane movements.
– Designed and implemented firmware on ESP32-S3 leveraging its dual-core architecture.
– Allocated one core for time-critical UWB distance measurement and the second core for zone calculation, system logic, and embedded web interface.
– Implemented ESP-NOW for low-latency peer-to-peer wireless communication between system nodes.
– Established MODBUS RTU over RS485 communication with Masibus DO cards to control an 8-channel industrial relay system.

– **Additional Projects and Contributions**
– Interfaced sensors including AHT10 and external ADCs (ADS1115) with STM32 microcontrollers.
– Configured STM32 peripherals such as timers, internal ADC, and DAC using STM32CubeIDE.
– Integrated external ADC and DAC devices for analog measurement and control.
– Implemented two-wire and four-wire RS485 communication for industrial data exchange.
– Worked with Masibus DI, DO, AI, and AO cards for industrial automation systems.
– Established long-range wireless links using LoRa modules.
– Developed firmware using blocking/non-blocking delays, polling, and interrupt-driven designs.

Research and Development Engineer, Ampnics Mar 2025 – Sep 2025 (Remote)

– Contributed to open-source hardware projects by designing and reviewing PCB schematics and layouts.
– Supported rapid prototyping through circuit testing, debugging, and iterative design improvements.
– Collaborated with the R&D team on electronics innovation initiatives aligned with Ampnics' open-hardware vision.

Projects

Solar Track (Mar 2025)
Automated sun-tracking system using sensors to dynamically optimize solar panel orientation.

RTOS Weather Logger (Jan 2025)
Real-time weather data logger using multiple sensors with RTOS-based task scheduling.

LM2596 5V Buck Converter PCB (Dec 2024)
Designed a 5V DC buck converter PCB using LM2596S-5.0 with wide input range and output filtering.

5V to 3.3V Voltage Regulator PCB (Oct 2024)
PCB design using AMS1117-3.3 regulator for reliable 3.3V power delivery to low-voltage devices.

Servo Tester using NE555 Timer PCB (Sep 2024)
A servo motor tester PCB using NE555 in astable mode to generate adjustable PWM signals.

Transformerless Power Supply PCB Design (Aug 2024)
Compact AC–DC power supply PCB using IN4007 diodes and LM7805 regulator for 5V output.

Fire Detection System (Jun 2024)
Fire and smoke detection system using MQ-2 sensor with visual and audible alerts.

Water Level Detector (May 2024)
Water level monitoring system to provide LED and buzzer alerts for overflow prevention.

Morse Caster (Jan 2024)
Encodes text into Morse code and transmits it through sound and light with LCD output.

Skills

Programming Languages	C, Embedded C/C++, Rust (async / Tokio), Python, MATLAB
Embedded Linux & OS Development	Yocto Project, BitBake, OpenEmbedded, kas, meta-layers, Yocto recipes (.bb / .bbappend), IPK packaging, RAUC A/B OTA updates, custom Linux distribution build, cross-compilation, board support packages (BSP), device tree fundamentals
Linux Internals	systemd unit design, D-Bus service interfaces, journald, SQLite (schema design, migrations, concurrency tuning), Mosquitto MQTT (TLS, ACL hardening)
Embedded Firmware	ESP-IDF v5.x for ESP32 / ESP32-S3, FreeRTOS & dual-core task allocation, STM32 HAL/LL drivers via STM32CubeIDE (timers, ADC, DAC, GPIO, UART), bare-metal firmware, interrupt-driven & polling designs, BLE provisioning (NimBLE), NVS lifecycle, OTA firmware updates
Communication Protocols	UART, SPI, I^2C, CAN, RS485 (MODBUS RTU), MQTT, D-Bus, BLE, Wi-Fi, ESP-NOW, LoRa, UWB
Hardware Platforms	Raspberry Pi 5 (16 GB), ESP32 & ESP32-S3, STM32 microcontrollers
Sensors & Peripherals	HLK-C4001 mmWave radar, PIR motion, PM / VOC / CO_2 air-quality sensors, AHT10 temp/humidity, ADS1115 external ADC, UWB modules, Masibus DI/DO/AI/AO industrial cards, industrial relays
On-Device ML & Voice	PyTorch, ONNX, tract (Rust ONNX runtime), transfer learning, keyword spotting (KWS), VAD, mel-spectrogram features, Whisper STT, Piper TTS, multi-mic best-source fusion, barge-in
PCB Design	KiCad, schematic capture, layout, power-supply design, prototyping, testing
UI & Tooling	Qt6 / QML (MQTT-backed model design), Git / GitHub, STM32CubeIDE, ESP-IDF, kas, BitBake

Certifications & Languages

2025 **NPTEL: Embedded Sensing, Actuation and Interfacing Systems** (Score: 85%)
View Certificate

2025 **NPTEL: Electronic Systems Design, Hands-on Circuits and PCB Design with CAD Software** (Score: 88%)
View Certificate

Languages English (Proficient), Telugu (Native), Hindi (Native)