SHUBHAM MOHAPATRA

Embedded Systems Engineer

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Skilled Embedded Systems Engineer with over 8 years of experience in designing, developing, and debugging Embedded Systems and IoT solutions. Proficient in Embedded C, Assembly, and real-time operating systems like FreeRTOS, with extensive hands-on expertise across microcontrollers (STM32, ESP32, nRF52) and communication protocols (I2C, SPI, UART, BLE).
Passionate about crafting efficient, reliable firmware to power innovative hardware products. Proven ability to deliver production-ready code and prototypes, with a strong foundation in hardware integration and testing.

TECHNICAL SKILLS

- **Programming Languages**: Embedded C/C++, Assembly, Python
- **MCUs/SoCs**: STM32, ESP32, nRF52, ESP8266, Atmega328, ATtiny
- **Firmware Development Platforms**: FreeRTOS, nRF SDK, ESP IDF, Cube IDE(STM32), Arduino IDE, CircuitPython.
- **Communication Protocols**: I2C, SPI, UART, USB, CAN, BLE, MQTT, Modbus, RS-485.
- **Other Tools**: Git, JTAG, Logic Analyser, Oscilloscope,
- **Additional Skills:** Rapid Prototyping, PCB Design, Circuit Design, Component Selection/Procurement, Hardware Testing & Debugging, Technical Documentation

PROFESSIONAL EXPERIENCE

CTO & Embedded Systems Engineer
Hictros Industries PVt. Ltd., Bengaluru, Karnataka   *(October 2023 - April 2025)*

- Design & Development of IoT Products
- Led Firmware Architecture Design, Cloud Integration(AWS, Blynk, HiveMQ) and Firmware Programming for custom IoT Controllers in industrial automation.
- Developed FreeRTOS based firmware for ESP32 & STM32 platforms, integrating BLE, WiFi & LoRa-WAN.
- Managed Hardware Design & Development, Circuit Design, PCB Design & Development.

Embedded Systems Engineer
Self Employed, Bengaluru, Karnataka   *(July 2021 - September 2023)*

- Design & Development of IoT Products, and other custom Embedded Systems.
- PCB Design, Schematic Design, Prototype Fabrication & Assembly.
- Firmware Development - ESP32(Xtensa Dual-core), STM32(Arm Cortex-M3), Raspberry Pi(Zero W & Pi-4).

Electronics Engineer
IoTReady Technology Solutions Pvt. Ltd, Bengaluru, Karnataka   *(January 2020 – June 2021)*

- Lead Hardware Designer and Developer
- Firmware Development & Testing for ESP32 and nRF52 based Systems.
- Digital and Analog Circuit Design.
- Schematic design & PCB layout in KiCAD.
- **Projects: Smart UHF RFID Security System, RFID Solutions for Smart Factories, Smart Weighing Scale, Industrial Current Measurement System, and Instruments for Electrical Cable/Wire Insulations.**

Hardware Design Engineer
Zazu Wildlife Technologies Pvt. Ltd, Bengaluru, Karnataka   *(November 2017 – December 2019)*
- Schematic Design & PCB Layout in KiCAD, Digital and Analog Circuit Design.
- Prototype Development, Component Selection, Hardware Testing & Debugging.
- 3D Enclosure Design in FreeCAD & Fusion360.
- **Projects: SenseBe, SensePi, and Arduino & Raspberry Pi based internal projects.**

Trainee (Hardware Design Engineer)
Expert Global Solutions Pvt. Ltd, Aurangabad, Maharashtra   *(April 2017 – September 2017)*
- Schematic Design & PCB Layout in Altium Designer.
- Hardware Testing & Debugging, Prototype Development, Component Selection, Inventory Management.
- **Projects: Automatic Welding Machine, Hand Held Remote.**

Trainee Engineer
Automation and Control Systems, Pune, Maharashtra   *(August 2016 – March 2017)*
- Technical Documentation.
- PLC and SCADA Programming.

EDUCATIONAL QUALIFICATIONS
<u>B. Tech in Electrical and Electronics Engineering</u>
Graduated in 2016 from Gandhi Institute for Technological Advancement (GITA), Bhubaneswar with a CGPA of 7.99 out of 10.
<u>Higher Secondary Education (Science, CBSE Board)</u>
Passed out in 2012 from Kendriya Vidyalaya, CRPF Campus, Bhubaneswar with 70.60%.
<u>Secondary Education (CBSE Board)</u>
Passed out in 2010 from Kendriya Vidyalaya, CRPF Campus, Bhubaneswar with 81.70%.

PROJECTS
IoT Data-Loggers, Controllers and Gateways
Designed and developed a modular IoT platform consisting of three interoperable devices—**Data-Loggers**, **Controllers**, and **Gateways**—for industrial automation and remote equipment monitoring. The system was built with flexibility in mind, supporting multiple networking protocols (Wi-Fi, ESP-NOW, LoRaWAN, 4G) and cloud integration via **AWS IoT, HiveMQ & Blynk**.

- **Data-Loggers:**
  - Sensor data acquisition from industrial environments
  - Support for analog, digital, and Modbus sensors
  - Direct Wi-Fi connectivity to AWS IoT Core, or indirect sync via Gateways
  - Local data buffering with timestamped logs (RTC + flash storage)
- **Controllers:**
  - Edge control units for managing actuators and equipment (relays, pumps, valves, etc.)
  - Received commands from AWS or Gateways, or processed logic locally
  - Optional LoRaWAN-to-Wi-Fi or 4G bridging
- **Gateways**
  - Aggregation hubs collecting data from multiple controllers and data-loggers
  - Enabled cloud sync to AWS or private MQTT brokers
  - Provided offline logging and batch upload when internet restored
  - Configurable via BLE or Wi-Fi hotspot for local setup
  - Uplink via Wi-Fi / LoRaWAN / 4G (via AT commands to cellular module)

Key Contributions:

- **Firmware Architecture:**

  - Designed scalable FreeRTOS-based firmware architecture in C/C++ for all three devices
  - Implemented communication stacks for **ESP-NOW**, **MQTT over Wi-Fi/4G**, and **LoRaWAN**
  - Developed modular task-based logic for sensor reading, device pairing, data buffering, OTA updates, and power management
  - Integrated BLE setup modes and web-config UI for provisioning devices in the field

- **Cloud Integration:**

  - Architected AWS IoT Core integration for all device types using secure certificates
  - Built **AWS Lambda** functions for data routing, alerting, and device provisioning
  - Integrated **Amazon DynamoDB** for time-series storage and **Amazon S3** for bulk export
  - Supported JSON-based messaging structure over MQTT for easy frontend/backend parsing

- **Hardware System Design & Team Management:**

  - Designed core architecture and modular hardware blocks for all device types
  - Led and reviewed schematic/PCB designs created by the hardware team
  - Handled component selection for low-power design, battery operation, and industrial-grade reliability
  - Created unified connector and casing standards to simplify manufacturing and field deployment

RFID Based Music Player for Kids

Designed hardware architecture and developed firmware (in C with FreeRTOS) for an ESP32-based smart music player that plays curated playlists when RFID cards are tapped. Each card triggers a specific playlist stored on an SD card, with audio output via a DAC and amplifier to an onboard speaker. Designed for connected operation with cloud-managed playlist updates and usage analytics.

Cloud & IoT Architecture:

- **AWS IoT Core** used for secure MQTT-based device communication
- **AWS Lambda** functions processed user usage data and handled playlist update logic
- **Amazon S3** served as the storage backend for downloadable audio content
- Devices requested and downloaded updated songs directly from S3 using secure, signed URLs

Key Contributions:

- Developed complete FreeRTOS-based firmware in C to handle audio playback, RFID events, cloud sync, and local storage
- Architected MQTT communication pipeline between ESP32 and AWS IoT Core
- Implemented SD card audio playback via external DAC and amplifier modules, and physical playback controls for enhanced usability
- Designed hardware architecture using modular components on a custom PCB

Smart EV GPS Tracker

Designed hardware and firmware for a GPS tracking system tailored for electric vehicles, compatible with both new and retrofitted models. The system acquired location data via GPS/GNSS modules and transmitted it to Blynk IoT servers over 4G.

Key Contributions:

- Integrated 4G module using AT commands for cloud connectivity
- Supported both battery-powered and EV-supply-powered configurations
- Delivered a compact, production-ready solution for fleet tracking and remote monitoring

Smart EV Control System

Designed hardware and developed firmware for a CAN-based control system used in an agricultural electric vehicle (pesticide/fertilizer spraying machine). The system coordinated multiple subsystems including motor controllers, BMS, battery charger, and a central control unit via the CAN bus.

Key Contributions:

- Designed custom hardware for all major EV subsystems
- Developed embedded firmware for the Main Control Unit in C
- Implemented remote control via high-range RF joystick (drone-style)
- Integrated a smart remote interface with Web-App-based control for driver usability and diagnostics

Smart UHF RFID Security System

Designed and developed a prototype security system integrating a UHF RFID reader with a BLE-based facility lockdown mechanism using electromagnetic door locks. Enabled real-time breach alerts with timestamp and damage reports over Wi-Fi to customer servers. Users could monitor and control the system via smartphone using BLE/Wi-Fi.

Key Contributions:

- Firmware development in C using FreeRTOS
- Component selection and hardware procurement
- Delivered a fully functional demo prototype for client presentations

Smart Weighing Scale

Developed a compact, high-accuracy BLE-enabled weighing scale with extended battery life. Designed to transmit measured data to a mobile app in real time.

Key Contributions:

- Designed custom PCB hardware
- Developed test firmware for validation and calibration

SenseBe – Active Infrared Beam Sensor

Created a long-range Active Infrared Beam sensor system with STM32-based IR Transmitter and nRF52-based IR Receiver. The receiver was BLE-configurable via mobile app and capable of triggering DSLR cameras for wildlife photography and virtual fencing applications.

Key Contributions:

- Complete hardware development: circuit, schematic, PCB design
- Component selection, procurement, and hardware debugging
- Designed, fabricated and assembled 3D-printed enclosures for field testing

SensePi – PIR Motion Sensor

Engineered a BLE configurable PIR motion sensor using nRF52, capable of triggering DSLR cameras with configurable features such as sensitivity (2–25 meters), angle modes, timer, and day/night operation. Designed for wildlife photography, surveillance, and farm security.

Key Contributions:

- Designed low-power circuit and PCB (battery backup: 1+ year on 2xAA batteries)
- Developed complete hardware stack including component selection, assembly, and enclosure design
- Supported feature testing and optimization for power efficiency and field reliability

DECLARATION

I hereby declare that the above information is true and correct to the best of my knowledge.

Place : Bengaluru, Karnataka

Date :   **Shubham Mohapatra**