Ibrar **Ahmad**

Embedded Systems Engineer | EEG Hardware & Biosensors

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Professional Summary

Embedded Hardware Engineer specializing in Biosensor/EEG Hardware Design, High-Speed PCB Design, Signal & Power Integrity, Firmware Development (C/C++, FreeRTOS, Zephyr RTOS), IoT Systems (ESP32, STM32, nRF52), nRF Connect SDK, Altium Designer, Medical Device Development, Bioelectrode Technology, Hardware-Software Integration, Technical Consultation, R&D, and JTAG Debugging.

Professional Experience

Niura (MindTune Innovations regional office, Pakistan) — Wah Cantt, Pakistan

Biosensor/EEG Hardware Engineer — Mar. 2025 - Present

- Designed and developed EEG hardware and bioelectrode systems focused on stable, high-quality biosignal capture for real-world use
- Engineered compact earbud hardware and multilayer PCBs to support both neural sensing and consumer wearable constraints
- Developed embedded firmware for real-time EEG acquisition, filtering, and reliable wireless transmission from miniaturized earbuds
- Integrated TWS stereo audio features so the device performs normal earbud functions while simultaneously supporting EEG data flow
- Improved overall signal quality through hardware tuning, electrode interface optimization, noise reduction, and validation testing
- Executed end-to-end hardware verification including bring-up, debugging, performance testing, and iterative prototype refinement
- Collaborated across hardware, firmware, and product teams to deliver production-ready designs aligned with medical and quality requirements

Zinovaa — Remote

Technical Consultant (Remote/Sessional) — May 2025 - Present

- Providing expert consultation on embedded systems architecture, hardware design decisions, and firmware optimization strategies
- Guiding development teams in selecting appropriate microcontrollers, sensors, and components for IoT and wearable applications
- Reviewing and optimizing PCB schematics and layouts for signal integrity, power distribution, and thermal management
- Advising on Bluetooth Low Energy (BLE), Wi-Fi, and LoRa implementation for wireless IoT systems using ESP32, STM32, and nRF52
- Conducting remote troubleshooting sessions using JTAG debuggers, logic analyzers, and oscilloscopes to resolve complex hardware issues
- Ensuring robust hardware-software integration through code reviews, HAL implementation guidance, and RTOS configuration
- Providing strategic guidance on design-for-manufacturing (DFM) and design-for-testability (DFT) best practices

Revive Medical Technologies — Rawalpindi, Pakistan

Embedded Hardware Engineer Team Lead — Feb. 2024 - Mar. 2025

- Led the PCB team in schematic design, layout, fabrication, testing, and implementation for embedded hardware projects
- Managed BOM creation and component planning while overseeing PCB assembly and printing workflows to meet quality standards
- Coordinated with cross-functional engineering teams to deliver hardware milestones on schedule and align with project deliverables
- Developed and validated embedded hardware prototypes through structured bring-up, debugging, and verification testing
- Built industrial automation simulations in Factory I/O and integrated PLC logic for real-world process-control scenarios
- Contributed to process improvement through design reviews, technical documentation, and troubleshooting support across teams
- Supported handoff to manufacturing by validating design files, test checklists, and production documentation for repeatable builds

Education

COMSATS University Islamabad   Islamabad, Pakistan
Bachelor of Science in Electrical Engineering (Computer Electives)   Aug. 2019 - Feb. 2024

- Major: Electrical Engineering with specialization in Embedded Systems, Digital Signal Processing, and Power Electronics
- Relevant Coursework: Microprocessor Systems, FPGA Design, Control Systems, Digital Image Processing, Data Communication & Computer Networks, Industrial Automation, Circuit Design
- Developed expertise in MATLAB, NI LabVIEW, Proteus, and Altium Designer through academic projects and laboratories
- Final Year Project: Smart Door Lock System using ESP32-CAM with optimized image processing and wireless authentication
- Gained hands-on experience with ARM Cortex-M, ESP32, STM32, and FPGA development boards

University College for Boys, Univ. of Peshawar   Peshawar, Pakistan
Higher Secondary School Certificate - Pre-Engineering   2017 - 2019

- Studied Mathematics, Physics, Chemistry with focus on analytical and problem-solving skills
- Built strong foundation in engineering principles, calculus, mechanics, and scientific methodology

Islamia Collegiate School   Peshawar, Pakistan
Secondary School Certificate - Science Group   2015 - 2017

- Completed foundational studies in Mathematics, Physics, Chemistry, and Biology
- Developed strong academic performance and critical thinking abilities

Technical Skills

Embedded Systems	ESP32, STM32 (Cortex-M3/M4), nRF52 Series, AVR, i.MX8MM MPU, ARM Cortex Architecture, Bare-Metal & RTOS Programming
Firmware Development	C, C++, Embedded C, FreeRTOS, Zephyr RTOS, nRF Connect SDK, HAL/LL Drivers, Bootloader Development, DFU/OTA Updates
PCB Design & CAD Tools	Altium Designer, KiCad, Autodesk Eagle, PADS, Proteus, OrCAD, High-Speed & Multilayer PCB Design (up to 12 layers)
Signal & Power Integrity	Impedance Control, Controlled Routing, Ground Plane Optimization, PDN Analysis, SI/PI Simulation, EMI/EMC Compliance
Biosensor & Medical Devices	EEG Hardware Design (ADS1299), ECG/PPG Acquisition (MAX86150), Bioelectrode Technology, AFE Design, IEC 60601-1 Compliance
Communication Protocols	I2C, SPI, UART, USB 2.0/3.0, CAN Bus, BLE 5.x, Wi-Fi (802.11), LoRa, MQTT, WebSocket, Modbus
Wireless & IoT Systems	Bluetooth Low Energy (BLE), Nordic nRF52, ESP32 Wi-Fi/BLE, LoRa/LoRaWAN, Wireless Charging (Qi Standard, BQ51003)
Industrial Automation	Siemens S7-300/S7-1200 PLC, TIA Portal, Factory I/O, Ladder Logic, SCADA Systems, Process Control
Manufacturing & Testing	CNC Programming (G-Code), PCB Fabrication, Pick-and-Place Assembly, BOM Management, DFM/DFT, IPC-7351 Standards
Hardware Debugging Tools	JTAG/SWD Debuggers, Oscilloscopes (up to 500MHz), Logic Analyzers, Spectrum Analyzers, Thermal Cameras, Multimeters
Software & Simulation	MATLAB, Simulink, NI LabVIEW, LTspice, ANSYS HFSS, Python (NumPy, SciPy, Matplotlib), Git/GitHub
Design Standards & Compliance	IPC-2221, IPC-7351, IEC 60601-1, ISO 13485, RoHS 3, CE Marking, FDA Class II Device Requirements
Project Management	Agile/Scrum Methodologies, Jira, Confluence, Bitbucket, Cross-functional Team Leadership, Technical Documentation
Languages	English (Professional), Urdu (Native)

Key Professional Projects

1. Next-Generation Smartwatch with Wireless Charging

- Designed complete hardware architecture for advanced wearable featuring nRF5340 dual-core SoC (ARM Cortex-M33).
- Implemented BQ51003 wireless charging receiver with ADP5360 PMIC for optimized power management.
- Integrated MAX86150 for ECG, PPG, and SpO_2 measurements with clinical-grade accuracy.
- Developed dual display system: 1.54" IPS LCD for interactive UI + low-power E-Ink for always-on display.
- Incorporated environmental sensors: BME680 (temperature, humidity, pressure), CCS811 (air-quality monitoring).
- Designed 6-axis ICM-20689 IMU integration for motion tracking and gesture recognition.
- Achieved <30mA average current consumption with 7-day battery life on 300mAh LiPo battery.
- Implemented Nordic BLE 5.2 stack with secure DFU over-the-air firmware updates.

2. True Wireless Stereo (TWS) Earbuds with Jieli IC

- Developed complete PCB design for TWS earbuds using Jieli Bluetooth 5.0 audio SoC.
- Implemented advanced audio processing with ANC (Active Noise Cancellation) and ENC (Environmental Noise Cancellation).
- Designed compact charging case with wireless charging capability and battery management system.
- Achieved <60ms low-latency audio transmission for gaming and video applications.
- Optimized antenna design for stable Bluetooth connectivity within 10-meter range.

3. Smart Earbuds with EEG Sensing

- Pioneered innovative design integrating dry-electrode EEG sensors into TWS earbud form factor.
- Developed biopotential acquisition circuit with $<1\mu V$ noise floor for in-ear neural signal detection.
- Implemented real-time mood/emotion analysis algorithms using machine learning on embedded MCU.
- Created dynamic audio adjustment system responding to detected emotional states.
- Designed miniaturized PCB with RF isolation between Bluetooth and analog EEG frontend.

4. Medical Device Hardware (SDCM-II, DermScope, UV Curing Chamber)

- Stent Drug Coating Machine II (SDCM-II): Designed precision motion-control electronics with stepper motor drivers and closed-loop feedback for automated pharmaceutical coating.
- DermScope: Developed compact medical imaging device with high-resolution camera interface, LED illumination control, and USB 2.0 data transfer.
- UV Curing Chamber: Engineered embedded control system with precise temperature regulation, UV intensity monitoring, and automated curing-cycle management.
- All projects designed with IEC 60601-1 safety isolation and medical-grade components.

5. Compact 49 × 49 mm NRF Smartwatch

- Designed ultra-compact smartwatch PCB with nRF52832 SoC and 0.96" OLED display.
- Implemented aggressive miniaturization techniques including via-in-pad and HDI technology.
- Achieved <2mm total PCB thickness including battery and display assembly.
- Optimized power consumption: $<50\mu A$ in deep sleep, <5mA during active BLE connection.

6. Athletic Mouthguard Wearable Device

- Developed NRF-based wearable embedded in an athletic mouthguard for real-time health monitoring.
- Integrated sensors: temperature, SpO_2, bite force (FSR), and 3-axis accelerometer for impact detection.
- Designed waterproof and impact-resistant enclosure with biocompatible materials.
- Implemented BLE communication for real-time data streaming to a mobile application.
- Created custom charging dock with pogo-pin interface for battery recharging.

7. OpenBCI EEG Data Processing System

- Developed custom firmware for ADS1299-based OpenBCI board with 8-channel EEG acquisition.
- Implemented SPI communication protocol achieving 16kSPS sampling rate across all channels.
- Created Python-based data processing pipeline for real-time brainwave analysis (alpha, beta, theta, delta bands).
- Integrated machine learning algorithms for artifact detection and signal classification.

8. Custom DFU/OTA Bootloader for nRF52840

- Developed secure bootloader for Adafruit nRF52840 Sense enabling over-the-air firmware updates.
- Implemented cryptographic signature verification using mbedTLS library.
- Created dual-bank flash memory management for fail-safe update mechanism.
- Achieved <30-second update time for 512KB firmware images.

Final Year Project

Smart Door Lock System   COMSATS University Islamabad

Team Lead & Hardware Designer   Aug. 2022 - Jul. 2023

- Developed integrated smart door lock system using ESP32-CAM and ESP32 for wireless access control and surveillance
- Implemented TJpeg library achieving 25 FPS real-time video streaming with optimized image compression
- Designed modular locking mechanism compatible with existing doors using solenoid lock and servo-based actuation
- Integrated bidirectional audio communication using I2S digital microphone and amplifier circuit
- Developed custom authentication system supporting RFID, fingerprint, and mobile app-based unlocking
- Created intuitive user interface on 3.5" TFT LCD displaying live camera feed and visitor information
- Implemented low-power modes achieving <100mA standby current with instant wake-up capability
- Designed PCB with integrated power supply (5V/2A), ESP32 modules, and peripheral interfaces
- Successfully demonstrated system with <1-second authentication response time and 99% recognition accuracy

Open Source Contributions

Custom Altium Component Library   GitHub - Public Repository

Maintainer & Creator   Ongoing

- Developed comprehensive Altium Designer component library with 500+ components optimized for rapid PCB design
- Each component stored in individual file with modular structure for easy integration and version control
- Ensured 100% RoHS 3 compliance with detailed environmental and safety documentation
- Designed footprints according to IPC-7351B standards with manufacturing tolerances verified through DRC
- Focused on JLCPCB Parts Library compatibility for seamless fabrication and component procurement
- Included 3D models for accurate mechanical clearance verification in Altium 3D viewer
- Actively maintained with bi-weekly updates adding latest components and fixing reported issues
- Received 100+ stars and contributions from embedded systems community worldwide

Professional Certifications

2024	**PEC Registered Electrical Engineer**, Registration Number: ELECT/107509	Pakistan Engineering Council (PEC)
Sep. 2023	**Certified PCB Designer**, Completion of Altium Education PCB Basic Design Course (Credential: cert_c8lmf4pd)	Altium
2024	**Learn Altium Essentials – Second Edition**, Advanced PCB Design Techniques and Best Practices	Altium
2024	**High-Speed & Multi-layer PCB Design**, Advanced techniques for signal integrity and impedance control	Online Certification
2024	**Signal & Power Integrity Specialist**, Advanced Course on SI/PI Analysis for PCB Designers	Sintecs Training Program
2025	**nRF Connect SDK Fundamentals**, Hands-on training in Nordic Semiconductor's IoT platform	Nordic Semiconductor Academy
Mar. 2024	**Introduction to IoT**, Fundamentals of Internet of Things architecture and applications	Cisco Networking Academy

Key Achievements & Recognition

2024–2025	**Team Leadership**, Led cross-functional team of 5 engineers delivering 10+ medical device projects on time and within budget	
2024	**Process Improvement**, Reduced PCB manufacturing defects by 40% through implementation of DFM/DFT standards and automated design reviews	
2024–2025	**Freelance Success**, Completed 15+ Upwork projects with 100% client satisfaction rating and 5.0/5.0 average review score	
2024–2025	**Open Source Impact**, Altium component library received 100+ GitHub stars and adopted by developers in 15+ countries	
2025	**Technical Innovation**, Pioneered integration of EEG sensors into TWS earbud form factor for emotion-responsive audio	