

Manish Man Shrestha

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PROFILE SUMMARY

Senior Embedded Firmware Engineer with 15 years of total experience, including 8 years of industry experience, developing real-time firmware and low-level software for hardware-centric embedded systems. Strong background in Embedded C/C++, bare-metal and RTOS-based firmware design, microcontroller programming, device drivers, board bring-up, hardware debugging, and firmware-hardware integration. Experienced in optimizing firmware for timing, memory usage, power consumption, reliability, and real-time performance in constrained embedded environments. Hands-on experience with embedded DSP, ROS-based robotic systems, sensor interfaces, PWM/control systems, wireless connectivity, firmware validation, and test/debug tooling using Python and C#/.NET.

CORE SKILLS

- **Embedded Firmware Development:** Embedded C/C++, real-time firmware, device drivers, board bring-up, interrupt-driven systems, low-level hardware programming
- **RTOS & Real-Time Systems:** FreeRTOS, task scheduling, inter-task communication, semaphores, mutexes, queues, timing optimization
- **MCUs / SoCs / SBCs:** ARM Cortex-M, STM32, NXP/LPC, ESP32/ESP-IDF, Raspberry Pi, PIC, AVR, 8051
- **Hardware Interfaces:** UART, SPI, I2C, GPIO, ADC/DAC, PWM, DMA, USB CDC, memory-mapped I/O
- **Debugging & Bring-Up Tools:** JTAG/SWD debugging, oscilloscopes, logic analyzers, serial debugging, firmware trace analysis, CAN analyzer
- **Control & Electromechanical Systems:** ROS 2 / micro-ROS, PWM motor/control systems, ADC feedback, sensor integration, power management, real-time control logic
- **Signal Processing:** Embedded DSP, FFT, IIR/FIR filters, Butterworth filtering, MATLAB-based signal analysis, CMSIS-DSP
- **Connectivity & Protocols:** TCP/IP, lwIP, MQTT/MQTTs, Wi-Fi, BLE, Modbus RTU, RS-232/485, CAN, BACnet
- **Programming Languages:** C, C++, Python, C#, R
- **Development Platforms:** ESP-IDF, Keil MDK, MPLAB, Visual Studio, Git, Altium Designer, Eagle, KiCad, OpenSCAD, Azure IoT Hub
- **Memory & Boot Systems:** EEPROM, NOR/NAND Flash, SPI Flash, NVS, bootloaders, OTA-safe firmware updates
- **Security:** TLS, AES, ChaCha20-Poly1305, MQTT over TLS, post-quantum cryptography (Kyber, Dilithium)

WORK EXPERIENCE

Graduate Research Assistant

January 2023 - Present

South Dakota State University, Brookings, South Dakota

- Architected and developed Embedded C firmware on ESP32/ESP32-S3 using FreeRTOS for real-time sensor acquisition, device drivers, Modbus RTU communication, and secure MQTT/TLS telemetry over Wi-Fi.
- Designed and integrated MCU drivers for sensors and peripherals, enabling reliable data acquisition from soil moisture, temperature, humidity, nitrate, and chloride sensing systems.
- Performed hardware bring-up, peripheral integration, and low-level debugging for sensor-based embedded systems using SPI, I2C, UART, RS-485, GPIO, and ADC interfaces.
- Supported PCB design, schematic review, and board-level integration using KiCad for custom IoT sensing hardware.
- Engineered secure telemetry pipelines using AES, MQTT over TLS, Kyber, Dilithium, and ChaCha20-Poly1305, with backend validation and visualization using C#/.NET tools.
- Designed and validated embedded systems using structured testing, debugging, and verification workflows to ensure reliable operation in real-world greenhouse and hydroponic environments.
- Designed and 3D-printed custom OpenSCAD prototypes with integrated sensor mounts, leak-resistant fluid containment, drainage ports, and hose interfaces for leachate collection.

Assistant Professor

August 2017 - December 2022

Cosmos College Of Management and Technology, Kathmandu, Nepal

- Taught embedded systems, microcontroller programming, and real-time firmware development.
- Led embedded R&D projects involving MCU firmware, sensor integration, and hardware–software systems.

CTO / Technical Consultant

April 2017 - December 2022

Samadhan Engineering Pvt. Ltd., Kathmandu, Nepal

- Led embedded systems development from concept to deployment, including requirements review, firmware architecture, hardware integration, testing, documentation, and production validation.
- Developed real-time firmware using PWM, timers, ADC feedback, RTOS scheduling, sensor interfaces, and communication protocols on microcontroller platforms.
- Developed CAN bus driver code for an access management system involving motorized door control, and used a CAN analyzer to inspect, verify, and debug CAN message traffic during system integration.
- Designed and reviewed PCB layouts using Altium Designer for embedded sensing and control systems, supporting board bring-up, testing, and hardware–firmware debugging.
- Developed BLE-based telemetry for a structural health monitoring prototype to transmit damage-index data, later migrating the system to Wi-Fi for improved deployment reliability.
- Designed embedded firmware architectures for field-deployed systems with robust error handling, communication reliability, and maintainable driver-level code.

- Established Git-based version control and YAML-based CI/CD workflows using Docker images to generate repeatable firmware builds and manage release artifacts for embedded systems.

Research Scientist
KAIST - Measurement Robotics & Diagnostic AI Lab, Daejeon, South Korea

March 2016 - March 2017

- Developed embedded DSP firmware with lwIP TCP/IP networking for wireless structural monitoring systems.
- Implemented high-speed signal acquisition and wireless communication pipelines on ARM-based embedded platforms.
- Supported sensor electronics integration, signal validation, and embedded system testing for real-time structural monitoring applications.

Research Assistant
Jeonbuk National University, Jeonju, South Korea

August 2013 - February 2016

- Developed firmware for a dual-core ARM Cortex-M4/M0 LPC4370 system for ultrasonic signal generation, synchronized data acquisition, and real-time DSP processing.
- Configured the LPC4370's built-in USB peripheral as a virtual COM port to transfer ultrasonic waveform data to a laptop for verification before migrating wireless transmission to an external Bluegiga Wi-Fi modem.
- Designed and supported PCB layouts using Eagle for embedded ultrasonic sensing hardware and assisted with board bring-up and hardware debugging.
- Developed Qt-based GUI tools to control a laser excitation system, acquire ultrasonic wave data from an embedded sensing device, and visualize/analyze received waveforms for structural monitoring experiments.
- Implemented FFT, IIR, and FIR filtering algorithms for embedded structural monitoring applications.
- Supported hardware–software integration, signal validation, and debugging for real-time sensing systems.

Firmware Engineer
Real Time Solutions Pvt. Ltd., Lalitpur, Nepal

March 2011 - August 2013

- Developed embedded C/C++ firmware for ARM, PIC, and 8051 microcontrollers, including device drivers, communication stacks, and RTOS-based task scheduling.
- Implemented Protothreads-based cooperative multitasking on 8051 and PIC microcontrollers and developed custom bare-metal schedulers for resource-constrained embedded systems.
- Implemented communication protocols including UART, SPI, Modbus RTU, and cellular telemetry using AT commands.
- Developed firmware for industrial and field-deployed systems including panel meters, MPPT solar battery chargers, queue management systems, and flood early-warning devices.
- Debugged hardware–firmware interactions using oscilloscopes, logic analyzers, and serial debugging tools to improve system reliability.

EDUCATION		
Ph.D., Agricultural & Biosystems Engineering - South Dakota State University, USA		Aug 2026
Graduate Certificate, Data Science - South Dakota State University, USA		Aug 2025
M.E., Mechatronics Engineering - Jeonbuk National University, South Korea		Dec 2016
B.E., Electronics & Communication - Cosmos College of Management and Technology, Nepal		Dec 2010

SELECTED PROJECT

- MPPT-Based Solar Battery Charger (PIC MCU):** Developed embedded firmware for a solar battery charging system implementing an MPPT algorithm using ADC-based voltage/current feedback and PWM control for efficient energy conversion under varying solar conditions.
- Panel Meter with Energy Accumulation and Modbus RTU (NXP Cortex-M0):** Built firmware for a panel meter with LCD and push-button interface, implementing a 4th-order Butterworth IIR filter for stable signal conditioning and precise energy accumulation. Designed a custom Modbus RTU slave to interface with external dataloggers.
- Multichannel Ultrasonic Structural Health Monitoring Device (STM32 Cortex-M4 + ESP32):** Developed real-time firmware for signal generation, synchronized sensing, high-speed data acquisition, and wireless communication. Implemented FFT/IIR-based DSP pipelines and a dual-MCU architecture separating deterministic STM32 processing from ESP32 communication and display functions. Integrated a custom I2C SSD1306 OLED display driver for local device status and measurement feedback, and performed hardware bring-up/debugging using oscilloscopes, logic analyzers, and serial tools.
- Distributed IoT Monitoring System with Post-Quantum Security (ESP32-S3, FreeRTOS):** Developed a distributed embedded telemetry system for real-time nitrate monitoring using multiple IoT nodes, secure MQTT/TLS communication, and post-quantum cryptography. Implemented sensor interfacing, encrypted data transmission, signature verification, and backend integration for reliable monitoring and visualization.
- Teleoperated Mobile Robot (Raspberry Pi):** Built a Raspberry Pi-based mobile robot using ROS for modular teleoperation, integrating H-bridge DC motor control, GPIO-based direction control, Bluetooth input-event handling, and live camera streaming. Debugged command-response timing and hardware/software interaction issues for reliable operation.

PUBLICATIONS (SELECTED)	
Structural Health Monitoring (SAGE): Wireless ultrasonic device for aircraft structures (2017).	
Smart Agricultural Technology (ELSEVIER): Distributed IoT + PQC for nitrate/soil-moisture monitoring in corn production (2026).	