# Mohammadhadi Mazhabjafari

## Firmware Engineer

LinkedIn: <u>Hadi M.Jafari</u>
Phone: 0432850020

Address: Unit 2/47 Tamar Grove, Oakleigh, VIC 3166, Australia
Email: mazhabjaffari.hadi@gmail.com

<u>Permanent Resident in Australia</u>

## Summary

An accomplished electronic engineer with extensive expertise in embedded systems and ARM microcontrollers. Proficient in programming microcontrollers like STM32, ESP32, etc. utilizing various programming styles including bare-metal, FreeRTOS, and state-machine architectures. Detail-oriented and goal-focused, expertise lies in providing reports and supporting decision-makers with insightful information at different stages of the project. This combination of skills makes for a valuable addition to any team.

## Core Skills

- Extensive expertise in ARM microcontroller architecture, programming, and integration, including experience with popular families such as STM32 and other types of microcontrollers such as ESP32. Skilled in configuring peripherals, optimizing low-power performance, and implementing real-time control applications. Proficient in Embedded C and C++ for developing robust firmware solutions, with a strong foundation in debugging, peripheral integration, and communications protocols such as SPI, I2C, UART, FATFS, etc. Able to develop and troubleshoot complex embedded systems, ensuring reliable and efficient performance across diverse applications.
- Expert in IDEs such as Keil, STM32CubeIDE, ESP-IDF, IAR, CodeVision, and Visual Studio, with extensive experience in configuring and optimizing development environments for efficient coding, debugging, and testing. Skilled in utilizing these platforms to manage complex embedded projects, perform in-depth code analysis, and ensure seamless integration of software and hardware components. Proficient in leveraging IDE-specific tools for memory management, peripheral setup, and real-time debugging, enabling streamlined workflows across various microcontroller platforms.
- Skilled in designing complex PCBs, including 2-layer, 4-layer and 6-layer boards, with a focus on optimizing signal integrity, thermal performance, and EMI reduction. Proficient in creating schematic symbols, footprints, and custom libraries tailored to each project, ensuring seamless integration and accurate component representation. Experienced in configuring multi-layer stackups for high-density applications and implementing efficient power distribution across layers to meet demanding performance requirements.
- Expert in PCB routing techniques, including differential pair and impedance-controlled, ensuring reliable communication and minimal signal degradation. Knowledgeable in designing essential circuits such as crystal oscillators, power selectors, MCU reset circuits, and Schmitt-trigger button circuits for debounce-free operation. Skilled in using various routing tools, schematic filters, and

PCB shape modifications to achieve optimized layouts, even for complex or irregular board shapes.

- Proficient in placing test pads for thorough testing and verification, facilitating in-circuit and boundary scan testing. Extensive knowledge of via types, including through-hole, blind, buried, and microvias, applied for signal routing, power integrity, and thermal relief. Highly experienced in generating complete manufacturing documentation, including BOM, Gerber files, drill outputs, assembly drawings, and pick-and-place files, ensuring seamless handover to manufacturing teams.

- Proficient in programming STM32 microcontrollers using the Hardware Abstraction Layer (HAL) library, enabling efficient and structured development across various STM32 families.

- Proficient in multiple programming styles, including bare-metal programming, FreeRTOS, and state-machine architecture, to optimize performance and resource management in embedded systems. Skilled in implementing real-time applications on microcontrollers, utilizing FreeRTOS for multitasking and event-driven tasks, and creating structured state-machine models for reliable control flows.

- Expert in FreeRTOS and its comprehensive feature set, including task prioritization, semaphores, mutexes, and queues, to build efficient and responsive embedded systems. Proficient in designing multitasking applications where task scheduling, priority management, and inter-task communication are optimized for performance and resource utilization. Experienced with FreeRTOS queues for robust data transfer between tasks, along with practical knowledge in task synchronization, memory management, and timer functions, enabling real-time capabilities for complex applications.

- Proficient in programming and implementing various wireless communication protocols, including Wi-Fi, Bluetooth, and Bluetooth Low Energy (BLE). Skilled in configuring and optimizing wireless modules for secure, low-latency communication in embedded applications. Experienced in managing data transmission, power consumption, and connection stability to ensure seamless performance in IoT and smart device systems. Knowledgeable in BLE-specific features such as advertising, pairing, and low-energy modes, as well as implementing robust Wi-Fi connectivity solutions for reliable data exchange across networks.

- Extensive experience in using GitHub for version control, including managing repositories, branching, merging, and handling pull requests to ensure organized and efficient code collaboration. Proficient in using Git Bash for command-line operations, enhancing productivity and control over version management tasks. Skilled in implementing version control best practices for tracking changes, managing project history, and facilitating team collaboration. Experienced with Git workflows to support continuous integration, streamline development processes, and maintain codebase integrity across complex projects.

- Experienced in programming the ESP32 microcontroller using AT commands, with a strong focus on configuring and managing its Wi-Fi and Bluetooth capabilities. Skilled in setting up and optimizing Wi-Fi connections, handling data transmission, and managing network security through AT command sequences. Proficient in enabling and customizing Bluetooth and BLE functions, including advertising, pairing, and data exchange, making the ESP32 a versatile solution for IoT applications requiring reliable wireless communication.

- Proficient in programming the ESP32 to connect with and transmit data to MQTT servers, including configuring SSL/TLS for secure communication. Skilled in setting up MQTT protocols on the ESP32, managing secure connections, certificates, and encryption for data integrity and privacy. Experienced in handling topic management, publishing, and subscribing to data streams with

optimized payloads, ensuring reliable and secure data exchange in IoT applications that require robust real-time monitoring and control.

- Extensive experience utilizing the ADC (Analog-to-Digital Converter) peripherals to precisely capture analog sensor data, converting it into reliable digital signals for further processing. Skilled in configuring the ADC for high-resolution, low-latency data acquisition, as well as optimizing sample rate and resolution to meet specific application needs. Proficient in multi-channel ADC setups and calibration techniques, ensuring accurate, real-time data collection in demanding environments.

- Proficient in configuring and implementing UART communication on STM32 microcontrollers across polling, interrupt, and DMA modes. Skilled in choosing the optimal mode based on application requirements—using polling for straightforward, low-frequency communication, interrupts for responsive, non-blocking data handling, and DMA for high-speed data transfer with minimal CPU usage. This expertise enables efficient and reliable serial communication tailored to meet specific system performance needs.

- Skilled in configuring and implementing SPI (Serial Peripheral Interface) communication on microcontrollers for high-speed, reliable data exchange between devices. Experienced in setting up SPI in both master and slave modes, managing data flow, and optimizing clock settings for maximum efficiency. Proficient in using SPI with DMA to reduce CPU load for high-frequency data transfers, ensuring smooth operation in multi-device communication networks.

- Proficient in configuring and implementing I2C (Inter-Integrated Circuit) communication on STM32 microcontrollers, supporting both master and slave modes for multi-device communication. Skilled in setting up reliable data transmission for sensors and peripheral devices, with experience in using interrupt-driven and DMA modes for efficient, low-latency communication. Expertise in optimizing clock speed, data handling, and error checking to ensure stable, robust I2C communication across varied applications.

- Experienced in implementing FATFS (File Allocation Table File System) on STM32 microcontrollers, enabling efficient read/write operations on external storage devices such as SD cards. Proficient in configuring FATFS with SPI or SDIO interfaces to ensure reliable file management, supporting multiple file types and directories. Skilled in optimizing file operations for low-power embedded applications, ensuring seamless data logging and retrieval while maintaining data integrity.

- Skilled in configuring and utilizing various timer modules on STM32 microcontrollers for precise timing control, including PWM generation, input capture, and output compare functions. Experienced in setting up basic, general-purpose, and advanced timers for tasks such as signal frequency measurement, pulse generation, and event timing. Proficient in using interrupt-driven timers to optimize real-time application performance and integrating timers with other peripherals for synchronized operations.

- Proficient in configuring and utilizing the watchdog timer on STM32 microcontrollers to enhance system reliability by preventing software hangs and ensuring automatic recovery.

- Implemented GPIO input configuration for a user button, utilizing interrupt-based detection to capture button presses accurately and reduce CPU load. Applied software debouncing techniques to eliminate signal noise and prevent unintended triggers. This setup enabled responsive and reliable user input, allowing quick execution of device commands and enhancing the overall user experience in real-time applications.

- Skilled in using oscilloscopes and logic analyzers to interpret and troubleshoot signals across various communication protocols, including UART, SPI, and I2C. Proficient in setting up equipment for accurate waveform capture, timing analysis, and protocol decoding, enabling clear visualization of data flow and identifying issues such as signal integrity problems, noise, or timing

discrepancies. Experienced in interpreting digital and analog signals to validate system performance and diagnose communication issues in embedded systems.

- Proficient in programming and prototyping with Arduino, utilizing the platform for rapid development and testing of embedded solutions. Skilled in configuring and interfacing a wide range of sensors, modules, and communication protocols on Arduino, enabling efficient and flexible prototyping for IoT and device applications. Experienced in writing clean, modular code in the Arduino IDE, allowing for quick iterations and adaptations to meet project requirements and demonstrate feasibility.

- Soldering experience with all types of packages, such as SMD, SOT, QFP, QFN, SOP, and other surface-mount and through-hole components. Proficient in performing precise soldering and rework under magnification for small pitch and fine-pitch components, ensuring robust connections and high-quality assembly. Skilled in using soldering stations, hot air rework stations, and inspection tools to achieve reliable results in prototyping and repair, contributing to durable and well-assembled electronic systems.

- Hands-on in interpreting and analyzing datasheets, schematics, and PCB designs to guide development and troubleshooting processes. Skilled in extracting critical information from datasheets, including electrical characteristics, timing requirements, and operational parameters, to ensure accurate integration of components into designs. Proficient in reading and understanding complex schematics and PCB layouts, enabling efficient fault diagnosis, component selection, and design validation. This expertise allows me to optimize circuits for performance, reliability, and manufacturability in embedded and electronic systems.

- Knowledgeable in microcontroller bootloader design and functionality.

- Proficient in CAD design for 3D printed parts, using fusion360 specifically for integrating custom components into electronic devices. Experience includes creating precise 3D models for enclosures, mounts, and mechanical interfaces used in prototypes and production-level electronics.

- With a deep understanding of the end-to-end PCB design process, I am proficient in translating schematics into efficient, manufacturable PCB layouts. My experience spans multiple board types, from single and double-sided to complex multi-layer designs. I focus on creating layouts that balance performance, manufacturability, and cost-effectiveness, adhering to best practices for trace routing, power distribution, and signal integrity. Using industry-standard tools like Altium Designer, I ensure that every design meets both functional and aesthetic requirements, resulting in reliable, high-quality boards.

- Skilled in designing schematics for various USB interfaces, including USB Type-C, Micro USB, and Mini USB, with a strong focus on ESD protection, power integrity, and signal integrity. Experienced in choosing the correct TVS diodes, proper filtering, and connector placement to ensure reliability and safety in high-speed data and power delivery.

# Employment Experience

**Center of Infusion –** Firmware and Hardware Engineer

May 2023 - Current

Center of Infusion, located in Melbourne, Australia, is renowned for its strong emphasis on research and innovation across various disciplines. The company's commitment to social responsibility and community engagement is evident through its numerous partnerships and initiatives aimed at addressing global challenges.

**Key Responsibilities:**

- Embedded C/C++ Developer: Developed and optimized embedded software in C and C++ for a range of microcontroller applications, focusing on performance, reliability, and resource efficiency. Created modular, maintainable code structures to support both simple and complex embedded systems, integrating various communication protocols and peripherals as needed.

- Microcontrollers Firmware Developer: Programmed and configured microcontrollers such as STM32 and ESP32 to interface with sensors, manage data acquisition, and perform real-time processing. Used diverse programming styles including bare-metal, FreeRTOS, and state machines to meet project-specific requirements, ensuring responsive and stable operation across all applications.

- Electronic PCB Design using Altium designer, Assembly, and Manufacturing: Designed and developed PCBs from schematic to layout, including component selection, routing, and ensuring adherence to EMI/ESD standards. Collaborated closely with manufacturing teams to streamline assembly processes, troubleshoot issues, and ensure high-quality production. Conducted hands-on assembly and soldering of prototype boards as needed for testing and verification.

- Hardware and Software Test and Verification: Developed and executed detailed testing protocols for both hardware and software components to ensure functional integrity and reliability. Utilized tools such as oscilloscopes and logic analyzers for signal and protocol verification, and conducted rigorous debugging to resolve issues in pre-production stages, contributing to product quality and durability.

**Achievements:**

- Successfully designed and implemented a data acquisition system on a single microcontroller, integrating eight different sensors using FreeRTOS to manage concurrent data collection tasks efficiently. Configured the MAX14830 SPI UART expander chip to extend the microcontroller's capacity, allowing seamless communication with additional sensors. Developed firmware to read and write sensor data to an SD card, ensuring reliable long-term storage and easy data access.

This solution provided real-time data logging with optimized memory usage and high data integrity, enhancing system functionality and scalability.

- Successfully programmed the BMI323 accelerometer and gyroscope sensor using the I2C interface on an STM32 microcontroller, configuring the sensor to capture high-resolution motion data. Developed firmware to read acceleration and angular velocity values, processing this data to calculate the angle of a motorcycle wheel during turns. This implementation provided precise angle measurements in real time, enabling accurate monitoring of wheel dynamics and improving performance insights for enhanced stability and control during riding maneuvers.

- Successfully controlled an ESP32 microcontroller with an STM32 using AT commands, by UART communication protocol in DMA mode, managing full initialization and configuration for seamless communication. This included setting up the ESP32 by disabling echo, testing connection stability, configuring flash memory, initializing Wi-Fi, scanning for available networks, and connecting to a local hotspot. Additionally, I programmed the ESP32 to connect to an MQTT server and transmit data, allowing efficient real-time data exchange via the STM32. This setup ensured reliable connectivity and data transmission, enhancing system capabilities for IoT applications.

- Successfully implements a FIFO in the firmware for debugging in order not to miss any of the debugging information since in the project, there was so much debugging information going on.

- Developed a complete API firmware for seamless communication between the device and an MQTT server, enabling full remote control over device functions. This API included commands for sensor calibration, as well as start, stop, pause, and rename functionalities for data logging, providing flexible and responsive control from a central interface. By structuring the API to handle real-time commands and responses via MQTT, I enabled efficient management and monitoring of the device, enhancing its functionality and adaptability for various applications.

- Successfully designed and implemented 4-layer and 6-layer PCBs for high-density applications, achieving enhanced signal integrity and reduced EMI. These designs enabled reliable operation in performance-sensitive applications, showcasing advanced skills in stackup planning and power distribution, ultimately contributing to the robustness of the final product.

- Leveraged advanced routing techniques to ensure precise, interference-free communication between components, employing differential pairs and controlled impedance where required. Created custom circuits for power, reset, and debounce-free input, enhancing system stability and reliability. These designs provided seamless integration of multiple features on compact boards, allowing for cost-effective and efficient manufacturing.

- Leveraged the STM32's ADC functionality to design an efficient battery monitoring system, providing accurate real-time measurements of battery voltage and current levels. Configured the ADC for low-power operation and implemented periodic sampling to extend battery life while maintaining precise monitoring. This solution enabled effective power management and early detection of low-battery conditions, significantly enhancing the device's reliability and user experience by reducing unexpected power loss incidents.

- Implemented SPI communication on the STM32 microcontroller to Read and write data to an SD card, optimizing SPI clock speed and data handling for efficient storage operations. Configured SPI in interrupt mode to handle large data transfers with minimal CPU involvement, allowing continuous data logging without impacting system performance.

- Configured I2C communication on the STM32 microcontroller to interface with a BME sensor for precise environmental data acquisition, including temperature, humidity, and pressure readings. Optimized the I2C settings for stable and efficient data polling, and implemented DMA for continuous, non-blocking data transfer.

- Successfully integrated FATFS on the STM32 microcontroller to manage data storage on an SD card for a real-time data logging system.
- Successfully implemented the watchdog timer on an STM32-based system to monitor software execution and prevent system lockups during continuous operation. Configured the watchdog to trigger a system reset if the main application failed to respond within specified intervals, providing a robust fail-safe mechanism.
- Configured STM32 timers to control addressable LED indicators for device status signaling, using precise timing to manage color and brightness changes based on device conditions. Implemented PWM and timing sequences to synchronize LED patterns, providing clear, real-time visual feedback for operational states, errors, and notifications. This setup enabled customizable and responsive device status indicators, enhancing user interaction and simplifying troubleshooting.
- Utilized STM32 timers to control the speed of a pump motor by generating a high-precision PWM signal, allowing for fine-tuned speed adjustments based on operational requirements. Integrated input capture functionality to measure feedback on the pump's actual speed, enabling real-time closed-loop control. This approach improved system efficiency and stability by maintaining the desired pump speed with minimal deviation, even under varying loads, leading to a 20% improvement in performance consistency and resource management.
- Implemented GPIO input configuration for a user button, utilizing interrupt-based detection to capture button presses accurately and reduce CPU load. Applied software debouncing techniques to eliminate signal noise and prevent unintended triggers. This setup enabled responsive and reliable user input, allowing quick execution of device commands and enhancing the overall user experience in real-time applications.
- Leveraged oscilloscopes and logic analyzers to evaluate and troubleshoot communication protocols like UART, SPI, and I2C within an embedded system. Used precise timing analysis and protocol decoding features to identify and resolve issues, such as misaligned signals, timing conflicts, and data corruption.
- Implemented control of WS2808 addressable LED strips using PWM signals to provide real-time visual warnings for the motorcycle rider. Programmed custom LED patterns to indicate different warning levels, such as speed alerts, tilt angle, and proximity to obstacles, enhancing rider safety and awareness. This solution enabled dynamic, easily recognizable visual cues, improving the user experience and contributing to proactive safety measures while riding.
- Successfully developed a prototype sensor device using an Arduino board and Arduino programming to demonstrate feasibility to a client. Integrated multiple sensors to collect and write real-time data to the SD card, showcasing the device's capabilities and functionality in a user-friendly format. This prototype provided a proof-of-concept that validated the design approach, securing client approval for further development and paving the way for full-scale implementation.
- Designed and developed custom 3D printed parts using CAD software, ensuring that all components fit seamlessly into electronic systems. Collaborated with engineering teams to integrate these parts into larger assemblies, focusing on durability, precision, and compatibility with manufacturing processes.

**ASD** – Firmware and Hardware Engineer                          June. 2017- February 2023

Artin System Dana (ASD) is a small, fast-growing and science-based company that specializes in IoT equipment design and implementation.

### Key Responsibilities:

- Designing and programming a diverse range of smart home products by employing various protocols, including Z-wave and WiFi.
- Generating intricate PCB layouts using Altium Designer, specifically for battery-powered products, and producing all necessary documentation such as Gerber files and Bill of Materials.
- Programming different types of Microcontroller chips, including STM32, ZM5202, ESP32.
- Designing and programming a variety of LCDs using different ICs such as STM32F767 (LTDC Unit) and FT800.
- Designing and controlling systems to regulate small DC motors with the aid of H-Bridge technology.
- Designing circuits that utilize various voltage converters, including a 24VAC to 5VDC converter and a 5VDC to 3.3VDC converter, with the aim of controlling an air conditioning system by the help of a microcontroller.
- Developing and implementing circuits to control the heating and cooling of air conditioning units.

### Achievements:

- Successfully implemented a network of IoT devices containing up to 50 devices with reliable communication links via the Z-wave protocol.
- Designed a 100% noise free PCB for smart home products that passed all the safety and EMI related tests.
- Elevated the battery's energy efficiency by 60% to a minimum of 10 microamperes.
- Improved the antenna matching circuit for the 868MHz Z-wave antenna from -4dB to -15dB, resulting in a 200% enhancement.

---

**MEP –** Automation System Integrator                          June 2013- June 2017

Mehrab Pirouz Co (MEP), is a solutions-based building automation company with extensive experience from the Luxury Domestic, Assisted Living, Commercial Building Automation and IOT Platform Sector.

### Key Responsibilities:

- Devised and executed specialized security system configurations to suit the unique needs of different building categories, including residential, office, industrial, and villa buildings.
- Created and implemented home automation electrical diagrams and control panels using AutoCAD Electrical as the software.
- Successfully performed intricate integration of smart home systems, including lighting, HVAC, security, and audio-visual systems, using protocols like KNX, S-BUS, Z-wave, and ZigBee.
- Implemented customized software solutions to optimize the functionality of automated home systems.

**Achievements**

● Successfully installed a vast variety of brands in the home automation industry, including ABB, Siemens, Control4, Fibaro, Zipato, Tuya, and others, in more than 150 commercial and residential buildings.
● Improved the efficiency and reliability of automation systems by up to 30% through the selection of the appropriate protocol.
● Reduced power consumption by 30-40% through the automation of HVAC and lighting systems.

## Education

● M. Sc. Degree in Electrical Engineering- Islamic Azad University of Tehran          2011 - 2013
● B. Sc. Degree in Electrical Engineering- Islamic Azad University of Saveh          2006 – 2010

## References

● Reference Available on Request