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Firmware verification for Automotive Wireless Battery Monitoring Systems

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Aim

The objective of this project is to validate the firmware on the battery monitor sensors in order to ensure its compliance with established functional safety criteria for a wireless battery monitoring system used in an automotive environment.

Introduction

- Growing need for modern cockpit electronics: Result of the industry's shift toward electric mobility
- Also a growing need for highly safe systems to monitor various components of the automotive in concern
- The battery is the most important component in any electric vehicle and requires constant monitoring. Especially considering most of the vehicles have packs with Li-ion substrates. The damage can be catastrophic if not monitored closely and properly

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- ADI provides various wBMS solutions that can help address concerns regarding the same

Product Walkthrough

- Hardware setup
  - Sensors
  - Monitors
  - Connected wirelessly through specific connection protocols
  - Specialised library designed to work with client microcontollers to collect data
  - Various safety guidelines agreed upon by all parties involved. These will be implemented on all the hardware components involved
- Software setup
  - Relevant firmware that runs on each controller present
  - Using the software that runs on the sensors, various functional safety capabilities can be tested
    - Either inject erroneous instructions into the sensor, or corrupt the sensor output
    - Compare this to a set baseline to evaluate the performance
  - Various frameworks that utilise this concept have been developed and tested in the field

Testing Methodologies

- Original testing procedure was implemented using python scripts with a combination of scripting techniques and OOP concepts
  - Problems: Difficult to maintain, non-flexible framework
- Solution: Newer test frameworks being developed are utilising OOP concepts to aid in easy maintenance of the codebase and retain flexibility of requirement-based changes
- Use APIs exposed by ADI's internal software to directly communicate with the system to evaluate/baseline performance. Also helps in keeping the codebase modular

Work Progress

- Completed understanding of various hardware and software components of the system
- Analysed various faults with the previous testing methodologies and how they can be improved
- Basic implementation of the newer framework using OOP concepts has been implemented. With minor modifications, the test framework will be easy to use for all possible test cases
- Modularised code to a large extent
- (Timelines for specific events updated in the diary)

Future Work

- Complete implementation of said OOP framework
- Work on automation of testing the various cases possible [1]
- Extend the framework to work with various sensor families

Product Innovation

A major innovative aspect of this project is to purpose various freely available tools (like python/pytest) [2, 3] to generate automatic reports on testing various firmware which is very specific to a certain use case

References[1]

[1] Automation of testing: (CI/CD Pipeline). URL: https://www.jenkins.io/.

[2] Python docs. URL: https://docs.python.org/3.9/.

[3] Python test scripts. URL: https://docs.pytest.org/en/7.1.x/contents.html.

[1] Other documents regarding specific hardware/software architecture are for internal use only and cannot be shared as open sources/references