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OBD Suite: An OBD-II Vehicle Diagnostic System

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Problem

- A check-engine light gives the driver close to zero information about what is wrong with their car.
- A trouble light on the dashboard can mean a costly visit to the dealer.
- Consumer adapters often ship with unreliable software.
- Students and enthusiasts need an affordable and transparent diagnostic tool to better understand their cars.

Stakeholders & Requirements

Stakeholders
- Vehicle owners
- Car enthusiasts, hobbyists & tuners
- Automotive & CS students / trainees
- Independent mechanics / small repair shops

Functional requirements (all implemented)
- Connect over USB / Bluetooth / Wi-Fi with auto-reconnect
- Trouble codes, freeze frames, and plain-language descriptions
- Live sensor dashboard, VIN read + decode, raw-traffic capture
- Reports (PDF / CSV / JSON), vehicle profiles, self-update

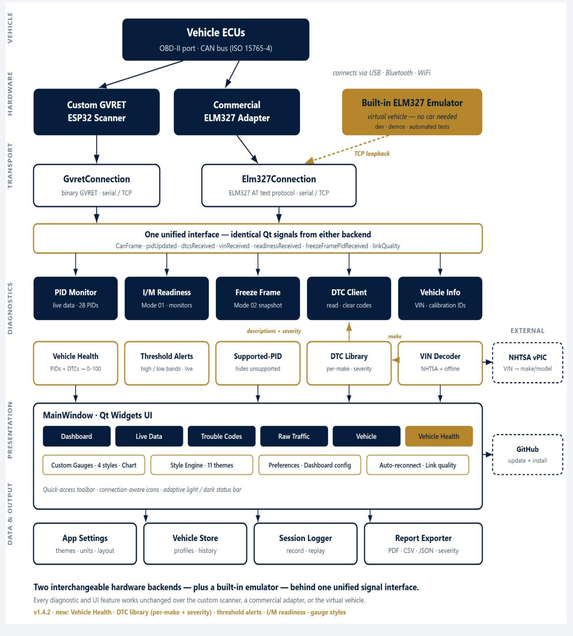
Non-functional targets
- Launch < 3 s · live data ≥ 2 updates/s · 8-hour sessions
- Auto-recovery from dropouts · light / dark + themed UI

Our Solution

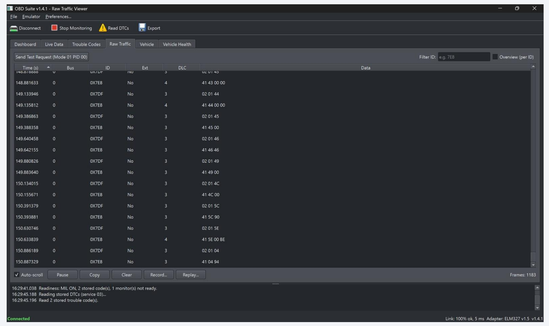
OBDSuite:
- Native Qt 6 / C++ Windows app with two interchangeable hardware backends: A custom GVRET/ESP32 scanner and commercial ELM327 adapters.
- Both backends emit identical signals, so every feature works with either.

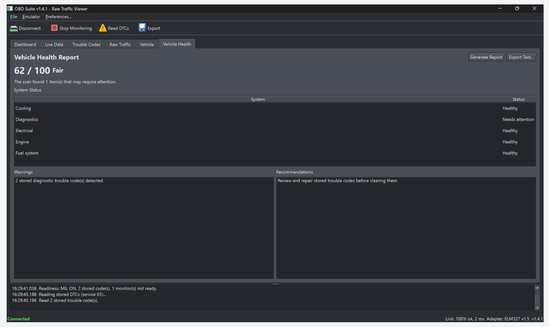
Key design decisions
- In-app ISO-TP / SAE J1979 protocol stack — not dependent on adapter firmware.
- Built-in ELM327 emulator (a “virtual vehicle”) de-risks development and drives automated testing.
- User data kept outside the install folder for non-destructive updates.

Architecture



Demo & Screenshots

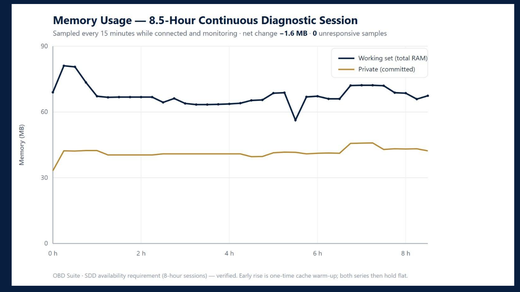




Results & Evaluation

- Five releases shipped (v1.0-beta → v1.4.1); every SDD requirement implemented.
- Validated on a real vehicles — found, fixed, and regression-tested a multi-ECU response-parsing defect discovered on the car.
- Four automated test suites, including an end-to-end test driving the app’s real adapter link against the emulator over a live socket.
- 8 hours soaking test to ensure stability.

Headline numbers:
- Launch time: median 482 ms (target < 3 s)
- Memory: ~64 MB steady
- 8-hour continuous session: stable memory, zero unresponsive samples



Engineering Process (SO6)

- Scrum framework divided across five sprints: Planning, daily scrums, backlog grooming, sprint retrospectives – all recorded in meeting minutes.
- Feature-branch workflow on GitHub with code review before every merge.
- Requirements capture in a Software Development Document; delivered incrementally; verified against multiple cars and automated test suites.
- Major setback handled: State of the project by end of sprint 4 forced replanning and explicit per-member assignments to ensure project completion.

What's Next

Future work
- Port to other OS (MacOS/Linux) + Mobile version.
- License acquisition for brand specific interactions.

Ethics & Practice

Privacy — no personal data; vehicle data stays local. Network calls only to NHTSA (VIN, HTTPS) and GitHub (updates).
Safety — no commands that alter vehicle operation in motion; explicit confirmation before clearing codes; no ECU reflashing.
Licensing — Qt (LGPL, dynamic link); ESP32RET open-source; themed UI uses only published palette colors.
Sources — all tools, standards, and datasets cited [1]–[7]; AI assistance (Claude) disclosed.

Acknowledgments

Product owner: Luis Lopez.
KFSCIS Capstone Program, Prof. Masoud Sadjadi.
Development assisted by AI pair programming (Anthropic Claude).

References

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