Project Status Report #2

Team Name: Autonomists

Date: February 05, 2026

1. Executive Summary

Following the successful hardware restoration and initial GUI communication established in December 2025, the Autonomists have transitioned from foundational hardware troubleshooting into active sensor optimization and high-level software development. This reporting period focused on custom hardware modifications, the development of robust vision-based algorithms, and securing the project's financial and software infrastructure. Despite significant academic pressures and administrative hurdles regarding funding, the team has successfully validated lane and sign detection models on external hardware and is now prepared for full-system integration on the BFMC platform.

2. Hardware Optimization & Custom Integration

2.1 Camera Module Mounting & Field of View (FOV)

During initial testing with the provided car chassis, the team identified a limitation in the stock camera mounting system. The provided mount was found to be insufficiently sized, restricting the stability and optimal positioning of the camera module. To ensure the high-fidelity visual input required for lane tracking and object detection, we designed and **3D-printed a new custom camera mount**. This modification allows for a more secure fit and better angle adjustment, which is critical for reducing perspective distortion during the upcoming lane-keeping tests.

2.2 System Stability & RPi5 Troubleshooting

The transition to mechanical calibration was met with a critical technical hurdle involving the **Raspberry Pi 5 (Brain)**. During fine-tuning, the RPi5's internal hotspot became non-functional, preventing any connection to the car's UI.

- **Diagnostic Process:** The team performed a series of network resets and configuration audits.
- **Resolution:** After several days of troubleshooting and leveraging AI-assisted diagnostic scripts, the team restored the wireless communication interface. The vehicle is once again fully operational and able to communicate via the standard interface.

2.3 Mechanical Fine-Tuning

Building upon the calibration phase mentioned in Report #1, we have completed the fine-tuning of the mechanical components. This involved adjusting the steering geometry and ensuring the chassis's physical alignment matches the digital offsets required by the control software.

3. Software Development: Vision & Perception

3.1 Risk Mitigation & Parallel Testing

To protect the integrity of the official BFMC-provided hardware, the team adopted a "Sandbox" development strategy. All initial vision algorithms and heavy computational models were developed and tested on a **personal Raspberry Pi 5**. This allowed us to iterate rapidly without risking software corruption or thermal stress on the primary competition hardware.

3.2 Lane Detection & Tracking

We have successfully implemented a functional lane detection model.

- **Methodology:** The system utilizes image processing techniques to identify lane boundaries and calculate the vehicle's position relative to the center of the track.
- **Current Status:** The primary logic is complete. We are currently in the **refinement phase for offset calculation**, which will translate pixel-level lane data into precise steering commands for the STM32-based low-level controller.

3.3 Traffic Sign Recognition (TSR) & YOLO Dataset

A significant portion of this month's effort was dedicated to the "Traffic Sign Detection and Identification" module.

- **Dataset Generation:** We are currently compiling a massive **dataset of 2,000 images** specifically tailored for the BFMC environment.
- **Model Training:** This dataset is being used to train a **YOLO (You Only Look Once)** model to ensure real-time, high-accuracy detection of various traffic signs.
- **Success:** Initial tests have shown successful identification of signboard types, which will eventually govern the car's decision-making (e.g., stopping at stop signs or yielding).

4. Administrative & Team Updates

4.1 Accountability Statement Regarding Report Submission

The team acknowledges that this report is being submitted past the February 2nd deadline. Due to a miscommunication regarding the submission schedule, the team was operating under the incorrect assumption that the deadline was February 6th. We take full accountability for this oversight and have implemented a shared digital calendar to ensure all future milestones and Bosch deadlines are tracked with redundancy.

4.2 Funding & Sponsorships

The project faced a significant setback when university funding was denied. In response, the team pivoted toward corporate outreach to secure the necessary resources for car upgrades.

- **Achievement:** We are proud to announce that we have secured a **software sponsorship from Dassault Systèmes SolidWorks**. This partnership will provide us with industry-standard CAD tools, which will be instrumental for any further custom mechanical designs and simulations.

4.3 Resource Allocation

Progress this month was intentionally moderated as three of our team members are currently preparing for national-level competitive exams occurring in the next 30 days. We balanced our workload to maintain technical momentum while supporting the academic success of our members.

5. Comparative Progress Tracking

Feature	Status in Report #1 (Dec 22)	Status in Report #2 (Feb 5)
Power	BAT2 damaged; rerouted to BAT1	Stable; supporting vision testing
IMU	Data inconsistent; hardware verified	Calibrated; integrated into chassis
Camera	Stock setup	**Custom 3D-printed mount installed**
Lane Detection	Not started	**Implemented; refining offsets**
Object Detection	Not started	**2,000-image YOLO dataset in progress**
Control	GUI-based manual control	Moving toward autonomous logic

6. Roadmap & Future Tasks

The upcoming phase represents the most critical transition in the project: moving from isolated software modules to full-vehicle integration.

Phase 1: Integration (Immediate)

- **Cross-Platform Migration:** Port the lane detection and sign recognition algorithms from the personal RPi5 to the official BFMC RPi5.
- **Algorithm Testing:** Execute live "Lane Keeping" tests to ensure the car can maintain a trajectory without manual GUI intervention.

Phase 2: Model Expansion

- **Vehicle Detection:** Train the existing YOLO model to recognize other cars on the track to facilitate collision avoidance.
- **Signboard Integration:** Link the TSR (Traffic Sign Recognition) module to the car’s speed control logic.

Phase 3: High-Level Navigation

- **Mapping:** Implement localized mapping and navigation protocols.
- **Communication:** Develop the final communication protocols for V2X (Vehicle-to-Everything) or inter-system data exchange.

7. Conclusion

Despite the challenges of funding and academic scheduling, the Autonomists have made substantial technical leaps in computer vision and hardware customization. By securing a sponsorship with Dassault Systèmes and successfully developing a robust lane-detection pipeline, the team has laid the groundwork for a competitive autonomous performance. We remain committed to the BFMC 2026 challenge and are now focused on the rigorous integration of our AI models into the physical vehicle.

8. Image Gallery:-

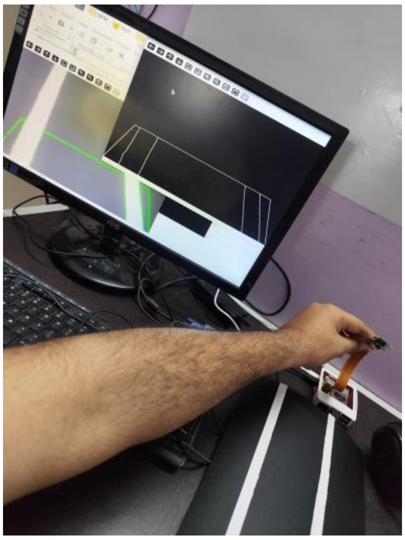
Fig1. Previously provided mount

Fig2. New fit custom mount

Fig3

Fig4

Fig3& Fig4. Wheel Alignment (in process)



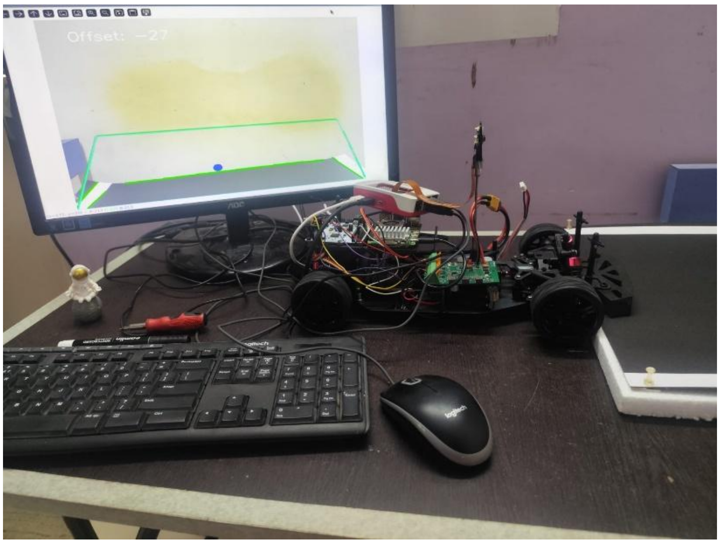


Fig5 Fig6

Fig 5. & Fig6. Developing and testing Lane Detection and offset measurement algorithm

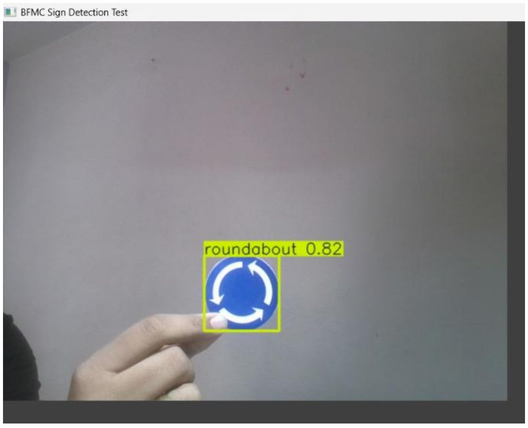
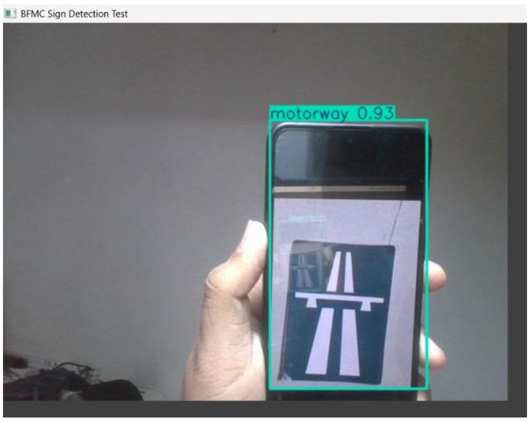


Fig7

Fig8



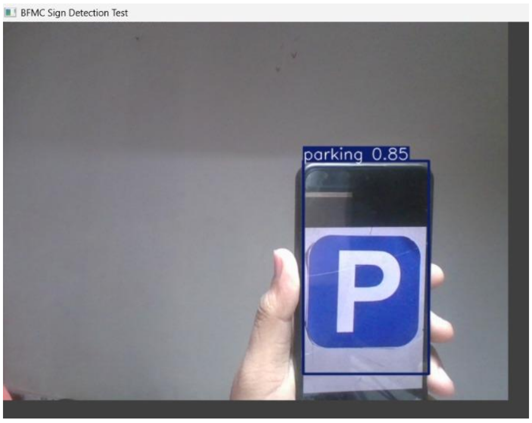


Fig9 Fig10

Fig 7, Fig8, Fig9, Fig10. Sign Board detection YOLO model Output