

Executive Summary

Modern vehicle diagnostics require interpreting complex sensor data and OBD codes, which can be time-consuming and error-prone. This project develops an **AI-powered diagnostic assistant** that analyzes engine sensor data and fault codes to provide real-time insights and recommendations. By combining **data visualization, statistical analysis, and AI reasoning**, this system improves diagnostic speed, accuracy, and accessibility for technicians.



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Background

Engine diagnostics involve:

- RPM
- Fuel pressure
- Coolant temperature
- Oil pressure

Technicians must manually interpret:

- Sensor trends
- OBD-II fault codes

Challenges:

- Increased diagnostic time
- Risk of human error
- Inconsistent results
- Need:** A data-driven diagnostic solution.

Project Objective

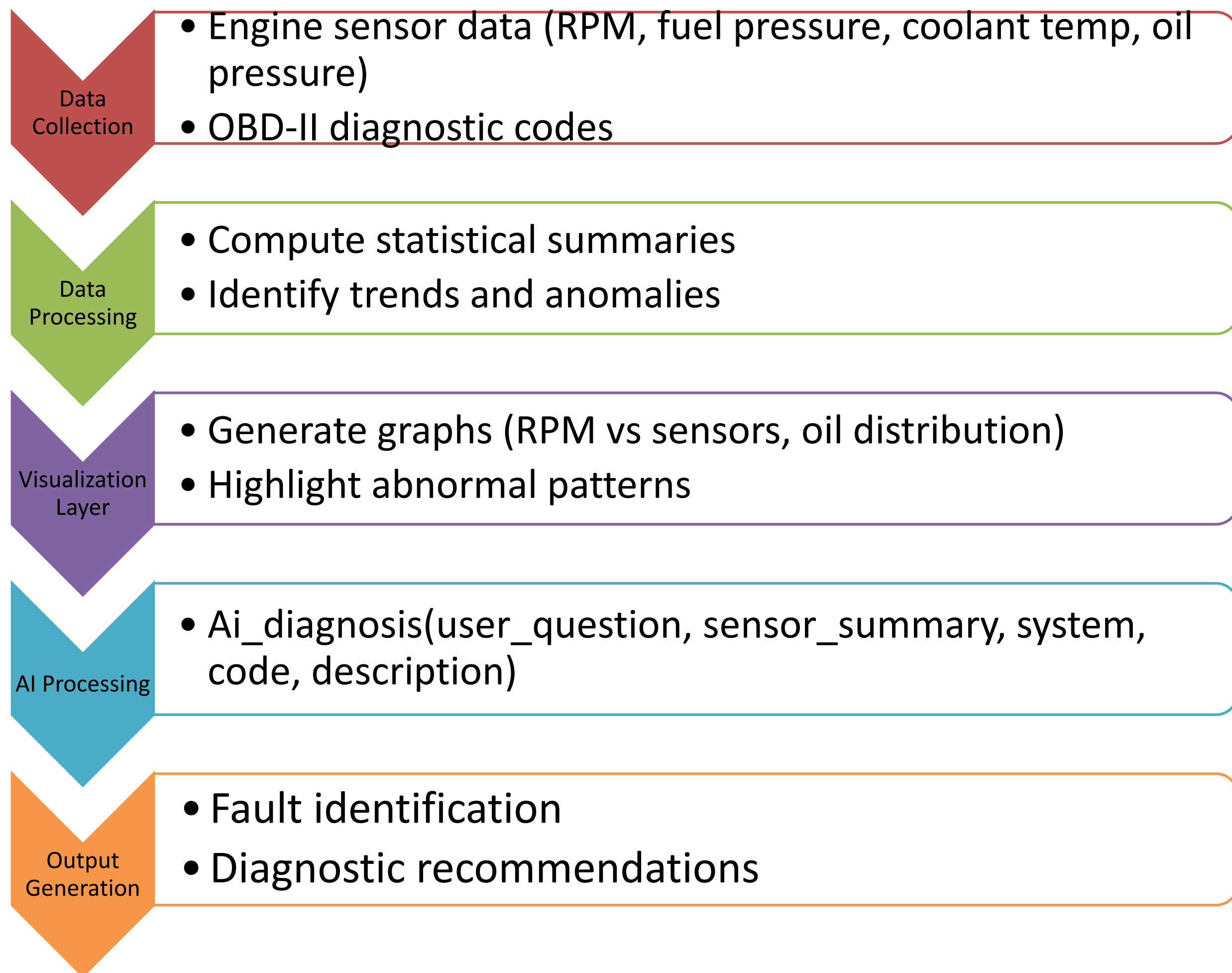
Develop an **interactive AI diagnostic system** that:

- Interprets engine sensor data
- Analyzes OBD fault codes
- Provides clear diagnostic recommendations
- Assists technicians in real-time decision making



Model Framework

Our purpose is to create an AI that can help to quickly diagnose potential problems in vehicles.



Experimental Test Plan

System Workflow:

- Collect engine sensor data
- Analyze patterns using visualizations
- Combine with OBD-II diagnostic codes
- Process user query using AI
- Output diagnosis and recommendation

Key Capabilities:

- Detect abnormal patterns
- Identify possible faults
- Recommend corrective actions

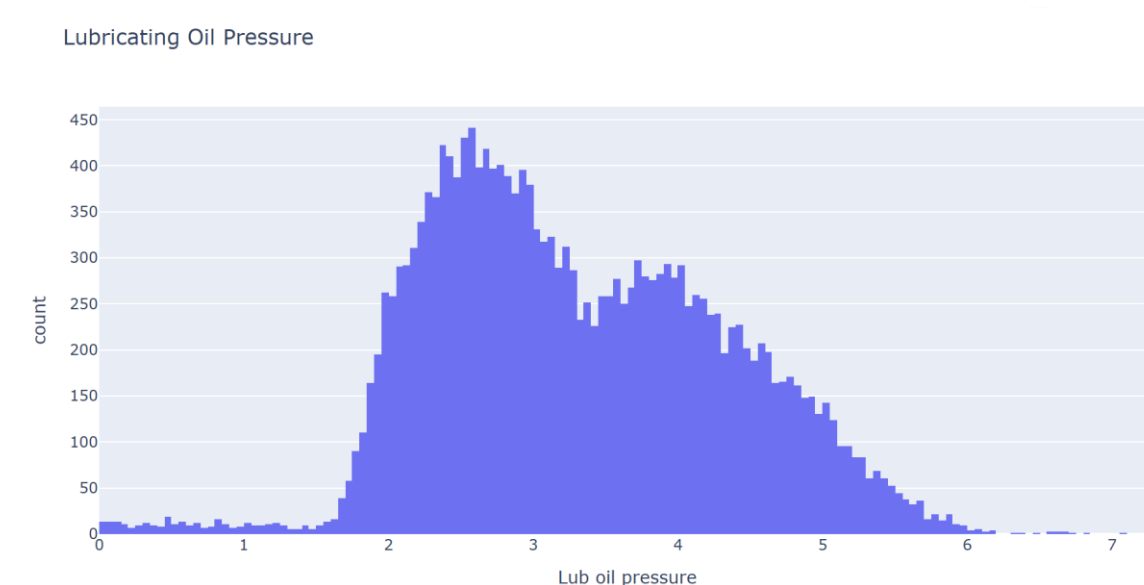


Figure 2: Analyzes lubrication performance. Helps to detect low oil pressure, oil pump failure, or risk of engine wear

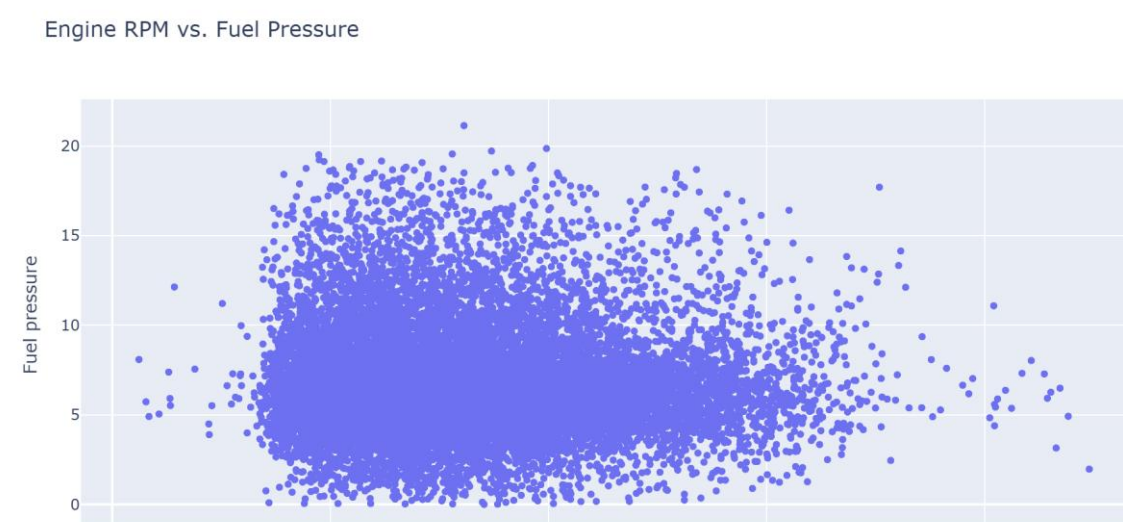


Figure 1: Shows the relationship between engine load and fuel delivery. Helps to detect weak fuel pump, faulty injectors, and pressure regulator issues.

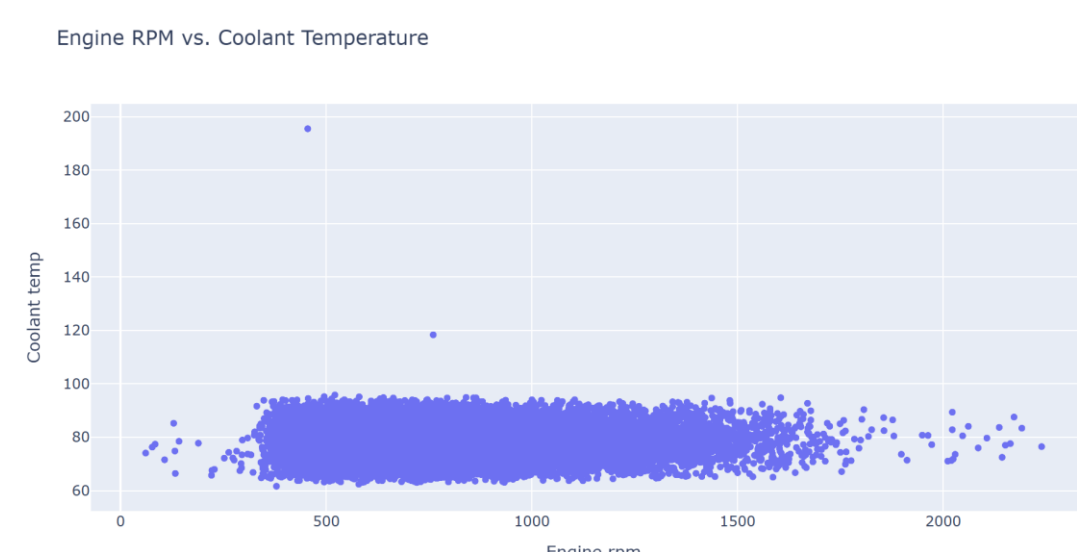


Figure 3: Evaluates thermal response of engine. Helps identify cooling efficiency, thermostat failure, and overheating issues

Experimental Results

The experimental evaluation shows that the AI diagnostic system improves as more contextual information is added to prompts. Basic prompts produced generic and less accurate responses, while incorporating sensor data improved relevance. The best performance was achieved when both sensor data and OBD codes were included, resulting in precise and actionable diagnostics. The system was evaluated based on accuracy, relevance, hallucination risk, and clarity, with results showing that richer input leads to more accurate, reliable, and well-structured responses. Dataset analysis confirmed that relationships such as RPM vs. fuel pressure, coolant temperature, and oil pressure are strong indicators of engine health. The prototype successfully delivered real-time diagnostic insights, showing the practical feasibility of AI-assisted engine diagnostics.

Key Findings:

Integrating structured sensor data and OBD codes enhances the reliability and effectiveness of AI-driven engine diagnostics.



Conclusions

- AI improves diagnostic consistency
- Combining Sensor data and OBD codes increases accuracy
- Visualization enhances understanding of engine behavior

Future Work

- Real-time vehicle integration
- Larger datasets
- Automated fault detection

References

- Dananos. (2023, March 30). *Vehicle Engine Data*. Kaggle. <https://www.kaggle.com/datasets/dananos/vehicle-engine-data>
- Oluwari, D. (2022, January 29). *OBD2 powertrain codes*. Kaggle. <https://www.kaggle.com/datasets/donnetew/odb2-powertrain-codes>