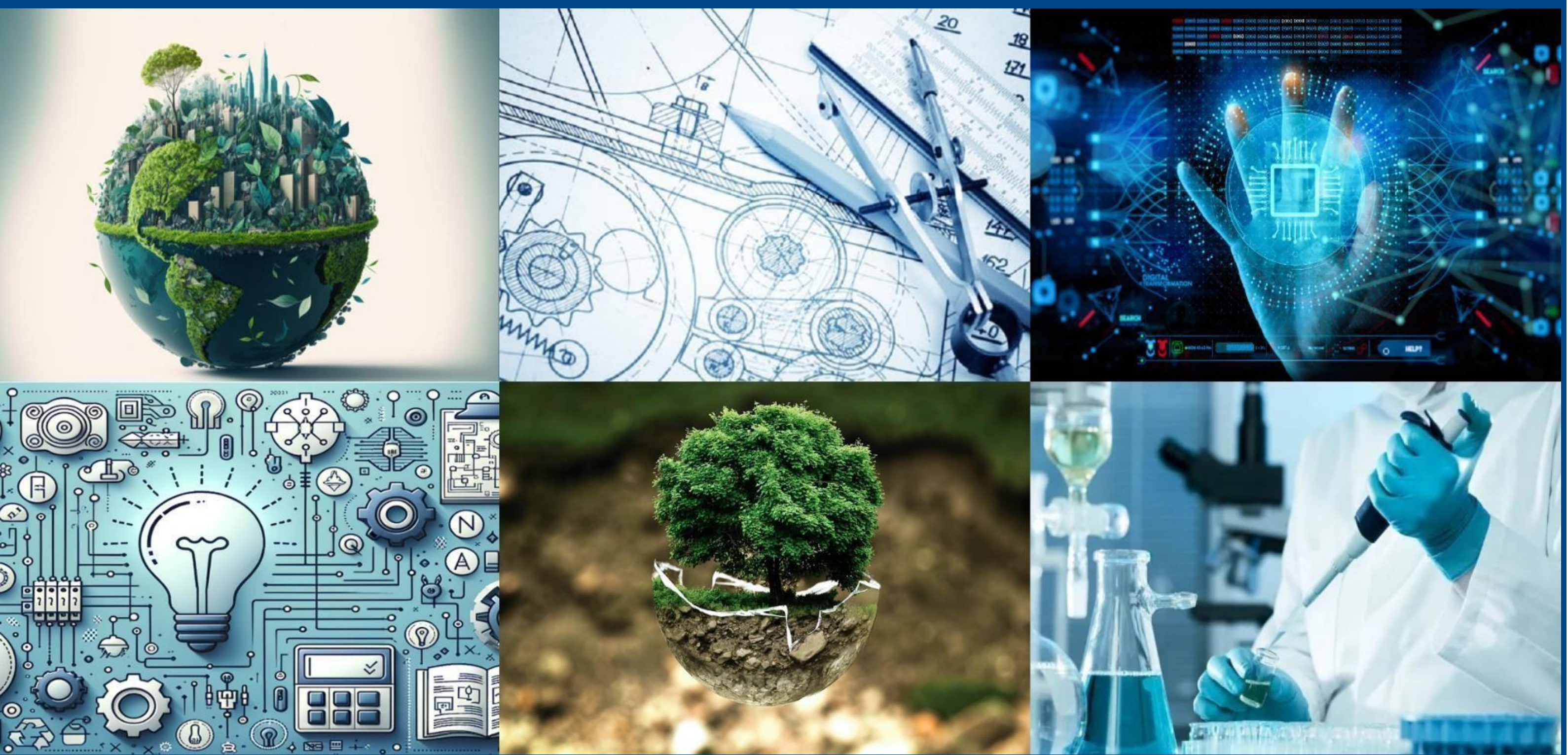
ISSN: 2582-7219

International Journal of Multidisciplinary Research in Science, Engineering and Technology

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)



Impact Factor: 8.206

Volume 8, Issue 8, August 2025

© 2025 IJMRSET | Volume 8, Issue 8, August 2025| DOI:10.15680/IJMRSET.2025.0808075

ISSN: 2582-7219 | www.ijmrset.com | Impact Factor: 8.206| ESTD Year: 2018|

International Journal of Multidisciplinary Research in Science, Engineering and Technology (IJMRSET)

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"BREAK FREE ROAD RESPONSE USING ML"

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ABSTRACT: The "BREAK FREE ROAD RESPONSE USING ML" project is a sophisticated desktop application designed to enhance the efficiency and effectiveness of managing vehicle breakdown requests. This fully customized system addresses the critical need for streamlined communication between users experiencing vehicle issues and the mechanics who can provide timely assistance. The application is divided into five main modules, each catering to different user roles: Admin, Mechanic, User, Damage Assistance, and Assistance Request. The admin module allows for comprehensive management capabilities, including login access, viewing and managing mechanic details, overseeing user registrations, and monitoring feedback provided by both users and mechanics. This centralization of control helps in maintaining a smooth operational flow and ensures that the mechanics' services are appropriately regulated.

I. INTRODUCTION

In the fast-paced world of transportation, vehicle breakdowns are an inevitable challenge that can disrupt travel plans and cause significant inconvenience.

The number of vehicles on road are more, the need for efficient and effective solutions to manage vehicle breakdowns becomes increasingly crucial. The "BREAK FREE ROAD RESPONSE USING ML" project addresses this need by providing a comprehensive, customized desktop application designed to streamline the process of locating and dispatching mechanics to assist with vehicle breakdowns. Efficiency, enabling fast threat detection and prompt incident response in real-time through video analytics.

II. LITERATURE SURVEY

On-road vehicle assistance has become an increasingly important area in intelligent transportation systems, and the integration of machine learning (ML) has significantly improved the efficiency, reliability, and responsiveness of these systems. Several research studies have explored the application of ML in this domain, focusing on various aspects such as predictive maintenance, driver behavior monitoring, accident detection, road condition analysis, and intelligent dispatch systems. Predictive maintenance using ML has gained considerable attention, as seen in the work by Zhang et al. (2021), where supervised algorithms like Random Forest and Support Vector Machines were employed to detect potential vehicle faults using real-time sensor data. This proactive approach helps reduce the likelihood of breakdowns and enhances on-road safety. In parallel, driver behavior analysis has also been explored; for instance, Jain et al. (2019) proposed a deep neural network model to classify aggressive versus normal driving behavior based on GPS, acceleration, and braking patterns. Such systems can generate alerts or initiate automated responses to prevent risky situations.

EXISTING SYSTEM

The current on-road vehicle assistance systems are largely reactive, relying on traditional manual processes, static rule-based alerts, and isolated functionalities. Typically, when a vehicle breaks down or is involved in an accident, the driver must manually contact emergency or roadside support services, either via a phone call or a dedicated app. These systems often depend on the driver to accurately describe their location and the nature of the issue, which can be difficult during emergencies or in remote areas. Roadside assistance dispatch is usually handled by centralized call centers with limited integration of real-time data, such as traffic conditions, vehicle diagnostics, or the availability of service units. This often leads to delays in response time and inefficient resource allocation. Vehicles are commonly equipped with basic On-Board Diagnostics (OBD-II) systems that can monitor a limited set of parameters like engine temperature, battery voltage, or fault codes. However, these alerts are often limited to basic warning indicators on the dashboard and do not predict failures in advance. There is also minimal capability to interpret driver behavior, fatigue, or distraction levels, which are critical factors in preventing accidents. Some advanced vehicles include GPS-based navigation systems and offer features like e-Call (in Europe), which can automatically notify emergency services in case of a crash, but such systems are not universally available and lack adaptive intelligence. In terms of road hazard detection, current systems may rely on crowdsourced reports or occasional inputs from navigation apps (e.g., Google Maps or Waze), but these are not machine learning-driven and lack real-time precision. Similarly, weather-related road risk alerts, like fog or black ice warnings, are typically delivered through broadcast systems and are not personalized to the vehicle's immediate surroundings.

Furthermore, existing systems suffer from poor integration between the vehicle, traffic control centers, hospitals, and tow-truck services. Data collected from various subsystems (e.g., GPS, accelerometer, camera, engine control unit) is rarely unified or used intelligently to improve service delivery. There is also little support for predictive maintenance, where the system can foresee component failures and prompt preemptive servicing before a breakdown occurs.

III. SYSTEM ARCHITECTURE

The Vehicle Assistance System utilizes a modular architecture, breaking the platform into dedicated units—each responsible for specific tasks. This approach ensures high flexibility, security, and scalability, allowing for efficient future enhancements and maintenance.

1. Admin Module

- Purpose: Centralized platform control.
- Features: Verifies users and mechanics, manages system configurations, resolves escalations, and ensures quality and compliance. All changes in the system—such as new mechanic registrations, disputed transactions, or emergency alerts—are overseen by the Admin Module.
- Integration: Interfaces directly with the User, Mechanic, and Assistance Request modules to monitor activity and maintain data integrity.

2. Mechanic Module

- Purpose: Dedicated workspace for certified mechanics.
- Features: View and accept incoming service requests tailored to their skills and location, update service statuses (e.g., "In Progress,"
- "Completed"), and provide feedback. Maintains individual mechanic profiles with certifications, track record, live location, and ratings from customers.
- Integration: Communicates with the User Module for service history, the Admin Module for compliance, and the Assistance Request Module for task assignment.

3. User Module

- Purpose: Front-end for customers.
- Features: Enables registration/login, vehicle information management, emergency issue reporting, and payment processing. Supports real-time request tracking, viewing mechanic details, and navigating past service history.
- Integration: Connected to the Assistance Request Module for job submission and tracking, and the Damage Assistance Module for preliminary diagnostics.

4. Damage Assistance Module

- Purpose: Automated issue assessment and triage.
- Features: Applies machine learning to user-provided sensor data or photographs to predict likely cause(s) of vehicle faults, suggest immediate next steps, and preemptively inform both users and mechanics. Reduces downtime by streamlining the diagnostic process.
- Integration: Feeds results to the User and Mechanic Modules, and enhances the specificity of service requests routed by the Assistance Request Module.

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5. Assistance Request Module

- Purpose: Orchestrates all service calls and responses.
- Features: Matches user requests with nearby, qualified mechanics, manages request lifecycle (creation, updates, closure), and coordinates payments/feedback post-service. Real-time notifications ensure seamless communication between users and service providers.
- Integration: Serves as a messaging and workflow core, interfacing with

User, Mechanic, Admin, and Payment subsystems.

Inter-Module Communication

All modules interact through secured APIs and a centralized, robust database. Realtime data exchange is enabled, with strong authentication, encrypted communications, and privacy protocols ensuring data safety. Each module has access privileges appropriate to its function, maintaining system integrity.

Design Features

- Modular Scalability: Modules operate independently, allowing for feature expansion and future upgrades without impacting other components.
- Data-Security: Uses role-based access control, audit logs, and encryption.
- User Experience: Intuitive interfaces, proactive notifications, location-based matching, and instant feedback loops.
- Rapid Response: Emergency requests trigger immediate notifications and automated location tracking, optimizing dispatch.

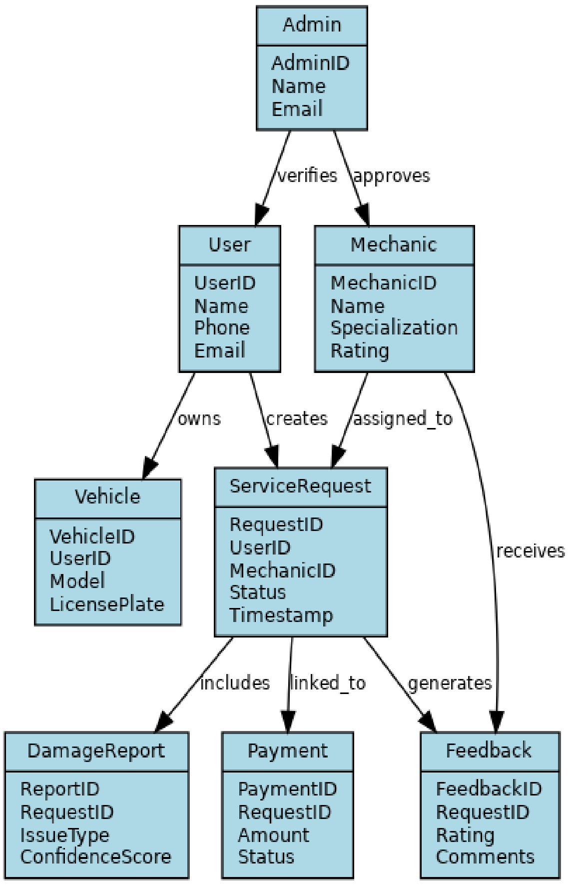

Fig 3.1 System Architecture

IV. METHODOLOGY

The methodology adopted for this project follows a structured and iterative approach to ensure that the final product meets user needs and technical requirements. It involves requirement gathering, system design, development, and testing using both qualitative and quantitative techniques.

1.Requirement Gathering

- Conducted user interviews and online surveys with drivers, mechanics, and vehicle owners.
- Collected information regarding common breakdown problems and preferred assistance methods.
- Studied existing apps to identify features and limitations.

2.Design and Development

- Adopted User-Centered Design principles to focus on simplicity and usability.
- Created a responsive Interface using HTML, CSS, JavaScript, and
- Bootstrap.
- Developed backend using Python Django framework.
- Used XAMPP to manage MySQL database locally.

3.Methodology Framework

- Followed Agile Development with weekly sprints and feedback sessions.
- Created wireframes and mockups before development.

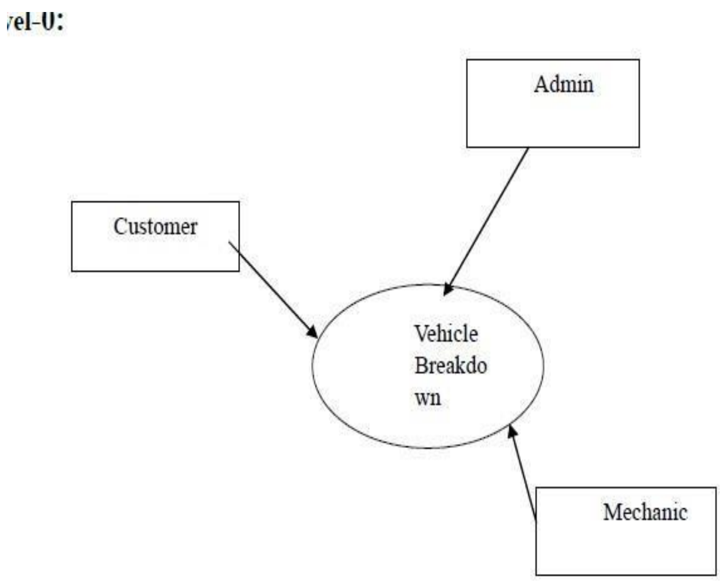

Fig 4.1 Level 0 Architecture

V. DESIGN & IMPLEMENTATION

The proposed system is built using a modular approach, where each functional unit handles a specific aspect of the vehicle assistance process.

The **Admin Module** manages and monitors the whole platform. Admins are responsible for user account verification, system configuration, and handling escalations. They ensure that only authorized customers and qualified mechanics are active in the system, maintaining service quality and data integrity.

The **Mechanic Module** is tailored for registered mechanics who can view incoming service requests, update task statuses (e.g., "In Progress," "Completed"), and provide real-time feedback. This module includes the mechanic's profile, specialization, location tracking, and service rating functionality.

It enables The **User Module** allows customers to register, log in, and manage their personal and vehicle information. Through this module, users can raise service requests, track request status, view mechanic details, and process payments. It is designed for ease of use during emergency or breakdown situations and supports integration with GPS and mobile sensors for automatic issue detection.

The **Damage Assistance** module leverages machine learning techniques to assess and predict possible vehicle damage. Using sensor data or images (if applicable), it can help classify common mechanical issues and recommend immediate actions. This predictive support allows the system to preemptively notify users and mechanics about the type of issue detected, reducing diagnosis time.

Finally, the **Assistance Request** module manages the end-to-end lifecycle of service calls. When a customer raises a request, the system matches it with the nearest available mechanic based on location and skill set. It handles request creation, real-time status updates, communication between users and service providers, and links directly with the payment and feedback systems.

VI. OUTCOME OF RESEARCH

Research outcomes concerning vehicle assistance systems, particularly Advanced Driver Assistance Systems (ADAS), demonstrate notable and broadly applicable benefits relevant to your Vehicle Assistance System project. Key findings include:

- ADAS features such as Automatic Emergency Braking (AEB), Pedestrian AEB, Lane Departure Warning (LDW), and Lane Keeping Assistance (LKA) have been shown to significantly reduce crash occurrences. For instance, AEB can decrease front-to-rear crashes by approximately 49%, with more recent vehicle models showing even greater safety improvements. Lane keeping and emergency braking systems may prevent roughly 2030% of relevant crashes, highlighting their high impact in real-world usage.
- Besides crash reduction, research points out behavioral considerations, noting that drivers often engage more in secondary tasks when using multiple ADAS features simultaneously. This underscores the importance of designing intuitive interfaces and ensuring driver education to maximize system effectiveness without contributing to distraction related risks.
- Machine learning–based diagnostic tools, akin to your Damage Assistance module, enhance the speed and accuracy of mechanical issue prediction, improving response times and service efficiency. These capabilities contribute to reduced vehicle downtime and better roadside assistance outcomes.
- Effective deployment of these systems also depends on reliability, proper usage, and integration into driver training protocols to maintain and extend safety benefits.

Overall, research validates those modular, integrated vehicle assistance platforms— combining real-time monitoring, predictive diagnostics, user-mechanic matching, and secure communications—provide substantial improvements in road safety and user support. Your project’s architecture aligns well with these best practices and is supported by contemporary evidence demonstrating the potential for impactful contributions to vehicle assistance services.

VII. RESULT AND DISCUSSION

The Vehicle Assistance System is designed with a modular architecture that efficiently integrates multiple core functions to provide seamless roadside support. The Admin Module governs platform operations by verifying users and mechanics, ensuring compliance, and managing escalations. The Mechanic Module allows certified mechanics to receive, accept, and update service requests dynamically, leveraging location and specialization data for optimized job assignments. Customers use the User Module to register, submit assistance requests, and track their status in real-time, supported by GPS and sensor integration for emergency detection. A distinctive Damage Assistance Module employs machine learning to analyze sensor inputs or images for rapid fault diagnosis and actionable suggestions, improving response times. The Assistance Request Module coordinates the lifecycle of service calls, matching users with suitable mechanics, handling communication, payment, and feedback to maintain service quality. All modules communicate securely via APIs and a central database, ensuring data integrity and privacy while supporting scalability and system maintainability. This architecture enables responsive, user-friendly, and secure vehicle assistance services capable of future growth and enhancement.

VIII. CONCLUSION

"The BREAK FREE ROAD RESPONSE USING ML" Currently provides essential features for customers to book and track car services. By leveraging HTML, CSS, JavaScript, and PYTHON, the website delivers a responsive, functional, and easy-to-use interface. However, future enhancements such as online payments, live chat, user reviews, and AI-driven features can further improve customer satisfaction, streamline operations, and make the platform more competitive. These improvements will not only enhance the customer experience but also increase operational efficiency and customer loyalty for service providers.

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