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Track And Fix: A Gps-Based Smart Roadside Assistance System

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Abstract: ***Vehicle breakdowns on highways often result in delays, safety risks, and inconvenience due to the lack of immediate assistance. This paper proposes Track and Fix, a GPS-based web application designed to provide real-time roadside assistance. The system enables users to send emergency requests by sharing their live location. Nearby mechanics receive instant notifications and can navigate to the breakdown location using map services. The system integrates mobile computing, GPS tracking, cloud backend services, and notification systems to ensure efficient communication. A distance-based algorithm is used to identify the nearest mechanic and assign the request. Experimental observations show reduced response time and improved coordination. The proposed system provides a scalable and practical solution for emergency roadside assistance.***
Keywords—GPS, Roadside Assistance, Mobile Application, Real-Time Tracking, Location-Based Services, Emergency Systems.

I. INTRODUCTION

Vehicle breakdown is a frequent problem faced by drivers, especially on highways and remote areas. In such situations, finding immediate help is difficult, leading to delays and safety concerns. Traditional roadside assistance methods depend on manual communication, which is often inefficient and time-consuming.

With the growth of smartphones and GPS technology, real-time location tracking has become feasible. web applications can now provide location-based services that improve response time and service delivery. This paper introduces Track and Fix, a system designed to connect vehicle users with nearby mechanics using real-time GPS tracking.

The objective is to provide quick assistance, reduce waiting time, and improve safety for users during emergencies.

II. RELATED WORK

Several studies have proposed mobile-based roadside assistance systems. Most systems use GPS and web applications to identify vehicle locations and connect users with service providers. However, many existing systems have limitations:

- Lack of real-time tracking
- Delayed notification systems
- Poor coordination between users and mechanics
- Dependence on manual processes

Cloud-based systems improve scalability but introduce challenges such as data privacy and high operational costs. Some solutions fail in remote areas due to poor network connectivity.

These limitations motivate the development of a more efficient and reliable system like Track and Fix.

III. SYSTEM ARCHITECTURE

The proposed system follows a client-server architecture consisting of multiple interconnected components designed to ensure real-time communication, scalability, and efficient processing.

A. Components of the System

1) User WebApplication:

- Used by vehicle owners
- Allows login, request submission, and location sharing
- Displays nearby mechanics and tracking interface

2) Mechanic WebApplication:
- Used by mechanics
- Receives notifications of nearby breakdown requests
- Allows acceptance of requests and navigation to location

3) GPS and Location Services:
- Captures real-time latitude and longitude
- Enables accurate location tracking
- Integrated with Google Maps API

4) Backend Server:
- Handles authentication and request processing
- Implements logic for matching users with mechanics
- Manages communication between applications

5) Database:
- Stores user and mechanic details
- Maintains service request records
- Stores location and history data

6) Notification Service:
- Sends real-time alerts to mechanics via Firebase Cloud Messaging (FCM)

B. Architecture Workflow

1. User logs into the web application
2. User sends breakdown request
3. GPS captures live location
4. Request is sent to backend server
5. Server finds nearby mechanics
6. Notification is sent to mechanics
7. Mechanic accepts request
8. Mechanic navigates using maps
9. Service is completed

C. System Architecture Diagram

```
User web App   Mechanic web App
    |              |
    +-- GPS/Map Svc -----+
          |
     Backend Server
          |
        Database
          |
   Notification Service
```

Fig. 1. System Architecture – Real-Time Assistance Flow.

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Fig. 3 – GPS Real-Time Tracking Flow

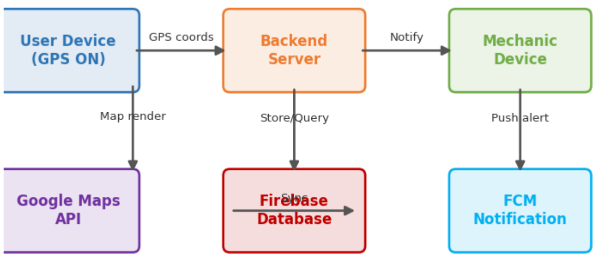

Fig. 3 – GPS Real-Time Tracking Flow

IV. Proposed Methodology

The methodology of the system is divided into the following sequential steps:

10. Registration of users and mechanics
11. Login authentication
12. Emergency request generation
13. Real-time GPS location capture
14. Distance calculation using the Haversine algorithm
15. Identification of nearest available mechanic
16. Notification dispatch and request acceptance
17. Navigation and service completion

This process ensures efficient and quick response during emergencies.

V. Algorithms Used

A. Haversine Algorithm

The Haversine formula calculates the great-circle distance between two geographical points. By accounting for the spherical shape of the Earth, it provides accurate distances for identifying the nearest mechanic:

$$d = 2r \cdot \arcsin(\sqrt{[\sin^2(\Delta\varphi/2) + \cos\varphi_1 \cdot \cos\varphi_2 \cdot \sin^2(\Delta\lambda/2)]})$$

where φ = latitude, λ = longitude, and r = Earth's mean radius.

B. Nearest Mechanic Selection

After computing distances to all registered mechanics, the algorithm selects the one with minimum distance from the user's current GPS coordinates, directly optimizing response time.

C. Request Assignment Algorithm

The breakdown request is dispatched to all nearby mechanics simultaneously. A first-come-first-served (FCFS) strategy assigns it to the first mechanic who accepts, minimizing response latency.

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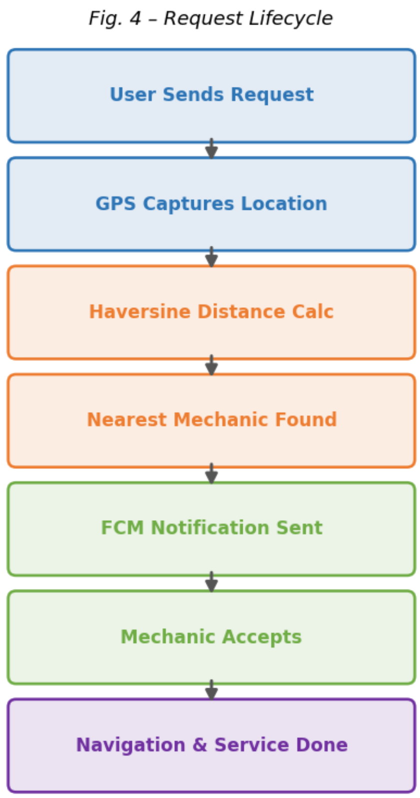

Fig. 4 – Request Lifecycle Flowchart

VI. IMPLEMENTATION

The system is built using modern, cross-platform technologies:

- Frontend: Android (HTML/CSS)
- Backend: TILWIND/SQL
- Database: Firebase Realtime Database / MySQL
- Maps: Google Maps API
- Notifications: Firebase Cloud Messaging (FCM)

The application provides an intuitive interface for both vehicle owners and mechanics, minimizing the learning curve during high-stress emergency situations.

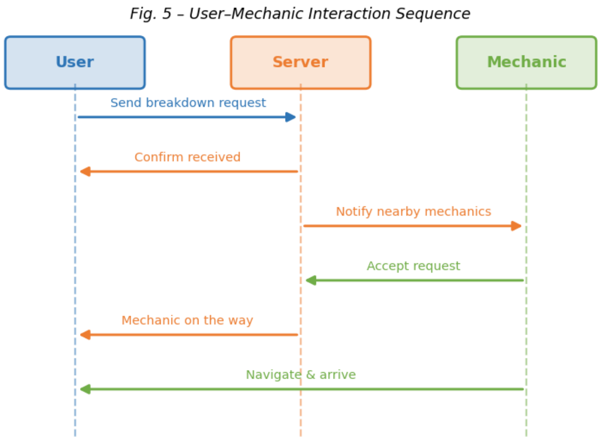

Fig. 5 – User–Mechanic Interaction Sequence

VII. Advantages

- Real-time GPS tracking for accurate location sharing
- Rapid emergency response through automated mechanic matching
- Improved safety for stranded vehicle users
- Intuitive interface accessible to non-technical users
- Scalable cloud-based architecture for wide deployment

VIII. Limitations

- Requires active internet connectivity for all operations
- GPS accuracy may degrade in signal-obstructed areas
- Response time dependent on mechanic availability
- Continuous GPS tracking leads to higher battery consumption

IX. Future Work

Future enhancements to the Track and Fix system binclude:

- Integration of secure online payment gateways
- AI-based predictive breakdown detection using vehicle telemetry
- Voice-activated emergency request submission
- Multi-language support for broader accessibility
- Integration with towing and emergency response agencies
- Offline fallback mode for poor-network areas

X. Conclusion

Track and Fix presents an effective and scalable solution for emergency vehicle breakdowns. By integrating GPS technology, mobile applications, and cloud-based backend services, the system ensures rapid response and improved safety for stranded users. The proposed system overcomes the limitations of traditional manual assistance methods and demonstrates a practical application of location-based services in real-world emergency scenarios. Future work will further enhance the reliability, intelligence, and accessibility of the platform.

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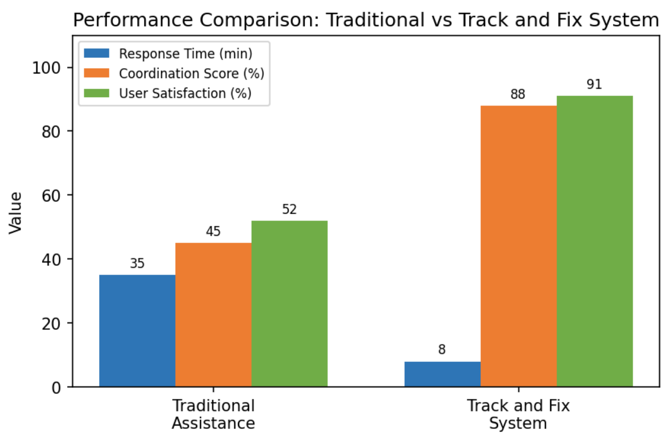

Fig. 2. Performance Comparison: Traditional vs Track and Fix System.