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A Smart Platform for Real-Time Vehicle Breakdown Assistance and Mechanic Locator Services

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ABSTRACT

On Road Vehicle Breakdown Assistance is a real-time, cloud-integrated web application designed to help users locate nearby mechanics efficiently. The system utilizes Azure Maps API for geolocation tracking, Firebase Firestore for real-time database management, and role-based access control for secure user authentication and mechanic verification. ORVBA features a mechanic locator that enables users to search for available service providers based on location and service requirements, significantly reducing response time and improving accessibility.

To enhance service recommendations, the system implements the K-Nearest Neighbours algorithm for location-based filtering, allowing users to find the nearest mechanics based on distance and service availability. The platform allows administrators to manage user and mechanic accounts, including approval, blocking, and monitoring of services to ensure reliability. Unlike traditional systems that rely on static mechanic directories, ORVBA provides a dynamic and centralized platform that ensures efficient service matching, real-time updates, and secure cloud-based data storage. Additionally, Local SEO techniques and structured data markup enhance mechanic discoverability, improving search engine visibility and accessibility. By leveraging cloud computing, KNN-based filtering, and real- time tracking, ORVBA offers a scalable and user-friendly roadside assistance solution for modern vehicle support needs.

Keywords -- Azure Maps API, Firebase Firestore, K-

Nearest Neighbours (KNN) Algorithm, Local SEO.

1. Introduction

The advancement of technology has significantly transformed various industries, including the automobile service sector. Vehicle breakdowns are a common occurrence, often leaving drivers stranded in unfamiliar locations with limited access to mechanical assistance. The lack of real-time tracking and centralized service management further exacerbates the issue, leading to delays in response times and inefficiencies in connecting users with available mechanics.

The On-Road Vehicle Breakdown Assistance (ORVBA) system is designed to bridge this gap by leveraging modern web technologies to offer a real-time, location-based solution for finding nearby mechanics. Unlike traditional roadside assistance services that rely on static directories or manual intervention, ORVBA integrates cloud computing, geolocation tracking, and AI-driven service recommendations to enhance accessibility, reliability, and efficiency.

The proposed system provides an interactive platform where users can search for available mechanics, book services, and track their arrival in real-time. Mechanics, in turn, can accept or reject requests, update their availability status, and receive feedback to improve their service credibility. Admins oversee the platform by verifying mechanics, monitoring service requests, and maintaining system integrity.

1.1 OBJECTIVES OF ORVBA

- **Real-Time Mechanic Discovery:** Enable users to locate and connect with nearby mechanics using Azure Maps SDK.
- **Secure User Authentication:** Implement Firebase Authentication for safe and role-based access control.
- **AI-Driven Recommendations:** Use K-Nearest Neighbours (KNN) algorithm for personalized service recommendations based on proximity and availability.
- **Service Request & Tracking:** Allow users to book mechanics and track their arrival in real-time.
- **Enhanced Visibility for Mechanics:** Implement Local SEO strategies and structured data markup to improve discoverability.
- **Scalable & Secure Data Management:** Utilize Firebase Firestore for real-time, cloud-based data storage and synchronization.

The primary objectives of ORVBA are:

- To enable real-time mechanic discovery using Azure Maps SDK.
- To ensure secure authentication and user role management through Firebase Authentication.
- To improve service recommendations using KNN-based filtering.
- To enhance mechanic visibility using Local SEO and structured data markup.
- To allow administrators to manage users and services dynamically.

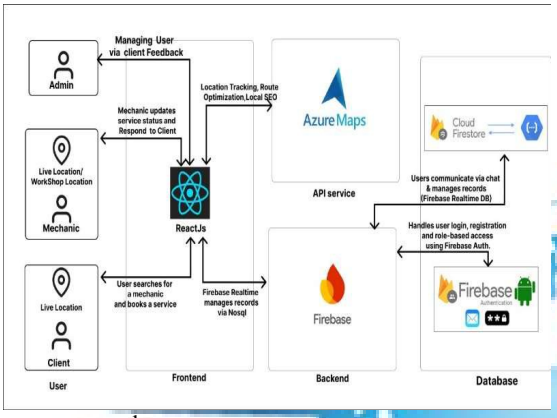
2. LITERATURE SURVEY

2.1 EXISTING METHODS

- Users rely on asking locals or calling known mechanics, which is often slow and unreliable. Availability is uncertain, leading to long wait times, especially in remote areas.
- Platforms like Google Maps help find mechanics but lack real-time availability tracking. Users must

manually contact multiple mechanics, causing delays.

- Insurance-backed services offer breakdown help but are subscription-based and have slow response times. Coverage is often limited, making it inaccessible in rural areas.



- Some apps connect users to mechanics but are mostly limited to urban areas without real-time tracking. Users cannot track mechanic arrival times, leading to uncertainty.

2.2 PROPOSED SOLUTION

- The system uses Azure Maps SDK and the Geolocation API for accurate user location tracking and nearby mechanic discovery. GPS-based route optimization ensures the shortest and fastest paths. The Haversine Formula is applied for precise distance calculation between users and mechanics.
- Firebase Authentication ensures secure logins, while Firestore Database manages real-time mechanic and service data. The system maintains accurate records and updates mechanic availability dynamically.
- Offline access is supported by local storage, allowing users to retrieve stored mechanic details even without an internet connection, ensuring accessibility in remote areas.
- Local SEO and service visibility are enhanced using structured data markup and geotagging, improving local search rankings and making mechanics easily discoverable.
- An admin dashboard developed in React.js provides tools to manage mechanics, monitor user requests, and track service activities efficiently. KNN is used for location-based filtering, helping users connect with the nearest available mechanics.

3. SYSTEM ARCHITECTURE AND DESIGN

Fig 1.1 SYSTEM ARCHITECTURE

3.1 SYSTEM COMPONENTS

- **Frontend:** Developed using React.js with Bootstrap for UI styling to ensure a responsive and user- friendly experience.
- **Backend:** Firebase Firestore as the NoSQL cloud database, supporting real-time updates and data storage.
- **Mapping & Location Tracking:** Azure Maps SDK for geolocation tracking and route optimization.
- **Authentication:** Firebase Authentication for secure login & role-based access, ensuring data privacy.
- **Machine Learning:** K-Nearest Neighbors algorithm for service recommendations, dynamically ranking mechanics based on distance, availability, and user ratings.
- **Admin Dashboard:** React.js-based interface for managing users, services, and monitoring real-time activities.

3.2 Data Flow & System Operation

1. Users register and log in securely through Firebase Authentication.
2. Mechanic availability and location data are stored and dynamically updated in Firebase Firestore.
3. Users search for mechanics based on their location; Azure Maps SDK fetches real-time data and displays nearby service providers.
4. KNN Algorithm ranks mechanics based on distance, ratings, and availability.
5. Users book a mechanic, and real-time notifications alert the service provider.
6. Admins oversee service requests, verify mechanic profiles, and manage platform reliability.

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