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INTELLIGENT ROAD RESCUE APPLICATION

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Abstract: Road accidents and vehicle breakdowns are increasing rapidly due to the continuous growth in vehicle usage and urban traffic density, resulting in frequent delays in emergency assistance and roadside services. In many critical situations, the absence of accurate location information, combined with manual communication methods, significantly delays rescue operations, which may lead to serious injuries, loss of life, and property damage. To overcome these challenges, this paper presents an Intelligent Road Rescue Application, a real-time, location-based emergency assistance system designed to provide fast, reliable, and transparent roadside rescue services. The proposed system connects users facing emergencies with nearby service providers such as mechanics, towing services, fuel suppliers, and ambulances through a centralized digital platform. By leveraging GPS technology, cloud computing, and real-time communication frameworks, the application enables automatic location detection, nearby vendor identification, continuous live tracking, secure digital payments, and structured feedback mechanisms. The system significantly improves response time, enhances transparency, and ensures efficient coordination between users and service providers. This paper presents a detailed discussion of the system architecture, methodology, implementation, simulation framework, and performance evaluation of the proposed solution.

Keywords: Roadside Assistance, GPS Tracking, Real-Time Systems, Emergency Services, Web Application

I. INTRODUCTION

Road transportation plays a crucial role in economic development, logistics, and daily human mobility. However, the rapid increase in vehicle ownership and road usage has led to a corresponding rise in road accidents, unexpected vehicle breakdowns, and medical emergencies during travel. In many cases, accident victims and stranded vehicle users fail to receive timely assistance due to delayed communication, inaccurate location identification, and inefficient coordination between emergency responders and roadside service providers.

Traditional roadside assistance systems primarily rely on manual phone calls, roadside help centers, or personal contacts. These methods are often inefficient, time-consuming, and lack transparency. During emergency situations, users may be unable to clearly communicate their exact location, particularly on highways or unfamiliar routes, leading to further delays in rescue operations. Additionally, users have no real-time visibility regarding the arrival status of service providers, which increases anxiety and dissatisfaction.

With advancements in web technologies, GPS-based location services, and real-time communication frameworks, intelligent systems can be developed to automate emergency response workflows. The **Intelligent Road Rescue Application** aims to address these challenges by providing a smart, automated, and location-aware platform that ensures quick roadside assistance with minimal human intervention, thereby improving safety, reliability, and user experience.

1.1 Project Description

This project develops an **Intelligent Road Rescue Application** designed to provide rapid, reliable, and efficient roadside emergency assistance using real-time location tracking and distributed service coordination. The system allows users facing vehicle breakdowns, accidents, fuel shortages, or medical emergencies to request help through a digital platform that automatically identifies and connects them with nearby service providers.

Unlike traditional roadside assistance systems that depend on manual communication and centralized call centers, the proposed application leverages GPS technology, cloud-based services, and real-time data exchange to ensure faster response and improved service transparency. The system continuously monitors service provider availability and user location, enabling efficient rescue operations without unnecessary delays. The scalable architecture supports both urban and highway environments, making the solution suitable for real-world deployment.

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1.2 Motivation

Road accidents and vehicle failures continue to increase due to growing traffic density, long-distance travel, and unpredictable road conditions. Existing roadside assistance mechanisms often suffer from slow response times, poor coordination, and lack of real-time visibility. Manual phone-based systems frequently fail during critical situations where users are unable to accurately describe their location or situation.

Additionally, traditional systems are static and fragmented, making them incapable of adapting to dynamic traffic conditions and emergency scenarios. These limitations highlight the need for an intelligent, automated, and location-aware rescue solution. This project is motivated by the objective of improving road safety by ensuring timely assistance, reducing response delays, and enhancing coordination among service providers through real-time digital interaction.

II. RELATED WORK

Paper [1] discusses traditional roadside assistance systems that rely on centralized call centers and manual dispatching of service providers. Although these systems provide basic emergency support, they lack real-time tracking capabilities and often suffer from delayed response and inaccurate location identification.

Paper [2] explores mobile-based emergency applications that provide GPS-based location sharing during accidents. While these applications improve location accuracy, they offer limited integration with service providers and lack automated dispatch and live tracking features.

Paper [3] introduces cloud-based emergency management platforms that enable centralized monitoring and coordination of rescue services. Although these systems improve service management, they raise concerns related to scalability, dependency on centralized infrastructure, and potential single points of failure.

Paper [4] applies real-time tracking and map-based navigation techniques to transportation services such as ride-hailing and logistics. While these approaches enhance transparency, limited attention is given to emergency roadside assistance and service prioritization.

Paper [5] reviews intelligent transportation and emergency response systems, emphasizing the need for scalable, real-time, and location-aware rescue frameworks. The study highlights that integrating GPS tracking, automation, and real-time communication can significantly improve roadside emergency response efficiency.

III. METHODOLOGY

A. System Environment

The experimental environment is designed to evaluate the Intelligent Road Rescue Application under realistic roadside emergency scenarios. Multiple user devices represent vehicles encountering breakdowns, accidents, or medical emergencies, each generating real-time GPS location data and service request information. Service provider nodes, including mechanics, towing services, ambulances, and fuel suppliers, operate independently and receive requests based on proximity and availability. A centralized application server coordinates request processing, vendor allocation, notification delivery, and live tracking. This setup effectively simulates a distributed roadside assistance environment where quick response, accuracy, and transparency are critical.

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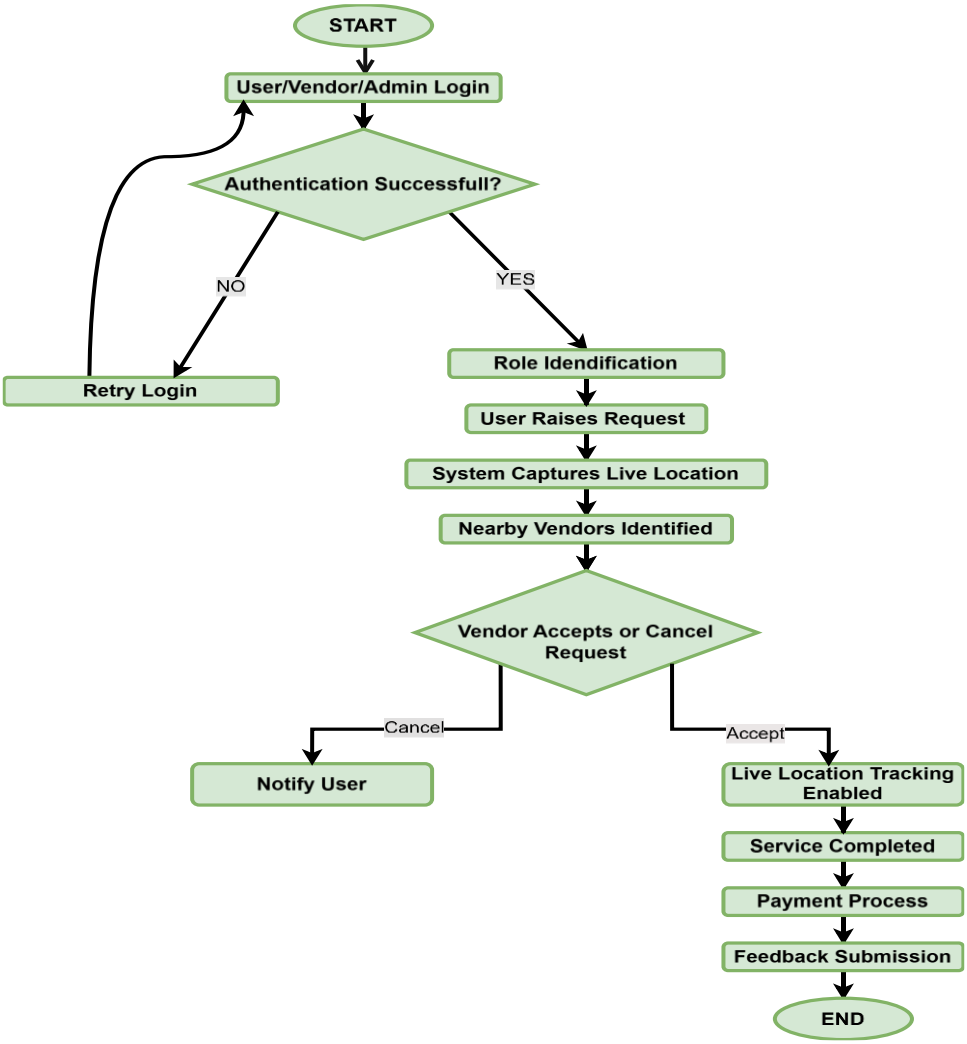

Fig.1.Flowchart of methodology

B. **System Architecture**

User-Side Interaction:
Each user accesses the application through a web or mobile interface to submit an emergency request. The system automatically captures the user's live GPS location and request details.

Server-Side Coordination:
The central server processes incoming requests, identifies nearby service providers, and dispatches requests in real time. Service providers receive notifications and can accept or reject requests based on availability.

C. **Intelligent Rescue Mechanism**

The system continuously updates user and vendor locations through real-time communication. Once a service provider accepts a request, live tracking is enabled, allowing the user to monitor the provider's movement. This adaptive mechanism ensures efficient routing, reduced response time, and improved service reliability without manual intervention.

D. Implementation Flow

1. Initialize the application server and registered service providers
2. User submits an emergency request
3. Capture and process live GPS location
4. Identify nearby available vendors

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5. Dispatch request notifications
6. Enable live tracking after acceptance
7. Complete service and process payment
8. Collect user feedback for service evaluation

E. Hardware and Software Requirements

- **Hardware:** GPS-enabled smartphone or system with minimum 4 GB RAM; server system with at least 8 GB RAM.
- **Software:** React.js, Node.js, Express.js, MySql, Google Maps API, Socket.IO.

IV. SIMULATION AND EVALUATION FRAMEWORK

This section describes the system design, simulation process, and evaluation strategy adopted for the Intelligent Road Rescue Application. The framework integrates real-time location tracking with intelligent service coordination to enable fast and reliable roadside assistance. The system is implemented using modern web technologies to support real-time updates, vendor allocation, and user interaction across multiple distributed nodes.

A. System Architecture and Workflow

The proposed system architecture is designed to provide timely roadside emergency assistance while maintaining transparency and efficient coordination. The system consists of three main components: user nodes, service provider nodes, and a central coordination server. User nodes represent vehicles or individuals who request assistance during emergencies such as breakdowns or accidents. These users submit requests through the application, which automatically captures real-time GPS location details. Service provider nodes include mechanics, towing services, ambulances, and fuel suppliers who receive requests based on proximity and availability. The central coordination server manages request routing, vendor selection, notifications, and live tracking, ensuring smooth communication and fast response throughout the rescue process.

D. Simulation Setup

The simulation environment is designed to replicate real-world roadside emergency situations under varying traffic and service availability conditions. Users and service providers are distributed across different geographic regions to represent urban roads and highways. Multiple emergency scenarios, including vehicle breakdowns, accidents, fuel shortages, and medical emergencies, are simulated to evaluate system performance. Variations in vendor availability and request frequency are introduced to test the system's ability to handle dynamic conditions. This setup enables effective assessment of response time, service accuracy, and overall system reliability.

C. Request Handling and Tracking Process

Each emergency request is processed in real time to ensure rapid assistance. Once a request is submitted, nearby service providers are identified using GPS data and notified instantly. Upon acceptance by a provider, live tracking is enabled, allowing users to monitor the provider's movement until service completion. Continuous location updates and status notifications ensure transparency and improve user confidence. This real-time handling and tracking mechanism reduces delays and enhances the efficiency of roadside emergency response.

E. Results and Observations

Service Response Performance:

- The system successfully matched users with nearby vendors in minimal time.
- Live tracking improved user awareness and reduced uncertainty.

System Adaptability:

- The application handled multiple concurrent requests efficiently.
- Vendor allocation remained accurate despite varying availability.

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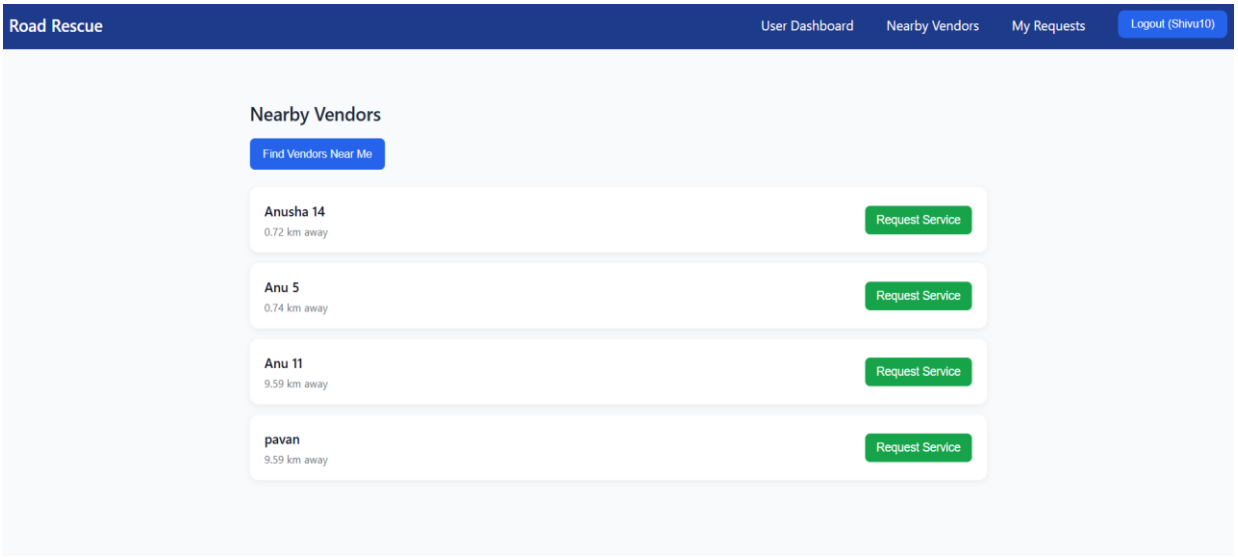

Fig 2 User Dashboard displaying Available Vendors for Service

This page displays nearby available vendors who are on duty and user can request help to available vendors .

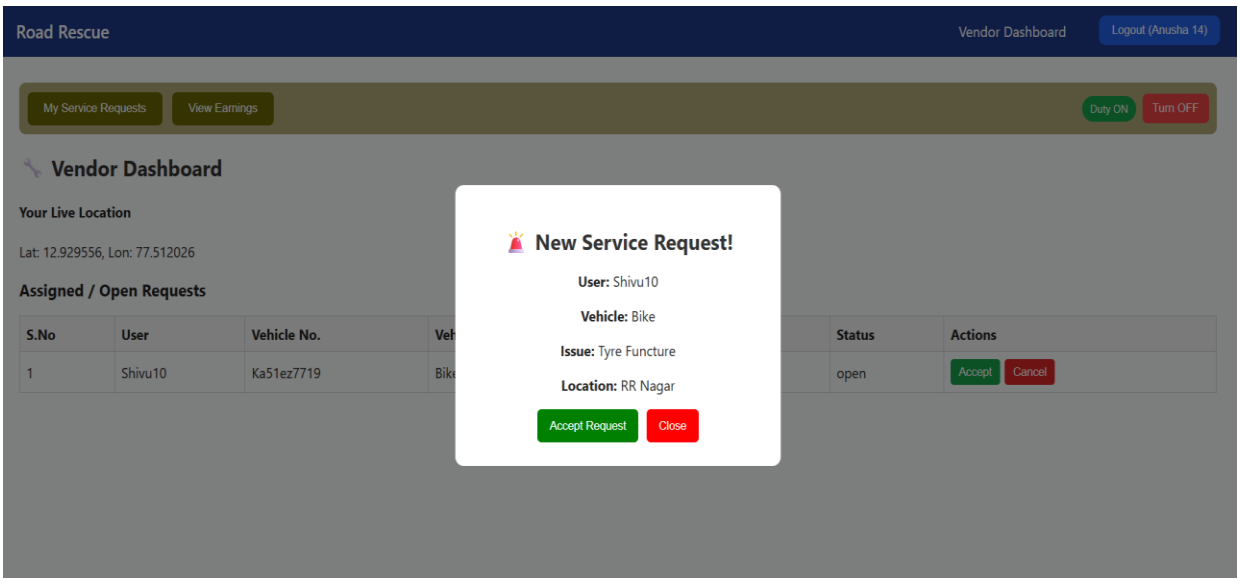

Fig. 3. Vendor Dashboard displaying Service Request from users

The vendor dashboard shows all received service requests along with options to accept or reject them and pop up message comes whenever vendor gets new request .

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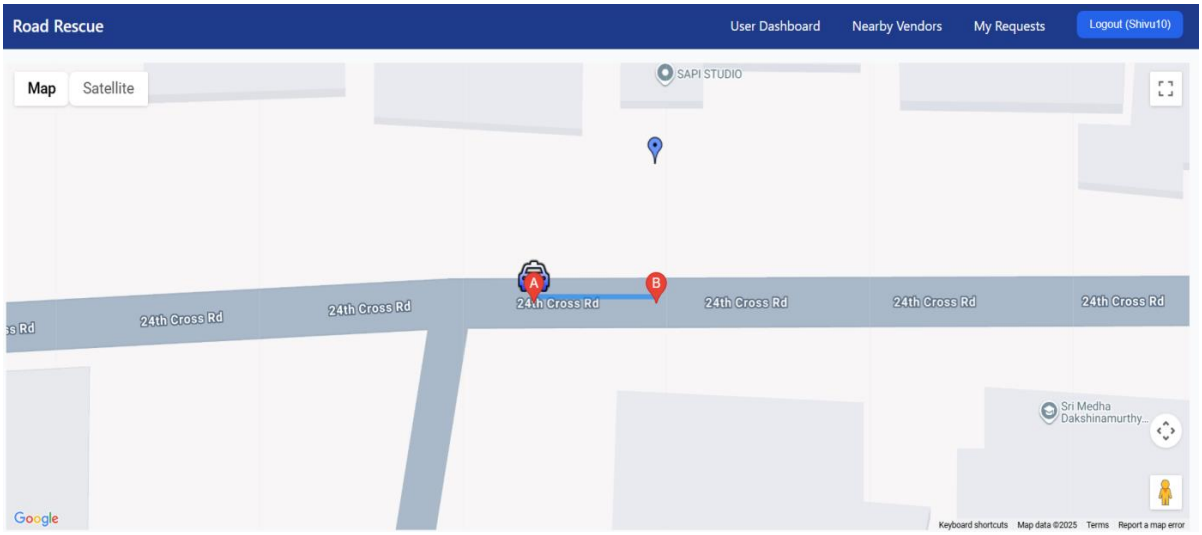

Fig. 4. Live Tracking of the Vendor by the User

This screen displays real-time movement of the assigned vendor on the map, helping users track service arrival.

V. RESULTS AND DISCUSSION

The experimental evaluation of the Intelligent Road Rescue Application demonstrates its effectiveness in delivering timely and reliable roadside emergency assistance. The system was tested under multiple simulated emergency scenarios, including vehicle breakdowns, accidents, and fuel shortages, to evaluate response time, tracking accuracy, and overall service reliability. The results show that automated vendor allocation combined with real-time GPS tracking significantly reduces assistance delays when compared to conventional phone-based roadside support systems.

The application maintained stable and consistent performance even when handling multiple simultaneous user requests. Live tracking of service providers improved user awareness and confidence during emergency situations. Additionally, integrated digital payment and feedback mechanisms enhanced service accountability and user satisfaction. Overall, the experimental results validate that the proposed system provides a practical, efficient, and scalable solution for modern roadside emergency management.

VI. CONCLUSION

This project demonstrates the practicality and effectiveness of an intelligent, location-based road rescue system designed to support roadside emergency assistance. By integrating GPS tracking, real-time communication, and automated service coordination, the proposed application successfully overcomes key limitations of traditional roadside assistance models, such as delayed response and poor location accuracy. Experimental evaluation confirms that the system improves response time, service transparency, and operational efficiency. The scalable architecture and real-time monitoring capabilities make the proposed solution suitable for deployment in smart transportation systems and emergency response frameworks, contributing to improved road safety and user convenience.

VI. FUTURE WORK

Although the proposed system shows promising results, several enhancements can further improve its functionality and real-world applicability. Future work may include the development of native mobile applications for Android and iOS platforms to enhance accessibility and performance. AI-based accident detection using vehicle sensors and cameras can be integrated for automatic emergency alerts. Additional features such as traffic and weather data integration, multilingual support, and predictive analytics for service provider availability can further improve response efficiency. Integration with government emergency services and smart city infrastructure may also be explored to support large-scale deployment.

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