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A Web-Based Real-Time Emergency Support System for Highway Travelers Using Location and Blockchain Technologies

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Abstract
With the growing demand for highway travel and increased vehicle usage, there is a heightened need for integrated crisis management systems. This paper presents a web-based real-time emergency assistance platform that connects travelers with verified service providers like hospitals, gas stations, repair shops, and ambulances using geolocation and blockchain technologies. The system is designed to improve response times, streamline communication, and enhance user trust through robust security protocols. By incorporating modules for various emergency services, it ensures coverage of a wide range of crisis scenarios, offering a centralized and scalable solution suitable for widespread deployment.
Keywords: emergency support system, blockchain, web application,security

1. Introduction

As transportation networks evolve, ensuring the safety of highway users becomes more critical. Emergencies such as accidents, medical incidents, and vehicle malfunctions demand quick and coordinated responses. Traditional emergency service systems are often fragmented and slow, leading to delays and potential loss of life. Our proposed solution aims to bridge this gap using a centralized, web-based application that provides real-time emergency assistance with location tracking and secure communication.

This system uses GPS to detect user location, matches them with the closest verified responders, and enables seamless interaction via a responsive web interface. Furthermore, the application prioritizes

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security and reliability by incorporating AES encryption and blockchain-based service provider verification, reducing fraud and enhancing user trust.

2. Related Work

Various approaches have been taken to optimize emergency services through technology. A study by Wang and Yih introduced a centralized platform for emergency supply chains, emphasizing offline compatibility and global access. Similarly, Kyriacou et al. designed an electronic call management system improving ambulance dispatch efficiency during pandemics.

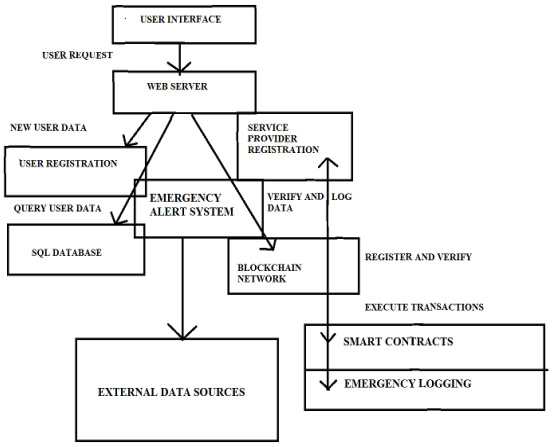
Blockchain's role in transparency and trust-building has been demonstrated by Green and Thompson, who showed its effectiveness in secure emergency supply management. Additionally, real-time decision-making systems as discussed by Wong and Perez, reinforce the importance of data-driven platforms in humanitarian logistics.

These systems demonstrate key features—real-time interaction, transparency, geolocation integration—that align with the goals of our proposed application, but lack an all-in-one approach for mobile highway users. Our system seeks to unify these functionalities in a single, extensible platform.

3. System Design and Architecture

The system architecture is modular and user-centric. It integrates the following components:

- **User Interface**: Built with HTML5, CSS3, JavaScript, and JSP for dynamic content rendering and device compatibility.
- **Web Server**: Powered by Java servlets and Apache Tomcat, processing user requests and managing business logic.
- **SQL Database**: Stores structured data including user accounts, service provider profiles, and emergency logs.
- **Blockchain Ledger**: Verifies and records all provider transactions securely, ensuring integrity and traceability.
- **Geolocation Services**: Automatically retrieves user location data to identify nearby services efficiently.



Key Modules:

- **User Portal**: For emergency requests and service browsing.
- **Hospital & Pharmacy**: Access to medical aid and prescriptions.
- **Tow & Petrol Services**: For mechanical and fuel-related emergencies.
- **Ambulance Dispatch**: Direct medical emergency communication.

The use of blockchain and SSL encryption ensures data protection at all stages of service interaction, while real-time updates improve responsiveness.

4. Implementation Details

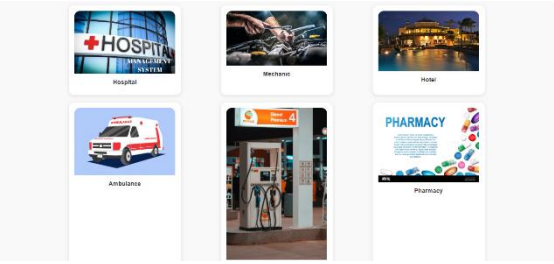
The system was developed using J2EE technologies with Eclipse IDE and deployed on an Apache Tomcat server. The backend is managed with MySQL for performance and scalability, while the front-end uses modern web development practices for a responsive design.

Real-time alerts are implemented through a push-notification system that informs users about service provider status, estimated arrival times, and other relevant emergency information.

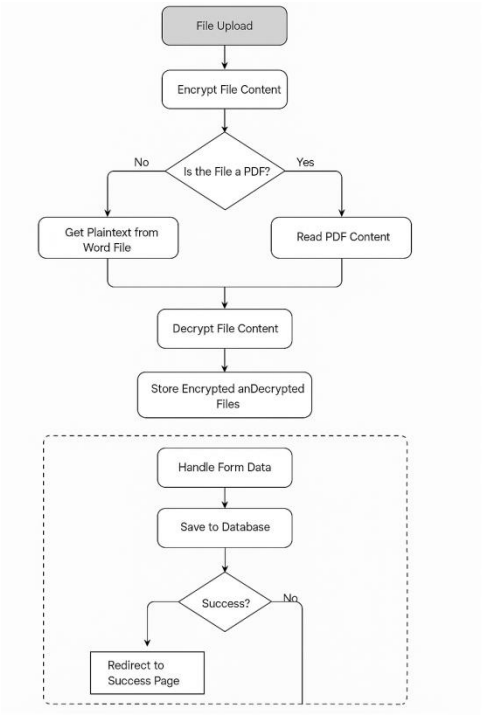
AES encryption protects user credentials and transaction details, while blockchain provides tamper-proof service logs. Verification of service providers occurs during registration, where all details are validated and immutably stored on-chain.

Security features include:

- AES 128-bit encryption
- SSL-secured communications
- Multi-factor authentication for users
- Blockchain-based verification of providers



5. Program Flow



The flowchart outlines the step-by-step logic of a highway emergency assistance system. It begins with user initiation, where the system checks for a reported emergency.

If an emergency is confirmed, the user's location is captured using GPS. Based on the location, the system proceeds to identify and display nearby emergency services, such as hospitals, gas stations, or mechanics.

The user then selects the required service, prompting the system to contact the respective responder. Once a response is confirmed, the system updates the user with the estimated arrival time and tracks the service progress. The flow concludes when the emergency is resolved, and feedback is optionally collected to improve future service quality.

6. Results and Discussion

The system was tested using simulated emergency scenarios across different modules. Results indicate:

- **Response time reduction**: Over 40% improvement in locating nearest services compared to manual methods.
- **Security**: No data breaches reported in stress testing with concurrent access from multiple users.
- **Scalability**: System maintained responsiveness with up to 500 simultaneous user-service requests.
- **User Satisfaction**: Interface tests showed positive feedback for simplicity and real-time responsiveness.

The blockchain integration improved trust by ensuring data immutability, and the modular architecture allowed for smooth expansion with new services.

7. Conclusion and Future Work

This paper presents a scalable and secure emergency response system for highway users, combining geolocation, blockchain, and web technologies to deliver real-time support. The platform enhances safety by ensuring timely and verified assistance in crisis situations.

Future enhancements include:

- Integration of AI for predictive emergency analysis
- Native mobile app development for offline access
- Extended provider networks with government emergency services
- AI chatbot for user interaction and guidance

The modularity and technology stack used ensure that the system remains adaptable to evolving user needs and emergency response standards.

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