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GPS Enabled Disaster Alert and Awareness System

B Kavya[1], B Arun Kumar[2] , A Harshitha Reddy[3] , DVSR Sesidhar[4]

[1234]*Dept. of Electronics and Communication Engineering, MVSR Engineering College, Hyderabad, India*

Abstract - *Natural disasters such as floods, cyclones, and earthquakes often disrupt communication systems and create panic among affected populations. This paper proposes a GPS-enabled disaster alert and awareness system that provides real-time alerts, offline access to critical information, and AI-based chatbot assistance.*

The system integrates a mobile application and web platform to deliver disaster-related information, safety guidelines, helpline numbers, and location-based rescue services. It utilizes geofencing and real-time location tracking to notify users when they enter disaster-prone areas. The offline functionality ensures accessibility even during network failures, while multilingual support enhances usability across diverse populations.

By combining real-time alerts, geolocation tracking, and intelligent assistance, the system aims to improve disaster preparedness, reduce response time, and minimize the impact on human lives and property.

Key Words **Disaster Management, GPS, Geofencing, Mobile Application, AI Chatbot, Emergency Alerts.**

1. INTRODUCTION

Natural disasters such as floods, earthquakes, cyclones, and landslides pose significant threats to human life, infrastructure, and the environment. In recent years, the frequency and intensity of such disasters have increased due to climate change and urbanization. One of the major challenges during disasters is the lack of timely and accurate information, which leads to delayed response and increased casualties.

Existing disaster management systems primarily rely on mass communication methods such as television, radio, and SMS alerts. While these methods are effective to some extent, they often fail to provide realtime, location-specific warnings to individuals. Moreover, network failures during disasters further limit the accessibility of critical information.

With the rapid advancement of mobile technology and the widespread availability of GPS-enabled smartphones, it is possible to develop intelligent systems that can provide real-time, personalized alerts based on the user's location. Geofencing, a technique that creates virtual boundaries around specific geographic areas, can be used to detect when a user enters a disasterprone zone and trigger immediate alerts.

This paper presents a GPS-enabled disaster alert and awareness system that leverages geolocation tracking, geofencing, and mobile notifications to enhance disaster preparedness and response. The system provides real-time alerts, offline access to safety information, navigation to nearby rescue centers, and AI-based chatbot assistance for user guidance.

The primary objective of the proposed system is to improve situational awareness, ensure timely alerts, and assist users in taking appropriate actions during emergencies. By integrating modern technologies with user-friendly design, the system aims to reduce disaster impact and enhance public safety.

2. LITERATURE REVIEW

Disaster management systems have been widely researched to improve early warning mechanisms and emergency response efficiency. Several studies have focused on communication systems, geofencing techniques, and intelligent assistance tools.

The study by Xinyan Zhao et al. [1] highlights the importance of AI-based chatbots in disaster communication. The research demonstrates that chatbot systems can provide real-time, adaptive responses and improve user preparedness. From this work, the proposed system adopts the concept of **AI-based chatbot assistance** to guide users during emergencies.

Another study by SK McBride et al. [2] evaluates the effectiveness of geofencing in delivering timely alerts. The study shows that location-based alerts can be delivered within a few seconds and are highly reliable in real-world scenarios. Inspired by this, the proposed system implements **GPS-based geofencing alerts** to notify users when they move into unsafe zones.

In addition, Swapnil Sonawane et al. [3] proposed a geofencing-based disaster management system where virtual boundaries are created around disaster-prone areas, and alerts are triggered when users enter these regions. This research confirms the feasibility of geofencing in disaster applications. Based on this approach, the proposed system enhances geofencing by integrating **real-time tracking and alert triggering using mobile GPS**.

Existing disaster alert systems such as SMS-based alerts and weather applications provide large-scale communication but

lack personalization and offline functionality. Many systems also depend heavily on internet connectivity, making them unreliable during network failures.

From the analysis of these studies, it is observed that:

A. Chatbots improve user interaction but are not integrated with real-time alerts
B. Geofencing systems provide location-based alerts but lack navigation and offline support
C. Traditional systems provide alerts but lack personalization and intelligence

Therefore, the proposed system combines the strengths of these approaches by integrating:

- GPS-based geofencing alerts
- Offline accessibility for critical information
- Navigation to nearest rescue centers
- AI-based chatbot for emergency guidance

This integrated approach aims to provide a comprehensive and reliable disaster management solution.

3. METHODOLOGY

The proposed system is a GPS-enabled disaster alert and awareness application designed to provide real-time alerts, safety information, and emergency assistance to users during disaster situations. The system integrates geolocation tracking, geofencing techniques, and mobile notification services to enhance user safety and preparedness.

The system continuously tracks the user's location using GPS services. A virtual boundary, known as a geofence, is created around a predefined safe zone. When the user moves beyond this safe zone and enters a potential danger zone, the system automatically triggers an alert. This alert includes a notification message, an alarm sound, and an emergency alert screen to immediately capture the user's attention.

The application also provides navigation to the nearest disaster response centers using Google Maps integration. This feature helps users quickly find safe locations during emergencies. Additionally, the system includes an AI-based chatbot that assists users by providing disaster-related information, safety guidelines, and quick responses to user queries.

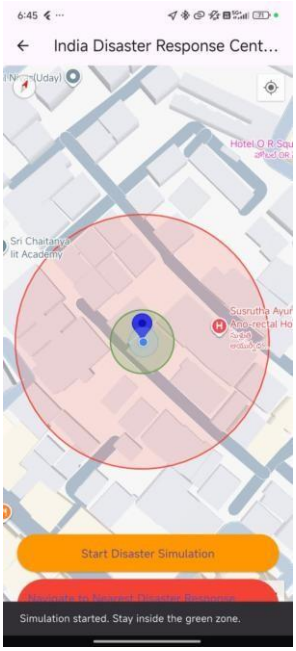

Fig -1 System Geofencing

To ensure reliability during network disruptions, the system supports offline access to essential disaster information such as safety tips and emergency contacts. The application also includes multilingual support to make it accessible to users from different linguistic backgrounds.

The overall workflow of the system is as follows: the user's location is continuously monitored, the system checks whether the user crosses the defined safe zone boundary, and if a threshold distance is exceeded, an alert is triggered along with navigation assistance.

This integrated approach combines real-time monitoring, intelligent alerting, and user assistance into a single platform, making it more effective than traditional disaster management systems.

System Workflow: User → GPS Location Tracking → Geofence Detection → Danger Zone Entry → Alert Notification + Alarm → Emergency Screen → Navigation to Rescue Center.

4. SYSTEM ARCHITECTURE

The system architecture of the proposed disaster alert and awareness system is designed to provide real-time monitoring, alert generation, and emergency assistance using mobile and web technologies. The architecture consists of multiple interconnected components that work together to ensure efficient disaster detection and response.

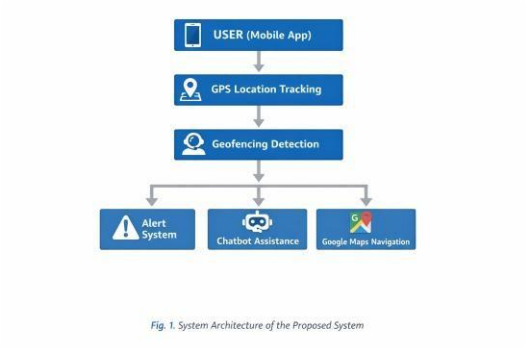

Fig -2: System Architecture of the Proposed System

The primary component is the user device, which runs the mobile application developed using Flutter. The application continuously collects the user's location using GPS services through the Geolocator module. The location data is then processed within the application to determine whether the user is within a safe zone or has entered a predefined danger zone.

The geofencing module plays a crucial role in defining virtual boundaries around safe and risk-prone areas. When the system detects that the user has crossed the defined boundary, it triggers the alert system. The alert system includes push notifications, alarm sound generation, and an emergency alert interface to notify the user instantly.

The application is integrated with Google Maps API to display the user's current location and nearby disaster response centers. It also provides navigation support to guide users to the nearest safe location.

Additionally, the system includes a chatbot module that provides disaster-related guidance and answers user queries. A web platform is also integrated to provide informational support and multilingual disaster awareness content.

The architecture ensures seamless interaction between all components, enabling real-time alerting, user assistance, and improved disaster response efficiency.

5. IMPLEMENTATION

The proposed disaster alert and awareness system is implemented as a mobile application using the Flutter framework. The application integrates multiple technologies such as GPS-based location tracking, geofencing logic, real-time notifications, and map services to provide an effective disaster management solution.

Fig -3: Home Screen of Application

The system uses the Geolocator package to continuously track the user's real-time location with high accuracy. A safe zone is dynamically created based on the user's initial position when the simulation or monitoring starts. A geofencing mechanism is implemented by calculating the distance between the user's current location and the defined safe zone center. If the user moves beyond a predefined threshold distance, the system identifies it as entry into a danger zone.

Upon entering the danger zone, the application triggers multiple alert mechanisms. These include a push notification using local notification services, an audible alarm using the audioplayers package, and an emergency alert screen to capture user attention immediately. This multi-layered alert system ensures that the user is informed eve n if one alert method fails.

The application also integrates Google Maps API to display the user's current location and nearby disaster response centers. Markers are used to represent rescue centers, and navigation functionality is provided using external map services to guide users to the nearest safe location.

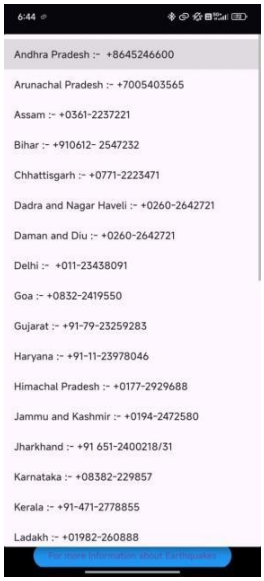

Fig -4: Helpline Contacts

Fig -5: Rescue centers in India

Additionally, a chatbot module is implemented to provide disaster-related information and safety guidelines. The chatbot responds to user queries based on predefined disaster scenarios such as earthquakes, floods, cyclones, and landslides.

To improve reliability, the application includes offline support for essential safety instructions and emergency contacts. This ensures that users can access critical information even when internet connectivity is unavailable.

The implementation demonstrates that the system is capable of providing real-time alerts, location-based assistance, and user guidance effectively during disaster situations.

6. RESULTS AND DISCUSSION

The proposed GPS-enabled disaster alert and awareness system was successfully implemented and tested in a real-time environment. The system demonstrated effective performance in detecting user movement and triggering alerts when the user entered a predefined danger zone.

During testing, the application accurately tracked the user's location using GPS services and continuously monitored movement with minimal delay. The geofencing mechanism effectively identified when the user crossed the safe zone boundary. Upon entering the danger zone, the system triggered a multi-level alert, including a notification message, alarm sound, and an emergency alert screen. This ensured that the user was immediately informed about the potential risk.

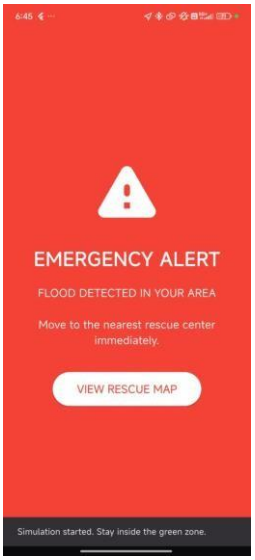

Fig -6: Emergency Alert & Alarm

The integration of Google Maps allowed users to visualize their current location along with nearby disaster response centers. The navigation feature successfully guided users to the nearest safe location, improving response time during emergency situations.

The chatbot module provided quick and relevant responses to user queries related to disaster safety, enhancing user interaction and awareness. The offline functionality ensured that essential safety information remained accessible even in the absence of internet connectivity.

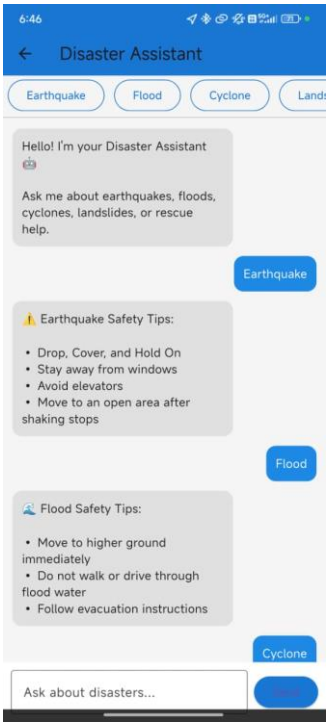

Fig -7: Chatbot

Overall, the system achieved its objective of providing real-time, location-based alerts and improving disaster preparedness. The combination of geofencing, alert mechanisms, navigation support, and intelligent assistance makes the system more effective than traditional disaster alert systems.

However, certain limitations were observed. The accuracy of location tracking depends on GPS signal strength, and minor delays may occur in alert triggering due to device or environmental factors. Despite these limitations, the system provides a reliable and practical solution for disaster management.

7. CONCLUSION

This paper presented a GPS-enabled disaster alert and awareness system designed to improve real-time disaster preparedness and response. The system integrates geolocation tracking, geofencing, mobile notifications, alarm mechanisms, and navigation services to provide timely alerts and guidance to users during disaster situations.

The implementation results demonstrate that the system can effectively detect user movement, identify entry into disaster-prone areas, and trigger immediate alerts through notifications and audible alarms. The integration of Google Maps enables users to locate and navigate to nearby disaster response centers, while the chatbot module provides quick access to safety guidelines and essential information.

The proposed system offers several advantages over traditional disaster management systems, including real-time personalized alerts, offline accessibility, and a user-friendly interface. These features contribute to improved situational awareness and faster response during emergencies.

However, certain limitations exist, such as dependency on GPS accuracy and device capabilities. Future enhancements can focus on integrating real-time disaster data from government agencies, implementing AIbased prediction models for early warning, and improving offline functionality. Additionally, the system can be extended to support wearable devices and IoT-based sensors for enhanced monitoring and automation.

In conclusion, the proposed system provides a practical and efficient solution for disaster alerting and awareness, with the potential to significantly reduce risks and improve public safety.

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