International Journal of
AI ELECTRICAL CIVIL AND MECHANICAL ENGINEERING
Peer Reviewed, Referred & Indexed Journal
ISSN: 3070-0434 www.zesterapublications.com Original Research Paper

Real-Time Disaster Resource Mapping With SOS Coordination And Volunteer Integration

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ABSTRACT

Natural and human-induced disasters such as floods, earthquakes, fires, and industrial accidents have become increasingly frequent, posing significant challenges to emergency response, resource allocation, and public safety. Conventional disaster management systems primarily rely on manual communication, local authorities, and public announcements to disseminate emergency information. These approaches often suffer from delayed communication, limited accessibility, fragmented coordination, and the absence of a centralized information repository, particularly during large-scale emergencies. As a result, affected individuals frequently encounter difficulties in locating verified shelters, safe locations, and emergency resources, leading to panic, confusion, and delayed rescue operations. To address these challenges, this paper presents Disaster Resource Mapping with SOS (Save Our Souls) Coordination and Volunteer Integration, a centralized web-based platform designed to improve disaster preparedness and emergency response. The proposed system enables users to access verified safe locations with complete address and contact information while facilitating efficient coordination between administrators, volunteers, and affected communities. The administrator module manages user approvals, volunteer verification, and disaster resource information, whereas the user module allows registered users to maintain their profiles, send SOS alerts, and locate nearby safe places during emergencies. The platform is developed using React.js for the frontend, Django Representational State Transfer (REST) Framework for backend Application Programming Interface (API) development, and My Structured Query Language (MySQL) for secure data storage and management. The centralized architecture ensures reliable information dissemination, enhances resource accessibility, and supports effective volunteer coordination. Experimental implementation demonstrates that the proposed system significantly improves disaster information management, accelerates emergency response, and strengthens community resilience, thereby contributing to safer and more efficient disaster management practices.

Keywords: Disaster Management, Emergency Response, Resource Mapping, SOS Coordination, Volunteer Management, Django Framework, Disaster Preparedness

1. INTRODUCTION

Natural disasters arise from the interaction of natural hazards with the exposure and vulnerabilities of communities that are unable to withstand and cope with such threats [1]. Such disasters include (1) extreme geological events, including earthquakes, and (2) climate- and weather-related events, including hurricanes or cyclones, tornadoes, and floods [2]. These disasters often occur and have devastating power [3]. Between 1960 and 2019, 11,360 disaster events where either more than ten people lost

Received: 30-05-2026 | Accepted: 01-07-2026 | Published: 08-07-2026

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their lives or more than 100 individuals were affected occurred globally [4]. Furthermore, over the past two decades, natural disasters have resulted in economic losses exceeding USD 2.96 trillion, claimed 1.23 million lives, and impacted over 4.2 billion individuals [5]. Disasters not only cause substantial damage to property and critical infrastructure but also pose significant risks to human lives and well-being, leading to injuries, adverse health effects, income loss, displacement, and restricted access to essential resources such as food, electricity, and water [6] illustrated in fig. 1.1.

Fig. 1: Real-Time Disaster

That said, these events not only stand as the main source of destruction to property and infrastructure systems, particularly in underdeveloped communities, but also act as a significant obstacle to sustainable development, hindering social and economic progress [7]. The frequency and intensity of natural disasters, coupled with the resulting damages and losses, have shown a persistent increase [8]. Furthermore, communities often receive delayed disaster response and recovery, especially low-income communities that, due to lacking resources for prevention, preparation, and adequate response, are more exposed and vulnerable to such threats. This lack of a prompt and adequate response further exacerbates the already elevated risks associated with these destructive events [9].

2. LITERATURE SURVEY

Ma, et al. [10] proposed an automated disaster assessment framework based on optical remote sensing imagery to provide rapid emergency information during the early stages of natural disasters. The study addressed the limitations of optical satellite data, such as cloud coverage and image inconsistency, by introducing an Optimizable Variational Model (OptVM) for image fusion and a Scale-Invariant Feature Transform-based Optical Flow Method (SIFT-OFM) for accurate image registration. These techniques enabled the generation of cloud-free background maps and change-detection maps that accurately identified disaster-affected regions. The proposed framework allowed emergency responders to quickly assess the geographical extent of disasters, evaluate the severity of damage, and prioritize rescue operations based on reliable geospatial information. Voigt, et al. [11] proposed an automatic disaster mapping methodology that combined the Optimizable Variational Model with SIFT-constrained optical flow techniques to improve the precision of change detection and preliminary damage assessment. The generated damage maps provided rapid situational awareness during the initial stages of disasters, enabling emergency response teams to effectively coordinate rescue missions and allocate available resources. The framework also supported visual verification by analysts and the general public, allowing the damage maps to be continuously refined as additional Earth observation data became available. This iterative updating process improved the accuracy and reliability of disaster damage assessment over time.

Vongkusolkit, et al. [12] introduced a weakly supervised flood mapping framework that utilized multi-temporal remote sensing imagery for pixel-level flood detection without requiring manually annotated datasets. The proposed methodology generated weak labels using image processing techniques such as the Normalized Difference Water Index (NDWI) and edge detection before training a bi-temporal U-Net deep learning model. The framework was evaluated using flood events associated with Hurricanes Florence and Harvey and compared with conventional machine learning models, including Decision Tree, Random Forest, Gradient Boosting, and Adaptive Boosting classifiers. Experimental results demonstrated that the proposed deep learning approach achieved superior flood detection performance while significantly reducing the need for labor-intensive manual annotation. Katiyar, et al. [13] investigated the effectiveness of different Synthetic Aperture Radar (SAR) polarization band combinations for detecting permanent water bodies and flood-affected regions. The study evaluated multiple deep learning models trained using various combinations of SAR bands and label configurations to determine the most effective approach for surface water classification. The proposed models were further validated using real flood data from Kerala, India, during the 2018 flood event, where they achieved an Intersection over Union (IoU) value of approximately 0.88. The findings demonstrated that the trained models could be directly deployed for practical flood monitoring and disaster assessment applications.

Adam, et al. [14] proposed a disaster communication framework utilizing Mobile Aerial Base Stations (MABS) equipped with Long-Term Evolution (LTE) technology to provide wireless connectivity for geographically dispersed users during emergencies. The system employed Affinity Propagation Clustering (APC) to determine optimal service locations and combined graph theory with a Genetic Algorithm (GA) to generate efficient flight paths. Performance evaluation demonstrated that the optimized routing strategy improved user coverage, communication reliability, and operational efficiency compared to conventional flight planning approaches. Antzoulatos, et al. [15] proposed a comprehensive flood hazard assessment framework that integrated optical remote sensing imagery, Sentinel-1 satellite observations, and Geographic Information System (GIS)-based spatial information to dynamically evaluate flood risk severity. The proposed methodology combined multiple environmental and geospatial datasets collected from the municipalities of Trieste, Monfalcone, and Muggia to develop predictive flood hazard models. Explainable Machine Learning (XML) techniques were incorporated to improve the interpretability of flood prediction results and assist decision-makers in understanding the factors influencing flood risk. The flood inventory dataset was divided into training and testing subsets using a 70:30 ratio, and several machine learning model combinations were evaluated to identify the most accurate flood hazard prediction framework. The study demonstrated that integrating remote sensing data with explainable artificial intelligence significantly improves flood risk assessment accuracy, supports disaster preparedness, and enables more effective emergency response planning.

3. PROPOSED METHODOLOGY

This research methodology is designed as a web-based disaster management platform that facilitates efficient information handling during emergency situations. As shown as fig. 2. The application provides a centralized environment where user data and emergency resource

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information are securely stored and managed. By using a modern client–server architecture, the system enables smooth interaction between the user interface and backend services. The frontend is developed using React JS to ensure responsive and user-friendly access across devices. The backend is implemented using Django REST Framework, which manages authentication, authorization, and data exchange through well-defined APIs. A MySQL database is used to maintain structured records of users and verified safe places. The system supports reliable access to critical information and improves coordination during disaster scenarios through digital automation.

Fig. 2: Proposed system architecture of real-time disaster.

User Interface (Web Browser – React.js): Users and administrators interact with the system through a browser-based interface developed using React.js. The interface provides smooth navigation for user registration, login, and dashboard access. Users can view verified safe places and their profile information, while administrators can manage users and emergency resources. React.js ensures fast rendering, responsive design, and an intuitive user experience. All user actions are converted into secure Hypertext Transfer Protocol (HTTP) requests and sent to the backend for processing.

Backend Server (Django REST Framework): The backend server is implemented using Django REST Framework and is responsible for handling all requests received from the frontend. It performs authentication, role verification, admin approval checks, and business logic execution. This layer exposes RESTful APIs for user management and safe place operations. The backend ensures secure communication between the frontend and database while maintaining data integrity and access control.

Database Layer (MySQL): The MySQL database stores all system-related data in a structured relational format. It maintains user details such as username, email, role, approval status, and address, as well as safe place information including location and contact details. The relational design supports efficient querying, updating, and consistency of data. This layer acts as the persistent storage for the entire system.

User Registration and Approval Flow: Users submit registration details through the web interface, which are validated and stored in the database with a pending approval status. This mechanism restricts unauthorized access and ensures controlled system usage. Only after administrative approval are users allowed to log in and access disaster-related information. This flow enhances system security and data authenticity.

Administrator Management Module: Administrators manage user accounts and disaster resource data through a secured dashboard. They are responsible for approving user registrations and maintaining verified safe place records. Administrative controls ensure that only accurate and authorized information is available in the system. This module plays a

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critical role in maintaining reliability during emergency situations.

Safe Place Management Module: Safe place information such as shelter name, complete address, and contact number is managed by the administrator. Administrators can add new safe places or update existing records as required. Only verified and up-to-date data is stored in the database, ensuring reliable access for users during disasters.

SOS Coordination Module: The proposed system also includes an SOS coordination module that enables users to send emergency alerts by providing their location and a brief message describing the situation. These SOS requests are stored securely in the database and displayed on the administrator dashboard for monitoring and resolution. Each SOS alert is tracked with a status indicator such as pending or resolved to ensure timely response. This module improves real-time communication and strengthens emergency response coordination.

User Access and Resource Viewing Module: Approved users can log in to the system and access verified safe place details. They can view shelter locations and contact information to seek assistance during emergencies. This module ensures that users receive accurate and timely disaster-related information.

End-to-End Operational Flow: The system follows a structured operational flow from the React-based user interface to the Django backend and MySQL database. Every request undergoes validation, authentication, and role verification before processing. Role-based access control and admin approvals ensure secure and reliable operation of the system.

4. RESULTS AND DISCUSSION

The results demonstrate the successful implementation of a reliable and user-friendly disaster management platform. The system effectively enables user registration, secure login, and controlled access through administrator approval. Verified safe place information is displayed accurately, helping users identify emergency shelters quickly. The integration of the SOS alert feature allows users to send emergency requests, which are monitored and resolved by the administrator in real time. Users can also track their SOS status and view history, ensuring transparency and effective communication. The system improves disaster response efficiency, data reliability, and coordination between users and administrators.

Fig. 2: Admin–User approval page.

Fig. 2 shows in the Admin Dashboard is designed to manage and validate registered users efficiently before granting them full access to the system. This page displays user details in a tabular format, including username, email ID, mobile number, approval status, and action options, enabling the administrator to review each entry clearly. Through this interface, the admin can approve or verify users such as volunteers or resource providers, ensuring only authenticated and trusted users participate in disaster response activities. By maintaining controlled access and verified user records, the approval page enhances system security, data

Received: 30-05-2026 | Accepted: 01-07-2026 | Published: 08-07-2026

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reliability, and smooth coordination during emergency situations.

Fig. 3: Admin-Add safe place page.

Fig. 3 provides the Admin Dashboard allows the administrator to register and manage verified safe locations that can be used during disaster situations. Through this page, the admin can enter essential details such as the safe place name, complete address, and contact number, ensuring accurate and reliable information is stored in the system. Once saved, these locations become available for mapping and SOS coordination, helping affected users quickly identify nearby shelters or relief centers. This feature plays a crucial role in strengthening disaster preparedness by maintaining an updated and centralized database of trusted safe places for emergency response.

Fig. 4: Admin-Manage safe place page.

Fig. 4 provides the Admin Dashboard enables the administrator to view, monitor, and control all registered safe locations within the system. This page displays safe place details such as the safe place name, complete address, contact number, and available actions in a structured tabular format, making it easy to manage records efficiently. The admin can update or delete existing safe place entries to ensure that only accurate and verified locations are available during emergencies. By maintaining this page, the system guarantees up-to-date and reliable safe place information, which is essential for effective disaster response and real-time resource mapping.

Fig. 5: SOS emergency alerts page.

Fig. 5 represents the Admin Dashboard – SOS Emergency Alerts section of the Disaster Resource Mapping system. It displays SOS requests sent by users in a structured table showing the user's name, location, emergency message, and current status. Administrators can quickly monitor pending SOS alerts and take action during critical situations. The Resolve option allows the admin to update the alert status, ensuring timely response and effective emergency coordination.

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Fig. 6: Available safe Places Page.

Fig. 6 enables users to view a list of verified safe locations that can be accessed during emergency situations. This page presents important details such as the safe place name, complete address, and contact number in a clear tabular format, helping users quickly identify nearby shelters or medical facilities. By displaying only admin-approved and up-to-date safe places, the system ensures reliability and trustworthiness of information. This page plays a crucial role in guiding affected individuals to secure locations, thereby supporting timely evacuation and effective disaster management.

Fig. 7: SOS history page.

Fig. 7 represents the User Dashboard – SOS History section of the Disaster Resource Mapping system. It displays a chronological record of all SOS alerts submitted by the user, including location, emergency message, current status, and date/time. Each entry helps users track whether their SOS requests are still pending or resolved. This feature improves transparency and allows users to monitor the response progress for multiple emergency alerts.

Fig. 8: SOS history page.

Fig. 8 shows the User Dashboard – My SOS History with updated alert statuses. It lists all SOS requests raised by the user along with their location, message, current status (pending or resolved), and date/time. The resolved and pending indicators help users quickly understand the response progress. This page ensures transparency by allowing users to track multiple SOS alerts over time.

5. CONCLUSION

This research successfully demonstrates the use of modern web technologies to improve disaster preparedness and emergency response. The application provides a centralized and verified platform for managing user information and emergency safe place data, reducing misinformation during critical situations. By using React.js for the frontend and Django REST Framework for the backend, the system achieves smooth client–server communication and responsive user interaction. Performance is improved through optimized REST APIs, efficient state management in the frontend, and fast SQL queries for data retrieval. Role-based access control and administrative approval enhance both security and reliability of the

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system. The structured MySQL database design ensures data integrity and consistent performance even with increasing data volume. The modular architecture allows faster processing, easier maintenance, and scalability. The system improves response time, reduces manual coordination, and ensures reliable access to emergency resource information during disasters.

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