RESCUE CONNECT SYSTEM

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ABSTRACT

In the face of increasing natural and man-made disasters, timely and accurate information is crucial for effective response and life-saving efforts. Disaster response agencies frequently struggle to collect relevant, real-time data from diverse sources such as social media, news outlets, and other open platforms. This project aims to develop a comprehensive software solution where the platform enables users to quickly report emergencies like floods, fires, or earthquakes by selecting from predefined disaster categories. It also allows victims to specify critical needs—such as the number of people needing rescue, food, water, or medical supplies directly through the platform. This information is instantly relayed to the nearest disaster response teams with precise location data and navigation to ensure that critical messages reach disaster response agencies in the shortest possible time. By using GPS technology, the platform provides disaster response teams with accurate routes, minimizing delays in reaching affected areas.

The real-time nature of the system allows for quick decision-making, empowering agencies to save lives, reduce disaster impacts, and optimize resource allocation during crises. The software is designed for all types of disasters, providing a unified interface for both responders and affected individuals.

Keywords: Disaster response, Emergency reporting, Realtime data collection, Natural and man-made disasters, Critical needs assessment, Rescue coordination, Food, water, and medical supply requests, Disaster response teams, GPS-based navigation

1. INTRODUCTION

The increasing frequency and intensity of natural disasters such as floods, wildfires, hurricanes, and droughts have become some of the most pressing challenges of the 21st century, largely driven by climate change. These events are growing more severe and unpredictable, causing widespread devastation, especially in developing countries with weak infrastructure, limited resources, and inadequate disaster preparedness systems. Climate change exacerbates the risks, with rising sea levels threatening coastal cities, droughts disrupting agriculture and water supplies, and extreme weather events causing infrastructure collapse and loss of life. The economic cost is staggering, with global damages reaching hundreds of billions of dollars annually, further straining economies and increasing social inequalities. As a result, communities, particularly in vulnerable regions, bear the brunt of these disasters, experiencing long-term disruptions to daily life, economies, and infrastructure.

Disaster management, which involves preparedness, response, recovery, and mitigation, is essential to minimizing damage and suffering. However, despite advancements in technology, many existing disaster response systems are still inadequate in handling large-scale emergencies. Communication breakdowns often occur during disasters, with traditional methods such as phone calls, radio broadcasts, and social media becoming unreliable due to damaged infrastructure or network congestion. This delays critical information and slows down response times, further complicating coordination between government agencies, humanitarian organizations, and the private sector. The lack of a unified response system often leads to confusion, duplication of efforts, and delays in aid distribution, exacerbating the crisis.

To address these challenges, there is an urgent need for a more efficient, reliable, and unified disaster management platform. Such a system would enable real-time data sharing, allowing disaster victims to report their exact locations, needs, and conditions directly to responders. This would improve the speed and accuracy of relief efforts and ensure that resources are allocated to areas with the greatest need. Additionally, the platform should provide tools for public engagement, offering disaster preparedness education, early warning alerts, and community-driven reporting.

1.2. EXISTING SYSTEM

Current disaster management systems rely on manual reporting, traditional communication methods (like phone calls and radio), and local authorities, leading to delays in response times. They lack centralized platforms for real-time data collection and processing, causing inefficient coordination and resource allocation. Some systems use social media for updates, but this is prone to misinformation and struggles to filter large amounts of unstructured data, delaying decision-making. Additionally, existing systems lack real-time GPS tracking for precise victim location and do not allow victims to specify urgent needs like medical supplies, food, or water, leading to resource mismanagement. Many systems also depend on stable network connections, rendering them ineffective in remote or damaged areas. Furthermore, they lack integration with technologies like sensor networks or predictive analytics to proactively detect disaster risks.

1.3. PROPOSED SYSTEM

The proposed system introduces a comprehensive mobile application to transform emergency reporting and disaster response into a streamlined, real-time process. It empowers users to report emergencies quickly by selecting predefined disaster categories such as floods, fires, or earthquakes, and specifying critical needs like rescue, food, water, or medical aid through a user-friendly interface. The app ensures immediate action by transmitting detailed messages, including precise GPS-based real-time location data, directly to nearby government rescue teams. This minimizes delays and enhances the accuracy of rescue operations, enabling quicker response times and more efficient resource allocation.

In addition to reporting, users can access a dynamic map showing rescuers' real-time locations and estimated arrival times, offering transparency and reassurance during crises. The platform's unified interface simplifies the process for victims, reducing the complexity of reporting emergencies, while also enhancing collaboration among responders by enabling instant data sharing. This facilitates faster decision-making and prioritization of critical cases, ensuring that help reaches those who need it most, as quickly as possible.

2. LITERATURE REVIEW

[1] Hawkar Jabbar H. Ali, Karwan Jacksi (2021): An Automated Early Alert System for Natural Disaster Risk Reduction: A Review, Qalaai Zanist Scientific Journal, 2021

They proposed that an automated early alert system for natural disaster risk reduction, focusing on weather-related disasters like storms, floods, and hurricanes. The system uses meteorological data and mobile technology to provide real-time notifications via mobile apps and SMS. This proactive approach aims to reduce life and property loss by informing individuals in vulnerable regions about potential risks.

[2] Shin-Yan Chiou, Zhen-Yuan Liao (2018): A Real-Time, Automated and Privacy-Preserving Mobile Emergency-Medical-Service Network for Informing the Closest Rescuer to Rapidly Support Mobile-Emergency-Call Victims, IEEE Access, 2018

They proposed that a real-time, automated mobile emergency-medical-service network that informs the nearest rescuer to assist victims in medical emergencies. Using GPS tracking and secure data transmission, the system ensures timely response while preserving privacy through encryption. It automatically selects the closest available rescuer based on proximity, optimizing response times for critical situations.

[3] Deepshikha Sarma, Amrit Das, Pankaj Dutta, Uttam Kumar Bera (2022): A Cost Minimization Resource Allocation Model for Disaster Relief Operations With an Information Crowdsourcing-Based MCDM Approach, IEEE Transactions on Engineering Management, 2022

They proposed that a cost-minimization resource allocation model for disaster relief, utilizing crowdsourced data and multi-criteria decision-making (MCDM). The system prioritizes resource distribution based on urgency, location, and availability, ensuring efficiency in delivering critical supplies. This model helps optimize decision-making and reduce costs during relief operations.

[4] Kirtan Gopal Panda, Shrayan Das, Debarati Sen, Wasim Arif (2019): Design and Deployment of UAV-Aided Post-Disaster Emergency Network, IEEE Access, 2019

They proposed that a UAV-aided emergency communication network for post-disaster scenarios. UAVs, equipped with Wi-Fi nodes and surveillance cameras, provide temporary communication and real-time damage assessment in areas with infrastructure failure. This system enhances situational awareness and aids in prioritizing rescue efforts by ensuring connectivity for victims and responders.

[5] Areej Alshutayria, Nahla Aljojo, Basma Alharbia, Ameen Banjar, Atheer Alshehri, Mashaiel Alargoubi, Ola Barradah, Rahaf Helabi: An Interactive Mobile Application to Request the Help of the Nearest First Aider by the Injured, ADCAIJ: Advances in Distributed Computing and Artificial Intelligence Journal

They proposed that an interactive mobile app to connect injured individuals with the nearest first aider using GPS and route optimization. The app allows distress signals to be sent, helping first aiders locate and reach the victim quickly. This system empowers bystanders to assist in emergencies, reducing response times and providing timely help before medical professionals arrive.

[6] Aliza Sarlan, Wan Fatimah Wan Ahmad, Rohiza Ahmad, and Nurliyana Roslan (2016): Emergency Accident Alert Mobile Application, Indian Journal of Science and Technology, vol. 9, pp. 1-10, 2016

They proposed that an emergency accident alert app that allows bystanders to send real-time accident reports to emergency response teams (ERTs). Using GPS, the app provides accurate location data, speeding up response times and improving the efficiency of medical interventions. The system is designed for cross-platform use, ensuring accessibility on both Android and iOS devices.

[7] Xu, L.D., Cai, H., Xie, C., Hu, J., and Bu, F. (2014): Ubiquitous Data Accessing Method in IoT-Based Information System for Emergency Medical Services, IEEE Transactions on Industrial Informatics, vol. 10, pp. 1578-1586, 2014

They proposed that an IoT-based system for emergency medical services that enables real-time monitoring of patients using IoT sensors. This system transmits health data, such as heart rate and temperature, to healthcare providers, allowing for quick responses in emergencies. The framework ensures data access from any location, optimizing medical decisions with minimal latency.

[8] Fan, C., & Mostafavi, A.: Metanetwork Framework for Performance Analysis of Disaster Management System-of-Systems, IEEE Systems Journal

They proposed that a Metanetwork Framework for analyzing disaster management system-of-systems (DM-SoS) performance. By leveraging network analysis, it evaluates how different subsystems, like response agencies and resource units, interact. This framework helps identify performance bottlenecks and improve coordination, enabling better decision-making and faster responses during disaster scenarios.

[9] Lidres, K. A., Sadava, D. J. G., & Soberano, K. T. (2017): RescueLink: SOS Alert System for Disaster Response and Management, International Journal of Computer Science and Mobile Computing

They proposed that **RescueLink**, an SOS alert system that connects users with rescue teams via real-time GPS tracking. The system allows individuals to send emergency signals, and responders receive exact location data for quick rescue operations. It also supports two-way communication, improving situational awareness and optimizing resource allocation during emergencies.

[10] Dave, R. K. (2012): Role of Media in Disaster Management, National Disaster Management Authority, Government of India

He proposed that a comprehensive study on the role of media in disaster management, emphasizing its importance in disseminating emergency information like weather alerts and evacuation notices. While media helps raise public awareness and mobilize resources, challenges such as misinformation and accessibility in remote areas can hinder its effectiveness during disasters.

[11] Sundaresan, R., Ajay, A., Hariharan, S., & Yuvalatha, S.: Women Safety Application Using Flutter, International Journal of Advanced Research and Innovative Ideas in Education

They proposed that a Flutter-based women's safety app with SOS alerts, GPS tracking, and emergency notifications. The app allows users to activate an emergency feature by shaking their phone or pressing a button, sending their real-time location to trusted contacts. The app also includes continuous tracking, providing real-time updates to responders.

3. DESIGN AND METHODOLOGY

3.1. ARCHITECTURE

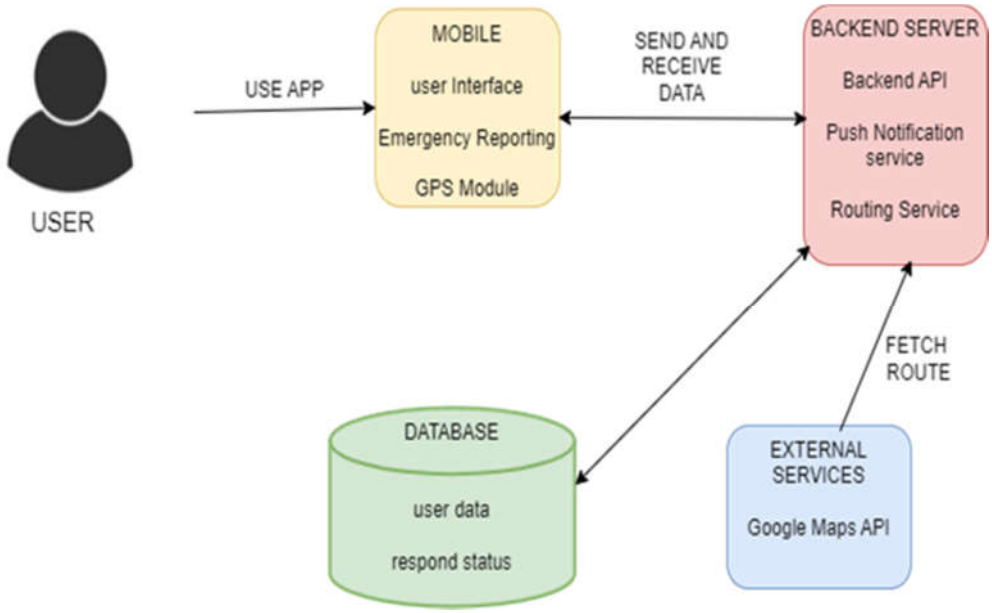


Figure 1. Architecture

The emergency reporting system is a comprehensive solution designed to efficiently handle emergency incidents through a series of interconnected components spread across various modules. At the heart of the system is the User, who interacts with the system through a mobile application. The mobile app is composed of several key elements, including a User Interface for seamless interaction, an Emergency Reporting module that allows users to report incidents in real-time, and a GPS Module that captures the user's precise location and transmits this geolocation data to the Backend Server. The Backend Server serves as the core processing unit of the system, handling multiple crucial tasks. The Backend API facilitates communication between the mobile app and the server, ensuring smooth data exchange. Additionally, the server integrates a Push Notification Service, which is responsible for sending alerts and updates to the user, informing them about the status of their emergency report or the response they are receiving.

For enhanced functionality, the system integrates with external services like the Google Maps API, which is used to provide location-based services such as displaying the user's location on a map and determining the most efficient routes for emergency responders. The entire flow of interaction begins when the User reports an emergency through the mobile app, triggering the GPS Module to send the location data to the Backend Server. The server processes this information, invokes the appropriate services like the Routing Service to find the best response routes, and sends notifications to the user through the Push Notification Service. All relevant data, including the user's emergency status, is stored in the Database, which continuously updates to reflect the current situation. The system's integration with Google Maps allows for real-time tracking and navigation, further optimizing the response process. Ultimately, the system is designed to provide fast, efficient, and reliable emergency support by seamlessly connecting users with the necessary services and delivering real-time information throughout the entire emergency response process.

3.2. MODULES

- **User Registration and Authentication Module:**
  - Handles user authentication, allowing users to sign up and log in securely. This module also handles role-based access (victims, responders, administrators).
- **Emergency Reporting Module:**
  - Allows users to report emergencies by selecting a disaster type (fire, flood, earthquake) and specifying needs (e.g., rescue, food, medical help). GPS automatically captures the user's location.
- **Responder Dashboard Module:**
  - A web-based dashboard for responders to monitor emergencies in real-time, assign tasks, and manage resources. It displays real-time alerts, user needs, and available resources.
- **Push Notifications Module:**
  - Sends push notifications to users and responders using Firebase Cloud Messaging or One Signal, notifying them of emergencies, updates, and assigned tasks.
- **Navigation and Routing Module:**
  - Integrates Google Maps API to provide responders with optimized routes to affected areas, taking into account traffic and road closures.

3.3. METHODOLOGY

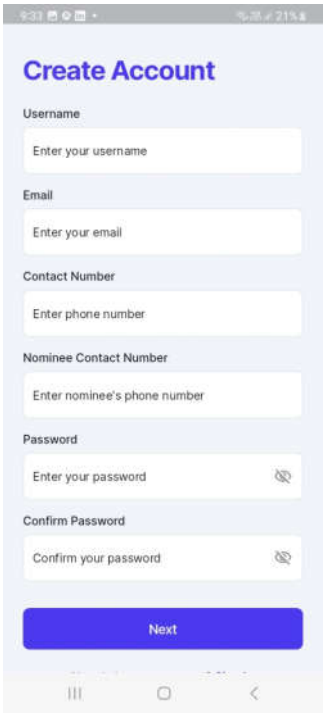
The Rescue Connect System follows a streamlined workflow involving data collection, processing, real-time notifications, and routing to support disaster response operations. It starts with data collection, where users submit emergency reports through the mobile app, providing details such as disaster type, severity, and location. The app is integrated with GPS, which automatically captures the geographical coordinates of each report to ensure accurate responder routing. The backend server then processes the data, categorizing it based on the type and urgency of the disaster. All information is stored in a centralized database, accessible to both responders and administrative teams for coordinated action. For real-time response, the system sends push notifications to nearby responders immediately after a report is filed. A routing algorithm calculates optimized paths using the responder's location and current traffic conditions.

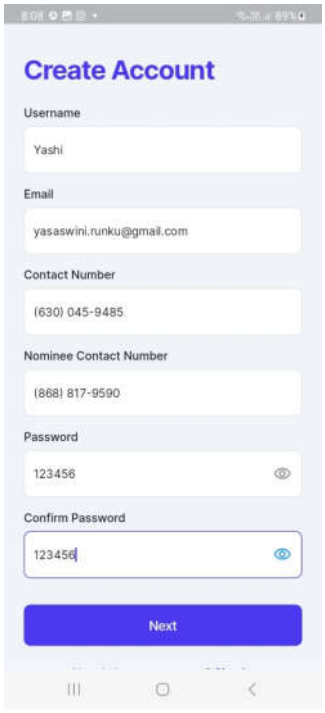
Finally, the system uses the Google Maps API for navigation, offering real-time GPS-based directions to help responders reach the emergency site efficiently and quickly. This integrated approach ensures timely and effective disaster management.

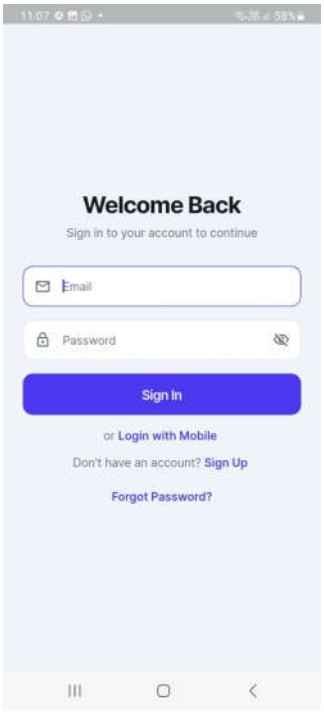
4. RESULT AND DISCUSSIONS

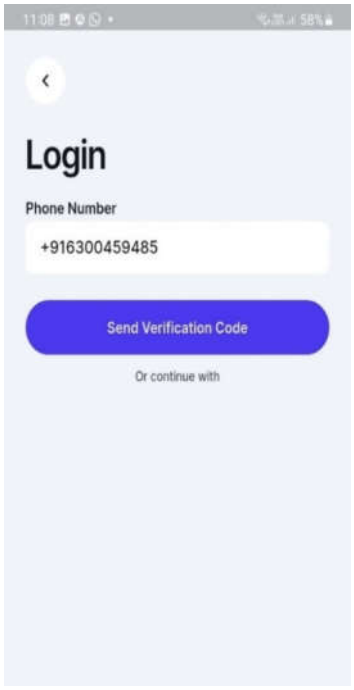
The Rescue Connect System mobile application was successfully designed, implemented, and tested using Flutter and Firebase. It provides a real-time emergency reporting platform where users can send SOS alerts that include GPS location, selected disaster type, and recorded audio evidence. These alerts are uploaded to Firebase Storage and stored in Firestore with relevant metadata, ensuring timely and accurate incident tracking. Rescuers receive instant notifications via Firebase Cloud Messaging and can visualize the incident location on an interactive Google Map, enabling them to respond quickly and efficiently. The application's functionality, including user authentication, real-time database updates, media uploads, and role-based access, performed reliably during testing. The user interface, developed with Flutter's widget-based architecture, was responsive and easy to navigate. Overall, the system demonstrated strong potential to support rapid and secure disaster communication, highlighting the effective integration of cloud services with mobile technologies.

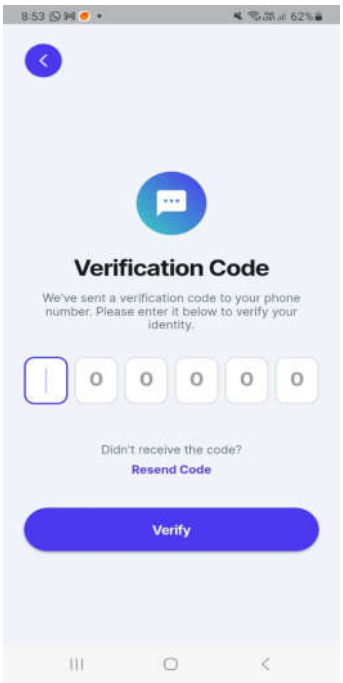
4.1 User Login and Signup page



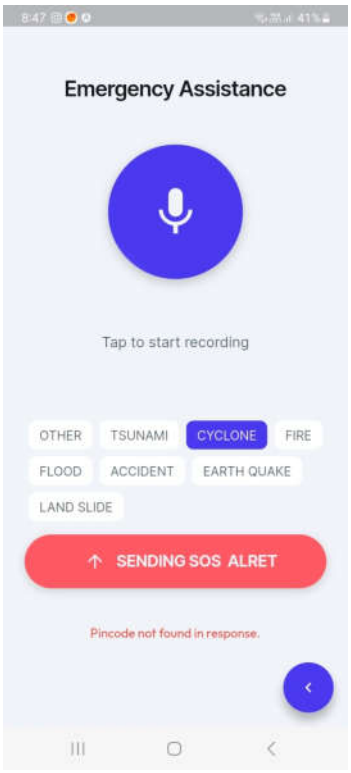


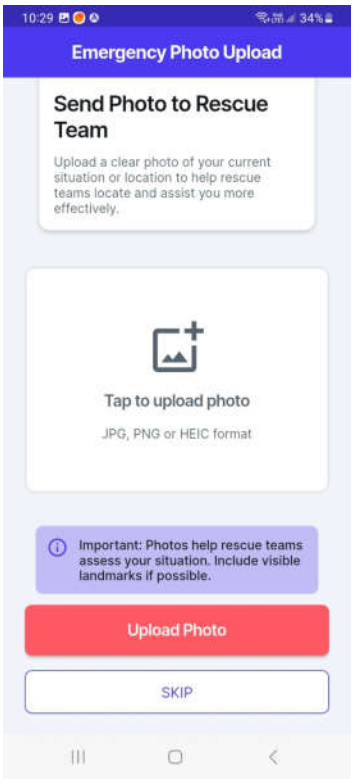


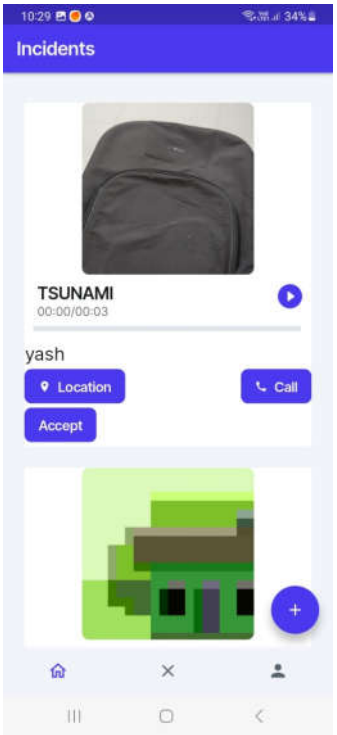


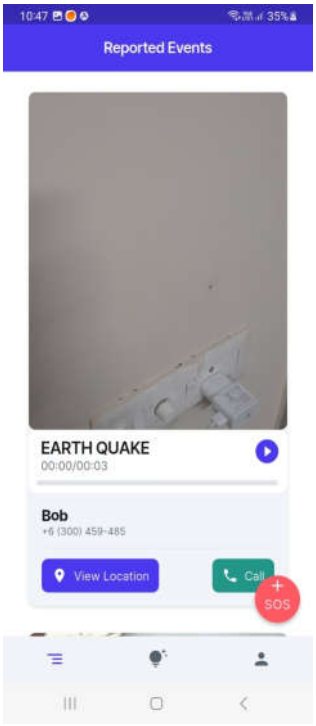


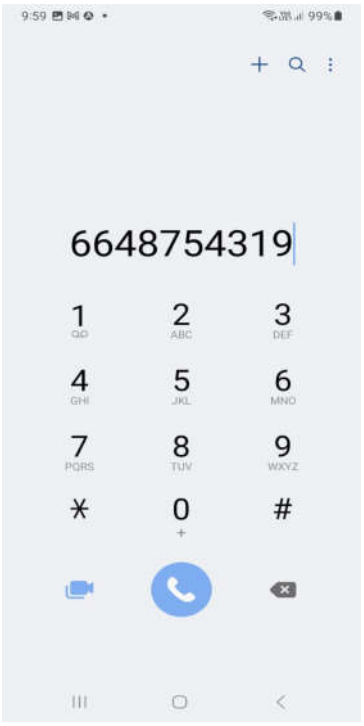
4.2 User Incidents page

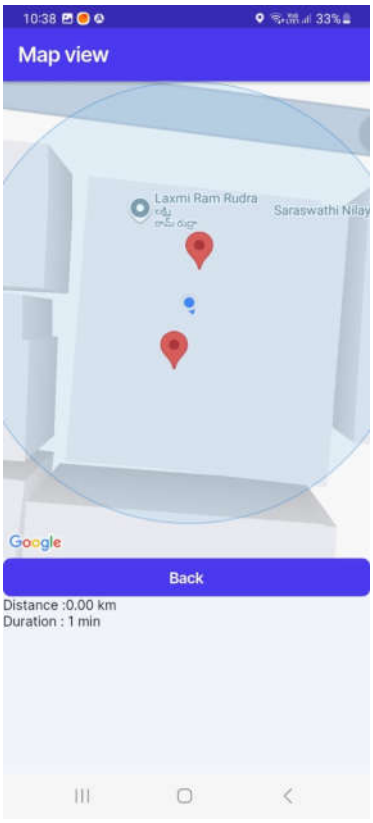




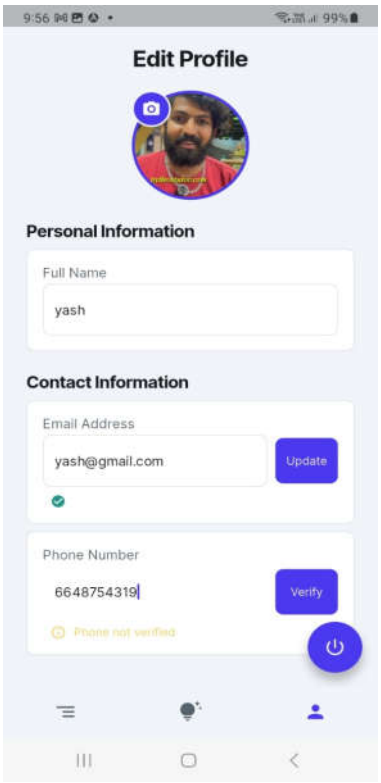


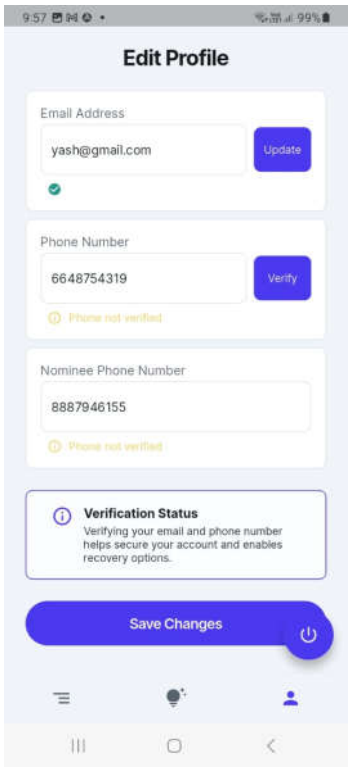




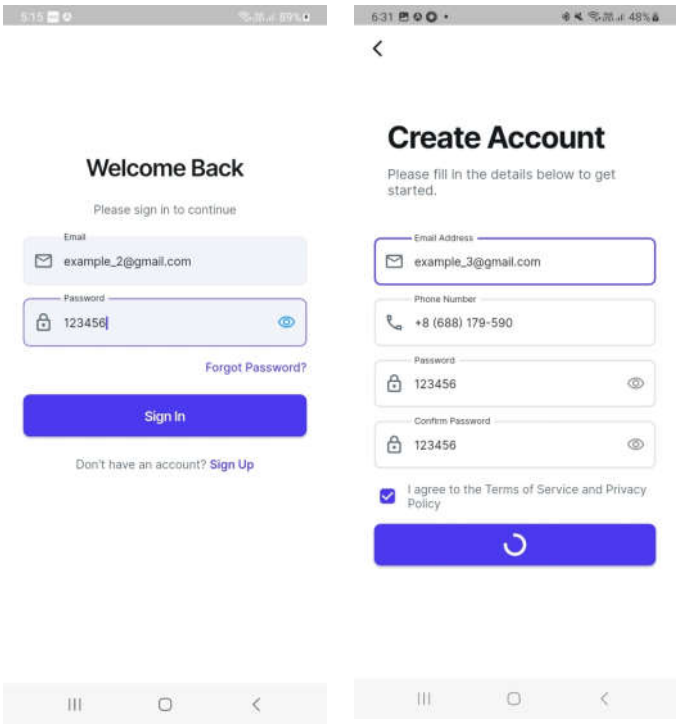


4.3 Users profile page

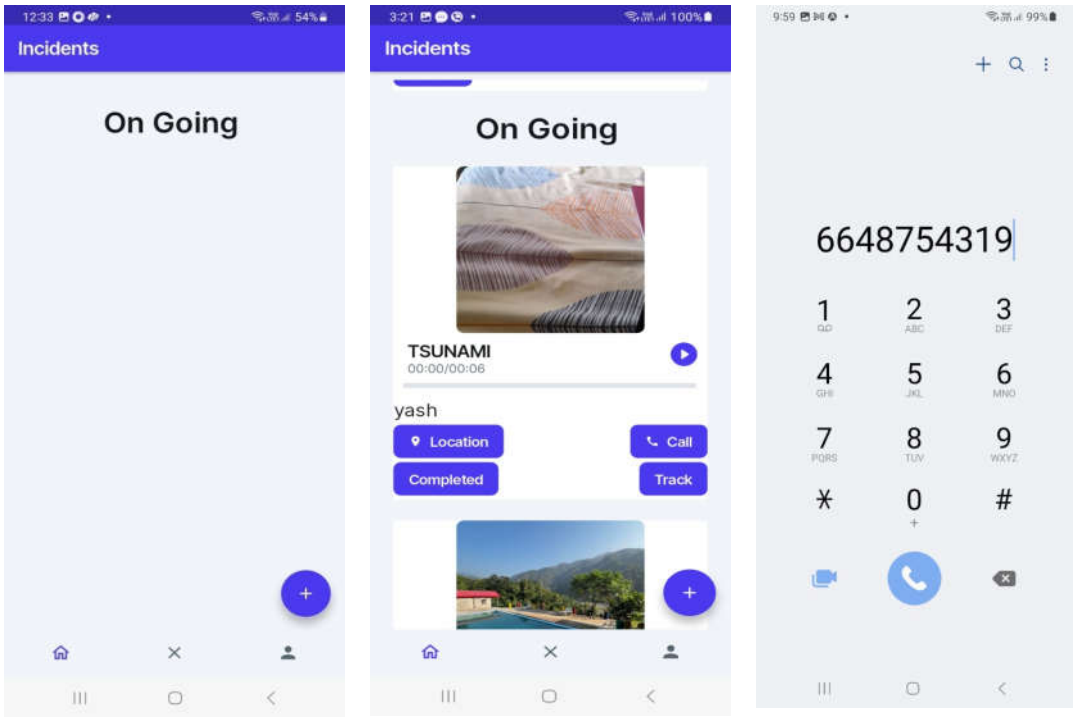


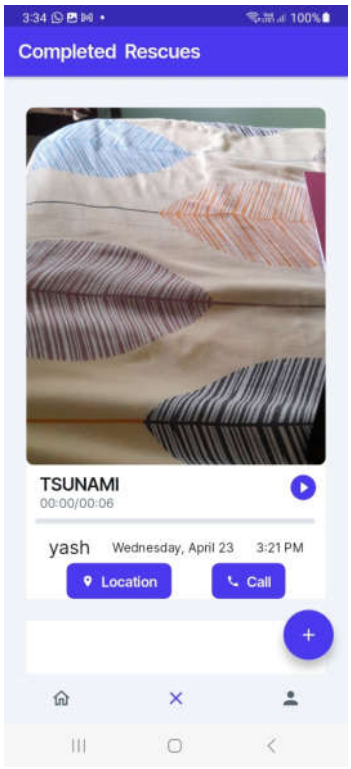


4.4 Rescue team login and Signup page

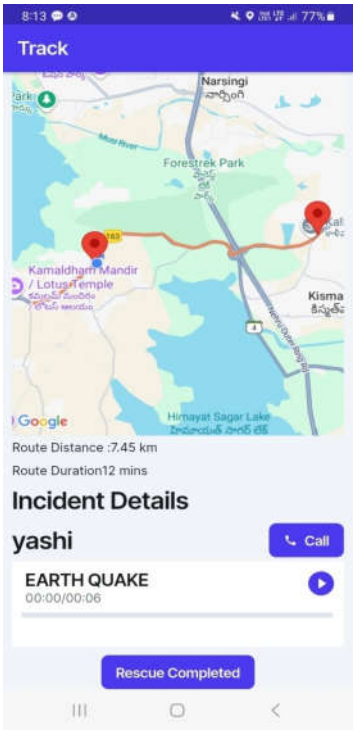


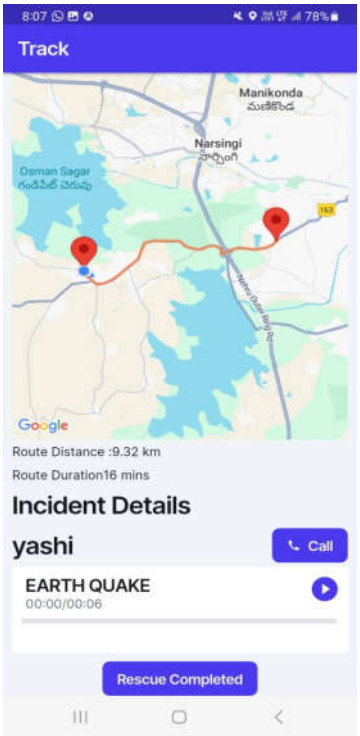
4.5 Rescue team Incidents Page

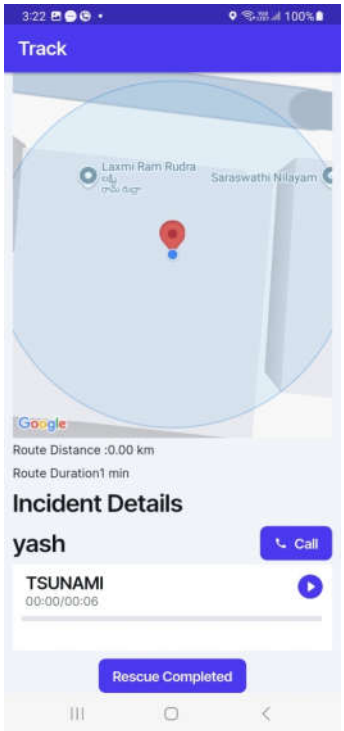




4.6 Rescue team Tracking Page







5. CONCLUSION

The proposed application provides an efficient and real-time solution for disaster management, enabling users to quickly report emergencies such as floods, fires, and earthquakes through a structured and user-friendly interface. By allowing victims to specify their critical needs—such as the number of people needing rescue, food, water, or medical supplies—the platform ensures that clear and actionable information is available to response teams. Integrated GPS-based location tracking further enhances the system's capability to deliver accurate and precise location data, allowing disaster response teams to act swiftly and reach the affected areas with minimal delays.

The real-time nature of the system ensures rapid communication between victims and the nearest rescue teams, facilitating quick decision-making and efficient resource allocation. This capability significantly enhances the ability of agencies to reduce disaster impacts, save lives, and minimize property damage. The application's ability to address multiple types of disasters through predefined categories provides a unified solution, simplifying the process for both affected individuals and responders. The system also empowers users by enabling them to specify the exact kind of attention they require, ensuring that the most pressing needs are prioritized and addressed.

By bridging the gap between victims and rescue agencies, the application enhances coordination, improves response efficiency, and promotes a more organized disaster management process. Overall, this project demonstrates the potential of technology to streamline emergency response operations, ensuring timely intervention and optimized resource utilization during crises. It effectively supports both disaster victims and response teams, contributing to a safer and more resilient society.

6. FUTURE WORK

To further enhance the capabilities of the Rescue Connect System, upcoming versions can integrate several advanced features aimed at increasing its effectiveness, accessibility, and scalability. One major improvement is the inclusion of offline functionality via SMS gateways, allowing users in low-connectivity or disaster-affected areas to send emergency alerts. The use of artificial intelligence can aid in automatically prioritizing incidents based on factors like severity, urgency, and location. Multilingual support for regional and national languages will help make the system more inclusive for diverse user groups. Additionally, live video streaming can enable real-time visual assessment of incidents by rescuers and control centers. Integration with government dashboards, municipal authorities, and NGOs will support large-scale, coordinated disaster responses. Predictive analytics, driven by IoT and environmental sensors, can provide early warnings for events such as floods or fires. Blockchain technology may be adopted to ensure secure and tamper-proof logging of rescue activities. The system may also support wearable devices like smartwatches for automatic emergency detection, and the development of a verified volunteer network will enhance community-based response and reduce rescue times.

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