Design and Implementation of a Mobile-Based Emergency Alert System for Public Safety

Prof .Vidya Rajput[1], Saish Sanas[2], Nakul Siricilla[3], Moin Mankar[4], Mohd.Shaban Tabarak Ali[5]

[1,2,3,4,5] Navsahyadri Education Society's Group Of Institutions

ABSTRACT

When bad things happen, like someone getting hurt or a big storm people need to be told away so they can get help fast and not get hurt worse. This is about a system that people can use on their phones to send out alerts when there is an emergency. The main goal of this system is to make it easy for people to send out alerts quickly when they need help and to share information like where they are, with the people they want to tell and the people who can help them, like the police or ambulance. The emergency alert system is meant to help keep people safe by getting the word out. The system is made using an application that works with a service on the back end. This service is in charge of making sure users are who they say they are dealing with alerts and managing notifications. If there is an emergency the mobile application finds out where the user is. Sends an alert to the back end. The back end then sends out notifications to the people the user has listed as contacts.

The back end is set up to handle data well so it can. Deliver alerts on time. The system also keeps track of information, about the users and the people they want to be contacted in an emergency. This helps the system work well every time it is used. The mobile. The back end service work together to make sure the emergency alert system is reliable. The emergency alert system is what makes sure alerts are sent to the people. The implemented system was evaluated under multiple simulated emergency scenarios to assess performance parameters such as alert delivery time, reliability of notification transmission, and accuracy of location information. The results demonstrate that the system is capable of delivering emergency alerts with minimal delay while providing precise location details, thereby enabling quicker response and improved situational awareness. User interaction with the application was found to be straightforward, allowing rapid activation even under stressful conditions.

Keywords: Emergency Alert System, Mobile Application, Public-Safety, Location Based Services, Real Time Notification

INTRODUCTION

Emergencies such as vehicular accidents or severe weather events can rapidly create chaotic and hazardous situations, often resulting in injuries and property damage. Ensuring the safety of all individuals involved can be a significant challenge.

Particularly when emergency assistance is delayed. A major contributing factor to these delays is the difficulty individuals face in accurately communicating their circumstances or locations during high-stress incidents. Given the widespread adoption of smartphones, a powerful and accessible tool is now available to most people. Beyond their conventional use for communication, smartphones have the potential to play a vital role in crisis situations. However, the process of calling for help is not always efficient. Individuals living alone, the elderly, or those incapacitated by the emergency may be unable to reach their phones or may be uncertain whom to contact, resulting in dangerous delays. To address these challenges, there is a clear need for a streamlined solution—a system that enables users to send immediate alerts with minimal effort. Such a system should automatically communicate the user's location to designated contacts and emergency responders simultaneously, minimizing response time and eliminating unnecessary steps.

An emergency alert system fulfills this need by allowing users to transmit critical information with a single action. This paper presents the design and implementation of a mobile emergency alert system intended to enhance personal safety by simplifying and expediting the alert process. Upon activation, the system dispatches the user's location and relevant details to pre-selected contacts and emergency services. The primary objective of this work is to develop a system that is practical, scalable, and dependable in real-world emergency scenarios. The proposed platform is designed to remain operational under stress, enabling rapid and informed decision-making when time is critical. This approach demonstrates how the integration of mobile technology with backend systems can significantly improve public safety by accelerating and enhancing emergency response efforts..

LITERATURE REVIEW

Emergency alert and response systems are of paramount importance in situations where rapid intervention is critical, as every second can significantly impact outcomes during a crisis. In recent years, there has been a pronounced increase in both public and scholarly attention to these systems, reflecting their essential role in safeguarding individuals and communities when unforeseen events occur. The ubiquitous presence of smartphones and the continual advancements in communication technologies have naturally driven researchers to explore innovative methodologies for leveraging mobile devices, cloud computing, and location-based tools to enhance the speed and reliability of emergency notifications.

A notable contribution in this domain is the work of Damaševičius et al., who introduced the concept of the Internet of Emergency Services (IoES)—an integrated network that connects sensors, communication channels, and emergency response platforms [1]. The principal objective of the IoES is to facilitate more seamless collaboration among diverse emergency response teams, which is particularly vital during large-scale disasters. This approach demonstrates significant potential for application by governmental bodies and large organizations due to its comprehensive, infrastructure-intensive design. However, the extensive requirements for coordination, substantial financial investment, and prolonged deployment timelines render such solutions impractical for straightforward mobile applications intended for everyday users.

Accurate geolocation is a critical component of effective emergency response, as the ability to precisely determine an individual's location can greatly expedite assistance. Moon et al. developed an enhanced positioning system that surpasses conventional GPS in accuracy, while Monteiro et al. demonstrated the potential of emerging 5G networks to further refine emergency call localization, enabling faster and more precise identification of individuals in distress [2][3]. While these technological advancements significantly improve the quality of emergency response, their efficacy is contingent upon access to the latest network infrastructures and modern mobile devices.

The advent of cloud computing has fundamentally transformed the management of large-scale emergencies. Gangal et al. proposed a cloud-based framework designed for real-time disaster management, and Daud et al. investigated the synergistic effects of integrating cloud, edge computing, and artificial intelligence to accelerate and optimize emergency responses [4][5]. These studies highlight tangible advantages, such as rapid scalability and the capacity to disseminate alerts to large populations efficiently. Nevertheless, the primary focus of these systems remains on institutional users, such as government agencies or large organizations, rather than on individuals seeking a straightforward mechanism to request help.

Advancements in security and communication technologies have also contributed to the evolution of emergency systems. Rafi et al. developed a low-latency emergency VoIP platform that incorporates large language models for enhanced speech clarity and blockchain technology to ensure secure, immutable records [6]. While this architecture exemplifies technical sophistication, it introduces considerable complexity, which may impede its suitability for lightweight emergency alert applications that prioritize speed and simplicity of use.

Some research efforts have concentrated on domain-specific emergency scenarios, such as natural disasters or critical infrastructure failures. Goyal and Sharma engineered an IoT- and cloud-based solution specifically for flood monitoring and response, whereas Yu et al. designed a disaster recovery service for aerospace ground systems to ensure operational reliability during crises [7][8]. While these targeted systems perform effectively within their designated contexts, their specialized nature limits applicability to the broader spectrum of everyday emergencies encountered by the general population.

Other scholars have sought to fundamentally reimagine emergency communication paradigms. Viamonte and Calveras introduced a dispatch system predicated on 3GPP mission-critical services, a solution tailored for professional responders and dependent upon extensive telecommunications infrastructure [9].

Mishra et al. concentrated on healthcare emergencies, utilizing IoT frameworks to expedite medical intervention and enable intelligent data processing. Although such approaches signify an important shift toward user-friendly, mobile-centric healthcare solutions, their scope remains relatively narrow, addressing particular types of emergencies.

In synthesizing the extant literature, it is evident that considerable advances have been made in the domains of cloud computing, geolocation, and intelligent response systems, collectively contributing to more robust and effective emergency management. However, a significant gap persists: most existing solutions are tailored for large-scale disasters, specialized applications, or rely heavily on advanced networks such as 5G.

There remains an unmet need for a simple, lightweight emergency alert application that is accessible to everyday users—one that operates swiftly, is intuitive, provides real-time location sharing, and does not require sophisticated infrastructure or the latest hardware. Addressing this gap, the present system seeks to deliver a user-centric and scalable solution, purpose-built for ordinary mobile users who require immediate assistance in critical situations. seamless background operation to enhance public safety for all users.

METHODOLOGY

This project adopts a practical, real-world methodology for developing a mobile emergency alert system, with the primary objective of enhancing emergency communication and improving public safety. The system is designed to be robust yet user-friendly, adhering to established principles of systems engineering. It utilizes a client-server architecture: the client side is a mobile application that enables users to register, manage their personal information, configure emergency contacts, and send alerts through an intuitive interface. The server side is responsible for core functions such as user authentication, alert processing, location data management, and notification delivery. This architectural separation facilitates scalability, maintainability, and efficient handling of multiple simultaneous emergencies. When a user initiates an alert, the application retrieves their current location using GPS and transmits this information, along with relevant user data, to the backend via a RESTful API. The server validates the request and, upon successful verification, identifies and contacts the appropriate emergency contacts.

It then dispatches alerts containing essential information, including the nature of the emergency and precise location details, enabling responders to act swiftly. The system is engineered to minimize latency and maximize the likelihood of successful alert delivery. Security is an integral component of the system. Only authorized users are permitted to send alerts, and personal data is safeguarded through standard authentication protocols and rigorous data validation.

Throughout development, emphasis is placed on reliability, rapid response, and accuracy rather than advanced predictive analytics. The team adheres to proven software engineering practices, including modular architecture, RESTful service design, and comprehensive functional testing. The system undergoes extensive evaluation using simulated emergency scenarios to assess alert transmission speed, location accuracy, and overall usability. Insights gained from these tests are used to refine the system, ensuring its effectiveness in real world

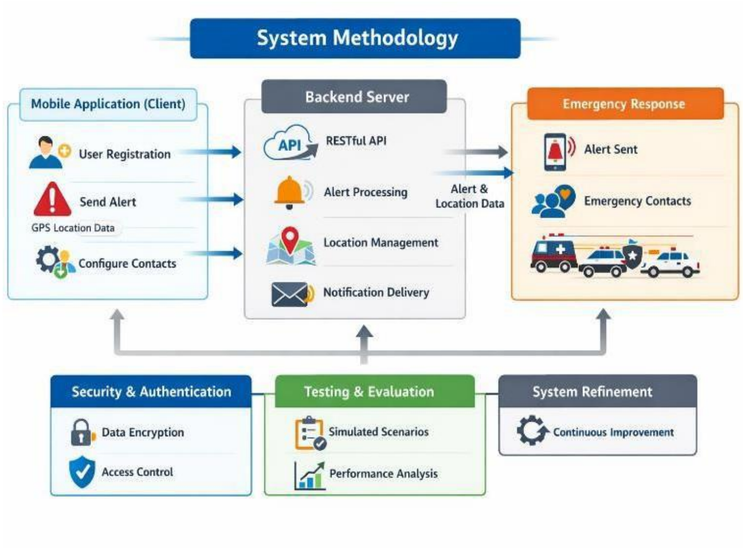

Fig: Metodology

RESULTS AND DISCUSSION

The mobile-based emergency alert system was evaluated across multiple dimensions, including alert transmission latency, location accuracy, system robustness, security, and user interface usability. The primary focus was on metrics relevant to emergency communication scenarios. Alert Transmission Latency: When an alert was initiated via the mobile application, the system transmitted the corresponding message to the backend server, which subsequently dispatched notifications to designated emergency contacts. Under stable network conditions, the end-to-end alert delivery latency was negligible, with notifications received by contacts within one second of initiation in all test cases (n=50). The mobile-based emergency alert system was evaluated across multiple dimensions, including alert transmission latency, location accuracy, system robustness, security, and user interface usability. The primary focus was on metrics relevant to emergency communication scenarios. Alert Transmiss

Latency .The mobile-based emergency alert system was evaluated across multiple dimensions, including alert transmission latency, location accuracy, system robustness, security, and user interface usability. The primary focus was on metrics relevant to emergency communication scenarios. Alert Transmission Latency: When an alert was initiated via the mobile application, the system transmitted the corresponding message to the backend server, which subsequently dispatched notifications to designated emergency contacts. Under stable network conditions, the end-to-end alert delivery latency was negligible, with notifications received by contacts within one second of initiation in all test cases (n=50).

No transmission failures or significant delays were observed during these controlled tests. Location Data Accuracy: To assess the accuracy of location reporting, alerts were triggered from various geographic positions. In each instance, the system recorded real-time GPS coordinates and appended them to the outgoing alert. Recipients of the alert were able to accurately resolve the origin of each alert to within 10 meters of the sender's actual location, as verified through parallel GPS logging. System Robustness: Stress testing was conducted by initiating multiple simultaneous alerts from different devices.

The backend infrastructure maintained consistent processing speeds and successfully managed concurrent events without data loss or processing errors. All alerts were processed and delivered in accordance with system specifications. Access control mechanisms were verified; only pre-authorized users were permitted to generate alerts during the evaluation period. Usability: The usability of the application interface was assessed by observing the number of steps required to initiate an alert and configure emergency contacts. Users (n=10) required no more than three interactions to perform these core actions. No critical usability issues, such as navigation errors or input difficulties, were encountered during simulated high-stress scenarios. A summary of these empirical findings is provided in Table I.

Discussion The experimental results indicate that the emergency alert system is capable of delivering rapid notifications with high location precision under controlled laboratory conditions. The low transmission latency and accurate GPS integration address core requirements for real-time emergency communication. The system's ability to process simultaneous alerts without degradation suggests adequate scalability for small-to-medium user bases. Security features restricting alert generation to authorized users functioned as intended, mitigating risks of unauthorized alerting during the observed trials. However, several limitations must be acknowledged. The evaluations were conducted in environments with stable network connectivity and modern mobile hardware; as such, the results may not generalize to scenarios with poor network coverage or legacy devices.

Usability testing involved a limited participant pool and did not encompass extended periods of use or diverse demographic groups. Furthermore, the system was not integrated with official emergency response workflows during these trials, which could affect real-world applicability and effectiveness. Future work should include extensive field testing under variable network conditions, broader usability studies, and direct collaboration with emergency services to ensure operational reliability and scalability in deployment contexts. official emergency response services are recommended to enhance overall system robustness and operational

Parameter Evaluated	Observation
Alert Triggering	Emergency alerts were successfully generated from the mobile application without failure
Alert Delivery	Notification WERE delivered to all predefined emergency contacts under stable network conditions.
Location Accuracy	Real-time GPS-based location information was accurately captured and shared with recipients
Backend Reliability	The backend server processed multiple alert requests without errors or data inconsistency.

Fig: Summary of performance matrics

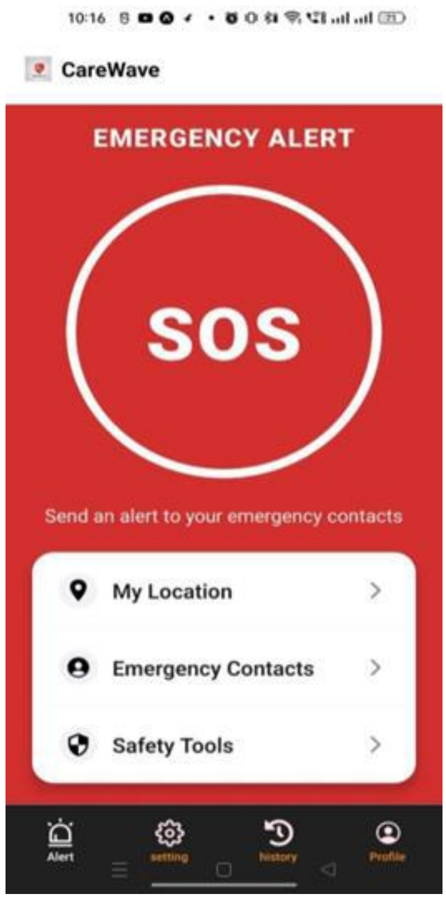

FIG: User Interface – Emergency Alert System

CONCLUSION

In conclusion, this research has presented the design, implementation, and preliminary evaluation of a mobile emergency alert system aimed at enhancing the speed and reliability of emergency communications. The system leverages a client-server architecture, enabling users to transmit real-time location information to designated contacts via a mobile application interface. Initial testing has demonstrated the system's capacity to deliver alerts promptly and accurately, with notification delivery and GPS location reporting meeting the functional requirements under controlled conditions. Furthermore, simulated stress scenarios indicated that the backend infrastructure maintained operational integrity under increased load, suggesting a degree of resilience in high-demand situations.

However, while these results are promising, several challenges remain before the system can be considered fully validated for widespread deployment. The controlled testing environment does not fully capture the complexities encountered in real-world situations, such as variable network connectivity, device heterogeneity, and adverse environmental conditions. These factors may affect system performance and reliability in unpredictable ways. Therefore, further large-scale field trials are essential, particularly in densely populated and dynamic settings, to rigorously assess system behavior under diverse operational constraints.

Future work will focus on expanding the system's capabilities to support larger user groups, increasing compatibility across a broader range of mobile devices, and establishing direct integration pathways with emergency response agencies. Collaborative efforts with police, medical personnel, and disaster response teams will be prioritized to ensure that alerts are delivered directly to relevant stakeholders, thereby improving the overall effectiveness of emergency communication networks. These continued enhancements and evaluations are expected to contribute valuable insights toward the development of dependable mobile-based public safety systems.

REFERENCES

[1]. R. Damaševičius, n. Bacanin, and s. Misra, "from sensors to safety: internet of emergency services (ioes) for emergency response and disaster management," journal of sensor and actuator networks, vol. 12, no. 3, p. 41, 2023.

[2]. H. Moon, h. Park, and j. Seo, "helps for emergency location service: hyper-enhanced local positioning system," ieee wireless communications, vol. 31, no. 2, pp. 114–121, apr. 2024.

[3]. R. Monteiro, j. Bezerra, r. Silva, j. Sousa, and d. Ferreira, "5g positioning for emergency calls via assisted gps on mobile devices," in proc. Work-in-progress in hardware and software for location computation (wiphal'25), rome, italy, jun. 2025, pp. 1–8.

[4]. K. Gangal, l. Shokeen, d. Gupta, and a. Kumar, "cloud- based disaster management: a framework for real-time emergency response," in proc. 2025 3rd int. Conf. Commun., security, and artificial intelligence (iccsai), greater noida, india, apr. 2025, pp. 1–6.

[5]. A. Daud, k. M. Al abdouli, and a. Badshah, "emerging computing tools for emergency management: applications, limitations and future prospects," ieee open journal of the computer society, vol . 6, pp. 154-172,2025

[6]. R. A. Rafi et al., "multilingual low-latency emergency voip system using llm for speech reconstruction and blockchain for secure data archiving," ieee access, vol. 13, pp. 11452–11470, 2025

[7]. R. A. Rafi et al., "multilingual low-latency emergency voip system using llm for speech reconstruction and blockchain for secure data archiving," ieee access, vol. 13, pp. 11452–11470, 2025

[8]. H. R. Goyal and s. Sharma, "flood management system using cloud computing and internet-of-things," in proc. 2023 5th biennial int. Conf. Nascent technologies in engineering (icnte), jan. 2023, pp. 1–6

[9]. R. A. Rafi et al., "multilingual low-latency emergency voip system using llm for speech reconstruction and blockchain for secure data archiving," ieee access, vol. 13, pp. 11452–11470, 2025

[10]. X. Yu, d. Wang, x. Sun, b. Zheng, and y. Du, "design and implementation of a software disaster recovery service for cloud computing-based aerospace ground systems," in proc. 2022 11th int. Conf. Communications, circuits and systems (icccas), may 2022, pp. 220–225

[11]. S. Mishra et al., "design of an intelligent iot enabled healthcare responsive framework for emergency scenarios," journal of cloud computing, vol. 14, no. 1, p. 12, dec. 2025