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# Emergency Response System: Design and Development of an SOS Mobile Application

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**Abstract -** Emergency applications have revolutionized emergency response systems by providing swift and efficient assistance, significantly enhancing user safety. Unlike earlier SMS-based models with basic location tracking, modern SOS applications integrate advanced functionalities, including real-time location sharing, multilingual support, offline accessibility, medical data storage, and hands-free activation. These improvements ensure effective emergency communication, particularly in remote or inaccessible regions. Additionally, some applications utilize mapping algorithms, such as Dijkstra's algorithm, to identify the fastest route for emergency services, reducing response time and increasing efficiency. Other systems send distress alerts via SMS and email to emergency contacts and helplines, ensuring immediate intervention during crises . Recent technological advancements have introduced innovative features like offline location tracking, voice-activated emergency responses, and crowd-assisted rescue operations. Furthermore, artificial intelligence (AI) and machine learning (ML) are being integrated into SOS applications to predict emergencies, assess their severity, and allocate resources efficiently. Cloud-based infrastructure enhances data management and connectivity, facilitating seamless coordination between users, emergency centers, and first responders . As SOS applications continue to evolve, future developments will focus on enhancing predictive capabilities, automating response mechanisms, and improving accessibility. These innovations aim to strengthen emergency preparedness and optimize crisis management, ultimately saving more lives.

***Key Words*:** Android applications, Emergency response systems, Medical Location tracking, Multilingual medical data voice command storage, Offline gesture activation, AI/ML, Emergency safety,Flutter,Firebase.

## 1. INTRODUCTION

Ensuring personal safety has become a growing concern due to increasing incidents of harassment, assault, abduction, and other violent crimes. Despite legal protections and safety initiatives, individuals—especially in public spaces—remain vulnerable. Traditional safety measures, such as police patrols and emergency helplines, often prove inadequate due to delayed response times, limited accessibility, and challenges in discreetly reporting incidents. This underscores the need for technology-driven solutions that provide real-time protection and rapid emergency response [1]. With the widespread use of smartphones, SOS applications have emerged as essential tools for personal security, enabling users to send distress signals, share live locations, and notify emergency contacts and authorities instantly [2]. Early SOS applications relied on basic SMS alerts and GPS tracking, but these systems had limitations, including internet dependency, manual activation, and limited real-time assistance [3]. To address these challenges, modern SOS applications incorporate offline location tracking, allowing users to send their last known position without internet access, and voice-activated alerts, enabling hands-free distress signaling when using a phone is not possible [4]. Additional features such as real-time audio and video recording, live location sharing, and automatic alerts to law enforcement have significantly improved emergency response efficiency ..

Further advancements include multilingual support to overcome language barriers and medical profile integration, providing first responders with critical health information for personalized assistance. AI-driven and IoT-based solutions are also being explored to predict high-risk areas, send automated danger alerts, and connect with smart wearables for seamless distress signaling [5]. A key aspect of these safety applications is their universal accessibility—they are not limited to women but designed for all individuals, including children, the elderly, professionals working late hours, and people with medical conditions [6]. Future SOS applications aim to offer versatile safety features adaptable to various emergency situations, including personal threats, medical crises, and natural disasters This paper explores the evolution of SOS applications, from basic distress tools to AI-powered, comprehensive emergency response systems. By analyzing their development, current innovations, and future potential, this research highlights the increasing role of digital safety solutions in crime prevention, emergency response, and personal security for all individuals [19]..

## 2. LITERATURE REVIEW

**a. SOS Android Application**

Pratyush Poddar (2013) developed an SOS emergency application designed to assist individuals in distress by utilizing the Google Maps API to locate essential services such as hospitals, police stations, and fire departments. The app enables users to send distress alerts, make emergency calls, and access real- time maps. It is built using J2EE and Android technologies and operates via GPS, GPRS, and

WiFi connectivity. While practical in emergencies, a major limitation is its requirement for manual activation, which could be a challenge if the user is unconscious or unable to access their phone[7].

**b. Advanced SOS Application**

G. Shri Krishna & M.P. Lokesh (2014) introduced the Advanced SOS App, an improved version of SMS-based emergency applications. It incorporates cloud- based messaging and voice alerts, reducing delays in distress communication. Additionally, it features IMEI-based user registration and satellite connectivity, making it functional even in low-network areas. The key advantage of this system is its enhanced emergency response speed, particularly in remote locations. However, its dependency on GPS could be an issue in areas with weak satellite signals, such as underground spaces and enclosed buildings[8].

**c. Emergency Push Notification System**

Mior Suffian Thuri Bin Mior Khir (2015) designed an Emergency Push Notification System to simplify emergency activation. This system enables users to send alerts with a single click, instantly notifying selected emergency contacts. It is particularly beneficial in urgent scenarios such as kidnappings, assaults, and severe accidents, where immediate response is crucial. However, a drawback is that its functionality is limited to specific regions, making it less effective outside designated areas[9].

**d. Women Warrior – Secure, Smart & Safe Application**

Prasad & Hiwarkar (2016) created the Women Warrior app to enhance women's safety. It features geo-fencing, allowing users to establish a secure zone, and utilizes IMEI-based authentication for secure access. The app's emergency SOS button facilitates quick distress signals, supported by GPS tracking and emergency messaging. Additionally, it offers local database storage, ensuring functionality even offline. However, one limitation is that it does not directly connect with law enforcement agencies, meaning alerts are sent only to personal contacts rather than police or security services[10].

**e. SHIELD: Personal Safety Application**

Sagar Khan et al. (2017) launched SHIELD, an Android safety application featuring real-time GPS tracking and emergency activation through the power button. Users can trigger an SOS alert by pressing the power button five times, providing a quick and simple emergency response mechanism. The app also includes a campus-specific safety mode, making it particularly beneficial for university students. Despite its improved accessibility, the continuous GPS tracking raises privacy concerns and can cause high battery consumption[11].

**f. LifeCraft: An Android-Based Application System for Women Safety**

Rabbina Ridan Khandoker (2019) introduced LifeCraft, a safety application for women featuring voice command activation, real-time location tracking, and live audio recording. The app sends periodic emergency alerts every five minutes to maintain ongoing communication with emergency contacts. Additionally, it incorporates safe zone detection and an offline distress mode, allowing users to send alerts even without internet access. However, the five-minute interval for distress messages could lead to delays in critical situations[12].

**g. Gesture-Based Women Safety Application**

Mohamed Amirul Syafiq Bin Peer Mohamed (2021) developed a gesture-based SOS system that allows users to trigger an alert by shaking their phone. This feature eliminates the need for manual activation, making it useful in situations where users are physically restrained. The system sends GPS-tracked alerts, emergency SMS, and activates a loud alarm to deter threats. However, a significant limitation is the potential for accidental activation, which could lead to false alarms and unnecessary emergency responses[13].

**h. AI-Powered Emergency SOS Application**

Varsha Jadhav and colleagues (2023) designed an advanced SOS application incorporating AI to analyze sensor data, past incidents, and user behavior for real-time emergency prediction. This AI-driven approach enhances emergency severity detection and optimizes resource allocation, improving response times. The system prioritizes distress signals based on urgency, reducing false alarms and increasing efficiency. However, continuous data collection for AI training poses privacy concerns, as it involves monitoring users' locations, movements, and behavioral patterns[14].

**i. Android-Based Women Safety Application**

Parismita Sarma (2023) developed a women's safety application integrating Google Maps, WhatsApp for emergency communication, and the ability to locate the nearest police station. The app enables users to send real-time emergency alerts, share live locations, and contact law enforcement directly. While WhatsApp integration enhances communication speed, the app's dependency on internet connectivity may limit its functionality in areas with poor network coverage[15].

## 3. METHODOLOGY

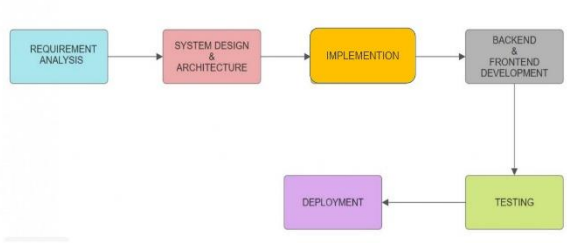


*Figure 1: Emergency Application Development Lifecycle*

The qualitative research methodology is chosen and implemented by the author for the purpose of study. Several journal articles, newspaper articles, and books were referred in this study to get a clear and more in depth knowledge regarding the subject mattered.

**a. Start:-** The first step is understanding the main issue that the project aims to solve. In this research, the problem identified was existing personal safety mobile applications require multiple steps to send an emergency request, making them inefficient in life-threatening situations .

**b. Requirement Analysis:-** This phase focuses to understand the problem. Requirement Analysis is on identifying what is need from these systems, not how the system will achieve its goals. Requirements were also collected by looking at other devices like personal locator beacons and satellite messengers that are commercially available. In the software requirement we are dealing with the requirements of the proposed system, that‘s the capabilities of that system, which is yet to be developed, should have.

**c. Planning Phase:-** This is the initial phase of project planning, On week 2, the author has submitted the proposed project title together with the brief description of the project title. Afterwards, the author is being assigned to be under the supervision of the selected project guide for the rest of FYP-1 and FYP-2. Proceeding with the successful project title, the author has engaged with the assigned supervisor to further discuss the potential development procedures to be done, background study, objective, etc.

**d. Analysis Phase:-** In this phase, the author is going to collect the information regarding the problem statement that has been determined in the planning phase, from the perspective of the public (potential user). This step is crucial to identify the requirements of the system. Then, the author is required to analyse all the collected information and data to extract the requirements of the system for further reference in the design and implementation phases.

**e. Design Phase**:- Analysis of the data that have been collected during the previous phase are classified and further analyzed to come up with suitable system architecture. The system architecture will be supported by other tools of system architecture (use-case diagram, activity diagram, etc.) that will help to portray the system. The design will be shown and reviewed by the project guide and further discussed to carefully decide on the final architecture so that it will positively affect the stakeholders. Towards the end of this phase, the author is required to submit the analysis and design phase of the project development as the requirement for FYP .

**i. Backend**- The core language that we have used as backend is Dart (Flutter) because of its-

- Simplicity
- Security
- Open Source Libraries
- Robustness & scalability

**ii. Frontend**- The frontend is done using mostly Flutter(Dart). Google Maps API is used for tracking purposed.

**f. Development Phase**:- For this phase, it is required to build the mobile app based on the designs that have been determined in the design phase. Key deliverables in this phase is the functionalities of the mobile app. When the mobile app development is completed, the deployment of the mobile app should be executed to the user.

**i. SOS Alert Messages :-** On the press of SOS, the database must be checked if the emergency contacts are added or not. Alert activity should get opened which will set of timer of 15 seconds. In the time, the user‘s location should get fetched. And Messages must be sent to that saved contact.

**ii. Contact Management:-** A dialog must be displayed alerting the user to add contacts.

**iii. Location Management:-** In the time, the user‘s location should get fetched. Google Map API is used to fetch the live location.

**iv. Notification Management:-** The tips fragment must get open after clicking on the corresponding icon in the Bottom Navigation Bar.

**g. Testing Phase:** System testing is a critical phase implementation. Testing of the system involves hardware

device and debugging of the computer programs and testing information processing procedures. Testing can be done with text data, which attempts to stimulate all possible conditions that may arise during processing.

**i. Unit Testing**: unit test is the smallest part while testing the programming system. integration testing and interface testing are done together to find the flaws in the interface

**ii. Operational Testing:** In operational testing, it checks the interface testing while it checking the system meets the requirements of the previous integrated product.

**iii. Acceptance Testing:** In the acceptance test, whether the software is accepted or not will be checked in the acceptance testing it is checked by requirements documents.

**iv. Release Testing**: If it is any no judgment that has to be made for a product or software. That is release application for the use**.**

**h. Deployment Phase**: In this phase application is installed and tested in real-world conditions, and made available for actual users. Some task are performed before testing like final testing, optimizing performance, security check.

**i. Maintenance Phase**: The app must be maintained properly in each phase by doing various testing methods. Maintenance is done by using various debugging tool and also manually by discussion and virtual mode.

**j. End**: The project stages are ended here project is deployed and user is ready to use application in real-world.

## 4. TECHNOLOGY USED

A variety of modern technologies are used by the Needunow emergency application to guarantee a smooth, effective, and responsive user experience. The following are the main technologies utilized in this project:

a. Flutter : Google created the open-source Flutter UI toolkit, which allows developers to create natively built desktop, web, and mobile apps from a single codebase. Its cross-platform features allow for consistent performance on both iOS and Android devices as well as quick development. The needunow application's vast widget library offers a dynamic layout, smooth animations, and an intuitive user interface—all crucial for prompt engagement in emergency situations.

**b. Firebase :** In order to guarantee real-time communication, data storage, and authentication within the application, Google's Backend-as-a-Service (BaaS) platform Firebase is required. Among the main Firebase services utilized are:

- Firebase Realtime Database: For immediate data synchronization, guaranteeing real-time updates of users' locations, emergency notifications, and other critical data.
- Firebase Authentication: user identities can be safely managed while providing fast login alternatives for emergency access.
- Firebase Firestore: Used to store structured data, including emergency records, user profiles, and medical data.

**c. APIs (Application Programming Interfaces):** Through the smooth integration of external services, APIs improve the functionality of the program. The application Needunow utilizes the features of:

- Google Maps API: For precise real-time location tracking and sharing
- Voice Recognition APIs: To facilitate hands-free operation by supporting voice-activated emergency alerts.
- Third-party APIs: For extra functionality like emergency contact databases and weather updates during emergencies.

## 5. CONCLUSION

The SOS application is an advanced and reliable safety tool designed to provide immediate emergency assistance, particularly for women in distress. It incorporates key features such as GPS tracking, a one-touch SOS button, direct police reporting, and a Gesture control-alert function, ensuring quick and efficient communication with emergency contacts and law enforcement . Unlike many existing safety applications, which can be complex or lack essential features, this system offers a user-friendly and highly responsive platform for improved personal security.

Moreover, it can operate without an internet connection, allowing users to instantly locate the nearest police station and send automated distress signals, making it a dependable and efficient emergency solution .

In addition to emergency alerts, the application functions as a preventive safety measure, discouraging potential threats while maintaining c

ontinuous communication between users and authorities. The integration of motion detection for violent movements enhances security by automatically triggering alerts and notifying emergency contacts when needed .

By overcoming the limitations of existing safety tools, this system provides individuals with greater confidence and a sense of security, ultimately contributing to a safer and more protected society .

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