

APSAS- Advanced Public Safety & Security System

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Abstract— Public safety has become a major issue for cities due to various situations such as accidents, robbery, harassment, fire, and medical emergencies that people may come across. In order to solve such issues, this paper discusses a public safety and security platform called APSAS (Advanced Public Safety and Security System). This application comprises multiple safety services into one single application including SOS alerts, live location tracking, emergency contacts, incident reporting, safety zones, suggested routes, and real-time notifications. APSAS is equipped with a centralized News & Safety Updates feature in which the user can find all safety alerts and important local updates. The location-based functions of the system are provided through GPS and map services while the operator/administrator dashboard is restricted to the management of incidents and safety-related information. The system is implemented using Flutter, Supabase, PostgreSQL/PostGIS, GPS, map services, and notification services. The performance of the system is analyzed in terms of delivery of SOS, reporting of incidents, location tracking, real-time notifications, and usability.

Keywords— Public Safety, APSAS, SOS Alert, GPS Tracking, Incident Reporting, Emergency Communication, Safety Zones, Real-Time Notifications, Nagpur.

1. Introduction

Public safety is a major concern in the modern urban settings in which people encounter various emergencies including accidents, robberies, harassment, fire, health emergencies, and missing person cases. In such

emergencies, it is possible to communicate easily with the proper authority or people by obtaining quick help and sharing accurate location information. APSAS is also built with a centralized News and Safety Updates module in which users can find verified safety alerts, local news, and advisories.

Today, people use various applications or manually communicate when making emergency calls, location sharing, incident reporting, and obtaining safety information. Utilizing various applications for the above mentioned purposes could make communication difficult and slow especially during emergencies.

There have been developments in mobile technologies, GPS, location services, and real-time communication which have opened doors for creating a more integrated system of public safety. Mobile applications will enable users to report any emergencies, share their current location with trusted contacts and submit incident information. Location services will enable users to know about verified nearby facilities and select their route using the available safety information.

A number of systems that cater to different safety requirements have already been designed, which include women's safety, emergency response services, crime reporting, and accidents detection [1]–[7]. ERSS (Emergency Response Support System) 112 in India provides a central emergency service for its citizens [8], [9]. Since safety applications can store personal, contact, and location related information, data security is another aspect that has to be considered [10].

In order to overcome these problems, this paper introduces APSAS (Advanced Public Safety and Security System), a location based public safety solution for Nagpur. APSAS integrates SOS messages, real time location tracking, emergency contact numbers, incident reporting, safety areas, route suggestions, and real time notifications under one application. The application is available in English, Hindi, and Marathi languages.

2. Literature Survey

Prior work on public safety has taken different directions. "Safety for HER" is a system which emphasizes SOS-based assistance, emergency contacts, live location updates and coordination during distress [1].

The mobile reporting system developed in [2] emphasizes digital reporting, location services, real-time communications and management of reported incidents.

The system proposed in [3] brings together safe navigation with reporting of emergencies and location assistance and primarily aims to promote safety of women.

Some studies have focused on accident detection and emergency alerts using IoT technologies [4], [5], whereas [6] and [7] have examined technology based solutions for accident-related accessibility and safety.

ERSS-112 is a system implemented in India which offers emergency responses to citizens [8], [9]. The official description of ERSS states 112 as a unified emergency number and includes options like calls, SMS, panic alert and 112 India app.

These pieces of prior work illustrate that the individual safety needs can be catered to quite efficiently with the help of mobile, location and communication technologies. APSAS extends this idea by combining various citizen safety functions in a single platform for Nagpur.

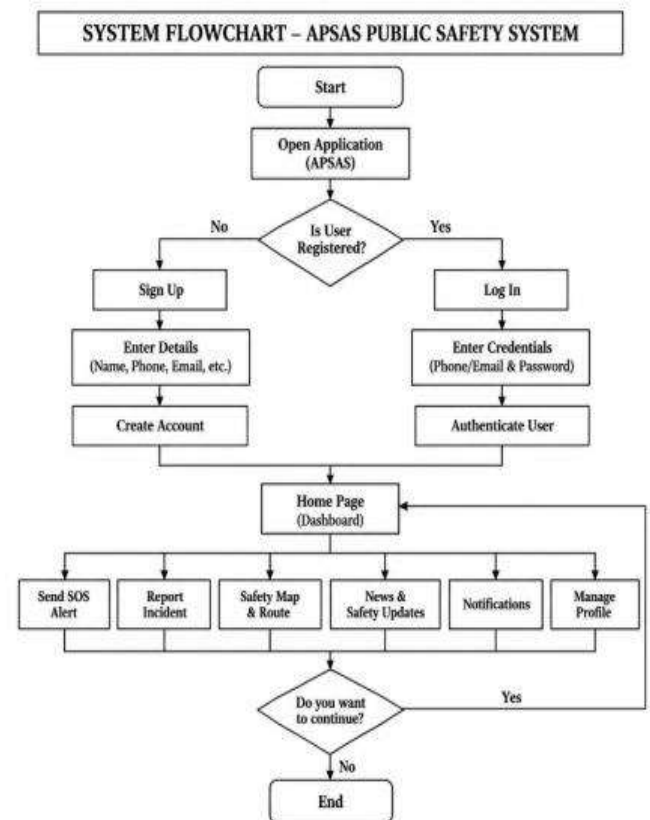
3. Problem Statement

The citizen would require several services while handling the safety-related scenario, which include emergency communication, location communication, incident reporting, and safety information. It would become inconvenient for the citizen to handle all these tasks using several applications. There is also a need for providing safety information in an organized manner while ensuring

that no unnecessary information regarding location and individual is exposed.

APSAS would solve these problems by using a common platform for handling emergency communication, location-based services, incident reporting, safety information, and route assistance. This system is developed for the citizens of Nagpur city and also includes the restricted access for the authorized operators.

4. Proposed System Architecture



However, each component of the APSAS architecture will be designed in distinct modules to allow for the cooperation of the different safety services in an effective and efficient manner. They include the frontend application, the backend services, database, location and map services, notification services and an Operator/Admin restricted dashboard.

a. Frontend Module

The frontend module offers an easy-to-use interface where citizens can access different APSAS safety features. Users can request emergency alerts, share location with their contacts, report an incident, check safety maps, get route suggestions and access safety-related information updates.

b. Application Server

The backend server is created using Supabase and is responsible for the core operations of the system. This

will include user authentication, user requests, SOS alerts, incident reports and notifications as well as communication with other services. Access control will be used to protect the user information.

c. Database Module

This module contains the application data stored using PostgreSQL along with PostGIS. This includes the data like user profiles, trustworthy contacts, SOS events, reports about incidents, safety zones, locations, notifications, and more. PostGIS facilitates the use of location-based functionalities

d. Location & Notification Services

The GPS service is used to determine the user's current location and facilitate location tracking in real-time. Services like Maps and Routing are used to provide the safety map and route recommendations. The Push Notification service like FCM/APNs is used to notify the recipients regarding any SOS alerts and other safety notifications.

e. System Integration

The limited Operator/Administrator dashboard is available for reviewing incidents' reports, safety information management, and tracking authorized system activities. The access to the administrative functionalities is controlled among the authorized users to ensure the security of the system.

5. System Design and Methodology

This study focuses on the stages associated with the development and evaluation of the public safety platform referred to as APSAS. Such stages include the following processes: user registration and authentication; emergencycommunication; location processing; incident reporting; safety information management; and testing of the system.

a. User Authentication and Profile Management

First, the user creates an APSAS account and fills in the necessary profile data. The user can manage personal data, emergency contacts, languages, and permissions.

The stage of authentication assists in restricting protected services to authorized users only.

b. SOS and Emergency Communication

Using the SOS feature of the application, the user can issue an emergency signal requiring the provision of help. After the SOS activation, the system receives the GPS location of the user and registers the SOS message. The user has an opportunity to contact his/her selected emergency contacts and to contact the 112 emergency service. The state of notification is registered within the system, while the function of notification retry can be implemented in case of temporary lack of the network connection

c. Incident Reporting

APSAS provides a facility for the citizens to report various kinds of safety incidents which may occur in their neighborhoods. Such incidents may be related to accidents, robbery, harassment, fires, suspicious activities, missing people, and infrastructural problems. One can provide information regarding the incidents along with its location and any photo or video evidence. This information can then be verified by authorized operators before it can be made public.

d. Location-Based Services and System Improvement

The use of GPS and maps is done for the location-based services offered in APSAS. Verified safety facilities, safety zones, and reported incidents can be displayed by APSAS. Routes that are safe for travel can also be suggested using the information available on safety. It is important to note that the routes suggested by the system are not guaranteed to be completely safe.

e. News and Safety Updates

APSAS has an exclusive section that contains safety-related news and updates. There are alerts regarding any issues from the authorities as well as verified safety news and any local updates. Depending upon the kind of update, information Like

its source, date and time of update, verification, and expiry is provided.

6. Implementation

a. Technology Stack

The APSAS app employs mobile, backend, database, and location technology to provide safety features. The mobile application is built using the technologies of Flutter and Dart, making it run on multiple platforms. Supabase is used to authenticate users, perform backend functions, facilitate real-time communication, and store data.

b. Data Management and Safety Information

Structured data is kept for various sections of the system including user details, emergency contact information, SOS alerts, incident reports, safety zones, and safety alerts. Details such as the type of incident, location, time, report status, and notification are kept in the database. Structuring the information in a particular way helps in the management and easy access to the data needed by the application.

c. SOS and Incident Module Implementation

Users are allowed to send an SOS alert and notify their trusted contacts of the same as well as sharing their current locations. Once the SOS alert is sent, the system records the event and manages the notifications of the event. Users have the ability to report any accidents, robberies, harassment, fires, missing persons, or other safety incidents.

d. News and Safety Updates Implementation

The News and Safety Updates feature gathers all the necessary safety information in one place. This feature can show any official warnings, APSAS-verified alerts, licensed partners' news and moderated community updates. The information about the author, time, location, validity, and expiration date may be included with the update and help users estimate the value of the information provided.

e. Security and System Reliability

The issues related to security and reliability are seen as crucial for APSAS. The authentication and authorization help to limit the access to the protected features to the authorized users. The users' and locations' information is stored securely and the input validation and error handling minimize the risks associated with invalid input

and system errors. The system allows to store events locally in case of lack of network connectivity and synchronize them after reconnection.

7. Results and Discussion

1. Results

The proposed APSAS system was developed and tested in order to examine the major safety functions of the system. Testing was done using various user interaction models like authentication, SOS alerts, incidents, location-based services, notifications, and safety update.

CITIZEN DASHBOARD:-

1. Login & Registration

The APSAS framework is equipped with an authentication module that allows citizens to log in and register on the platform. New users have the option to sign up on the system by filling in all the necessary information for authentication, whereas existing users can log in to the system by entering their log in details. The module ensures that the users authenticate themselves prior to gaining access to the safety services provided via the Citizen Dashboard.

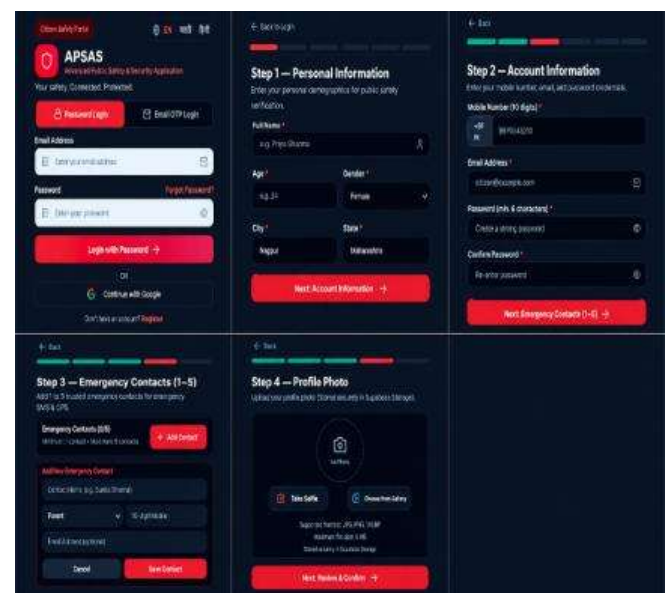


Fig. 1. Login and registration interface

2. Home Dashboard

The citizen dashboard acts as the primary portal for accessing all the significant safety services available in APSAS.



Fig. 2. Home Dashboard interface

a. Track Me

The Track Me module enables the user to track and share their location details. The location details are required by other safety features like emergency alerts and routing assistance.

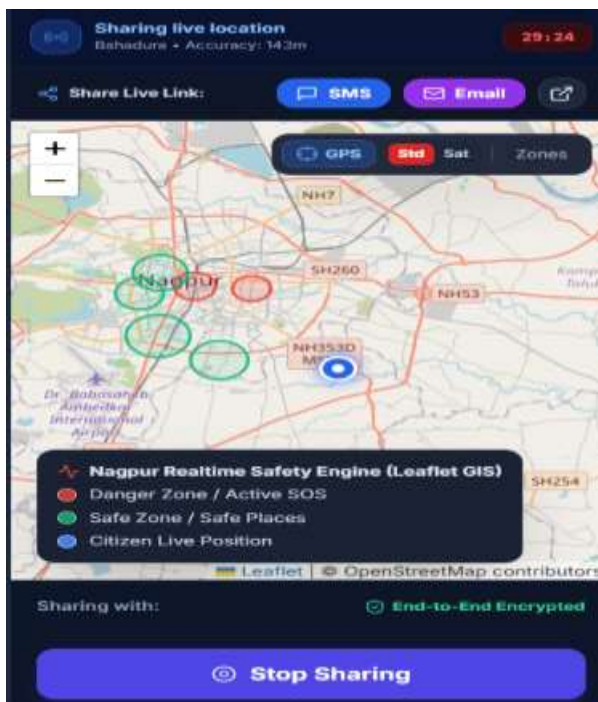


Fig. 2.1 Track Me interface

b. My Contacts

The My Contacts module helps citizens to maintain a list of emergency contacts. The emergency contacts will be used in the event of an SOS alert being raised.

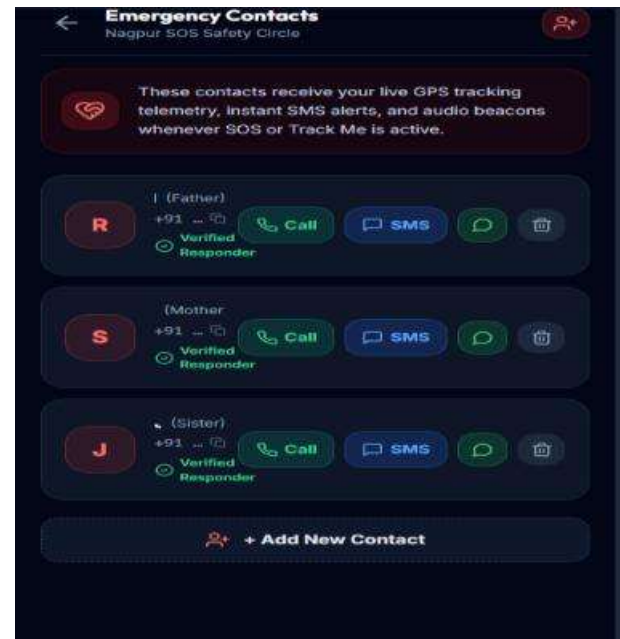


Fig. 2.2 My Contact interface

c. Safe Route

The Safe Route module suggests routes for the citizen based on their current location and other safety information. The module intends to help citizens in choosing safer routes when travelling.



Fig. 2.3 Safe Route interface

d. Report Incident

The Report Incident module enables citizens to report safety incidents. Citizens can include any safety related

incident details like type of incident, description of the incident, location of the incident, and media if any.

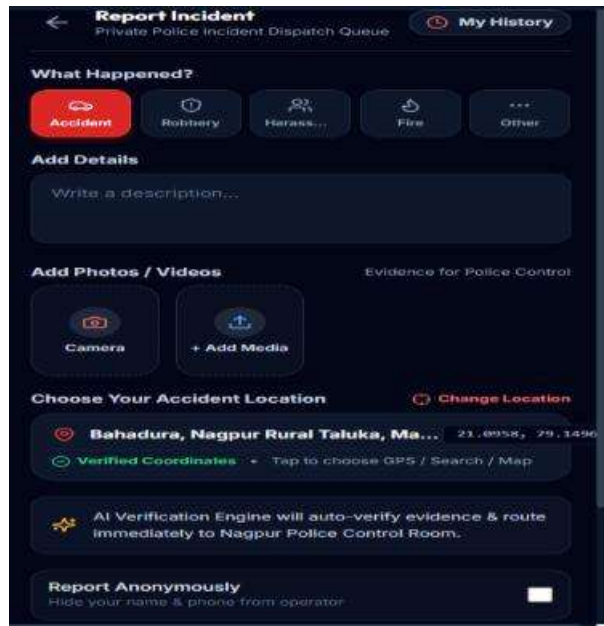


Fig. 2.4 Report Incident interface

3. SOS Alert and Emergency Communication

The SOS Alert module helps citizens in raising emergency alerts. In case of an SOS alert, the location of the user and their emergency contacts can help in facilitating emergency communication.

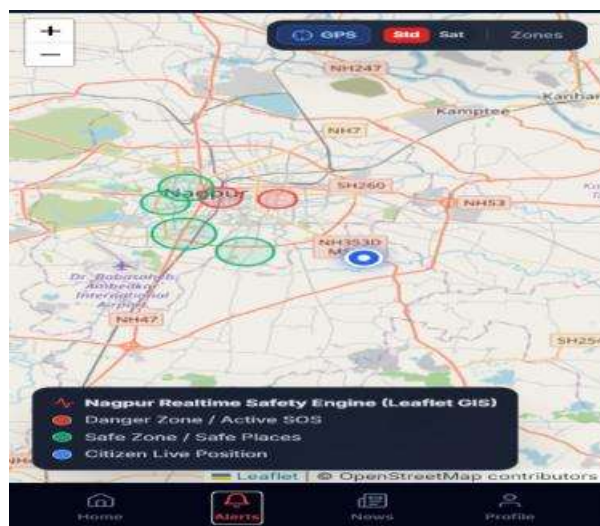


Fig. 3. SOS Alert and Emergency Communication Interface

4. News and Safety Updates

News and Safety Updates module gives safety related news to the citizens. It can show any important alerts, advisories, local safety updates, etc. This module keeps

users updated about any safety related condition and updates.

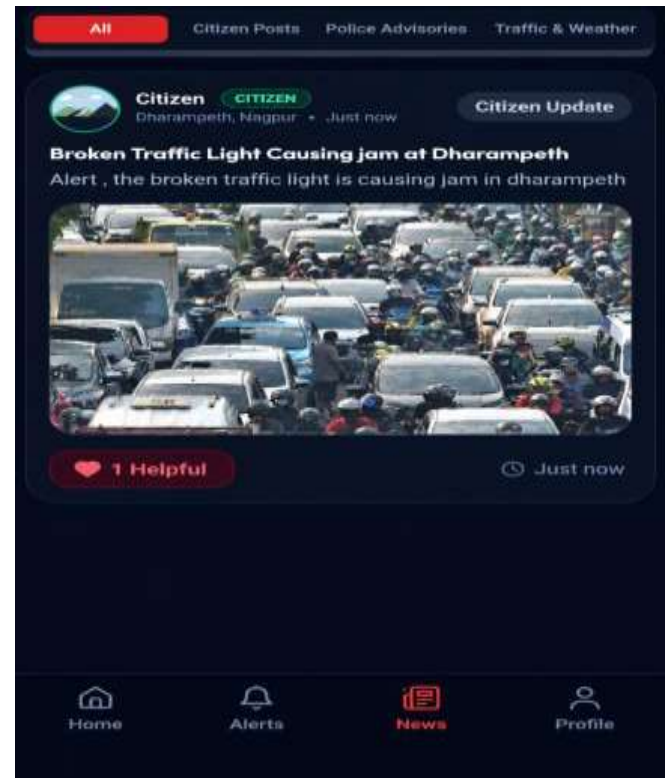


Fig. 4. News and Safety Updates interface

5. Profile

The Profile section provides users with an option to view and modify their own profile. Profile holds all the information needed by the system for identifying, communicating and personalizing APSAS services for them.

This section is also useful to keep user related information in one place.

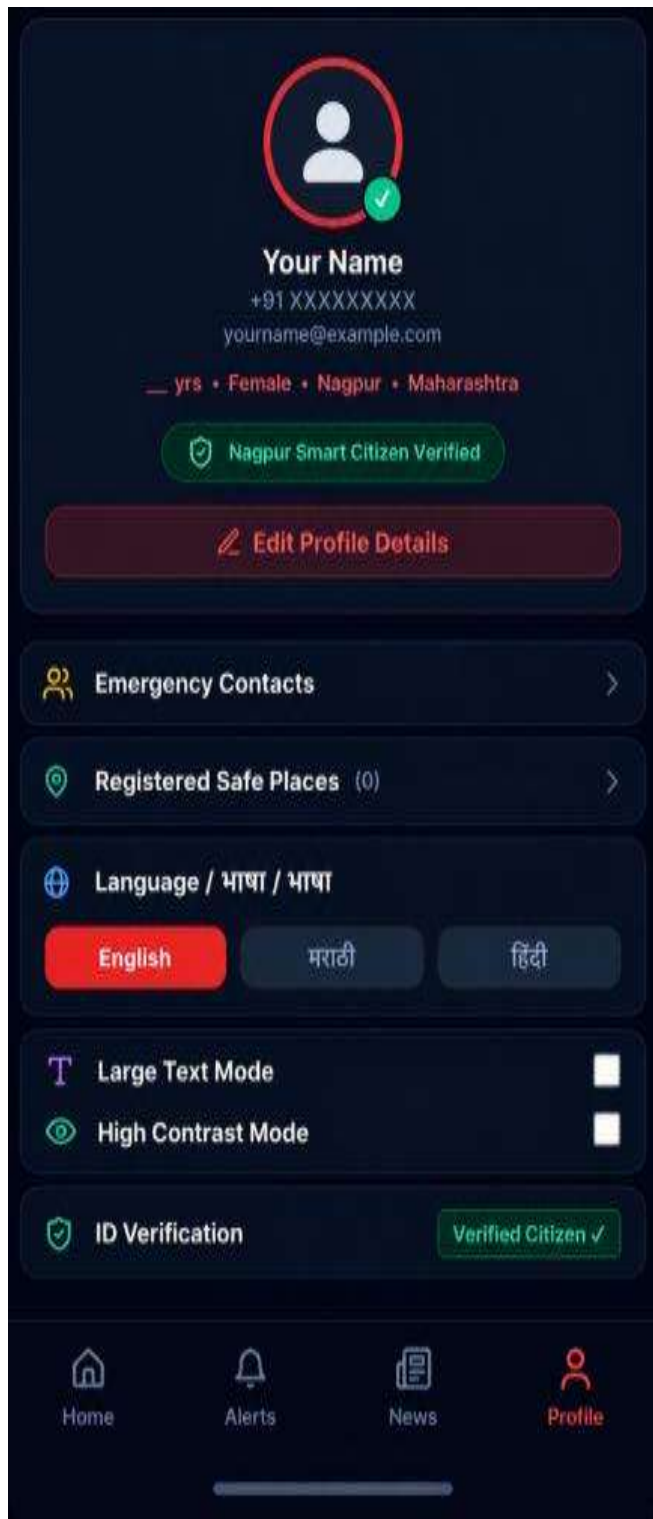


Fig. 5. Citizen Profile Interface

OPERATOR DASHBOARD:-

1. Operator Login

The Operator Login provides restricted access to the APSAS to its authorized operators only. This authentication process makes sure that only permitted users are able to access administrative functions of APSAS.

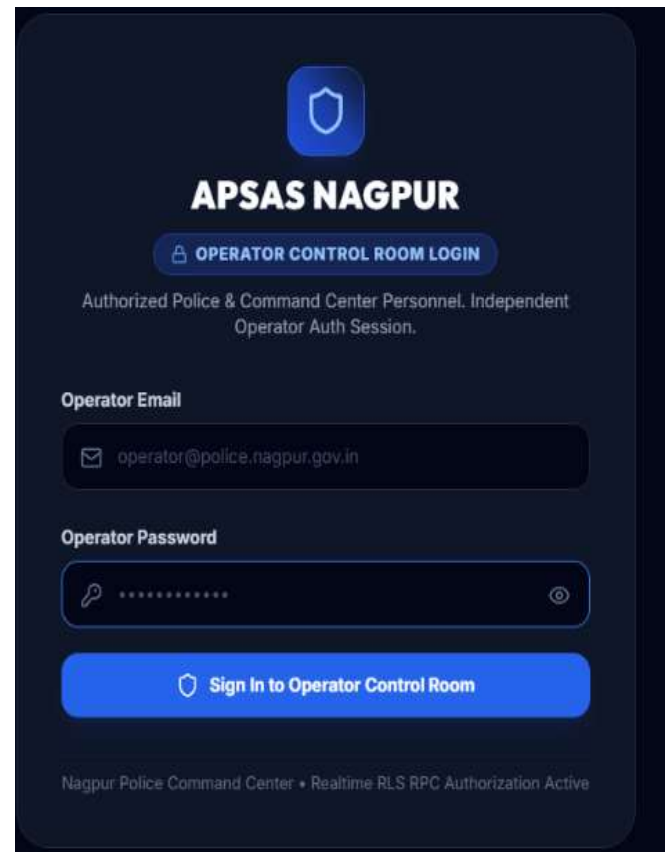


Fig. 6. Operator Login Interface

2. Command Centre

Command Centre provides the overall picture of the APSAS system to users. It shows verified citizen accounts, their SOS status, incidents reports, solved cases, latest safety reports and Nagpur safety map for monitoring the ongoing activities.



Fig. 7. Operator Command Centre

3. Live SOS Workspace

Live SOS Workspace allows the authorized operators to monitor the ongoing SOS activity in real time. It provides location information through the safety map and their current emergency status..



Fig. 8. Live SOS Workspace

4. Incident Management

Incident Management module enables operators to access and manage citizen incident reports submitted by them. Reports can be sorted based on various parameters including the status of the report, the category, location, etc.

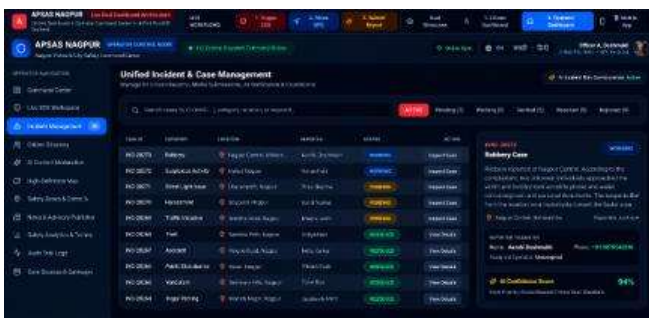


Fig. 9. Operator Incident Management Interface

5. Citizen Directory

Citizen Directory allows authorized operators to access citizen profile information that is registered in the system. Citizen directory contains all relevant information related to the citizen, including citizen information, contacts, location, and account status.

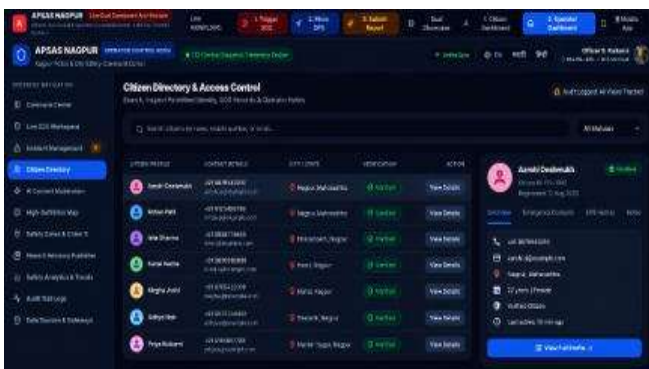


Fig. 10. Operator Citizen Directory

6. Safety Zones and Crime Analysis

Safety Zones and Crime Analysis module gives a map-based view of safety zones and information related to

crimes. Interface shows different zones with varying degrees of risk and crime density, along with the danger time and surveillance information and safety recommendations.



Fig. 11. Safety Zones and Crime Analysis Interface

7. News and Advisory Publisher

News and Advisory Publisher allows operators to monitor citizen-posted news and manage safety information. Module helps in monitoring citizen posts and identifying any risk of misinformation. Official safety notices can also be published through this module.

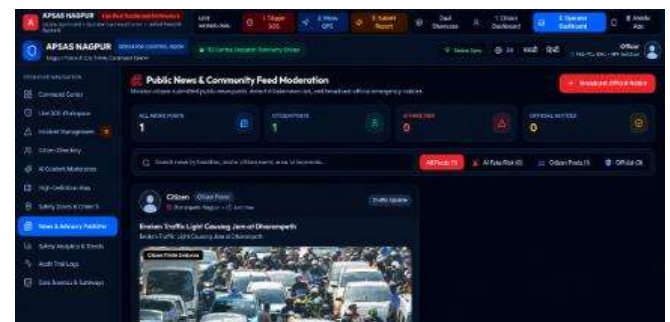


Fig. 12. Operator News and Advisory Publisher

8. Audit Trail

Audit Trail keeps track of the activities carried out by operators in the system. Information kept in this module includes operator action, timestamp, targeted entity, and the activity carried out by the operator.

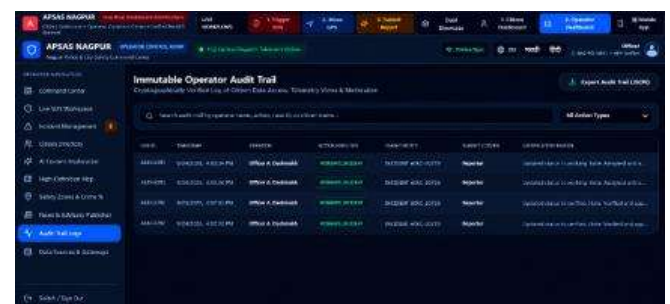


Fig. 13. Operator Audit Trail Interface

7. Discussion

From the results, it is evident that the APSAS incorporates various safety features into one platform. Safety features like the SOS alert, safety map, incident reporting, news, and notifications can facilitate communication and access to safety services by the users.

This consolidation of safety services in one platform eliminates the need for switching to different platforms based on the safety needs of the user. The GPS technology and real time communication facilitate location-based services and the delivery of emergency notification to trusted contacts.

The performance of APSAS can be influenced by the availability of network, accuracy of the GPS, user involvement, and safety information among others. Evaluation and improvement of this system requires further testing involving more users and integration with emergency services.

8. Conclusion

It can be observed from the implementation of APSAS that how multiple safety services can be integrated into a single application. The application includes various features like SOS, real-time sharing of location, emergency contacts, incident reports, safety details, and routing information that help citizens in various safety conditions.

In this way, APSAS provides a common platform for citizens for both emergency communication as well as safety information. English, Hindi, and Marathi languages' support in the application also adds ease to the users.

APSAS is a good foundation for a public safety platform intended for Nagpur. In the coming days, the platform can be enhanced by integrating it with the verified emergency services along with various other safety features.

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