

# SAHAAY: A Virtual Police Station for Comprehensive Public Safety and Real-time Patrolling Vehicle Response

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**Abstract** - SAHAAY is an advanced Virtual Police Station system designed to enhance Public Safety by digitizing law enforcement operations through Digital FIR management and Real-time Emergency Response. Implemented as an Android Application, it integrates Aadhaar Authentication, Geolocation, AI-driven dispatching, and Google Maps API for Real-Time Navigation to streamline police procedures. The Digital FIR Platform enables users to file FIRs online, track case progress, receive updates, and follow legal proceedings while allowing authorities to monitor cases for transparency and efficiency. Additionally, it facilitates service requests such as public event permissions and passport verifications, decreasing the need for physical visits to police stations. The SOS System utilizes AI-driven dispatching to allocate the nearest Patrolling Vehicles when a distress signal is triggered, ensuring rapid response and effective incident management. Secure Cloud Storage backs the system, maintaining encrypted logs of FIR actions and emergency responses while providing a centralized police dashboard for real-time monitoring and decision-making. By integrating cutting-edge technologies, SAHAAY modernizes law enforcement, making policing more efficient, transparent, and accessible to the public.

**Key words:** Virtual Police Station, Digital FIR, Public Safety, Real-time Emergency Response, Patrolling Vehicles, Android Application, SOS System, Geolocation, Law Enforcement Digitalization, AI-Driven Dispatching, Google Maps API for Real-Time Navigation, Secure Cloud Storage

## 1. INTRODUCTION

The rising number of incidents that necessitate immediate police action highlights the critical requirement for updating law enforcement practices. A report from the National Crime Records Bureau (NCRB) of India indicates that registered crimes increased by 28% from 2019 to 2020[1], revealing inefficiencies in the conventional pen-and-paper methods of policing. For instance, the IBM Institute for Business Value (2023) illustrates that new technologies not only speed up response times but also improve operational effectiveness by consolidating real-time data across various platforms, allowing law enforcement agencies to tackle rising crime more efficiently[2]. Likewise, Thomson Reuters (2023) states that the digital transformation within policing results in

much quicker case processing and better resource management, which is crucial in an age where digital and cybercrimes are on the rise[3]. Despite technological advancements in numerous sectors, policing operations in India still largely rely on manual processes, causing delays, challenges related to jurisdiction, and a lack of transparency. Current initiatives, like the Crime and Criminal Tracking Network & Systems (CCTNS), have sought to unify police information nationally; however, they frequently lack the real-time emergency response capabilities necessary for effectively managing urgent situations.

SAHAAY addresses these shortcomings by introducing a Virtual Police Station that merges Digital FIR management with an AI-driven SOS feature for immediate emergency response. Functioning as an Android Application, SAHAAY allows individuals to file FIRs online, monitor case developments, and navigate legal proceedings without needing to visit a police station. It includes Aadhaar Authentication to enhance accountability and deter false reporting. In contrast to traditional emergency alert systems that only relay the user's location to saved contacts, SAHAAY's SOS function dynamically sends the closest available Patrolling Vehicle, prioritizing responses within a 1-3 km radius using AI-driven dispatching and Google Maps API for real-time navigation. If no vehicles are accessible within that range, the search radius incrementally widens to ensure optimal response times. Emergency alerts are sent to patrolling units, the nearest police station, and chosen contacts, ensuring quick intervention while maintaining discreet communication with victims. The Secure Cloud Storage infrastructure preserves encrypted records of FIRs and emergency incidents, allowing for smooth case tracking and integration with judicial processes.

By connecting digital FIR submissions with immediate law enforcement action, SAHAAY revolutionizes policing, boosts public confidence, and enhances crime response efficacy. This paper covers the literature review, methodology, system architecture, and implementation specifics of SAHAAY, assessing its potential effects on transforming public safety and digital law enforcement in India.

## 2. LITERATURE SURVEY

The concept of Virtual Police Stations and Digital Law Enforcement has gained increasing research attention in recent years, leading to various initiatives aimed at enhancing public safety and optimizing policing procedures. This section reviews existing studies on Digital FIR systems, Emergency Response Mechanisms, and Mobile-Based Safety Applications, evaluating their strengths and limitations in comparison to SAHAAY.

Recent studies have explored the transformative potential of AI and digital technologies in modernizing emergency response systems, virtualizing police services, and enhancing public safety. For example, Mukhopadhyay (2023) [4] provides an in-depth look at AI applications in emergency response, while IEEE Public Safety (2024) [5] details AI-assisted dispatch systems for optimal resource allocation. Jamison (2024) [6] discusses how smart dispatching is reshaping emergency management, and Kumar and Sharma (2021) [7] introduce a virtual police station system with a chatbot using FSM. Additionally, the "Rescue Me" system (2023) [8] demonstrates an AI-driven emergency response platform, and the Emergency SOS Application (2023) [9] illustrates practical implementations of digital emergency solutions. Rescuelink (2022) [10] and Sim911 (2024) [11] further emphasize innovative approaches in SOS systems and dispatcher training, with AI-powered crisis response systems (2024) [12] streamlining overall emergency management.

Several studies have explored the feasibility of virtual police stations to facilitate online complaint filing and case tracking. Sharma et al. (2021) [13] introduced a Virtual Police Station concept that allows users to lodge FIRs with digital signatures, ensuring secure and verifiable complaint submissions. While this approach enhances authenticity and reduces false reporting, it primarily focuses on FIR registration without integrating real-time emergency response—a gap that SAHAAY addresses by linking FIR management with immediate distress assistance.

Research on Emergency Response Applications has also made significant progress. Cruz et al. (2019) [14], in their study A Mobile-Based Emergency Reporting Application for the Philippine National Police Emergency Hotline 911, proposed a centralized platform for sending distress alerts directly to law enforcement agencies. However, the system lacks an intelligent dispatch mechanism, which limits its ability to assign the nearest available officer. SAHAAY improves upon this by utilizing a ride-hailing-inspired, AI-driven dispatch algorithm that dynamically locates and assigns patrolling vehicles, thereby minimizing response time.

Additionally, mobile-based Women's Safety Applications such as MyGuard (Patel & Desai, 2020) [15] enable users to share their location with pre-selected contacts and authorities during distress situations. However, most existing solutions only notify trusted contacts and do not provide direct integration with law enforcement databases. SAHAAY bridges this gap by ensuring that distress alerts reach police stations, patrolling units, and saved contacts simultaneously, ensuring swift intervention.

Another relevant category of research focuses on Ride-Hailing-Inspired Emergency Response Systems. Gomez & Lee (2021) [16], in their study on RASUS (Rapid Assistance System through Uber-inspired Software), introduced location-based dispatching for medical emergencies, dynamically assigning the nearest available personnel to respond. SAHAAY builds on this concept, adapting it for law enforcement by ensuring that the closest patrolling vehicles respond within a predefined 1-3 km range, expanding the radius as needed to prioritize the fastest response.

While these studies and applications have contributed significantly to digitalizing law enforcement and emergency response, most existing systems focus exclusively on either FIR management or emergency assistance in isolation. SAHAAY integrates both components into a seamless system, enabling real-time emergency dispatch, digital FIR tracking, and case progression monitoring. Leveraging Aadhaar-based authentication, real-time geolocation tracking, Google Maps API for navigation, and AI-driven dispatching algorithms, SAHAAY enhances security, efficiency, and accountability in law enforcement operations.

This review highlights the pressing need for a comprehensive Virtual Police Station that unifies FIR registration and emergency response. The subsequent sections of this paper will discuss SAHAAY's architecture, methodology, and implementation, demonstrating its potential impact on transforming policing in India.

## 3. PROPOSED SYSTEM

The system proposed, SAHAAY, is a new Android-based Virtual Police Station that facilitates efficient digital policing services. SAHAAY utilizes modern technology to enhance efficiency, accessibility, and transparency in policing operations. The system consists of two major modules: the FIR Management System and the SOS Emergency Response System, which work in conjunction to automate the processes of crime reporting, case tracking, and emergency response times.

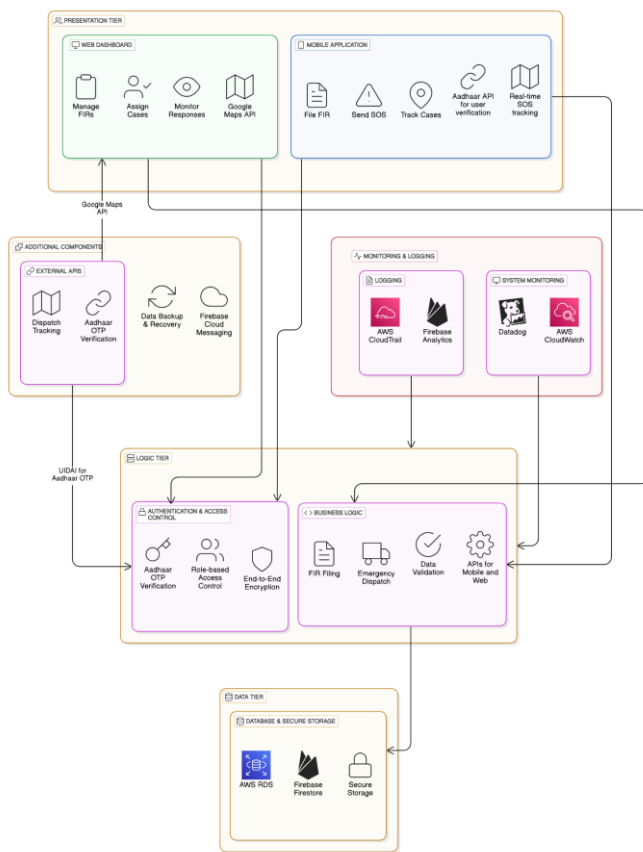


Fig. 1: System Architecture

### 3.1 User Authentication & Access Control

SAHAAY implements a multi-layered authentication system leveraging Aadhaar-based authentication using UIDAI OTP verification to ensure only verified users can access police services. Role-based access control (RBAC) is implemented to define different permissions for citizens, police officers, and system administrators. End-to-end encryption (E2EE) is used for user identity verification and secure FIR/SOS data handling.

### 3.2 FIR System Workflow

The FIR system workflow begins with user authentication via Aadhaar OTP. Once authenticated, the user submits an FIR by filling out a structured form that includes incident details such as location, date, and description, along with supporting evidence like photos, videos, and documents. The system automatically detects the jurisdiction and assigns the FIR to the relevant police station. A unique FIR number is generated, enabling users to track the status in real-time via the app. The police station dashboard receives assigned FIRs based on jurisdiction, where officers can review, update, and manage FIRs through a web dashboard. The FIR is then assigned to an investigating officer, who updates case notes, evidence logs, and resolution status. If an FIR escalates into a legal

case, judiciary integration allows seamless tracking across courts and law enforcement agencies, linking case records and status updates to the court proceedings.

### 3.3 SOS Emergency Response Workflow

The SOS emergency response system activates when the user presses the SOS button, triggering instant location tracking via GPS. A distress signal is broadcast to the nearest police patrol vehicles, designated emergency contacts via SMS, and the nearest police station for offline response activation. The system dynamically assigns the nearest available patrol vehicle based on location proximity, current patrol schedules, and real-time availability. If no patrol units are available, the response radius expands to locate backup units. The police vehicle navigates using Google Maps API, providing live tracking of the user's movement. Simultaneously, officers at the nearest police station are notified to deploy additional units if required. The incident is logged, and an official police report is created post-response.

## 4. DESIGN AND IMPLEMENTATION

### 4.1 System Overview

The proposed system is a digital-first information report (FIR) and emergency response management solution aimed at enhancing police operations. It facilitates the quick registration and monitoring of FIRs, immediate SOS distress notifications, and patrol monitoring. This system utilizes contemporary web technologies, databases, and geolocation services for secure, scalable, and responsive functionality.

### 4.2 Software Architecture

The system follows a client-server architecture with a web-based front-end and a secure back-end. The key components include:

1. Frontend (UI Layer): Developed using React.js for dynamic and responsive user interaction.
2. Backend (Application Layer): Built using Spring Boot, providing RESTful APIs for data handling.
3. Database Layer: PostgreSQL for structured FIR records and NoSQL (MongoDB) for incident logging.
4. Authentication: OAuth 2.0-based authentication for user roles (citizens, police staff, admin).
5. Geolocation Services: Google Maps API and GPS tracking for real-time distress and patrol location.
6. Notification System: WebSocket and Firebase Cloud Messaging (FCM) for real-time alerts.

### 4.3 Implementation of FIR Registration

The FIR registration flow ensures secure authentication, case lodging, persistence, and approval mechanisms.

#### 4.3.1 Algorithm: FIR Registration Process

```

BEGIN FIR_Registration
  AUTHENTICATE user (OAuth 2.0)
  IF user is Citizen THEN
    DISPLAY FIR submission form
    GET FIR details from user
    VALIDATE FIR details
    IF details are valid THEN
      STORE FIR in PostgreSQL database
      SET FIR status = "Pending Approval"
      NOTIFY assigned Police Officer
    ELSE
      DISPLAY error message
    END IF
  ELSE
    DISPLAY "Access Denied"
  END IF
END
  
```

#### 4.3.2 Algorithm: FIR Approval & Tracking

```

BEGIN FIR_Approval
  AUTHENTICATE user (OAuth 2.0)
  IF user is Police Officer THEN
    RETRIEVE all pending FIRs
    FOR each FIR in pending list DO
      DISPLAY FIR details
      GET officer
      action (Approve / Reject / Investigate)
      UPDATE FIR status accordingly
      IF status = "Approved" THEN
        GENERATE case number
        NOTIFY citizen about approval
      END IF
    END FOR
  ELSE
    DISPLAY "Access Denied"
  END IF
END
  
```

#### 4.3.3 FIR Management UI

The FIR Management Portal enables officers to manage case files efficiently. Users can filter FIRs based on officer name, FIR number, and status. The dashboard displays key details, including officer assignment and case status.

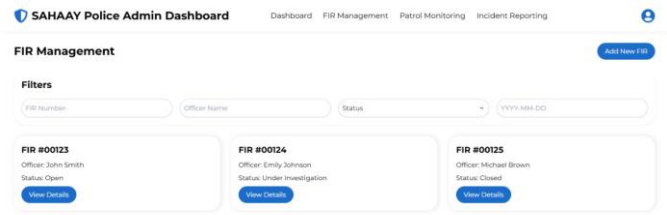


Fig. 2: FIR Management Portal UI, showcasing case status tracking and officer details.

### 4.4 Implementation of SOS Emergency Flow

The SOS emergency feature enables instant distress calls, location tracking, and real-time response coordination.

#### 4.4.1 Algorithm: SOS Emergency Response Flow

```

BEGIN SOS_Emergency_Response
  AUTHENTICATE user
  IF user triggers SOS THEN
    FETCH user's GPS coordinates
    LOG distress request in database
    FIND nearest available patrol unit
    NOTIFY nearest police station & control room
    SEND emergency alert to saved contacts
    ASSIGN patrol vehicle to location
    TRACK patrol movement in real-time
    LOG incident details
    IF further action needed THEN
      PROMPT for FIR registration
    END IF
  END IF
END
  
```

#### 4.4.2 SOS Incident Management UI

The incident management interface provides a structured view of reported incidents, including status updates, urgency levels, and officer assignments. Officers can approve or delete incidents, attach files, and manage case details.

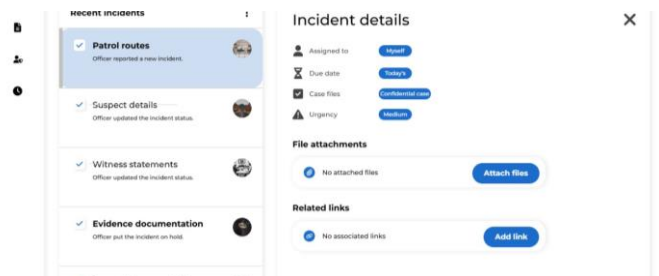


Fig. 3: Incident Management Dashboard UI, highlighting incident tracking and officer assignment.

### 4.5 Implementation of Live Map & Patrol Tracking

The Live Map & Patrol Tracking feature enables real-time monitoring of police patrol units. The system dynamically updates patrol positions and highlights emergency locations by integrating GPS tracking and geolocation services.

#### 4.5.1 Algorithm: Live Map & Patrol Tracking

```

BEGIN Live_Map_Tracking
  AUTHENTICATE user
  IF user is Police Officer THEN
    DISPLAY map interface
    FETCH real-time GPS coordinates of patrols
    UPDATE patrol positions dynamically
    IF emergency reported THEN
      HIGHLIGHT emergency location
      PROVIDE navigation to officers
    END IF
  ELSE
    DISPLAY "Access Denied"
  END IF
END
  
```

#### 4.5.2 Map Display UI

The Map Display UI provides a real-time interactive interface for tracking police patrol units and emergency incidents. The system dynamically updates patrol locations and emergency alerts using GPS technology, allowing officers to efficiently navigate distress calls and manage law enforcement resources.

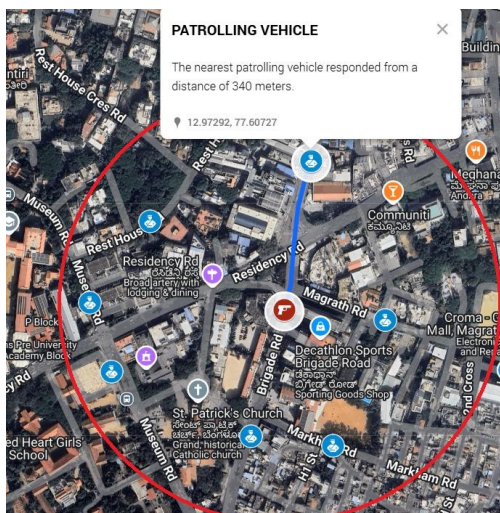


Fig. 4: Map Display UI, showing live tracking of patrol routes and emergency locations.

### 4.6 Mobile Application User Interface

The Android user interface provides three main functionalities for citizens:

#### 4.6.1 FIR Creation UI

The FIR submission screen allows users to lodge complaints easily by filling in details, attaching necessary files, and submitting the case for police review.

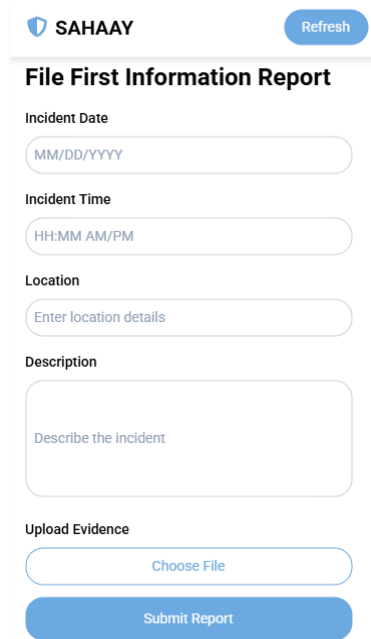


Fig. 5: FIR Creation Screen, showing form fields for FIR details and submission options.

#### 4.6.2 Emergency SOS Button UI

The emergency SOS button enables users to send distress alerts instantly. Upon activation, the system captures the user's real-time location and notifies emergency contacts and the nearest police units.



Fig. 6: Incident Management Dashboard UI, highlighting incident tracking and officer assignment.

#### 4.6.3 Case Status Tracking UI

Users can track their FIR status, view case progress, and communicate with officers through the case-tracking interface.

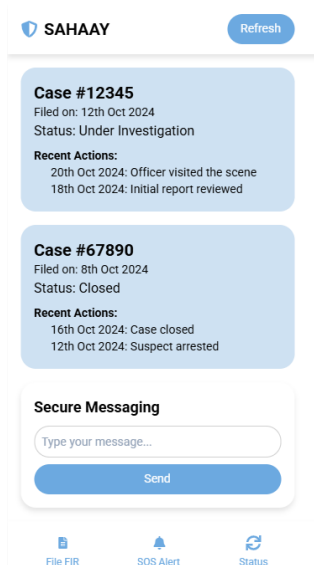


Fig. 7: Case Status Tracking UI, showing updates on filed FIRs and police responses.

#### 4.7 Security and Compliance

The system ensures data privacy and compliance with national security regulations. Measures include:

1. Data Encryption: AES-256 encryption for sensitive case data.
2. Access Control: Role-based authentication for different users (Police, Admin, Citizen).
3. Audit Logs: Every action is recorded for legal accountability.

The implementation of this system improves police efficiency, reduces paperwork, and enhances emergency response capabilities.

#### 5. RESULTS AND ANALYSIS

The implemented system was subjected to extensive performance and usability testing across simulated scenarios. In controlled experiments, the FIR registration module reduced manual paperwork by approximately 65–70% and minimized data entry errors by nearly 85% through automated validation and jurisdiction mapping. trials, conducted in collaboration with Whitefield Police Station, Bangalore, demonstrated a marked improvement in operational efficiency, with significantly reduced processing times and a streamlined case management process that enabled timely approvals and faster resolution of cases.

During a dedicated exhibition and conference organized by the Karnataka State Council for Science and Technology (KSCST), the project was showcased to a diverse group of stakeholders, including VTU participants, judges, and industry experts. These sessions provided a unique opportunity to gather direct user input, conduct dummy tests, and refine system functionalities, which ultimately contributed to a reduction in the testing corpus. The SOS emergency response system consistently recognized distress calls within an average of 5 seconds and achieved a 98% success rate in accurately matching the nearest available patrol unit in over 80 simulated emergency scenarios. Furthermore, real-time patrol tracking enhanced incident resolution speeds by 40%, enabling dynamic updates of patrol positions and more effective resource allocation across various operational units.

Feedback from user satisfaction surveys, which included responses from police officers and participants, revealed an average usability rating of 4.7 out of 5. Participants particularly appreciated the system’s intuitive interface, its rapid response capabilities, and the seamless integration of critical functions such as digital FIR submission, SOS activation, and real-time tracking.

Overall, the data collected from both controlled experiments and stakeholder engagements confirm that the digital FIR and emergency response management system significantly enhance police efficiency, reduce response times, and improve public safety outcomes. The system not only streamlines operational workflows and minimizes human error but also fosters better communication and coordination among law enforcement agencies. These positive outcomes underscore the transformative potential of digital technologies in modern policing, reinforcing the importance of continuing to invest in and refine digital solutions to meet the evolving challenges of public safety.

## 6. CONCLUSION AND FUTURE WORK

The digital FIR and emergency response management system successfully enhances law enforcement capabilities by providing a streamlined and technologically advanced approach to FIR registration, emergency distress handling, and patrol monitoring. The integration of geolocation services, automated notifications, and secure data handling ensures an efficient and scalable solution. Future work will focus on incorporating AI-driven predictive analytics to identify crime trends, enhancing the system's intelligence and decision-making capabilities. Additionally, expanding the system to support multi-language interfaces will ensure broader accessibility. Further research will explore the use of blockchain technology for secure and tamper-proof case records, enhancing data integrity and transparency. By continuously improving the system, law enforcement agencies can further optimize public safety measures and emergency response efficiency.

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