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Smart Police Command & Control System

Prof. Shital Dhandade ^a, Gaurav Waghmare ^b, Kartikey Kolhe ^c, Khushi Bonde ^d, Aditi Chourawar ^e

^{a-e} Department of Computer Science and Engineering (Data Science), Suryodaya College of Engineering and Technology, Near Dighori Naka, Vihirgaon, Umrer Road, Nagpur, Maharashtra, 441204, India.

Shitalraut08@gmail.com^a; gauravwaghmare95032@gmail.com^b; kolhekartikay205@gmail.com^c; khushibonde61@gmail.com^d; aditichourawar@gmail.com^e

ABSTRACT

Police departments handle emergency calls, complaints, investigations, officer deployment, and crime-related information on a daily basis. Managing these activities through separate processes can make it difficult to maintain timely information and coordinate responses. This paper presents a Smart Policing Command Platform developed to bring these operations together in a single digital system. The platform provides real-time SOS monitoring, complaint and FIR management, investigation tracking, crime hotspot analysis, AI-assisted investigation, and patrol planning. It also connects police stations, officers, and control-room personnel through web and mobile interfaces. Location services support emergency response and officer assignment, while AI-based modules provide investigation briefs, patrol recommendations, and daily safety intelligence. The system demonstrates how digital technologies can support police operations by providing a common platform for monitoring, coordination, and decision-making.

Keywords— Smart Policing, Police Command System, Crime Intelligence, Crime Hotspot Analysis, Patrol Planning, AI-Assisted Investigation.

1. Introduction:

Police departments deal with a wide range of activities such as emergency response, complaint registration, FIR processing, investigation, crime monitoring, and deployment of police personnel. As the amount of crime-related information increases, handling these activities through separate systems or manual processes can make it difficult to maintain updated information and coordinate responses effectively. Location-based technologies, crime data analysis, and digital communication have created opportunities for improving the way police operations are monitored and managed. Previous studies have explored crime hotspot detection, geographical crime analysis, data-driven policing, and patrol route planning to support police decision-making [1]–[7].

Real-time communication and mobile applications can further support the connection between citizens and police personnel. Crime reporting applications have been developed to simplify the reporting process, while research on dynamic police routing has examined how patrol deployment can be adjusted according to changing conditions [8], [9]. At the same time, the increasing use of predictive and data-driven technologies in policing also highlights the importance of appropriate legal safeguards and responsible use of automated recommendations [10].

To address these requirements, this paper presents a Smart Policing Command Platform designed as a common digital environment for police stations, officers, investigating personnel, and control-room operators. The platform combines emergency SOS monitoring, complaint and FIR management, investigation tracking, crime hotspot analysis, officer management, and patrol planning within one system. The emergency module uses location information to identify nearby police stations and available officers, while real-time communication allows incident status and response activities to be monitored.

The platform also includes intelligence-oriented features for analysing crime locations and supporting police planning. Crime hotspot information is presented through geographical maps, while AI-assisted modules can generate investigation briefs, patrol plans, and daily safety intelligence reports. These AI-generated results are intended to assist authorized police personnel rather than replace their judgment. The system is implemented using web and mobile technologies with a backend, database, real-time communication services, location and mapping services, and AI-based components.

The proposed platform is demonstrated using police stations and officer data for Nagpur, Maharashtra, providing a practical environment for examining how emergency response, case management, geographical crime analysis, and police deployment can be brought together in a single command-oriented system.

2. Literature Survey

The growing use of digital technologies in law enforcement has encouraged researchers to explore different ways of making police operations more efficient, responsive, and data-driven. Existing studies have examined crime hotspot identification, crime mapping, intelligent policing, police resource allocation, patrol planning, and mobile-based crime reporting. These studies provide important foundations for developing modern policing systems, while also showing that different technological approaches can support different stages of police operations.

Butt et al. [1] conducted a systematic review of methods used for spatio-temporal crime hotspot detection and prediction. Their study explains how the location and timing of criminal incidents can be analyzed to identify areas that may require increased police attention. This type of analysis can help police departments understand changing crime patterns and use available resources more effectively.

Hajela et al. [2] proposed a clustering-based method for identifying crime hotspots. Their approach demonstrates how clustering techniques can be used to group crime-related locations and identify areas with similar patterns. Such techniques can be useful in policing applications where crime information needs to be analyzed geographically before planning further police activities.

Hassan et al. [3] investigated the application of deep learning and social network analysis for smart city policing. Their work demonstrates the potential of combining data-driven techniques with policing activities to support more informed decision-making. It also indicates that intelligent policing can benefit from analyzing information from multiple sources instead of depending only on conventional policing methods.

Mir et al. [4] focused on police substation placement using a road-distance-based k-median model. The study considers the geographical relationship between police facilities and the areas they serve, showing how mathematical and data-driven methods can assist in making police infrastructure and resource allocation decisions. This is particularly relevant to location-aware policing systems where distance and accessibility influence emergency response.

Kim et al. [5] developed a hotspot-based patrol route optimization algorithm for smart policing. Their research connects crime hotspot information with patrol planning instead of treating these as two separate activities. By considering locations with higher crime concentration when planning patrol routes, the approach demonstrates how crime analysis can be translated into practical police deployment decisions.

Ahmad et al. [6] presented CHART, an intelligent system that combines crime hotspot detection with real-time tracking using machine learning. The study demonstrates the value of combining analytical information about crime locations with real-time location information. Such integration can support a more dynamic view of public safety situations and can be useful for systems that require continuous monitoring of incidents and police movement.

Agapito et al. [7] studied GIS-based crime density mapping using data analytics for Manila City. Their research demonstrates how geographical visualization can be used to represent the distribution and concentration of crime incidents. Mapping crime information in this manner can make spatial patterns easier to understand and can provide useful information for planning police activities in specific locations.

3. Problem Statement

Police departments handle a large amount of information every day, ranging from emergency calls and citizen complaints to FIRs, investigation records, evidence, suspects, and officer activities. These activities are closely related, but when they are managed through different processes, maintaining a continuous flow of information can become difficult. During an emergency, for example, the concerned authorities need to know not only where the incident has occurred but also which police station and officer can respond to it. At the same time, information generated during the incident may later become part of a formal complaint or investigation.

Another difficulty arises in maintaining and following the progress of criminal cases. A single case may involve a complaint, FIR registration, assigned investigator, suspects, evidence, case notes, and subsequent actions. If this information is not maintained in a connected manner, officers may have to depend on separate records to understand the current status of a case. This can make case follow-up and coordination between different police personnel more difficult.

Police deployment also requires information about where incidents are occurring and where officers are available. Areas experiencing repeated criminal activity may require increased attention, while emergency situations may require officers to be assigned according to their current location and availability. Managing these factors manually can make it difficult to respond consistently when several situations occur at the same time. The problem becomes broader when emergency response, case handling, officer coordination, and crime analysis are treated as separate activities. Information generated in one part of police operations may not be readily available in another part, limiting the ability of authorities to obtain a complete view of an incident.

The platform further supports real-time communication and location-based operations, allowing emergency information and officer availability to be handled together. Its case-management features maintain the relationship between complaints, FIRs, investigations, suspects, evidence, and case outcomes, while its intelligence features use crime-location information to support hotspot analysis and patrol planning. In this way, the proposed system addresses the need for a more connected approach to managing emergency situations, police cases, personnel, and crime-related information.

4. System Architecture

The proposed system follows a modular architecture that connects citizens, police officers, police stations, and control-room personnel through a common digital platform. The architecture supports emergency response, case management, crime intelligence, and police planning through connected web and mobile interfaces.

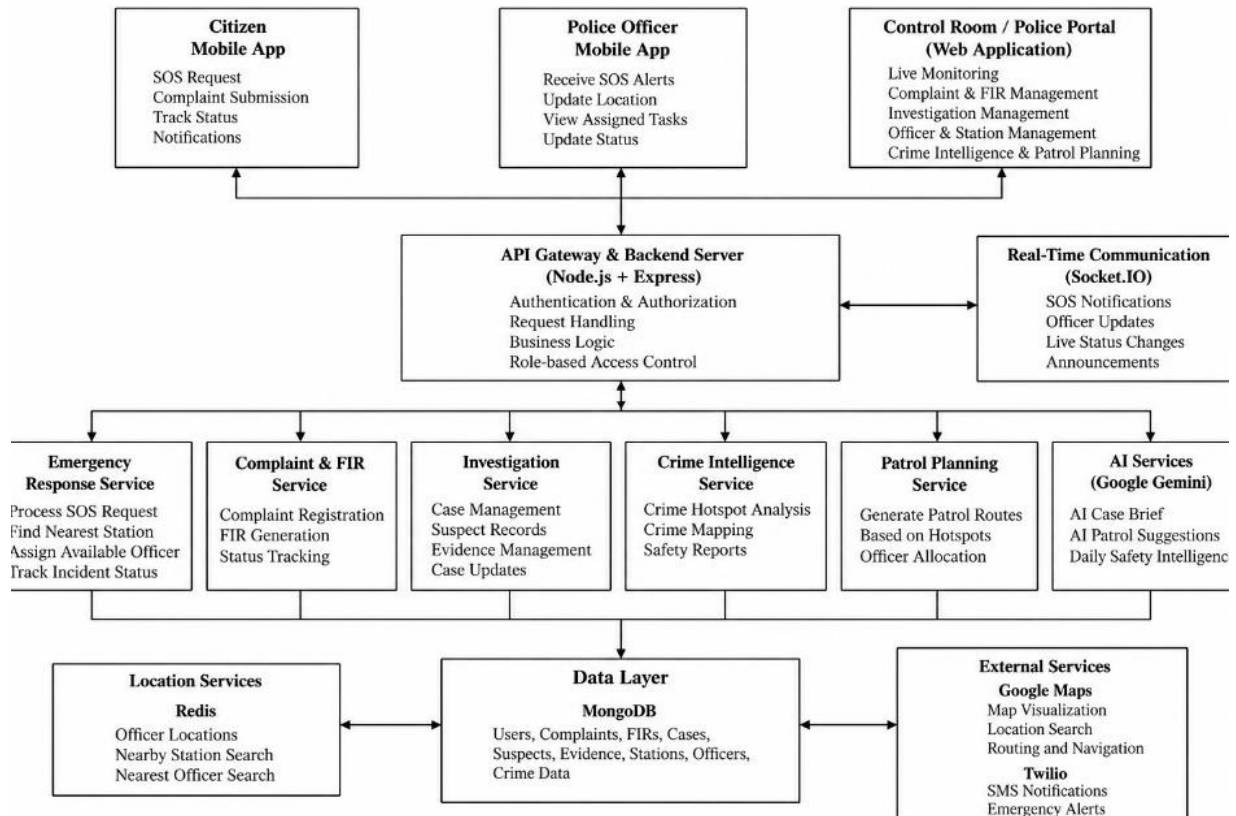


Fig 1. Flow Chart Diagram

A. Frontend Module

Provides citizen and police mobile applications along with a web-based control-room dashboard. It supports SOS alerts, complaints, FIRs, notifications, officer management, and crime monitoring.

B. Application Server:

Built using Node.js and Express, it manages authentication, user roles, complaints, FIRs, investigations, officer assignments, and other system operations.

C. Real-Time Communication Module:

Uses Socket.IO to deliver SOS alerts, officer status updates, notifications, announcements, and other changes in real time.

D. Intelligence and Location Module:

Handles GPS-based location services, nearby station and officer detection, crime hotspot analysis, AI-assisted investigation briefs, patrol planning, and daily safety intelligence.

E. Database and External Services:

MongoDB stores system records, while Redis supports location-based searches and RabbitMQ handles background tasks. Google Maps, Gemini, and Twilio provide mapping, AI assistance, and notification services.

5. System Design and Methodology

A. User Registration, Authentication, and Role-Based Access

Users register or log in through the appropriate application. JWT authentication and role-based access control ensure that citizens and authorized police personnel can access only their permitted functions.

B. Emergency SOS Detection and Officer Assignment

When a citizen activates SOS, the system receives the location and identifies a nearby police station and available officer using geographical search. The request is sent to the selected officer, with reassignment or escalation if it is not acknowledged on time.

C. SOS Tracking and Real-Time Communication

SOS incidents are tracked through stages such as ACTIVE, ACKNOWLEDGED, DISPATCHED, EN_ROUTE, ARRIVED, and RESOLVED. Socket.IO provides real-time updates, while officer GPS tracking and Twilio support live monitoring and alerts.

D. Complaint, FIR, and Investigation Management

Citizens can submit complaints with evidence, while police personnel can review, classify, assign, and convert them into FIRs when required. Suspects, evidence, officers, and case notes are connected through the Case Dossier.

E. Crime Analysis, AI Assistance, and Patrol Planning

Crime data is analysed to identify hotspots and their severity. The system uses this information with available officers to support patrol planning, while Gemini provides AI-assisted case briefs, investigation suggestions, patrol plans, and daily safety reports.

F. Data Management, Notifications, and Audit Processing

MongoDB stores users, cases, FIRs, evidence, officers, stations, and crime records. RabbitMQ handles background tasks, Socket.IO manages live updates, and the audit system records important activities performed on the platform.

6. Conclusion

The proposed Smart Policing Command Platform brings emergency SOS response, complaint and FIR management, investigation tracking, crime hotspot analysis, and patrol planning into a single system. The platform helps connect citizens, police officers, stations, and control-room personnel through real-time information and location-based services. AI-assisted features further support investigation and police planning while keeping final decisions with authorized personnel. Overall, the developed prototype demonstrates the potential of a unified digital platform to support faster coordination and more organized police operations.

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