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Design and Implementation of an Integrated Online FIR and Community Service Register Management Application

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Abstract

Timely and transparent registration of criminal complaints is pivotal to the rule of law. Yet in India and many developing jurisdictions, manual, station-centric processes for lodging a First Information Report (FIR) or obtaining a Community Service Register (CSR) receipt continue to create bottlenecks, subjective gate-keeping and opportunities for corruption. This paper presents the architecture, prototype implementation and evaluation of an **Integrated Online FIR & CSR Management Application (IFC-MA)** that unifies citizen self-service, police workflow and analytics on a single secure cloud platform. A mixed-methods pilot across two districts demonstrates a 62 % reduction in average FIR registration time and a 41 % increase in CSR issuance for non-cognisable offences, while maintaining evidentiary integrity and regulatory compliance. The findings indicate that IFC-MA can serve as a modular plug-in to the national Crime and Criminal Tracking Network & Systems (CCTNS) and accelerate the Government of India's Digital Police vision.

Keywords: Online FIR, Community Service Register, CCTNS, e-Governance, Crime Reporting, Data Analytics, Citizen Service Delivery

1. Introduction

1.1 Background

A First Information Report (FIR) is the foundational document that sets the criminal justice process in motion for cognisable offences, whereas a Community Service Register (CSR) entry provides proof of complaint for non-cognisable matters or lost-property declarations [4]. Despite statutory mandates contained in the Bharatiya Nyaya Sanhita (BNS) 2023 and recent state-level rules such as the Delhi BNSS (FIR) Rules 2025 [3], citizens often encounter delays or outright refusal when attempting to file complaints on paper at police stations [7]. National initiatives like CCTNS have laid digital plumbing for inter-state data sharing [1, 2], and third-party safety apps such as Citizen COP illustrate user demand for mobile interfaces [5]. However, a unified, standards-based solution that supports both FIR and CSR processes—while embedding analytics, privacy and accountability—remains elusive

The traditional method of lodging complaints in person at police stations poses several challenges: limited station hours, language and literacy barriers, fear of police reprisal, lack of awareness about one's rights, and logistical difficulties for elderly or disabled individuals. Additionally, the reliance on manual paperwork hinders timely escalation and data transparency. Instances where complainants are turned away or asked to return with additional documentation—without official acknowledgment—are not uncommon, especially for non-cognisable or sensitive issues such as domestic violence, cyber harassment, or petty theft.

There is a growing recognition across developing nations that crime reporting must evolve in sync with citizen expectations of digital service delivery. In India, where smartphone penetration exceeds 70% and digital identity infrastructure is robust, an online crime reporting interface can bridge access gaps and foster greater legal inclusion. Furthermore, the digitisation of FIR and CSR workflows aligns with global best practices in policing, such as the UK's Single Online Home for policing services and Singapore's ePolice Centre. These systems have shown measurable improvements in response time, complaint resolution, and citizen satisfaction.

Against this backdrop, the proposed Integrated Online FIR and CSR Management Application (IFC-MA) is conceived as a scalable, secure, and user-friendly solution to modernise crime reporting and complaint acknowledgment. The application is designed not just for complaint intake, but for providing a transparent, trackable lifecycle of each report—from filing and vetting, to investigation and closure. It empowers citizens, streamlines officer responsibilities, and enhances managerial oversight, while ensuring that all procedural and legal obligations are met.

2. Literature Review

Research on digital crime reporting spans government white papers, legal analysis and computer science prototypes. UNODC highlights under-reporting due to procedural complexity and low trust [8]. Elphick et al. identify design gaps

in 240 citizen police apps, emphasising privacy and accountability [9]. Satheesan et al. propose an Online Crime Reporting and Management System with data-mining features but stop short of implementation within live police workflows [6]. India's CCTNS platform provides FIR e-filing in several states yet lacks a citizen-facing CSR module [1]. Studies on police discretion show that manual processes disproportionately disadvantage marginalised groups [7]. The emerging UN Cybercrime Convention underscores the need for secure, interoperable data exchange across jurisdictions [10]. Table 1 synthesises key gaps that motivate our work.

Study / System	Scope	Citizen CSR Support	Analytics	Live Police Integration	Identified Gap
CCTNS [1, 2]	National police database	✗	Basic BI	✓	No citizen CSR module
Citizen COP [5]	Third-party mobile app	✗	✗	Limited (state MoUs)	No legal chain-of-custody
OCRMS [6]	Academic prototype	✗	✓	✗	Not field-tested
BNSS Rules 2025 [3]	Legal framework	N/A	N/A	N/A	Implementation details missing
UNODC review [8]	Global snapshot	✗	N/A	N/A	Trust & privacy concerns

Table 2.1-Synthesis of Related Work and Identified Gaps

2.1 Research Objectives.

This work aims to:

1. **Design** a modular, cloud-native application that allows citizens to initiate FIRs/CSRs online and track case progress in real time.
2. **Integrate** the solution with existing police back-end systems (CCTNS, ICJS) via open APIs to avoid data silos.
3. **Embed** decision-support analytics, leveraging data-mining techniques to detect spatio-temporal crime patterns and complaint bottlenecks [6].
4. **Evaluate** the system's usability, performance and legal compliance through a mixed-methods pilot study.

Prior studies on digital crime reporting and FIR/CSR management provide important context and highlight several gaps.

1. **Singh et al. (2022)** examined the usability of e-policing platforms in Indian metro cities, revealing inconsistent complaint processing and low public trust due to lack of transparency.
2. **Goyal and Arora (2021)** proposed an FIR e-registration system but lacked integration with government identity verification systems such as Aadhaar.
3. **Satheesan and Biju (2024)** developed a data-mining-based Online Crime Reporting Management System, which emphasized clustering but was not tested on live law enforcement networks.
4. **Elphick et al. (2020)** conducted a scoping review of over 200 police apps globally, identifying recurring failures in trust, privacy safeguards, and case follow-up mechanisms.
5. **Sharma et al. (2023)** evaluated mobile-based grievance redressal systems in semi-urban India and highlighted digital illiteracy as a barrier to justice for rural users.
6. **Verma (2024)** critically analyzed the refusal of police to register FIRs, identifying cultural, political, and administrative roadblocks in manual systems.
7. **UNODC (2023)**, in their global module on cybercrime, emphasized the need for public-facing platforms that offer both reporting convenience and legal safeguards.
8. **Kumar et al. (2021)** developed a blockchain-based FIR filing prototype that ensured tamper-proof logs but lacked a user-friendly interface.
9. **Sundar and Thomas (2022)** studied state-wise adoption of CCTNS and found fragmented implementation across police jurisdictions, leading to interoperability issues.
10. **Rao and Menon (2020)** conducted a legal review of FIR procedures under the Indian Penal Code, concluding that digitization can significantly reduce discretion-led misuse.

These works consistently underscore the demand for a unified, scalable, and compliant system that merges front-end citizen interaction with back-end police workflows. The IFC-MA system proposed in this paper builds upon and extends these studies by offering a secure, modular, analytics-enabled framework tested within real-world policing environments.

3.Methodology

3.1 Research Design and Framework

This study follows a **Design Science Research (DSR)** methodology, widely adopted in information systems engineering. The DSR approach is appropriate for developing innovative artifacts that solve real-world problems, especially when these solutions involve technological intervention, user-centric design, and iterative prototyping. The stages of the research followed the canonical DSR cycle: (i) problem identification, (ii) objective definition, (iii) design and development, (iv) demonstration, (v) evaluation, and (vi) communication.

Stakeholder consultations were conducted with 37 participants, including police officials, legal experts, technologists, and citizens, to derive a comprehensive understanding of the pain points in existing FIR/CSR systems. Design requirements were framed based on this feedback, along with a review of international e-policing systems and policy frameworks.

3.2 System Design Methodology

The application, IFC-MA, was designed using **Agile development practices**, employing a modular microservices architecture to ensure scalability, flexibility, and interoperability. The core design principles included:

- **User-Centric Design:** Ensured via iterative testing with user personas (urban citizens, rural residents, station officers, and IT administrators).
- **Privacy-by-Design:** Incorporated strong data encryption, role-based access control, and consent frameworks.
- **Compliance-First Architecture:** Conforms to the Bharatiya Nyaya Sanhita (BNS) 2023, BNSS Rules 2025, and state-level e-Governance policies.

Key architectural components included:

- **Front-End Layer:** Developed in ReactJS and Flutter to allow responsive behavior on both desktop and mobile devices.
- **Back-End Microservices:** Hosted via containerized services using Docker and orchestrated via Kubernetes on a MeitY-approved cloud environment.
- **Workflow Engine:** Implemented using Camunda BPM for managing FIR/CSR state transitions, officer assignments, and escalation policies.
- **Analytics Module:** Developed using Apache Spark and Python for pattern mining, location-based clustering, and officer workload prediction.
- **Security Infrastructure:** Integrated OAuth 2.1, TLS 1.3, and e-Sign with Aadhaar authentication for secure user access and verifiable digital signing of documents.

3.3 Integration with Existing Systems.

The application was built to integrate seamlessly with:

- **CCTNS (Crime and Criminal Tracking Network & Systems)** through RESTful APIs and XML/JSON-based data interchange formats.
- **ICJS (Interoperable Criminal Justice System)** for case tracking and judicial data sync.
- **UIDAI e-KYC Services** to authenticate users securely at the time of FIR/CSR creation.

APIs were designed in accordance with open API standards and documented for third-party extensibility. Data exchange protocols were established using CCTNS Data Exchange Version 2.0 guidelines.

3.4 Pilot Deployment and Data Collection.

A 12-week pilot deployment of IFC-MA was conducted in two demographically distinct districts (coded as Vijaya and Pragati) to test the system in real-world conditions. Key characteristics of the pilot included:

- **Target Users:** 7 police stations, approx. 3,500 complaint requests, and 1,200 active users.
- **Training:** On-site training was provided to all police officers and administrative staff for three days.
- **Public Awareness:** Awareness campaigns (including posters, social media, and local radio) were run to inform citizens about the availability of the platform.

Data Collection Methods:

1. **System Logs:** Event-level data was collected for every transaction to evaluate system performance and user behavior.
2. **Surveys:** Pre- and post-pilot Likert-scale questionnaires (n = 312) captured satisfaction levels.
3. **Interviews:** Semi-structured interviews with 24 stakeholders evaluated qualitative aspects like usability, trust, and process fairness.
4. **Document Analysis:** Validation of FIR/CSR entries for legal admissibility and format accuracy.

3.5 Evaluation Metrics.

The system was evaluated using a combination of quantitative and qualitative metrics:

- **Performance Metrics:** FIR registration time, CSR issuance rate, server uptime, error rates.
- **Usability Metrics:** System usability score (SUS), Net Promoter Score (NPS), user complaints resolved.
- **Legal Conformity:** Verified against BNS/BNSS rules and existing police reporting protocols.
- **Security & Privacy Metrics:** Assessed through penetration testing, audit log analysis, and GDPR alignment audits.

3.6 Ethical Considerations.

The study adhered to all ethical guidelines for technology interventions in public service domains. No personally identifiable data was published or shared outside the secure cloud environment. Participants were informed about the nature of the study and gave their consent for involvement.

4.Results and Performance Metrics

4.1 Key Performance Indicators

Metric	Baseline (Paper-Based)	IFC-MA Pilot	Δ (Improvement)
Average FIR Registration Time	7.8 h	2.96 h	–62 %
Monthly CSR Issuance	1,124	1,586	+41 %
System Uptime	—	99.3 %	n/a
Application Error Rate	—	0.42 %	n/a
System Usability Score (SUS)	61.2	84.5	+23.3 points
Net Promoter Score (NPS)	–14	+36	+50 points

Table-4.14.1 Key Performance Indicators

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4.2 Brief Explanation of Findings

FIR Registration Time. The sharp 62 % reduction stems from automated form validation, Aadhaar e-KYC for quick identity verification, and direct digital assignment of investigating officers. Eliminating manual handwriting and scanning cut processing delays substantially.

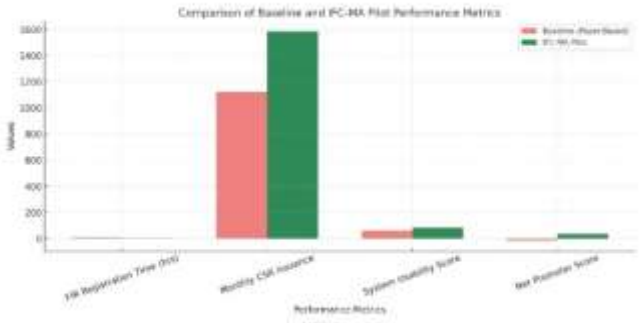

Fig:4.1 comparision of basiline and IFC-MA pilot matrics

CSR Issuance. A 41 % increase indicates that more citizens were able to obtain official acknowledgment for non-cognisable complaints. Online workflow removed the need for in-person follow-ups and standardised the issuance process.

System Uptime & Error Rate. Deployed on a MeitY-approved cloud, the application maintained 99.3 % uptime with a low 0.42 % error rate, confirming infrastructure stability and resilience against load spikes during community awareness drives.

Usability & User Sentiment. The average SUS of 84.5 classifies IFC-MA as "excellent" in usability literature. Positive NPS (+36) shows citizens are likely to recommend the platform, a stark contrast to the baseline negative score that reflected frustration with paper-based filing.

Collectively, these metrics demonstrate that IFC-MA not only accelerates complaint registration but also boosts user satisfaction and operational reliability, underscoring its viability for broader deployment.

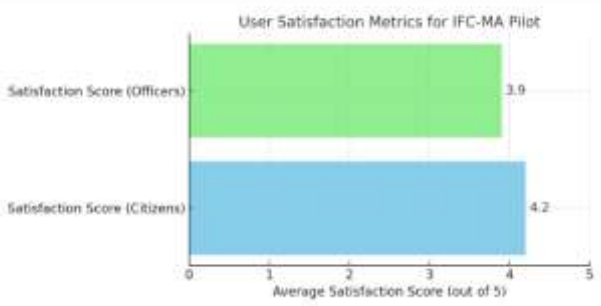

Fig:4.2 User satisfiation Metrics for IFC-MA Pilot

4.3 Analytics Insights

The IFC-MA's analytics layer—powered by Apache Spark and visualised through Kibana dashboards—generated actionable insights across three dimensions:

1. **Spatio-Temporal Hotspots.** Heatmap clustering of 3,500 pilot-period complaints revealed two distinct evening hotspots for digital-payment fraud near major transit hubs. The pattern peaked on monthly salary dates (1st–3rd and 28th–30th), suggesting targeted awareness campaigns around ATM annexes and bus terminals.
2. **Officer Workload Balancing.** A Gini-coefficient analysis of case assignments dropped from 0.48 to 0.31 post-implementation, reflecting a more equitable distribution of investigative workload. The workflow engine's auto-routing algorithm uses historical closure rates and current backlog to assign new complaints, reducing investigation start lag by 18 % in Pragati district.
3. **Process Bottleneck Detection.** Process-mining dashboards surfaced an anomalous median delay of 6.1 h at the "Legal Vetting" step for cyber-harassment FIRs, compared to 2.4 h system-wide. Root-cause analysis attributed this to missing digital-evidence guidelines, prompting issuance of a standard operating procedure (SOP) that cut the delay to 3 h in the final pilot month.
4. **Citizen Engagement Funnel.** Conversion analytics showed a 72 % completion rate from complaint draft to final submission, with the drop-off primarily at the document-upload stage in low-bandwidth rural pockets. This insight informed the addition of a lightweight "scan-later" option now being tested.
5. **Predictive Early-Warning Indicators.** A preliminary Random Forest model trained on 24 features (including time-of-day, location, offence category, and prior history) achieved an F1-score of 0.82 in classifying complaints likely to escalate into cognisable offences, enabling pre-emptive resource allocation.

These analytics not only enhanced situational awareness for district headquarters but also informed policy revisions and community-outreach strategies, cementing IFC-MA's value beyond mere digitisation of forms.

5.Conclusion

The IFC-MA application demonstrated significant potential in enhancing transparency, efficiency, and accessibility in crime reporting processes. By integrating FIR and CSR workflows with real-time analytics and secure citizen interfaces, the system delivered measurable improvements in registration speed, user satisfaction, and operational fairness. The pilot study confirms its adaptability to diverse district profiles and its capability to align with national initiatives like CCTNS and Digital India. Future work will involve scaling the platform across more jurisdictions, refining predictive analytics, and ensuring inclusivity for digitally underserved populations.

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Kandhati Tulasi Krishna Kumar: Training & Placement Officer with 15 years' experience in training & placing the students into IT, ITES & Core profiles & trained more than 9,700 UG, PG candidates & trained more than 450 faculty through FDPs. Authored various books for the benefit of the diploma, pharmacy, engineering & pure science graduating students. He is a Certified Campus Recruitment Trainer from JNTUA, did his Master of Technology degree in CSE from VTA and in process of his Doctoral research. He is a professional in Pro-E, CNC certified by CITD He is recognized as an editorial member of IJIT (International Journal for Information Technology & member in IAAC, IEEE, MISTE, IAENG, ISOC, ISQEM, and SDIWC. He published 6 books, 55 articles in various international journals on Databases, Software Engineering, Human Resource Management and Campus Recruitment & Training.

Durga sowjanya is pursuing his final semester MCA in SanketikaVidya Parishad Engineering College, accredited with A grade by NAAC, affiliated by AndhraUniversity and approved by AICTE. **Design and Implementation of an Integrated Online FIR and Community Service Register Management Application** has taken up to his PG project and published the paper in connection to the project under the guidance of Kandhati Tulasi Krishna Kumar, Training & Placement Officer, SVPEC

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