Blockchain Based Police Complaint Management System

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Abstract*: The Police Complaint Management System (PCMS) is a decentralized application template designed to modernize the processes of lodging, tracking, and resolving complaints within law enforcement systems. Leveraging the Next.js framework, Web3 technologies, and blockchain integration, the system ensures tamper-proof complaint records, real-time updates, and enhanced transparency for citizens and authorities. By utilizing Wagmi and Ethers.js for seamless wallet connections, IPFS for decentralized evidence storage, and a user-friendly interface styled with Tailwind CSS, the PCMS provides a scalable, efficient, and accessible platform. With automated processes for complaint categorization and routing, as well as immutable blockchain records, the system fosters greater accountability and trust in public services. Built with TypeScript for reliability and enhanced with modular tools for rapid deployment, the PCMS exemplifies a modern, citizen-centric approach to grievance management, ensuring data security and operational efficiency in law enforcement agencies.*

Keywords: AI Chatbots, Blockchain, Healthcare Management, Data Security, Patient Assistance, Smart Contracts, Data Privacy, Patient Engagement

I. INTRODUCTION

The Police Complaint Management System (PCMS) is developed to address the significant inefficiencies and challenges within traditional complaint handling processes, such as manual errors, delayed resolutions, and lack of transparency. Traditional systems, often reliant on paper-based or in-person processes, present several hurdles for citizens. These include limited accessibility, especially in remote areas, and lack of real-time updates on the progress of complaints. By digitizing the complaint registration and tracking process, and leveraging blockchain technology, the PCMS aims to make the entire system more accessible, efficient, and user-friendly. Blockchain provides the necessary immutability and transparency that ensure a tamper-proof and auditable record of complaints, thereby enhancing trust between citizens and law enforcement authorities.Traditional complaint systems are fraught with challenges. First, reliance on manual operations makes these systems prone to human errors, leading to inefficiency and inconsistent handling of complaints. The absence of a unified or centralized system often results in mismanagement, duplication, or even loss of important data. Additionally, citizens have limited visibility into the status of their complaints, resulting in frustration and mistrust toward the authorities. The inability to track progress also hinders accountability, leading to longer resolution times and poor public satisfaction. The lack of transparency and potential for corruption are particularly troubling aspects of the traditional systems, which blockchain technology can address by ensuring that records are immutable and publicly auditable.

The PCMS is a modern, web-based platform designed to streamline the complaint registration and resolution process, with a focus on improving transparency and security through the integration of blockchain technology. The system allows citizens to submit complaints through an online interface, categorize them according to urgency and type, and track their progress in real time. By utilizing blockchain, each complaint and its corresponding data (including evidence, timestamps, and status updates) are securely stored in an immutable ledger, ensuring that no data can be altered or deleted. Complaints are automatically classified and routed to the appropriate departments for resolution. This automation ensures that resources are allocated efficiently, reducing delays and improving response times. Citizens

are notified at each step of the process, providing them with continuous updates and enhancing trust in law enforcement.Technological Framework and Features are further. The PCMS is built using a modern technological stack that includes Next.js, Wagmi, Ethers.js, IPFS, and blockchain integration to ensure scalability, security, and immutability of complaint records. Blockchain enhances the system's transparency and accountability by providing tamper-proof and auditable records of complaints. The technological framework also integrates TypeScript for reliability and robust code structure, and Tailwind CSS for a responsive user interface.

• Real-Time Notifications: Automated updates are sent to citizens and law enforcement personnel regarding the status of complaints, ensuring all stakeholders remain informed throughout the process.

• Blockchain-Powered Transparency: Every complaint registered, including its evidence, status updates, and interactions, is recorded on a blockchain ledger, providing a transparent, immutable trail of actions.

• Decentralized Storage: Integration with IPFS ensures that supporting documents and media (e.g., evidence) are securely stored in a decentralized manner, enhancing data reliability and accessibility.

• User-Friendly Interface: Designed for accessibility, the system leverages Next.js to deliver a seamless web experience that can be accessed from desktops, tablets, and mobile devices, catering to diverse demographics and regions.

The PCMS provides several benefits to both citizens and law enforcement agencies. For citizens, the ability to file complaints from any location and track their progress in real time increases transparency and accountability in the grievance redressal process. With blockchain, every action related to a complaint (including evidence submission and status updates) is permanently recorded in a secure ledger, ensuring that data cannot be altered or manipulated. For law enforcement agencies, the system helps organize complaints more effectively, offering actionable insights through the analytics module that can help identify systemic issues and optimize response strategies. Moreover, by providing citizens with direct and transparent access to the system, trust in law enforcement is improved, ultimately enhancing the overall effectiveness of public safety initiatives.

II. LITERATURE REVIEW

A secure FIR system leveraging blockchain technology is proposed in [1]. The system eliminates reliance on police by the public and includes stakeholders such as complainants, witnesses, investigating officers, and suspects. It ensures transparency by enabling stakeholders to track activities while safeguarding digital FIRs from tampering. In [2], an online centralized police complaint management system for Saudi Arabia is presented. Registered users can submit complaints online, which are verified by officers. Based on the evidence, the complaints are processed, and the system maintains criminal data to monitor most-wanted individuals. An E-Police system is detailed in [3], where complaints can be lodged via an Android application. The complaints are stored on a WAMP server, and police officers access and update them through a web portal. The system uses IMEI numbers for unique user identification, highlighting its advantages over traditional paper-based FIR systems. The system described in [4] enables users to file FIRs under applicable IPC sections. It also incorporates an SOS feature, which shares the user's location with the nearest police station during emergencies. Only authorized users can lodge complaints through the app. A system in [5] aims to improve communication among Nigerian police force stakeholders via e-policing. Complaints can be submitted anonymously on a secure platform where documents are password-protected for restricted access by authorized personnel. To enhance e-governance in Bangladesh, [6] introduces an e-police system featuring an interactive website. The website provides resources like press releases and maintains databases of top criminals, detainees, and more, facilitating improved police administration. A mobile app discussed in [7] enables customers to file complaints against companies through a chatbot, which forwards the complaints to relevant departments. Classification is employed to ensure appropriate handling. The system in [8] stores user and police inspector data in a centralized database. It ensures data availability during calamities and allows users to lodge complaints, access criminal information, and track stolen items or wanted criminals. A centralized crime record management system is outlined in [9], where police officers manage complaints and investigations based on user submissions. The system categorizes users and officers with varying access levels and stores data like witness details and investigation reports in a database. A blockchain-based decentralized platform for criminal records is proposed in [10]. It ensures data integrity by encrypting records and limiting access to authorized personnel. Any modifications to the records are logged in the blockchain with details of the person responsible. The use of permissioned blockchain technology for managing citizen criminal records is

analyzed in [11]. The study demonstrates how decentralization improves security and availability, with consensus mechanisms controlling participant permissions for transactions. A web-based system for managing criminal records in Mangalore city is described in [12]. The system allows police to address regional issues without physical presence, with administrators managing users and complaints using a centralized database to reduce paperwork. The computerized system in [13] supports police in tracking offender release dates and managing modules for FIRs and criminal records. The system improves efficiency through faster information retrieval and provides notifications to police via an Android app, while administrators handle updates through a web portal. Finally, [14] presents a centralized database for criminal record management, allowing users to file online complaints and access SOS features for assistance from nearby police stations. FIR filing requires an Aadhar number, and users are notified when the police register an FIR.

III. IMPLEMENTATION

The development of the Police Complaint Management System (PCMS) was carried out with the primary objective of creating an efficient, secure, and decentralized platform for lodging, tracking, and resolving complaints within law enforcement agencies. By integrating Web3 technologies such as blockchain, decentralized storage, and wallet connectivity, the system ensures transparency, security, and scalability. This section provides an overview of the system's architecture, key functional components, and the technologies used.

A. System Architecture

The PCMS is designed as a decentralized web application to ensure accessibility, security, and trust for both citizens and law enforcement officers. It leverages a modular architecture that integrates Web3 components with a modern frontend framework. The system is divided into the following layers:

1. Frontend (Presentation Layer): Built using Next.js and React, the frontend is responsible for rendering the user interface and handling interactions with the users. The system employs Tailwind CSS for styling and Emotion for CSS-in-JS theming, ensuring an intuitive and responsive design that adapts to desktops, tablets, and smartphones.

2. Backend (Application Layer): While much of the system's logic runs on the client side, the backend acts as a bridge for processing specific API requests and connecting to blockchain networks. It uses Wagmi and Ethers.js to interact with Ethereum or other EVM-compatible blockchains.

3. Blockchain Integration (Security Layer): Blockchain serves as the backbone of the system, ensuring tamper-proof and immutable complaint records. Each action, such as complaint submission, status updates, or evidence addition, is recorded on a distributed ledger, enhancing transparency and accountability.

4. Decentralized Storage Layer:IPFS (InterPlanetary File System) is utilized for storing complaint-related media files (e.g., images, videos, and documents). This ensures decentralized, secure, and scalable storage while maintaining data accessibility across all nodes.
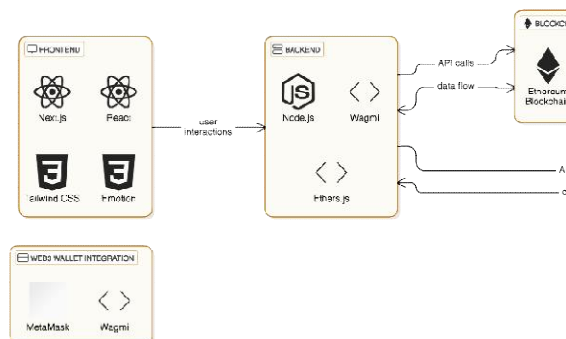

Figure 3.1: Architecture

B. User-defined Inputs and Interaction:

The PCMS provides an accessible interface for citizens and law enforcement officers to interact with the system. Key features include:

1. Complaint Submission: Citizens can file complaints through the web interface, including providing detailed descriptions and uploading supporting evidence. Complaints are directly recorded on the blockchain, ensuring they cannot be altered or deleted.

2. Complaint Tracking: Users can track the progress of their complaints in real time, with automated status updates logged on the blockchain for transparency. Notifications keep all stakeholders informed throughout the resolution process.

3. Law Enforcement Interaction: Officers access assigned complaints via a secure dashboard. They can update statuses, request additional information from complainants, and log actions, with all updates stored immutably on the blockchain.

C. Performance and Optimization

To ensure smooth functionality and scalability, the PCMS incorporates several optimization strategies:

1. Efficient Data Handling: Complaint records are indexed and managed through IPFS and blockchain, ensuring fast retrieval and secure storage of evidence and metadata.

2. Asynchronous Operations: The system uses asynchronous programming for non-blocking user interactions, especially for blockchain transactions, which can take variable times to confirm.

3. Gas Optimization: Smart contracts are optimized to minimize gas fees for on-chain operations, ensuring cost-efficiency for both users and law enforcement agencies. experience.

IV. COMPARATIVE ANALYSIS

The Police Complaint Management System (PCMS) offers significant advantages over traditional systems by using blockchain for tamper-proof records and IPFS for secure, decentralized storage. Unlike paper-based methods, PCMS provides real-time tracking, transparency, and automated updates, enhancing efficiency and trust between citizens and law enforcement.

Overall Comparison:

Table no. 4.1

Feature	Existing Systems	Proposed Framework
Complaint Submission	Manual, paper-based or limited online systems	Fully digital, web-based platform with wallet integration
Transparency	Limited visibility into complaint status	Blockchain-powered immutable records for transparency
Security	Vulnerable to tampering or data loss	Blockchain ensures tamper-proof complaint records

V. FUTURE SCOPE

- **Mobile App Development:** Building native applications for iOS and Android will provide a more streamlined experience for mobile users, especially in areas with limited web access.
- **Multi-chain Support:** Expanding compatibility to other blockchains will increase the system's flexibility and adoption, enabling cross-chain complaint records and broader ecosystem participation.
- **Enhanced Analytics:** Adding analytics tools to identify patterns in complaints, measure department efficiency, and predict public safety trends will help law enforcement agencies make data-driven decisions.
- **AI and ML Integration:** Incorporating AI/ML algorithms to prioritize urgent complaints, identify patterns in historical data, and recommend resolutions can enhance system intelligence and proactive policing strategies.

VI. CONCLUSION

The Police Complaint Management System (PCMS) is an innovative, decentralized platform designed to modernize the lodging, tracking, and resolution of complaints within law enforcement agencies. By integrating cutting-edge web technologies, blockchain for tamper-proof security, and a user-friendly interface, the system empowers citizens to easily file complaints and monitor their status in real-time. Additionally, the incorporation of advanced analytics and resource optimization tools enables law enforcement to provide timely responses and improve public safety outcomes. The PCMS fosters transparency, accountability, and efficient communication, making it an indispensable solution for transforming police complaint management in the digital age.

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