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Police Complaint Management System using Blockchain Technology

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***Abstract*—The criminal activities in India are increasing at a rapid rate. Many of these activities go unreported. Even after having an online portal for the police for storing FIRs and NCRs, most of the FIRs are handwritten as a traditional practice. In most of the cases, the complainant has to be present in the police station to file a cognizable offense. An effective system for e-governance was started in 2009 named Crime and Criminal Tracking Network and Systems (CCTNS) for the entire country. However, it is a centralized system for a particular state. Thus there is a need for a completely decentralized system for assuring that there is no central point of failure in the system and complaints are managed securely protected from unauthorized access. Our aim is to propose a blockchain-based solution to manage complaints against both cognizable and non-cognizable offenses. The FIR filed by the police will be encrypted, stored in the IPFS and hash is added to the blockchain network. If the police decide not to file the FIR under pressure or deny receiving any complaint, then the complainant will have strong proof against him/her as the complaint along with its timestamp was stored on the blockchain network. Having all the records stored in an immutable database would remove any chances of the FIR/NCR being tampered and going unnoticed.**

***Index Terms*—Blockchain, FIR, Encryption, IPFS, Ethereum, Cryptography**

I. Introduction

In India, complaints regarding offenses have to be registered under the law. There are two types of offenses i.e. cognizable and non-cognizable offenses [3]. Cognizable offenses include serious types of crimes like murder, theft, kidnapping, and rape, etc. As defined in Section 2 (c) of the Criminal Procedure Code 1973, in case of a cognizable offense, police can arrest the suspect without any warrant [6]. The assigned inspector can start the investigation process without any orders from the court. In the commission of any cognizable offense, the First information report aka FIR. is registered at the police station. Any individual can file an FIR. if he/she is a victim or has seen the offense being committed. FIR. details include the complainant's name and address, date and time of location and facts of the incident, etc. Once the FIR is registered, chargesheet report is filed by the police officer. The complainant can apply for acquiring the chargesheet by submitting a letter under the Right to Information Act (RTI) and by paying a certain amount of fees to the court.

Non-cognizable offenses include criminal activities like cheating or forgery etc. N.C. complaint aka non-cognizable complaint can be registered at the police station. It has a structure similar to FIR. As defined in Section 2(l) of Criminal Procedure court 1973, in case of non-cognizable offense, a police officer has no authority to arrest/investigate without a warrant [6]. The police officer has to obtain permission from the court/magistrate in order to start the investigation process. The crime rate i.e. crime per lakh is increasing at a rapid rate. More than 50 lakh cognizable crimes were registered in the year 2018 [1]. Due to increased criminal activities as well as the presence of corrupt police officials, they tend to refuse, avoid or detain the registration of FIR/NCR/Complaints which are the obstacles for the complainants to seek justice at the very beginning. According to a survey [2], 24% of people were unable to register their complaints and 9% of people said that the non-registration was because they were demanded to pay a bribe. Among the people who were able to register their complaints, 30% of the complainants didn't receive an FIR copy. There is a need for a transparent system to eradicate corruption from the public systems.

We aim to propose an online police complaint management system using blockchain technology for managing FIR's and NCR's in a decentralized manner in order to cater to problems involving denial of police officers to file complaints. Blockchain technology is based on a peer to peer network topology i.e. it is a distributed as well as a decentralized data structure that contains all the legal transactions in links of blocks. The first application of blockchain technology is bitcoin [5], which was proposed by Satoshi Nakamoto. The prime functionality of blockchain is to make sure that only valid blocks are entered into the chain i.e. the block should acquire minimum votes/consensus. The validation of a block is done with the help of consensus mechanisms like Proof of Work, Proof of State and Proof of Capacity, etc. Once a block of transactions is added to the network, it is computably infeasible to tamper a block. The Interplanetary file system(IPFS) is an algorithm which involves peer to peer network for storing as well as sharing files in a distributed manner. The mechanism uses content based addressing i.e. every file is hashed (based on content) and stored in a decentralized network. IPFS can be incorporated with blockchain to provide features like

immutability, high reliability and throughput. Relevant to this context, we tend to provide a decentralized application which keeps a track of all the activities related to police complaints right from filing a complaint to submission of charge-sheet to the court. The use of blockchain technology ensures trust between the complainants and the police department. The system is not only secure from loss of data but also from brute force hacking or other types of malicious attacks.

II. Literature Survey

[7] proposes a secure FIR. system using blockchain technology. The proposed system eliminates the need for trust in the police by the general public. The system has four stakeholders i.e. complainant, witness, investigating officer, and the suspect. The decentralized solution will enable the relevant stakeholders to keep a track of each and every activity and protect the digital FIR. from any malfeasance. [8] proposes an online centralized police complaint management system for Saudi Arabia. Any registered user can file a complaint online on observing some suspicious activity. The officers can verify the details and on the basis of the complaint and evidence provided, will register the complaint in the system. They have also maintained crime related data to track the most wanted or top criminals in the country. [9] proposes an E-Police System in which users can file their complaints through an android application that is stored on a WAMP server. Police officers can access the complaints using a web portal and update information regarding the complaint. They have also highlighted the various advantages of an E-police system over the conventional pen and paper-based FIR registration system. They have used IMEI numbers for unique user identification. [10] proposes a system in which the users can file an FIR under IPC sections applicable to the complaint. It also discusses an 'SOS' system that can be used by a user if he/she is in serious trouble. In that case, the location of the user will be sent to the nearby police station. Only authorized users can complain using the Mobile app. [11] aims at enhancing the information flow amongst various stakeholders in the Nigerian Police Force by an e-policing system. Any user can register a complaint on the website anonymously. Also, for improving security, they have added passwords to documents so that only authenticated police officers can access the corresponding files. In this paper [12], for the enhancement of e-governance in Bangladesh, they have proposed an e-police system. Along with it, they aim to improve their country's police administration by suggesting an interactive website that contains information such as daily press releases as well as maintaining a database of top criminals in the country, people under police custody, etc. [13] talks about a system for customers to file a complaint against the company if they are dissatisfied with the product bought. It is a mobile app where the user can file the complaint through a chatbot and the system submits the complaint to the respective department using classification. [14] talks about a system where all the details of the user will be stored in the database irrespective of whether or not he/she is a criminal. Their system also stores the data of the police inspectors. All data regarding any crime will be stored in the database. Keeping all data online in a database will make sure that even in the case of calamities the criminal and user data is available to the police at all times. The user can also have access to file any kind of complaint and can see the details like most wanted criminals, stolen cars, etc. [15] proposes a crime record management system which is a centralized system storing the data of various criminals and users of the system. There various designation police officers which are allotted different access to the system. In this system, the police officer files an FIR based on the user complaint. The details of the accused are also saved in a database. It also stores the witness and the criminal data in a database. The police officer depending on his designation can then file an investigation report. [16] proposes a blockchain-based decentralized system to store any kind of criminal records. Storing records in the blockchain would remove any possibilities of the criminal records being changed against the law. The criminal data is encrypted and stored in the blockchain and access to access them is only given to designated authorities. Any altercations are stored in the blockchain with the information of the person changing it. [17] proposes a system to store citizen criminal records in a decentralized way by using a permissioned blockchain. They have performed analysis on implementing blockchain technology to the Argentinian criminal records information system. Their analysis found out that using blockchain would bring decentralization in the system and will be available only to the participants of the system. Also, the consensus mechanism of the blockchain would take care of the permissions given to the various participants in the network to take part in a particular transaction. [18] proposes a web-based system for managing criminal records for Mangalore city. The author claims that the web application will not only manage criminal records but also helps the police department to find out existing problems in the region without actually visiting them. The admin of the system manages the users i.e. complainants and police. The author intends to use a centralized database to reduce the amount of paperwork and properly store criminal records. [19] proposes a computerized system that assists the police to keep a track of date and time of the release of a particular offender. The system contains several modules to provide insights i.e. FIR information, criminal records, etc to the admin/police. The key aspect of the proposed system is to improve the efficiency of police i.e. retrieving good quality as well as fast accessing of information. An Android application is used to notify the police whereas admin manages the release of any information/rule with the help of a website. The system [20] manages criminal records in a centralized database and provides a platform for registering online complaints. There is an SOS functionality i.e. users can seek assistance from the nearby police stations. The complainant can file FIR with the help of his/her Aadhar number and will be notified if the police have filed an FIR. The system also includes a feature i.e. if FIRs are put on hold by the police, the notification is sent to the higher authority in the system. The proposed system [21] helps to create awareness among the general public regarding

any criminal activities in their area. The author proposes an android mobile application to not only create awareness but also report a crime to respective law enforcement agencies. [22] proposes a system for crime area detection and easily managing criminal records. The application makes criminal related information available to the police during investigations which will speed-up the process of tracking criminal history/records. The applications also provide the safest path to reach their destination by giving notifications to travelers when they are passing through a crime affected area and providing an alternate path.

Most of the existing police complaint management systems are centralized which are prone to more attacks and vulnerable to a single point of failure. Many systems only store the FIRs and NCRs but not the complaint. This is a problem in a situation where a police officer refuses to file a complaint against influential people, users won't have a proof of registering a complaint. Also, some systems give high privileges to the police rendering it vulnerable to tampering. The drawbacks of existing systems highlight the need for a transparent and portable G2C e-governance framework where a user doesn't have to forcibly trust the police department.

III. Proposed Methodology

The proposed system is a decentralized platform for managing complaints with the help of various technologies like blockchain, IPFS, etc. The detailed architecture of the system is explained in the form of modules followed by the implementation of the system.

A. Security Module

The legal documents i.e. FIR/NCR/Chargesheet(which are discussed in Section 1) are available to the suspect, police, and the complainant. The use of public blockchain becomes a bottleneck since the transactions are broadcasted to each and every node. For this, our system encrypts the details that are to be stored on the blockchain network. The encryption is done with the help of a 16 bit AES algorithm (Symmetric-key cryptography). The Diffie Hellman key exchange algorithm is used to exchange secret keys. The following explains the implementation details of this module(Fig. 1).

(a) Whenever a new complainant/police officer registers in the system, he/she has to add a security pin (a/b). The hash of the security pin is saved in the database.
(b) The security components (prime number p, base g, A and B) stored in the database are the public components involved in the Diffie hellman key exchange algorithm. A and B are calculated by the following formula:

$$A = g^a mod(p), B = g^b mod(p)$$

(c) When a complainant registers a complaint, The complaint is encrypted with the help of a secret key. The secret key is calculated with the help of public components of the police station (p,g,B) and security pin (a).
(d) The complaint is added to the blockchain.

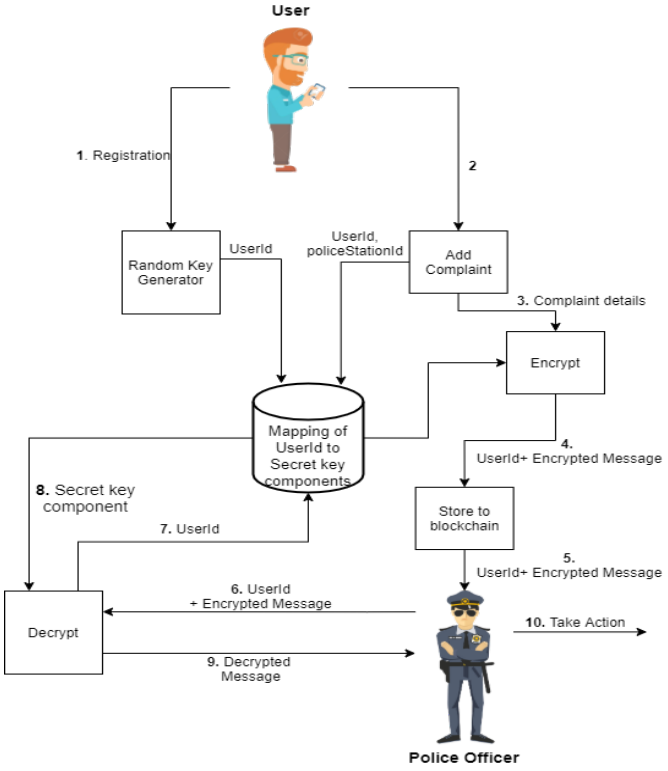

Fig. 1: Security Module

(e) The system decrypts the complaint (on the police side) using the secret key. The secret key is calculated using the public components of the complainant (p,g,A) and police officer's security pin(b).
(f) The police officer takes further action.

B. Blockchain Module

The blockchain used in this paper is Public Ethereum network which is based on proof of work concept. Ethereum along with encryption provides transparency while also ensuring privacy of confidential data. The smart contract program which runs on the ethereum blockchain creates unalterable ledger and makes sure that only those transactions that abide by the contact are committed to the network. The details of the complaint are encrypted by the procedure mentioned in the security module and the proofs provided by the user are stored on a public IPFS network. The transparent nature of ethereum ensures that presence of the complaint on the blockchain is visible to all the participants of the network. Further to maintain confidentiality the procedure explained in security module is implemented. The hash corresponding to the proofs, encrypted complaint details are stored on the blockchain network. The police officer who is a participant of the network can add another officer to the network. This ensures that only an authenticated police officer has access to the reports and crime data. Once the police files FIR/NCR/Chargesheet, it is rendered as a pdf and is encrypted using the similar procedure mentioned in the security module. This encrypted document

is then stored on the IPFS network and the corresponding hash is stored on the ethereum network. Fig 2. explains the implementation details of this module.

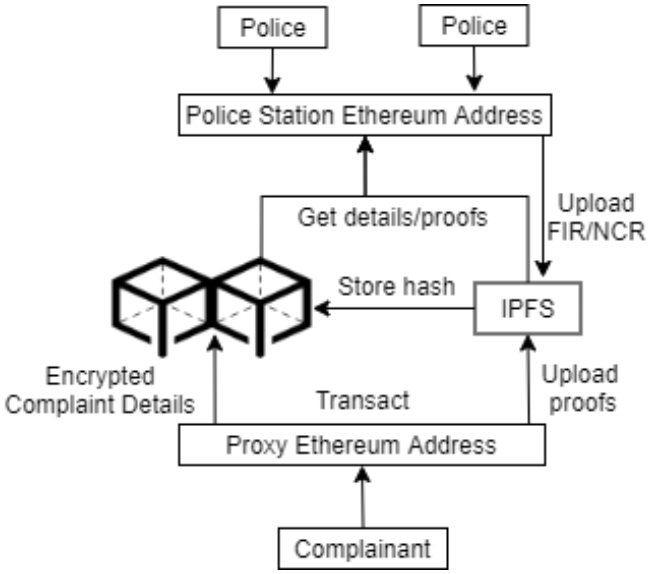

Fig. 2: Blockchain Module

C. Web/Mobile Interface

To provide a better user experience, a police officer can access the legal documents via a web portal. The web application provides simplicity in filing and managing length reports and documents. The complainant can file/access his complaint details via a cross platform mobile application built. This will provide quick access to the system while filing a complaint.

D. Implementation

1) Complainant Side (Fig. 3)
   (a) Firstly, a user will have to register himself in the system by providing authentic details.
   (b) Now, for registering a complaint, they will have to fill all the mandatory details regarding the complaint.
   (c) The complaint is then stored on the blockchain network and the corresponding police station is notified. Along with it, complaintID and policeStationID are stored in a database for fast retrieval of complaints on the police end. After successful registration of complaints, users can track the status of the complaint.
   (d) Complainants can apply for acquiring the chargesheet after the investigating officer files the chargesheet only if the complaint is against a cognizable offense.
   (e) Users can also file a complaint to the District Magistrate against a police officer in case of inactivity of the investigating police officer in filing the FIR. This will be sent in the form of a mail to the superior.
2) Police side (Fig. 4)
   (a) The Police can register on the website by providing appropriate details.

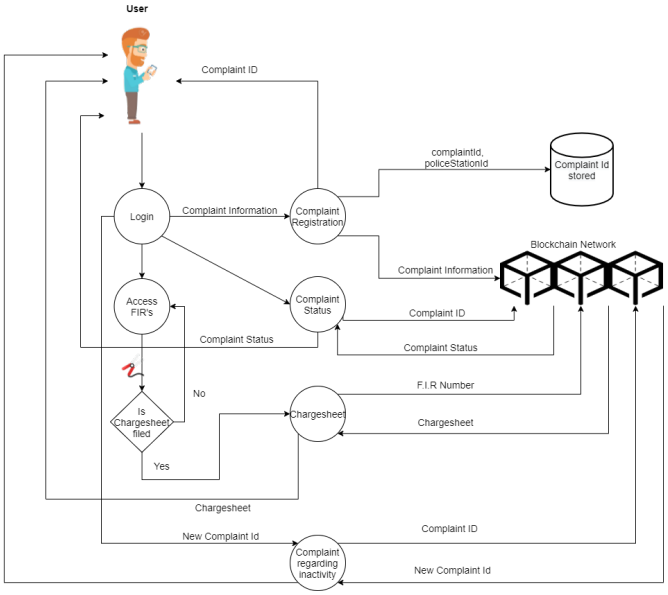

Fig. 3: Complainant Side Workflow

   (b) After logging in, complaints filed by various users will be made available to the police depending on the police station id.
   (c) The police will also be able to directly access the FIRs from the portal and file the chargesheet for the pending FIRs.
   (d) Depending on the type of complaint, for cognizable offence the police can file an FIR discard the complaint with appropriate reasons. The FIR or the reason for discarding will be stored on the blockchain network.
   (e) For non-cognizable offence the police can file an NCR or discard the complaint with appropriate reasons. The NCR or the reason for discarding will be stored on the blockchain network.

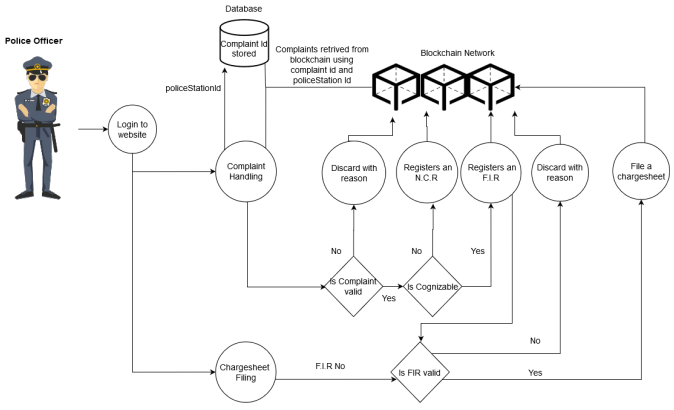

Fig. 4: Police Side Workflow

   (f) Depending on the validity of the investigation and the FIR filed, the police can then either file a chargesheet or discard the FIR with appropriate reasons. The Chargesheet or the reason for discarding will be stored

on the blockchain network.

(g) The Police can also view previously filed FIRs, NCRs and Chargesheet details.

IV. Results and Discussions

The system tackles the disadvantages in the existing system by providing the following enhancements which will be beneficial for both police officers as well as the complainants. The system ensures high abstraction such that the stakeholders can seamlessly use the system.

A. Complainant

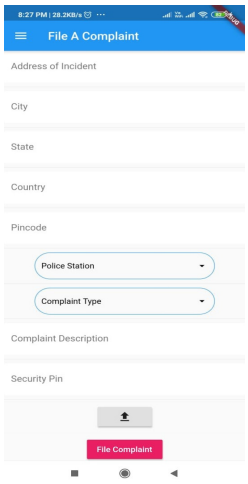

Fig. 5: File A Complaint

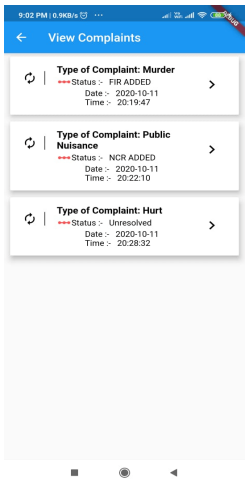

Fig. 6: View Complaints

(a) The complainants can easily file a complaint(Cognizable/non-cognizable) through a mobile application without having a need to go to a police station for registering a complaint. (Fig. 5)

(b) The complainant can track the status of the filed complaint in real-time. (Fig. 6)

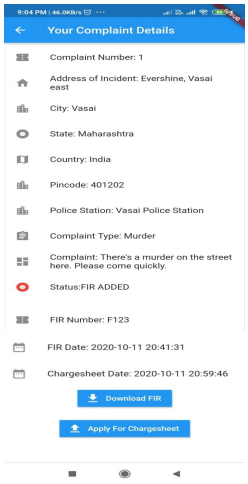

Fig. 7: FIR Details

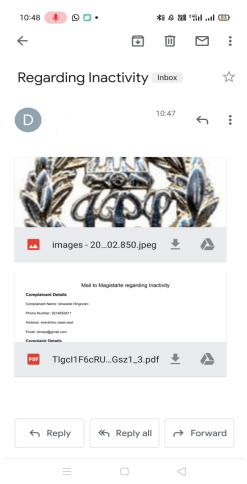

Fig. 8: Mail to Superior

(c) The use of IPFS ensures that the lodged FIRs/NCRs are always made available to the respective complainant. (Fig. 7)

(d) The mobile application has a facility to avail chargesheet by submitting a Right to Information(RTI) request using an "Apply For Chargesheet" button on the app.(Fig. 7)

(e) In case of inactivity (14 days after the complaint is filed) from the concerned police officer, the user can report to the District Magistrate(DM) i.e. the system automatically sends an email to the DM highlighting the inactivity of the police officer. (Fig. 8)

B. Police officer

The interactive website developed for the police officers ensures:

(a) Paperless management of complaints. (Fig. 9)

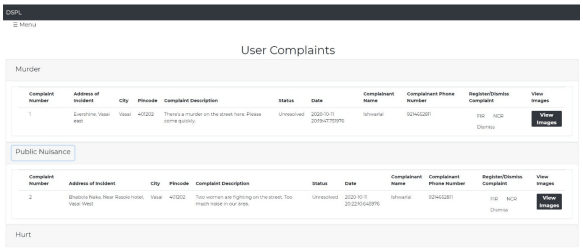

Fig. 9: Police Side view

(b) FIRs/NCRs can be easily filled/downloaded on the system. (Fig. 10,11)

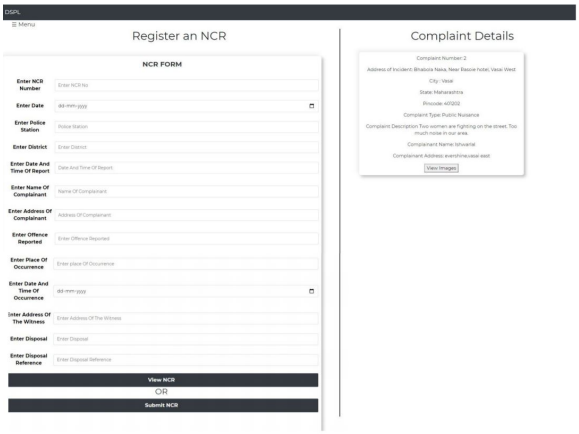

Fig. 10: Filing an NCR

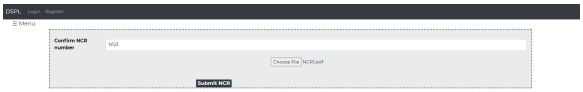

Fig. 11: Uploading an NCR

(c) Ease of filing an FIR. (Appropriate sections are recommended and complaint details are available while filing an FIR)
(d) Online serving of chargesheet. (Fig. 12)

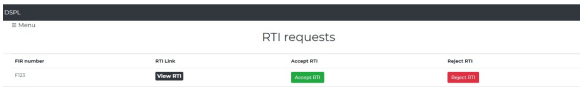

Fig. 12: Applications for acquiring Chargesheet

In the existing scenario, portals provided by Mumbai Police, Crime and Criminal Tracking Network Systems(CCTNS) etc. are being used to register complaints online. While Mumbai Police registers complaints against only Non-Cognizable Offences, CCTNS is providing a centralized system for each state, whilst being decentralized at the national level, taking into consideration both types of offences. Many governments have leveraged blockchain technology to provide cybersecurity, integrate hyper connected service and provide trust and accountability. This ensures the operational and technical feasibility of our proposed system.

V. Conclusion

Indian Police Services are a crucial part of our country. On a yearly basis, more than 50 lakh complaints against cognizable crimes are filed. Even after having systems to manage complaints online, there is still a burden on the police officers for filing handwritten reports and fear of filing a complaint in the mind of society. Managing Police Complaints in an efficient and secure way is very crucial because it contains sensitive data. The proposed system will provide transparency while also ensuring the confidentiality of the data stored. It will also motivate people to come forward and file their complaints knowing that it cannot be ignored by the police. It will also benefit the police officers by simplifying the tedious work of filing reports such as FIRs. The decentralized network does not rely on the trust factor of the stakeholders. We proposed a system that will protect against corrupt police activities and provide justice at the very beginning.

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