iJRASET
International Journal For Research in Applied Science and Engineering Technology



INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 12 **Issue:** V **Month of publication:** May 2024

DOI: https://doi.org/10.22214/ijraset.2024.61766

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International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 12 Issue V May 2024- Available at www.ijraset.com

Smart FIR: Blockchain Based FIR Lodging

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Abstract: ***In order to effectively deal with major crimes like murder, robbery, rape, and kidnapping, we need a secure system for case reporting. In general terms, victims or proxies complete and file e-initial reports (e-FIRs) online to report cybercrime offenses known as electronic crimes (e-crimes). This approach has some drawbacks which include susceptibility to cyberattacks and fraudulent entries. At the same time, scholars are examining various means of improving traditional ways based on technological advancements. One of the possible alternatives is the utilization of digital currencies like Bitcoin while dealing with criminals involved in electronic fraud. Ethereum has a blockchain which has raised curiosity due to its smart contract mechanism. Improvement in data integrity and prevention of fake registrations are the main goals that are meant to be achieved by incorporating Ethereum into the e-FIR system. Security plus reliability are provided for in high measures by the decentralized and immutable nature of the blockchain. This implies that after adding a record to it, it cannot be altered minus agreement from the network, giving it a high reputation based on how safe it is. The use of blockchain in smart cities, and more specifically the smart contracts in Ethereum, may revolutionize how major crimes are reported and recorded as it can offer much better transparency and information integrity in the eyes of both the public and the police.***
Keywords: Smart cities, Blockchain, e-FIR, Data integrity, Smart contract

I. INTRODUCTION

Smart cities utilize Information and Communication Technologies (ICTs) to improve the quality of life of its citizens, support sustainable development, and E-governance as well as support mobility security. These futuristic cities have seen massive investments by leading technology companies such as IBM, Intel, and Siemens who are motivated by the speed urbanization is taking place today. According to the UN report data, more than half of global inhabitants dwell in towns today and this figure is expected to increase up to 66 % by 2050 as of 2018. Ensuring secure and intelligent Electronic First Information Reports (e-FIRs) systems in police stations is crucial in such smart cities where daily vast data volumes are generated by the Internet of Everything (IoE) through interconnectedness networks. e-FIRs are filled out by victims or their representatives concerning cognizable offenses such as murder, rape, and hijacking among others. In areas with high police-to-population ratios, manual reporting may take a lot of time at police stations. Countries like Pakistan, India, Bangladesh, Malaysia, Japan, and Singapore utilize e-FIR systems however; procedures can vary in other parts of the world specifically Europe and the USA. It is due to police corruption; non-registration; inefficiency; and lack of accountability that these challenges of non-registration; false filings; and data integrity issues are emanating. The current storage of e-FIR data is done internally within the police station databases hence susceptible to manipulation. In dealing with these challenges, it is essential to see blockchain technology as a valuable tool because it boosts security and aids in the enforcement of data integrity due to its decentralized and tamper-proof nature. For every transaction that happens within the Peer-to-Peer (P2P) network; therefore; recording it on blockchain makes it tough for modification. The purpose of this study is to introduce a design based on blockchain technology that can be used to keep the integrity of e-FIR data within smart cities while reducing false reports. The utilization of blockchain technology in the e-FIR systems will make it possible to deal with false filings and guarantee the reliability of the data for the first time.

Table I: Police To People Ratio In Some Countries

No.	Country	Police-People Ratio
1	Bangladesh	1:645
2	India	1:655
3	Pakistan	1:545
4	Singapore	1:500
5	Malaysia	1:324

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ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
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II. BACKGROUND AND RELATED WORK

In conventional systems, criminal records and various offense data are typically centralized in a single repository. However, centralized systems present several drawbacks, such as a single point of failure. Conversely, storing offense data in individual databases at police stations exposes them to significant vulnerabilities:

1) *Data Tampering:* Data being saved within a local institutional database allows the administration to interfere with important data without the consent of other entities. The way to solve this is by digitally signing each piece of data then sharing them among different organizations so as to ensure transparency.
2) *False Registration:* If police officials can retrieve data from a local database, without disclosing the personal ID number and pertinent credentials of the officer in charge then they are able to wrongly book someone's charges. It is hard to trace the true person involved after the incorrect case has been lodged. To mitigate this, one may provide administrative rights across different organizations where you work.

Boosting the security of the system while verifying the defense's data integrity requires a decentralized consensus-based strategy. With no need to worry about data tampering, this enables users to share information confidently using the system. Recently, blockchain has attracted much interest primarily because of its decentralized nature that does away with centralized control among other reasons.

This requires numerous stakeholders to validate the records to guarantee their integrity: total transparency is then achieved. Public and private blockchains are the two main categories of blockchain networks today, Bitcoin and Ethereum being examples of public ones secured using Proof-of-Work (PoW), while Hyperledger Fabric represents private ones supported by Proof-of-Authority (PoA), all operating in trustless environments for online P2P transactions. Smart contracts, the reigning star in the arena of blockchains, are in a nutshell software-defined protocols assisting in the digital validation, enforcement, or negotiation of a contract without going through a middleman thus ensuring transparency and finality in transactions. Ethereum, one of the best examples of blockchain platforms, enables smart contracts to be scripted through object-oriented Solidity.

Different issues related to blockchain as a solution have been researched. In her article about induced pluripotent cells, Samorej presented some of the major benefits that were identified during her research, such as greater efficiency in generating large numbers of them. These problems still remain today and they must be addressed as soon as possible so that we can take full advantage of this technology.

We can quickly find patients for clinical trials if more researchers join us in this project since they would be able to access a vast number of databases with just one click. Kirti et al. brought a portal-based e-FIR system, with data authenticity and integrity ensured through pre-registration, but did not fully consider the issues of data integrity. Third eye' is a description by Mohammad Baqer Mollah et al. of a system which links all police stations in the city to the Home Ministry in order to watch over what goes on there, however, its central database under Home Ministry officers is not fully secured.

After a review of the literature, no one has really looked at how electronic FIR databases could be managed so that they remain truthful, especially against fake registrations made in a central police station database. As such, we recommend that a consortium-led blockchain approach should be utilized to enhance the transparency of such databases.

III. PROPOSED BLOCKCHAIN-BASED FRAMEWORK

To manage e-FIR data integrity in the future a central database within a fully-connected digital city (smart city) interoperability scenario, a proposed intelligent system will handle it. The approach seeks to improve e-FIR data accountability across many organizations rather than just one controlling it through a decentralized oversight which is achieved using blockchain technology.

This new system involves two important things: one is the system that employs decentralized blockchain ledgers together with smart contracts so as to secure e-FIR data, making it impossible to distort or commit fraud.

A. System Architecture

The suggested workflow of the system architecture, outlined in Figure 1, is briefly described as follows.

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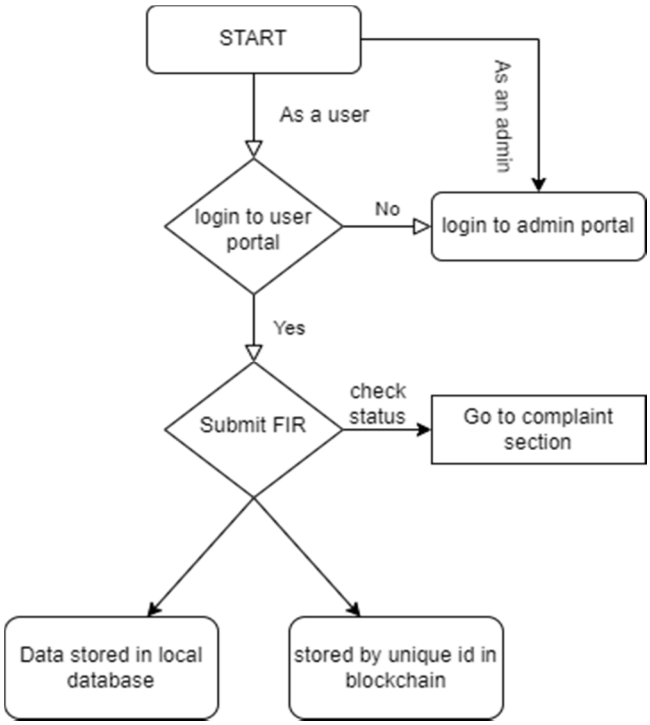


Figure 1: Diagram Illustrating The Suggested Architecture Based On Blockchain Technology.

1) *User Filing an e-FIR:* In the submission of FIR perpetrators fill in their residence, nature of offense, and the incidence description on the user portal for FIR lodging. This will ensure the unique hash ID is generated so that data integrity, as well as immutability, are guaranteed on the blockchain. The complaints dashboard permits users to monitor the stages that their FIRs are in while also viewing what state their complaints are at. Hence, this approach promotes user interactivity and openness which boost confidence in the FIR filling process
2) *Admin Approves e-FIR Transaction:* The entire process is overseen by the authority that the administrator has to ascertain the status of a given FIR and approve modifications where necessary. The admin can also see the details of workers for effective supervision. Opening FIRs will allow the admin to expound on it by giving comprehensive information like the user's location, kind of crime committed, and description for instance. This comprehensive perspective helps administrators to make the right choices and act accordingly. In this way, administrative duties are done with ease through such features.
3) *False FIRs:* If a First Information Report (FIR) is found to be misguided or intentionally misplaced, the administrator has the power to scrap it to prevent the wastage of resources that would have been used otherwise. By changing the status of this kind of FIRs, only genuine ones get to utilize the scarce resources available thus increasing effectiveness. This is due to the ability of the admin to coordinate the system of FIR submission and resource utilization with regard to available options. Their judgment enables them to maintain credibility on the platform and ensure that true cases have a priority over others enhancing confidence in police enforcement.

IV. IMPLEMENTATION

A. *User Interface*

1) *User Portal*

Users are required to provide a detailed explanation of the incident/service they are complaining about including detailed descriptions, the exact time and date when it happened, and where it happened. There are clear instructions on what is expected of them on this page which is user-friendly too. Users can see the status of their complaints by going to the complaints section. A user-friendly interface makes it easy to submit complaints, and a prominent submit button completes the process. After submitting the FIR, it receives a unique FIR ID.

2) Admin Portal

The administrative dashboard showcases significant performance indicators to summarize all complaints effectively. Lists of detailed complaints make handling and ranking concerns easy for the administrators. Resolution of reported incidents is fast by changing complaint status and taking required steps by the administrators. Therefore, this platform aims to enhance the efficiency of administrators and make it simple to deal with grievances.

B. Ethereum Blockchain

For the Ethereum blockchain we implemented, we used Ganache provided by Ethereum devs. It offers ten accounts and each of them has a hundred ethers for their sole use in developmental stages. To make sure it scales, we designed and deployed one individual blockchain that can produce multiple node-exclusive addresses. When you appoint an authority to oversee mining tasks, the personal blockchain utilizes computational power efficiently to speed up the process of block mining. However, in contrast to Ethereum's PoW mechanism which involves performing a lot of computations before a block can be mined, PoA benefits can be realized by using smart contract functions and specifying addresses for particular operations.

3) Smart Contract

In the model that we have created, a secure agreement was established using Solidity with the Remix IDE for the Ethereum network to keep the data hashes. The smart contract contains some functions referred to in part 3 discussed herein above. That is; registering all Police Stations, posting hashes in the blockchain, and changing the Detective's details.

In our blockchain framework, different hashing algorithms were used. The computational work for operations in Ethereum is measured by "gas". Even though it is the safest hashing algorithm by far, SHA-512 (512 bits) consumes high gas such that transactions per block are restricted. On the other hand, SHA-1 (160 bits) allows the largest number of transactions per block though it is not as secure. As such, SHA-256 (256 bits) is what we have decided on since it balances gas consumption against hashing security thereby ensuring data integrity.

4) System Specifications

We conducted tests on the proposed e-FIR model using the system specifications outlined in the provided table

Table II: System Specifications

System RAM	16 GB DDR4
Hard Drive	512 SSD
System Core	Intel Core i5
Operating System	Windows 11

V. METHODOLOGY

There are several key steps employed in this project's methodology. To begin with, the Ethereum blockchain network is set up using Truffle for programming smart contracts while Ganache is used for testing them locally. Additionally, deployed on this network are smart contracts that control the FIR filing process ensuring its transparency, immutability as well as security measures are in place. Furthermore, SQL alongside blockchain technology is used efficiently to manage the FIR database making it easier for user queries and downloading data without any interruptions. A method of making RESTful APIs with Python Flask is used so that communication can occur between blockchains and user interfaces. Front-end development makes use of JavaScript and React.js to create user-friendly entry points for both individuals submitting FIRs as well as admin staff who are tracking the progression. This creation process proceeds in an iterative manner involving continual testing, fixing errors, and improving systems until they become both useful and usable.

VI. RESULTS

The user interface of the system to register FIR is shown in Figure 2. And Figure 3 shows the Admin Panel which gives the overview of the FIRs.

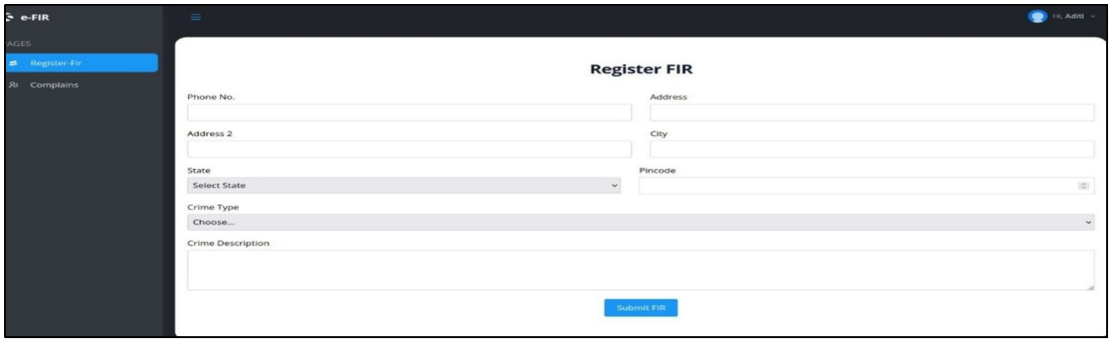


Figure 2: User Interface of Proposed System



Figure 3: Admin Panel of Proposed System

VII. CONCLUSION

This research looks into how blockchain technology can be used in addressing data tampering issues as well as fake report filings at police stations which has not been explored much. The document proposes a way to ensure the truth behind crime statistics that are saved by various police stations via blockchain. A number of tests were conducted on models for the maintenance of e-FIR data transactions by smart contract to showcase the equilibrium between transaction numbers per block and hashing security level. Our outline combines Python, Flash, and MySQL for Ethereum blockchain integration with React.js to make e-FIR data exchanges secure via smart contracts.

VIII. FUTURE WORK

There are plans to expand the utilization of the FIR lodging project that is blockchain-based nationally at police stations so that all of them can be easily enrolled and integrated. The security of the system could increase through the inclusion of an OTP verification arm which guarantees genuineness in complaint submissions. This system may also integrate with a central database covering all citizens' details and that improves its efficiency and scope. Including these components would increase the efficiency of FIR management as well as make law enforcement more effective. It is in line with the main aim behind this initiative to boost transparency, accountability, and accessibility in reporting incidents, hence making a legal system that is not only robust but also credible.

IX. ACKNOWLEDGMENT

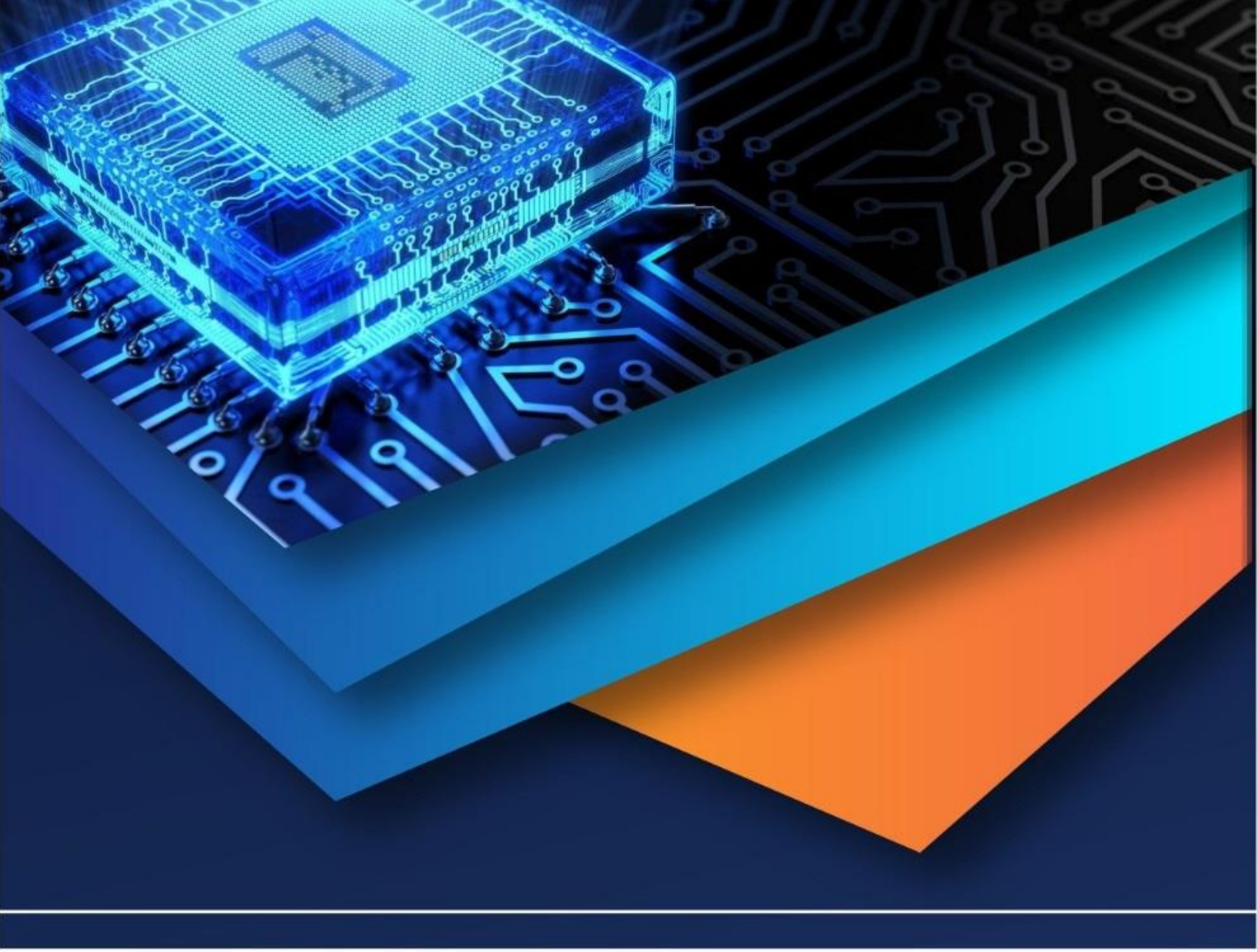
We thank our guide, Professor Rahul Sonkamble, for all the help and advice you have given us throughout this project. This project would not have been successful without his guidance.

Also, we would like to thank Dr G.R Pathak, the Head of the Computer Science and Engineering Department along with S.P. Phansalkar, for their help during the research period. We appreciate help from other instructors who offered much needed support. Finally, we are grateful to MIT ADT University for giving us this opportunity.

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