Enhancing Justice with Secure, Privacy Preserving Blockchain & XAI

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Abstract:
This project, is a web-based program used to modernize and secure judicial process. It uses the Blockchain to guarantee the integrity and immutability of case records, and Machine Learning offers the judges the second opinion on the basis of historical case data. The system enables the judges to obtain detailed information about the cases, evidence management, and secure sharing of data with the stenographers. Cases and evidence can be generated in police stations and uploaded on the Blockchain which is securely stored. The access provided to stenographers to manipulate case updates and add new evidence only with the permission of the judiciary creates transparency and accountability throughout the process. The platform also includes a public view feature, allowing citizens to access case information online, promoting openness in the judicial system. All the relevant people receive automated messages about case dates and times, enhancing communication and efficiency. This system will ensure a more reliable, transparent, and efficient judicial process to all stakeholders by integrating the security of Blockchain with analytical power of Machine Learning.

Key Words: Blockchain in Judiciary, Machine Learning for Case Prediction, Secure Case Management, Judicial Transparency.

INTRODUCTION

The judicial system is an essential aspect of the society that provides fair and efficient delivery of justice. Nonetheless, historical court proceedings are known to encounter challenges like slow processing of cases, paperwork in record keeping, lack of transparency, and challenges in processing big data. These problems may increase the rate of justice delivery and in some cases, decrease the trust the people have in the system. These issues can be significantly solved with the assistance of modern technology. The Project is going to modernize the judicial process with the help of new technologies. Blockchain is employed to keep the records of cases and evidence in a secure way cannot be interfered with. This guarantees integrity and reliability of all judicial documents. Case information can be accessed and updated securely by the judges, police and stenographers and fraud or loss of information is minimized.

The system enhances transparency, as citizens can access information on cases in the public on line. All stakeholders remain informed on the dates and updates of the cases through automated notification, enhancing communication and eliminating the chances of missing crucial information. This assists officials and the population to remain involved and informed about judicial issues at hand. This platform offers a safe, efficient and transparent system of justice by using a combination of Blockchain and Machine Learning. It saves time on paperwork, enhances decision-making and creates public trust, and makes the entire process quicker, safer, and more trustworthy to all parties involved.

LITERATURE SURVEY

1. Blockchain in Legal Evidence Management: Dr. J Rajeshwar et al. (2025): This article is a holistic method of Blockchain in managing legal evidence. The authors suggest a scheme based on SHA-256 hashing, Merkle Trees, and a Proof of Authority (PoA) consensus mechanism, which would make sure that all the evidence stored on the blockchain is unalterable and highly secure. [1]
2. CourtSafe: Legal Records storage management with blockchain-Rohit Kumar et al. (2024): The

CourtSafe is a project that aims at modernizing the legal record management using blockchain. This system will be set to manage high quantities of legal documents whilst upholding security, transparency, and efficiency. It supports Ethereum smart contracts to automate access control and impose rules on how the documents are used and AES encryption to keep sensitive information confidential. CourtSafe also has an easy to use, multi- platform interface making it available to both judges and lawyers as well as administrative staff. [2]

3. Liu and Lapata (2019) suggested an extractive text summarization model that uses the pre- trained BERT transformer, a model that provides deep contextual representations of text. When the sentences are encoded using BERT, the model was able to identify and extract the most important sentences of a given document and produced summaries that scored high in ROUGE scores, and which were also able to extract the main information. Although the method showed good performance on extractive summarization, it failed to perform well on abstractive summarization, i.e. it was not able to produce new phrasing or paraphrase text. The model further consumed a lot of computational resources since it was complex and this may limit its implementation in real time or large scale applications. [3]

4.

METHODOLOGY

The suggested system is the Justice with Blockchain and Machine Learning, an online tool that will help to make the judicial system more secure, transparent, and efficient. It employs Blockchain in order to store all the records of cases and evidence in a safe place where no information can be tampered or lost. It uses Machine learning to give the judges clues and predictions using past case data, to make a better decision. 10 Under this system, police would have the capability of creating cases and uploading evidences, judges would be able to access detailed case in formation and handle evidence and stenographers would update case records with judicial acceptance. People are also able to access information about cases in the society online and this enhances transparency. Case updates and hearing dates are informed to all concerned parties through automated notifications. All in all, the proposed system would guarantee secure data management, enhanced decision support, effective communication and transparency, which would enhance the judicial process to all stakeholders.

OBJECTIVE

1. To securely store case records and evidence using Blockchain, ensuring data cannot be altered or lost.
2. To assist judges in decision-making by providing insights and predictions based on historical case data using Machine Learning.
3. To improve transparency by allowing authorized officials and the public to access relevant case information safely.
4. To enhance communication and efficiency by sending automated notifications about case up dates, dates, and important events.

PROBLEM DEFINATIONS

The judicial system has a number of issues such as slowness in handling cases, records are lost or dispensed, no transparency, and handling large masses of cases. Paper-based or centralized digital systems tend to be vulnerable to human errors and electronic security breach, which may diminish public trust and effectiveness. It is necessary to have a new solution to provide safe, open, and effective management of case records and evidence as well as offer analytical assistance to make better decisions. This project will help to solve these problems by implementing both Blockchain (to store records safely and without tampering) and Machine Learning (to advise judges with the help of numerical data) in order to enhance the overall credibility and efficiency of the judicial system.

SYSTEM ARCHITECTURE

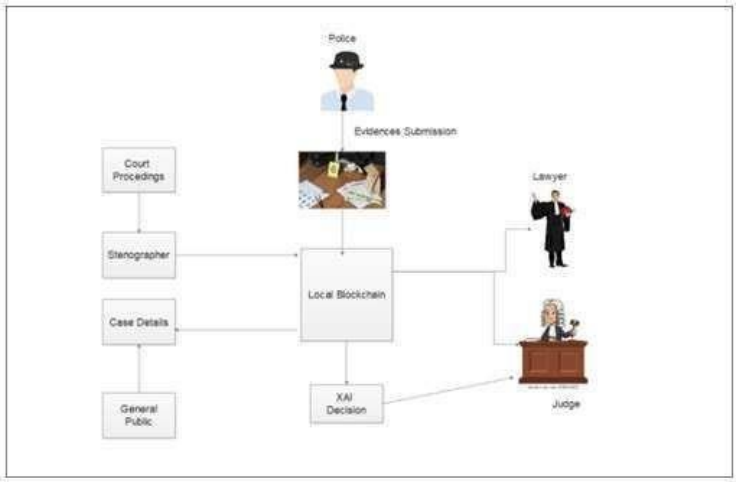

Fig: System Architecture

It is a web based system developed with the role based access control and is used to allow interactions between the police, judges, stenographers and citizens in a secure and efficient way. Evidence, updates, and case records are stored in a blockchain, which is immutable, encrypted, and audited. It uses Machine Learning to analyze past case information, uncover patterns, and offer decision-support analytics to judges, enhancing the effectiveness and accuracy of the judgments. The system provides an easy-to-use interface where users can create cases and add evidence, judges can review cases and work with evidence, stenographers can update records after approval, and citizens can access information about the public cases to be transparent. Notifications are automated to ensure that all stakeholders are informed about updates of the cases and the schedule of the hearings. Multi- factor authentication and stringent security are also embedded in the system to ensure that sensitive information is not stolen. Functional, performance and security testing is done to provide reliability, scalability and confidentiality during the judicial process.

FUCTIONAL REQUIREMENTS

Functional user requirements could be high-level statements of what the system must do but functional system requirements must also provide statements on what the system services are in detail. The following are the key fields, which should be part of the functional requirements:

1. 1. User Authentication: The system should permit the secure access of the judges, police, stenographers, and citizens.
2. 2. Case Management: Police are able to create new cases, add evidence and update cases.
3. 3. Evidence Handling: Judges and stenographer scan add, verify, or handle evidence with blockchain secured security.
4. 4. Machine Learning Support The system offers predictive information or suggestions to judges on the basis of past case information.
5. 5. Public Access: Citizens have the ability to access public case information in a controlled way.

NON FUCTIONAL REQUIREMENTS

1. Security: Data should be stored safely in the blockchain so that it cannot be tampered with and accessed by unauthorized persons.
2. Performance: The system must be able to support multiple users at a time and huge amounts of data.
3. Scalability: Should be able to handle an increase in the number of cases, users and data without a drop in the performance.
4. Reliability: System must be highly available and robust so that there is minimum downtime.
5. Usability: The interface must be easy to use, intuitive and multi-platform friendly.

IMPLEMENTATION

CONCLUSION

Finally, project offers a contemporary answer to enhance a judicial system through securing it, making it more transparent and efficient. With the help of Blockchain, all the records and evidence of cases are kept securely and cannot be corrupted, and the judges are assisted by Machine Learning in making more effective decisions, relying on the past information. The system also facilitates easy cooperation between police, judges and stenographers, issues automatic notifications, and permits access to some information in a case, which enhances transparency. On the whole, the platform will minimize delays, provide confidence in the judicial system, and make the process of delivering justice to all parties quicker and more predictable.

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