

An Intelligent Tender Management System Using Block Chain And IPFS

Mohd Basit Mohiuddin¹, B Deepa², C Jabilli³, Narayana Sneha⁴

¹Assistant Professor; Department Of Computer Science And Engineering (AI&ML) Bhoj Reddy Engineering College For Women Hyderabad India

^{2,3,4}B.Tech Students; Department Of Computer Science And Engineering (AI&ML) Bhoj Reddy Engineering College For Women Hyderabad India

Mail Id; bdeepagoud01@gmail.com², cheerlajabilli@gmail.com³, snehanarayana11@gmail.com⁴

ABSTRACT

The tendering process is a fundamental component of procurement systems in both public and private sectors; however, conventional approaches are often affected by issues such as data manipulation, limited transparency, centralized storage risks, and inefficient manual procedures. These limitations reduce trust, fairness, and accountability in procurement operations. To overcome these challenges, this work presents an Intelligent Tender Management System based on Blockchain and the InterPlanetary File System (IPFS), aimed at achieving a secure, transparent, and tamper-resistant tendering environment. The proposed system leverages blockchain technology to maintain a decentralized and immutable ledger that records all critical tender activities, including tender creation, bid submission, and evaluation processes. This ensures data integrity and prevents unauthorized modifications. In addition, IPFS is utilized for decentralized storage of tender documents, providing content-addressable access through cryptographic hashing and eliminating reliance on centralized servers, thereby improving fault tolerance and security of sensitive information. Smart contracts are integrated into the system to automate key operations such as bid validation, opening of tenders, evaluation, and selection of winning bids. This automation reduces human intervention, minimizes errors, and eliminates potential bias in decision-making. The implementation is developed using Solidity for smart contracts, Python and Flask for backend services, and Ethereum-based tools such as Ganache and MetaMask for testing and interaction.

KEYWORDS

Blockchain, IPFS, Smart Contracts, Tender Management System, E-Procurement, Decentralized Applications, Ethereum, Transparency, Security, Automation

Introduction

Tendering is a critical procurement mechanism used by organizations to select suitable contractors or suppliers for executing various projects and services. Despite its importance, traditional tender management systems are associated with several

limitations, including data manipulation, lack of transparency, processing delays, and human-induced errors. These issues significantly reduce stakeholder confidence and compromise the fairness and reliability of the overall tendering process. In response to these challenges, this project proposes an Intelligent Tender Management System based on Blockchain and the InterPlanetary File System (IPFS). The adoption of blockchain technology ensures a secure and immutable record of all tender-related activities, where once data is recorded, it cannot be altered or deleted, thereby guaranteeing integrity and accountability. Furthermore, IPFS is utilized to provide decentralized storage for tender documents, ensuring secure, distributed access while eliminating the risks associated with centralized data repositories. In addition, smart contracts are incorporated to automate key operations such as bid submission, validation, evaluation, and winner selection, thereby improving processing efficiency, reducing human intervention, and ensuring unbiased decision-making.

Existing System

Existing e-tendering systems enable organizations to publish tenders and collect bids through online platforms; however, they continue to depend heavily on centralized database architectures. In such systems, all tender-related data is stored within a single controlled environment, making it vulnerable to security threats such as data tampering, unauthorized access, and potential system failures. Since control remains with a central authority, participants are required to place complete trust in the system administrator, which raises concerns regarding transparency and fairness. Moreover, current systems provide limited auditability, as there is no strong mechanism to guarantee that submitted bids remain unchanged throughout the evaluation process. The reliance on manual or semi-automated evaluation methods further increases the possibility of bias, manipulation, and processing delays. As a result, existing tender management solutions fail to deliver the level of security, transparency, and trust required for fair procurement operations, highlighting the need for a decentralized, tamper-resistant approach using blockchain and IPFS technologies.

Proposed System

The proposed system introduces a decentralized Intelligent Tender Management System that integrates Blockchain technology and IPFS to enhance security, transparency, and automation throughout the tender lifecycle. In this approach, all critical tender operations such as tender creation, bid submission, evaluation records, and final results are securely stored on a blockchain ledger, ensuring data immutability and verifiability. At the same time, large tender-related documents are stored on IPFS in a distributed manner, while only their cryptographic hashes are recorded on-chain to enable secure validation and integrity checking. Smart contracts are employed to automate essential processes including bid verification, deadline enforcement, bid evaluation, and winner selection, thereby eliminating manual intervention and reducing the possibility of bias or delays. Additionally, the system incorporates secure user authentication and encryption mechanisms to control access to sensitive data. A web-based interface acts as the user interaction layer, connecting frontend applications with backend services that communicate with both the blockchain network and IPFS, resulting in a secure, efficient, and fully transparent digital tendering environment.

LITERATURE SURVEY

The development of the Intelligent Tender Management System is based on extensive research in the areas of blockchain technology, decentralized storage systems, and secure e-procurement frameworks. Several studies have been reviewed to understand existing approaches and identify research gaps relevant to the proposed system.

The study by Rutuja D. Sanjekar and Balaji M. Patil, titled *“Techniques of Securing Educational Document using Blockchain and IPFS Based System: A Review,”* examines various methods for securing digital documents using blockchain technology. The authors analyze how blockchain can be used as an immutable ledger to ensure data integrity, while IPFS is applied for decentralized document storage to prevent unauthorized modifications and forgery. Although the study identifies challenges such as scalability limitations and computational overhead, it concludes that the integration of blockchain and IPFS significantly enhances document authenticity and trustworthiness, making it suitable for secure digital systems. Another important contribution by Yufei Lin and Chongyang Zhang, titled *“A Method for Protecting Private Data in IPFS,”* explores privacy-preserving mechanisms in distributed storage environments. The authors propose a hybrid approach where blockchain is used to store metadata and access permissions, while IPFS handles decentralized file storage. Smart contracts are utilized to manage user access and improve data security. Despite increased system complexity, the

study demonstrates that combining blockchain with IPFS improves privacy protection and reduces unauthorized data access, highlighting the effectiveness of permission-based decentralized storage models. The work by Jiwon Bang and Mi-Jung Choi, *“Design of Personal Data Protection Decentralized Model Using Blockchain and IPFS,”* focuses on decentralized identity and personal data protection systems. The authors propose a self-sovereign identity framework where sensitive user information is stored in distributed storage systems with blockchain ensuring integrity and user control. While issues such as scalability and energy consumption are discussed, the study concludes that blockchain-based decentralized identity systems significantly improve data privacy and reduce dependence on centralized authorities, thereby strengthening trust in digital ecosystems. In addition, the paper *“Blockchain-Based E-Tender Management System”* presents a blockchain-enabled approach to enhance transparency and security in procurement processes. The system is designed to manage the entire tender lifecycle through smart contracts, covering stages such as tender publication, bid submission, evaluation, and final selection. All tender-related data, including bids and approval records, are securely stored on the blockchain to ensure transparency and prevent tampering. Although implementation complexity and scalability remain challenges, the study confirms that blockchain technology improves fairness, accountability, and trust in e-tendering systems.

REQUIREMENTS ANALYSIS

Functional Requirements

The proposed Intelligent Tender Management System consists of multiple functional modules designed to support different user roles and ensure secure and efficient tender processing. The Bidder Module allows users to register, authenticate, and participate in tenders. Bidders can view available tenders, access detailed tender documents, submit bids by uploading documents to IPFS, and store corresponding hashes on the blockchain for verification. Additionally, bidders can track bid status, view results, and securely log out from the system. The Tender Officer Module enables authorized officials to manage the entire tender lifecycle. This includes registering and logging into the system, creating and publishing tenders, uploading specifications and deadlines, reviewing submitted bids, and announcing final results. This module ensures proper control over tender operations and maintains structured workflow management. The Admin Module is responsible for system monitoring and governance. The administrator can view blockchain transaction records, manage bidder and tender officer details, and monitor overall system activity. This ensures

transparency, accountability, and system integrity. The Blockchain and Smart Contract Module forms the core of the system. It stores tender document hashes and bid hashes on the blockchain to ensure immutability. Smart contracts automate key operations such as bid validation, automatic bid opening after deadlines, locking of bids, and recording of final results. This ensures a tamper-proof and transparent audit trail throughout the tendering process.

Computational Resources

The system requires a standard hardware and software configuration for development and deployment. The hardware setup includes a Windows operating system, an Intel i5 or higher

processor, a minimum of 8 GB RAM, and at least 25 GB of available storage space. On the software side, Python IDLE (version 3.7 or above), Node.js, Visual Studio Community Edition, Ganache, and MetaMask (Chrome extension) are utilized. The backend is implemented using Python, JavaScript, and Solidity, while the frontend is developed using HTML, CSS, JavaScript, and Bootstrap. The system is built using a Flask framework to integrate frontend and backend services with blockchain and IPFS components.

DESIGN

Architecture

Software Architecture

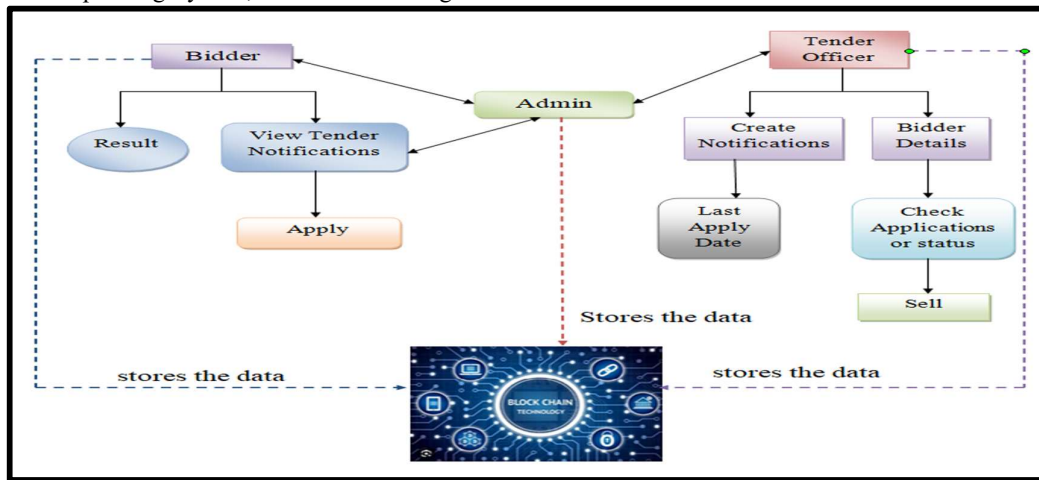


Fig 1 Software Architecture

The architecture of the proposed Intelligent Tender Management System is designed to ensure secure, transparent, and decentralized management of the entire tendering process. It is divided into two main components: software architecture and technical architecture. The system integrates blockchain technology, IPFS storage, and a web-based application layer to provide end-to-end

functionality. The software architecture illustrates how different modules such as bidder, tender officer, and administrator interact with the backend services, blockchain network, and IPFS storage system. Each module communicates through APIs, ensuring smooth data flow and secure transaction handling.

Technical Architecture

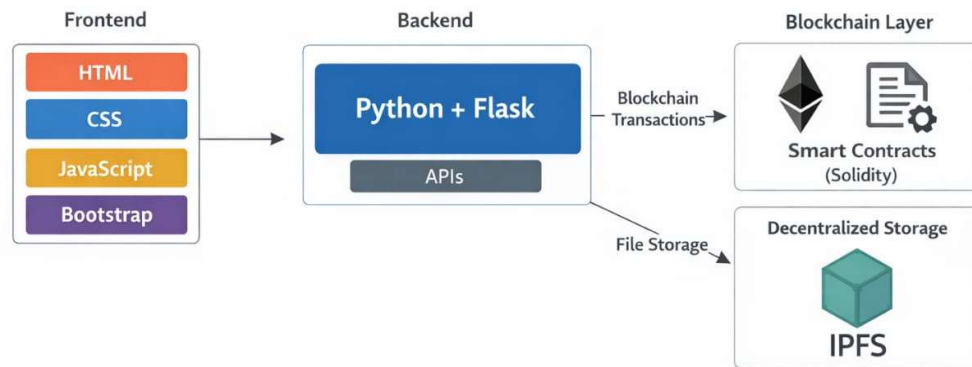


Fig 2 Technical Architecture

The technical architecture defines the underlying technological framework of the system. It consists

of a frontend interface built using web technologies, a backend developed in Python using Flask

framework, and a blockchain layer implemented using Ethereum smart contracts. IPFS is used as a distributed storage system for storing tender documents, while only their cryptographic hashes are stored on the blockchain. This hybrid architecture ensures data integrity, decentralization, and high security across the entire system.

IMPLEMENTATION

The implementation of the Intelligent Tender Management System is carried out using blockchain technology, IPFS storage, and web-based frameworks. The backend is developed using Python with Flask, which handles API requests and system logic. Blockchain integration is achieved using Web3 libraries, enabling communication with Ethereum smart contracts deployed on a local Ganache network. IPFS is used for decentralized file storage, where uploaded tender documents are converted into hash values for secure referencing. Smart contract functions are used to manage user registration, tender creation, bid submission, and transaction recording. These functions ensure immutability and automate critical operations in the system. Additionally, OTP-based email verification is implemented to enhance user authentication and security. The frontend is developed using HTML, CSS, JavaScript, and Bootstrap, providing a user-friendly interface for interaction with the system.

TESTING

Testing is a critical phase in the development of the Intelligent Tender Management System to ensure correctness, security, and reliability. The system is tested to validate the functionality of blockchain integration, IPFS storage, smart contracts, and user interfaces. Since the system handles sensitive tender data, special attention is given to security and data integrity. Testing ensures that all modules perform as expected and that the system meets functional and non-functional requirements before deployment.

Dimensions of Testing

The system is evaluated using multiple testing dimensions. Functional testing ensures that all features such as tender creation, bidding, and evaluation operate correctly. Performance testing measures system responsiveness, scalability, and load handling capability. Security testing verifies protection against unauthorized access and ensures blockchain-based data protection. Usability testing evaluates the ease of use and user interface design. Compatibility testing ensures the system works across different browsers and environments. Data integrity testing confirms that information stored on blockchain and IPFS remains consistent and tamper-proof.

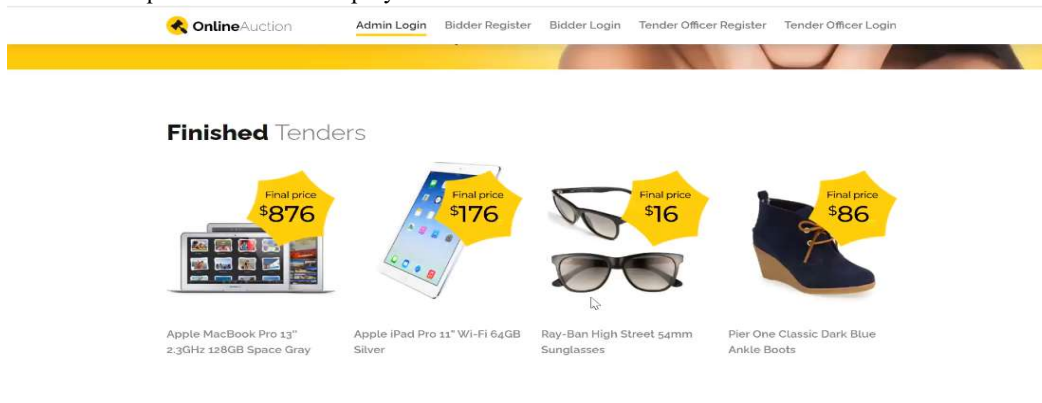
Stages of Testing

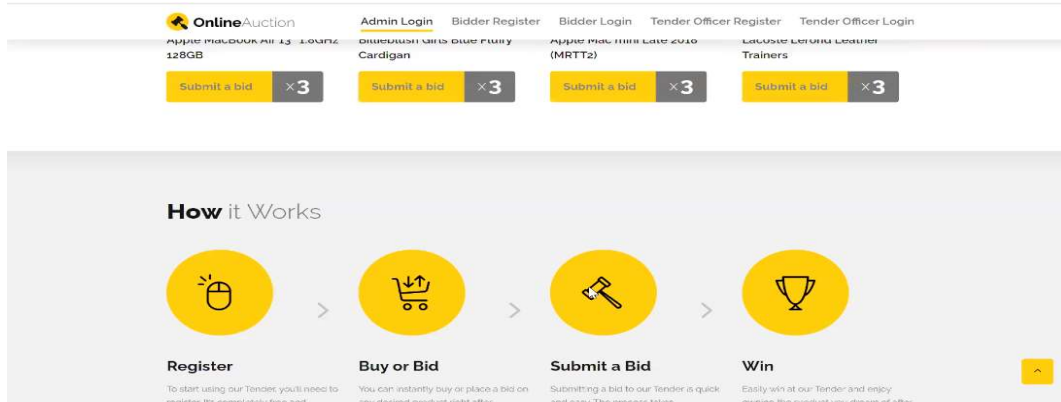
Testing is carried out in multiple stages to ensure system reliability. Unit testing is performed on individual components such as smart contracts and backend modules. Integration testing verifies the interaction between blockchain, IPFS, and frontend components. System testing evaluates the complete system functionality as a whole. User acceptance testing allows end users to validate system requirements. Regression testing ensures that updates do not affect existing functionality. Finally, deployment testing checks system performance in a real-world environment.

Types of Testing

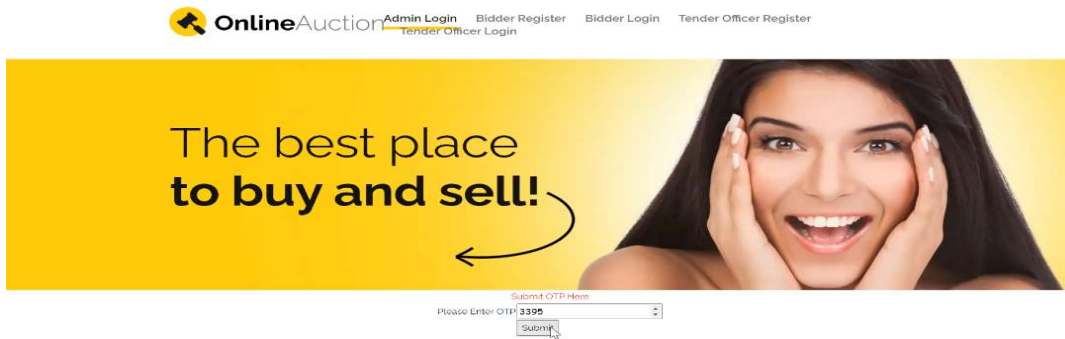
Various types of testing techniques are applied in the system. Black box testing focuses on validating outputs without analyzing internal code. White box testing examines internal logic and code structure. Manual testing is performed by testers to identify functional issues. Automated testing is used for repetitive test cases to improve efficiency. Security testing ensures smart contract safety and data protection. Performance testing evaluates system speed, stability, and scalability under different loads.

Screenshots

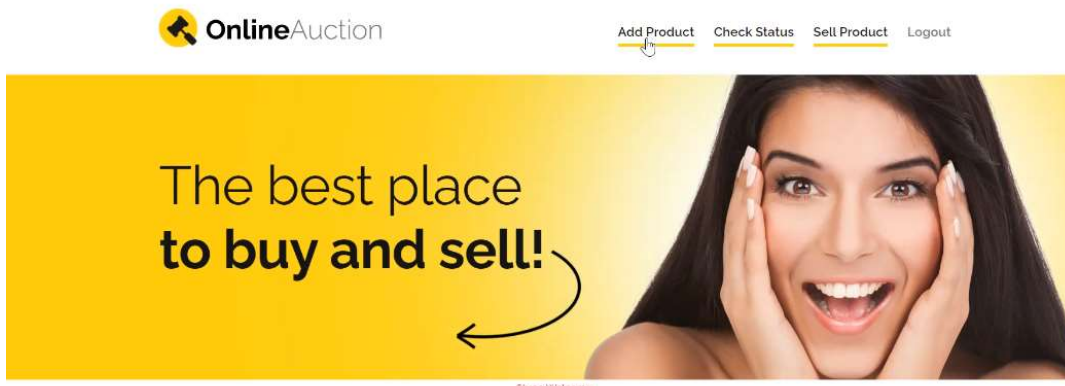




Fig;1 Opening Tender Management Application



Fig;2 Product Management and Bidding Process



Fig;3 Tender Evaluation

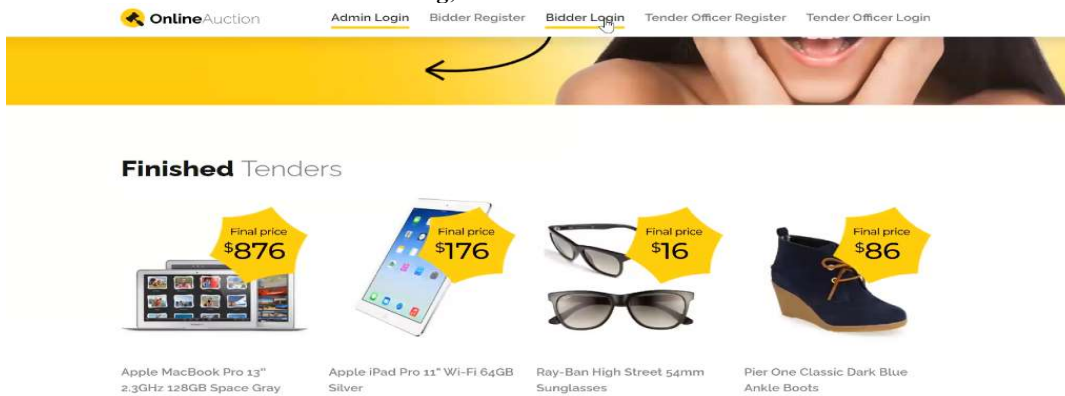




Fig 4; Result and Transaction Details

CONCLUSION

The proposed Intelligent Tender Management System addresses the major challenges associated with traditional tender and contract management processes, particularly issues such as data manipulation, lack of transparency, and centralized system vulnerabilities. By integrating blockchain technology with secure cryptographic mechanisms, the system establishes a decentralized and tamper-resistant framework for managing tender operations. Blockchain ensures that all transactions, including bid submissions, evaluations, and contract records, are stored in an immutable ledger, thereby preventing unauthorized modifications and enhancing trust among participants. In addition, the incorporation of the InterPlanetary File System (IPFS) strengthens the document management process by enabling secure, distributed storage of tender-related files. Instead of storing raw documents, the system stores their cryptographic hash values on the blockchain, ensuring data integrity while optimizing storage efficiency. This hybrid approach significantly improves the reliability, security, and scalability of the system.

FUTURE SCOPE

The proposed system has significant potential for further enhancement and real-world deployment. In the future, it can be integrated with existing government and enterprise-level e-tender platforms to improve transparency and standardize procurement processes. Artificial Intelligence techniques can also be incorporated to analyze bid patterns, detect fraudulent activities, and assist in intelligent decision-making during bid evaluation. Additionally, the development of a mobile application version of the system would improve accessibility and user convenience, allowing stakeholders to participate in tenders from anywhere. The system can also be deployed on public blockchain networks to enhance scalability, decentralization, and global accessibility.

Furthermore, integration with advanced technologies such as machine learning, digital identity systems, and real-time analytics can further strengthen the security and efficiency of the platform.

REFERENCES

1. Vineetha Marati, Shreya Pinagani, N. Sathwika, V. Lakshmi, and A. Yaraswini, "Revolutionizing Tender Management through Blockchain Technology," *International Conference on Inventive Computation Technologies (ICICT), 2023*, DOI: 10.1109/ICICT57646.2023.10134275.
2. Gangarapu Dileep and Dr. E. Sreedevi, "Smart Tender and Contract Management System Using Blockchain," *International Research Journal of Modernization in Engineering Technology and Science*, Vol. 04, Issue 11, 2022.
3. Vinod Alone, Tejaswinee Lahare, Pooja Gophane, and Afreen Jamadar, "Blockchain-Based E-Tender Management System," *International Journal of Advanced Research in Science, Communication and Technology*, DOI: 10.48175/ijarsct-8652.
4. Rutuja D. Sanjekar and Balaji M. Patil, "Techniques of Securing Educational Document Using Blockchain and IPFS Based System: A Review," *2022 International Conference for Advancement in Technology (ICONAT)*, DOI: 10.1109/ICONAT53423.2022.9726032.
5. Yufei Lin and Chongyang Zhang, "A Method for Protecting Private Data in IPFS," *IEEE CSCWD 2021*, DOI: 10.1109/CSCWD49262.2021.9437830.
6. "Secure and Transparent KYC for Banking System Using IPFS and Blockchain Technology," *IEEE Xplore*, DOI: 10.1109/9230987.

7. "Research and Application of Data Sharing Platform Integrating Ethereum and IPFS Technology," IEEE Xplore, DOI: 10.1109/9277805.
8. "Blockchain and IPFS-Based Data Storage for VANET," IEEE Xplore, DOI: 10.1109/9952736.
9. "Decentralized E-Health Patient Record Management System Using Blockchain and IPFS," IEEE Xplore, DOI: 10.1109/10100060.
10. "OTP-Based Security Authentication Model," IEEE Xplore, DOI: 10.1109/7566012.
11. "E-Voting System Using Ethereum and MetaMask," IEEE Xplore, DOI: 10.1109/9354310.
12. "Secure File Sharing System Using Blockchain, IPFS and PKI Technologies," IEEE Xplore, DOI: 10.1109/9733608.
13. "Implementation of Distributed File Storage Using IPFS and Blockchain," IEEE Xplore, DOI: 10.1109/8985677.