

Orphanage Management Using IPFS and Hyperledger Fabric

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Abstract - In a typical orphanage, records are usually kept for future reference, retrieval, reproduction, and easy management. The daily activities, schedules and events are also recorded. For instance, if there is need to know the population of the orphanage/ children home, one may need to count the records obtained from different files that contain papers with information. The main objective of this project was to design and develop a new system of managing information in these orphanages. The system helps in reducing paperwork and enhance efficiency in record keeping since the existing one uses manual keeping i.e. use of files and papers. It also reduces costs incurred in purchasing files and papers for individual entities. The system manages records of children, guardians/doctors, donors, adoptive-Guardian and adoption. The system allows the user to add, modify, delete the records.

Keyword - Orphanage , Blockchain , children, guardians, doctors, donors, adoptive-Guardian, adoption, add, modify, delete.

I. INTRODUCTION

Orphanage Management System is software which is helpful for managing and maintaining orphan's data which can be used by orphanages. In the current system all the activities are done manually. It's very time consuming and costly. Orphanage Management deals with the various activities related to the orphanage. In this project an admin can manage the orphan details and take decision about the record like deletion of any. This system provides a simple interface for the maintenance of orphan. Attaining this goal is challenging when using a manual system due to the scattered nature of information, the potential for redundancy, and the time-consuming process of collecting pertinent information.

"To create a prototype-based website for Orphanage management system using blockchain" Recently, due to the covid-19 pandemic there has been immense growth in the number of orphans and the problem has become a global issue. Due to these reasons, the maintenance of proper records for the Orphanage is difficult to handle. So we can use Blockchain to maintain the basic records of these people on a private network to store and share data among the network.

In the proposed system, we are using blockchain technology instead of storing our data in a centralized cloud database or any alternatives of that to ensure a decentralized and more secure approach. Our system aims to store sensitive information such as the details of orphans and all the necessary details regarding

the child and the Guardian , including address, phone number, and contact details. To secure this sensitive data, we employ [1] Blockchain consensus protocol such as PBFT (Practical Byzantine Fault Tolerance) and methods blockchain technology such as IPFS and Hyperledger Fabric

PBFT is an innovative security concept that enhances the security of data in a decentralized blockchain environment. Anonymity-based methods are also employed to anonymize sensitive data before storing it in the blockchain. This system ensures safe and secure storage of sensitive data, and IPFS is an essential tool used to assure the accuracy of data. The use of blockchain technology helps to protect sensitive data in a decentralized environment.

The goal is to develop a blockchain-based orphanage management system that improves transparency, security, and accessibility while protecting the privacy and personal information of the orphans. The system should automate the tracking of medical and educational information, allow for easy donation management, and enhance communication and collaboration between authorized parties to ensure the best possible care and support for the orphans. The use of blockchain technology provides immutability and tamper-resistance to enhance the security of the system.

The foundation of this platform is to revolutionize orphanage management by providing transparency, accountability, and better security through the use of a blockchain-based system. By storing background and health-related information, the platform aims to connect with a ready-to-give audience and charge fewer fees than traditional orphanage agencies. The system is built to be traceable, immutable, and reliable, using advanced technology to ensure a secure and trustworthy process.

Without an Orphanage Management System, managing and maintaining the details of orphans is a tedious task for any organization. The Orphanage Management System will store comprehensive information about the orphans, including their medical reports.

The proposed system is a secure and efficient orphanage management solution that utilizes blockchain technology to protect orphan data from unauthorized access. The system provides a comprehensive view of orphan details including background information, educational qualifications, personal data, and medical reports. Data exchange among connected orphanages is enabled, and donor and adoption management are streamlined. Donor information and donations received are

easily managed and adoption processes are tracked and reported in real-time. Overall, the system provides a transparent and reliable solution to orphanage management.

II. Related Work

Securing and authenticating healthcare records through blockchain technology. [2] Healthcare data is critical for medical professionals and policymakers, but it is also at risk of being compromised by cyber-attacks. Traditional centralized record-keeping systems have a single point of vulnerability that can be exploited by attackers. A decentralized system, on the other hand, can provide greater security and privacy by distributing the data across a network of nodes. Blockchain technology offers a way to implement such a system, using cryptographic algorithms to ensure the reliability, transparency, and interoperability of electronic healthcare data. In this context, a blockchain-based architecture can provide a secure and transparent mechanism for healthcare data exchange. Reports and prescriptions of patients can be stored using hash values of the patient ID, and only authorized persons can make transactions to retrieve stored reports. [3]

The proposed blockchain-based architecture for e-healthcare systems offers several benefits, including improved security and privacy, greater transparency and accountability, and interoperability between different healthcare providers. By keeping the patient at the center of the system, the proposed architecture aims to provide a more patient-centric approach to healthcare data management. With the help of blockchain technology, the proposed system can prevent unauthorized access to sensitive patient data, ensure the integrity of the data, and enable efficient data exchange among healthcare providers. In summary, a blockchain-based architecture can provide a secure, efficient, and patient-centric solution for healthcare data management.

Land Record Management using IPFS and Hyperledger Fabric [3] Land ownership records in many countries are fragmented and not available in a comprehensive single location, which creates inefficiencies and challenges for property buyers. The proposed solution presented in this paper involves bringing all stakeholders for a piece of land/property onto a single peer-to-peer, decentralized network using Hyperledger Fabric, a blockchain framework. This network maintains a detailed record of every transaction that any property listed on the platform has been involved in, providing transparency and accountability. The central government can view land records pertaining to all state government offices under its jurisdiction, while each state government maintains land records that can be accessed and edited by private realty companies, the Builders' Association of India, and Tehsil Level Property Registrars of each district in the state. Each landowner can access the details of their respective land, which are maintained by the blockchain. The proposed solution aims to make documents such as registered sale deeds, records of rights, property tax receipts, survey data, and land titles easily available to all stakeholders on a single platform by

interfacing Hyperledger Fabric with Interplanetary File System (IPFS), a decentralized distributed file system.

To ensure data security and privacy, the paper proposes to integrate Passports, a secure authorization and authentication middleware, and require record-entry makers to log in through their Github accounts before accessing the blockchain network. This integration of IPFS and Passports with Hyperledger Fabric will greatly improve land acquisition and record management practices in the region and prevent malicious tampering of information that requires utmost confidentiality. The proposed solution provides a clear framework for a transparent, efficient, and secure land ownership record keeping system, which has the potential to improve land acquisition and real estate investment practices, benefitting property buyers, landowners, and real estate developers.

BlockIPFS - Blockchain-enabled Interplanetary File System for Forensic and Trusted Data Traceability [5]

The InterPlanetary File System (IPFS) is a distributed file system that aims to connect all computing devices with the same system of files, providing a more efficient way to share large files across the network. IPFS incorporates technologies such as BitTorrent and Git to achieve high throughput and allows users to share files and information without relying on centralized servers.

However, the popularity and effectiveness of IPFS also create security and access control concerns. When an object is uploaded to the network, anyone who has access to the hash address of the file can access its content. This lack of control over who can access uploaded files raises serious security and intellectual property concerns. In addition, there is no way to trace or audit access to files on the network, making it difficult to investigate and resolve disputes.

To address these issues, the solution proposes called BlockIPFS, which enhances IPFS with Hyperledger Fabric, [5] a permissioned blockchain platform that provides immutability and high performance. By integrating BlockIPFS within IPFS, the proposed approach provides traceability capabilities to record and audit access to files on the network, improving security and access control.

BlockIPFS provides a clear trail of activities associated with a given file, including who accessed it and when. This can be used for forensic investigations and dispute resolution, as it can help to identify who has downloaded a file and narrow down the scope of investigation in the event of illegal sharing. The proposed approach also protects authorship by providing evidence of ownership and authorship of files on the network.

In summary, the solution proposes called BlockIPFS that enhances IPFS with Hyperledger Fabric to provide traceability capabilities for auditing and safeguarding authorship of files. The proposed approach provides a clear audit trail of all activities associated with a given file, improving security and access control on IPFS.

EduChain: A highly available education consortium blockchain platform based on Hyperledger Fabric [6]

The proposed solution is a blockchain platform for education

consortiums that aims to address scattered data in educational institutions and traditional limitations in recording learners' learning behaviors. The platform utilizes the advantages of blockchain technology, including decentralization, anonymity, immutability, and high-trust. To ensure credible sharing and verification protection of education data, the solution uses a data transfer mechanism and a data collaboration scheme based on "onchain and offchain."

To reduce storage pressure on the blockchain ledger, the solution employs erasure codes to process blockchain ledger files, reducing the total ledger storage by about 53.56%. It also introduces the Byzantine fault-tolerant ability to the platform by designing a HotStuff consensus to access the ordering service of Hyperledger Fabric. The solution completes Fabric deployment based on Kubernetes to solve the education blockchain runtime environment problem and designed a container control plug-in for Fabric to support Kubernetes at the code level.

Overall, the solution aims to promote the reform of the education system and build an education information system compatible with the national economic, social, and educational development level. By providing a credible and secure platform for storing and sharing educational data, the solution is expected to contribute to the development of the digital economy and promote economic and social development.

III. Proposed Solution

To address the challenges faced by orphanages, a proposed solution is to create a prototype-based website for Orphanage management system using [4] IPFS and Hyperledger Fabric. Hyperledger Fabric is a permissioned blockchain platform that allows organizations to create private and secure networks for storing sensitive information. In this solution, a private chain will be used to store and manage the basic records of the orphans, including medical and educational information. By using a private chain, only authorized personnel will have access to sensitive information, ensuring its security.

In addition, refer to Fig -1 , Inter Planetary File System (IPFS) will be used to store and share files related to the orphanage management system. IPFS is a decentralized storage system that allows files to be stored and shared in a distributed network. By using IPFS, the system can offer high performance and low latency, making it a suitable choice for storing and sharing files related to the orphanage management system.

By creating a private chain for storing and managing the orphan's records, it becomes easier to manage the data efficiently. The records can be accessed and updated by authorized personnel, reducing the risk of errors and duplications. Additionally, the use of a private chain ensures that the data is tamper-proof and cannot be modified by unauthorized personnel.

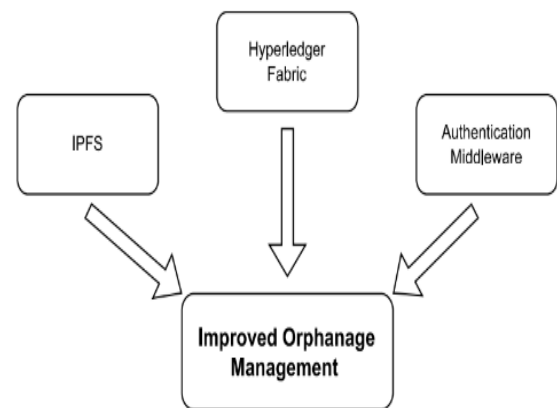


Fig -1: Interfacing Underlying technologies with Fabric to improve Orphanage Management System [1]

Finally, a public chain will be used to manage donations, providing transparency and accountability to donors. By using a public chain, donors can be assured that their contributions are being tracked and recorded in a secure and immutable manner.

IV. UNDERLYING TECHNOLOGY & ARCHITECTURE

A. Making the choice with Hyperledger Fabric :

When considering blockchain platforms for the Orphanage Management system, the two main options are open-public blockchains, such as Ethereum, and permissioned enterprise blockchains, such as Hyperledger. While open-public blockchains do not require parties to verify their identity, permissioned enterprise blockchains only allow trusted parties who have been approved by the network creator to transact, and their identities can be abstracted.

In the case of the Orphanage Management system, where only known, verified parties will be transacting with each other, using an open-public blockchain [8] with its computational power requirements would be inefficient. Instead, a permissioned enterprise blockchain like Hyperledger Fabric would be more suitable. The Smart Contract, or Chaincode in Hyperledger Fabric, ensures that only transactions that satisfy set conditions and do not violate the consensus algorithm can be admitted to the chain.

Hyperledger Fabric also offers benefits such as modularity, distributed ledger and logic processing, confidentiality, resilience, and flexibility, all of which are crucial for the Orphanage Management system. Furthermore, Hyperledger Fabric has a higher throughput in terms of the number of transactions performed per minute compared to Ethereum, which is important for a system handling a large amount of data.

Overall, choosing Hyperledger Fabric as the blockchain platform for the Orphanage Management system ensures efficient and secure management of orphanage records while minimizing operational and hardware costs.

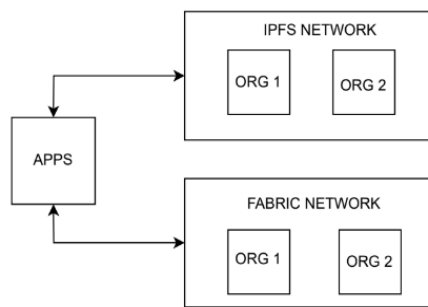


Fig -2: Simple Storage and Retrieval on IPFS

B. Peers :

Endorsing Peers, Ordering Nodes (Orderer), and Committing Peers. Endorsing Peers receive transaction requests from the Application SDK and check if business logic is satisfied. Ordering Nodes bundle up approved transactions into blocks and distribute them to Committing Peers. The solution uses Kafka consensus algorithm to minimize network downtime. Committing Peers validate and commit the transactions to the Blockchain. Application SDK sends requests to Endorsing Peers and gets a response after checking all rules. The transaction is divided into blocks by Orderer and validated by Endorsing and Committing Peers

C. IPFS :

IPFS (InterPlanetary File System) is a decentralized file storage system that allows for the secure storage and access of files over a distributed file system. [1] , Refer to the Fig -2 Every file is given a unique cryptographic hash and stored in nodes. These nodes are indexed so that each file can be accessed through a node, preventing duplication. [9]

V. Implementation

The management of orphanages requires accurate and transparent record-keeping to ensure that the orphans receive the necessary care and support they need. The proposed solution for orphanage management involves the use of Hyperledger Fabric and IPFS to create a tamper-proof, secure, and transparent system for orphan record-keeping [6] .

To implement the proposed solution, a private network will be set up using Hyperledger Fabric, which includes all necessary services such as Certificate Authority (CA), Peers, Orderer, and CouchDB. The CA will issue certificates to each user to validate their identity for transactions on the blockchain.

The algorithm of the consensus, i.e. Chaincode, will be written in Go or Node.JS to ensure that only legitimate actions pertaining to the mutation of orphan-records can be performed. Transactions satisfying set conditions defined in the Chaincode can only be admitted in the Blockchain.

In addition, [9] IPFS provides versioning and content-addressing features, which can be beneficial for managing and updating files related to the orphanage management system. This can be particularly helpful for orphanages that need to store and share large files, such as videos or images.

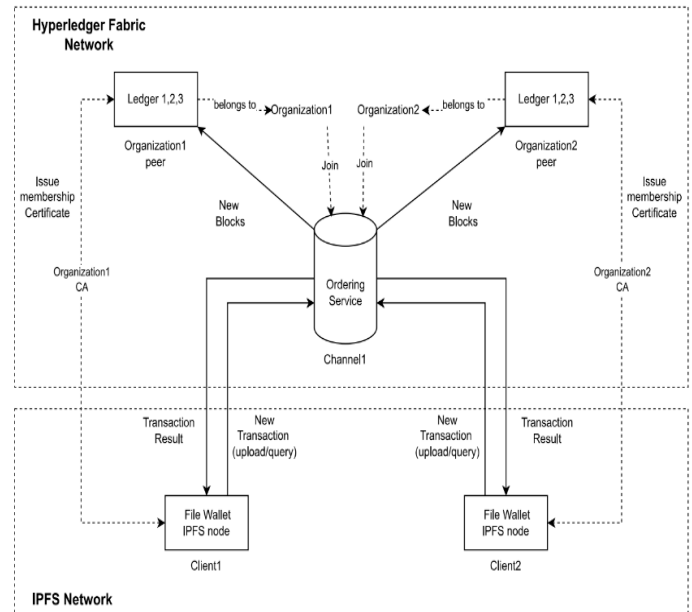


Fig -3: The System Architecture

The front-end interface of the business network will be developed using React to enable authorized persons to access the orphan record-keeping system. The interface will be connected to the backend to display the orphan records in real-time. The implementation of an authentication middleware using Redis will ensure that only authorized persons can access the orphan record-keeping system refer the Fig -3 , thus preventing unauthorized access and data breaches.

To ensure data integrity and avoid data loss, a distributed storage system using IPFS will be implemented. Each organization will maintain a distributed storage system using IPFS, which can be accessed using the CID of the item and gateway, open on port 8080. This will ensure that orphan records are safe and accessible at all times.

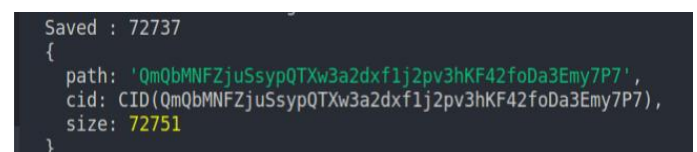


Fig -4: The Terminal Screen Shows Uploaded Document to IPFS Network

In addition, a donation system will be implemented using Ethers to provide a better future for orphans in the orphanage and fulfill their daily needs. Donations will be made using Ethers, [10] and the records of the donations will be stored on the blockchain, providing transparency and accountability in the use of funds.

To ensure that the proposed solution meets the requirements of the orphanage management system, it will be thoroughly tested. The testing process will involve verifying that all transactions are recorded on the blockchain, and that orphan records are accessible to authorized persons in real-time. Any issues encountered during testing will be addressed and resolved to ensure the optimal performance of the system.

VI. Methodology

Requirement Gathering : In this initial phase, the project team should meet with the orphanage staff, doctors, and Guardian to gather the requirements for the orphanage management system. The team should identify the key pain points and challenges faced by the orphanage and also the goals and objectives for the new system. Based on the requirements, the team should define the scope of the project.

Design : In this phase, the project team should design the architecture of the orphanage management system. The team should identify the different types of data that need to be stored in the blockchain, such as information about the orphans, doctors, and Guardian. Based on this, the team should create separate blockchains for each type of data, using IPFS and Hyperledger Fabric. Additionally, the team should design the public network for accepting donations using cryptocurrency.

Development : In this phase, the project team should develop the orphanage management system. This involves implementing the various features and functionalities required by the system, such as the ability to store and update information about the orphans, doctors, and Guardian. The team should also implement the different roles and access levels for the system. Furthermore, the team should create a public network for accepting donations using cryptocurrency and connect it with the orphanage management system.

Testing : In this phase, the project team should conduct various types of testing to ensure that the system is secure. This includes functional testing, performance testing, and security testing. The team should also test the donation system to ensure that it is working as expected.

Deployment : In this phase, the project team should deploy the orphanage management system on the appropriate infrastructure, such as cloud-based servers.

Maintenance and support : In this final phase, the project team should provide ongoing maintenance and support for the orphanage management system. The team should also monitor the system to ensure that it is functioning properly and addressing the needs of the orphanage. Additionally, the team should provide support for the public network that accepts donations using cryptocurrency.

VII. Result and Discussion

Our research has successfully created a private blockchain-based orphanage management system using Hyperledger Fabric and InterPlanetary File System (IPFS) to store and manage orphan details and medical records. The system ensures transparency between orphanages, doctors, and Guardian and provides a tamper-proof solution for securing orphan data from unauthorized access.

The use of Hyperledger Fabric offers several advantages in terms of scalability and security. Fabric allows for the creation of private blockchain networks with customizable levels of

permission, which ensures that only authorized parties can access and modify data on the network. This makes Fabric a suitable choice for our orphanage management system as it requires a high level of data security and privacy.

In addition, we have implemented the Practical Byzantine Fault Tolerance (PBFT) consensus algorithm to ensure that all nodes on the network agree on the validity of transactions. This consensus algorithm ensures that the system is resistant to malicious attacks and prevents any single point of failure.

VIII. Conclusion

The proposed solution of using IPFS and Hyperledger Fabric for orphanage management provides a secure, transparent, and tamper-proof system for orphan record-keeping. The implementation of the proposed solution ensures that orphan records are safe and accessible at all times, and that authorized persons have real-time access to orphan records. Additionally, the use of Ethers for the donation system provides transparency and accountability in the use of funds, providing a better future for orphans in the orphanage and fulfilling their daily needs.

IX. Future Work

Optimizing the system for scalability and security: Upgrading hardware, software, and network infrastructure to handle a larger volume of data and users as the orphanage grows and expands.

Improving usability based on user feedback: Gathering and analyzing feedback to identify issues or concerns and making improvements to ensure a positive user experience.

Conducting further research on blockchain technology: Investigating the potential benefits and limitations of public and private blockchains and identifying ways to optimize them for enhanced security, privacy, and efficiency.

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