

NFT AS A PROOF OF DIGITAL OWNERSHIP-REWARD FRAMEWORK INTEGRATED TO A SECURE DISTRIBUTED COMPUTING SYSTEM MANAGED BY BLOCKCHAIN



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01 - INTRODUCTION

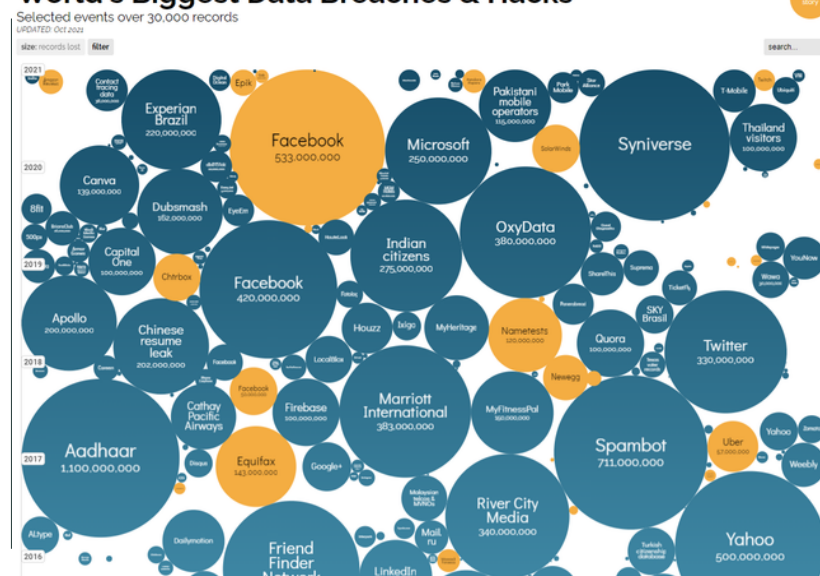


The industry is nowadays severely affected by security threats and cyber-attacks. Data and security breaches can cost enterprises and government institutions millions of dollars. The time costs in updating a whole digital infrastructure make it impossible to ensure that enough data and systems remain secure.

HYPOTHESIS

Creating a Blockchain-based system for industrial applications and data protection through NFTs and decentralized data storage systems facilitate data security assurance while preserving system integrity.

World's Biggest Data Breaches & Hacks



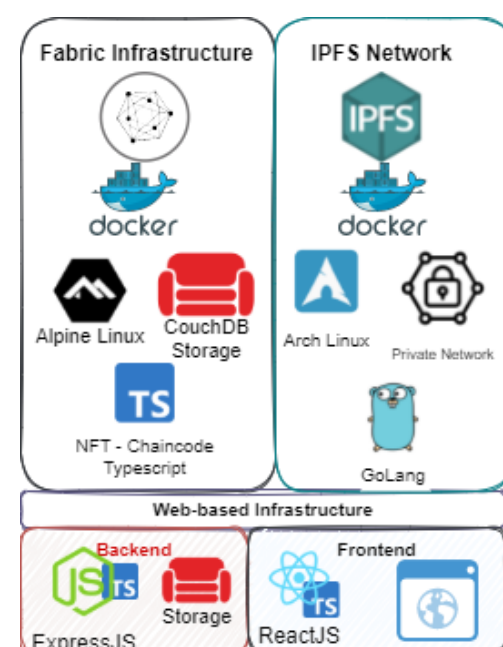
02 - OBJECTIVE



Provide a decentralized open-source web-based blockchain infrastructure that enables industries to securely share data and build trust by combining an IPFS network as a decentralized file system, smart contracts, and NFT (non-fungible tokens-ERC-721 standard) with a Hyperledger Fabric network.



03 - METHODOLOGY



The project was created using open-source technologies:

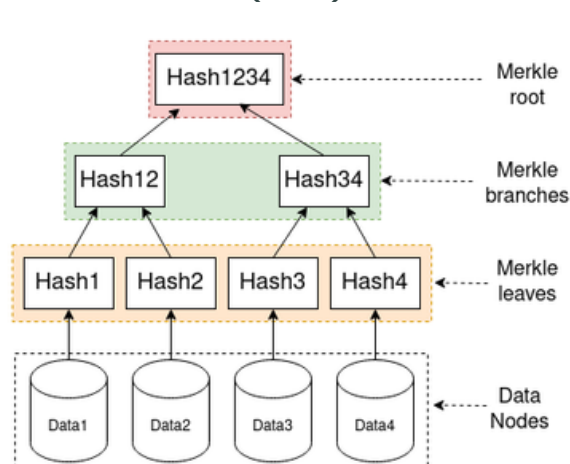
- **Hyperledger Fabric:** Permissioned blockchain infrastructure for industry applications.
- **Docker:** Virtualization technology used for microservice creation.
- **CouchDB:** Key-Value data storage system.
- **Typescript:** Programming language sitting as a superset of JavaScript.
- **IPFS:** Decentralized file system storage (private).
- **ArchLinux/Alpine Linux:** Linux OS distributions.
- **GoLang:** C-like compiled programming language.
- **ExpressJS:** Backend web application framework
- **React:** Open-source frontend library to build User Interface applications

04 - ANALYSIS



Organizations can join a private channel in the network with a trusted certificate and enroll users. Users can upload any data as NFT, then mint an NFT (which represents ownership). A unique ID (Hash) describes the content of the data and can be located in the IPFS network. Consensus mechanisms work to acknowledge authenticity and ownership of the user data. Other organizations can rank, endorse and acknowledge data ownership and relevance and. Users can transfer assets, amend data and add new version of it. System is **trustless**, decentralized and maintained by all organizations in the community.

MERKLE DIRECTED ACYCLIC GRAPH (DAG)



~A Merkle tree is a relevant data structure in a blockchain system. It consists of a binary tree where each node stores the hash of its children nodes, and the root hash represents the hash of hashes. A single change in any node will drastically alter the root hash. This enables non-repudiation and trustability among systems.

- **Permissioned Blockchain infrastructure**
- **Extended ERC-721 NFT Smart Contract**
- **Private IPFS Network**
- **REST API Server**
- **Client UI**
- **Proof of Ownership Consensus**

The organization can enroll users in a private channel on the network with a trusted certificate. Any data can be uploaded as a NFT and then minted as an NFT (which signifies ownership). The unique ID represents the Hash of stored data, which provides access to the file when requested by the IPFS network (content-addressing). Consensus mechanisms acknowledge the authenticity and ownership of users' data. Other organizations can recognize the data ownership and relevance and be recognized, endorsed, and ranked. Assets may be transferred, amended, and re-versioned by users. As community members, we provide our infrastructure (Hyperledger, IPFS, database nodes) and connect them to the network to maintain the system.

05 - RESULTS



The NFT Blockchain-based system created the basis to demonstrate the plausibility of implementing an infrastructure for decentralized data governance in which multiple parties can interact with implicit trust. Implementing the adequate consensus mechanism, smart contract, and decentralized file system for data storage leverages cooperation and promotes fair participation by entities willing to manage data and be certified as asset owners. Treating information as a Non-Fungible token with the correct technology unleashes new ways of working and challenging security workflows with current centralized systems.

Since the solution is open-source and documented, it is possible to extend the functionality via smart contract extension and Backend/Frontend to be applied for other industries with specific business logic (food industry, real estate, music industry, health, use of NFT for royalties, tokenization, even IoT).

06 - CONCLUSION



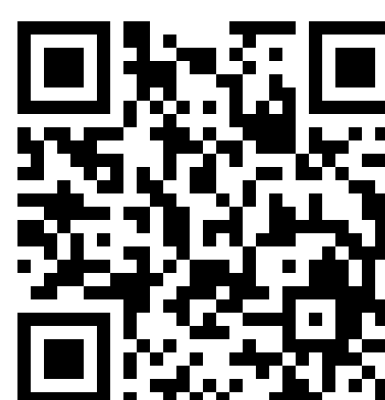
Decentralized and Blockchain-based systems are relevant for the industry, its application can solve multiple security and trust-related problems. Shortly its implementation will be highly demanded. The NFT Technology began with digital technology, but its application and potential go far beyond. NFT and decentralized storage is key to building Web 3.0 and bringing society to a new era of cooperation, ownership, disruption, deconstruction, contribution, and reorganization.

RELATED LITERATURE

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SOLUTION PROJECT



<https://github.com/asahicantu/NFT-Thesis>

