HEALTHDEMIC

Blockchain Solution to Health Care Record System

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Agenda

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Literature Review

The Solution

Implementation

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Introduction
Background/Need

- To avoid casualties
- Massive increase in online consultation
- Value of Medical records
- To help reduce Fraud, Corruption and other Illegal Activities.

Introduction
Existing Systems

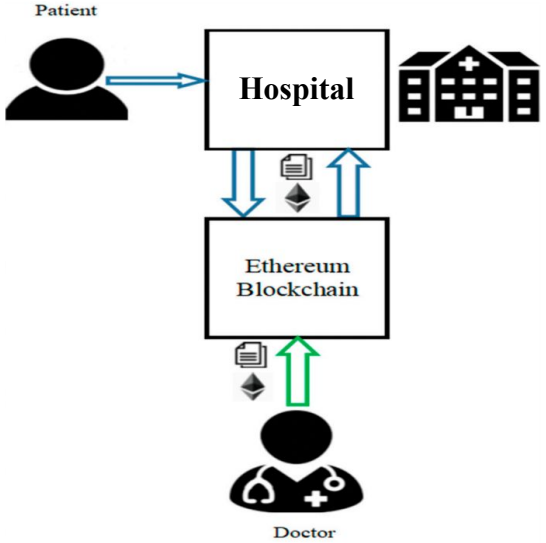
- Most of the hospitals across India manually store medical records.
- Medical Health Records are also stored in form of databases.
- Indian Government launched the Digital Health Mission

Introduction
Limitations

- Need for large storage areas
- Difficulties in the retrieval of records
- Risk of leakage of critical information
- Compromised data security and privacy

Introduction
Proposed System

- Medical records are stored within individual nodes in the blockchain networks.
- It can be viewed as a distributed database, which stores data in each network node to avoid the halting problem.
- The whole system is viewed as a private blockchain network.
- User identity is directly recognized by the system and the corresponding privilege is authorized.



Literature Review

- Legacy systems typically only share healthcare resources internally in the medical and healthcare field and are not fully compatible with external systems.
- Nonetheless, evidence indicates numerous benefits from integrating these networks for interconnected and better healthcare, calling for interconnection between different organizations for health informatics researchers [1].
- Litchfield et al. [2] have discussed issues regarding healthcare data security and privacy and suggested blockchain to overcome these issues besides doing a survey on healthcare issues.
- Wu and Tsai [3] did a literature review on healthcare management systems and proposed two algorithms for providing network security.

Literature Review

Leading healthcare Organizations using blockchain

MEDICALCHAIN

London, England

Medicalchain's blockchain maintains the integrity of health records while establishing a single point of truth.

Real-life impact: In May of 2018, Medicalchain announced the release of MyClinic.com. A telemedicine platform, MyClinic enables patients to consult with their doctors via video and pay for those consultations with "MedTokens."

SIMPLYVITAL HEALTH

Watertown, Massachusetts

SIMPLYVITAL HEALTH is Nexus Health platform is an open source database that allows healthcare providers, on a patient's blockchain, to access pertinent information.

Real-life impact: SimplyVital recently partnered with genemics and precision medicine company Shivom to form a Global Healthcare Blockchain Alliance that employs blockchain security to protect DNA sequencing data.

CORAL HEALTH RESEARCH & DISCOVERY

Vancouver, Canada

Coral Health uses blockchain to accelerate the care process, automate administrative processes and improve health outcomes.

Real-life impact: According to Coral's chief strategy officer Jeremy Mullin, the company is looking into the possibility of using a blockchain and the Smart on FHIR protocol "to let patients track their own health files."

Literature Review

Companies to watch for healthcare blockchain solutions
Factom, Medvault, Tierion, Health Nautica, MedRec, Blockchain Health Co, Apple - EHR
PokitDok – APIs for blockchains
Hashed Health consortium – collaborative working solutions (policy guidance)
Hyperledger Healthcare Working Group
Philips Blockchain Lab
Office of the National Coordinator of Health IT (USA) - innovation
GemHealth: information exchange between patients, healthcare providers, payers
Hexoskin smart shirt – PGHD, wearable body biometrics
Healthbank – privately owned HER
Guardtime – Estonia
DNA.Bits – genetic data
BitHealth – payments using bitcoins
BlockVerify – fight counterfeit drugs
Stanford Uni – distributed supercomputer simulations

Literature Review

Blockchain In Indian Healthcare System

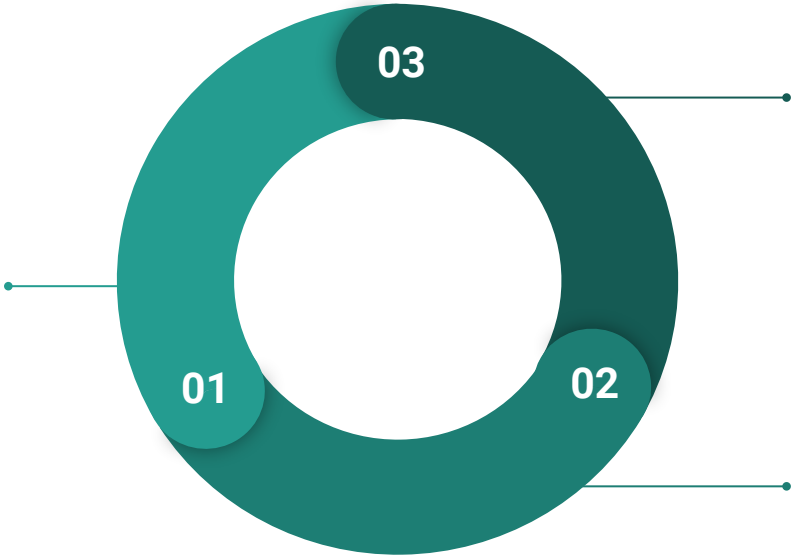
- In 2017, the Indian government produced a National Health Policy (NHP) with the purpose of ensuring the well-being of all Indian citizens.
- The Digital Information Security in Healthcare Act (DISHA) was created in 2017 to safeguard the privacy and security of health data of patients.

The Solution

Why Ethereum Based Blockchain?

Data integrity and incorruptibility

The cryptographic property in the blockchain networks guarantees the patients' privacy.



Fast and feasible

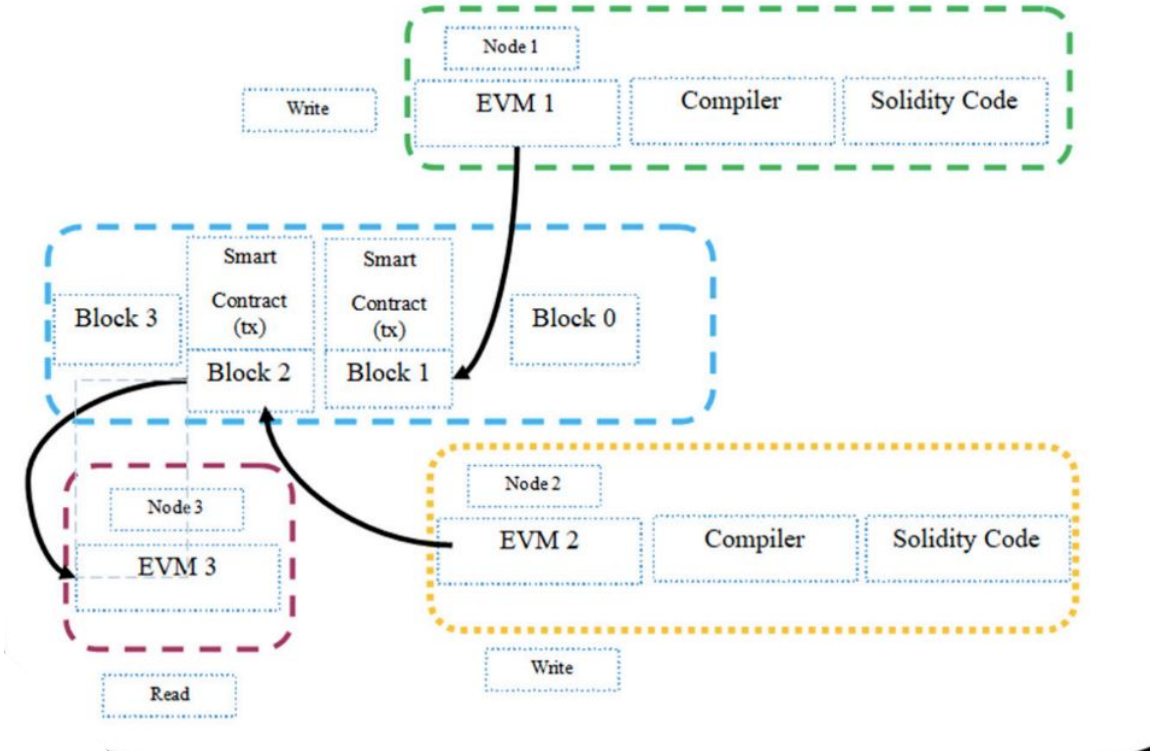
Not only provides the reliable service but also speeds up the medical record exchange.

Accessible

Ethereum platform allows anyone to develop applications in blockchain networks.

The Solution

Ethereum SC Mechanism



Implementation
Smart Contracts

Ganache

3

Ganache is a personal blockchain for rapid Ethereum and Corda distributed application development.

Remix

Remix is a Solidity IDE that's used to write, compile and debug Solidity code.

2

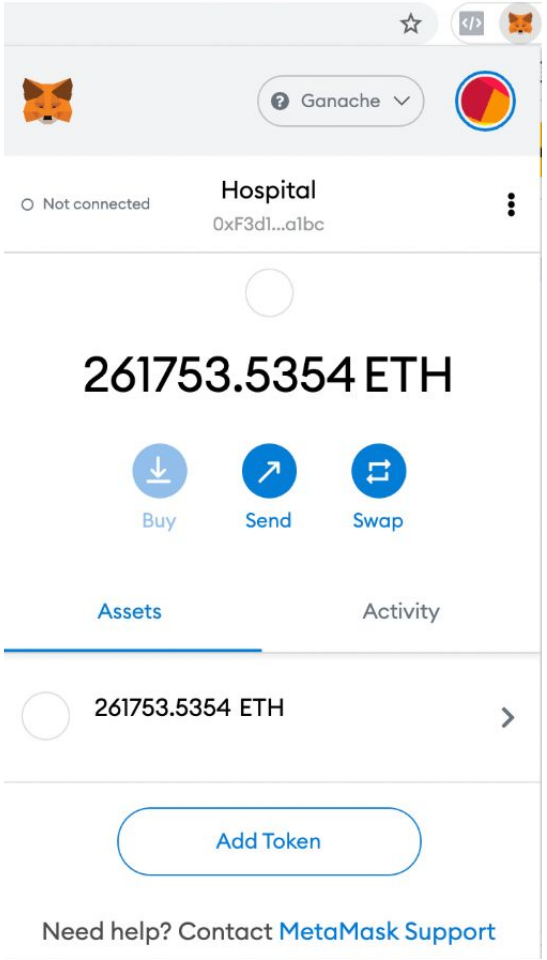
Solidity

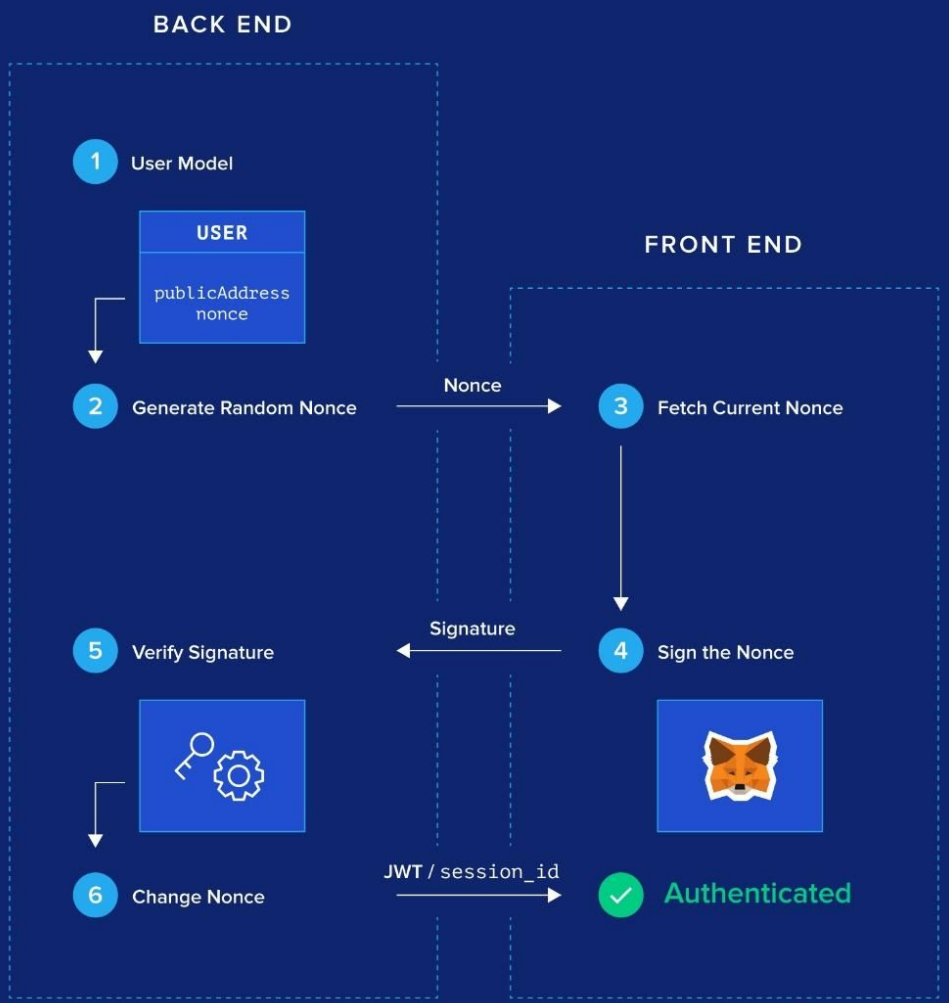
1

It is an object-oriented programming language for writing smart contracts.

Implementation
Security Mechanism

- MetaMask is a software cryptocurrency wallet used to interact with the Ethereum blockchain.
- Used to store keys for Ethereum cryptocurrencies only.
- Allows users to access their Ethereum wallet through a browser extension or mobile app.



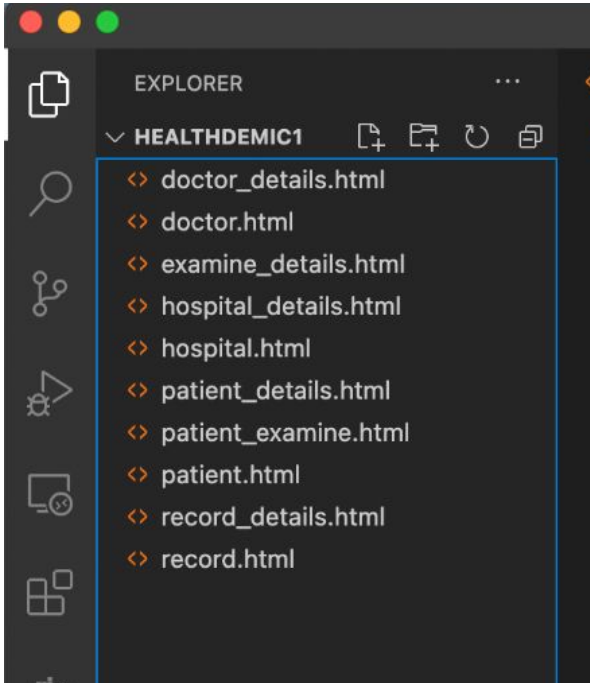

BACK END
1
User Model
USER
publicAddress
nonce
FRONT END
2
Generate Random Nonce
Nonce
3
Fetch Current Nonce
Signature
5
Verify Signature
4
Sign the Nonce
6
Change Nonce
JWT / session_id
Authenticated

Implementation
NFT

- Tokens are value counters in contracts.
- A non-fungible token (NFT) is a uniquely identifying token.
- ERC stands for Ethereum Request for Comment, and 721 is the proposal identifier number.
- Every NFT is identified by a unique uint256 ID inside the ERC-721 smart contract.

```solidity
import "../../introspection/IERC165.sol";

/**
 * @dev Required interface of an ERC721 compliant contract.
 * Taken from: https://github.com/OpenZeppelin/openzeppelin-solidity/blob/master/contracts/token/ERC721/IERC721.sol
 */
contract IERC721 is IERC165 {
    event Transfer(address indexed from, address indexed to, uint256 indexed tokenId);
    event Approval(address indexed owner, address indexed approved, uint256 indexed tokenId);
    event ApprovalForAll(address indexed owner, address indexed operator, bool approved);

    /**
     * @dev Returns the number of NFTs in `owner`'s account.
     */
    function balanceOf(address owner) public view returns (uint256 balance);

    /**
     * @dev Returns the owner of the NFT specified by `tokenId`.
     */
    function ownerOf(uint256 tokenId) public view returns (address owner);

    /**
     * @dev Transfers a specific NFT (`tokenId`) from one account (`from`) to
     * another (`to`).
     * Requirements:
     * - `from`, `to` cannot be zero.
     * - `tokenId` must be owned by `from`.
     * - If the caller is not `from`, it must be have been allowed to move this
     * NFT by either `approve` or `setApproveForAll`.
     */
    function safeTransferFrom(address from, address to, uint256 tokenId) public;

    /**
     * @dev Transfers a specific NFT (`tokenId`) from one account (`from`) to
     * another (`to`).
     *
     * Requirements:
     * - If the caller is not `from`, it must be approved to move this NFT by
     * either `approve` or `setApproveForAll`.
     */
    function transferFrom(address from, address to, uint256 tokenId) public;

    function approve(address to, uint256 tokenId) public;
    function getApproved(uint256 tokenId) public view returns (address operator);
    function setApprovalForAll(address operator, bool _approved) public;
    function isApprovedForAll(address owner, address operator) public view returns (bool);
    function safeTransferFrom(address from, address to, uint256 tokenId, bytes memory data) public;
}
```

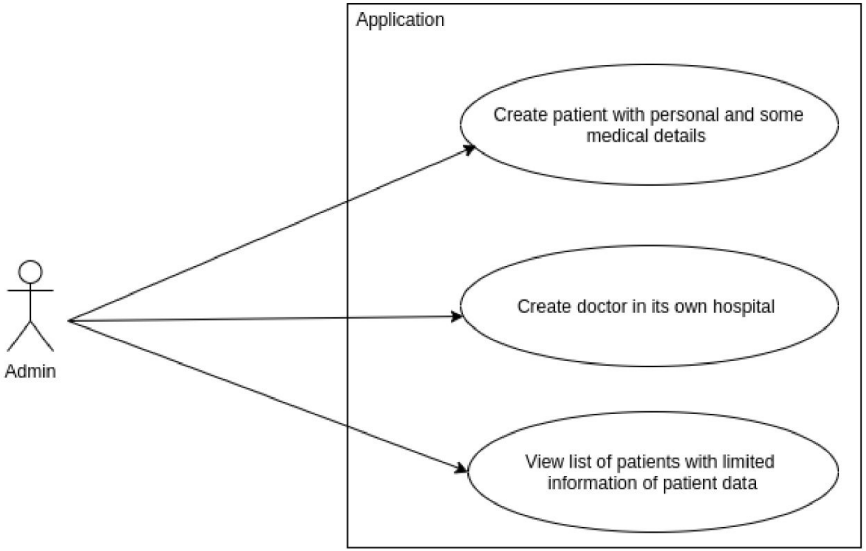
Implementation
Front-End

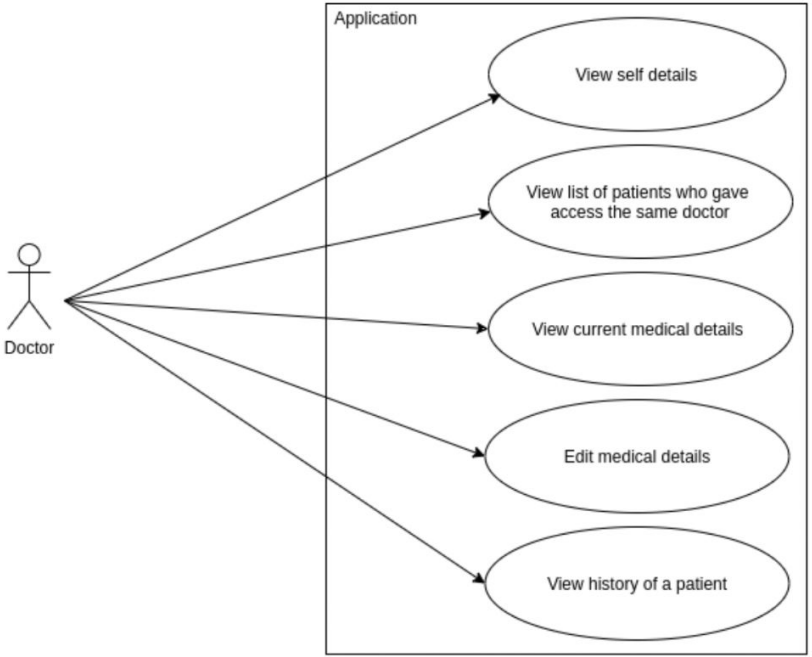


- Web3 is used to connect backend with frontend.
- Web3 allows us to interact with a local or remote ethereum node using HTTP, IPC or WebSocket.

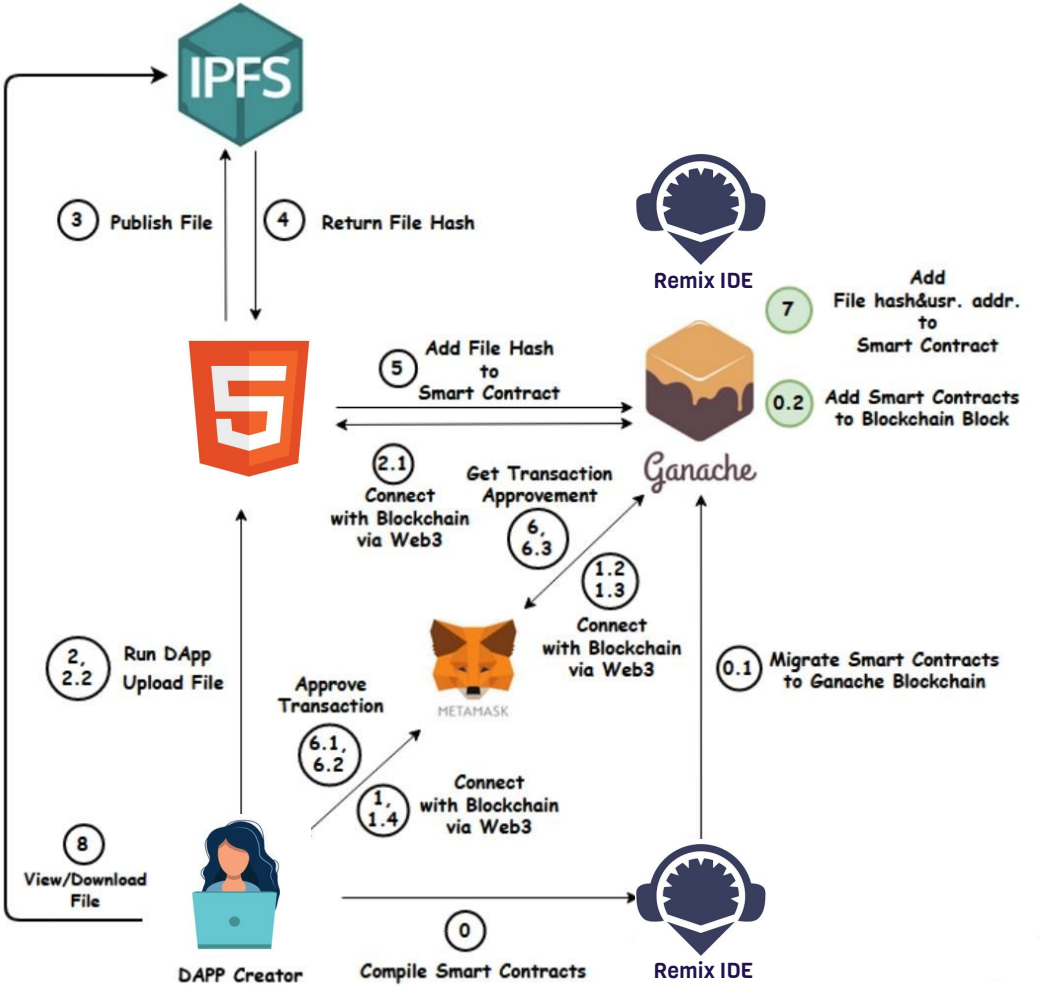
The Solution

Use Case Diagram





Project Diagram



DEMO

Results

Pros and Cons of using Ethereum

Pros

- Ethereum has the largest developer community in the world. This gives Ethereum a tremendous advantage over other protocols.
- Ethereum is the second most decentralized cryptocurrency in the world, there is no centralized authority with ultimate control.
- Ethereum cannot operate without a blockchain infrastructure. Therefore, it is the perfect example of a project leveraging the advantages of the blockchain.

Figure 1 Source: https://medium.com/@micheledaliessi/how-does-ethereum-work-8244b6f55297

Results

Pros and Cons of using Ethereum

Cons

- The Ethereum blockchain is still undergoing lot of changes; this also includes moving the consensus method from the PoW to the PoS system.
- Decentralized protocols tend to be slow. For instance Bitcoin has average speeds of 7 TPS (Transactions Per Second), while Ethereum has a speed of 15 TPS. That's double Bitcoin's speed, but it's not nearly enough.
- While wanting to create apps and tokens on the Ethereum network need to code in Solidity. This is a new programming language that has some well-known problems.

Conclusion

Future Scope

Ethereum is a promising blockchain framework. It provides reliable and secure solution in managing medical field records.

Tracing and securing Medical Supplies

Health Insurance Claims

Tracking Diseases and Outbreaks

Safeguarding Genomic

References

https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7010942/

https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7474412/

https://www.sciencedirect.com/science/article/pii/S2214212- 619306155

https://jira.hyperledger.org/browse/FABC-548, Accessed-On:28/03/2020

https://jira.hyperledger.org/browse/FAB-5094, Accessed-On:28/03/2020 Dynamic Spectrum Management, Signals and Communication by Ying-Chang Liang

https://www.mdpi.com/1099-4300/22/2/175

The End