

Applying Federated Learning with Smart Contracts in Healthcare

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Abstract

DEDOC is an innovative federated learning mechanism which aims to address the problem of the lack of medical data sharing in healthcare, which is a major obstacle in integrating artificial intelligence (AI) technology. The reason behind the data- sharing hurdle is that medical data is highly confidential, and hospitals are reluctant to share it due to privacy concerns. As a result, machine learning (ML) models cannot be trained, and progress in this field is stalled. To overcome this issue, this project proposes an alternative approach, which involves model sharing and federated learning. The proposed system consists of two entities, the Super user and hospitals. The Super user requests hospitals to participate in federated learning, and registered hospitals are granted access to global model files through IPFS hashes. These hashes are stored on the block chain via smart contracts. The technologies used in this project include Solidity for smart contract development, React.js for the frontend, and IPFS Piñata for hosting ML model files. This solution provides a viable and secure way to enable AI integration in healthcare while maintaining patient privacy.

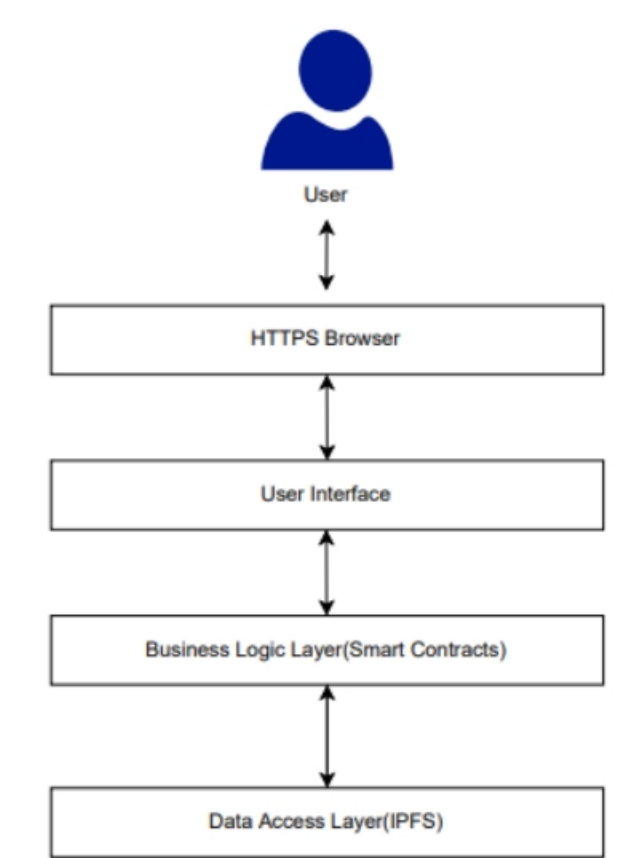
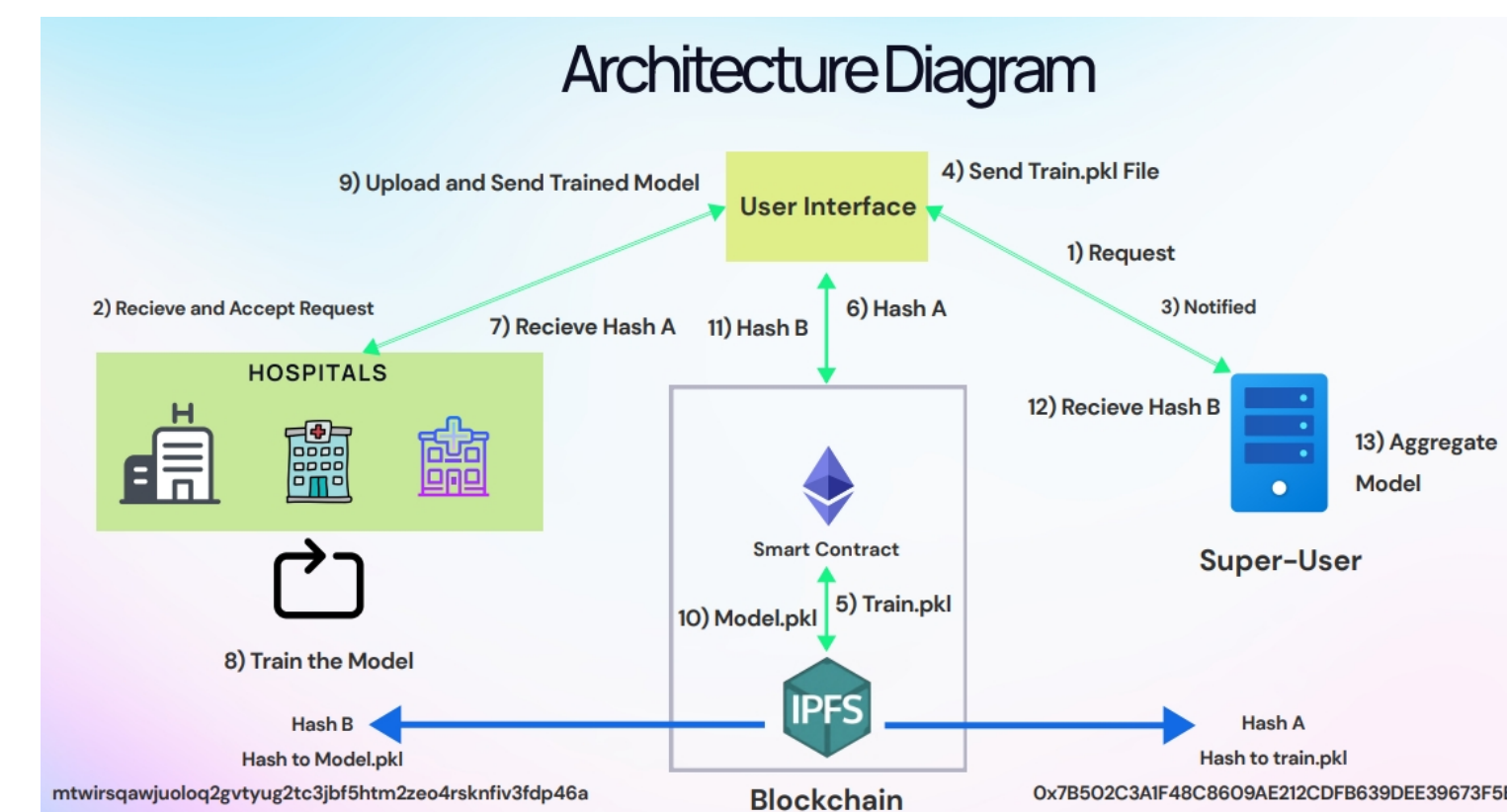
Project Scope

- Scope of the final year project is limited to the medical sectors
- Patient data will be recorded on the system
- Data will be used to train a machine learning model
- Federated Learning concept will be employed
- Multiple organizations or institutions collaborate under a central server
- Deep-learning model is maintained and improved upon within the central server
- Data is kept localized at each collaborating site, not exchanged or transferred
- Central server maintains a global shared model disseminated to all institutions
- Each entity maintains a separate model based on its own patients' data
- Centers provide feedback to the server based on individually trained model
- Feedback can be based on weight or error gradient of the model
- Central server aggregates feedback and updates the global model based on predefined criteria

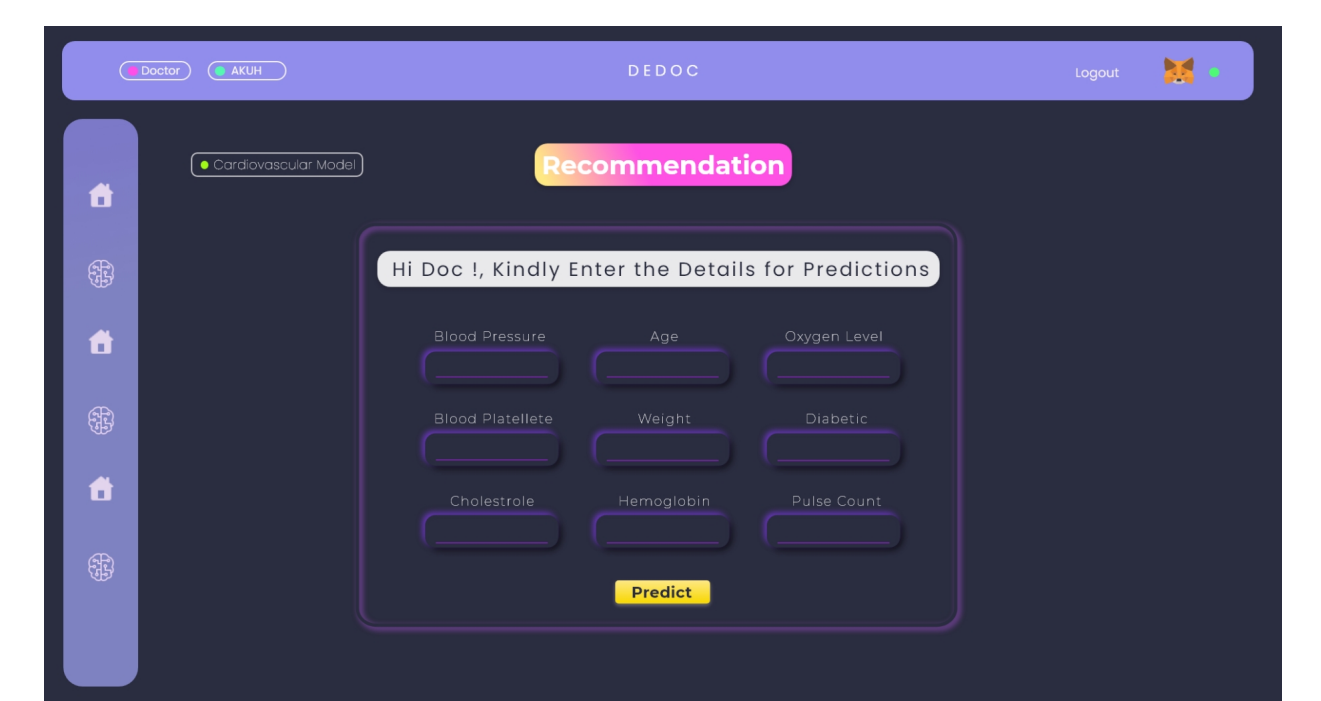
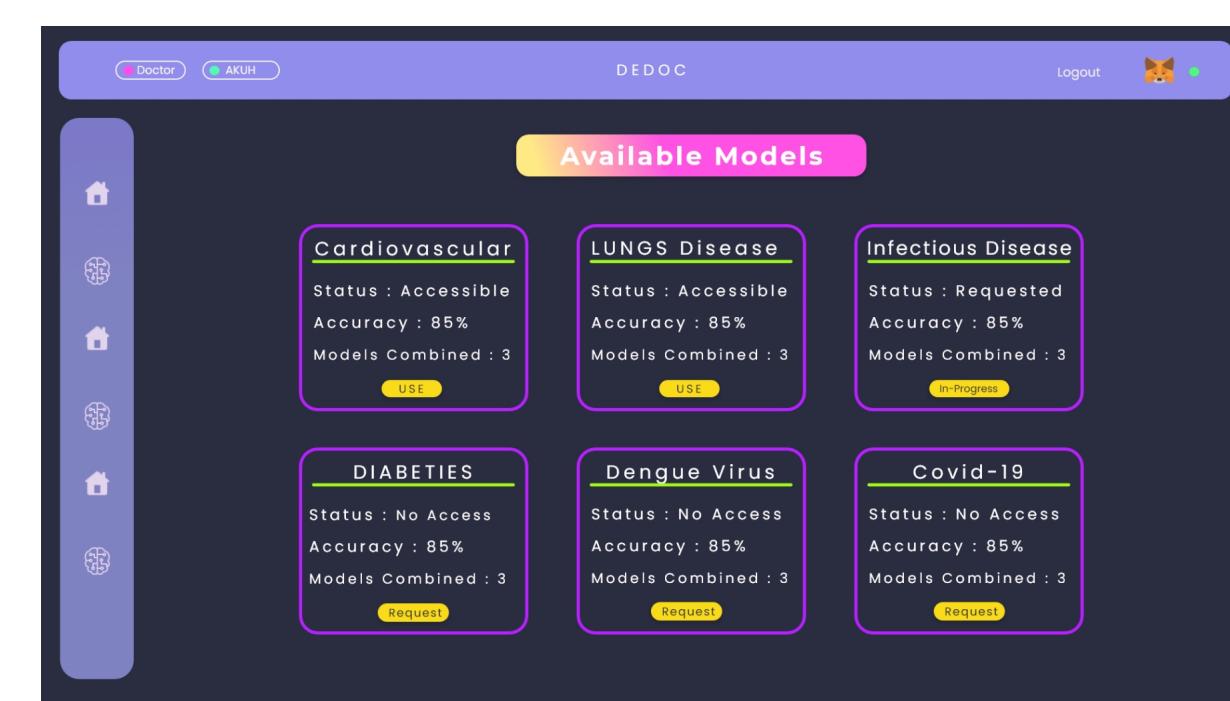
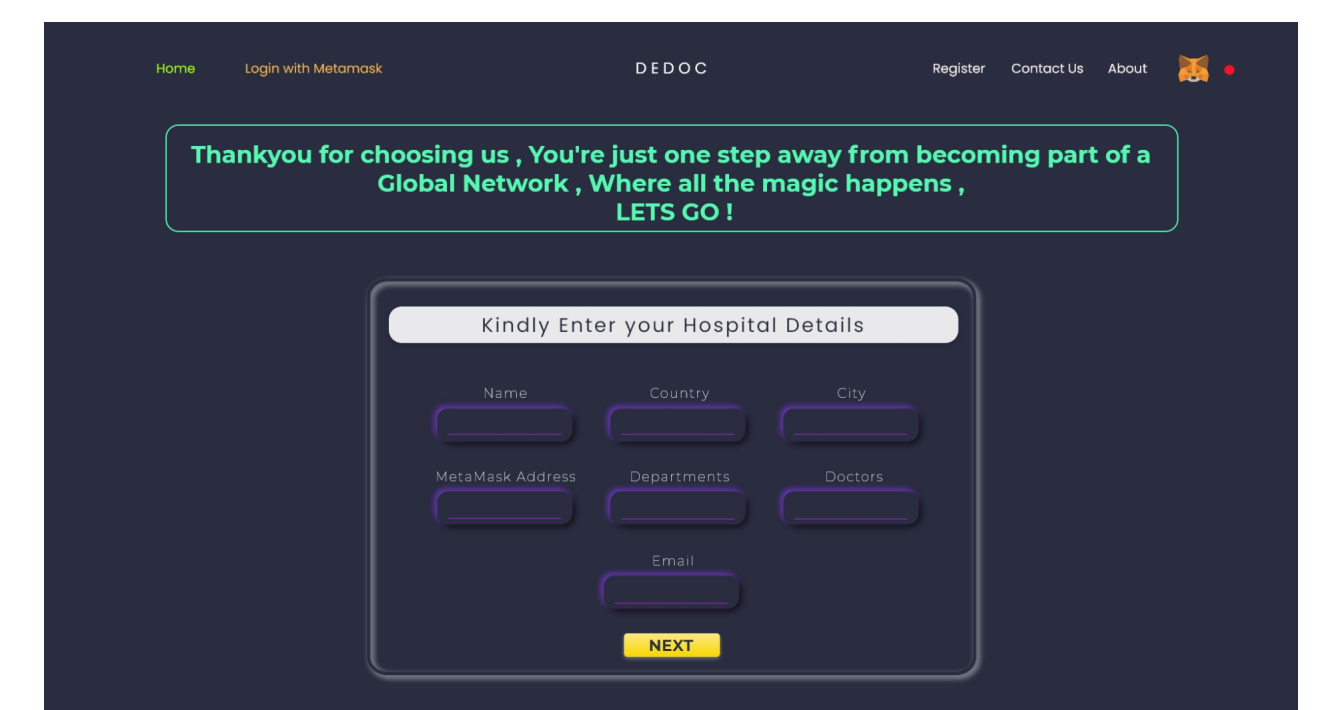
Project Objective

- Objective: Develop a secure and efficient system for medical data sharing in healthcare using federated learning and model sharing techniques.
- Primary goal: Overcome challenges related to privacy concerns and integrate AI technology in the healthcare sector.
- Establish a collaborative framework between the Super user and hospitals.
- Enable training and sharing of machine learning (ML) models.
- Ensure confidentiality of patient data.
- Leverage technologies such as Solidity, React.js, IPFS, and blockchain.
- Create a robust and scalable solution.
- Promote AI integration while maintaining patient privacy.

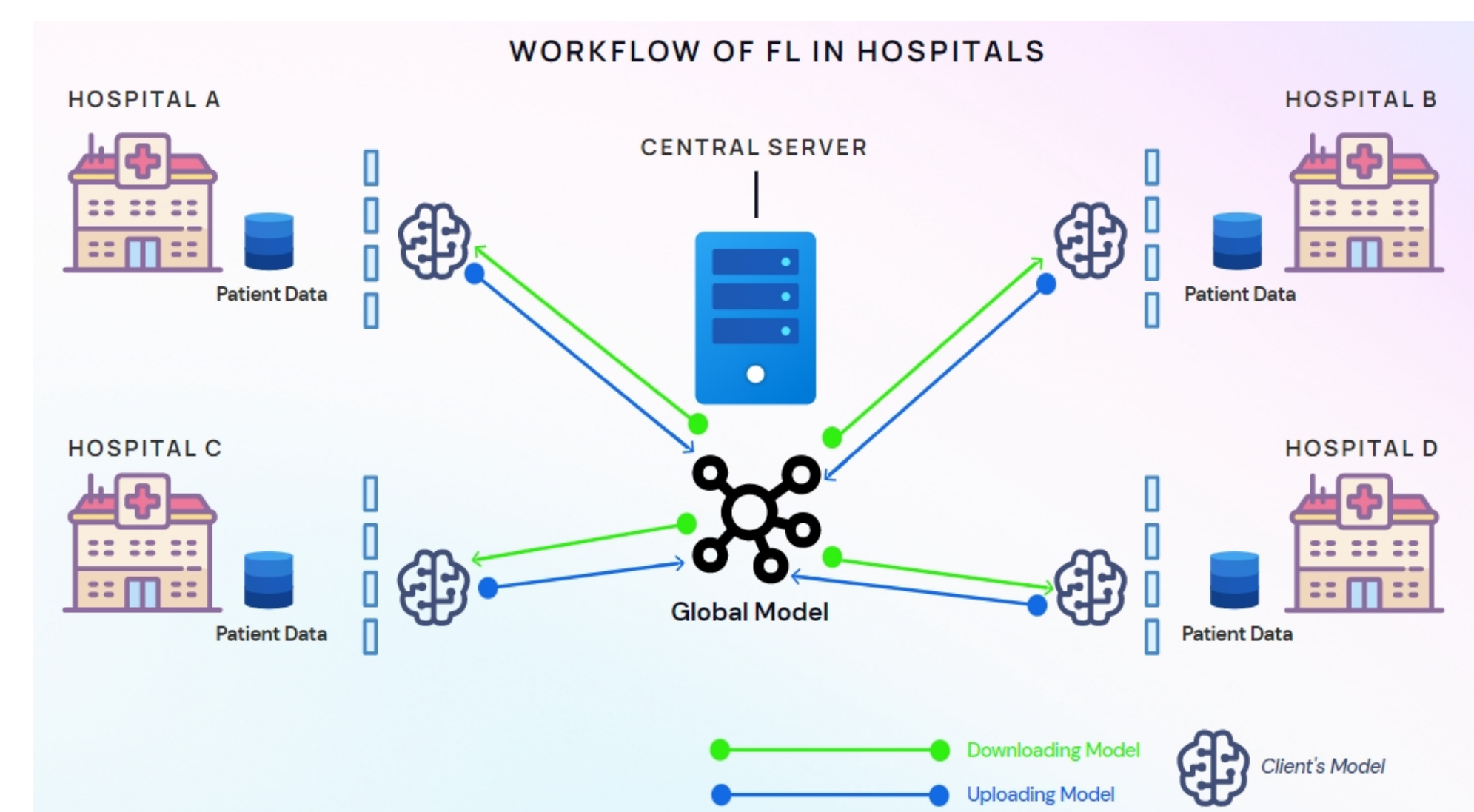
System Architecture



Snapshots of Web-App

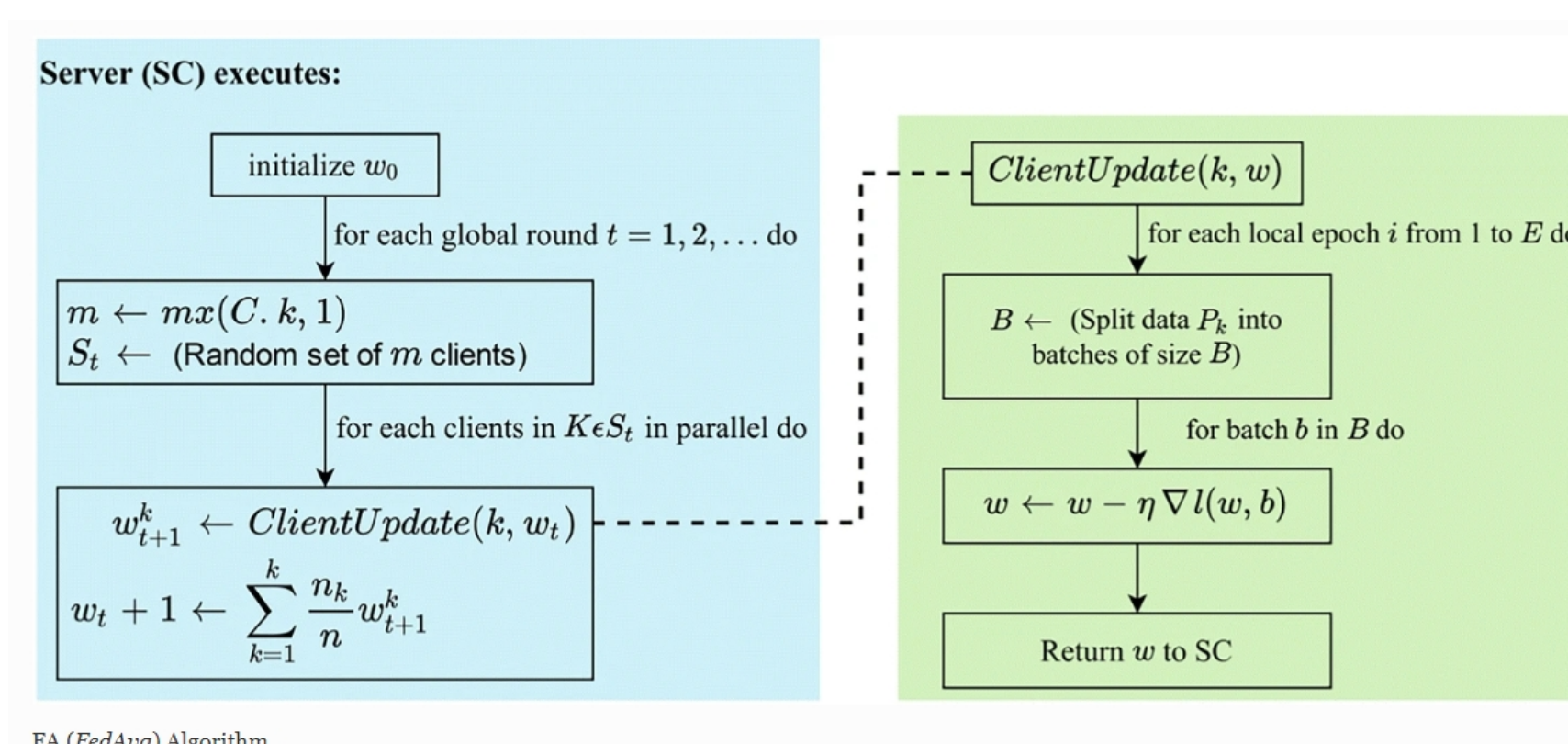
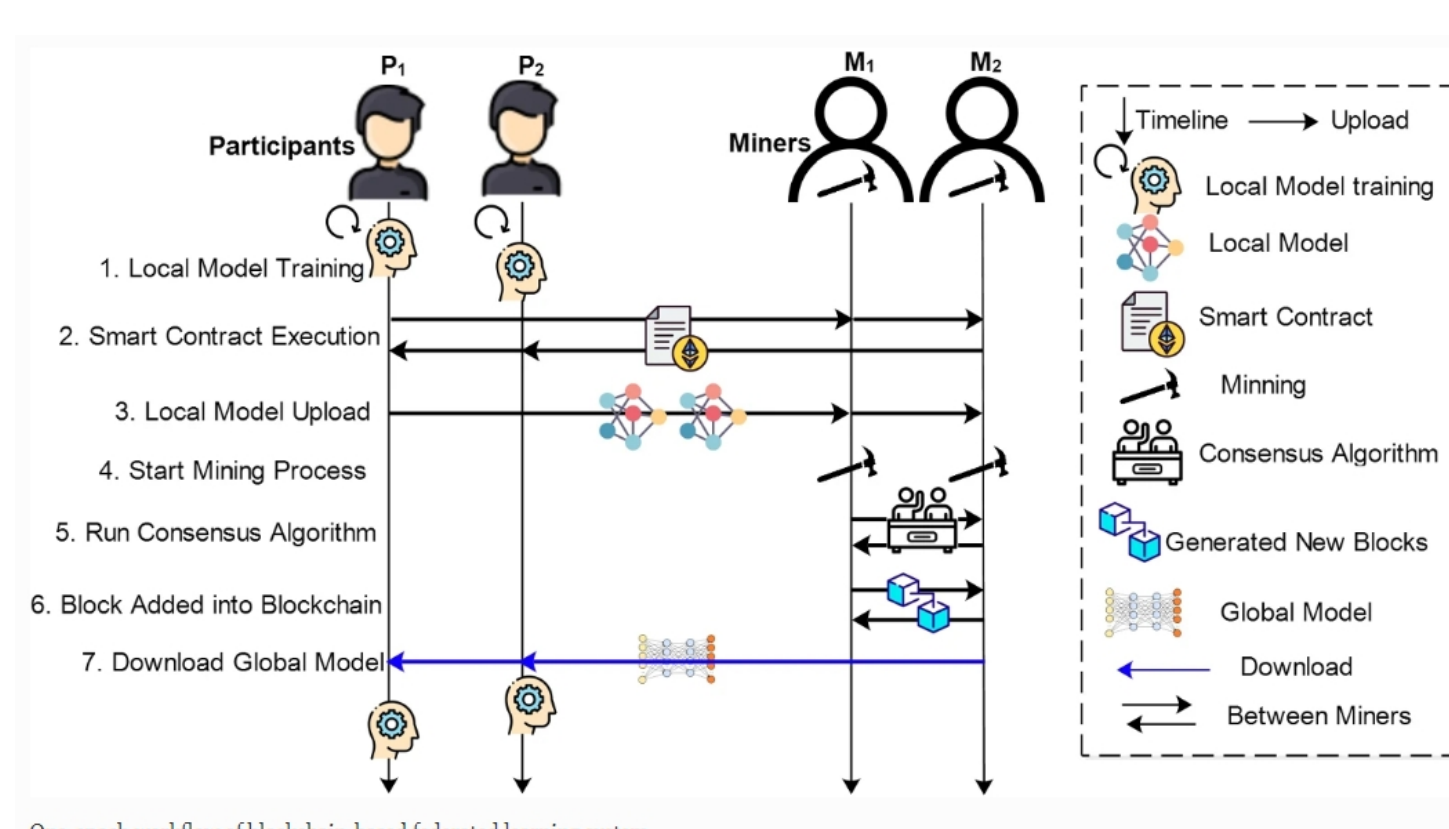


Workflow of Federated Learning



Future Work

- Register our ERC-20 "Doc-Token" on Decentralized Exchange (DEX)
- Assign a Market Cap and Market Value of our Doc-Token
- Create a Lending Pool where Hospitals can trade their Doc-Tokens and gain monetary benefits as well as Rent Models.
- Onboard Hospitals in our System



Development Tools and Technologies Used

