MICHIGAN STATE
UNIVERSITY

Project Plan Presentation
Blockchain Based Vaccine Passport System

The Capstone Experience

Team MaxCogito

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From Students…
…to Professionals

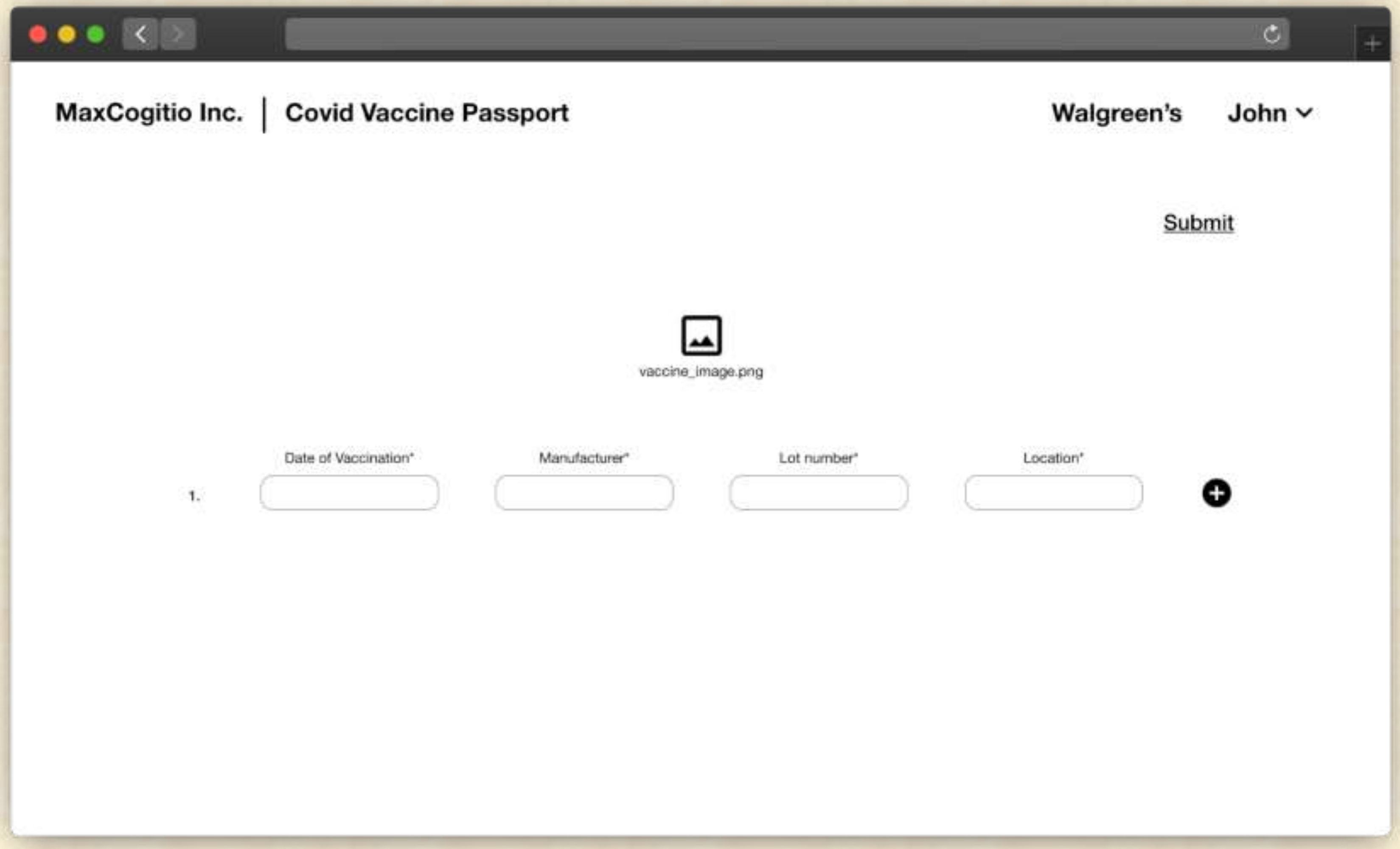
Functional Specifications

- Secure, verifiable "vaccine passports" are essential for public safety amidst the COVID-19 pandemic.
  - By verifying individual's vaccination statuses, the risk of spreading the virus via travel, sporting events, concerts, etc. can be minimized.
  - Paper vaccination cards are easy to fake and could put the public at risk.
- By leveraging the immutable nature of the blockchain, secure digital "vaccine wallets" can be verified.
  - The goal of this project is to create a system that allows users to easily display vaccination status and request updates.
  - A verified medial entity will approve and record vaccine status of users to the blockchain to ensure authenticity.
- The system should support users that don't want a wallet.
  - These users will not have the benefits of the blockchain.

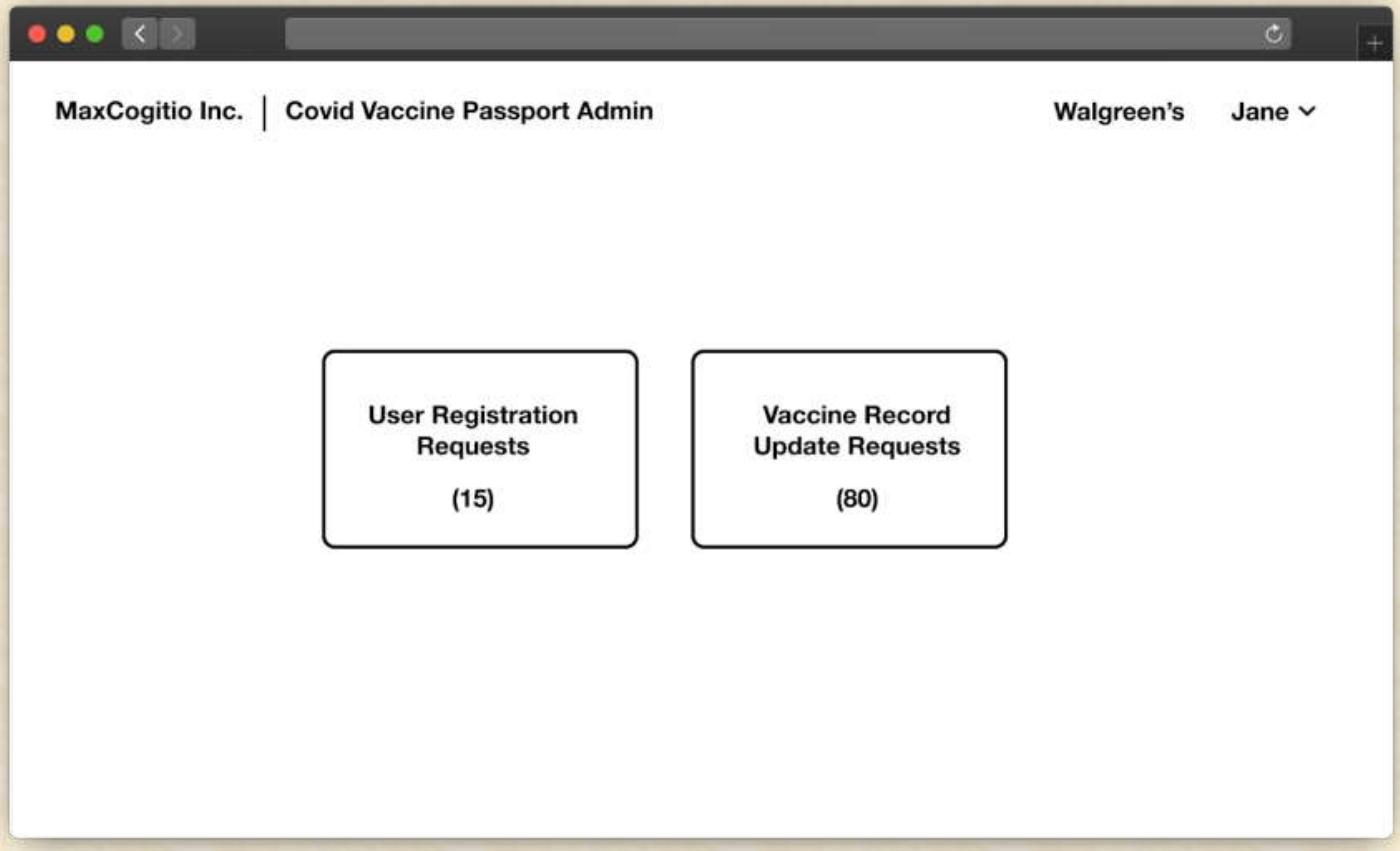
Design Specifications

- Admin Application
    - User registration approval
    - Vaccine update approval
- User Web Application
    - Register an account
    - Request update to vaccine status
    - View vaccine status
- User Wallet Application
    - Register wallet account
    - Request update to vaccine status
    - View vaccine status

Screen Mockup: Vaccine Data Collection



Screen Mockup: Administrative Dashboard



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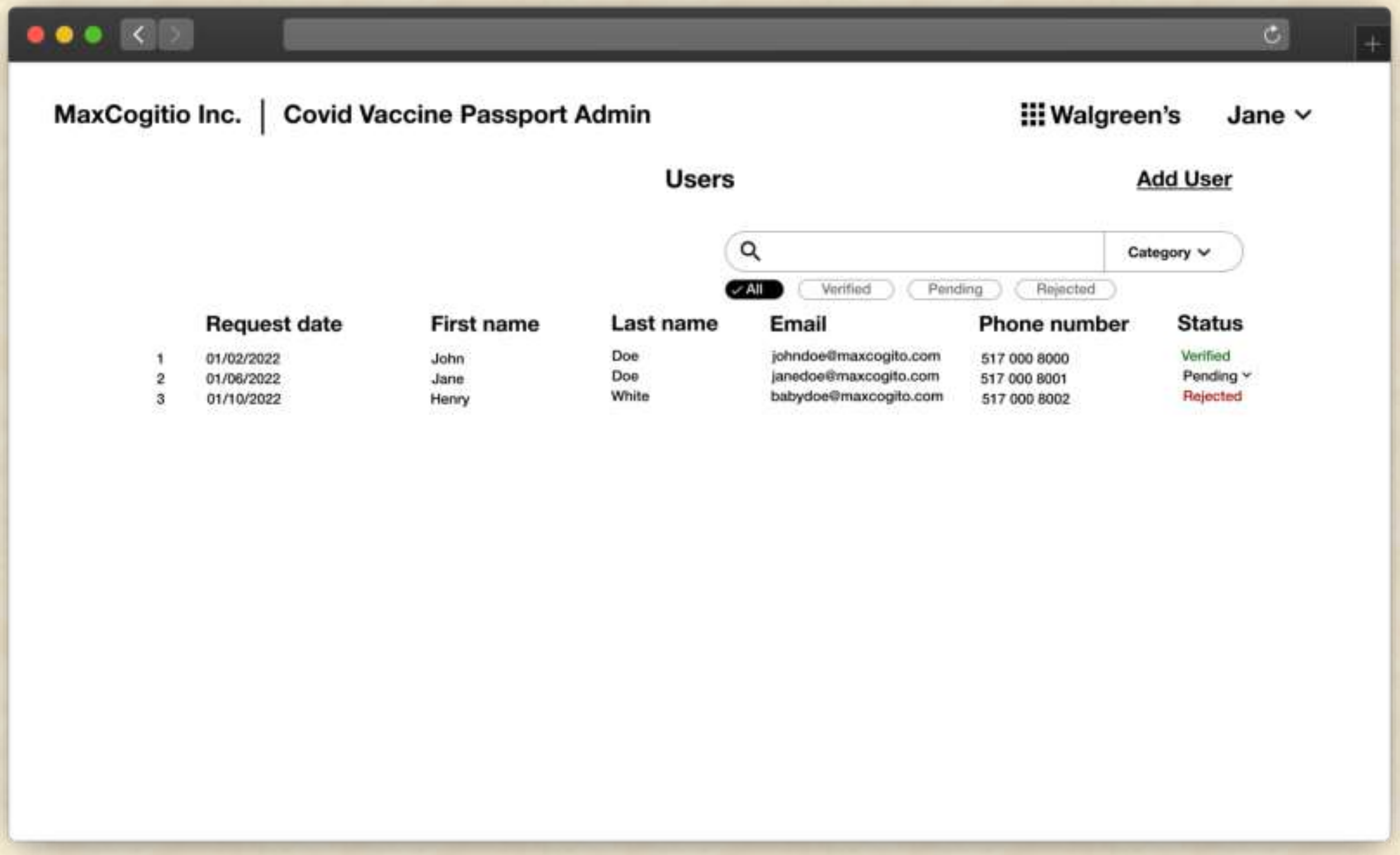
User Registration Requests

(15)

Vaccine Record Update Requests

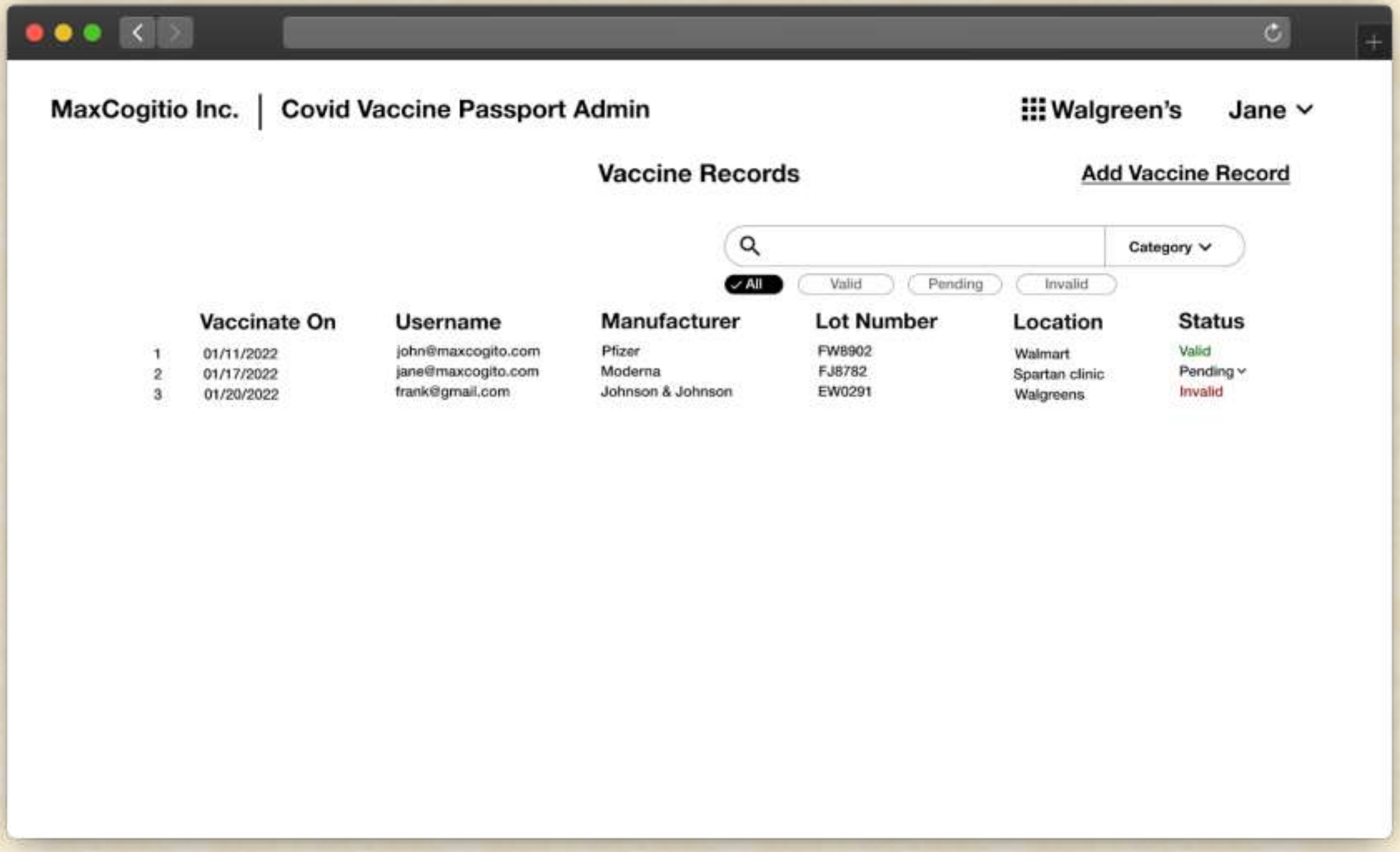
(80)

Screen Mockup: Registration Requests



	Request date	First name	Last name	Email	Phone number	Status
1	01/02/2022	John	Doe	johndoe@maxcogito.com	517 000 8000	Verified
2	01/06/2022	Jane	Doe	janedoe@maxcogito.com	517 000 8001	Pending
3	01/10/2022	Henry	White	babydoe@maxcogito.com	517 000 8002	Rejected

Screen Mockup: Vaccine Update Requests



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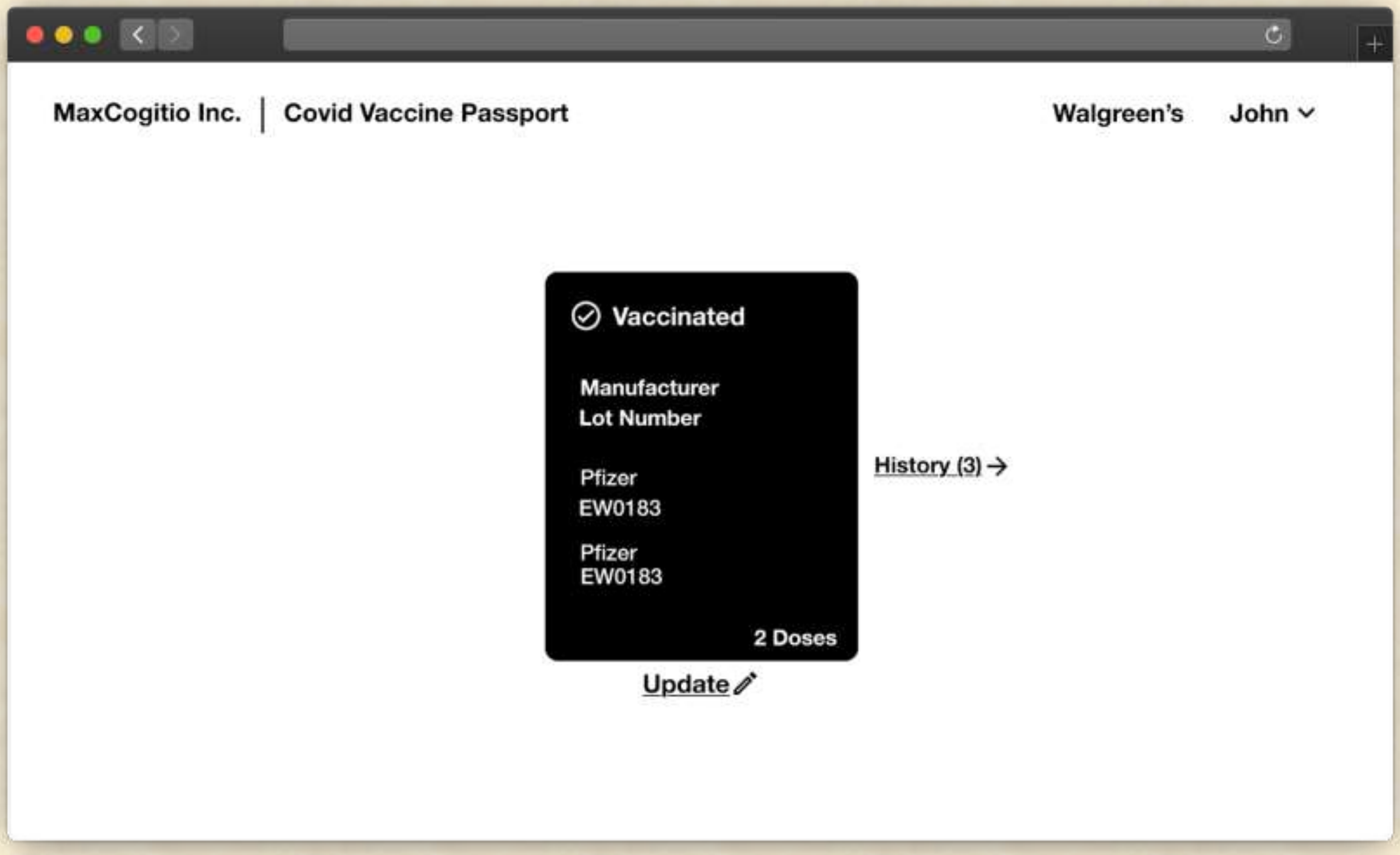
Walgreen's Jane

Vaccine Records

Add Vaccine Record

	Vaccinate On	Username	Manufacturer	Lot Number	Location	Status
1	01/11/2022	john@maxcogito.com	Pfizer	FW8902	Walmart	Valid
2	01/17/2022	jane@maxcogito.com	Moderna	FJ8782	Spartan clinic	Pending
3	01/20/2022	frank@gmail.com	Johnson & Johnson	EW0291	Walgreens	Invalid

Screen Mockup: Current User Vaccine Status



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Walgreen's John

Vaccinated

Manufacturer
Lot Number

Pfizer
EW0183

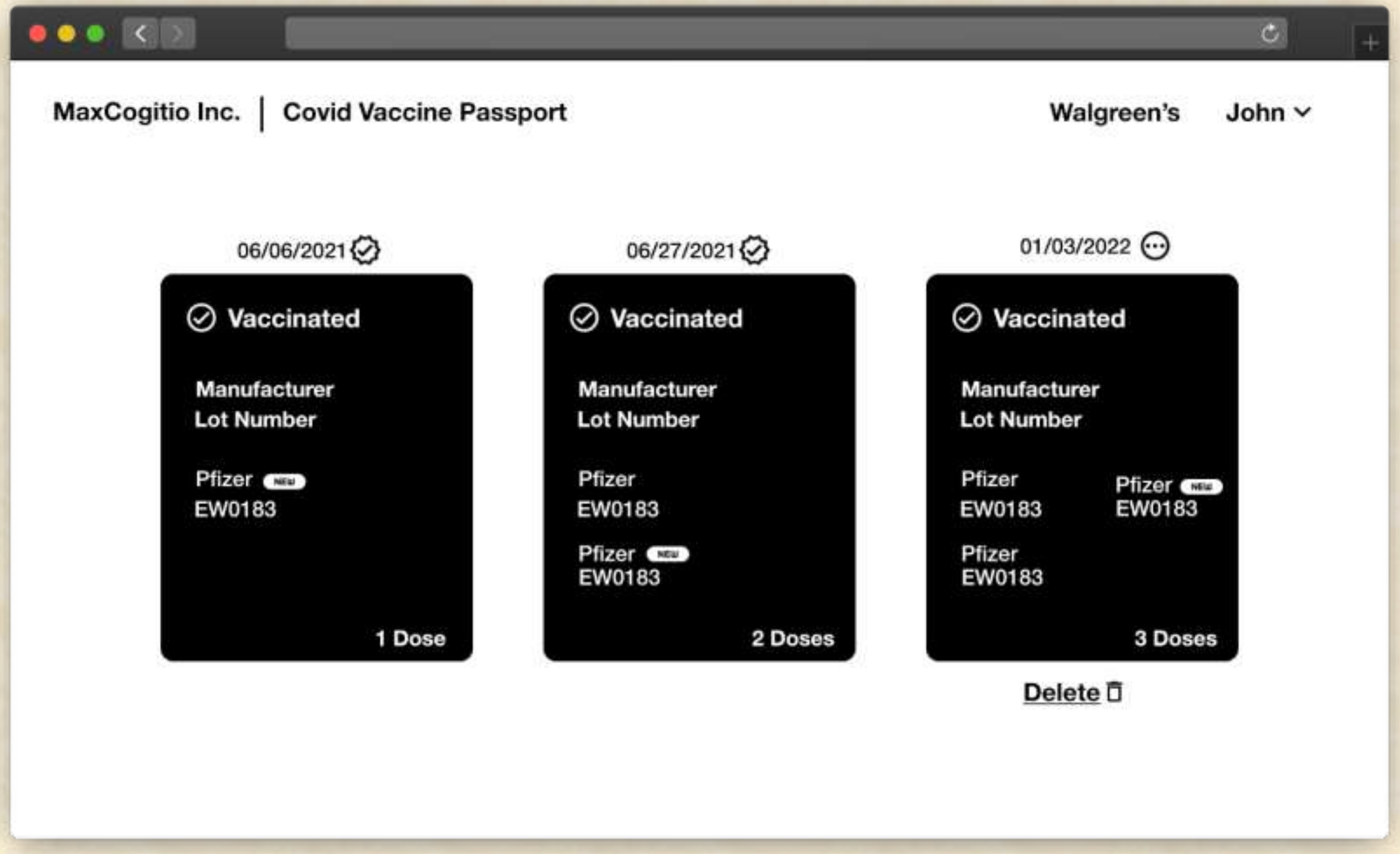
Pfizer
EW0183

2 Doses

History (3) →

Update

Screen Mockup: User Vaccine History



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06/06/2021

Vaccinated

Manufacturer
Lot Number

Pfizer NEW
EW0183

1 Dose

06/27/2021

Vaccinated

Manufacturer
Lot Number

Pfizer
EW0183

Pfizer NEW
EW0183

2 Doses

01/03/2022

Vaccinated

Manufacturer
Lot Number

Pfizer
EW0183

Pfizer
EW0183

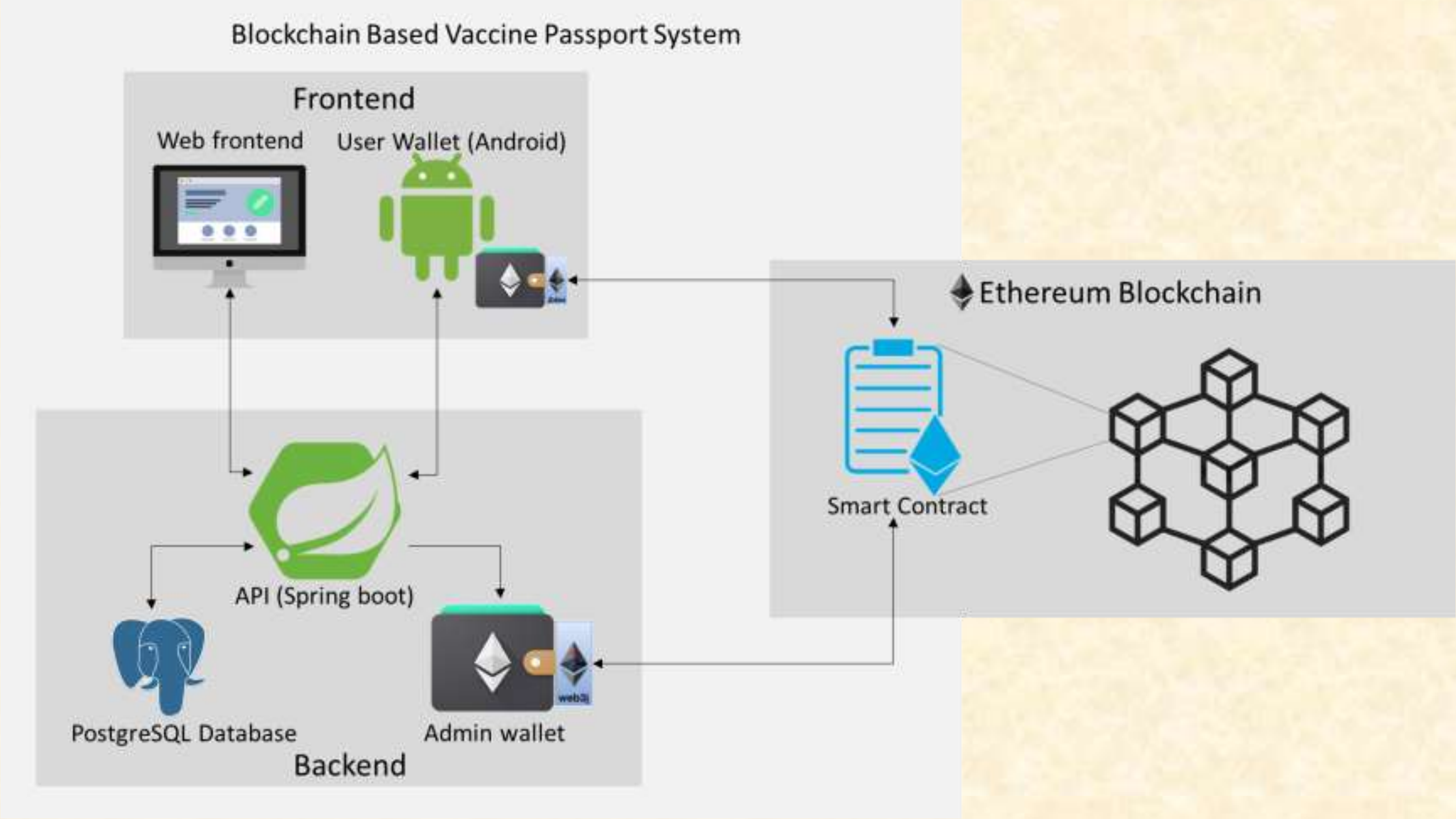
Pfizer NEW
EW0183

3 Doses

Technical Specifications

- Spring boot API
  - Interface for communicating with the database
  - Interface for interacting with administrative wallet
- Angular frontend
  - Web based interface for users (with or without an Ethereum wallet) and admins
- Smart contract
  - Interface to the Ethereum network
  - Functions to read and update the Ethereum network
- Ethereum wallet (Store for cryptographic information)
  - Administrative wallet
    - Performs reads and writes on the blockchain using the smart contract
  - User wallet
    - Implemented as a java application
    - Performs only reads on the blockchain using the smart contract
- PostgreSQL database

System Architecture



System Components

- Hardware Platforms
  - Android
- Software Platforms / Technologies
  - Front End
    - HTML
    - CSS
    - Angular
    - Typescript
  - Back End
    - Spring Boot
    - PostgreSQL
    - Solidity
    - PGAdmin
    - Java
    - Remix IDE
    - Web3j
    - Truffle
    - QuickNode.io
  - Environments
    - AWS Server

Risks

- **Efficiency**
  - **Description:** Fees are associated with transactions that add blocks/make changes to the Ethereum network. As such, we need to optimize smart contracts to reduce gas fees.
  - **Mitigation:** Our smart contracts will be tested extensively on Ethereum network simulators to ensure that we pay the least possible gas fee.
- **Security**
  - **Description:** Different authentication protocols have been developed over the past years (e.g., OpenID Connect, SAML, etc.). We need to settle down on one of them or an authentication service provider and avoid reinventing the wheel to better protect user data and secure our APIs.
  - **Mitigation:** We will immediately find a library that provides the best support for one of the authentication protocols and implement that as soon as possible. If no such library exists, we will resort to an authentication service provider (e.g., Auth0). We will be using elliptic curve cryptography and digital signatures for securing communication between clients and the backend web service. We will also encrypt all information sent across the internet thus providing an additional level of security aside transport layer security.

Questions?

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