



NALLA MALLA REDDY ENGINEERING COLLEGE

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NBA Accredited Programs:B.Tech in CSE, ECE, EEE & Mechanical
Accredited by NAAC with 'A' Grade

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

Leveraging Blockchain Technology for Electronic Health Record (EHR)

UNDER THE ESTEEMED
GUIDANCE OF

Dr. N. Lakshmi Priya
Assistant Professor, CSE

Presented By: Batch-12

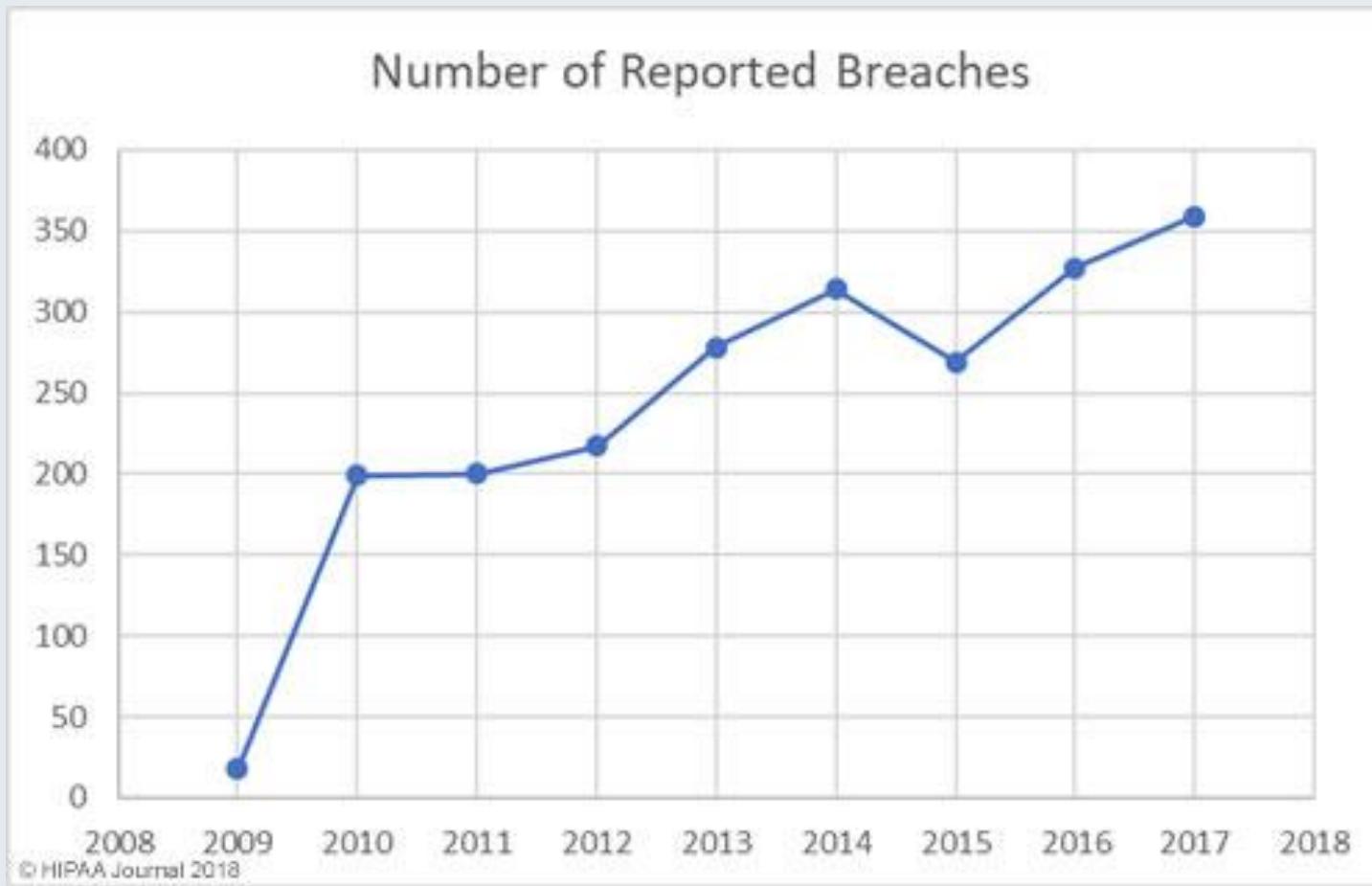
N. Praveen Kumar Reddy	(16B61A0578)
P. Koushik Reddy	(16B61A0584)
P. Jayakumar	(16B61A0590)
S. Sai Priyatham	(16B61A05A4)

Problem Statement

This problem statement is collected from the **SIH-2020**. It was given by the "Logo Company pvt. Ltd". (Id-SS45)

EHR generally contains highly-sensitive and critical data related to patients, which is frequently shared among clinicians, radiologists, healthcare providers and researchers, for effective diagnosis and treatment. The Electronic Health Record (EHR) systems face problems regarding **data security, integrity and management**.

Statistics of EHR



Existing solution

EHRS fall into
two broad
categories:

Server based

Cloud based

Our Solution

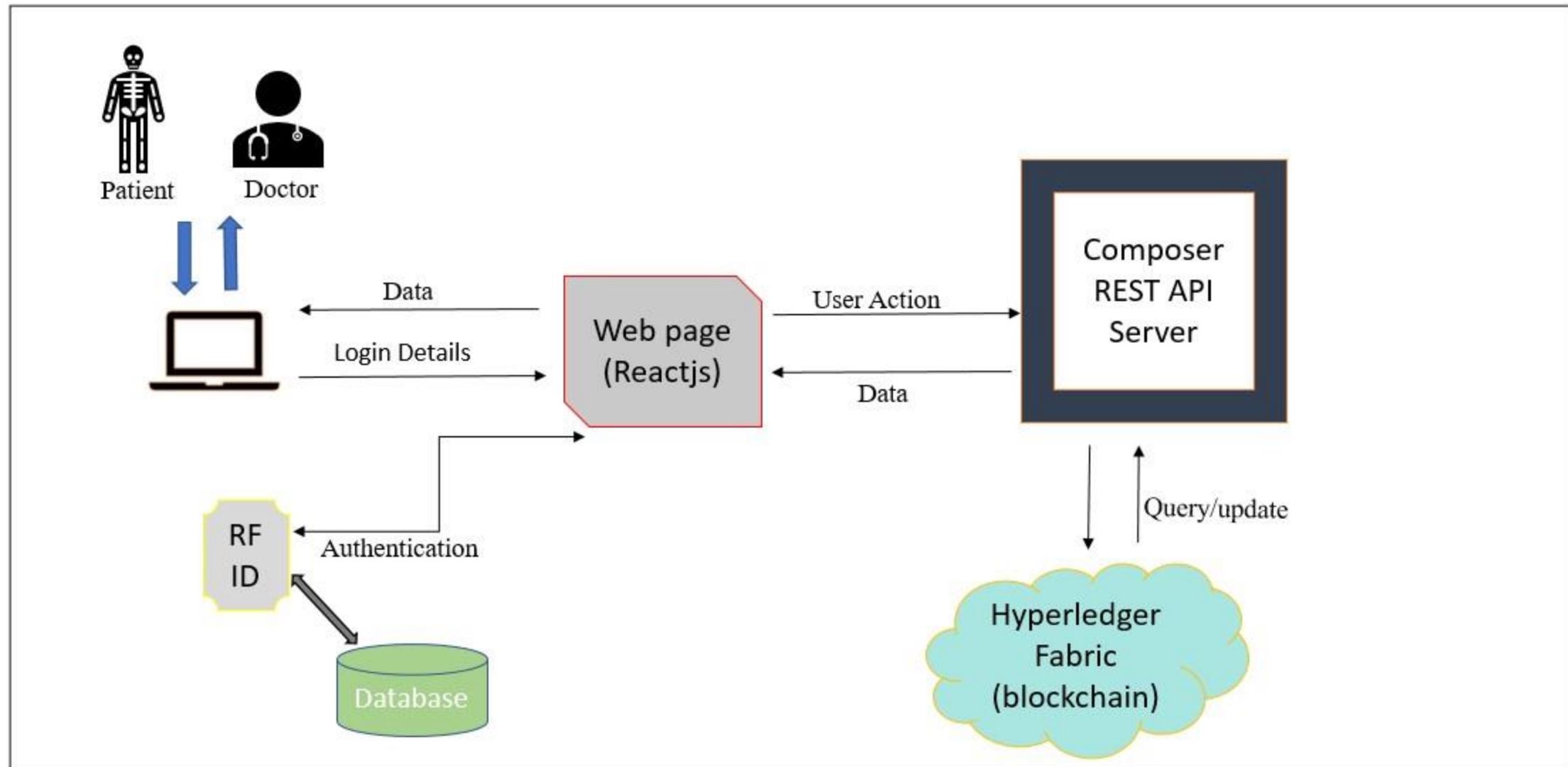
1

Implementing blockchain
network to store the Health
Records.

2

Providing secure Granular
access rules for the users.

EHR - Architecture



System Requirements:

SOFTWARE REQUIREMENTS:

Operating System: Windows 10/ Ubuntu-18.02

Client-side Scripting: JavaScript, NodeJS

Server Deployment: ReactJS

Programming Language: Golang

IDE/Workbench: Visual studio

Database: MongoDB

Blockchain Technology: Hyperledger Fabric and Composer

HARDWARE REQUIREMENTS:

Hard Disk : 500 GB HDD and above

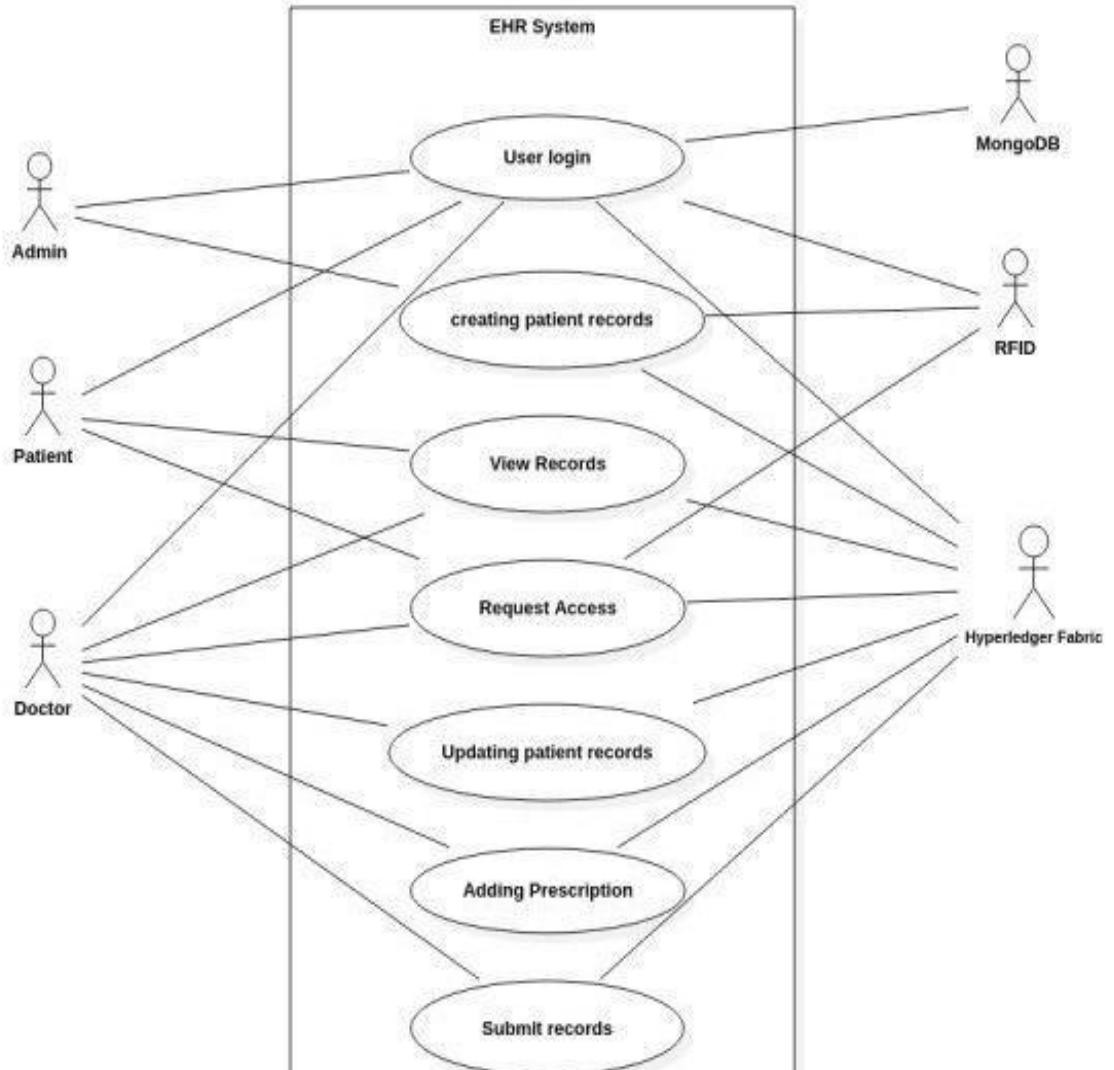
Processor : Intel i7 and above

Type : 64-bit Operating System

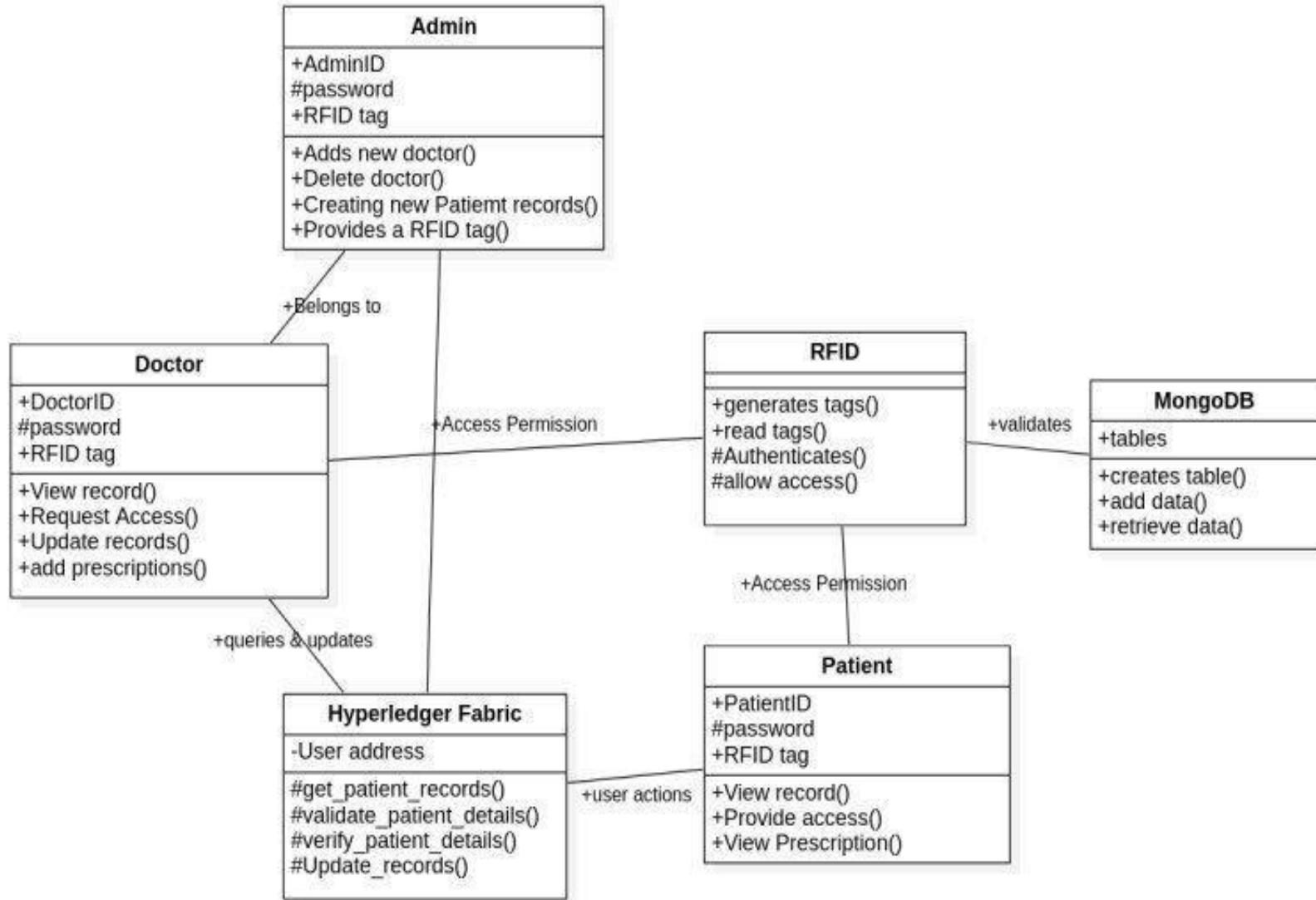
RAM : 8GB and above

Technology : RFID-MFRC599, Arduino Uno 3, RFID tag

use case EHR

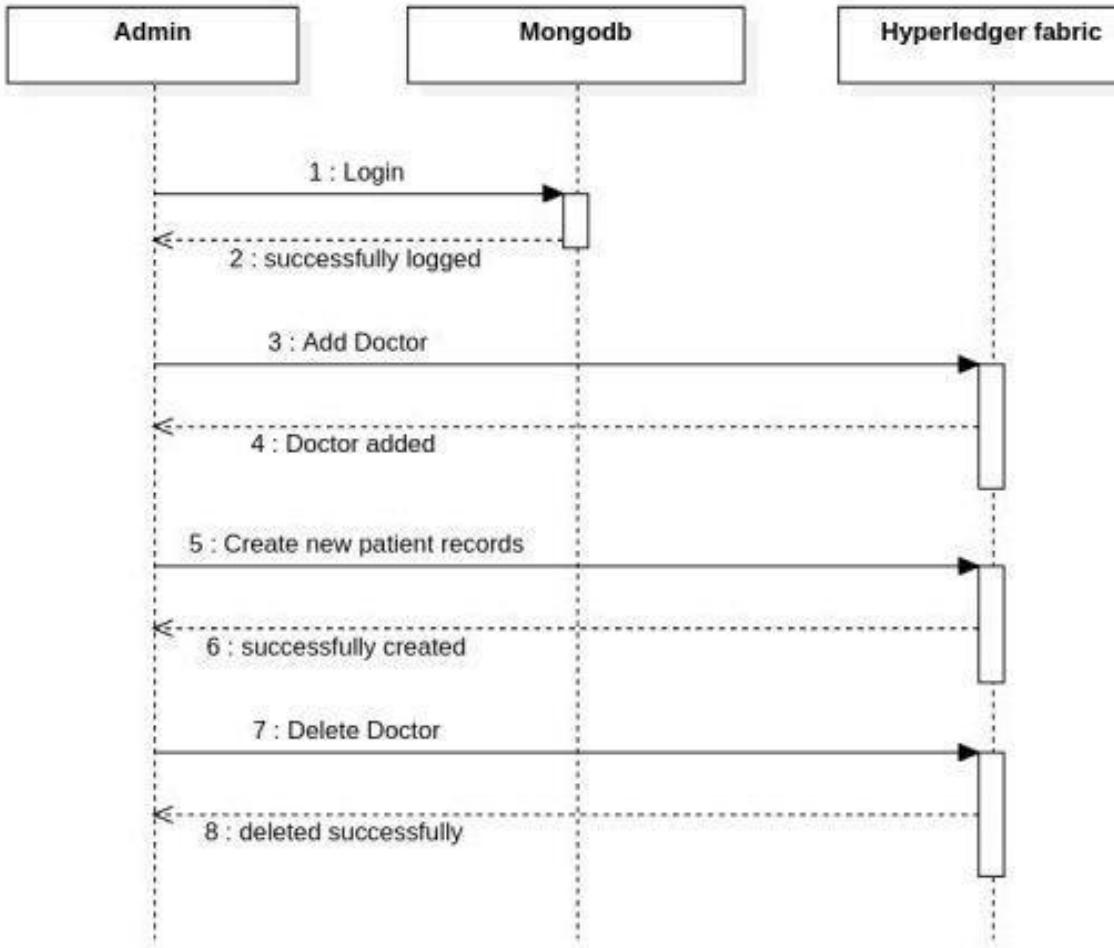


Use case diagram



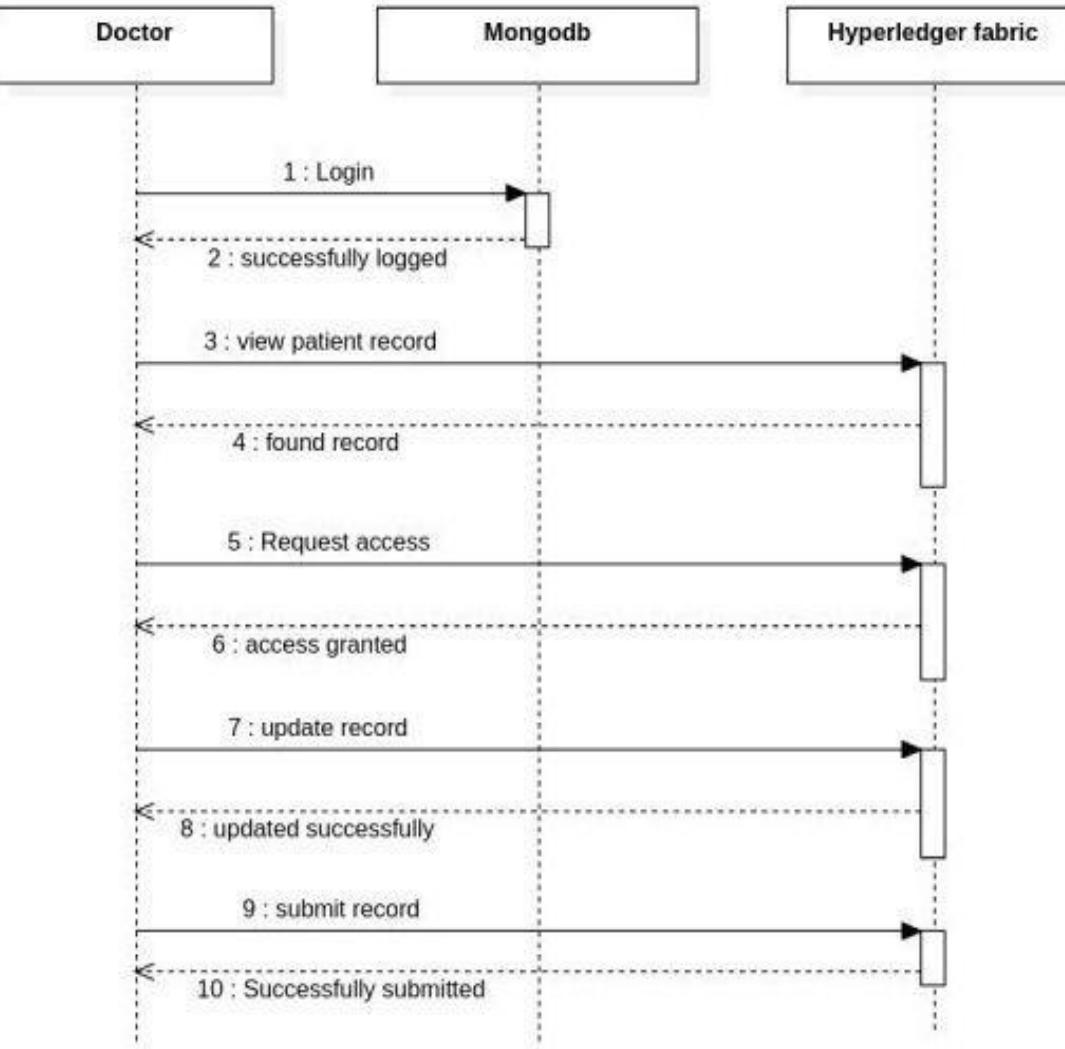
Class diagram

interaction SequenceDiagram1



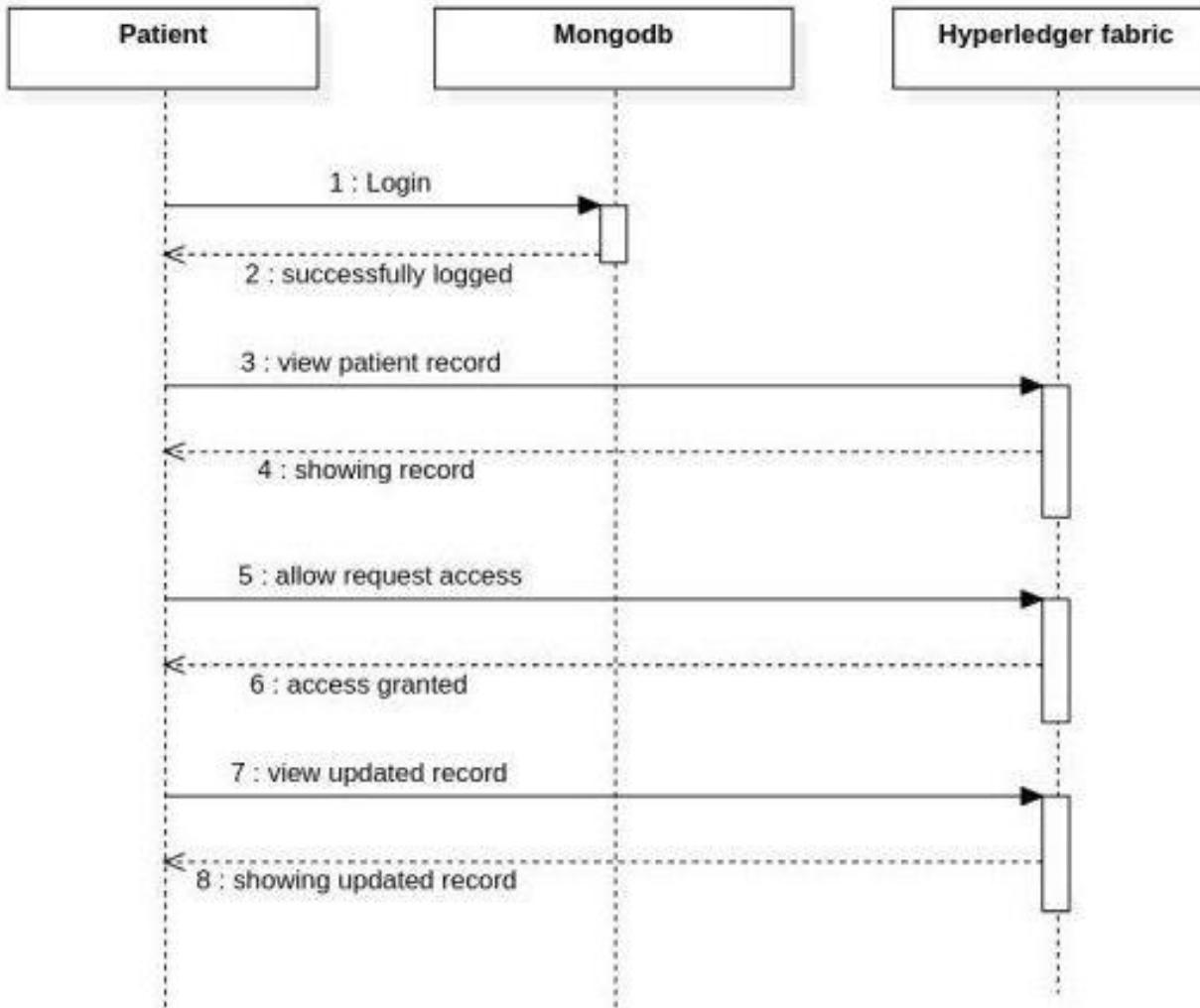
Sequence diagram

interaction SequenceDiagram2



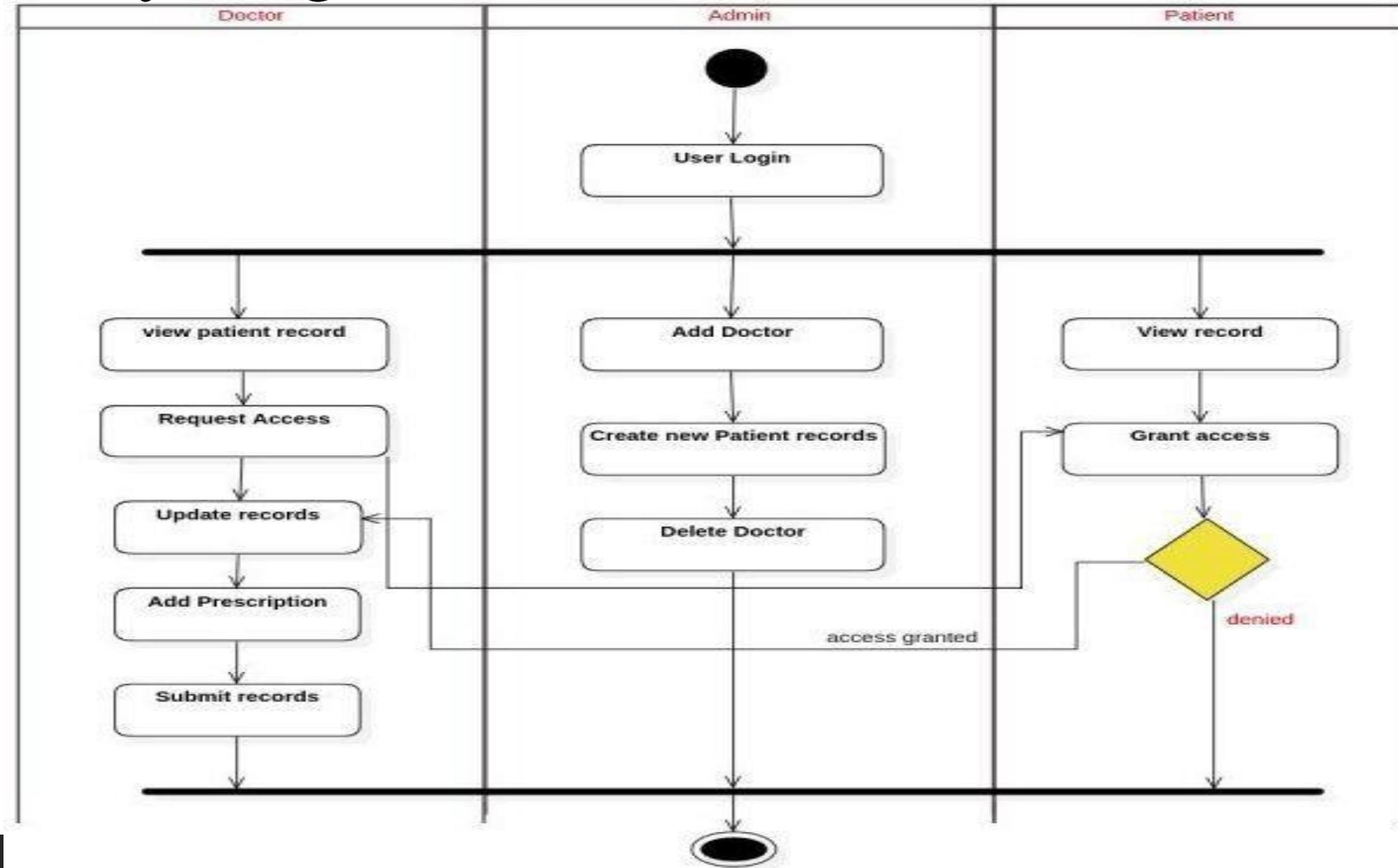
Sequence diagram

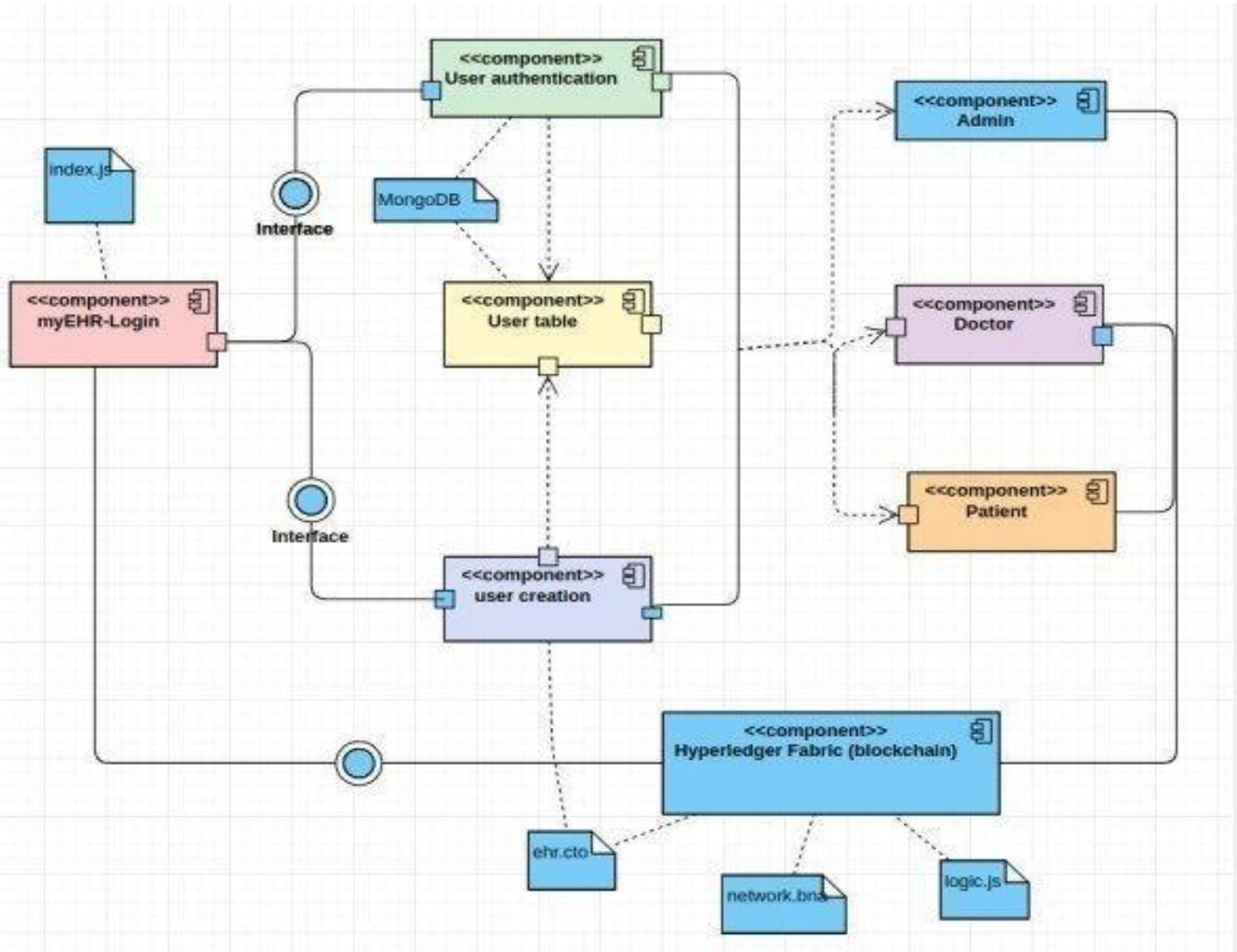
interaction SequenceDiagram3



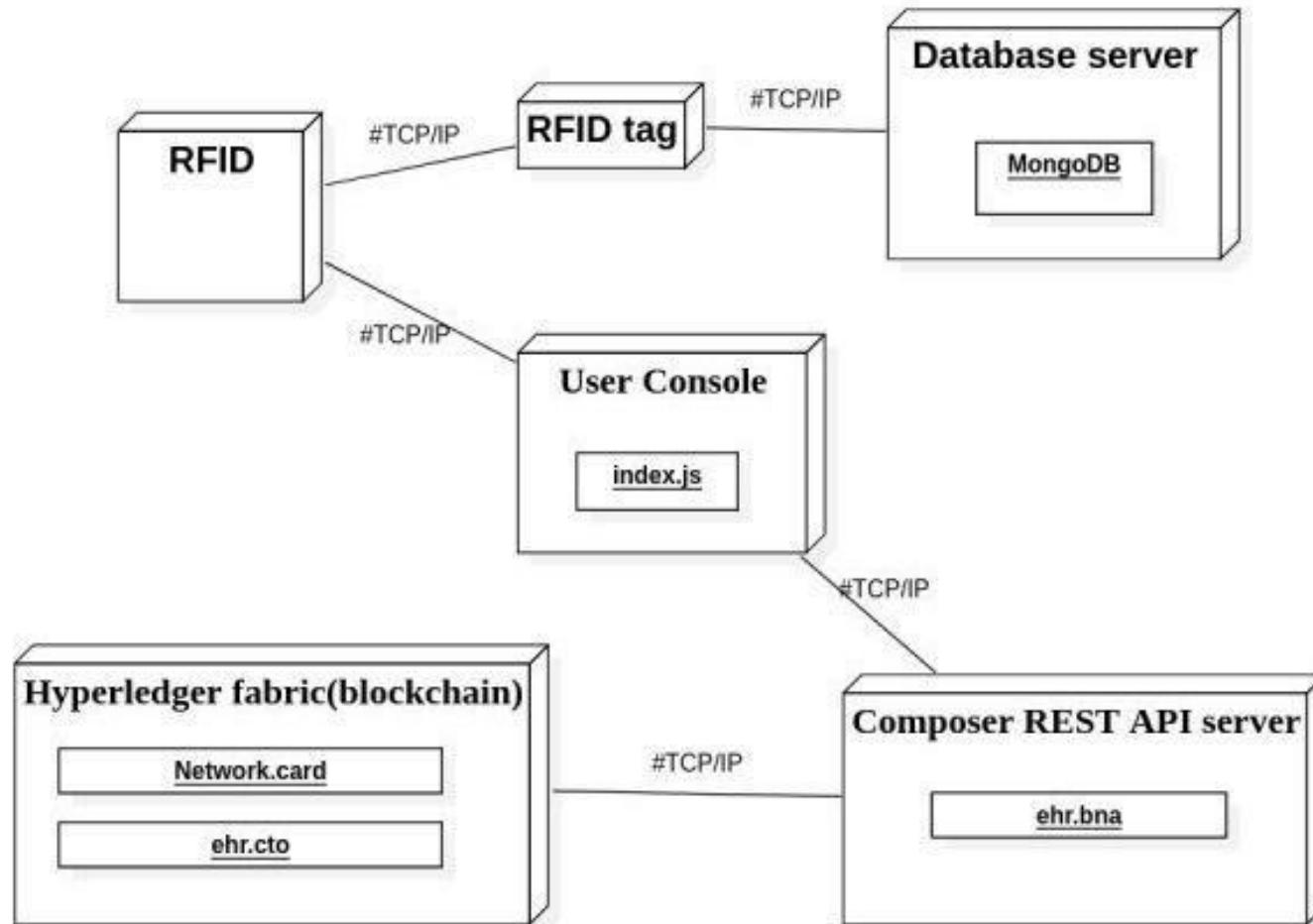
Sequence diagram

Activity diagram





Component diagram



Deployment diagram

Advantages of Blockchain for storing patient records

Security

Decentralized Data

Managed Consent

Simplified claim processing

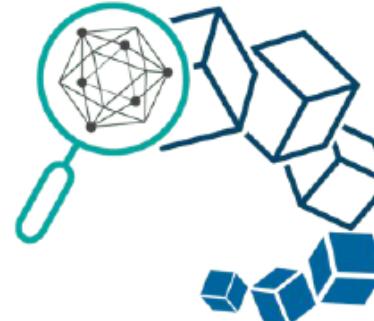
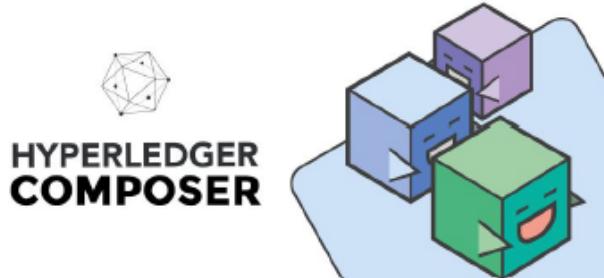
Patient Access control

Technology Stack

- IBM's Hyperledger Framework for Blockchain
- Hyperledger Composer based on Fabric Architecture
- Hyperledger Playground
- JavaScript for website



HYPERLEDGER



GUI Screens

Activities Terminal Wed 19:04

dop@dop: ~/Downloads/Test/EHR-HYPERLEDGER-master

```
File Edit View Search Terminal Help
Response from attempted peer comms was an error: Error: Failed to connect before the deadline
Command failed

dop@dop:~/Downloads/Test/EHR-HYPERLEDGER-master$ composer network install --card PeerAdmin@hlfv1 --archiveFile ehr@0.0.1.bna
✓ Installing business network. This may take a minute...
Successfully installed business network ehr, version 0.0.1

Command succeeded

dop@dop:~/Downloads/Test/EHR-HYPERLEDGER-master$ composer network start --networkName ehr --networkVersion 0.0.1 --networkAdmin admin --networkAdminEnrollSecret adminpw --card PeerAdmin@hlfv1 --file netwo
rkadmin.card
Starting business network ehr at version 0.0.1

Processing these Network Admins:
  userName: admin

✓ Starting business network definition. This may take a minute...
Successfully created business network card:
  Filename: networkadmin.card

Command succeeded

dop@dop:~/Downloads/Test/EHR-HYPERLEDGER-master$ composer card import --file networkadmin.card

Successfully imported business network card
  Card file: networkadmin.card
  Card name: admin@ehr

Command succeeded

dop@dop:~/Downloads/Test/EHR-HYPERLEDGER-master$ composer-rest-server
? Enter the name of the business network card to use: admin@ehr
? Specify if you want namespaces in the generated REST API: never use namespaces
? Specify if you want to use an API key to secure the REST API: No
? Specify if you want to enable authentication for the REST API using Passport: No
? Specify if you want to enable the explorer test interface: No
? Specify a key if you want to enable dynamic logging: n
? Specify if you want to enable event publication over WebSockets: Yes
? Specify if you want to enable TLS security for the REST API: No

To restart the REST server using the same options, issue the following command:
  composer-rest-server -c admin@ehr -n never -d n -w true

Discovering types from business network definition ...
Discovering the Returning Transactions..
Discovered types from business network definition
Generating schemas for all types in business network definition ...
Registering returning transaction: verifyInteraction
Generated schemas for all types in business network definition
Adding schemas for all types to Loopback ...
Warning: overriding remoting type admin
Added schemas for all types to Loopback
Web server listening at: http://localhost:3000
Rest Server dynamic logging is enabled
```

File Edit View Search Terminal Help

npm run eject

Removes this tool and copies build dependencies, configuration files and scripts into the app directory. If you do this, you can't go back!

We suggest that you begin by typing:

cd myehr
npm start

Happy hacking!

dop@dop:~/Downloads/Test/EHR-BlockChain-Front-master\$ yarn build

Command 'yarn' not found, but can be installed with:

sudo apt install cmdtest

dop@dop:~/Downloads/Test/EHR-BlockChain-Front-master\$ npm run build

> myehr@1.0.0 build /home/dop/Downloads/Test/EHR-BlockChain-Front-master
> react-scripts build

Creating an optimized production build...

Compiled with warnings.

./src/views/Pages/Login/Login.js

Line 121: img elements must have an alt prop, either with meaningful text, or an empty string for decorative images [jsx-a11y/alt-text](#)

./src/components/Services.js

Line 20: 'index_heroBG' is assigned a value but never used

Line 105: The href attribute requires a valid value to be accessible. Provide a valid, navigable address as the href value. If you cannot provide a valid href, link, use a button and change it with appropriate styles. Learn more: <https://github.com/evcohen/eslint-plugin-jsx-a11y/blob/master/docs/rules/anchor-is-valid.md> [no-unused-vars](#) but still need the element to resemble a [jsx-a11y/anchor-is-valid](#)

./src/components/News.js

Line 23: 'index_heroBG' is assigned a value but never used

Line 42: The href attribute requires a valid value to be accessible. Provide a valid, navigable address as the href value. If you cannot provide a valid href, link, use a button and change it with appropriate styles. Learn more: <https://github.com/evcohen/eslint-plugin-jsx-a11y/blob/master/docs/rules/anchor-is-valid.md> [no-unused-vars](#) but still need the element to resemble a [jsx-a11y/anchor-is-valid](#)

Line 43: The href attribute requires a valid value to be accessible. Provide a valid, navigable address as the href value. If you cannot provide a valid href, link, use a button and change it with appropriate styles. Learn more: <https://github.com/evcohen/eslint-plugin-jsx-a11y/blob/master/docs/rules/anchor-is-valid.md> [no-unused-vars](#) but still need the element to resemble a [jsx-a11y/anchor-is-valid](#)

Line 46: The href attribute requires a valid value to be accessible. Provide a valid, navigable address as the href value. If you cannot provide a valid href, link, use a button and change it with appropriate styles. Learn more: <https://github.com/evcohen/eslint-plugin-jsx-a11y/blob/master/docs/rules/anchor-is-valid.md> [no-unused-vars](#) but still need the element to resemble a [jsx-a11y/anchor-is-valid](#)

Line 47: The href attribute requires a valid value to be accessible. Provide a valid, navigable address as the href value. If you cannot provide a valid href, link, use a button and change it with appropriate styles. Learn more: <https://github.com/evcohen/eslint-plugin-jsx-a11y/blob/master/docs/rules/anchor-is-valid.md> [no-unused-vars](#) but still need the element to resemble a [jsx-a11y/anchor-is-valid](#)

Line 53: The href attribute requires a valid value to be accessible. Provide a valid, navigable address as the href value. If you cannot provide a valid href, link, use a button and change it with appropriate styles. Learn more: <https://github.com/evcohen/eslint-plugin-jsx-a11y/blob/master/docs/rules/anchor-is-valid.md> [no-unused-vars](#) but still need the element to resemble a [jsx-a11y/anchor-is-valid](#)

Line 61: The href attribute requires a valid value to be accessible. Provide a valid, navigable address as the href value. If you cannot provide a valid href, link, use a button and change it with appropriate styles. Learn more: <https://github.com/evcohen/eslint-plugin-jsx-a11y/blob/master/docs/rules/anchor-is-valid.md> [no-unused-vars](#) but still need the element to resemble a [jsx-a11y/anchor-is-valid](#)

Line 62: The href attribute requires a valid value to be accessible. Provide a valid, navigable address as the href value. If you cannot provide a valid href, link, use a button and change it with appropriate styles. Learn more: <https://github.com/evcohen/eslint-plugin-jsx-a11y/blob/master/docs/rules/anchor-is-valid.md> [no-unused-vars](#) but still need the element to resemble a [jsx-a11y/anchor-is-valid](#)

Line 65: The href attribute requires a valid value to be accessible. Provide a valid, navigable address as the href value. If you cannot provide a valid href, link, use a button and change it with appropriate styles. Learn more: <https://github.com/evcohen/eslint-plugin-jsx-a11y/blob/master/docs/rules/anchor-is-valid.md> [no-unused-vars](#) but still need the element to resemble a [jsx-a11y/anchor-is-valid](#)

Line 66: The href attribute requires a valid value to be accessible. Provide a valid, navigable address as the href value. If you cannot provide a valid href, link, use a button and change it with appropriate styles. Learn more: <https://github.com/evcohen/eslint-plugin-jsx-a11y/blob/master/docs/rules/anchor-is-valid.md> [no-unused-vars](#) but still need the element to resemble a [jsx-a11y/anchor-is-valid](#)

Line 72: The href attribute requires a valid value to be accessible. Provide a valid, navigable address as the href value. If you cannot provide a valid href, link, use a button and change it with appropriate styles. Learn more: <https://github.com/evcohen/eslint-plugin-jsx-a11y/blob/master/docs/rules/anchor-is-valid.md> [no-unused-vars](#) but still need the element to resemble a [jsx-a11y/anchor-is-valid](#)

Activities Google Chrome ▾ Wed 13:07

Electronic health record a x | Electronic health record a x | GitHub - mamsilimen/EHR x | GitHub - mamsilimen/EHR x | hyperledger_composer_fi x | Hyperledger Composer x | localhost:3000/status/ x | +

localhost:8080/editor

Apps Gmail YouTube Maps

hlfv1 ehr Define Test admin

FILES

About README.md, package.json

Model File models/model.cto

Script File lib/logic.js

Access Control permissions.acl

Add a file... Export

UPDATE NETWORK

From: 0.0.1

To: 0.0.2-deploy.0

Deploy changes

Script File lib/logic.js

```
14
15 'use strict';
16
17
18 /**
19 * PharmacyAddDrug transaction
20 * @param {model.PharmacyAddDrug} PharmacyAddDrug
21 * @transaction
22 * @author Jay
23 */
24
25 async function PharmacyAddDrug(tx) {
26     /**
27      * Getting the Factory for creating new events and resources
28      */
29     let factory = getFactory();
30     /**
31      * Getting the Patient Registry to update the model later
32      */
33     return getParticipantRegistry('model.Patient').then((patientRegistry) => {
34         /**
35          * Pushing the new drug into the patient's pharmacy drug collection
36          */
37         tx.patient.pharmacyDrugs.push(tx.drug);
38         /**
39          * Updating the patient with the new details
40          */
41         patientRegistry.update(tx.patient);
42     }).then(() => {
43         return getAssetRegistry('model.Pharmacy').then(pharmacyRegistry => {
44             return pharmacyRegistry.get(tx.pharmacy.pharmacyId).then(pharmacyAsset => {
45                 /**
46                  * Firing the event of completion
47                  */
48             })
49         })
50     })
51 }
52
53 module.exports = {
54     PharmacyAddDrug
55 }
```

Everything looks good!

Any problems detected in your code would be reported here

Legal GitHub Playground v0.20.9 Tutorial Docs Community

Activities Google Chrome ▾ Wed 13:11

Electronic health record a x | Electronic health record a x | GitHub - mamislimen/EHR x | GitHub - mamislimen/EHR x | Hyperledger Composer x | localhost:3000/status/ x | +

localhost:8080/test

Apps Gmail YouTube Maps

hlfv1 ehr Define Test admin

PARTICIPANTS

Admin Patient Pharmacy Practitioner

+ Create New Participant

Participant registry for model.Admin

ID	Data
0590	{ "\$class": "model.Admin", "adminId": "0590", "firstName": "Jayakumar", "lastName": "pujar", "username": "jaykumar", "password": "1234567890" }

Show All

ASSETS

Allergies ChronicDiseases Consultation Drug LabTestResults MriResults Nutrition PharmacyDrugs PhysicalActivity PractitionerDrugs Prescription

TRANSACTIONS

Legal GitHub Playground v0.20.9 Tutorial Docs Community



myEHR
Because life matters

HOME ABOUT US SERVICES NEWS DOCTORS

Medical Services that you can trust

We provide a lot of services and we take care of every individual data in our network.

[READ MORE](#)





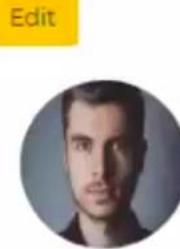
Profile

Physical Activity

Nutrition

Home / Dashboard / Profile

My Profile



SLIMEN MAMI

CIN : 11111
CNSS/CNAM : 00000000
Blood Type: O
Height: 175M
Weight: 70KG

Phone: 22365478
Emergency Phone: 22365478
Email: mamislimenproxy@gmail.com
Birthday: 2019/05/21
Address: AVENUE JAHEDH
Gender: MALE
Obesity Test: 

Drugs

MRI

Lab Test



Chronic Diseases

Allergies

Name	Manufacturer	Price	LotNumber
Panadol	Opalia	2	E018

 Profile[Home](#) / [Dashboard](#) / [Profile](#) Physical Activity Nutrition

My Profile

[Edit](#)

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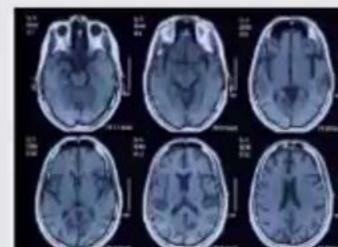
Phone: 22365478
Emergency Phone: 22365478
Email: mamilimamiproxy@gmail.com
Birthday: 2019/05/21
Address: AVENUE JAHEDH
Gender: MALE
Obesity Test: [Test](#)

[Drugs](#)[MRI](#)[Lab Test](#)[Chronic Diseases](#)[Allergies](#)

Establishment

lab

Image



Test Date

2019-05-24T00:00:00.000Z

Profile

Edit



SLIMEN MAMI

CIN : 11111
CNSS/CNAM : 00000000
Blood Type: o
Height: 175M
Weight: 70KG

Phone: 22365478
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Birthday: 2019/05/21
Address: AVENUE JAHEDH
Gender: MALE
Obesity Test: Test

Drugs

MRI

Lab Test

Chronic Diseases

Allergies

Establishment	Image	Test Date
estab		2019-05-24T00:00:00.000Z

Patient Profile

Consultation

Prescription

Allergies

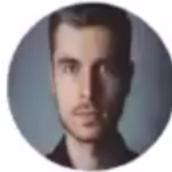
MRI results

Lab Test Results

Chronic Disease

[Home](#) / [Dashboard](#) / [Profile](#)

Patient Profile



SLIMEN MAMI

CIN : 11111

CNSS/CNAM : 00000000

Blood Type: O

Height: 175M

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Phone: 22365478

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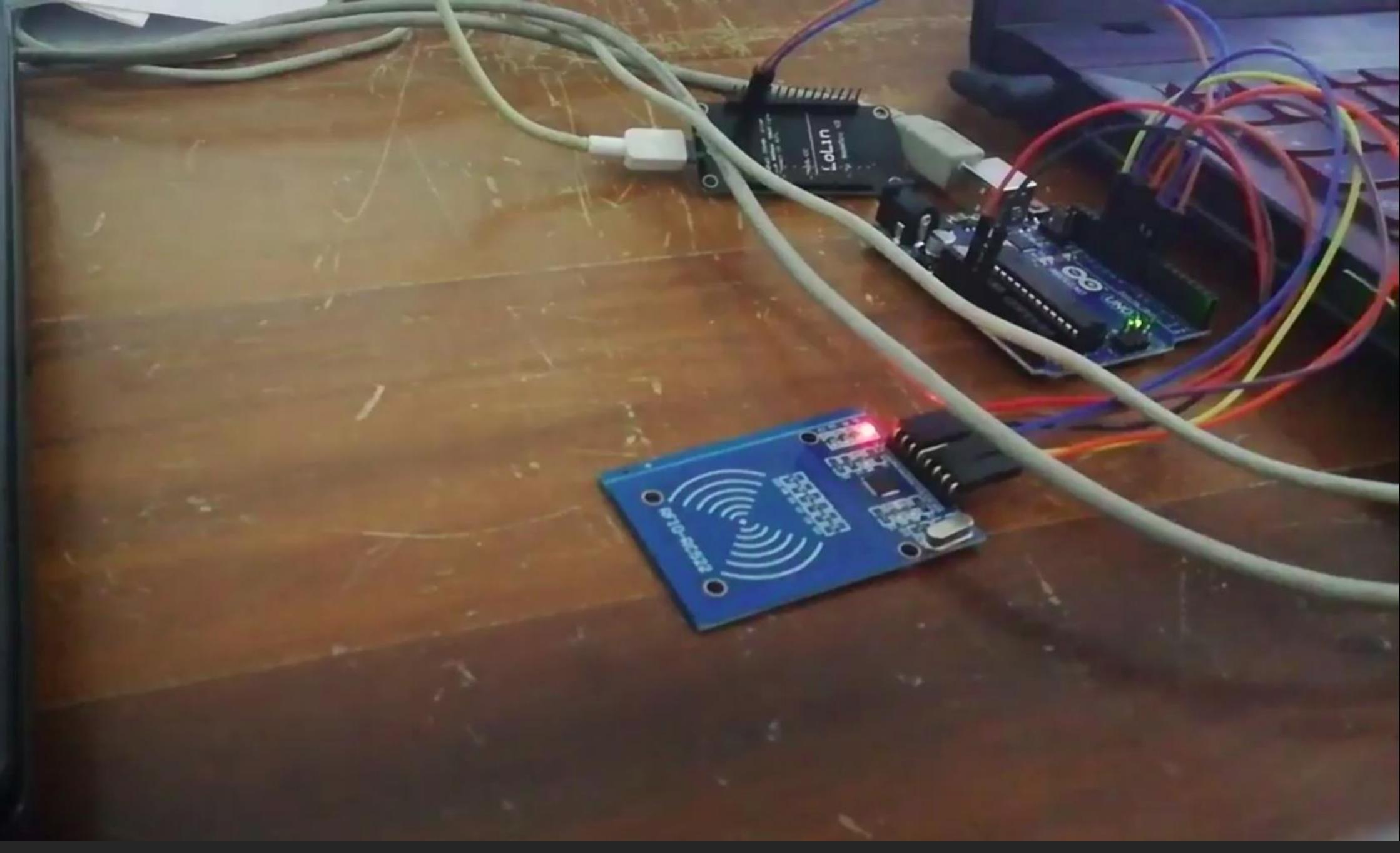
Email: mamislimenproxy@gmail.com

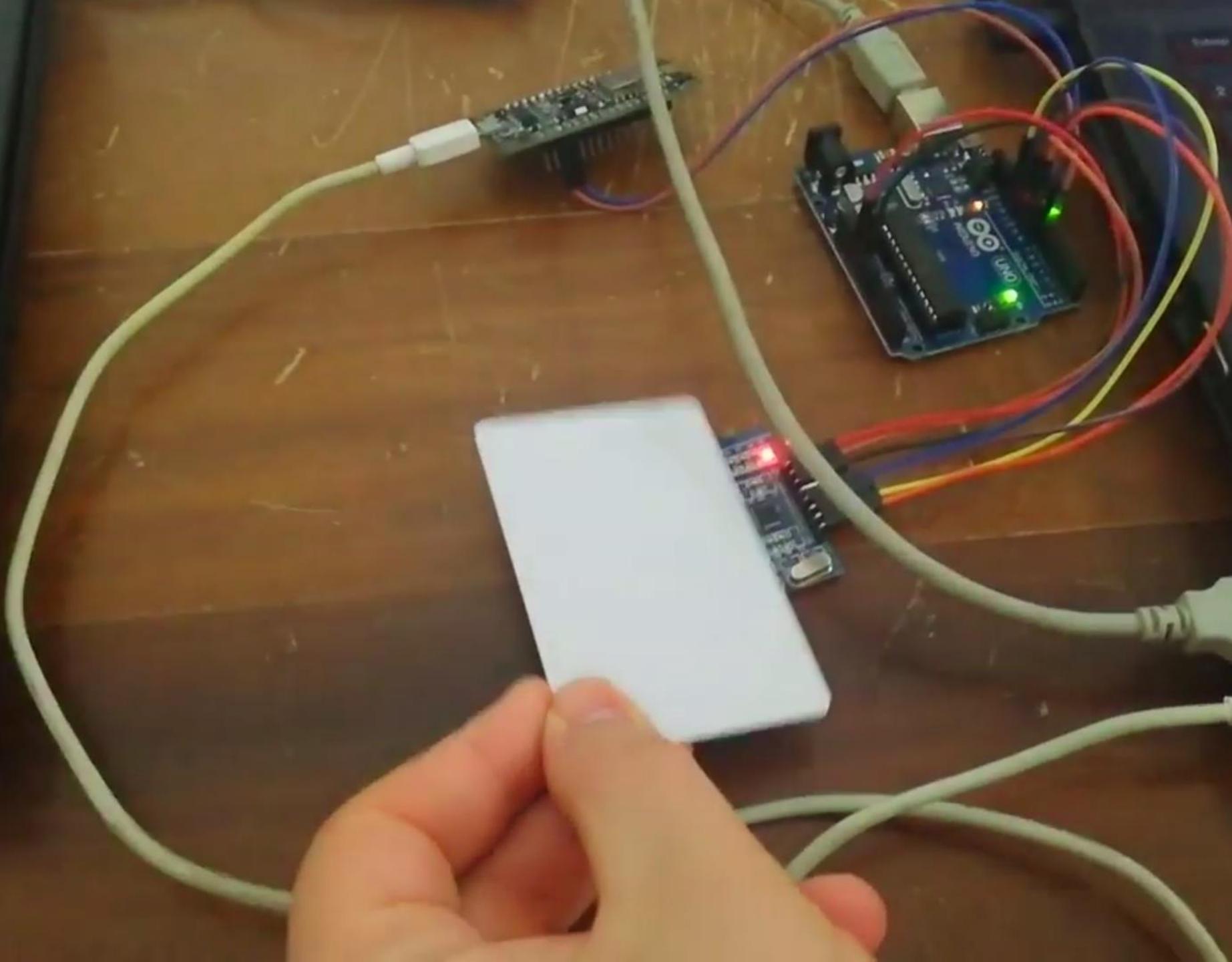
Birthday: 2019/05/21

Address: AVENUE JAHEDH

Gender: MALE

[Request Access](#)





Card Patient



card successfully
authenficated

Card
Practitioner/Phar
macy



Card not authenficated

 Profile Physical Activity Nutrition[Home](#) / [Dashboard](#) / [Profile](#)

My Profile

[Edit](#)**SLIMEN MAMI**

CIN : 11111
CNSS/CNAM : 00000000
Blood Type: O
Height: 175M
Weight: 70KG

Phone: 22365478
Emergency Phone: 22365478
Email: mamislimenproxy@gmail.com
Birthday: 2019/05/21
Address: AVENUE JAHEDH
Gender: MALE
Obesity Test: [Test](#)

[Drugs](#)[MRI](#)[Lab Test](#)[Chronic Diseases](#)[Allergies](#)

Name	Manufacturer	Price	LotNumber
Panadol	Opalia	2	E018

Profile

Physical Activity

Nutrition

Home / Dashboard / PhysicalActivity

Physical Activity

Add

Add a new Workout

Type

pushup

Duration

30

Add Physical

Cancel

Edit

Profile

Physical Activity

Nutrition

Home / Dashboard / Nutrition

Nutrition

Add

Add a new Nutrition

Name

bread

Type

Breakfast

Quantity

100

Add Nutrition

Cancel

Patient Profile

Consultation

Prescription

Allergies

MRI results

Lab Test Results

Chronic Disease

Home / Dashboard / Consultation

Consultation Form

Patient's name SLIMEN MAMI

Practitioner's name Dr firas mrad

Date of Consultataion 05/24/2019

Reason behind consultation

consultation|

Consultation output

Content...

Patient Profile

Consultation

Prescription

Allergies

MRI results

Lab Test Results

Chronic Disease

Home / Dashboard / Prescription

Prescription FormPatient's name **SLIMEN MAMI**Practitioner's name **Dr firas mrad**Date of Prescription **05/24/2019****Add Drug** **Remove Drug**

Drug #1

FERVEX ADULTE Poudre r

 Morning Noon Night Before meal After meal
 Indifferent

Quantity

Submit **Reset**

Add Drugs To Medical Record

Patient's name

Ines

Pharmacist's name

Hbibi

Add Drugs From Prescription

Prescription#ID: 1

Issued In : 2019-05-24T04:27:08.579Z

Add Drugs From Prescription 1

Add Drugs Manually

Drug #1

Drug Name

Lot Number

Manufacturer

0

 Submit

Add Drugs To Medical Record

Patient's name

lines

Pharmacist's name



Interaction Verification In Process

This may take a minute!



Add Drugs Manually

Drug #1

Drug Name:

Lot Number:

Manufacturer:

0

Submit

Drugs

Add Drugs To Medical Record

Patient's name

Ines

Pharmacist's name

Hbibi

**No Interaction Detected !**

Drug Has Been Added Successfully



Drug #1

Drug Name

Lot Number

Manufacturer

0

Submit

Patient Profile

Consultation

Prescription

Allergies

MRI results

Lab Test Results

Chronic Disease

Home / Dashboard / Allergies

Allergies Form

Patient's name SLIMEN MAMI

Practitioner's name Dr firas mrad

Date of Consultataion 05/24/2019

Name of the Allergy Lactose intolerance

Treatment brief

Submit

Reset

Patient Profile

Consultation

Prescription

Allergies

MRI results

Lab Test Results

Chronic Disease

Home / Dashboard / MRI

Mri Results

Patient's name SLIMEN MAMI

Practitioner's name Dr firas mrad

Date of Consultataion 05/24/2019

Select MRI Images Choose File images.jpegConsultation related to these results

Patient Profile

Consultation

Prescription

Allergies

MRI results

Lab Test Results

Chronic Disease

Home / Dashboard / Lab Results

Lab test ResultsPatient's name **SLIMEN MAMI**Practitioner's name **Dr firas mrad**Date of Consultataion **05/24/2019**Select Scanned Lab Results **Choose File Screenshot_2.png**Consultation related to these results **select an option****Submit** **Reset**

Patient Profile

Consultation

Prescription

Allergies

MRI results

Lab Test Results

Chronic Disease

Home / Dashboard / chronic disease

Chronic Disease Form

Patient's name SLIMEN MAMI

Practitioner's name Dr firas mrad

Date of Consultataion 05/24/2019

Chronic disease Diabetic ketoacidosis (DKA)

Additional Notes Content...

I

Submit Reset

Conclusion and Future Works

We conclude that Hyperledger fabric framework is used to implement the proposed system. **Blockchain encrypted** information cannot be modified or deleted, it ensures complete **integrity** and **security** of medical records from day one of its use. Thus, to enable trusted access to medical data, patients would be place at the center of their healthcare data and could grant or revoke access to any other person who needs to access their information.

In future, we plan to further strengthen the design of the interface application with login access to allow easy and trusted user interaction. We can add more functions and services like Insurance coverage, hospital bills and online payments.

References

Books: Blockchain for Business with Hyperledger Fabric by Nakul Shah, Beginning Node.js by Basarat Ali, Intro to Go by Caleb Doxsey.

- [1] Yaorong Ge, David K Ahn, Bhagyashree Unde, H Donald Gage, and J Jeffrey Carr. Patient-controlled sharing of medical imaging data across unaffiliated healthcare organizations. *Journal of the American Medical Informatics Association*, 20(1):157–163, 2017.
- [2] Chris Clifton, Murat Kantarcio glu, AnHai Doan, Gunther Schadow, Jaideep Vaidya, Ahmed Elmagarmid, and Dan Suciu. Privacy-preserving data integration and sharing. In *Proceedings of the 9th ACM SIGMOD Workshop on Research Issues in Data Mining and Knowledge Discovery*, pages 19–26. ACM, 2018.
- [3] Joshua R Vest and Larry D Gamm. Health Information Exchange: persistent challenges and new strategies. *Journal of the American Medical Informatics Association*, 17(3):288–294, 2016.
- [4] Paul C Tang, Joan S Ash, David W Bates, J Marc Overhage, and Daniel Z Sands. Personal health records: definitions, benefits, and strategies for overcoming barriers to adoption. *Journal of the American Medical Informatics Association*, 13(2):121–126, 2006.
- [5] Jan Walker, Eric Pan, Douglas Johnston, Julia Adler-Milstein, et al. The value of health care information exchange and interoperability. *Health Affairs*, 24:W5, 2005.

Queries ?

Thank You
