4ME302 Foundation of Computational Media

Project Report: Modeling of a data management for eHealth application

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Abstract. This report gives an overview of authentication system of the eHealth application and how this application manages roles after authentication. It also explains requirements, design and implementation techniques. Finally, it discusses technology, limitation and improvement of the application.

INTRODUCTION

This application provides an authentication system using different OAuth services and manages users' roles. It is only used by patients, physicians and researchers to login and manage data.

To develop the application, we used Lina's previous application and implementation.

First, we will have requirements analysis, followed by implementation and finally, we are going to see the technologies used, the problems faced and the limitation.

REQUIREMENTS

This is a web application that should be hosted and compatible with most of the browsers.
Its requirements are:

- Allow different external authentication systems like Google, LinkedIn and Github.
- Every user gets a role based on the service he/she chooses when login.
- Patients can only see Youtube videos about Parkinson's disease exercises and their activity like medicine and dosage.
- Physicians can see their patients' data and also their patients' activity.
- Researchers can see their patients' data (and all patients' data), their patients' activity, their patient's localization and the latest news related to Parkinson Disease.

IMPLEMENTATION

Users use external provider to login into the system. We distinguish three types of users: patients, researchers and physicians. Each one has its specific role:

- Patients ⇔ Linkedin
- Physicians ⇔ Github
- Reasearchers ⇔ Google

More details can be found in the diagrams attached to this project. We attached new diagrams since not all the functionalities of the application are implemented so the diagrams of the previous assignment are not fully valid.

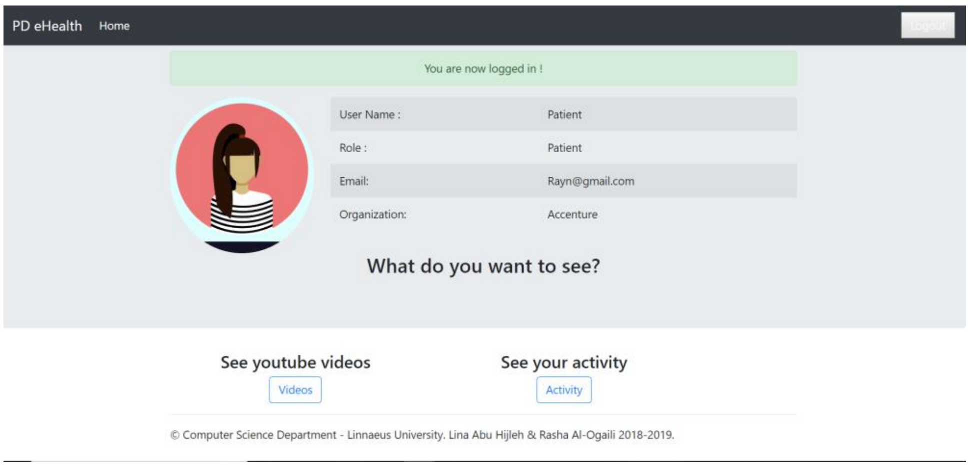
Login:

1. Open the application
2. Click on the service depending on which user wants to login
3. Login with email: stepv321@gmail.com, password: stepv@123 (for an easier use)
4. User is authenticated and gives authorization to the service

5. The application verifies the given information and creates the user if he doesn't exist or identify him otherwise

Patient: after login, he/she is redirected according to his/her choice

- Youtube button to see exercises videos (using youtube API)
- Activity button to see his/her activity: therapy table (using Google Chart) and heartbeat graph (using HighChart js)



You are now logged in !

User Name :	Patient
Role :	Patient
Email:	Rayn@gmail.com
Organization:	Accenture

What do you want to see?

See youtube videos

See your activity

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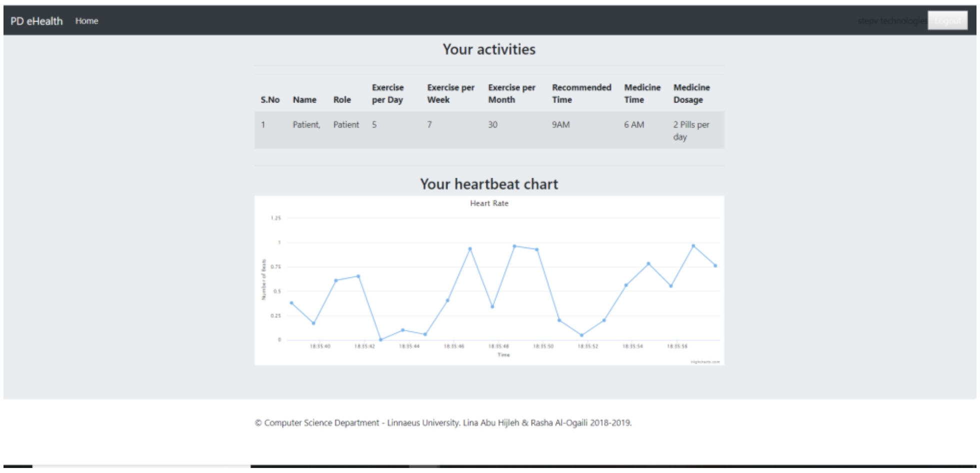
Figure 1: Patient's profile page



Your activities

S.No	Name	Role	Exercise per Day	Exercise per Week	Exercise per Month	Recommended Time	Medicine Time	Medicine Dosage
1	Patient,	Patient	5	7	30	9AM	6 AM	2 Pills per day

Your heartbeat chart

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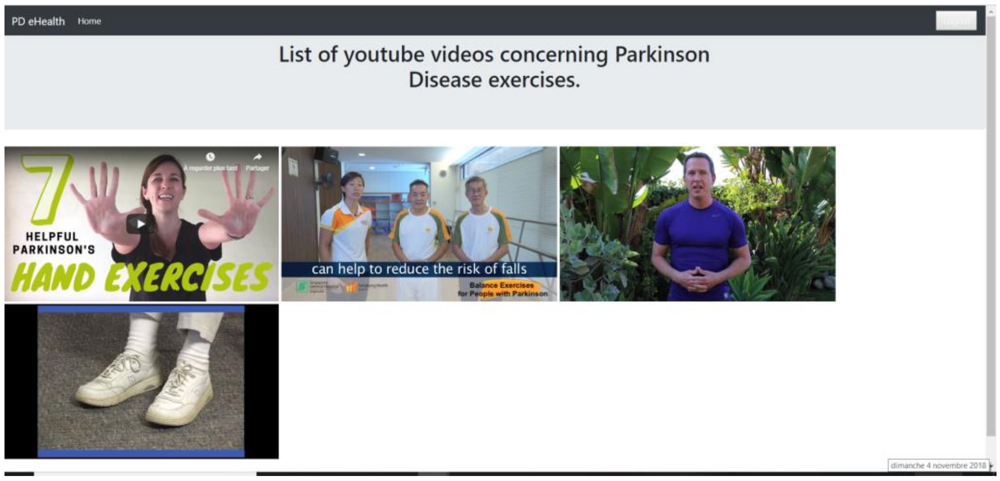
Figure 2: Patient's activity page

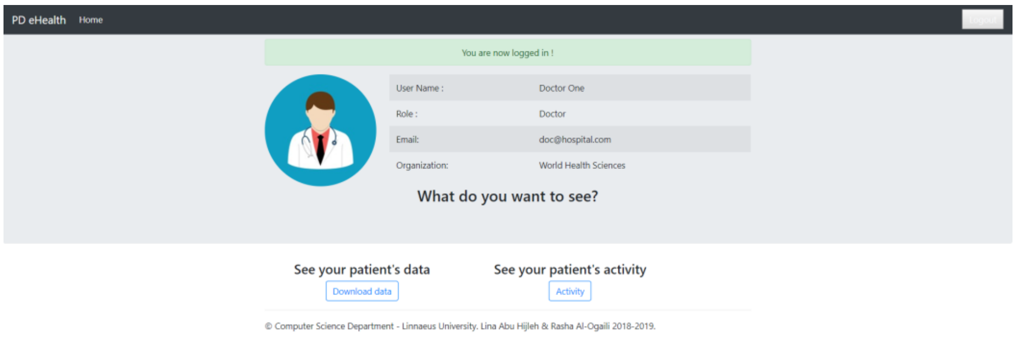

PD eHealth
Home
HELPFUL PARKINSON'S HAND EXERCISES
can help to reduce the risk of falls
Balance Exercises for People with Parkinson
dimanche 4 novembre 2018

List of youtube videos concerning Parkinson Disease exercises.

Figure 3: Patient’s youtube page

Physician: after login, he/she is redirected according to his/her choice

- Download data button to see his/her patient’s data by downloading the corresponding csv file
- Activity button to see his/her patient’s activity: activity table (using html) and types of exercises (using Google Chart)



You are now logged in !

User Name :	Doctor One
Role :	Doctor
Email:	doc@hospital.com
Organization:	World Health Sciences

What do you want to see?

See your patient's data

See your patient's activity

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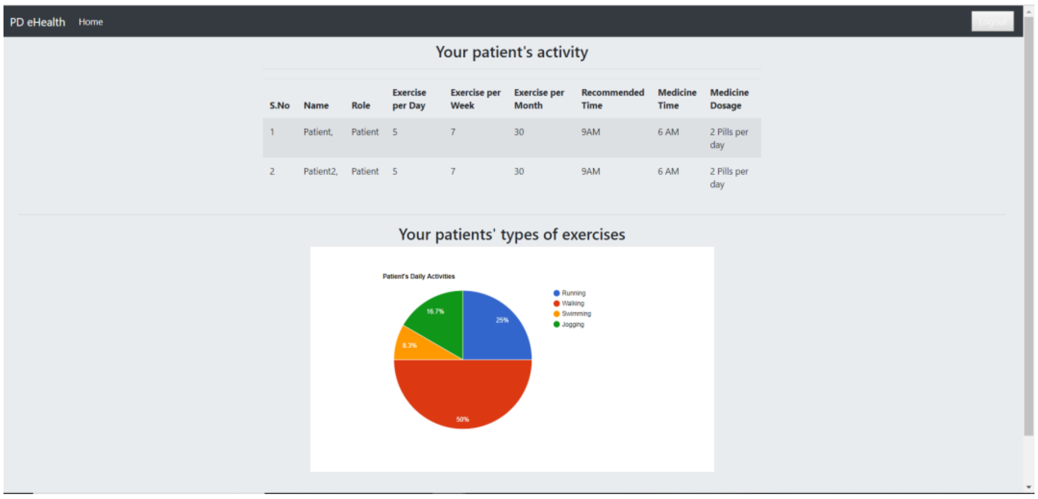
Figure 4: Physician’s profile page



Your patient's activity

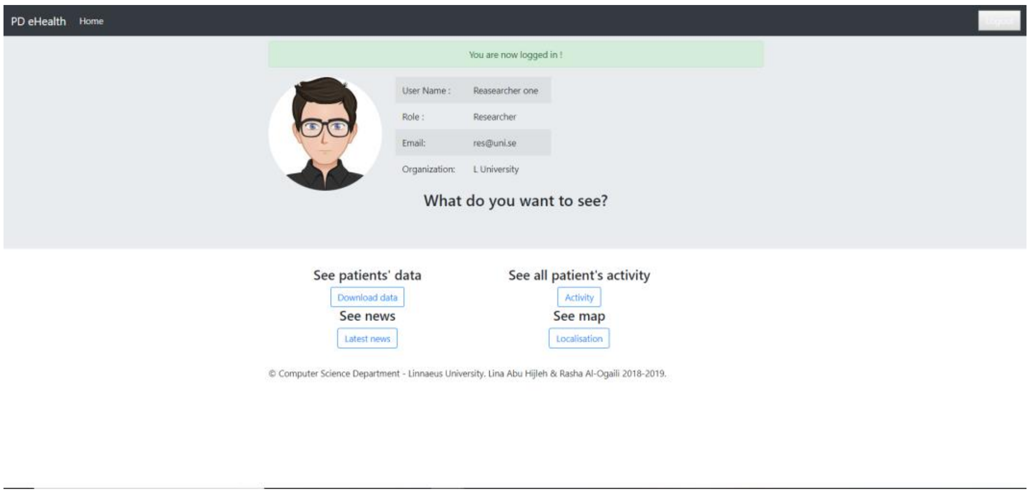
S.No	Name	Role	Exercise per Day	Exercise per Week	Exercise per Month	Recommended Time	Medicine Time	Medicine Dosage
1	Patient,	Patient	5	7	30	9AM	6 AM	2 Pills per day
2	Patient2,	Patient	5	7	30	9AM	6 AM	2 Pills per day

Your patients' types of exercises

Figure 5: Physician’s activity page

Researcher: after login, he/she is redirected according to his/her choice

- Download data button to see his/her patient’s data or all the patients’ data by downloading the corresponding csv file
- Activity button to see all patients’ activity: activity table (using html) and types of exercises (using Google Chart)
- News button to see the latest news related to Parkinson Disease using an RSS Feed
- Localization button to see each patient localization and unique profile (using Leaflet js): once redirected to the specific patient’s profile page (only accessible by the researcher who logs in), he can among other things see therapy table (using Google Chart), comment, heartbeat chart (using HighChart js) and patient’s localization (using Leaflet js).



You are now logged in !

User Name :	Reasearcher one
Role :	Researcher
Email:	res@uni.se
Organization:	L University

What do you want to see?

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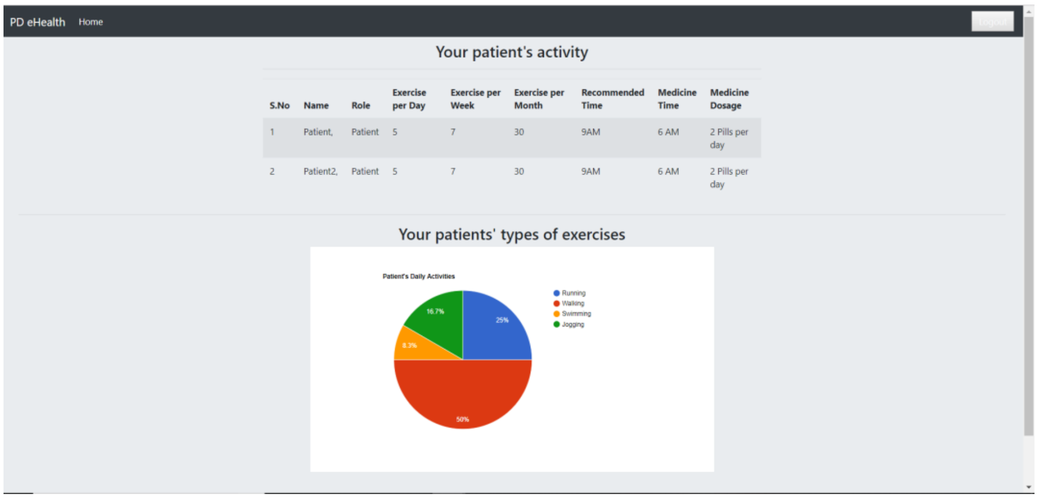
Figure 6: Researcher’s profile page

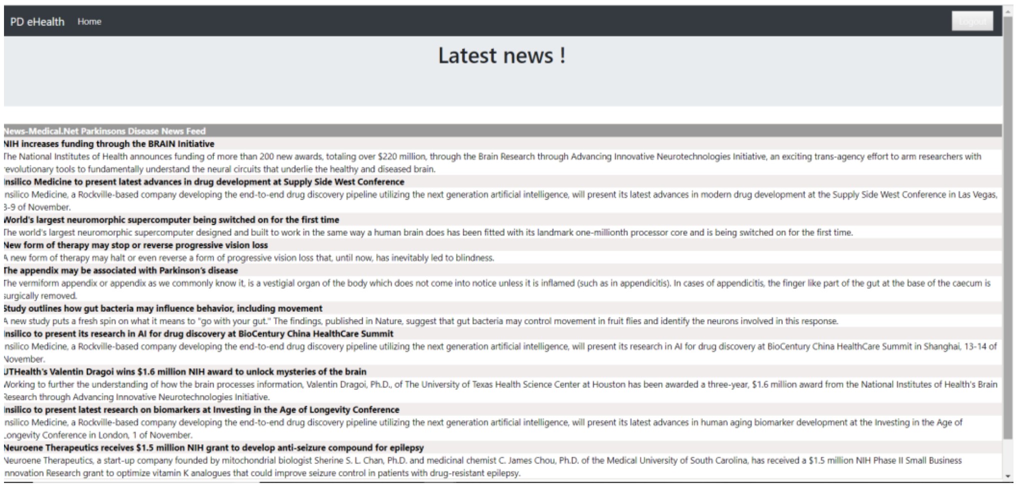


Your patient's activity

S.No	Name	Role	Exercise per Day	Exercise per Week	Exercise per Month	Recommended Time	Medicine Time	Medicine Dosage
1	Patient,	Patient	5	7	30	9AM	6 AM	2 Pills per day
2	Patient2,	Patient	5	7	30	9AM	6 AM	2 Pills per day

Your patients' types of exercises

Figure 7: Researcher's activity page



Latest news !

ews-Medical.Net Parkinsons Disease News Feed

NIH increases funding through the BRAIN Initiative
The National Institutes of Health announces funding of more than 200 new awards, totaling over $220 million, through the Brain Research through Advancing Innovative Neurotechnologies Initiative, an exciting trans-agency effort to arm researchers with evolutionary tools to fundamentally understand the neural circuits that underlie the healthy and diseased brain.

nsilico Medicine to present latest advances in drug development at Supply Side West Conference
nsilico Medicine, a Rockville-based company developing the end-to-end drug discovery pipeline utilizing the next generation artificial intelligence, will present its latest advances in modern drug development at the Supply Side West Conference in Las Vegas, 3-9 of November.

World's largest neuromorphic supercomputer being switched on for the first time
The world's largest neuromorphic supercomputer designed and built to work in the same way a human brain does has been fitted with its landmark one-millionth processor core and is being switched on for the first time.

New form of therapy may stop or reverse progressive vision loss
A new form of therapy may halt or even reverse a form of progressive vision loss that, until now, has inevitably led to blindness.

The appendix may be associated with Parkinson's disease
The vermiform appendix or appendix as we commonly know it, is a vestigial organ of the body which does not come into notice unless it is inflamed (such as in appendicitis). In cases of appendicitis, the finger like part of the gut at the base of the caecum is surgically removed.

Study outlines how gut bacteria may influence behavior, including movement
A new study puts a fresh spin on what it means to "go with your gut." The findings, published in Nature, suggest that gut bacteria may control movement in fruit flies and identify the neurons involved in this response.

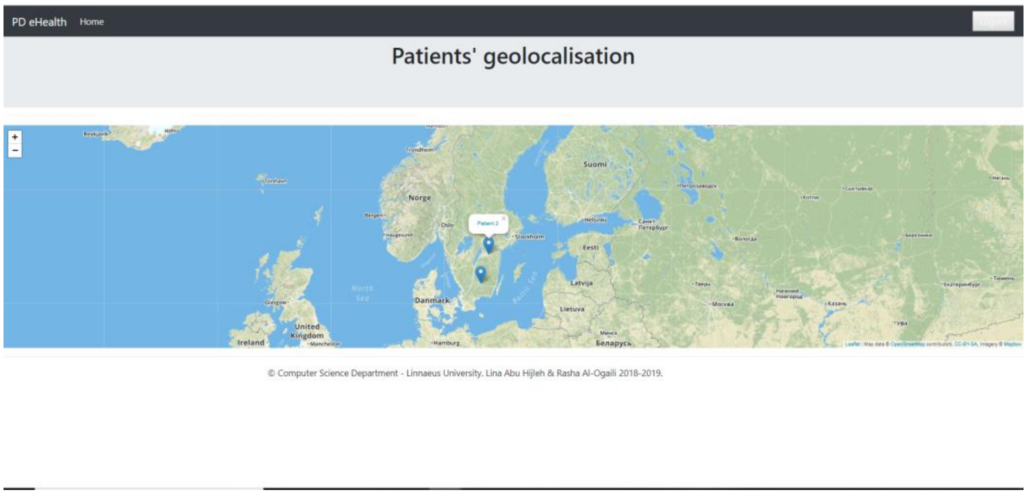
nsilico to present its research in AI for drug discovery at BioCentury China HealthCare Summit
nsilico Medicine, a Rockville-based company developing the end-to-end drug discovery pipeline utilizing the next generation artificial intelligence, will present its research in AI for drug discovery at BioCentury China HealthCare Summit in Shanghai, 13-14 of November.

UTHealth's Valentin Dragoi wins $1.6 million NIH award to unlock mysteries of the brain
Working to further the understanding of how the brain processes information, Valentin Dragoi, Ph.D., of The University of Texas Health Science Center at Houston has been awarded a three-year, $1.6 million award from the National Institutes of Health's Brain Research through Advancing Innovative Neurotechnologies Initiative.

nsilico to present latest research on biomarkers at Investing in the Age of Longevity Conference
nsilico Medicine, a Rockville-based company developing the end-to-end drug discovery pipeline utilizing the next generation artificial intelligence, will present its latest advances in human aging biomarker development at the Investing in the Age of Longevity Conference in London, 1 of November.

Neuroene Therapeutics receives $1.5 million NIH grant to develop anti-seizure compound for epilepsy
Neuroene Therapeutics, a start-up company founded by mitochondrial biologist Sherine S. L. Chan, Ph.D. and medicinal chemist C. James Chou, Ph.D. of the Medical University of South Carolina, has received a $1.5 million NIH Phase II Small Business nnovation Research grant to optimize vitamin K analogues that could improve seizure control in patients with drug-resistant epilepsy.

Figure 8: Researcher's news page



Patients' geolocalisation

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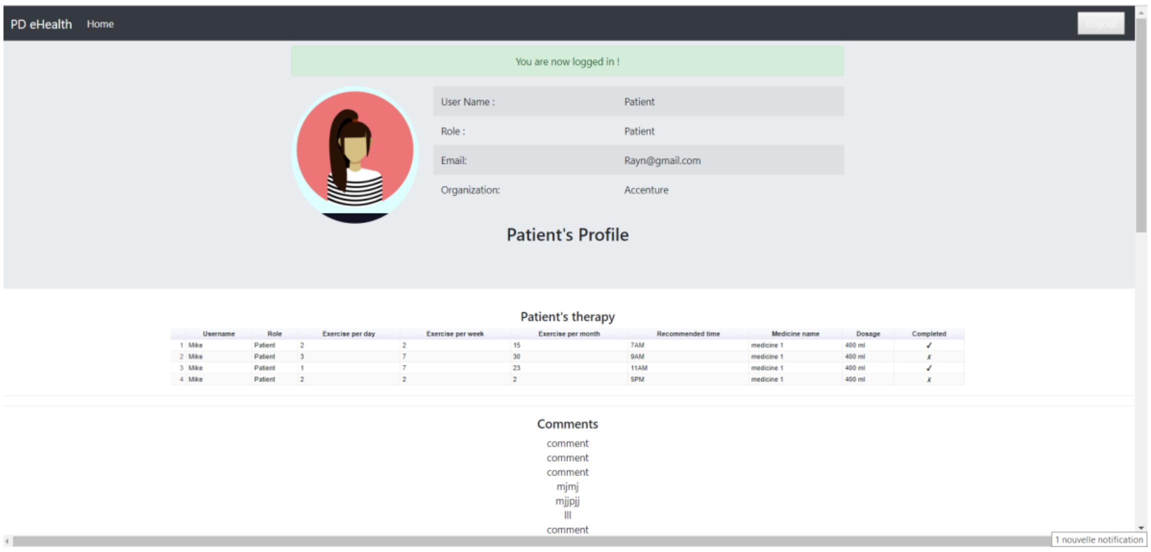
Figure 9: Researcher's map page



You are now logged in !

User Name :	Patient
Role :	Patient
Email:	Rayn@gmail.com
Organization:	Accenture

Patient's Profile

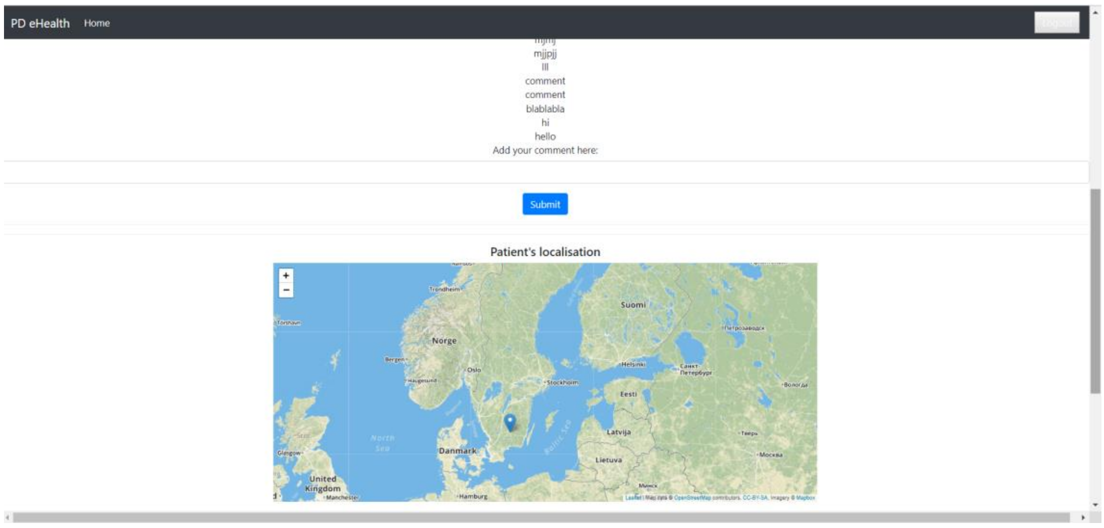
Patient's therapy

	Username	Role	Exercise per day	Exercise per week	Exercise per month	Recommended time	Medicine name	Dosage	Completed
1	Mike	Patient	2	2	15	7AM	medicine 1	400 ml	✓
2	Mike	Patient	3	7	30	9AM	medicine 1	400 ml	✗
3	Mike	Patient	1	7	23	11AM	medicine 1	400 ml	✓
4	Mike	Patient	2	2	2	5PM	medicine 1	400 ml	✗

Comments

comment
comment
comment
mjmj
mjjpjj
lll
comment

Figure 10: Patient’s profile page 1 (only accessible by researcher)



mjmj
mjjpjj
lll
comment
comment
blablabla
hi
hello
Add your comment here:

Figure 11: Patient’s profile page 2 (only accessible by researcher)

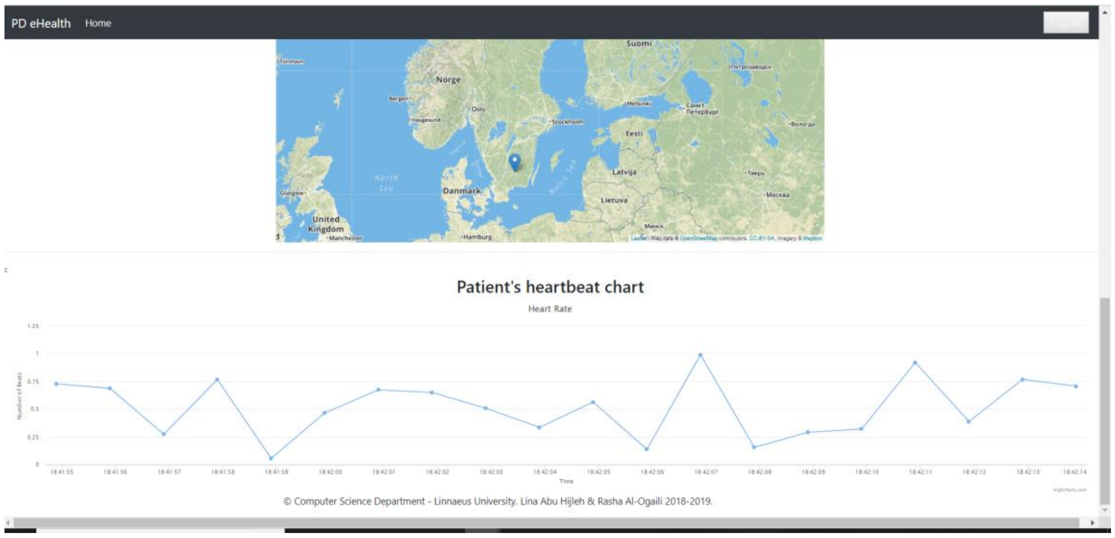


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Figure 12: Patient’s profile page 3 (only accessible by researcher)

To implement social login, we used Passport.js. We also used two kind of database:

1. ClearDB MySQL & HeidiMySQL for the given database to extract the data and the activity. In this database, RoleId = 1 corresponds to patient, RoleId = 2 to physician and RoleId = 3 to researcher. This database is hosted on Heroku.
2. MongoDB & MLab for storing users who login (they are either created or identified by the database). This database is stored on MLab.

The website is hosted on Heroku : https://pd-ehealth-app.herokuapp.com, but it doesn't work very well since when trying to log in with Linkedin, a connection problem is displayed in a Linkedin page. Contrary to http://localhost:3000 where everything works perfectly. That's why we decided to keep the localhost version. A video will be attached to confirm that everything works on localhost.
The code is also available on github : https://github.com/Linou92/pd-eHealth-app.
The heart-beat graph can be run on the terminal using the command- node data-gen.js.

To the project to be installed and work on Heroku, we had to do the following steps every time I changed my code:

1. git add --all
2. git commit --m "comment"
3. git push heroku master
4. heroku open

To install dependencies and packages, I had to do the following command on the console:

- npm install <name>

The app tree looks like the following:

1. configs
   1.1. keys.js
   1.2. passport-setup.js
2. models
   2.1. user-model.js
   2.2. activity-model.js
   2.3. userdetail-model.js
3. node_modules
4. routes
   4.1. data
   4.2. activity-routes.js
   4.3. activity2-routes.js
   4.4. auth-routes.js
   4.5. data-routes.js
   4.6. map-routes.js
   4.7. patientProfile-routes.js
   4.8. profile-routes-github.js
   4.9. profile-routes-linkedin.js
   4.10. profile-routes-google.js
   4.11. rss-routes.js
   4.12. youtube-routes.js
5. static
   5.1. css
      5.1.1. bk.jpg
      5.1.2. bootstrap.css
      5.1.3. style.css
6. views
   6.1. activity.ejs
   6.2. activity2.ejs
   6.3. home.ejs
   6.4. login.ejs
   6.5. patient.ejs
   6.6. physician.ejs

6.7. researcher.ejs
6.8. map.ejs
6.9. patient-profile.ejs
6.10. patientprofile.ejs
6.11. rss.ejs
6.12. youtube.ejs
6.13. avatar.jpg
6.14. doctor.jpeg
6.15. image.png
6.16. researcher.jpg

7. app.js
8. database.js
9. data-gen.js
10. mongo.js

TECHNOLOGIES

To implement the system, different languages have been used:

- HTML
- CSS
- Bootstrap
- Node.js
- Passport.js
- Express (as a web application framework)
- Javascript (a scripting-programming language for implementing the system functionalities)
- Google Chart (for some tables and charts)
- Leaflet js (for the mapping part)
- HighChart js (for the heartbeat chart)

Since the previous assignment was made with Node.js, we decided to continue using it because it has many frameworks and supports MVC. It was also easier to find some help on the internet.
A file named Readme.pdf is included in this project to explain the login process and to illustrate its functionality.
In this application, all the queries results are displayed in the console.

Due to time limit, the researcher's patients' profiles include the same features. Different features have not been created, but this is set on the system's plan of improvement. Also, not several different patients' profiles have been created and we decided to take the data1.csv file as an example to use it as the patient data in the application to illustrate the download feature. On the console, we can also see the database query result which is data1 for the file data1.csv. So we can see that the query works.
We still encounter issues setting the file bk.jpg as a background and also not allowing all youtube videos to work simultaneously.

CHALLENGES AND IMPROVEMENTS

The lack of time didn't allow us to make some improvements on our website.
Difficulties were mainly encountered on the mapping between the researchers vs patient's pages and physicians' pages.
We also had issues integrating the continuous generation of data for the graphs so it was solved by creating data-generator in the database.
Because of the quota limit of Google Maps, we had to switch to Leaflet js to generate the map.
Also, not all the data are linked to database, some of them are raw data (heartbeat graph and pie chart graph).
A way to improve the application next time would be:

- to make it work on webhost
- link every data to database
- separate activity pages for researcher and physician to have different patients

- to set a more beautiful interface and put a background
- to link the dataURL of the database with the corresponding csv file
- to fix the youtube issue
- to let the user choose which data/activity he wants to view
- to add more types of graphs (i.e spiral graph)
- to add chatting, emails etc
- use semantic web (OWL)
- to make personalized search for the doctors

We can use semantic web (OWL) to create relations between different users.
We can also provide a personalized search bar for the doctors so they can type different disease they're specialized in and see some various results.
The need to having more interactive and better designed web-pages and web applications increased since the emergence of the Internet and the World Wide Web. Technology, smart devices, the Internet of things and even intelligence in web design and business were explicitly used. This, however, added more complexity to sharing the different data types shared through the different domains in different fields, which made the existence of the HTTP- hyper-text transfer protocol very important as to make a concrete communication between clients i.e. web-browsers and servers i.e. computers in the cloud. Ontology and the OWL- Web Ontology Language have a linked philosophy in integrating different types of data and metadata in different fields and for different purposes. For instance, in the medical field and for the e-health applications there exist, the need for sharing very big data files between several parties i.e. people like patients, doctors, care givers, organizations, institutes… etc requires specific types of technologies and even data sharing methods to make it possible. Thus, today with the rapid development of technology it is made possible to share big data files in JSON, XML and CSV formats between different platforms. This is also included under the category of making complex ad smart data search. In the medical fields, ontology is defined by the disease ontology. This is mainly done by presenting a hierarchical list of a disease path i.e. disease-name, causes, classification, clinical features, diagnosis, conditions, symptoms, tests… etc. This, by itself is enormous data as it expands differently for each disease there exists and even for every diseases' data files. We are talking about each disease list of definitions and for every individual diagnosed with a specific disease. Thus, the debates about the importance of having semantic web applications particularly to serve the medical needs and generally the humans' infinite demands in sharing very big and different data files and types are many and non-stoppable. Ontology is one of the semantic web technologies used for data management and representation in the medical fields and e-health domains. In websites and web applications several APIs- Application Programming Interface are provided to minimize the complexity of infusing several and perhaps very complex data files that are needed to perform some functionalities or even make the web-pages more interactive by the system/web-application's design and features.
In our Parkinson's disease application, this is applicable when sharing the different types of data files i.e. CSV files for the patients, other data files such as the patients' reports, daily medical journals and prescriptions between doctors/physicians and researchers. In addition, the semantic web context and specialized- smart search can be very useful when inserting the different and huge data for the heart-beat graph of each patient in the system and for the doctors/researchers to see each patient's files i.e. medicines, activity reports and health condition reports.

CONCLUSION

This report illustrates the login system and the role management through different OAuth providers.
This project can be extended and improved in several ways. More functionalities can be implemented later on to make it better.
It was a very interesting project to work on.

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