Rene Happel[1*], Pavel Larionov[1], and Thomas Schanze[1]

On the development of a FHIR-compliant backend for processing HTTP requests and API-based management of healthcare documents

Abstract: In palliative care, it is important to inform relatives or caring persons about the condition of the affected person, this could also include vital or biomedical data. Non-professional caregivers need information around the topic. However, the data should be stored in a backend system and be able to be viewed and edited by multiple caregivers on multiple platforms. Using the example of the backend solution described here, we will show how a FHIR-compliant server for health data, which could be provided from a digital health App (DiGA), can be established, as well as a second server for article database as a "CRUD"-API and user identification.

Keywords: FHIR, API, DiGA, Caregiver

https://doi.org/10.1515/cdbme-2021-2034

1 Introduction

The development of the Caregiver App is part of the Avenue-Pal project, with the main goal to support the evidence based will of the palliative persons to spend their remaining lifetime at home.[1] Two thirds of the care cases are cared for by more than one caregiver, which don't need to be relatives at all.[2] Poorly integrated caregivers are a common source of discontentment and instability for all involved in the process of care, including affected persons.[3] In result, higher stress levels across all participants of the formal and informal care in such cases are not rare.[3] Moreover, one of the risks of palliative patients is the unwanted and contraindicated displacement from their known environment, be it home or nursing-home, to the clinics.[4] Well-intentioned assistance is neither effective nor helpful without adequate information or knowledge and, of course, clear communication.

Due to the general availability of smartphones, it makes sense to use them as a means of communication and documentation for exactly this situation. The realization of our app solution is described in another paper.[5] Users should be able to access and edit the patient's data, either entered by the user themselves or provided by personal of healthcare directly via API-access, e.g., vital data, if agreed by all involved. In addition, caregivers who strive to be helpful can find information on various caregiving topics in an article database. The following is a brief overview of the complete backend structure for this project.

2 Methods

The process of development is performed by using agile methods. Team coordination, task and deadlines tracking, knowledge base management are all performed by utilizing the collaboration platform Notion.

2.1 Knowledge base

In order to manage the knowledge base articles, created by the consortium [6], and allow app and browser users to view the always up-to-date version, a self-hosted content management system (CMS) was created on an Express server running Node.js. This makes it possible to provide only the most necessary functions independently of third-party providers and to use the server for other purposes as well. This server establishes an API to a MongoDB database. With the HTTP method GET users have free read access to the articles. Developers and authors have the possibility to change the non-relational database with the methods POST, DELETE, CREATE and PATCH and a password. The payload of the requests is always a JSON body. Each article is stored as a

***Corresponding author: Rene Happel:** Institute for Biomedical Engineering (IBMT), Faculty of Life Science Engineering (LSE), Technische Hochschule Mittelhessen (THM) - University of Applied Sciences, Gießen, Germany, e-mail: rene.happel@lse.thm.de

Pavel Larionov, Thomas Schanze: Institute for Biomedical Engineering (IBMT), Faculty of Life Science Engineering (LSE), Technische Hochschule Mittelhessen (THM) - University of Applied Sciences, Gießen, Germany

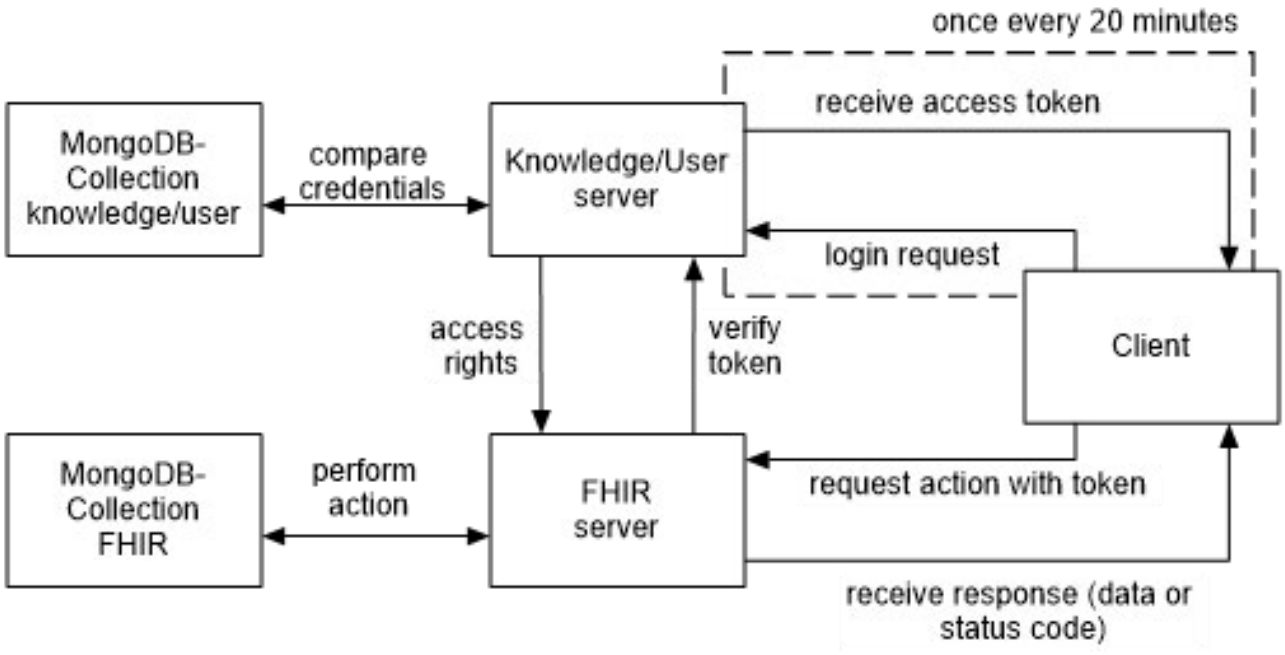

Figure 1: Workflow of the server architecture using the example of a FHIR-database request. Since the access token has a lifetime, the login procedure (dashed rectangle) has to be done only once every 20 minutes.

document with its own ID in the database. A document has different fields in which information about the article, as well as the article itself is stored as a string in html format. To ensure consistent user experience on different devices and browsers of the articles, one of the stored data fields contains a style sheet.

2.2 App-user-database

To ensure multi-user support, a user collection database is accessed through the same express server as mentioned in chapter 2.1. A user class document consists of the e-mail address, the encrypted password and the access rights to the FHIR database. Therefore, there is no access to edit this data. This endpoint creates a Java Web Token (JWT) when logging in, which is valid for 20 minutes. This token must be specified in the authorization header of every requests. This token can be used to make changes to the patient data and it does not expire when leaving the app. Since the token gets a timestamp on login the user must log in again after 20 minutes, even while using the app. For now, there are no specific further plans how the authorization process should work. The FHIR server communicates with another endpoint to query the access rights for each request (see Figure 1).

2.3 FHIR

Fast Healthcare Interoperability Resources (FHIR) is a standard developed by Health Level 7, to support data exchange between software systems.[6] Our JSON objects are stored in MongoDB and HTTP requests are processed using a customized server skeleton from Asymmetrik.[8] Furthermore, the JWT authorization method was incorporated and the “scope checker” was rewritten. This makes it possible to grant users specific rights to read/write various resources and specific documents. A new route has been added for PATCH requests. This allows documents to be processed in JSON patch format.

This prototype server, as well as the one described in 2.1 and 2.2 are running for test and accessibility reasons at the Technische Hochschule Mittelhessen on a dedicated machine running the operating system Ubuntu 18.04. For this machine, the university has provided an SSL certificate. The computer was also registered in the in-house Domain Name Service.

The resources currently shared in our FHIR server are Observation, Patient, DocumentManifest, AllergyIntollerance and DocumentReference. Personal information of the patient, as well as e.g., allergies or vital data such as blood pressure

or weight are distributed over these resources. Physician documents or living wills as well as subjective progress data collections, such as a pain diary, can be loaded into the database as a base-64 encoded string.

With the help of the FHIR approach it is thus possible to provide a compatible interface for different devices. This could be a hospital's or general practitioner's in-house database, or even third-party devices that measure, for example, blood pressure or blood glucose on an outpatient basis.

3 Results and discussion

This paper mainly deals with the functionality of the server structures and should serve as a good starting point when continuing the project. Security features as well as user-friendly functions, e.g., removing the 20 min relog, will be part of future work. It is possible to always retrieve the latest health data and important documents. The FHIR standard is a useful communication format to store health data that needs to be processed by different end groups. It is also very versatile and can be customized to meet needed requirements. The newly introduced electronic patient record (ePa) is also build around the FHIR format.[9] To our knowledge, connecting real patient databases or other digital health apps is possible, but careful review of data security and coordination discussions with healthcare providers must take place beforehand. JWT is a great starting method due to its simplicity and basic security features. An automatic registration route exists but is not necessary in the given development phase and is therefore not enabled. For the time being, users are still registered manually by admins to keep an overview of the users. Aspects of data security and data integrity that are particularly relevant in the field of healthcare or in related areas, e.g., digital health apps, will be addressed in a future paper. The approach presented here is a project-specific [6] new development, a comparison with other systems is still pending.

4 Conclusion

By using the smartphone as an end device, a mobile solution can provide vital data and document collection of care cases and can provide caregivers with useful information related to care anytime and anywhere. The backend implementation for the app for caregivers is a backbone for a future implementation of the cross-institutional bridge for the citizens' health data. In its current state, the project represents the user-centered approach of handling data, this also applies to backend access, as the user only has control over the flow of this data, and that is how it should be. However, the system is open for future extensions.

Author Statement

Research funding: The caregiver Server is developed within a research project funded by the Gemeinsamer Bundesausschuss, G-BA grant 01VSF17044, at the Competence Center for Biotechnology and Biomedical Physics and the Institute of Biomedical Engineering, University of Applied Sciences - Technische Hochschule Mittelhessen (THM). Conflict of interest: Authors state no conflict of interest. Informed consent: Informed consent has been obtained from all individuals included in this study.
The authors would like to thank their colleagues from the Avenue Pal project for the good cooperation. Special thanks to Wolfgang George.

References

[1] W. George and K. Weber. Ethische problemlagen durch die Verlegung sterbender Menschen zwischen verschiedenen Versorgungsorten und -einrichtungen. ZfmE; 2020;66:213-222.
[2] T. Lichte, C. Höppner, L. Mohwinkel, and et al. Pflegende Angehörige von Erwachsenen. DEGAM; 2018:25-26.
[3] U. George and W. George. Evidenzbasierte angehörigenintegration im gesundheitswesen. Pflege; 2005;18:0067–0068.
[4] W. George, T. Schanze, U. Sibelius, and et al. Status quo, aktuelle herausforderungen und neue wege der palliativen versorgung und begleitung. das Krankenhaus; 2018;12:1166–1169.
[5] T. Jürgens, P. Larionov, T. Schanze and W. George. Development of an assistive mobile application to improve informal home care. DGBMT; 2021 (submitted)
[6] https://www.avenue-pal.de/
[7] http://www.hl7.org/ Acessed 26.05.2021
[8] https://github.com/Asymmetrik/node-fhir-server-mongo. Accessed: 18.11.2020
[9] Kassenärztliche Bundesvereinigung. Mio-festlegung: Impfpass. https://mio.kbv.de/pages/viewpage.action?pageId=34668999&preview=/34668999/40241514/normative%20MIO%20Festlegung_Impfpass.pdf. Accessed: 15.02.2021.