Research Proposal: Develop a web application using Microservices Architecture for Healthcare

Motivation

In the recent decade, a lot of companies are considering transforming their existing monolithic-based systems to microservices-based systems. According to the survey results conducted by (leanIX, 2017) that over 80% of respondents are betting on microservices-architecture, and they have a tendency to apply it in future software development. However, microservices architecture is a pioneer concept for the healthcare sector because it stores a lot of sensitive and private patient information, and it is challenging on security and data protection while transforming existing systems into microservices-based systems. Therefore, applying microservices architecture for healthcare is a fascinating and emerging subject and required to take a deep dive in the related fields.

Significance/Knowledge Gap

After performing the literature review for healthcare, there are different scenarios in each study, such as IoHT, cloud-environment and web-based use cases. The most significant knowledge gap is the selection of the best microservice architecture approach for developing a scalable, reliable, and efficient web application for healthcare. It is ambiguous to distinguish the most suitable approach for this development because each study focused on figuring out different problems, such as facilitating monitoring and health assessments for elderly for better service level (Ianculescu, M. et al. 2019) and developing a model for

scaling out the chatbot architecture to enhance the capability for supporting chronic patients (Roca, S. et al. 2020).

Research Questions

In this section, I will outline research questions which this research aims to ensure that staying tight when developing the health information system.

In this research, there are two research questions.

1. How to determine the best fit approach for a current software development project?

   By answering this question, we can navigate the best fit approach swiftly while doing the system design. It equips us to distinguish between different approaches. Therefore, in the future, we can apply this strategy to do a quick selection for our development in the healthcare industry.

2. How to leverage and make tradeoffs between various approaches?

   There are various studies that have discussed the pros and cons between prior studies' approaches, however, few of them have discussed the tradeoffs for their proposed approach. By answering this question, it allows us to make a decision easier while designing the HIS.

Aims and Objectives

In this research, it aims to develop a strategic model for selecting the best fit approach for developing a web application for healthcare. Furthermore, it uses the designed strategic model for selecting the best fit microservices architecture approach for our development.

Key literature related to the project

In the following table, I have tabulated the key literatures by authors and their focused area. I will highlight the focused area and how the proposed approach works briefly.

Ianculescu, M. et al. (2019) proposed a multi-layer microservice architecture of an Internet-of-Health-Things (IoHT) healthcare information system which provides monitoring and conducts health assessment of elderlies. Their approach was focused on the capability of scaling up horizontally to support large amounts of IoHT devices. Furthermore, it provides better adaptability for all IoHT devices to be integrated into all sizes of medical units' healthcare information systems. Therefore, this approach offers a scalable and highly adaptable solution for developing the HIS.

Khoso, F. H. et al. (2021) introduced a microservice-based system to alleviate the underlying problems of IoT applications in the fog-cloud system, such as cost, security, and failure risks. From their evaluation results, competing with other healthcare applications on cost, security, and failure risks. We can see that the proposed microservice-based system is the winner, with the lowest expenditure, secure, and fault-tolerance capable application. Therefore, this approach offers an efficient and reliable solution for developing the HIS.

Zaki, J. et al. (2022) developed a microservice-based framework for developing the HIS on cloud infrastructures. The proposed framework attempts to resolve problems of the traditional approach, such as availability, efficiency, and performance issues. From the experimental results, their research showed that the framework enhanced the availability and performance by decreasing the latency of requests and enhanced reliability by minimizing the chance of dropping requests. Therefore, this approach offers an efficient and always available solution for developing the HIS.

Cyran, M. A. (2018) proposed a blockchain-based solution to address the security concerns of data exchange between microservices and the EHR system. The proposed solution is devoted to escorting for sensitive and private EHR information to prevent data leakage and adapt to versatile healthcare facility environments by installing blockchain software. In addition, the proposed solution concealed the classified business logic into a single service for processing cryptographic secrets. Therefore, this approach offers a reliable and better data protection solution for developing the HIS.

Methodology/Development strategy/Research Design

In this research, I will use an active research methodology throughout the entire research. Action research is an iterative process of gathering all expertises feedback for verifying researchers' theory, adjusting the theory, and re-testing it until the researchers satisfy the results. Nogueira, J. M. et al. (2013) As we can see that the purpose of this research is clear, I have to develop a health information system using the microservices architecture. However, I have obstacles in distinguishing different approaches. As a result, I will develop a strategy model for figuring it out, and invite medical practitioners to test the HIS. In addition, to verify my approach, I will conduct questionnaires with the medical practitioners to ensure that the HIS is a scalable, reliable, and efficient solution for them. Furthermore, I will perform several tests for the system, such as stress tests and load tests. Otherwise, I will revise my approach and strategy model until I get 90 percent of their satisfaction.

Ethical considerations and risk assessment

As the HIS stores sensitive information in its database, the proposed solution must secure this information to ensure it meets the GDPR and Data Privacy Act standard. It should conceal sensitive information on an encrypted basis while fetching/persisting data into the database to prevent data leakage and being exploited by malicious users. Furthermore, when commencing with the development of the HIS, I will use the Faker Python library to

generate EHR information such as patients' information, medical history, and medical practitioners' information for testing the system API and displaying the data on the graphical user interface.

Artefacts

In this research, below artefacts will be created.

1. A system design diagram which depicts all crucial system components and relationships between them.
2. A system APIs design & development which is the design for developing RESTful APIs and its implementation.
3. A data model design which is used to present the relationships between each model.
4. The graphical user interface which is the implementation of the HIS used for displaying the EHR information.

Timeline

About the timeline for this research, I broke down all tasks and filled it into a 40 week schedule.

The first five weeks, I will get the ethics approval from my supervisors. In the meantime, I will do the literature summary and point out all tradeoffs for their approaches.

In the second five weeks, I will design the strategy model to facilitate quick selection and navigation to different approaches.

In the third five weeks, I will gather the requirements for the HIS from the medical practitioners, such as the functional requirements, non-functional requirements, security requirements and privacy requirements.

In the fourth five weeks, I will draw the system architecture design. In addition, I will also provide the assumption on the amount of network traffic, data storage, and daily active users to ensure the proposed system can work well under the assumpted circumstances.

In the fifth five weeks, I will draw the data model design diagram. In the meantime, I will create the RESTFul APIs specifications. These activities will last for two weeks. For the last three weeks, I will commence to implement the graphical user interface based on the system design. During the development, I will also integrate the RESTFul APIs for the UI.

In the sixth five weeks, I will have the round one of design, distribute, and collect the survey with medical practitioners. In the meantime, I will perform several system performance testings. These activities will last for two weeks. For the last three weeks, I will revise the survey and HIS based on the survey and system performance test results.

In the seventh five weeks, I will have the second round of survey distribution and gathering activity. In the meantime, I will also retest the performance for the revised system. These activities will also last for two weeks. For the last three weeks, I will revise the HIS in case it cannot fulfill those medical professionals' expectations.

In the last five weeks, I will analyze the survey and system performance testing results. Finally, I might improve the developed strategy model based on the results.

This is the 40 week schedule for this research.

References

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