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eHealth and Smart Solutions framework for health monitoring in the course of the pandemic

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Abstract

Our main objective focusing on the different design principles for applications which can receive and store various data from smart devices e.g., smart bands, smart watches, smart homes and could gain more information about its users with some extent to their health. We would like to collect this information, store them, then create well understandable diagrams and show them to the user in a modern, responsive environment. We placed great emphasis on the architecture which holds the necessary features (scalability and extensibility). We have followed the standards, recommendations, and protocols during the design process. The result is an application framework which fulfills the duty of an XXI. century smart solutions application that could monitor the health of people and even help to live a healthier life avoiding chronic disorders e.g., obesity and/or diabetes.

Problem 1 (Data collecting)**.** *The first problem is finding a solution to gather health data from various IoT devices and sending them to the main application. Every device has it's own structure so we had to find a way to handle that.*

Example 2. Text of this example.

Corollary 3. *The newest smart watches provide SDK to design an application which solves this issue. The task is our application to collect health data and store in our defined data structure, convert to JSON and send to our server via REST API endpoint.*

Problem 4 (Data storing)**.** *Stroring data efficently is challenging especially if we handle different structures. Not every device could provide EKG or sleep information because of this reason we have to find a solution to avoid inconsistency in our database.*

Corollary 5. *NoSQL databases have many advantages like storing different structures of data. It comes handy in our case that is why we use MongoDB which stores data in JSON format. We installed and configured properly MongoDB to match to our case.*

Problem 6 (Creating diagrams)**.** *Raw data mean almost nothing to the user but if we are creating diagrams from them, the user could have more understanding of its health. The diagrams should be simple and well readable and most importantly the user gains new information from it.*

Corollary 7. *We used the R script language to create our diagrams. R is famous for its data processing and plotting abilities. We extracted the given data of user from our database and converted into csv file and we passed this file to our R script which creates diagrams and statistics from it and we can show these diagrams in our application.*

Problem 8 (The Architecture)**.** *As we stated before one of our goals is a flexible data model which could be a base of a general data managing platform. We wanted to design a layered architecture that is scalable, modular, expandable.*

Corollary 9. *The microservices architecture is a collection of services that are highly maintainable and testable and independently deployable. Spring offers an opportunity if we would like to wire many services together. All our services share the same database, but they have different endpoints with REST API interface and business logic. We chose this architecture because it is easy to expand later when we are adding more and more services to the application.*

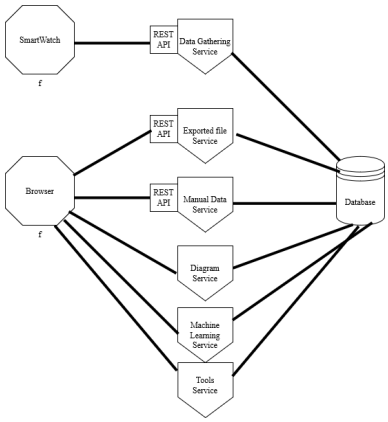

Figure shows the architecture

Problem 10 (Prediction on user's health condition)**.** *Today we have a great demand to foresee our condition and its consequences in the near future. From the gathered data we could predict a possible health change and maybe we can give advice to increase the user's health condition.*

Corollary 11. *For achieving this feature we relied on machine learning. We gathered enough data from our users to fit various machine learning algorithms and models. Most of them gave us the same results, depending on given steps or distance and daily calorie intake we found linearity in weight loss. On other hand we can classify if the user has covid or not because the heartrate increasement and constant fatigue could tell us this information.*

Problem 12 (Communication with healthcare providers)**.** *In our presents IoT devices provide a great amount of information about our health. In the near future we can imagine everyone having its own healthcare at home. We want to share these gathered data with healthcare providers and that way we can speed up healthcare and doctors will have more information about the patient. This feature*

Corollary 13. *Health Level Seven standards are set of international standards for transfer of clinical and administrative data between software application used by various healthcare providers. HL7 uses XML documents which includes information about the patient. We dedicated a new service in our architecture to HL7 which creates these XML documents and is ready to transfer between HL7 ready providers.*

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