Novel Framework Combining Health Records with Medical Algorithms

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Abstract
Information overload in the medical field is both visible by the increased number of publications as well as by the volume of patient data. In order to cope with this problem, we propose a novel framework combining patient's health records with medical knowledge, which is based on medical algorithms from frequently used guidelines. The framework uses new types of animation and layout algorithms for visualizing knowledge models in health records. At the Münster University Hospital the framework is already in prototypical use for education and communication purposes.

ACM Classification Keywords
H.5.2 [User Interfaces)]: Interaction styles (e.g., commands, menus, forms, direct manipulation)

Introduction
The rapid growth of knowledge in the medical sector created a variety of specialized fields tackling the increase of complex disease patterns. In order to keep updated with the latest methods, medical guidelines aim to ensure a high quality for patient's treatment. Experts consent guidelines giving recommendations for standardized examinations, diagnosis and treatments. Most guidelines are presented as texts, but there also exist visual representations, e.g. [2]. Such forms of guidelines provide medical algorithms, which are useful for practical usage. Additionally, huge volumes

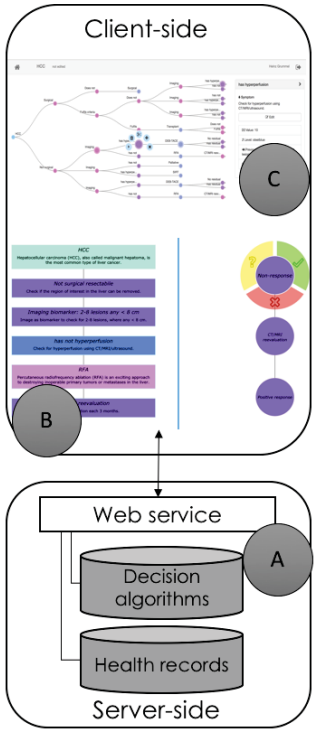

Figure 1: This image represents the architecture of the proposed framework showing the main components in the back end and client side.

of patient relevant data are retrievable e.g. in hospitals. As a solution health records need to be more intelligent providing only relevant information to the user. Several works present solutions for medical decision support and interactive visualizations of health records [1, 3]. But nowadays, time-consuming care of data entries prevent the usage in the daily clinical routine.

In order to tackle information overload and data editing, we created a framework combining both medical decision algorithms with patient's health records. The application consists of a novel decision graph representation for both desktop computers and mobile devices to filter relevant information for quick data manipulation. It can also be used to improve the communication between physicians and between physician and patient as well as for education assistance. This provides students insights in medical guidelines with real-world patient data. Especially for empowering patient's to get a second opinion, this application can influence the daily medical life. Next, we present the technical details about the implementation of the application.

Guided Health Records

As shown in Figure 1, the architecture of the framework consists of mainly three part: server-side back end, mobile and desktop application. The back end (A) provides a data storage containing both medical decision algorithms and patient's health records. Health records are placed in an Elasticsearch[1] database, while the decision algorithms are stored in a graph database. As graph database we use Titan[2]. In order to access and operate on both database, we created a Web service providing all functionalities needed for the client-side based on JavaEE. The main purpose of the mobile application (B) is providing a novel step wise user interaction through possibly complex decision algorithms. Additionally, detailed information about medical concepts are shown, which shall give the patient more insights about unknown medical concepts. Also the health record can be edited by the user. The desktop application (C) can be also used for editing the health record. Besides that its main purpose is for creating decision algorithms, which can be further used and shared with users. The technical implementation of the both desktop and mobile applications are primarily based on D3[3]. We extended the provided D3 functionalities with novel animation scripts giving the user smooth interactions with the application. Furthermore, we implemented new layout algorithms in order to visualize large complex decision algorithms on a bounded sized screen. The presented framework is currently tested at the University Hospital Münster in Germany for educational purposes and physician-patient communication.

[1] https://www.elastic.co/products/elasticsearch
[2] http://titan.thinkaurelius.com
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