ECHO – An mHealth Solution to Support Treatment of Chronic Patients

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Abstract More and more people all over the world suffer from chronic diseases, like asthma. The German-Greek bilateral research project Enhancing Chronic Patients Health Online developed online services for physicians and patients for use on smart phones or web browsers, in order to improve monitoring of those patients and to be able to detect possible exacerbations earlier. During the project we have developed smart phone applications and websites for both patients and physicians and a cloud-based health data management system. This demonstration shows how our system supports physicians and patients.

Keywords: mHealth, eHealth, Monitoring, Cloud Computing, Analysis

1 Introduction

Chronic diseases like diabetes, asthma, or chronic obstructive disease (COPD) are on the rise. For the proper treatment of chronic patients regular check-ups are inevitable. But due to lack of time or economic difficulties many patients do not get regular check-ups, which possibly leads to an exacerbation of their condition or even hospitalization.

In the project *Enhancing Chronic Patients Health Online (ECHO)*[1] smart phones, cloud computing, and data analytics are used to enable regular monitoring of COPD patients and avoidance of exacerbations. Patients who use the ECHO System are able to answer questions on their condition on a daily basis using their smart phones. The ECHO System even enables patients to enter measurements, like heart rate or body temperature. After submitting the daily report to the ECHO System, the data is analyzed by the ECHO System. If the system detects an imminent aggravation of the patients' health, the patient and the corresponding physician get notified and, if applicable, a treatment recommendation is given. Additionally, the ECHO System is able to store medical data like results of examinations or prescribed drugs. This extra data can be used to improve the analytics, such that imminent aggravations could be detected even earlier.

Section 2 presents a system overview and Section 3 presents our demonstration scenario.

[1] Project Website: http://www.chroniconline.eu

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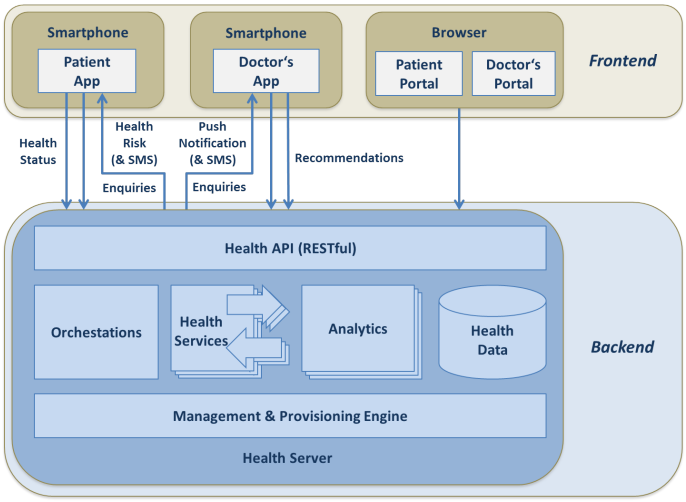


Figure 1. Architecture of the ECHO System [1]

2 System Overview

As shown in Fig. 1, the ECHO System is made up of 2 layers: Frontend-Layer and Backend-Layer. The Frontend-Layer consists of web and mobile applications for patients and physicians. The Backend-Layer contains the Health Server which is a cloud service. The Health Server is accessible from the Frontend-Layer via the Health API, which is a RESTful HTTP-API. The Health API enables the applications of the Frontend-Layer to use the Health Services and the Analytics. The Health Services can be used to store and query data from the Health Data Repository, where all patients' data is stored. The Analytics provide procedures to analyze data in the Health Data Repository, e.g., simple procedures to analyze the incoming daily reports or complex procedures which perform data mining. The Orchestrations can be used to orchestrate Health Services and Analytics to new complex services. Finally, the Management and Provisioning Engine is responsible for managing all the before mentioned components. Details on the implementation can be found in [3].

3 Demonstration Scenario

In our Demonstration Scenario we will show how the system can be used by physicians and patients. Fig. 2 shows the steps that need to be performed in order to monitor a single patient. The grey colored activities are administrative tasks. The first step, which is deploying the TOSCA[2] cloud service in a secure private cloud, will not be part of our demonstrations since it would take too much time. After that the administrator of the system creates an account for

Figure 2. Required steps for monitoring a patient

each physician and each patient. The physician is also able to create accounts for his patients using the web application. Fig. 3 shows the physicians' patients list in the web application. The next activity is the creation and maintenance

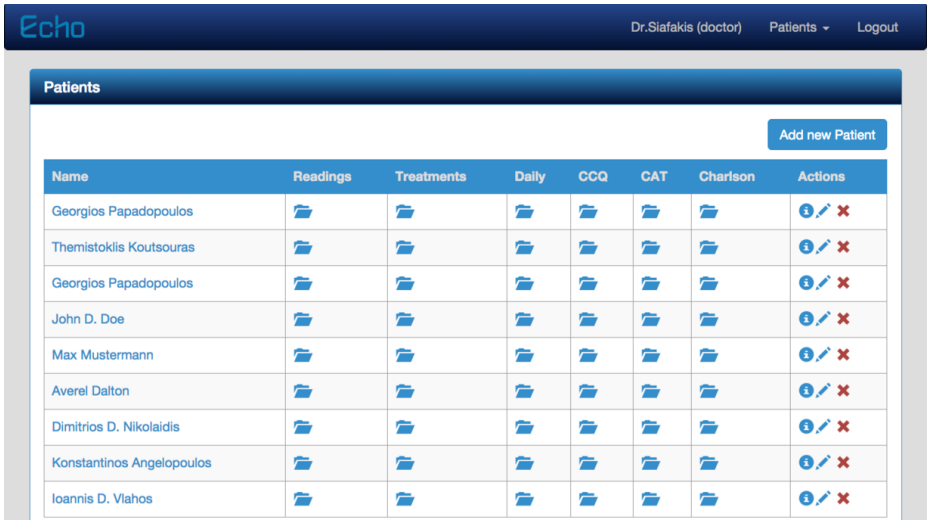
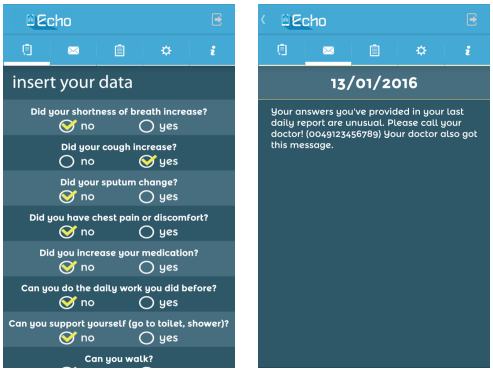


Figure 3. List of patients in the web application including an overview over all parts of the health record

of the patients' electronic health record by the doctor. Before the patient uses the mobile application, the physician can enter all relevant medical data into the system. Since the ECHO System can not replace the physician, it is still needed that the physician examines the patient from time to time. The results of those following examinations can also be added to the electronic health record of the patient. We will show how physicians' and patients' account can be created and how maintain the patients' electronic health record.

After the patient got introduced to the mobile application he can now fill in his data on a daily basis. This is the first of the dark-blue activities in Fig. 2. Fig. 4a shows the questionnaire on the smart phone which was already answered by the patient. After the submission of the report to the server, it is analyzed.

If the analytic functions detected a possibly worsening of the patients' health state, a notification is send to the physician and the patient via E-Mail, SMS or push notification. If there is a known treatment recommendation, the system will also send it along with the notification. Fig. 4b shows a notification in the mobile application. We will show how the mobile applications works and show the different outcomes of the analytics.



(a) (b)

Figure 4. Mobile Application: (a) shows the daily questionnaire (b) shows a notification received by the patient

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References

1. Bitsaki, M., et al.: An Integrated mHealth Solution for Enhancing Patients' Health Online. In: Proceedings of the 6th European Conference of the International Federation for Medical and Biological Engineering (MBEC'14). pp. 695–698. International Federation for Medical and Biological Engineering (IFMBE) (2014)
2. OASIS: Topology and Orchestration Specification for Cloud Applications (TOSCA) Version 1.0 (November 2013)
3. Steimle, F., et al.: Design and Implementation Issues of a Secure Cloud-Based Health Data Management System. In: Proceedings of the 9th Symposium and Summer School On Service-Oriented Computing. Technical Paper, vol. RC25564, pp. 68–82. IBM Research Report (2015)