A Cardiovascular Patient Follow-Up System Using Twitter and HL7

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Abstract

This project aimed at designing and developing a system for following-up cardiovascular patients integrating a social media (Twitter) and a healthcare communications standard (HL7 v2.x). Two applications – an android-based tool for gathering and tweeting vital cardiovascular signs and a Java-based desktop tool for receiving and parsing the information – were created within the framework of this project. The two applications developed provided a feasible prototype for following-up cardiovascular patients. A number of considerations concerning this novel approach are discussed in this paper. The modification of the health care flow empowers the patient and enhances the patient-physician communication. On the other hand, both patients and physicians may be reluctant to use the system as a daily basis due to security and privacy concerns. In any case, using a healthcare standard such as HL7 assures an extra layer of interoperability and makes the integration with existing information systems easier. The use of healthcare standards in conjunction with social media provides user-friendly applications that help bridge the gap in the patient-physician communication in a standard-compliant fashion. However, some research questions are still open and further projects are needed to guarantee the secure use of social media in healthcare.

1. Introduction

Cardiovascular diseases are a major cause of death in developed and developing countries. Monitoring the vital signs of cardiovascular patients is a common procedure to stratify patients at-risk.

Social media – such as Twitter or Facebook – provide a powerful tool for gathering, sharing and exchanging personal information in virtual networks. Based on the foundations of Web 2.0, social media allow the exchange of user-generated content. Twitter [1] is an online microblogging social media service that enables its users to send messages of up to 140 characters (known as tweets). It is estimated that Twitter has over 500 million registered users, generating circa 350 million tweets per day.

While most users consider Twitter just a news feed of updates reflecting their passions, it can be used for a wide variety of purposes. Indeed, Twitter quick response ability has led researchers to examine the advantages of Twitter in scenarios such as earthquakes [2], distributed politics [3], or education [4].

These promising capabilities have drawn the attention of the healthcare community. A variety of projects using Twitter in healthcare environments have been reported, including scenarios such as dementia [5], tobacco addiction [6], or influenza [7]. However, key challenges still must be addressed in order to deliver high-quality tools to the public health community, such as automatic extraction and aggregation of health data [8].

Furthermore, Twitter exposes its Application Programming Interface (API) as a web service. External third-party systems can therefore consume the publicly exposed methods to integrate Twitter services in their own applications. This can be used to build healthcare applications that use Twitter to handle healthcare data in an automatic way. In [9], Triantafyllidis *et al.* reported a pervasive health system that integrated patient monitoring and social sharing via Twitter. The proposed framework used the Systematized Nomenclature of Medicine—Clinical Terms (SNOMED-CT), and the Unified Medical Language System (UMLS) metathesaurus API in order to univocally identify the symptoms or alerts tweeted by the patient (e.g. #∗Light-headedness).

However, the standardization of the whole workflow – in addition to the thesaurus – would enhance the proposal presented in [9], since it would provide a fully-fledged standardized clinical data flow, which could be easily integrated with existing hospital information systems.

In this context, Health Level 7 (HL7) could provide the desired interoperability. HL7 [10] is an organization involved in the development of international healthcare informatics interoperability standards. Version 2 of the HL7 standard aims at supporting hospital workflows by means of messages [11]. HL7 v2.x messages are short, human-readable – as it uses the American Standard Code for Information Interchange (ASCII) – and its encoding syntax is not based on eXtensible Markup Language (XML). Furthermore, SNOMED-CT (or any other dictionary) could still be used. Therefore, HL7 v2.x messages are eligible to be tweeted.

Thus, this project aimed at designing and developing a system for following-up cardiovascular patients integrating social media and healthcare communications standards.

2. Methods

The proposed system was designed using Twitter as social network and Health Level 7 (HL7) version 2.x as healthcare standard.

2.1. Healthcare flow

The healthcare flow would be as follows (see Figure 1). First, the patient would measure his/her cardiovascular signs – namely, weight, blood pressure, pulse rate and temperature – using appropriate monitors. Subsequently, such signs were typed manually into an android application, which was developed within the framework of the project. Thereafter, the plain measurements were encapsulated into appropriate HL7 v2.x messages, according to the HL7 specifications [11]. Finally, the HL7 messages were tweeted to the hospital Twitter account.

At the opposite end, the hospital's Twitter account received notification of the incoming tweets. A desktop Java application simulating the front-end of the health care provider was developed within the framework of this project. This program read and parsed the HL7 v2.x messages, so that the plain measurements could be successfully extracted. Finally, the new vital signs could be adequately committed to the patient's Electronic Health Record (EHR). However, this is out of the scope of the project presented in this paper.

After consulting the results, the clinician may comment on the health status of the patient by just tweeting the patient back.

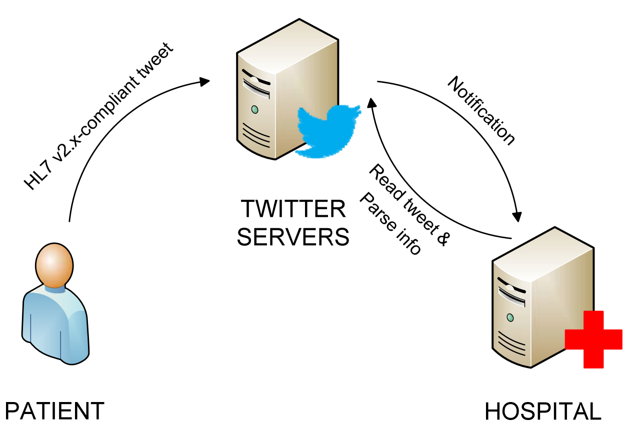

Figure 1. Architecture overview of the cardiovascular follow-up system using Twitter and HL7.

2.2. Authentication and authorization

Two Twitter accounts were created for testing the system: one used by the simulated patient and another one used by the simulated hospital.

The authentication is granted by OAuth, leveraging version 1.0A in both Android- and Java-based applications. OAuth is a protocol that allows users to approve an application to act on their behalf without sharing their password.

There are two forms of authentication in the Twitter API, namely: application-user authentication and application-only authentication. The former identifies both the application's identity and the identity of the end-user, represented by the user's access token. In the latter, the application makes API requests on its own behalf, without a user context. For this project, the application-user authentication procedure has been selected. This selection is further discussed in subsection 4.2.

The patient must register first at the hospital in order to bind his/her EHR profile to his/her Twitter account. The consumer key and the consumer secret must be generated in the patient's Twitter account for the application to work properly. Once the keys are known, the application would obtain access tokens to act on behalf of a user account and to authorize all HTTP requests it sends to Twitter's APIs.

2.3. Materials

In order to develop the applications, the Android Developer Tools (ADT) bundle (build version v22.0.5-757759) was used. This bundle contains all required tools to develop Android applications, including the last stable Eclipse version (Kepler) as Integrated Development Environment (IDE) with built-in ADT support. The same IDE was used to develop the Java-based application.

The integration with Twitter is made using the API version 1.1, which is compliant with the Representational State Transfer (REST) paradigm and, thus, exposed as a RESTful web service.

Also, the Java library Twitter4J (version 3.0.3) [12] was added to the project for easily integrating the Android- and Java-based applications with Twitter.

3. Results

Two applications – an android-based tool for gathering (Figure 2) and tweeting (Figure 3) vital cardiovascular signs and a Java-based desktop tool for receiving and parsing the information (Figure 4) – were created within the framework of this project. The two applications provide a feasible prototype for following-up cardiovascular patients.

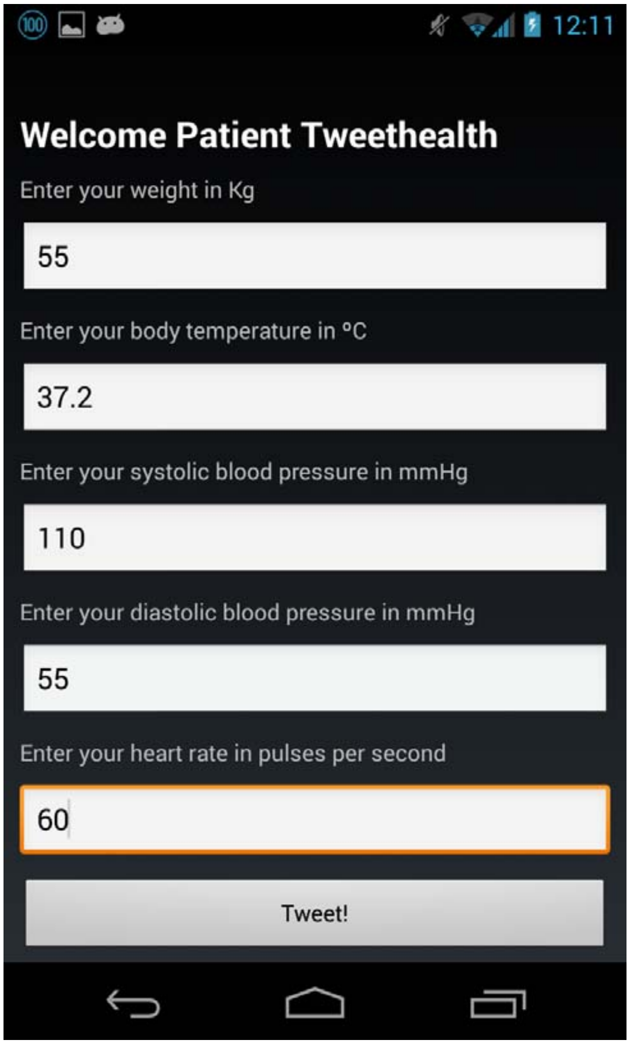

Figure 2. Android-based application.

Figure 3. Patient's Twitter timeline.

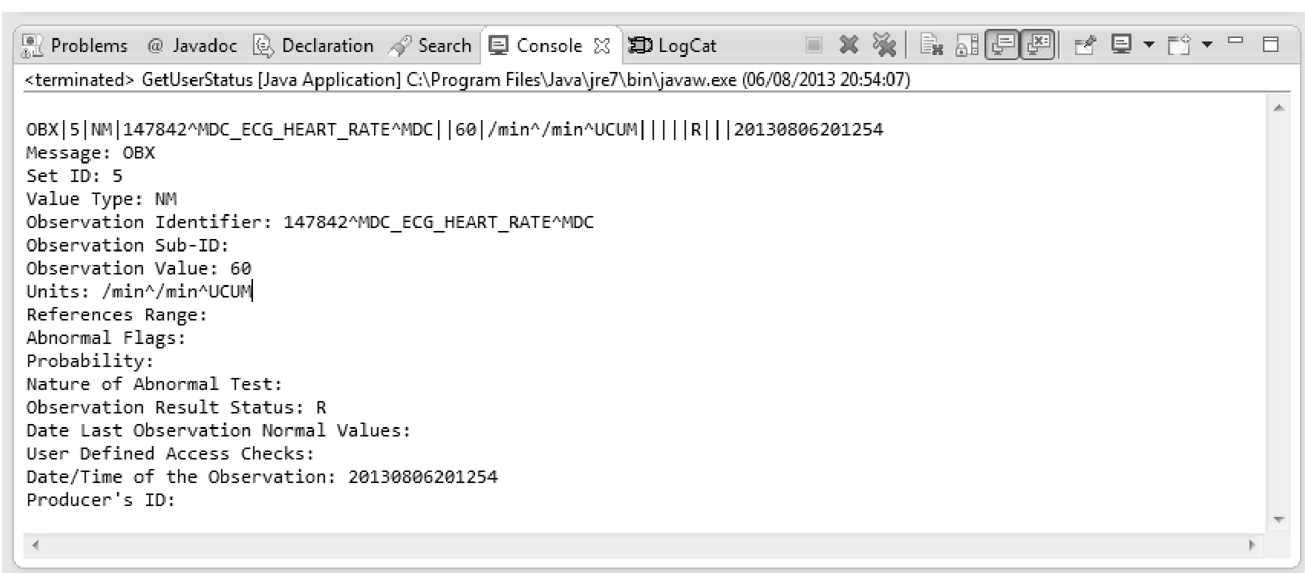

Figure 4. Console output for the Java-based program that parses the tweets arriving at the hospital Twitter account.

4. Discussion

4.1. General

The modification of the health care flow empowers the patient and enhances the patient-physician communication. On the other hand, both patients and physicians may be reluctant to use the system as a daily basis due to security and privacy concerns.

4.2. Authentication

The authentication of the patient is accomplished by means of the patient Twitter account. This may cause security breaches in case of false impersonation or abuse on the Twitter account.

Also, the application-only authentication could have been used instead of the application-user authentication. In this case, the measurements would not have been shown in the patient's Twitter timeline, but in the hospital timeline instead. This would have made the procedure easier, although the personalization and customization would have been lost as well.

4.3. HL7 v2.x vs. HL7 v3

Version 2.x of HL7 was chosen as it generates messages of reduced length that –usually– fit in a single tweet. The Minimum Lower Layer Protocol (MLLP) could be used to handle messages longer than 140 characters. Using HL7 v3 instead would not be suitable, since it is XML-based and, therefore, it implies a higher verbosity. In any case, using a standard such as HL7 assures an extra layer of interoperability and makes the integration with existing information systems easier.

4.4. Reliance on Twitter

Twitter is a popular, well-established service, which facilitates that patients and clinicians embrace the system. However, as Twitter is a proprietary solution, changes on the API may affect the service. A possible workaround would be the use of any of the available open source microblogging systems. This may imply a larger deployment time, but a higher control on data as well.

5. Conclusion and future lines

The integration of healthcare standards into social media provides user-friendly applications that help bridge the gap in the patient-physician communication in a standard-compliant fashion. However, some research questions are still open and further projects are needed to guarantee the secure use of social media in healthcare.

Current and future lines of research include the deployment of a pilot system in an actual hospital environment. Adequate questionnaires and surveys including both patients and clinicians will be conducted to assess the viability of the proposed system in a real scenario.

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