

E-health and the Web 2.0

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Abstract— As the application of information technology in healthcare is increasing and the volume of available health related information is rapidly growing, the importance of effective health information management is more and more recognized by healthcare professionals and providers. There also seems to be an evolution towards a patient-centered model of healthcare provision which is reflected on the increasing demand for personalized applications facilitating communication between patients and healthcare professionals and for the establishment of community based health networks. New technologies and relevant applications and services have emerged recently on the Internet, constituting the so called Web 2.0. These applications are characterized by features enabling collaboration, information sharing and aggregation, composition of independent services and provision of rich user interaction. In this paper we are investigating the capabilities, the potential benefits and limitations of Web 2.0 and the technologies it encompasses for the provision of advanced health-related online services and applications.

I. INTRODUCTION

ADVANCES in the Information and Communication Technology and the widespread use of Internet within the last decade is changing the way health care is provided and the term “e-health” is broadly used to describe this evolution. E-health can be defined as “the intersection of medical informatics, public health and business, referring to health services and information delivered or enhanced through the Internet and related technologies” [1]. A lot of research is being conducted on fields such as electronic health records, telemedicine, telehomecare, evidence based medicine, disease management and many more.

On the other hand, health care provision is going through a transition from a disease-centered model, where treatment decisions are made almost exclusively by physicians based on clinical experience, to a patient-centered model where patients are active participants in the decision making process about their own health [2], [3]. The Internet has played a drastic role in this movement by giving people access to an extreme amount of health information. People’s use of the web as a primary source of health information has increased dramatically [4], [5] and sometimes patients find

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online support communities more useful than their physician or primary care doctor [6]. The idea of a person who is actively participating in his/her own care decisions is the starting point of “consumer health informatics”, a growing research area which focuses on consumers’ needs for information and studies methods of making information accessible to consumers [7]. The impact of these ideas can be seen on the strategies for health care on UK’s NHS and NHS Scotland [8] and the implementations of healthcare networks and a personal health record system within the NHS.

In this paper we are discussing some of the characteristics of existing e-health applications, trying to identify problems and investigate for potential benefits of applying concepts and ideas used on Web 2.0 applications.

II. E-HEALTH APPLICATIONS ON THE INTERNET

There are various kinds of e-health systems focusing on different areas of health care. Following is an indicative, yet far from exhaustive, list of types of internet-based e-health applications:

1) *Health related web sites or portals offering health related information for patients or health professionals.*

2) *Virtual communities and online support groups where people share experiences and information about their disease and provide emotional support to each other.*

3) *Electronic Health Records used in the clinical environment by health professionals and online Personal Health Records where the individual is the owner of his/her medical records.*

4) *Home care and chronic disease management systems used to monitor chronic diseases at home, to monitor elderly people or to communicate with professionals from home.*

5) *Telemedicine and teleconsultation applications in areas such as dermatology, ophthalmology, radiology and psychiatry enabling collaboration between health professionals and communication with patients.*

III. PROBLEMS OF EXISTING E-HEALTH APPLICATIONS

While e-health applications provide patients, professionals and consumers with access to health information and information management tools, each application is still individually used and the produced information remains within the context of each system. Most systems are used within a narrow scope defined by organizational use, medical condition or specialty, time frame, locality. Each health care provider has its own medical records system. Telemedicine

and disease management applications focus on the specialized needs of specific diseases. People tend to seek for online health information only when they or their relatives are facing a health problem. Health information networks are deployed on a regional setting. A person has different health problems at different points in time, treated by different care providers on different locations. Information related to the person's health throughout his life is spread across many independent systems.

As health care moves towards a patient-centered model and information becomes an integral part of health care [8], information integration becomes a critical point. People should have easy access to their own medical records and to any information they need in order to make decisions about their own health care. This constitutes a great challenge at the moment, which requires a means to interconnect and interrelate information from various sources which are relevant to one person and create a personal virtual health space containing links to all the health information a person owns or is interested in.

IV. WEB 2.0 PRINCIPLES

The term "Web 2.0" is a controversial term that has been popularized during the last two years and various definitions have been given by different people. A short, broad definition is that Web 2.0 refers to a second generation of services available on the internet that lets people collaborate and share information online [9]. One viewpoint sees the Web 2.0 as the "web as platform" characterized by an "architecture of participation" [10]. According to Paul Miller the principles of Web 2.0 include freedom of data, composition of virtual applications from existing services, user participation, commitment to the users' needs, modularity, sharing of information, communication and community facilitation, and, finally, intelligent tools [11].

The first basic point of view of the "web as platform" describes a web where applications offer their data and functionality as a service through open Application Programming Interfaces (APIs) so that software developers can easily use the functionality and information to build new applications. Thus, it is possible to combine two or more existing services to create new applications for purposes that supersede the scope of the original applications. Such an example is Libmap [12] which combines the functionality of Google Maps [13] with data from the Silkworm Directory to build an academic library location service.

In order to be able to build valuable applications from existing services, information should be freely available. The notion of community and information sharing is dominant on the Web 2.0. Information increases value and one of the most effective ways to collect information is from the users of the application themselves. So, this is where the "architecture of participation" comes into play. Users become active participants, being simultaneously consumers and producers of information. This can happen either by

motivating people to contribute, but also, most importantly, by aggregating user information that has come up from ordinary use of the application, thus building value as a side effect. Applications are designed in such a way that they demonstrate network effects [10].

Next, we are introducing some of the technologies which constitute the Web 2.0.

1) *RSS*

RSS refers to a family of XML formats for syndicating web site content. An RSS feed contains web content or summaries of content together with links to the full versions of the content, and other metadata [14]. RSS allows someone to subscribe to a web page and receive notification when the page is updated. Programs called "feed readers" or "aggregators" can be used to manage multiple syndication feeds and read content from many sources.

2) *Blogs*

Weblogs, or, in short, blogs, are web pages which contain a series of frequently generated entries by an individual or a group and presented in chronological order with the latest entry listed first. These entries may contain text, links, photographs, video and audio files. Blogs are often used for news on specific subjects or as personal diaries. Most blogs use RSS feeds allowing user subscriptions. Another mechanism often used in blogs is "trackbacks" which allows bloggers to be notified when anyone else links to their blog entries, functioning like two-way hyperlinks, while still being implemented as one-way links. The interconnection between blogs leverages the creation of blog communities shaping the, so called, "blogosphere".

3) *Wikis*

A wiki is a type of web site that allows users to add, remove, or otherwise edit and change most content very quickly and easily, sometimes without the need for user registration [15]. Wikis can be seen as an example of self-organizing structures where the principle of evolution leads, in the course of time, to correct and complete content [16]. The most famous and successful example of wikis is Wikipedia, an online encyclopaedia where any internet user can add or edit an article, which currently counts more than 1.2 million articles in English language [17].

4) *Tagging*

Tagging refers to the process of assigning keywords or small phrases to digital items such as web pages, documents or photographs. An item can be associated with one or more tags. Collaborative tagging by many people formulate what is called a "folksonomy" [18], a cooperative, informal, free-style classification scheme. By using tags someone can organize a personal collection of items. Usually sites offering tagging functionality combine it with sharing capabilities which allow someone to share his items with other people, search for items of other people which are marked with a

specific tag, see tags other people have used for an item and add tags on existing items.

V. E-HEALTH AND WEB 2.0

While some of the tools and technologies of Web 2.0 have existed for several years and examples of their utilisation can be found in existing e-health applications, no research has been conducted so far about the potential impact of Web 2.0 on health information management and e-health. Although there is much debate about Web 2.0, its definitions and the criteria for characterising an application as Web 2.0, our belief is that there is still no example of a pure Web 2.0 e-health application. We further believe that e-health could benefit from applying principles of Web 2.0 and research should be made on this field.

The concept of the “web as platform” is probably the most interesting point for e-health. Small specialized applications could be developed exposing services that other applications can easily use. Such services could be for example services which store medical images, providing specialized tools for image processing, image annotations and secure sharing, or services which store measurements, laboratory values and vital signs, offering advanced graph and reporting tools, notification and alarm indication capabilities. Other services such as online calendars could provide scheduling capabilities and reminders for visits to care providers, medication intake and examinations. All these services could be utilized by existing or new e-health applications in several areas such as telehealth and teleconsultation applications or medical record systems. Also, new services would emerge by innovative assembly of existing services.

The main idea on all these examples is that applications should provide means of sharing and exchanging information, but in a controlled manner that does not sacrifice privacy. This is a key requirement in order to achieve information integration on e-health.

RSS is a technology that could have a strong impact on this direction, facilitating data aggregation from disparate sources. Wherever generation of data occurs, RSS can be applied. Doctors need to be informed on new data about their patients. Patients with chronic diseases need to receive news, articles and information about their condition from sites of their choice, or from their care provider. Authorized consumers of information can be notified about new available data through RSS feeds. Furthermore, personalised feeds, tailored to an individual’s specific needs and health condition, could be generated by intelligent software algorithms to inform patients or health professionals on new evidence, articles or advice related to the patient’s condition, by correlating information from patient’s health records.

Regarding blogs, there are already several health related blogs on the internet, formulating a health blogosphere. There are blogs of individuals describing their experiences with specific diseases and their treatments or blogs of experts and health professionals giving advice or discussing on

various health topics. There are also collaborative blogs on specific health areas, as in the case of “the Cancer Blog” [19], where many people provide information and share their experiences and emotions, acting as a virtual community or support group.

Though, we could take the idea of blogs a little bit further. Considering that a blog is a kind of diary with entries that could virtually contain any kind of data, a personal health record system could use a blog style interface for many parts of the recorded information. Blog entries could include information on visits to a practitioner, prescriptions of medication, daily comments about health incidents or even measurements and examination results. If we add to this a capability for selectively sharing specific entries with care professionals through RSS subscriptions, professionals could add comments to entries if needed, just like any person can add comments to other people’s blog entries.

Another interesting concept, tagging, could be applied in the context of seeking for medical information on the internet. A community bookmarking system, where users share their links to health information sources and rate the quality of the sources, is an interesting option regarding the problem of the quality of available online health information.

Tagging can also be offered as a tool to the users of a health information management system, such as a personal health record, for organizing items. It seems that tagging is not suitable for replacing taxonomies due to the nature of medical information and its function should be considered complementary or vertical to formal categorization schemes.

VI. CONCLUSION

We believe that the emerging philosophy, concepts and applications that conclude the “Web 2.0” and the notion of the web as a programmable platform should be further researched in relation to their applicability on health informatics. Security, privacy, confidentiality, ethical and legal issues are very critical due to the nature of health information and pose many restrictions on the wide implementation of the ideas described above. Thus, potential models of interaction and information interchange, identity management and authorization schemes should also be investigated in the context of Web 2.0.

In this paper we described some initial thoughts about possible application of the concepts of Web 2.0 on existing or new e-health systems and we intend to conduct further research on the subject by applying these ideas on two existing applications that we have developed from previous research on health informatics.

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