

A COLLABORATIVE APPROACH TO MANAGE AND SHARE ELDERLY BIOMEDICAL INFORMATION

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Abstract: Since the burst of internet as a participative medium in 2001, all the types of applications have been developed involving all the sectors, including commercial, financial, social, education, health, government, entertainment. One of the most important advantages noticed is the capability to allow people to interact to each other and to the services, anywhere, anytime and with any device connected to the network. Recently, the potential of new paradigms as social networks, big data, cloud computing have led to a change in technological and scientific scenario. As well, the advent of internet of things is promoting the development of many embedded applications, smart devices, middleware and web frameworks to integrate these new class of users to applications connected directed to people and services. In this paper we present HealthLook, a novel platform to integrate medical and biomedical information, allowing managing and sharing information among users connected to each other in a social network model. The objective is building a platform to serve as a repository of medical information and a database for the biomedical data collected from smart devices (sensors, actuators), to improve quality of life of elderly and its family. To develop this platform it is considered some needs as interaction and sharing data, interoperability of devices and sensors and web semantic.

Keywords: Elderly, Healthcare, IoT, Semantic, Social Network.

Introduction

The elderly population in Brazil in the last decades had its growth, according to the census conducted in 2010, very increased and the number of children decreased. Currently 7.6% of the population are children aged up to five years, fewer than those recorded by the survey in 2000 (9.8%) and 1991 (11.5%). On the other hand the elderly population above 60 years grew. In 1991, the elderly accounted for 4.8% of the population in 2000, 5.8%, and now amount to 7.4%. Of the total 190,755,799 of the population, 14,081,480 are 60 years older [1]. Estimates indicate that in 2050, seniors will represent approximately 30% of the population [2]. The population pyramid will then be similar to European countries nowadays and, in this period, Brazil could become one of the countries with the highest number of elderly in the world [3]. This new reality brings various

social, economic and cultural changes. With the high number of elderly being incorporated annually to the population, important consequence must be considered for the health system, such as increased attendance to patients with chronic diseases, complex and costly, common in the elderly that can last for years and require constant care, continuous medication and periodic exams [4]. This finding leads to the immediate concern with the increasing demand for health services, in addition raising their costs [5]. While there are limited financial resources available to the health sector, and considering that the elderly population is the age group that consumes more medical resources, tests and medications is noticed there are less information than necessary to plan the rational use of these resources. Epidemiological studies have shown to be essential to identify the usage profile of services in public health so that they can adopt strategic measures to ensure access to and rational use of all therapeutic resources, especially for elderly patients, due to all its particularities and needs of the aging. Moreover, the early diagnosis and control of chronic diseases such as diabetes and hypertension can optimize the use of physical and financial resources available in the Unified Health System (UHS), minimizing costs in therapy and waiting time in queues. In this new scenario, emerging technologies such Internet of Things (IoT), sensor networks, cloud computing and mobile devices can be great allies facing the new challenges related to health issues in the elderly. This paper describes a proposal for a novel platform based on the model of a social network called HealthLook, focused on healthcare for elderly, to integrate, manage and share biomedical information obtained from wearable biomedical devices. In the last years, e-Health science had a significant growth, several researches have been done and many projects were developed to solve many types of problems. The researches proposed the development of platforms for home care, to monitor the patient's life in their home [6]. Some projects are focused specially in elderly, to assure its independent life based in remote monitoring [7]. It has been noticed that intelligent forms of healthcare monitoring and innovative types of patient education and intervention platforms will be required, especially for elderly. Many groups are studying healthcare problems, exploring many types of technologies to provide cognitive alerts, decision support and remote monitoring, to improve chronic conditions of life

of patients, throughout mobile technologies [8].

The interest in e-Health area has such importance that studies all over the world are developed to understand its impacts and to plan the most critical problems to be solved. A study was developed involving 21 wealthiest nations for a leap forward in the ways and means to dealing with disease management through e-Health technologies [9]. The Telehealth technologies, such as sensor and monitoring applications has been developed trying to seek the healthcare demands for the dramatically increase of the older people, as the human and economic resources decrease. Indeed the Telehealth market was projected to grow 1000% from 2005 to 2010 [10].

In recent years, the IoT paradigm has been introduced and its advantages have been analyzed, especially using a middleware to integrate existing solutions. The study of this field can result in several applications to benefit in health area, such to track objects, to allow authentication people and automatic data collection, to help decision support and to prevent and detect emergency situations. For the last one, systems based in data-fusion are used, using different heterogeneous data such as geographical position, audio and video data, accelerometers and measurement of biosignals such blood pressure and heart rate. With this techniques, it is possible to predict dangerous situations and to take a decision properly [11].

The IoT Technologies have entered the healthcare field through telehealth and ambient assisted living, which aim at increasing patient autonomy and confidence, as to bring quality of life, to prevent domestic accidents, to monitor chronic patients and to optimize traditional health systems, such public or private health providers, to use better economic resources [12].

Ambient assisted living is a field in IoT which has gain special interest for its relation with elderly and its growing in the actual world scenario. Though the use of resources such artificial intelligence and IoT, it is possible to identify the health status of patients, learn about their behavior patterns, gain knowledge of the context, define rules for scenarios and study the relations about patients health and their behavior [13][14][15]. Such ambient assisted living platforms are capable to improve the life of patients, family, professionals involved in healthcare processes, as well to generate a considerable amount of data information to allow epidemiologic studies related to the age, with particular interest in elderly.

Materials and methods

The objective of the HealthLook is proposing a virtual ambient to provide shared healthcare information among professionals, users, devices and companies, to help decision support, improve knowledge gaps and storage health information. The focus is offering a platform user-friendly, capable to elderly, their family and

the medical professionals involved in the healthcare process. This way, it is possible to obtain data about the impact related to elderly in health area involving public and private services. These data will allow further studies, becoming possible to plan better ways to improve the use of current resources and the efficiency in health systems costs.

HealthLook platform provide a social network assisted living to elderly, aiming to monitor parameters of health to prevent or predict possible health problems, and to monitor in alert state when there is a problem or chronic diseases.

In the HealthLook Platform, all the users and devices are considered nodes and can be interconnected among itself (person to person, device to person), in a pervasive computational environment. As shown in Figure 1, Patient A can be connected to many types of devices, with its family, with Doctor W and Doctor X. The family can be connected directly with Doctor W, as well some devices can be connected with Doctors, to receive the data collected when it is important. All the information shared among these connections must be previously allowed by the users, in the other words, the Doctor must allow how many Patients, family, devices and other professional can interact in their network, as well the Patients must decide with which professionals and users they want to share their medical information and biomedical data collected by the devices. The devices are connected directly to the users as they were a person in the network, and can notify the interferences such abnormalities in biosignals to one or more responsible directly in the patient network, by using the smart features of IoT devices. This way, the IoT devices are considered as smart objects and can interact in the same level of humans, considering the autonomy principles for smart devices in IoT.

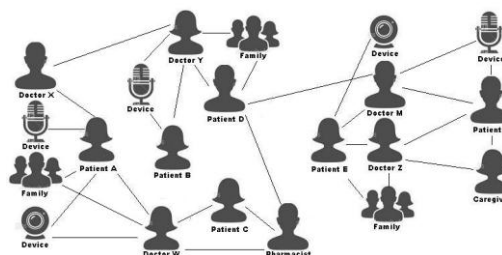


Figure 1 - Connections in the HealthLook Platform, with all the users and devices as nodes in the network

The importance of organizing a great amount of medical information about the elderly health behavior is an emerging subject, in both computational and medical environment, but the solutions proposed until now were usually related to electronic health records owned, according to medical treatment applied in their patients. This personal health records are usually responsibility of the hospitals or doctors. HealthLook platform is de-

sign to share the responsibility of personal health records through the social network, where is possible to update medical information whenever it is needed. This social network structure has notorious importance to elderly patients, because their medical frequency is high and generally, with many doctor specialties and medical treatments, many types of drugs to manage and some chronic diseases.

HeathLook platform aims to support a great amount and types of medical information, such simple orientations, drugs prescriptions, exams, images, medical plans, sensor data collections and daily information about the patients, helping the professionals to take decision in emergency or routine occurrence, and supporting the patient and family with medical information, which is very important specially for elderly that use to have many kinds of doctors and specialists involved in their healthcare practices. This source of personal health information can also help to improve knowledge about the diseases related to elderly, through the internal search engine in HealthLook Platform. It will allow to find correct information throughout semantic techniques, involving only the information important during the search. Another important tool can be provided to improve knowledge about diseases and treatments is creating an area to offer virtual courses where family and caregivers can learn more about elderly diseases and how to care to the elders. This kind of education is important to improve elderly daily life and help their healthcare.

HealthLook proposes an innovative model to integrate, manage and share biomedical data and medical information, by the use of a social network application model. In order to develop this platform for healthcare, some important points may be observed, such security issues, interoperability, questions about heterogeneous devices, data accuracy, confidence, friendly interface and universal access (web and mobile). In HealthLook architecture, were established some features, distributed in functional blocks, as observed in Figure 2:

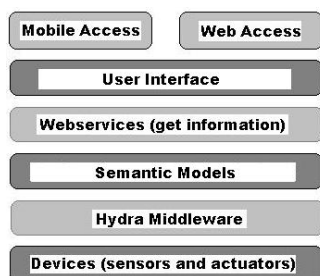


Figure 2 - Layers and functional blocks with access from many types of devices.

The layer containing the devices represents all the devices connected in the network and the heterogeneity in order the sensors, actuators and general devices in medical area proceed from many types of providers.

To guarantee interoperability, scalability and security

model Hydra Middlerare was chosen, aiming to achieve all these features. Hydra is directly connected to all devices being a gateway between hardware and the application. It offers functionalities to integrate heterogeneous devices to the same platform.

Interoperability is mandatory in an IoT platform. To provide this, it is necessary the use of a middleware layer, to support many types of devices in a transparent way. Hydra (also known as Linksmart) is middleware based on a Service-oriented Architecture (SOA), to which the underlying communication layer is transparent. It was designed to run on a variety of stationary and mobile devices [17]. The middleware includes support for distributed as well as centralized architectures, security and trust, reflective properties and model-driven development of applications. It is deployable on both new and existing networks of distributed wireless and wired devices, which operate with limited resources in terms of computing power, energy and memory usage. It will allow for secure, trustworthy, and fault tolerant applications through the use of novel distributed security and social trust components and advanced Grid technologies. The middleware was already tested in e-Health field, as a tool to allow the easy integration of heterogeneous devices in one application [18].

All the data collected pass by Hydra before arrives to application layer, where finds semantic models to treat the information and some functionalities to manage, distribute and integrate the information, based on software agents and webservices developed using XML (eXtensible Markup Language). With these features, it will be possible to build a software architecture model capable to offer interaction among the nodes in the network, trough a friendly user interface, with universal design

Besides, the features into the software intelligence though semantic models and software agents become possible to create a health research model of information consulting, analysis and decision-making.

Standardization of interfaces is an important point when developing a healthcare platform. Another important point is the format of the Eletronic Health Record (EHR). The HL7, EN 13606 (specified by the European Committee for Standardization) and the ISO 18308 are the principal initiatives for this purpose. This way, HealthLook platform will be developed following some definitions: (i) the protocol to possibility exchange EHR messages; (ii) the contents and structures EHR data, and (iii) the mechanisms to guarantee privacy and security of information sharing.

The universal access to the platform is also considered, all the presentation layer is web based, it is possible to access from computers, tablets and smarthphones, using open platforms as Android and proprietary platform as iOS. This allow the access to important information related to healthcare anywhere, anytime, from as much as devices is possible.

Besides, the front end will be created using universal design concepts, considering many elders can access their own biomedical data and update their medical

information.

Results

HealthLook proposes combining IoT paradigm and Social Networks Model to solve some critical problems, as:

EHR Management (i): One of the most important gaps in Healthcare is the knowledge about the patient medical information. Usually this is restored in hospitals or medical centers, and the patient knows part of this medical history, in special elderly by having many specialists in different medical areas. Centralizing information in the HealthLook platform can improve organization of all the medical information, in special chronic patients who need continuous monitoring and collaboration among many medical specialists. The medical information updated by the elder or family, combined to the monitoring practice and stored data from several devices with its own parameters (invasive or non invasive) can ensure the well-being of the elder person.

Diagnosis Support (ii): The systematic adoption of HealthLook can help in diagnosis to patients by the fact to be the centralized source of biomedical data collected and a platform to store medical exams from different medical professionals from different health centers. It can be work as a virtual medical office where can be discussed the health problem of the patient analyzing its EHR and actualized exams and symptoms. This is crucial when the patient has no time to wait and needs to start a health treatment quickly.

Medical Library (iii): The HealthLook platform can serve as a repository of friendly medical information, minimizing the limitation of technical readings by the use of semantic mechanisms, to approximate medical language to a understanding language to people who need to find this kind of information. This is very important when family, elderly and caregivers want to know more about diseases and treatments they are involved, facilitating the dialogue between medical professionals and common people.

Research and epidemiological studies (iv): With all the data from the biomedical devices associated to the elderly and information about elderly diseases and treatments, many types of analysis about the entire sector can be done (elderly behavior, doctor performance, health insurance, medical equipment). Moreover, the development of this platform can contribute in further studies in public health, trough researches using this important source of health elderly knowledge. With analytic functions could be possible to map the elderly health behavior, patterns and connections. From then, public policies to health area could be planned, as strategies to improve elderly life and the use of the resources in health care area.

Discussion and Conclusion

By the association of IoT and social networks concepts HealthLook Platform could provide important

instruments to facilitate elderly and family daily lives, as well the work of health care professionals. It provides mechanisms to improve the communication between doctors and patients, leading to better results in health treatments. It can also contribute to avoid serious events involving chronic patients, by the use of biomedical monitoring features, besides to help to prevent new diseases.

On the other hand, HealthLook Platform can help integration of many types of new devices, as new technologies to improve the internal source engines as semantics and web development components. Further studies can incorporate a proper ontology to improve the monitoring performance of the devices and the quality of data collection.

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