Telematics and Informatics 31 (2014) 648–659

Contents lists available at ScienceDirect

Telematics and Informatics

journal homepage: www.elsevier.com/locate/tele

Telemedicine using mobile telecommunication: Towards syntactic interoperability in teleexpertise

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ARTICLE INFO

Article history:
Received 2 January 2014
Received in revised form 29 January 2014
Accepted 31 January 2014
Available online 13 February 2014

Keywords:
Telemedicine
Webservices
Mobile technologies
Interoperability

ABSTRACT

Telemedicine allows collaborative activities between health professionals for the deployment of medical procedures carried out remotely by means of device using information and communication technologies. This article focuses on the Teleexpertise that allows collaboration between medical professionals in order to share knowledge and expert advices used as explanation elements for decision support. We propose a conceptual model integrating the FIPA (Foundation for Intelligent Physical Agents) Contract Net Protocol which permits to collect medical professionals' answers for a request for teleexpertise in an efficient manner. Our model satisfies four requirements (coverage, QoS (Quality of Service) guarantees and prioritisation, mobility and roaming, service usability) on the configuration and operation of the underlying network and the services. Therefore, we provide an operational assistance by improvement of the networks quality of service via interoperable web services. Finally, we hope to bring a tangible contribution on the implementation of this suggested conceptualization that will allow to generate relevant and action-oriented findings.

1. Introduction

Telemedicine is the fact to use telecommunications and information technologies to provide health at a distance by gathering images and information for diagnosis, treatment, follow-up and monitoring.

Telemedicine is very helpful in several areas such as: *rural area* (Barjis et al., 2013) where medical expert advices are not very often available, *critical area* to provide quick health care.

Telemedicine is declined in five acts (DGOS, 2012) that are listed below:

- Teleconsultation: it allows a medical professional to consult a patient remotely.
- Teleexpertise: it allows a medical professional to seek remotely some opinions to his fellows who have the relevant training and skills. It can be achieved outside the presence of the patient.
- Telemonitoring: it allows a medical professional to monitor and supervise a patient remotely.
- Teleassistance: it allows a medical professional to assist remotely another medical professional during an intervention.
- Medical response: it is used to provide quick and efficient emergency services. The paramedics support the medical response of both air and ground ambulances.

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http://dx.doi.org/10.1016/j.tele.2014.01.003
0736-5853/

Today with the rising of mobile devices many companies and research Institutes are trying to propose innovative solutions in the field of telemedicine adapted to mobile devices context. For example since 2009, the World Health Organisation (WHO) has been publishing reports covering initiatives and mobile health (Iwayaa et al., 2013). The mHealth Alliance (mHA), hosted by United Nations Foundation, is another institution who aims to maximise the impact of mobile health, especially in emerging economies, by ensuring interoperability and promoting open standards (Iwayaa et al., 2013). Actually, the mobile phone has been recognised as a possible tool of telemedicine since it became commercially available (Hung and Zhang, 2003). In this paper we follow this way *i.e.* proposing solutions including mobile devices related to the telemedicine.

In this study we will focus on the problem of *telemedicine* & *interoperability* between many devices such as laptop, desktop, mobile devices,...

In the rest of this paper, we talk first about the objective we want to reach, second the state of art to show what has been already done, finally the others sections (Materials and methods, Results, Discussion) show how we try to reach our objective.

2. Objective

Nowadays the number of mobile devices is rising increasingly. These devices are being part of human being life because they are multi task, they can be used everywhere and every time and are more and more efficient.

By the definition of telemedicine, it allows the use of telecommunication and information systems and it permits collaboration between medical professionals. Telemedicine is value-adding, with the strength and responsiveness of practitioners supporting remote patients or other practitioners. Particularly, the teleexpertise is most likely to exhibit value added services through sharing of expertise, consensus-building and exchange of good practices. Thus our goal in this work is to bring innovative solutions to solve the problem of interoperability and to improve the networks quality of services on mobiles devices by using interoperable web services. Achieving this goal will permit to medical professionals to gain in efficiency.

3. State of the art

3.1. Concept of interoperability

Interoperability is neither the consistency nor the integration in one same system, even if it may however contribute. It concerns exchanges between computer applications, that these are located on the same computer or another player. For the European Committee for standardisation, interoperability is "*a state between two applications when, for a specific task, an application can accept data from the other to perform this requires appropriate and satisfactory manner without this an external operator intervention*" (Altran, 2010).

The main problem of Interoperability is the nature of exchanged data because these data come from multiples sources. The information circulating are more and more issued by the technical systems: sensors, cameras etc., and communications between human beings and the complexity of their relationships, they also pass by a series of systems, the keyboard on the phone through the cameras (Altran, 2010). The information systems have to handle these data regardless their sources.

According to Adebesin et al. (2013) there are four levels of interoperability:

- *Technical level*: It permits heterogeneous systems to exchange data, but it does not ensure that the receiving system with be able to use the exchanged data in a meaningful manner.
- *Syntactic level*: It ensures the preservation of the clinical purpose of the data during transmission among healthcare systems.
- *Semantic level*: It permits multiple systems to interpret the information that has been exchanged in a similar manner through pre-defined shared meaning of concepts.
- *Organisational level*: It makes easy the integration of business processes and workflows beyond the limits of a single organisation.

These levels are illustrated in Fig. 1.

In Adebesin et al. (2013), the authors talk about many standards around healthcare, and also make a mapping of these standards with the four levels of interoperability cited above. *Messaging* standards are generally aimed at supporting syntactic interoperability through the transmission of structured *messages*, while those classified under structure and content address interoperability both at the syntactic and semantic levels by specifying the structure of clinical documents that contain both coded and free text data. Clinical terminologies and codes are used to prevent ambiguity in the use of medical terms, thereby ensuring the same interpretation of clinical data, irrespective of the application that is receiving the data. For more details about the correspondence of interoperability levels and standards see Fig. 2.

3.2. Solving interoperability issues

In Altran (2010), the authors try to solve the interoperability problem layer by layer. They give in each layer which technologies can be used. They divided their illustration into nine layers that are listed below: