MAPi DOCTORAL PROGRAM IN COMPUTER SCIENCE

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Thesis Proposal

Title:

Distributed and Interactive Solutions for Ubiquitous Telemedicine

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Introduction

During the last decade, several healthcare organizations have adopted telemedicine solutions to provide remote assistance to institutions with less specialized human resources. The same solutions have also been exploited for educational proposes.

From a technological point of view, it is expected that new solutions will continue to appear and services will become more integrated and ubiquitous. This progress will be strongly impacted by wireless and broadband innovations, and telemedicine applications will evolve beyond Internet-based opportunities, becoming wireless, portable and/or wearable. The continuous technology evolution will help to create new telemedicine services, the distinction between medicine and telemedicine will gradually disappear, and telemedicine will become a true standard of care.

Despite this expected technological evolution, telemedicine has yet a reduced record of execution and a very irregular adoption, with a slow and fragmented acceptance in routine operations of healthcare. Nevertheless, the increasing demand for new economic models to reduce costs and increase efficiency reopens the doors for telemedicine implementation as a way to optimize human resources and diagnostic equipment. In this context, cloud computing and mobile devices are key for the success of next-generation telemedicine approaches.

Many information and computational systems have been shifting their operational organization to embrace emerging distributed computing facilities. Ubiquitous services in telemedicine can easily be provided for health care centres with limited resources, without the need for large investments in the core IT infrastructure and maintenance. This cloud environment also facilitates the dissemination of medical communities, promoting telemedicine services and real-time collaborations. In this context, several social-network solutions may be adopted also in telemedicine, such as multimedia messaging, forum, video-conferencing, virtual shared spaces, on-line focus group, just to mention a few. The increasing awareness of this kind of tools will definitely help reduce the barriers for telemedicine general adoption. At the same time mobile devices are getting successively more powerful competing seriously with the traditional personal computer. Telemedicine solutions need to take advantage of this shift to stimulate and to facilitate the flexibility of work, anytime and anywhere.

Objective

The objective of this doctoral project is to investigate innovative telemedicine solutions that able to support real-time and asynchronous collaborative workspaces in a ubiquitous and secure way.

The work will be focused in critical scenarios, namely vital signals and medical imaging, and real case scenarios will be constructed with partners from clinical institutions.

This thesis proposal will focus on the following aspects:

- Studying the field: identify the requirements for establishment of mobile eHealth collaboration. Special attention will be put on health information exchange standards to support integration with actual electronic health record systems. Moreover, identification of operational critical constrains like, for instance, real time processes, data latency and privacy.
- State of art: perform a complete literature review, covering main authors and projects related to this issue.
- The question: identify better the key problem to be tackled in the following years of this doctoral program, defending its relevance and scientific impact, and describing the main strategy to conduct that research work.

Thesis Planning

Phase 1. Literature review (reading and writing)

The main goal of this task is to identify and retrieve source materials, both theoretical and empirical, which are appropriate for the topic, hypotheses, questions, and variables.

a) Some starting points:

- Al-Taei, Mohammed Hameed Ahmad. "Telemedicine needs for multimedia and integrated services digital network (ISDN)." In Computational Intelligence Methods and Applications, 2005 ICSC Congress on, pp. 4-pp. IEEE, 2005.
- Chorbev, Ivan, Martin Mihajlov, and Ilija Jolevski. "WiMAX supported telemedicine as part of an integrated system for e-medicine." In Information Technology Interfaces, 2008. ITI 2008. 30th International Conference on, pp. 589-594. IEEE, 2008.
- Kumar, Sajeesh. "Introduction to Teleradiology." Teleradiology (2008): 1-9.
- Yang, Chao-Tung, Lung-Teng Chen, Wei-Li Chou, and Kuan-Chieh Wang. "Implementation of a medical image file accessing system on cloud computing." In Computational Science and Engineering (CSE), 2010 IEEE 13th International Conference on, pp. 321-326. IEEE, 2010.
- Doukas, Charalampos, Thomas Pliakas, and Ilias Maglogiannis. "Mobile healthcare information management utilizing Cloud Computing and Android OS." In Conf Proc IEEE Eng Med Biol Soc, pp. 1037-40. 2010.
- Porumb, Cosmin, Sanda Porumb, Bogdan Orza, and Dinu Budura. "Computer-Supported Collaborative Work and Its Application to E-Health." In Advances in Mesh Networks (MESH), 2010 Third International Conference on, pp. 75-80. IEEE, 2010.
- Mills, Kevin L. "Computer-supported cooperative work." In ENCYCLOPEDIA OF LIBRARY AND INFORMATION SCIENCES (2ND EDITION. 2003.
- Tan, Joseph, ed. E-health care information systems: an introduction for students and professionals. Jossey-Bass, 2005.

- W. Glinkowski, “Advances in International Telemedicine and eHealth (Editor)”. Medipage, Warsaw, vol. 1 (2006).
- Maheu, Marlene, Pamela Whitten, and Ace Allen. E-health, telehealth, and telemedicine: a guide to startup and success. Jossey-Bass, 2001.
- Rodrigues, António, Carlos Resende, Luıs Carvalho, Pedro Saleiro, and Filipe Abrantes. "Performance analysis of an adaptable home healthcare solution." In e-Health Networking Applications and Services (Healthcom), 2011 13th IEEE International Conference on, pp. 134-141. IEEE, 2011.
- Huang HK: PACS and imaging informatics: Basic Principles and Applications, 2nd edn. New Jersey: Wiley & Blackwell, Hoboken; 2010.
- C. Costa, C. Ferreira, L. Bastião, L. Ribeiro, A. Silva, and J. L. Oliveira, “Dicoogle – an Open Source Peer-to-Peer PACS”, Journal of Digital Imaging, 2011 Volume 24, Number 5, Pages 848-856.
- Carlos Ferreira Viana, Daniel Ferreira, Frederico Valente, and Eriksson Monteiro. “Dicoogle mobile: a medical imaging platform for android". XXIV Conference of the European Federation for Medical Informatics, 2012.
- C. Costa and J. L. Oliveira, “Telecardiology through ubiquitous Internet services”, International Journal Medical Informatics, Elsevier, 2012. Volume 81, Issue 9, Pages 612-621.
- L. Ribeiro, Costa, C. and J.L. Oliveira, "Clustering of distinct PACS archives using a cooperative peer-to-peer network". Comput Methods Programs Biomed, Elsevier, 2012, Volume 108**,** Issue 3, Pages 1002-11.
- F. Valente, C. Costa, and J. L. Oliveira, “A RESTful Image Gateway for Multiple Medical Image Repositories”, IEEE Transactions on Information Technology in BioMedicine, 2012. Volume 16, Number 3, Pages 356-364.
- L. Bastião, C. Costa, and J. L. Oliveira, “A PACS archive architecture supported on Cloud services”, International Journal of Computer Assisted Radiology and Surgery. Springer, 2012. Volume 7, Number 3, Pages 349-358.

b) Review of scientific papers containing the following keywords:

- Telemedicine, Teleradiology, Telecardiology, PACS, DICOM, ECG, Cloud, Mobile, Collaborative Environments and Electronic Healthcare Records.

c) Some publications sources:

- IEEE Transactions on Information Technology in Biomedicine
- International Journal of Medical Informatics
- Computer Methods and Programs in Biomedicine
- Journal of Telemedicine and Telecare
- Journal of the American Medical Informatics Association
- Journal of Biomedical Informatics

- International Journal of Computer Assisted Radiology and Surgery
- Journal of Digital Imaging
- Several IEEE, ACM and Springer Conferences related to the subject Telemedicine and eHealth

Phase 2. Problem statement

Which issues or controversy need to be solved.

Phase 3. Plan of Attack

Plan approach to the problem in a systematic way.