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Extending a VEPR System Institutional Boundary

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Abstract

Information availability is a major concern when the provision of care is at stake. Physicians make their decisions based on the information at hand. Several Electronic Patient Record (EPR) systems have been developed in order to make available to physicians structured and helpful information. However most of these systems are unarticulated and usually address only the specificities of a single medical specialty. Virtual Electronic Patient Records (VEPR) such as MAID (Multi Agent system for the Integration of Data) system provide for the necessary means for intra-institutions departmental information integration. Nevertheless, patients are mobile entities, visiting multiple institutions during their life time and leaving a trail of information scattered around. In this paper is presented a mobile agent based extension to the agent based MAID system in order to enable inter-institution patient data integration.

Keywords:

mobile agents, computerized medical records systems, hospital information systems, systems integration

Introduction

Healthcare is information and knowledge driven. Good healthcare depends on taking decisions at the right time and place, according to the right patient data and applicable knowledge. Communication is of most relevance in today's healthcare settings, as health related activities, such as delivery of care, research and management, depend on information sharing. As more data on patients are now recorded than ever before [1] the economical impact of their management is high. In a single healthcare institution, information technologies usually tend to combine different modules or subsystems, resulting in a "best-of-breed" approach [2]. This leads to a great demand on creating efficient integrated electronic patient records that would facilitate the communication process. Centralized solutions are often infeasible and expensive. Thus, integration with legacy systems is a key issue in order to provide physicians with complete and reliable information. The combination of data from heterogeneous sources takes a great deal of effort because the participating systems usually differ in many respects, such as functionality, presentation, terminology, data representation and semantics [2]. Interfaces are needed in order to retrieve useful information. Taking into consideration the intra-institutional level, and departmental systems, Virtual Electronic Patient Records (VEPR) systems approach can provide for the necessary means for departmental systems integration, enabling, at the point of care, a single integrated view of all patients' clinical information existing on the institution. We could say that at the institution level local information integration could suffice to provide doctors with all the necessary information to deliver care to a given visiting patient. However, patients are mobile entities, they visit multiple institutions during their life time and leave a trail of information scattered around laboratories, primary care units and other hospitals. The patient clinical history available to the doctor should not be resumed only to the information produced locally in the institution but also to include external data. The lack of articulation observed at the institution level, in what information systems integration is concerned, is also present when looking at the inter-institution integration level. Usually data integration relies on patients carrying their paper lab reports, x-rays and other clinical documents themselves. In order to provide consistent and complete clinical data availability, solutions must be provided for bridging inter-institutional systems integration gap.

Methods

The implemented system was design for extending MAID patient data integration features [3]. MAID system was developed for patient data integration within hospital S. João, the second largest in Portugal. The MAID system was designed for gathering clinical documents such as lab results and discharge letters from several internal departments. MAID system makes use of agent paradigm in order to build an autonomous and scalable system running since 2004.

Our aim is to extend MAID enabling data integration at the inter-institutional level. In order to accomplish this, modules for external data discovery and collection need to be designed and developed. Given the error prone and instability of large networks, like the national health network, additional care must also be taken in consideration in order to enable data collection and data availability within a useful time frame.

Besides the social and autonomous behavior of agents, the system implementation makes use of their mobile capabilities. This mobility can eliminate the necessity of long running communication channels between institutions and can provide for stronger external data discovery procedures that don't lead to local communications system overloading.

Data collection activities will be trigged by surgeries, consultation appointments and other scheduled events within a health providing unit. The system is intended to be integrated not only with MAID system but also to be able to provide data search mechanisms to other existing systems. Given the widespread inexistence of international standards adoption in most of the Portuguese electronic patient record systems collection actions, at this point, will be directed only to formatted documents such as PDF files and will not retrieve data individually.

Results

Implementation

The implementation consists in three phases: Event Management, Document Discovery and Document Retrieval.

On the first phase each event corresponds to the schedulling of a new clinical episode (consultation, surgeries, etc). To each scheduled episode is associated a set of information that will be used latter for data discovery scheduling. Besides the patient identification a time interval is provided indicating the urgency of information retrieval. External systems where information is known to exist can also be added to this set.

Phase two is initiated by the event scheduler. It triggers a mobile agent for document discovery activities giving him a patient id and a set of starting locations of external systems.

Mobile agents will travel trough remote platforms asking for documents and additional locations for patient documents. In each remote platform a local broker agent will give the mobile agent a new procedure. This procedure contains all the necessary new actions for the agent to retrieve the desired information. When the procedure finishes the mobile agent will have retrieved a set of new locations and a list of remote document references and is ready to travel to a new system. When the agent is unable to move to the desired destination it will postpone the visit and continue to next available location. After a few attempts to visit a designated location the reason for failure is registered and the location is eliminated from the agent's itinerary.

After completing its itinerary the mobile agent will return to the home system and store the gathered information. This will trigger phase three were discovered documents are retrieved from remote systems by a local broker agent. After collection documents are made available within the hospital system.

The system is based on the widely used JADE multi-agent platform with the inter-platform mobility add-on.

Conclusion

Several efforts are being developed in order to make available the maximum amount of valuable health information when and where needed. Patient mobility, within a country and between countries is now more common than ever before. Health record systems should adapt to this reality and be able to cope with their patient's mobility. The implemented system is intended to enhance an existing institutional system in order to make available to care providers a more complete patient clinical history and consequently enabling patients better and faster care provision. Additional work is planned for this system regarding security and ontological issues regarding data transport and data integration respectively.

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