



Universidade do Minho

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# **ARCHETYPE BASED INTELLIGENT SYSTEM FOR HEALTHCARE INTEROPERABILITY**

Miguel Miranda  
Department of Informatics  
E-mail: miranda@di.uminho.pt

### **KEYWORDS**

Healthcare Interoperability, Multiagent Systems, Intelligent Systems

### **EXTENDED ABSTRACT**

Currently, information technologies acquired a key role on the flow of work, information and knowledge within healthcare institutions determining their inner functioning to an extent previously unexpected. The uniqueness of each service provided and technology implemented require particularly adapted Information Systems (IS), which need to exchange information and guarantee both information quality and effective technical capabilities, such as standardisation, modularity, extensibility, distributability and interoperability. (Bodart et al, 2000) Furthermore, the consolidation of patient information and knowledge is an increasingly tool to improve the quality of service; to reduce costs on the long run and an essential prerequisite for the development of group decision support systems. (Miranda et al, 2009a)

The dissemination of information technologies in the healthcare arena has been increasingly visible in the daily practices of healthcare institutions, mainly those related to patient clinical record. This tendency resulted in several solutions for providing support in the regular decisions clinical staff is presented with. (Dupuits and Hasman, 1995) (Dreiseitl and Binder, 2005)

The overall benefits of information systems in healthcare are however undermined by the complexity of making each of these systems communicate in a loosely bounded manner. From the diversity of existing solutions, each of them oriented towards a service or group of services, scattered information that is vital to be shared is often secluded or connected in an intricate bound.

In the specific case of healthcare interoperability and integration, not only technological advances have occurred. Several terminologies and ontologies, that can be imbedded in software applications for the most

distinct reasons, have been developed by international committees. The area of medical informatics is perhaps one the most standardised and rich in the area of interoperability and integration.

The existence of these resources enables the possibility to use ontologies towards semantic reasoning and to further enhance the interoperability and integrations processes within healthcare. Although some technological advances such as HL7 version 3 already aim to introduce semantic and conceptual notion of interoperability, their implementation is far from being disseminated and their relational models are not a pure reflection of existing ontologies such as the Unified Medical Language.

The following proposal presents a line of research that aims to use intelligent systems in order to overcome some of the previously mentioned limitation that are shed into light with current research and needs found directly in the field. Henceforth it aims to propose and validate methodologies as an prototype is developed towards the introduction of intelligent behaviours in healthcare multi-agent systems.

The grand objective of this work is to explore the limits of intelligent behaviours in multi-agent systems, when applied to interoperability in healthcare environments. This study is henceforth an application of existing AI algorithms to practical problems found within the healthcare industry.

Although multi-agent systems are already fairly and successfully used in healthcare interoperability, their level of interoperation and intelligence is still rather low. Communications between existing agents or systems are considerably flavoured according to the communication context, even when following standards such as HL7. The recent advances in medical ontologies and general ontology tools aimed for multi-agent systems enables an easier introduction of semantic interoperability, which is one of the direst needs for an high interoperability



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level.

Henceforth this objective centres in two basilar lines of thought:

- the discovery of archetypes and models for intelligent behaviours in healthcare interoperability, aiming to improve the availability, reliability, time response and quality of the information exchanged;
- explore the limits and evaluate the application of ontologies to agent communication language versus existing medical interoperability standards, towards greater levels of interoperability;

The underlying research will feed and drive the process of development, while research will be driven by both academic valour and industry's needs. In fact, this research opportunity derives mainly from important synergies with several healthcare institutions, which are presently using our platform for interoperation. The existing limitations leave a large margin of improvement regarding existing paradigms of the multi-agent based interoperation, and a potential to validate the research results in a large production environment (Machado, 2009).

The ongoing interoperation procedures using this platform will serve as development basis and will produce feedback and evaluation data for analysis of the selected interoperation techniques and studies improvements. Bearing in mind the objectives and expected derivables associated to the requirements of the healthcare industry, and the underlying aspect of knowledge and technological transference, the methodological strategy is clearly towards action research. In fact, the main orientation of this research is directed at the intervention over the object of study, and evaluation of the impact of this intervention based on inductive and deductive analysis of captured feedback (e.g.: monitoring logs, maintenance logs, activity logs, error logs).

This work implicated extending a currently mainstream and stable agent framework denominated Java Agent Development Framework, with a new core agents management module. This module is intended to test the addition of intelligent core behaviour of monitorization and mobility to the agents within the environment in order to improve the overall system reliability and scalability.

Other modules were developed in order to easily implement easy monitorisation, consistent information persistence and interoperation procedures that could be easily evocated and used by the agents.

This system was implemented in the Oporto Hospital Center in some interoperability projects with external service providers. The results were analysed and changes to the overall archetype are being developed at the moment.

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**MIGUEL MIRANDA** is currently pursuing doctoral studies in Biomedical Engineering in the area of Medical Informatics, at the University of Minho. His interests focused on healthcare interoperability, multiagent systems, intelligent systems and ontology usage. Before, he had also graduated with a master degree in Biomedical Engineering at the same university with a dissertation on decision support systems for cancer staging. His e-mail address is : [miranda@di.uminho.pt](mailto:miranda@di.uminho.pt).