

Chapter 2

An Ontology Driven Multi-Agent Approach to Integrated e-Health Systems

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ABSTRACT

One aim of an integrated e-Health system is to improve the quality of healthcare by providing transparent access to patient information. The current health information management environment has numerous systems with varying techniques for representing and managing patient data. The increasing mobility of patients results in patient information being spread across these systems. Presented in this paper is a conceptual architecture for the interoperability of e-Health systems. This architecture uses multiple cooperating software agents that actively access, recognize, and associate the information in distributed, heterogeneous e-health systems. Using a layered ontology structure we show how ontology based multi-agent systems can be used to resolve discrepancies in terminology and/or structure. This involves a case study in a distributed Electronic Health Record (EHR) environment.

1 INTRODUCTION

Increases in the quality of patient healthcare are dependent on transparent access to distributed patient information. The current healthcare industry finds healthcare consumers exercising their freedom to visit any number of healthcare providers who adopt Electronic Health Care (EHC) systems that does not coordinate with other providers (Rand Corp., 2005). During each episode of care, an addition or a modification is made to the Electronic Health Record (EHR) that is stored with the respective healthcare providers. The quality of service provided by a healthcare provider is intrinsically dependent on the availability and the interoperability of this distributed patient health information (Katehakis, 2001). In a clinical setting, each healthcare provider should be able to browse and query the patient's healthcare record, irrespective of the locality or format of the EHR. Information held within these various EHRs may allow the healthcare provider to make a more informed diagnosis or recognize potential adverse drug interactions.

While there is an obvious need to share and exchange health information, lack of standards and coordination between different health information systems have resulted in isolated islands of information. Healthcare providers need to be presented with a unified view of a patient's medical record, transparent from its distributed nature.

Our paper mainly addresses semantic interoperability amongst these e-Health systems based on a new approach called Ontology-Based Multi-Agent Systems (OBMAS). The focus will be on the layered ontology approach rather than the agent platform itself. The paper starts with a brief background and motivations to deal with interoperability problems in view of the complexity of healthcare information systems. This is followed by a discussion of our OBMAS conceptual model. A description of the layered ontology system design for the development of healthcare information systems based on OBMAS

paradigm is then presented. The interoperability through layered ontology structure is illustrated with a case study in healthcare.

2 BACKGROUND

This section presents a brief background on both the current standardisations of e-health systems as well as a basis for the Ontology-Based Multi-Agent System framework.

2.1 Standardisation

Heterogeneity is a product of the intrinsic differences between healthcare providers. Since healthcare providers have a particular focus in service provision, their E-Health systems are similarly designed. For instance, a pharmacist may need only to store information on prescriptions, while a physician would store medical histories as well. Furthermore, the healthcare domain is always evolving, reflecting new treatments and guidelines. Diabetes diagnostic tests, for instance, have evolved from testing for the presence of glucose in urine, to measuring blood glucose levels, to the glycosylated haemoglobin A1c test. The results of each test have different thresholds and units, requiring an individually specific structure and schema to store (Ganguly, 2005). As such, E-Health systems that adopt a new standard due to an update in both structure and schema for its data will be substantially different to E-Health systems that still adhere to old standards.

The ultimate aim in E-Health systems is to allow two healthcare providers to exchange patient health information seamlessly. One approach involves restricting E-Health systems to a standardised format or schema such as MML (<http://www.medxml.net/>), thus enabling interoperability with any supporting Clinical Computing Systems (CCS). This can be quite restrictive in terms of both implementation and extensibility of those

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