

TICSA Approach: Five Important Aspects of Multi-agent Systems

Maja Hadzic, Elizabeth Chang

Digital Ecosystems and Business Intelligence Institute, Curtin University of Technology
GPO Box U1987, Perth 6845, Australia

{m.hadzic, a.sidhu, t.dillon}@curtin.edu.au

Abstract. The issues of distributed and heterogeneous information, lack an underlying knowledge base, autonomy of the information resources, dynamic nature of the information retrieval process and dramatically increase of the available information are major factors hindering efficient and effective use of the available information. In this paper we explain the importance of multi-agent systems in addressing these issues effectively and illustrate this on an example of multi-agent system designed to intelligently retrieve human disease information. We also present a conceptual framework (TICSA) which focuses on the five different aspects of multi-agent systems namely, agent Types, Intelligence, Collaboration, Security and Assembly. This framework can be used to provide insight and guidance during the multi-agents systems design.

Keywords: multi-agent system, multi-agent system design, human diseases, information retrieval, biomedical information systems.

1 Introduction

Agents are intelligent programmes used for perform various actions. They can answer queries, retrieve information, make decisions and communicate with computer systems, other agents or users. Agents are capable to perform their actions autonomously and are sociable, reactive and proactive in an information environment [1]. The main features of agents are their autonomous, intelligent, mobile, cooperative and collaborative capabilities. The main operations of a multi-agent system are based on effort of collaborative working agents; different types of agents are working cooperatively towards a shared goal. The multi-agents systems greatly contribute to the design and implementation of complex biomedical information systems.

Effective implementation of multi-agent systems within biomedical domain could result in a revolutionary change that will positively transform the existing biomedical system. The main issues hindering effective use of the available information include [2]:

1. size of the available information
2. autonomous, distributed and heterogeneous nature of the information resources, and
3. lack of tools to analyse the available information and derive useful knowledge from it.

The users are faced with additional difficulties which include [2,3]:

- a) rapid increase of medical information (new papers or journals are being published with a high rate)
- b) inconsistent structures of the available information (as a result of autonomy of information resources)
- c) related, overlapping and semi-complementary information
- d) existence of complex diseases e.g. mental illnesses or diabetes. The complex diseases are caused by a number of genes usually interacting with various environmental factors [4].

In this paper we propose multi-agent systems as a solution to those problems. Related work is discussed in Section 2. In Section 3, we discuss the design of multi-agent systems used to intelligently retrieve information about human diseases. Each subsections of the Section 3 correspond with a specific aspect of the TICSAs generic conceptual framework that can be used to guide the system design. We give our final remarks in Section 4.

2 State of play

Multi-agent systems are being used more and more in the medical domain. Some of these agent-based systems are designed to use information within specific medical and health organizations, others use information from Internet.

The information available to organization-based systems is limited to a specific institution and these multi-agent systems help the management of the already available information. They do not have a purpose of gaining new knowledge regarding the disease in question. For example, Agent Cities [5] is a multi-agent system composed of agents that provide medical services. The multi-agent system contains agents that allow the user to search for medical centres satisfying a given set of requirements, to access his/her medical record or to make a booking to be visited by a particular kind of doctor. AACare [6] agent architecture is a decision support system for physicians. It connects patient's records with the predefined domain knowledge such as knowledge regarding a specific disease, a knowledge base of clinical management plans, a database of patient records etc. MAMIS [7] is a Multi-Agent Medical Information System facilitates patient information search and provides ubiquitous information access to physicians and health professionals.

Other multi-agent systems retrieve information from the Internet. BioAgent [8] is a mobile agent system where an agent is associated to the given task and it travels among multiple locations and at each location performs its mission. At the end of the trip, an information integration procedure takes place before the answer is deployed to the user. Hologic Medical Diagnostic System [9] architecture is a medical diagnostic system that combines the advantages of the hologic paradigm, multi-agent system technology and swarm intelligence in order to realize Internet-based diagnostic system for diseases. All necessary/available medical information about a patient is kept in exactly one comprehensive computer readable patient record called computer readable patient pattern (CRPP) and is processed by the agents of the hocracy. Different web crawling agents [10] have been designed to fetch information about diseases when given information about genes that when mutated may cause these diseases.

The importance of use of the multi-agent system within a specific institution such as hospital or a medical centre is great. In this project we focus on a different level of contribution, namely, on making a channel through which newly available and valid information from the research arena will flow into the medical practice to be effectively implemented there. Lots of the information is available but due to the large body of information some important information may escape the users notice and be neglected.

