

Chapter 2.17

Enabling Distributed Cognitive Collaborations on the Semantic Web

Amna Basharat

National University of Computer and Emerging Sciences, Pakistan

Gabriella Spinelli

Brunel University, UK

ABSTRACT

To date research on improving the state of multi-agent collaboration has only focused on the provision of grounding tools, technologies, protocols, standards and infrastructures that drive the Semantic Web and agent architectures. The basic cognitive and interactional requirements of agents have been neglected leading to the current state-of-the-art development of the Semantic Web whereby its full potential is constrained by the rigid state of multi-agent collaboration. This chapter illustrates and discusses an alternative approach to the development of the agent mediated Semantic Web. The fundamental premise of our approach is that enhancing agents cognitive and interactional abilities is the key to make the digital world of agents more flexible and adaptive in its role to facilitate distributed collaboration. The novelty of this research is that it adapts cognitive models from HCI to develop a heuristic frame-

work called Cognitive Modelling of Multi-Agent Action (COMMAA) for modeling agents' actions in an attempt to provide an architecture that improves the flexibility of Multi-agent interaction by promoting cognitive awareness. The results of the evaluation show an improved flexibility, interoperability and reusability of agents' collective behaviours and goals.

INTRODUCTION

Agents may be autonomous and intelligent entities which typically operate in distributed collaborative environments called Multi-Agent Systems (MAS) which allows multiple heterogeneous agents to collaborate by engaging in flexible, high-level interactions (Wooldridge, 2002; Jennings 2000). Presently, the usability of agent-based applications in a Semantic Web environment is limited due to lack of flexibility in agent's collaboration

with multiple agents including humans. This imposes constraints on the interoperability and reusability of agents' behaviour that operate in MAS environment. In addition, the inflexibility of the agents' behaviour does not provide direct mapping to the end user since the end user cannot predict how the agent will behave, thus generating cognitive overload on humans. To date, research on improving the state of multi-agent collaboration has only focused on the provision of grounding tools, technologies, protocols, standards and infrastructures that drive the Semantic Web and agent architectures. Neglect of basic cognitive and interactional requirements are discovered to be the basic reasons for the rigid state of multi-agent collaboration constraining its full potential.

This research presented in this chapter adapts a distributed cognitive view of the agent mediated Semantic Web and argues that enhancing cognition is the key to make the digital world of agents more flexible and adaptive in its role to facilitate distributed collaboration. To this end, work on imparting cognition to improve interaction between multiple agents has been limited. The novelty of this research is that it adapts cognitive models from HCI to develop a heuristic modelling framework for COgnitive Modelling of Multi-Agent Actions (COMMAA) in an attempt to provide an architecture that improves the flexibility of Multi-agent interaction by promoting cognitive awareness. The highlight of the framework is that it identifies architectural and knowledge-based requirements for agents to structure ontological models for cognitive profiling in order to increase cognitive awareness between themselves, which in turn promotes flexibility, reusability and predictability of agent behaviour. The ultimate aim is towards applications which advocate user-centeredness such that as little cognitive overload is incurred on humans. The Semantic Web is used as an action mediating space, where shared knowledge base in the form of ontological models provides affordances for improving cognitive awareness.

Based on the rationale and concerns described above, the objectives and a brief outline of the chapter presented in the next section.

OBJECTIVES OF THE CHAPTER

The following chapter will serve the following aims and objectives:

- Delineate upon the current limitations in the state of multi-agent collaboration in order to elaborate the rationale, need and the synergistic role of cognitive dimension to the Semantic Web with particular regard to distributed collaborations amongst agents
- Describe the conceptual constituents of a theoretical framework called Cognitive Model of Multi-Agent Action (COMMAA) derived from cognitive models in HCI to improve the state of multi-agent collaboration
- Detail upon the Design and Implementation of Semantic Representational and Ontological Models based on the theoretical principles of COMMAA that allow cognitive processing of an agents action using state of the art Semantic Web technologies
- Describe heuristic reasoning mechanisms that can be derived from cognitive models to enhance the cognition of Semantic Web agents
- Analyze and discuss the impact of using COMMAA to model multi-agent collaborative applications on the Semantic Web

BACKGROUND

The Semantic Web vision of Berners Lee (2001) has enabled the Web applications to move from a purely human user community towards a mixed user community consisting of humans as well as of software agents. This imposes certain challenges

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