Building Norms-Adaptable Agents from Potential Norms Detection Technique (PNDT)

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ABSTRACT

This paper presents a contribution to research on norms detection by proposing a technique, which is called the Potential Norms Detection Technique (PNDT). The literature proposes that an agent changes or updates its norms based on the variables of the local environment and the amount of thinking about its behaviour. Consequently, any changes on these two variables cause the agent to use the PNDT to update the norms in complying with the domain’s normative protocol. This technique enables an agent to update its norms even in the absence of sanctions from a third-party enforcement authority as found in some work, which entail sanctions by a third-party to detect and identify the norms. The PNDT consists of five components: agent’s belief base; observation process; Potential Norms Mining Algorithm (PNMA) to detect the potential norms and identify the normative protocol; verification process, which verifies the detected potential norms; and updating process, which updates the agent’s belief base with new normative protocol. The authors then demonstrate the operation of the algorithm by testing it on a typical scenario and analyse the results on several issues.

Keywords: Intelligent Software Agent, Normative Protocol Normative System, Norms Change, Norms Detection, Norms Mining

1. INTRODUCTION

Recently, numerous models on multi-agent systems have been investigated and this includes norms in agent architectures (Broersen et al., 2001; Sadri et al., 2007; Ahmad et al., 2011). The concepts of norms and normative systems are used to determine the behaviours of agents within a society and are generally accepted as efficient means to normalize their behaviours (Alberti et al., 2011).

The Webster’s Dictionary defines a norm as “a principle of right of action binding upon the members of a group and serving to guide,
control, or regulate proper and acceptable behaviour” (www.webster.com). Hexmoor et al. (2006) suggested that “a norm has different definitions in different areas of study such as social science, game theory, psychology and legal theory”. Hollander and Wu (2011) studied the use of norms for different purposes such as to indicate constraints on behaviour (Shoham & Tennenholtz 1992), to serve as obligatory actions (Verhagen, 2000), to act as regulatory or control devices for decentralized systems (Savarimuthu et al., 2008), and to create solutions to a macro level problem (Zhang & Leezer, 2009). Boella et al. (2008) defined a normative multi-agent system as “a system organized by means of mechanisms to represent, communicate, distribute, detect, create, modify, and enforce norms, and to deliberate about norms and detect norm violation and fulfilment”. In many normative multi-agent systems, norms are considered as constraints on behaviour (Hexmoor et al., 2006).

We define a normative protocol as a set of executable norms that are applied to some multi-agent communities (Mahmoud et al., 2012). Savarimuthu et al. (2010b) defined the normative protocol as “the order of occurrence of events or protocols that are related to a set of norms”. For example, arrive, order, eat, pay, tip and depart is a normative protocol for dining in a restaurant.

The underlying norms are driven by injunctive norms, which refer to people’s beliefs about what have to be done (Cialdini et al., 1990) and descriptive norms, which refer to beliefs about what is really done by majority in one’s social group (Lapinski & Rimal, 2005). This could be exemplified by a formal meeting, in which a majority of the attendees are silent and attentive (descriptive norms), so much so that others act in a similar manner fearing the incurrence of social sanctions such as frowning or given silent gestures if they do not comply (injunctive norms) (Lapinski & Rimal, 2005).

Villatoro et al. (2010) classified norms on two different types, which are conventions or conventional norms and essential norms. Conventions are natural norms that emerge without any enforcement. Young (1993) defined conventions as “a pattern of behaviour that is customary, expected, and self-enforcing. Everyone conforms, everyone expects others to conform, and everyone wants to conform given that everyone else conforms”. Conventions fix one norm amongst a set of norms which is always efficient as long as each one in the community employs the same norm i.e. greetings, driving side of the road (Villatoro, 2011). Essential norms solve or ease collective action problems when there is a conflict between an individual and the collective interests (Villatoro et al., 2010, 2011). For example, “the norm not to pollute urban streets is essential in that it requires individuals to transport their trash, rather than dispose of it on the spot, an act that benefits everyone” (Piskorski et al., 2011).

To motivate an agent to comply with the domain’s norms, the norms are enforced by sanctions. Normally, a third-party enforcement agent is given the ability and authority to implement the sanctions (Grossi et al., 2010). In addition, it deters an agent from directly getting involved in norms violations (Perreau et al., 2010). But non-compliant norms could also trigger emotions of shame or guilt in an agent even when a third-party enforcement is absent (Elster, 1999). This fact is especially valid in large-scale communities, where it may be difficult to monitor compliance to equilibrium behaviour (Young, 2008).

Norms can be imposed by a third-party enforcement which requires the presence of an authorised agent to penalize violations to norms. However, most current studies on norms detection exploit exceptional events, specifically those events that entail rewards or penalties to identify the norms (Centeno et al., 2010; Centeno & Billhardt, 2012; Savarimuthu et al., 2010a, 2010b; Campos et al., 2010; Andrighetto et al., 2007). But what if the authorised agent is not available and the exceptional events (reward and penalty) are absent? Consequently, in this paper, we focus on developing a technique based on self-enforcement that enables an agent to detect a domain’s norms in the absence of a third-party enforcement. To do so, an agent
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