Soft Computing Approaches for Human-Autonomous Agent Communication

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ABSTRACT

This paper describes soft computing approaches for human-agent communications in the context of influencing decision making behavior. Several methods are illustrated including using a person’s predispositions and generalization techniques that allow issues to be viewed in a more favorable light with social interaction persuasion tendencies modeled with soft computing. The context of a robotic assistant for the elderly is used to illustrate the various communication techniques. Finally the related topic of negotiations using some the developed techniques is presented.

Keywords: Communication, Human-Agent Communications, Human-Autonomous Agent, Social Interaction, Soft Computing

1. INTRODUCTION

Many environments and situations will come to consist more and more of a combination of humans and non-human autonomous agents. This paper will describe how soft computing approaches support the development of tools and formal mathematical concepts to enable the communication and coordination between these various heterogeneous components (Lin & Kraus, 2010).

An important issue that arises with such heterogeneous entities is the need to provide a common understanding of shared information, situation assessments and the goals and tasks of the specific environment. The problem is particularly acute between the human and the non-human components as they essentially employ differing communication modalities. We show how some approaches utilizing fuzzy sets and the related theory of approximate reasoning can play an important role in helping solve this problem by providing a bridge between the types of linguistic expression and cognition that human beings use with the types of formal mathematical representations needed for the

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digitally based autonomous agents. In particular some of the common linguistic aspects of social situational behavior can be represented by soft computing techniques and utilized in persuasive communication. To illustrate these issues we focus on the future use of robotic assistants for elder care (Matsusaka, Tojo, & Kobayashi, 2003; Fischer, 2010; Yamazaki, Yamazaki, Burdelski, Kuno, & Fukushima, 2010)

2. BACKGROUND

2.1. Robotic Elder Care

Robotic aids for the disabled and elderly is a growing area of research (Goth, 2011). This is strongly motivated by the rapidly increasing population in this age group. Japan has several active research programs (Severinson-Eklundh, Green, & Huutenrauch, 2003; Kanda, Nabe, Hiraki, Ishiguro, & Hagita, 2008) as 22% of their population is 65 or older and quickly expanding in the coming decades. In the United States the National Science Foundation has established the Quality of Life Technology Center at Carnegie Mellon and University of Pittsburgh.

For this paper we will illustrate our approach using a scenario in which a robotic assistant (RA) in the future can provide various forms of assistance in rehabilitation and even daily living requirements of the elderly. Often elderly residents of a nursing home may be somewhat addled or recalcitrant. So it is very important that a robotic assistant be able to communicate to persons with whom they are trying to persuade about issues such as medications or rehab activities. We will show how this communication can be modeled with soft computing techniques and recognize the social aspects of such interactions.

2.2. Context of Social Situations and Persuasion

In describing approaches to persuasion that are used in everyday social interactions, Cialdini (2001) describes basic tendencies of human behavior that come into play in generating a positive response: reciprocation, social validation, liking, authority and scarcity. By reciprocation he means that a norm exists that expects people to repay in kind what they have received including the concessions that people might make to one another. A basic way in which people decide what to do in a situation is to pay attention others are doing which is known as social validation. If many persons are seen as being in favor of a particular idea, others are more likely to follow, since they see this as being more correct or valid. The idea of liking can be captured in words such as “affinity,” “rapport” and “affection” all of which describe a feeling of connection between people since they tend to agree with people they like. Another aspect of liking that can lend itself to agreement is some sort of similarity such as having gone to the same school or from the same city. Authority is very commonly used where an expert or authority figure that is respected such as a physician lends credibility to a statement or position. Finally scarcity often effects decisions. Statements such as “only a few remaining” or “limited time offer” influence actions and decisions.

In this paper we discuss soft computing approaches that can support these sorts of social persuasions in the framework of a problem of trying to influence a person’s decisions by the manner in which relevant linguistic information is presented to them. In Section 3 of the paper, we show that linguistic information expressed in a statement such as \( S = B \) may be useful in helping to persuade a person perform a certain action or infer a desired related statement \( S = A \). Often, as we shall see, this is accomplished by using the person’s predispositions. So consider trying to convince someone to make a purchase by using the idea of scarcity. A valid statement that might be made is \( S = \text{“only a few items are left,”} \) where the validity of \( S \) depends on the interpretation of the soft linguistic term “few.” Here of course if a person is somewhat predisposed to want the item, they will interpret the term “few” in a way that will increase their anxiety about the possibility of not being able to get the item if they do not rapidly move toward the purchase.
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