

Agent-mediated architecture for reputation-based electronic tourism systems: A neural network approach

Qing Cao^a, Marc J. Schniederjans^{b,*}

^a *University of Missouri-Kansas City, Henry W. Bloch School of Business and Public Administration,
5100 Rockhill Road, Kansas City, MO 64110-2499, United States*

^b *University of Nebraska-Lincoln, College of Business Administration, Lincoln, NE 68588-0491, United States*

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Abstract

Agent technology can be used in searching and selecting a good e-tourism system. However, most such systems focus mainly on price and avoid important purchasing decision-making factors such as quality and reputation. Here we define a reputation-based architecture for an e-tourism system that we have called ‘reputation-based electronic tourism’ (RET). An artificial neural network model was created for a reputation agent to evaluate capabilities for selecting products and services in an e-tourism setting. The classification performance of the model was compared to another method. The results indicated that RET could outperform and be more accurate in classifying perspective products and services for consumers.

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1. Introduction

Since the first tourism website was launched, e-tourism has been one of the fastest growing segments of electronic commerce. In 2005, online tourism transactions jumped to \$32.4 billion from only \$8.6 billion in 1999, leading all other categories in electronic transactions [18]. To support this dramatic increase in business, e-tourism utilizes advanced technologies. One of the most promising technologies for development of electronic commerce is *agent technology*. It has been used in e-tourism and other e-commerce where a personalized, continuously running, autonomous behavior is desirable [11,29]. Agents can be defined as active

objects with special properties tailored to open environments. In computer science, an intelligent agent (IA) refers to a software component that exhibits some form of AI. While the working of software agents used for operator assistance or data mining (Bots) are often based on fixed pre-programmed rules, the term here implies the ability to adapt and learn. The key aspects of agents are their autonomy and abilities to reason and act in their environment, as well as to interact and communicate with other agents to solve complex problems [15]. Autonomy means that the agent can act without the direct intervention of humans or other agents and that it has control over its own actions and internal state. The agent must communicate with the user or other agents to receive instructions and provide results. An essential quality of an agent is the amount of learned behavior and possible reasoning capacity that it has.

At the basic level, the agent may follow a set of rules predefined by the user. The agent then applies them.

* Corresponding author. Tel.: +1 402 472 6732;
fax: +1 402 472 5855.

E-mail address: Mschniederjans1@unl.edu (M.J. Schniederjans).

The intelligent agent will learn and be able to adapt to the environment in terms of user requests consistent with the available resources [24]. Agent technology is playing an increasingly important role in the development of e-tourism, transforming systems from online brochures to advanced systems with innovative services. Software agents are catalysts for commerce on the Web, with the ultimate goal of agents to accelerate the evolution of the Web from a passive, static medium to a highly interactive environment.

Multiple agent system (MAS) may be formed by agents interacting with one another. This is the emerging subfield of distributed AI that tries to provide complex systems of multiple agents and mechanisms for coordinating their behavior [4,30]. In a MAS, a multitude of asynchronous and loosely coupled agents together solve problems, that are beyond the capacity of a single agent.

Currently agent-based e-tourism systems have employed software agents in some stages of consumer buying behavior, such as searching for information, communicating with vendors, and, in cases like *Expedia* [9] and *Priceline* [26], making purchase decisions for consumers.

However, the application of agent technology has limitations. Although tourism services produce more revenue than any other product, only about 5% of customers browsing the largest online tourism service sites actually purchase tickets online and use the service [28]. Another shortcoming is that most systems focus only on price and leave out important purchasing decision-making factors, such as the service and product quality and company reputation. Empirical studies have indicated that such factors determine many Internet purchasing decisions. To improve consumer e-tourism purchases, agent-mediated e-tourism systems should therefore be able to provide capabilities for consumers to evaluate and choose vendors based on multiple criteria.

We have therefore proposed a *reputation-based electronic tourism* (RET) approach that assesses and selects vendors on the behavior of consumers based on multiple criteria. It uses an artificial intelligence-based model (see Appendix A).

2. Related work

2.1. E-tourism

E-tourism involves the buying and selling of tourism products and services via electronic channels, such as the Internet, cable TV, etc. Most tourism products (e.g.,

hotel rooms or flight tickets) are time-constrained and non-stockable. As such, it is necessary for tourism vendors to distribute their products and services in a wide-reaching market where the customers have easy access. As a consumer-centric industry where information plays an important role, e-tourism fits well with the Internet. E-tourism falls into the category of E-retailing which is a special type of e-commerce business model [14]. By the end of year 2005, more than 700 online tourism websites were in operation. According to a recent report by Smith Travel Research (2005), e-tourism represented 25.4% of the total lodging industry revenues (\$113.7 billion) in the US alone. More recently however [13] claimed that the true size of the e-tourism market was substantially larger, since current e-tourism research focuses only on the marketing of tourism and hospitality operations online.

2.2. Intelligent agents and multiple agent systems

Intelligent agents are software agents or entities. They have four well accepted properties that distinguish them from other traditional approaches [16]: characteristics-autonomy (they operate without direct intervention), social ability (they, interact with other agents or humans), reactivity (they respond to the environment in a timely fashion), and pro-activeness (they exhibit goal-directed behavior). These allow agent-based systems to act semi-autonomously, giving agents an important role in the information-rich environment of e-commerce. As argued in [3] there is a strong affinity between the Web and the capability of agents to act through software.

Agent technology has received a great deal of attention over the last decade. Some of the more recent frameworks include JADE [1], ZEUS [23], and JACK [12]. Standards for agent communication have been proposed, the *knowledge query and manipulation language* [10].

More recently, MAS have gained popularity in IA research [4]. They may have several characteristics: each agent has as a limited viewpoint, there is no global system control, data is decentralized, and computation is asynchronous. These provide the benefits of robustness and efficiency, allowing inter-operation of existing legacy systems and solving problems in which data, expertise, or control is distributed.

2.3. Agent applications in electronic commerce

The “consumer buying behavior” (CBB) model presented in [21] had six stages of consumer buying

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