Software Agents in E–Commerce Systems

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INTRODUCTION

The Internet introduces a new global marketplace for a large number of relatively unknown and often small companies often offering substitutive or complimentary products and services. The merchants profit from reduced costs, reduced time, and unsold stocks. Customers are attracted by increasing convenience and fast fulfillment.

Merchants offering these products and services on this new marketplace need to acquire new customers and sustain ongoing relationships. Nowadays, most merchants' sites are passive catalogs of products and prices with mechanisms for orders (Dasgupta et al., 1998). The pull strategy is also applied in auctions available over the Internet, where the seller waits passively for bids. The new push technologies for electronic commerce, like software agents, enable customers to compare a bewildering array of products efficiently, effectively, and automatically (Jennings et al., 1998). Switching costs for customers and, thereby, their loyalty to previous suppliers in the marketplace decline.

Using the Internet, the producers profit from reduced cost through direct, non-intermediated sales. The key elements to successful long-term relationships between merchants and customers will be the offering of personalized and value-added services, like one-to-one marketing services, discounts, guarantees, and savings coupons (Seitz et al., 2002, p. 209).

In this article, we will analyze possible consequences of new push and pull technologies in electronic commerce for customers' loyalty. The active technologies enable customers to purchase efficiently and the merchants to offer highly personalized, value added, and complimentary products and services. We will discuss some examples of such services and personalization techniques sustaining one-to-one relationships with customers and other actors involved.

BACKGROUND

The World Wide Web provides a great opportunity to compare products and services. Customers as well as competitors may quickly gain detailed and up-to-date data. Especially, suppliers of digital goods are in fear of declining customers' loyalty. Customers compare catalogs of products of merchants and producers, and conduct transactions independently of their geographic localization. The crucial basic factors responsible for a limited loyalty of customers are convenience, time, and cost of fulfillment. So, an electronic commerce system should support the ability to embed intelligence to automate the decision process (Dasgupta et al., 1998). The system should not only compare products and prices, but also negotiate and finally purchase products (Teuteberg & Kurbel, 2002). Nowadays, most systems still involve a substantial human element that is from the consumer's perspective neither convenient nor efficient. The human involvement should be limited to transaction specification at the beginning of the process and to the buying or refusal decision at the end of the process (Chen, 2000). This means that an appropriate technology is necessary in the intermediate stages to coordinate between customers and suppliers (d'Inverno & Luck, 2003). Mobile software agents emerge as ideal mediators in electronic commerce and thereby as an appropriate technology for an automated procurement process. Customers may specify constraints on the features of products that enable mobile agents to select products from the merchant's catalogs and finally to determine the terms of the transaction. Otherwise, software agents may be used by suppliers as market surveyors to determine the current demand and an appropriate price for the good. Software agent technology also abolishes the problem of different technological standards, like hardware platforms and operating systems of remote computers. This means that geographical or technological barriers for customers are of no significant importance anymore. The key factors are convenience, time and cost of the procurement process.

AGENT MEDIATED ELECTRONIC COMMERCE

Software agents are computer programs showing the following characteristics (Joshi & Ramesh, 1998):

- Reactivity: Agent perceives and reacts to environmental changes.

- Autonomy: Agent has its own program code, data and execution state.
- Proactivity: Agent initiates changes to the environment.

The ability of an agent to travel around in networks enhances it to a mobile agent (Brenner, Zarnekow & Wittig, 1998). Mobile software agents may be classified based on their attributes, like mobility, type of cooperation and level of interactivity (see Figure 1) (Joshi & Ramesh, 1998). For further possible classifications see, for example, Nwana (1996), Sycara et al. (1996) or Kurbel and Loutchko (2001).

Competitive agents, mostly single-agents, maximize the interests of their owners. Collaborative agents, on the contrary, share their knowledge and try to maximize benefits of the community on the whole (Joshi & Ramesh, 1998). Mobile agents differ also in terms of the ease of the mobility between remote computers. A continuously traveling nomadic agent, like mobile sales agents (containing information of the total quantity of the product to be sold, the initial price of the product and the list of potential customers to visit), arrives at a customer's site and communicates with a stationary customer agent, which determines the quantity to be purchased at a given price (Dasgupta et al., 1998). The customer agent uses market values and demand curves of the product for its decision. The sales agent has to adjust the price dynamically during negotiations in order to maximize the gross returns. The price for the product may not be settled too low (an agent sells all of his stock at a bargain price) or too high (a given quantity of the goods may be unsold). Such a supplier-driven electronic commerce system enables merchants to maximize their gross return, but also to identify quickly the customers' needs and finally to cultivate long-term relationships with them. The architecture of the supplier-driven system was presented by Dasgupta et al. (1998).
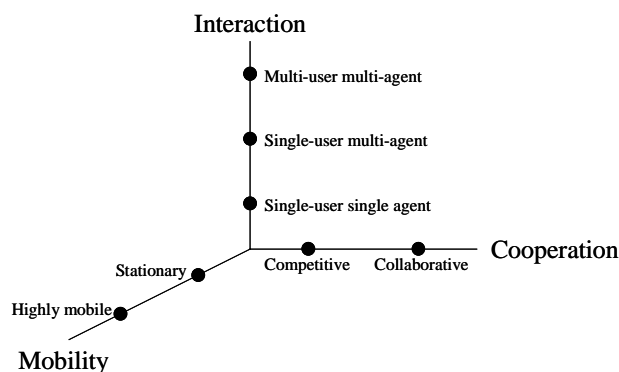
From a customer's perspective, software agents should be highly personalized, continuously-running and autonomous mediators, that have to delegate some process management tasks (Guttman et al., 1998). A software agent should identify customers' needs at first, then retrieve information about the product from the merchants' sites, compare the offers and finally determine the terms of the transaction (Castro-Schez et al., 2004). Nowadays, customer agents are mostly used for product and merchant brokerage and for negotiation (Guttman et al., 1998).

The price of a product may also be dynamically negotiated instead of being fixed. For example, tête-à-tête agents cooperatively negotiate multiple terms of a transaction, like warranties, return policies, delivery times, and loan options (Guttman et al., 1998). The buyer agent in a tête-à-tête system negotiates towards a pareto-optimal deal with the sales agent (Fatima et al., 2004). A system like this does not maximize gross returns to suppliers or price discounts for customers (Excelente-Toledo & Jennings, 2004; Rahwan et al., 2004). However, it takes into consideration the important value-added merchant's services.

Summarizing, software agents are helping customers to compare and to purchase goods on the Internet. Most of them are agents for a simple online product price comparison or for competitive negotiation over price without considering the value-added and post-purchase services from merchants. Such agents decrease customers' loyalty to a merchant towards zero. However, additional services, like guarantees, return policies, loans, gifts, discounts and insurance are of interest to customers. Therefore, they should rather use agents for comparing or negotiation over multiple terms of a transaction (tête-à-tête). Otherwise, merchants may also send their own sales agents to potential buyers in order to acquire new customers and remind the previous customers of new sales offerings (Dutta et al., 2003).

FUTURE TRENDS

In general, software agents helping customers in the procurement process may minimize their loyalty to merchants. Suppliers who do not want to compete solely on the basis of price provide their customers with highly personalized and value-added services to sustain a long-term relationship.

Personalization and Privacy

Personalization is defined as the customization of a Web site to meet the particular needs of individual users (Chaffey et al., 2000; Dean, 1998). The goal of personaliza-

Figure 1. Classification of software agents (Joshi & Ramesh, 1998).

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