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On the formulation of competitive negotiations in Web applications: The Latin-American market case

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ABSTRACT

Work on electronic negotiation has motivated the development of systems with strategies specifically designed to establish protocols for buying and selling goods on the Web. On the one hand, there are systems where agents interact with users through dialogues and animations, helping them to find products while learning from their preferences to plan future transactions. On the other hand, there are systems that employ knowledge-bases to determine the context of the interactions and to define the boundaries inherently established by the e-Commerce. This paper introduces the idea of developing an agent with both capabilities: negotiation and interaction in an e-Commerce application via virtual reality (with a view to apply it in the Latin-American market, where both the technological gap and an inappropriate approach to motivate electronic transactions are important factors). We address these issues by presenting a negotiation strategy that allows the interaction between an intelligent agent and a human consumer with Latin-American idiosyncrasy and by including a graphical agent to assist the user on a virtual basis. We think this may reduce the impact of the gap created by this new technology.

1. Introduction

Automated negotiation is an important type of interaction in systems composed of autonomous agents. We define a negotiation in electronic commerce as *the process by which two or more parties multilaterally bargain resources for mutual intended gain, using an online platform* (Beam & Segev, 1997). Given the agent's ubiquity, such negotiations may exist in many different shapes and forms. We focus on *competitive negotiations* (Agrawal & Chari, 2009) with a *hard exchange strategy* rather than on *cooperative negotiations* or on *double dealing strategies*. This means that there is no trickery or pressure and that the parties voluntarily enter an informed agreement to the exchange, albeit with one of them potentially more satisfied then the other. We assume that conflicts of interests can arise between the parties, so they are always able to choose *no deal* if they do not reach a mutually satisfactory agreement.

This paper introduces the description of a graphical intelligent agent represented by a virtual person (Shen, Radakrishnan, & Georganas, 2002), capable of negotiation (proposing offers and acting on them) in the business-to-consumer (B2C) and e-Commerce transaction models. The agent is also capable of learning user preferences so as to plan future transactions. We use both a formal negotiation protocol that includes a necessary ontology and a defined strategy as well as virtual reality to show an agent representing a real person. We focused our project particularly on the Latin-American market, where both the technological gap and an inappropriate approach to motivate electronic transactions are important factors. We respectfully submit that our new agent should reduce the impact and gap created by commercial technology (Rai & Kim, 2002), making it possible for more and more people to get involved in a new and more accessible way of doing electronic commerce.

2. Behavior of the Latin-American market

The Latin-American market lacks an appropriate tool to perform automated competitive negotiations over the Internet. The way e-Commerce is approached is either static (without using its inherent advantages), or dependent upon methods like auctions – mostly English language auctions – which are not well-suited for the particular Latin-American way of thinking (Kumar, 2000; Steenkamp & ter Hofstede, 2002). This method has not been successfully exploited due to the following reasons:

- Most people do not know exactly the processes followed in an electronic auction.

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- The average Latin-American consumer focuses primarily on the price. Thus, the perception of prices going up instead of going down, due to the extended use of auctions, has a negative impact.
- The fixed closing time in electronic auctions increases the waiting period before an auction winner is declared. The Latin-American consumer does not feel comfortable with waiting to know the outcome of the auction.
- A critical mass of buyers is needed for the auction to work properly; otherwise the reserve price may not be met, leaving the item unsold or underpriced.

These are some of the reasons which suggest that the English language auction model is incompatible with the idiosyncrasies of Latin-American buyers and sellers (Lynch, Kent, & Srinivasan, 2001). This work proposes a negotiation strategy and model based on a "haggling approach" somewhat related to the Dutch auction (Klemperer, 2002). We consider that the Latin-American buyer is more used to such a format and that it can provide the following advantages, among others:

- The buyer uses the same strategy as when he or she shops in real life.
- He or she gets the feeling of bargaining for a lower price because the price always goes down.
- The negotiated agreement can be reached within few minutes.
- The need for a critical mass of buyers is eliminated.

3. The formal model of the agent's domain

The domain is the environment where the interactions between the agent and the users will take place. We use the terminology and notation of set theory to describe all the elements involved and the logic behind their relations (Papadimitriou, 1994).

The environment has a set of states $E = \{e_1; e_2; \cdots\}$, wherein the agent can interact. The agent, on the other hand, has a set of possible actions for each stimulus, defined as $A_c = \{a_1; a_2; \cdots\}$. Based on a set of negotiation rules R and the interactions with the user, the agent chooses an action. This latter comprises the gathering of information that determines which option is most favorable for the user to buy a product.

The visit to the web store (v) can be summarized as a sequence of states and transitions as following (Wooldridge & Dunne, 2001):

$$v : e_{i_0} \xrightarrow{\alpha_{i_0}} e_{i_1} \xrightarrow{\alpha_{i_1}} e_{i_2} \xrightarrow{\alpha_{i_2}} e_{i_3} \xrightarrow{\alpha_{i_3}} \ldots \xrightarrow{\alpha_{i_{n-1}}} e_{i_n}, \quad (1)$$

where each e_{i_j} represents a (possibly different) state and each e_{i_j} represents a (possibly different) action.

Formally, we say an environment Env is a triplet $Env = \{E, \tau, e_0\}$ where E is a set of environment states, τ is a state transformation function represented concisely, and $e_0 \in E$ is the initial state of the visit to the web store. Then the agent is modeled as follows (Russell & Subramanian, 1995):

$$Ag : R \to A_c. \quad (2)$$

As a result, we can finally define the system as a set that comprises both the agent and the environment:

$$Sys = \{Ag, Env\}. \quad (3)$$

With (1)–(3), we can design scenarios for the interactions between the agent and the user. We can also determine the protocol of negotiation and the roles for this negotiation. To enhance the user's perception of the interaction, we separated the steps to be developed into two categories. The first one is the design of an embodied virtual agent that interacts in the virtual system. The second is the agent's negotiation ability: sending and receiving proposals, bargaining, and concession-making to the user. These properties intend to adapt the process to the real Latin-American market's behavior.

4. Negotiation model

Negotiation is a method of dispute resolution. It generally involves a dialogue to promote and motivate an agreement upon mutual courses of action, to bargain for individual or collective advantage, or to reach outcomes that can satisfy various interests. The negotiation can also be observed like a process in which a joint decision is reached by two agents with contradictory demands (de Paula, Ramos, & Ramalho, 2001; Narayanan & Jennings 2005). An agent can be a person, an organization or an intelligent agent. The participants move towards an agreement by means of a process of concessions, in search of new alternatives (Kowalczyk & Bui, 2001). It is important to observe that our proposed negotiation model was used successfully recently by two important firms in Mexico, Compaq and Elektra.

4.1. Definition of negotiation terms

The negotiation mechanism is based on a protocol and a strategy of negotiation. More formally, a negotiation can be represented in the following terms:

(a) The *initial price* (P_{int}) is defined as:

$$P_{int} = f(P_{min}, RP, COMM, LB), \quad (4)$$

where

- P_{min} is the *minimum price*. It is the lowest price at which the store will ever sell the product. It is the clearance price, and is obtained directly from the system database.
- RP is the *regular price*. This is the current market price for the product.
- $COMM$ represents the fees paid by the user of the negotiation system.
- LB represents the buyer's loyalty, a qualification that is granted to the buyer according to his/her consumption record. Its proposed range of value is $0 \leqslant LB \leqslant 0.3$.

The value assigned to P_{int} by the pricing function (4) is not necessarily equal to the market price of the product because it depends on the buyer's loyalty.

(b) The *reserve price* (P_{res}) is defined as follows:

$$P_{int} = f(P_{min}, FSD, LB, FS, COMM), \quad (5)$$

where

- FSD represents a supply-demand factor for the product. It is calculated using the number of items already sold, the quantity of remaining items in stock and the number of remaining days in which the items are expected to be sold.
- FS represents the season-of-the-year factor.

The reserve price (5) is the threshold value for a particular negotiation at which the agent may accept a proposal. It is the lowest price at which the product can be sold in such a particular scenario. It is calculated dynamically for each product and for each client and is influenced by supply and demand factors, buyer's loyalty, etc.

(c) A negotiation round is a complete negotiation cycle. This includes the agent sending a proposal, the buyer receiving it and then making a counteroffer. It can be defined as:

$$Round_i = (ask_i, bid_i) \text{ for } i = 0, 1, \ldots, i_{max}$$

where ask_i represents the agent's proposal at the ith round. bid_i represents the buyer's offer at the ith round. I_{max} is the maximum number of negotiation rounds.