A Decision Support System for Group Buying based on Buyers' Preferences in Electronic Commerce

Tokuro MATSUO and Takayuki ITO
Center for Knowledge Science
1-1 Asahidai, Nomi, Tatsunokuchi, Ishikawa 923-1292, JAPAN.
{ t-matsuo, itota} @jaist.ac.jp

ABSTRACT

Group buying is seen as an effective form of electronic commerce. When buyers cooperate with each other, a seller can discount the price of a good. In existing group buying sites, each buyer's preference may not be reflected effectively. We propose a decision support system for group buying based on buyers' preferences. In our system, each buyer's preference is reflected effectively by integrating member preferences by using AHP.

KEYWORDS

multiagent system, group buying, decision support system, electronic commerce, AHP, and MAUT.

1 INTRODUCTION

As the Internet develops it is becoming an increasingly prosperous network for many types of commerce. Group buying has become a particularly effective form of electronic commerce. Group buying is a model in which multiple buyers cooperate and buy a good/service at a discount price [rak]. When buyers can cooperate with each other, a seller can discount the price of a good. Group buying has made rapid progress in recent years, and there are many investigations of group buying [Yamamoto 01]. Furthermore, group buying has become a promising field in which to apply agent technologies.

Existing group buying sites, however, have a problem. Buyers need to compromise in their preferences on the quality of a good in order to buy the good at a discount price. Thus, each buyer in a group cannot purchase a good that satisfies his/her preference. Therefore, each buyer's preference is not reflected effectively enough. To solve this problem we propose a decision support system for group buying. Our system can support group buying in which the users' preferences are reflected when effectively trading.

The rest of the paper is organized as follows. Section 2 gives an outline of our group buying system. In section 3, we propose a new group buying support system and discuss the advantages of our system. In section 4, we present related work. Finally in section 5, we provide some final remarks and an outline of future work.

Table 1: Example of discount rate for group buying

number of goods	price of a good
1-1	$50
2-3	$45
4-6	$40
7-10	$37
11-15	$35
16-	$33

2 OUTLINE OF GROUP BUYING

In our group buying system, many buyers cooperate and goods are sold at a discount price. When buyers can cooperate with each other, a seller can discount the price of a good. For example, one set of a good is sold for $50, a set of two goods is sold for $90, and a set of four goods is sold for $160. If four agents cooperatively make a group, the price of a good is lower than that which is paid by an individual agent.

Table 1 shows an example of group buying as follows. We assume a buyer's evaluation value is $55. When a buyer does not cooperate, a buyer's utility is $55 - $50 = $5 under the assumption of quasi-linear utility. When a buyer cooperates with twenty buyers, a buyer's utility is $55 - $40 = $15.

In current group buying sites, a price of a good is different based on the number of cooperating agents. Strictly speaking, each buyer's preference is not reflected, because buyers cannot select a desired good from multiple substitutes.

3 A DECISION SUPPORT SYSTEM FOR GROUP BUYING

We propose a group buying system based on buyers' preferences. A buyer's preference is shown as a utility function. A utility function consists of multiple independent attributes based on MAUT (Multi Attribute Utility Theory) [Keeney 76] [Shintani 00]. In general, MAUT handles problems in which outcomes are characterized by two or more attributes. For example, purchasing a new car requires consideration of the price, the shape, the color, the type, etc. In MAUT, for an alternative C_i, there exist the attributes X_1, X_2, ..., X_n and their values $x_1(C_i)$, $x_2(C_i)$, ...,$x_n(C_i)$. We can represent the utility $u(C_i)$ for the attribute C_i as

$$u(C_i) = f(f_1(x_1(C_i)), ..., f_n(x_n(C_i))),$$

where f is a certain function. We can select several options with respect to f according to the application area. In our system, we select the AHP(Analytic Hierarchy Process) method[Saaty 80] for calculating a user's utility. Based on the above utility, each agent has a preference. According to von Neumann-Morgenstern, we define an agent's preference as follows: $C_i \succ C_j \iff u(C_i) > u(C_j)$ and $C_i \sim C_j \iff u(C_i) = u(C_j)$. $C_i \succ C_j$ means that the agent prefers C_i to C_j, whereas $C_i \sim C_j$ means that the agent has no preference for C_i or C_j. A user's preference is quantified into a multi attribute utility by using MAUT.

We propose a novel support system for group buying. Figure 1 shows an example of group decision-making in our system. Some substitutes are goods which are displayed in group buying sites. A successful seller is decided by an agent's utility based on AHP. In order to measure a user's subjective multiple

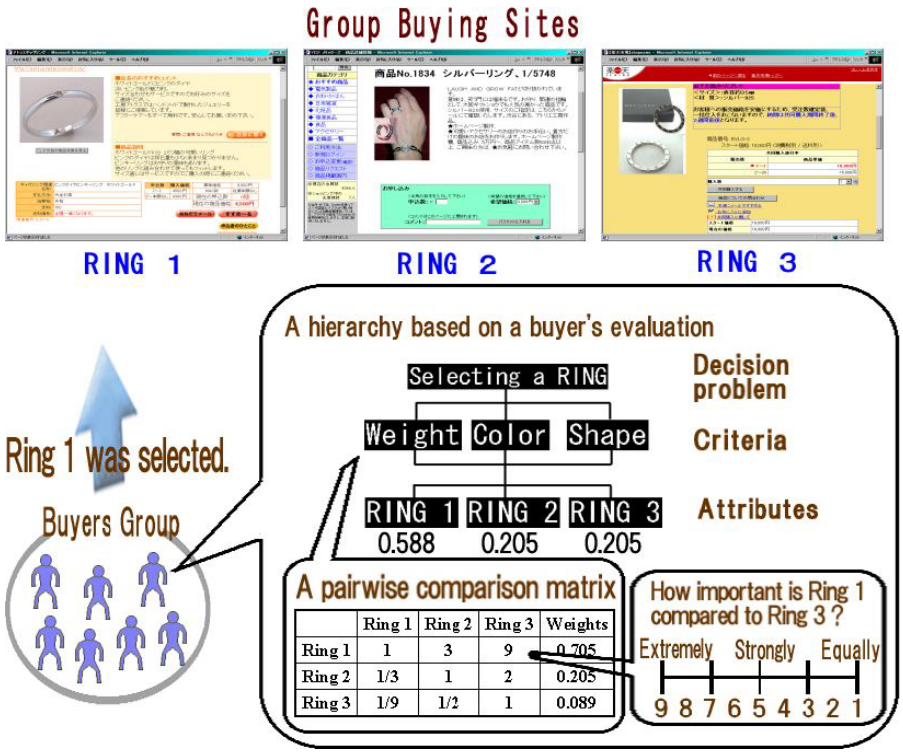

Figure 1: Example of group decision-making in our system

attribute preference, we employ AHP. The AHP enables users to input their preference intuitively and systematically. In general, the method of AHP is appropriate for group decision support. Figure 1 shows a typical hierarchy and a pairwise comparison matrix. In the AHP, users divide the problem into a hierarchy that consists of a goal, criteria, and alternatives. For example, in Figure 1 the goal, the overall objective of selecting a ring, is decomposed into the criteria of *Weight*, *Color*, and *Shape*.

4 RELATED WORK

In game theory, group buying is often discussed in relation to the coalition game. In [Yamamoto 01], stable and efficient coalition formation mechanisms are discussed based on the core. In that case, the problem is how to distribute social surplus. In behavioral theory, the MAUT is discussed as a method for rational choice [Morikawa 00]. We can find research conducted in terms of group decision support systems [Ito 98]. In this research, group decision systems are implemented in Java. Related to this group decision-making about a meeting schedule is supported by using AHP [Shintani 00]. In our previous paper [Matsuo 02], we discussed the effects of designated bids for reverse auctions.

5 CONCLUSION AND FUTURE WORK

In this paper, we proposed a decision support system for group buying. Existing group buying systems have a problem in that each buyer's preference is not reflected effectively enough when trading. Our support system can solve this problems. A user's preference is quantified by using AHP. Our future work will include adapting our group decision support system to the case where seller agents compete in an auction.

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