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Improved Win-Win Quiescent Point Algorithm: A Recommender System Approach

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Abstract: The aim of this study is introducing an online intelligent method for bidding negotiations in e-marketing. The growth and popularity of internet, increases using of modern techniques to help costumers and sellers in choosing best product and achieve higher benefit. Recommender systems as useful mean have memorable role in permanency customer loyalty. In traditional trade, customer and seller negotiate face to face. But now in online trade, it has changed to negotiation through internet and recommender systems. As a result, paying attention to preferences of both customer and seller in online structure is needed. In this study, we propose a method for making a recommender system for both seller and customer such that the satisfaction level of both be more than a threshold margin. First the needs and preferences of seller and customer are determined and then through the proposed algorithm successive suggestions are made until achieving a point that both sides of the business feel satisfaction.

Key words: Recommender systems, win-win strategy, customer satisfaction, decision support system, genetic algorithm, e-marketing, bidding

INTRODUCTION

Since, the internet has become popular, the consumer oriented electronic commerce has grown so huge that now companies are convinced of the importance of understanding this new emerging market. The rapid spread of the Internet has made it easy for a firm to develop a new style of e-business via one-to-one marketing (Min and Han, 2005).

It is becoming more important for the companies to analyze and understand the needs and expectations of their online users or customers because the Internet is one of the most effective media to gather, disseminate and utilize the information about its users or customers. Thus, it is easier to extract knowledge out of the shopping process to create new business opportunities under the Internet environment.

During the last decades, significant research efforts have been devoted to conceiving filtering systems that automatically provide users with desirable and interesting information. In this decade, the so-called recommender systems have been gaining momentum as another effective means of reducing complexity when searching for relevant information. Besides, these personalization tools have attracted an increasing public interest, leveling the ground for new business opportunities in different fields, such as E-Commerce (EC) and Digital TV (Schafer *et al*., 1999; Bedi *et al*., 2009).

Instead of the traditional on-spot shopping, EC provides alternative ways to get the information of products for purchasing the desired products with the following properties of transparency (Philips and Meeker, 2000):

- Price transparency
- Availability transparency
- Supplier transparency
- Product transparency
- Process transparency (Yang *et al*., 2004)

As a result, many different approaches have been researched to assist with data overload including personalization, information filtering and recommender systems. Recommender systems attempt to address the data overload problem by providing assistance in a decision making context; supplying a recommendation based on some predictive element related to the system user. Recommender systems are particularly useful for decision-makers where decisions must be made in a short time period and the effort required for interacting with the system be limited as much as possible (Russell and Yoon, 2008; Kazemi and Zarandi, 2008; Rigopoulos *et al*., 2008).

Recommender systems are one of important tools to be used in this world. Different technologies and sciences are employed to improve their performance. Web Recommender Systems (RS), the most successful example

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of web personalization tools, efficiently guide the user in a personalized manner to interesting items within a very large space of possible options (Burke, 2002). Typically RS recommend information (URLs, Netnews articles), entertainment (books, movies, restaurants), or individuals (experts) (Al-Shamri and Bharadwaj, 2008).

A recommender system is the information filtering that applies data analysis techniques to the problem of helping customers find the products they would like to purchase by producing a predicted likeness score or a list of recommended products for a given customer (Sarwar *et al*., 1998). Due to an explosion of e-commerce, recommender systems are rapidly becoming a core tool for accelerating cross-selling and strengthening customer loyalty (Min and Han, 2005).

The purpose of this study is to suggest new way for recommender system that pays attention to both preferences of customer and seller.

BACKGROUND

Recommender systems have gained an increasing importance since the early work on Collaborative Filtering (CF) in the mid-1990s when researchers started focusing on RS that explicitly rely on the ratings structure (Adomavicius and Tuzhilin, 2005). The recommender system analyzes a database of consumer preferences to overcome the limitations of segment-based mass marketing by presenting each consumer with a personal set of recommendations (Schafer *et al*., 2001). Recommender system help customer to choose efficient product related to their preferences to purchase. As many web retailer that use recommender system, we can point Amazon.com, MovieLens.org, CDNow.com (Al-Shamri and Bharadwaj, 2008).

There are two prevalent approaches for building recommender systems-content-based recommending and CF (Min and Han, 2005). CF is a general approach to personalized information filtering. CF systems work by collecting user feedback in the form of ratings for items in a given domain and exploit the similarities and differences among the profiles of several users in determining how to recommend an item. On the other hand, content-based methods provide recommendations by comparing representations of content that interests the users (Pazzani, 1999).

Customer satisfaction measurement enables EC managers to: (1) accurately identify customers' requirements and their relative importance; (2) understand how customers perceive the EC and whether its performance meets their requirements; (3) pinpoint the priorities for improvement; (4) Define objectives of service improvement and follow the progress towards a customer satisfaction index and (5) increase profits through improved customer loyalty. Different approaches dealing with the assessment of customer satisfactions already exist (Grigoroudis and Siskos, 2002).

WIN-WIN STRATEGY

Most recommender systems take into account only customer satisfaction. In practical situations, there is another approach for completing the negotiations between seller and customer. The win-win strategy should be applied to achieve a quiescent point. That is a situation in which both the seller and the customer feel they have enough benefits in the present purchase. For example, consider the process of buying a house. The seller offers a price for a house and the buyer announces the needs and preferences, including the qualities and quantities, but after some negotiations between them a point of compromise should be achieved (Niknafs *et al*., 2009).

When, the recommending processes takes solely from the viewpoint of the supplier, the goal will be to maximize the profits of the selling goods under a set of products that satisfy the customers' preferences and budgets. Although, maximal profit strategy will bring about the highest income to the suppliers, from management viewpoint, it may not retain customers. Therefore, an alternative strategy is considered by taking both supplier's and customer's preferences into account (Wang and Wu, 2009).

In electronic commerce, the interaction between two sides of purchase activity is usually carried out through the interface pages of a web site. So, it is better to use an algorithm that gathers necessary data from both sides and gives suitable recommendations such that a quiescent point is achieved. In this study a new algorithm is demonstrated that uses a win-win strategy. In addition to the preferences and needs of the customer the priorities of the seller are entered to the system.

Niknafs *et al*. (2009) proposed system tries to find a quiescent point that is satisfactory to both sides. Throughout, the study this algorithm is called Win-Win-QP algorithm. The main strategy of that approach is to find a situation in which both sides feel an acceptable level of satisfaction. In the new proposed method the way of implementing genetic algorithm and encoding the parameters of problem are modified and this has led to more degree of satisfaction and fewer steps for approaching the best results. The parameter like flag, direction and enable are some of new factors that causes this improvement.

PROPOSED METHOD

Our aim is to find a quiescent point compromising the satisfaction of both customer and seller. In the website of the store, information is gathered via interactive query forms. This information include: the importance of price, mode and material of the desired item from the point of view of both customer and seller. These questions are made for their satisfaction level also and then in a sequential process, some suggestions are proposed. Satisfaction of both seller and customer are compared in each steps until achieving the margin threshold and that suggestion is selected as the final result.

In our proposed algorithm, we assume some parameters to pursue steps and avoid repetition in making suggestion. The values of flag variable are 1 and 0 to be understood by the machine and easy to implement. Here, at first we will define the problem, then the used parameters will be introduced and finally we explain the steps of algorithm.

DESCRIBING THE PROBLEM

In this study, we propose a new way for special win-win problem as defined below:

Assume that we have an online shop for clothes, for each of clothes there are 3 features such as material, mode and price that will be shown with F and also for each feature there are 3 states like Table 1.

The customer wants to select one of these clothes with special features and state and announces the first suggestion. The proposed method checks that suggestion, if it can satisfy both customer and seller, it is accepted, but if it can't, some of the states should be changed to achieve satisfaction of both. For checking the level of satisfaction, we consider a formula such that the distance between their pleasures becomes less than a specified threshold. For example (pleasure of customer-pleasure of seller)>20 that means customer satisfaction is more important. If the above criterion is not satisfied, it is needed to improve and change some of parameters and the differences of pleasures should be less than threshold.

When, it detects that changing should be happened, checks all features and then select the feature with minimum importance, to changes it's state. This process will be repeated until terminating criterion is satisfied. That is a point that we can assume both seller and customer are satisfied and the business will be done. The terminate criteria is:

$$Pc-Ps<threshold$$

DEFINITION OF PARAMETERS

Parameter 1: Direction is used to show moving backward or forward through steps of algorithm:

$$\text{Direction} = \begin{cases} 1 & \text{forward move} \\ 0 & \text{backward move} \end{cases}$$

Parameter 2: Denotes the nth state of the mth feature. The customer suggests his/her preferences as shown in Table 2. For example according to Table 1, F_{11} is the old mode of clothes.

Parameter 3: Flag is like parameter 2 with zero value as default is used to show which feature is changed and which one is not. Zero means no change in feature, one means feature is changed.

Parameter 4: Enable: is also like parameter 2 filled by 1 as default value to show if changing in this feature is valid or not. 0 means not valid, 1 means valid. For example, if all three possible values of mode are used, it is not possible to change it again and so the enable value would be set to 0.

Parameter 5: State shows how many times a feature can be changed. After any changes in feature, the related value decrements by 1.For example in Table 1 and three states are defined for each feature, so maximum value is 2, if we have k states for each feature, the maximum will be k-1.

$$\text{State} = \begin{cases} 2 & \text{two states remaining for change} \\ 1 & \text{one states remaining for change} \\ 0 & \text{no states remaining for change} \end{cases}$$

Parameter 6: In this approach, we pay attention to both customer and seller, so we consider satisfaction parameter to measure the satisfaction level of customer and seller. Sc_{mn} is used to measure the level of Customer satisfaction for nth state of mth feature. Ss_{mn} is used similarly for seller. Table 3 and 4 show these parameters for customers and also same table for seller is considered.

Table 1: Different features and their states

Features	State 1	State 2	State 3
Mode	Old	Finishing	New
Price	Low	Medium	High
Material	Artificial	Synthetic	Leather

Table 2: Sample of parameters

F_{1i}	F_{2j}	F_{3k}

Table 3: Customer's satisfaction value of features

Mode	S_{11}	S_{12}	S_{13}
Price	S_{21}	S_{22}	S_{23}
Material	S_{31}	S_{32}	S_{33}

Table 4: Importance of features for customer and seller

Features	Ic	Is
Mode	Ic_1	Is_1
Price	Ic_2	Is_2
Material	Ic_3	Is_3

Parameter 7: Importance parameter shows the level of importance of each feature for customer (Ic_m) and seller (Is_m). Table 4 shows this parameter.

Parameter 8: Pleasure is the main parameter for assessing the final value of pleasure for seller and customer. This parameter is used for deciding about the final suggestion as the optimized setup of features such that both seller and customer feel satisfaction.

Pc stands for the pleasure of customer and Ps is the pleasure of seller. These parameters are considered to be the product of Sc_{ij} and Ic_i as below:

$$Pc = Sc_{ij} * Ic_i$$
$$Ps = Ss_{ij} * Is_i$$

For both seller and customer, we calculate the pleasure value and our objective is to decrease the distance between their pleasures. The threshold value will be the criterion of comparing the distances.

MATERIALS AND METHODS

Our algorithm, named I-WinWin-QP is proposed in different steps as below:

I-Win-Win-QP algorithm
Input: Preferences of seller and customer,
Importance level of seller and customer,
The first suggestion of customer,
Output: The final suggestion to seller and customer.

Method:

Step 1: Get the customer's suggestion
Step 2: Initialize all the parameters
Step 3: Calculate Ps and Pc for seller and customer:

$$Pc = Sc_{1i} * Ic_1 + Sc_{2j} * Ic_2 + Sc_{3k} * Ic_3$$
$$Ps = Ss_{1i} * Is_1 + Ss_{2j} * Is_2 + Ss_{3k} * Is_3$$

Step 4: Calculate (Pc-Ps). If termination criterion is satisfied, stop the algorithm, else continue
Step 5: Find the feature with minimum importance and consider it as changing feature
Step 6: For changing feature, evaluate flag

If related flag is 0, change it to 1 and continue

Step 7: Then evaluate enable for that feature

If enable = 1, continue
Else if enable = 0, set direction = 0 and flag = 1 for this feature

Step 8: Evaluate state for this feature to know how many times it can be changed

If state = 0, set direction = 0
If state = 1 decrease it so state = 0 and set enable = 0 to show that all states are checked,
If state = 2 decrease it so state = 1

Step 9: Evaluate direction

If direction = 1 continue,
Else set direction = 1 and go to step 11

Step 10: Select new state for the changing feature and reset the table of customer's suggestion as defined in step 1 with this state and then do steps 3 to 9

If terminate criterion is satisfied, finish,
Else select the last state and do steps 3 to 9
Check criterion, if satisfied, go to step 11
Else it is finished

Step 11: Find the next minimum importance and go to step 6. When all of the three features are checked go to next step
Step 12: Propose new suggestion as the final result

RESULTS

This approach is implemented by C#.Net and SQLServer2005. The project was done as a collaboration between Computer engineering department of shahid bahonar kerman university and information technology department of Industrial kerman university from march 2009 till January 2010. Figure 1 depicts the changing in pleasures of customer and seller. After detecting the importance and satisfaction of each feature by customer and seller, the proposed algorithm suggests new form of states depending on customer's satisfied state of each feature.

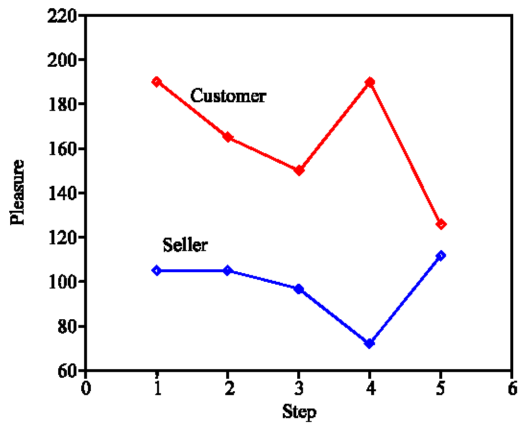

Fig. 1: Pleasure levels in first run

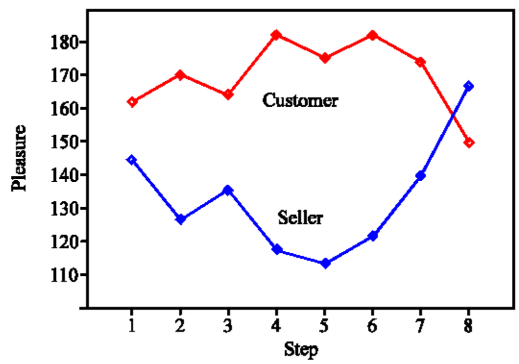

Fig. 2: Pleasure level in second run

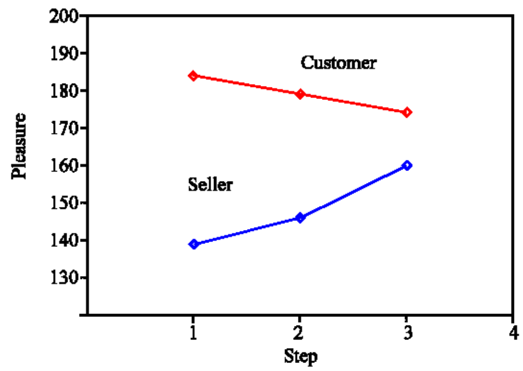

Fig. 3: Pleasure level in third run

In Fig. 1, it is shown that after five steps, the algorithm reaches the termination criterion and suggests new combination of states of features. In Fig. 2, chart of second run, it is shown that seller has higher pleasure level at the end of process. In Fig. 3, it is shown that in only three steps, algorithm reaches the termination criterion. Figure 4-7 show other runs of the algorithm. As it can be seen all the runs approach to a suitable point.

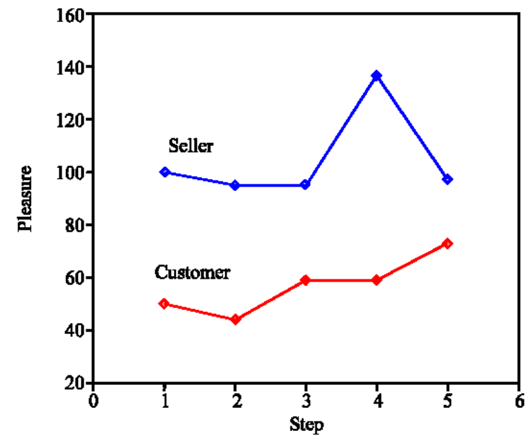

Fig. 4: Pleasure level in 4th run

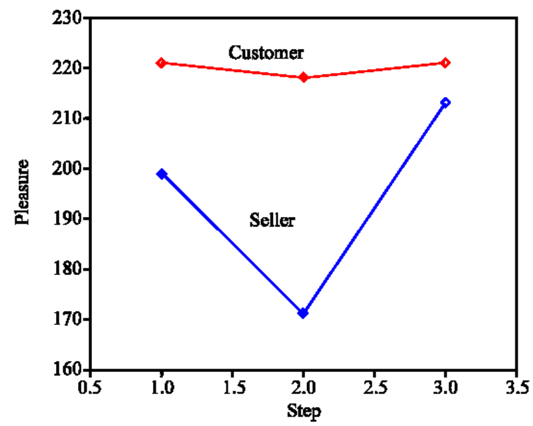

Fig. 5: Pleasure level in 5th run

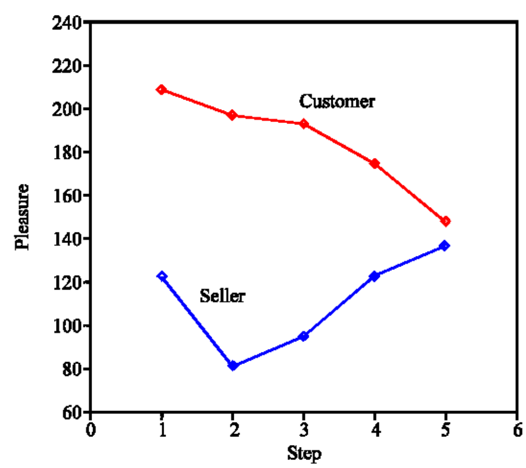

Fig. 6: Pleasure level in 6th run

As it is shown well in different runs, if one feature has high importance to customer, it won't be changed until the other two features are changed and algorithm

Table 5: Customer's satisfaction and importance

Run	Mode-satisfaction	Price-satisfaction	Material-satisfaction	Price-importance	Mode-importance	Material-importance
First	2,5,10	10,5,2	10,5,2	10	8	5
Second	6,7,9	9,8,5	8,7,8	6	8	7
Third	8,7,5	10,7,5	5,6,7	7	10	5

Table 6: Seller's satisfaction and importance

Run	Mode-satisfaction	Price-satisfaction	Material-satisfaction	Price-importance	Mode-importance	Material-importance
First	10,10,7	2,7,10	7,7,3	8	5	2
Second	8,7,6	4,6,9	7,6,8	9	9	4
Third	8,7,5	6,6,9	9,7,6	7	8	7

Table 7: Satisfaction of customer and seller

Run	Customer	Seller
First	126	112
Second	150	167
Third	174	160

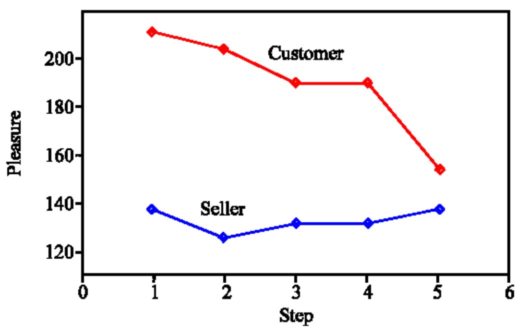

Fig. 7: Pleasure level in 7th run

doesn't reach termination criterion. For instance in first run, Mode has high importance to customer, so in system suggestion, mode doesn't change. It will be discussed in third run, too.

In Table 5-7 the summery of three run is gathered. In Table 5 and 6, the satisfaction and importance of different features are shown, satisfactions of one feature is related to Table 1 and based on that sequence, in this table only level of satisfactions is written. In Table 7, the final pleasure that software acquires, is explained.

CONCLUSION

In this study, we propose a method for making a recommender system for both seller and customer such that the satisfaction level of both be more than a threshold margin. First the needs and preferences of seller and customer are determined and then through the proposed algorithm successive suggestions are made until achieving a point that both sides of the business feel satisfaction. For this purpose, software is written and the result is shown.

Comparing with the previous algorithm (Niknafs *et al*., 2009), this new algorithm can find the result in less steps and the other benefit is to consider both customer and seller and related to their preferences suggests.

In this study, algorithm tries to find the minimum importance and then changes that feature, after that second minimum and finally if it doesn't reach the termination criterion, changes the highest importance feature for the customer.

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