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E-COMMERCE RECOMMENDATION SYSTEM BASED ON DEMAND CLUES

Author's Name: Ibnath Naour Reeve[1], Taushiqul Alam[2], Marzia Rahman Munia[3], Ahnaf Atif Showmik[4], Muhammad Fahim Faisal[5]

Affiliation:

1. Bachelor's Student, Department of Computer Science and Communication Engineering, University of Science and Technology Beijing, Beijing, China. revee.ibnath420@hotmail.com
2. Master's Student, Department of Economics and International Trade, University of Science and Technology Beijing, Beijing, China. taushiqulalam@icloud.com
3. Bachelor's Student, Department of Computer and Communication Engineering, University of Science and Technology Beijing, Beijing, China. mmarziarahman@gmail.com
4. Bachelor's Student, Department: Bachelor of Business Administration (BBA), Bangladesh University of Professionals, Dhaka, Bangladesh. ahnafatifshowmik@gmail.com
5. Bachelor's Student, Department of Electrical and Electronic Engineering, BRAC University, Dhaka, Bangladesh. fahimfaisal.fad@gmail.com

Corresponding Author Name and Email ID: Taushiqul Alam

ABSTRACT

Traditional e-commerce recommendation systems use offline methods to analyze and process customer demand information, thus losing timeliness. In order to solve related problems, a demand-based recommendation system came up for leads. The basic model, data structure, key algorithms and operation process of the system are given. The system uses demand clue tracking to collect the current needs of customers, seek information to conduct demand tendency analysis; and match and retrieve products and customers that need to be recommended in the demand VS product overlay space. Online marketing simulation experiments show that the system have good timely response ability and high customer satisfaction.

Keywords: E-commerce, Recommendation system, On-line demand clues

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INTRODUCTION

In the era of e-commerce, consumers are faced with a large amount of product information and it is often difficult to find goods that are most needed or suitable. Therefore, e-commerce systems usually adopt a recommendation system with purchasing assistant function to help consumers choose goods, which can automatically collect the products that consumers may be most interested in and recommend them to customers [1, 2].The currently popular E-commerce recommendation systems can be roughly divided into four types according to the recommendation technology they use [3]: One is the recommendation system based on content filtering; the other is the collaborative filtering recommendation system; the third is a hybrid recommendation system based on content filtering and collaborative filtering; the fourth is based on data mining technology recommendation system, which is currently the most widely used recommendation technology.

Although, the current e-commerce recommendation system based on offline data mining has been widely used, but such systems still have some problems that cannot be ignored, such as: poor timeliness, low real-time performance, etc. [4-6]. Based on the analysis of these issues, this paper proposes an e-commerce recommendation system and its model based on online demand clues.

1 Problem description and decomposition

Currently widely used recommendation systems such as collaborative filtering and content filtering have the following problems:

First, these systems are less time-sensitive: they require a longer lag (usually 24 hours or more), a certain amount of transaction and browsing data in the system before they can analyze customer demand analysis and recommendation processing. This data accumulation process brings about two types of timeliness issues: 1) The products sold through e-commerce there are a considerable number of seasonal products (such as fashion products). If the data accumulation time lag is too long, sellers will lose many business opportunities; 2) A considerable number of customers enter e-commerce, and their shopping needs change significantly. Specifically, the purchasing goals have changed significantly. Objects (adjacent or several times apart) will usually have large changes; the requirements of this system are investigated and developed. Currently, less than 8% of customers purchase the same or similar products twice in a row; therefore, there are obvious shortcomings in using recent or adjacent shopping records as a basis for short-term recommendations.

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Secondly, the information content collected and accumulated by these systems is subject to variability: for example: currently popular recommendation systems mainly collect and accumulate customers' shopping information, including time of purchase, type and characteristics of purchased goods, etc., and this information usually changes greatly and is difficult to provide long-term and reliable recommendation basis; despite shopping taste, shopping browsing behavior and other factors the visual demand factors rarely change, but few recommendation systems currently explore and utilize them, a lot of available information is wasted, and a lot of business opportunities are lost.

In addition, due to the main information collection, storage, and processing in the current recommendation system and recommendations are all completed by the server, causing the server to become a "computing" bottleneck, while causing large delays in recommendation work and client (browser) computing resources issues such as idle computing resources.

In order to solve the above problems, this system proposes the following solutions and uses them in e-commerce used in recommendation systems:

Most of the current recommendation systems adopt the B/S (browser/server) model, that is, the guidance ,the purchase and shopping web pages are transmitted to the client and "executed" by the browser; to solve the traditional recommendation system which has poor timeliness, this system monitors, collects and transmits information on the client deliver continuous online customer behavior information and generates the "demand clues" required by the recommendation system "Search" information, thereby reducing frequent interactions between the client (browser) and the server, achieving to reduce communication load and improve timeliness.

In view of the variability of information content in traditional systems, this system on one hand monitor and process customers' online browsing and shopping behavior to conduct online analysis of needs; on the other hand, specialize the customer's long-term shopping records on the client side .It is classified and processed, and then its relatively fixed shopping behavior characteristics, shopping taste and other historical needs are clues which are stored in the server, exchanging space for time, thus improving the efficiency of secondary information utilization efficiency and further improve timeliness.

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MAIN IDEAS, MODELS AND ALGORITHMS

1 Main ideas and system model

The structural model and main ideas of this system are shown in Figure 1

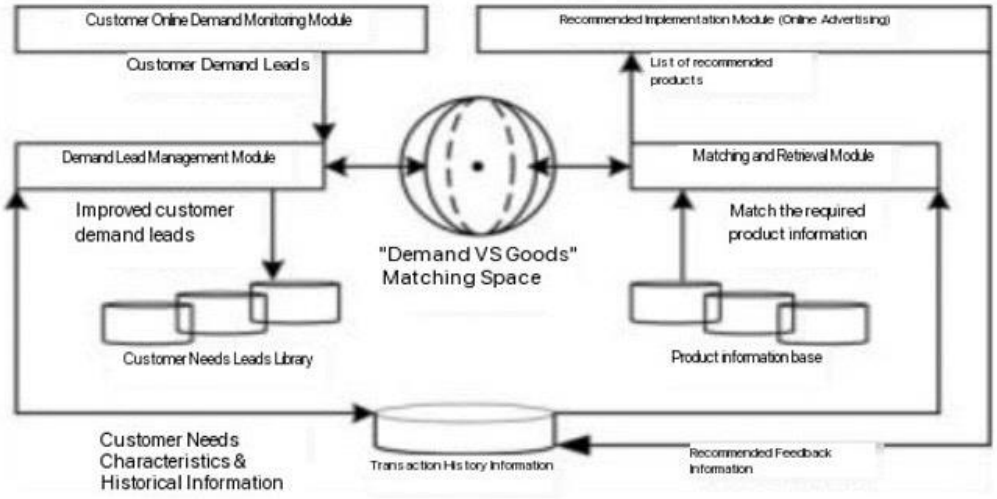

Figure 1 System model and processing flow

In order to solve the above problems, this system has constructed some data structure and function modules:

The special data structure used in this system is "demand clues". This structure describes as $<T_i, O_i. C_i, 0p_i, \ldots>$, where T_i is the time when the demand activity occurs; O_i is the demand behavior target (purchased products, viewed pages, etc.); $0p_i$ is the demand behavior (browsing, evaluation, ordering, etc.); C_i is the demand behavior characteristics (complex data structure, including preference intensity, residence time, etc.).

Special modules in this system include:

1) "Online demand monitoring module" running on the client (browser) ,This module is stored on the server and automatically transferred to the customer when they enter the e-commerce system terminal and executed by the browser; the module contains a customer operation queue to save the customer client information browsing, product retrieval and other activities that reflect demand characteristics, and proceed accordingly to the construction of customer demand clues and shopping tendency analysis; but the specific analysis process is left to be completed by the server to avoid frequent interaction of historical data between the server and the client.

2) The “matching and retrieval model” of demand clues and product features running on the server "Block" ,there are usually similar modules in traditional recommendation systems, but usually the customer's historical shopping records match with current inventory and select

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the best products to recommend; this system's matching module combines the information provided by the client's "online demand monitoring module "to perform "demand VS product" not only improves customer satisfaction, but also avoids the repeated overlay matching operations of traditional recommendation systems and improves system operation efficiency. A fuzzy matching algorithm is applied in this module to construct a multi-dimensional "demand VS commodity" matching space, for detailed description see section 2.3 Key Algorithms.

3) "Demand Lead Management Module" running on the server. Traditional recommendation system usually directly stores each purchase record of a single customer so that the system can mine the recommendations information; the demand clue management module of this system collects demand clues to the server after the client completes the shopping activity, and combines the shopping records with feedback information to create after corresponding processing, further improve the content of demand clues as the basis for next recommendation.

2 Recommendation process

This model consists of 4 main steps:

1) Customer demand clue monitoring; when customers enter the e-commerce system, online
collects customer demand behavior information and preprocess it to find the focus of their attention; and construct corresponding demand clues on the client, including its demand activities, requirements
objects, demand behavior characteristics, etc.

2) Demand measurement: When the customer's online demand intensity exceeds the threshold, according to the customer the demand clues obtained by the terminal and the historical demand clues pre-stored by the server are tested through similarity testing degree and other operations, and obtains the customer's current needs through the "Demand VS Product" matching space, find characteristics (demand target characteristics, demand intensity, demand pattern, etc.).

3) "Demand VS product" matching calculation and product information database retrieval server by retrieving product information, based on the characteristics of customers' current needs, in the "Demand VS Supply ""Product" matching space extracts those products whose product characteristics match customer needs.

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4) Post-processing of demand clues and implementation of recommendations on the list of recommended products modify and adapt for submission to customers via a variety of online advertising or offline methods; and the results of the final successful transaction are saved in the "Demand VS Commodity" matching solution library, Push after the recommendation is completed, the customer will select the corresponding product from the recommended list, and these results will be processed and submitted as feedback information to the demand lead management module to further improve the customer's demand clues for this transaction can be used as a reference for the next recommendation and customer demand management, Test basis (including shopping tendencies, browsing habits, etc.).

3 Key algorithms

Usually, the recommendation process of e-commerce systems is continuous, so it is impossible to wait for the receipt of the work of collecting transaction information must be completed before recommending and matching. Instead, it is necessary to provide timely recommendation information and provide a list of recommended products before the customer exits the system. The matching space model and algorithm used in the system are described, as shown in Figure 2

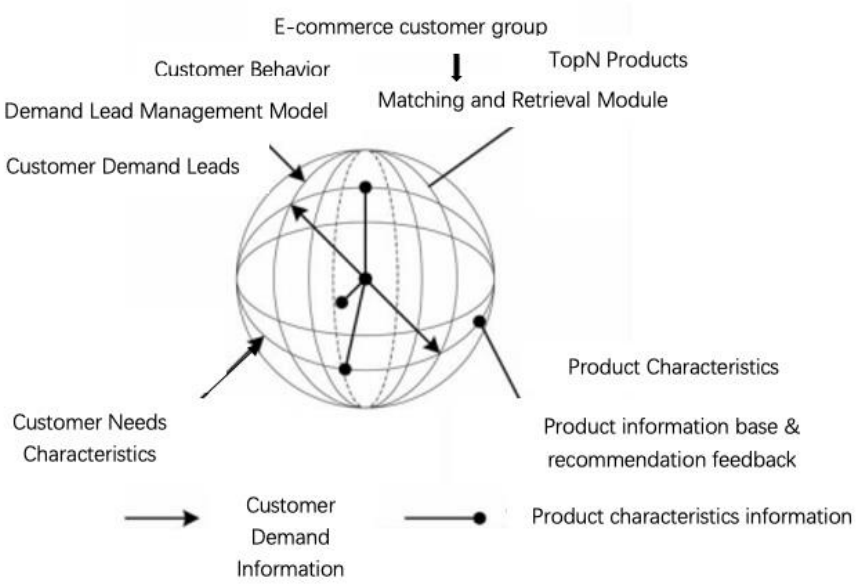

Figure 2 “Demand VS Commodity” matching and retrieval algorithm model

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In order to provide the fastest and most accurate recommendation matching service possible, this system uses Mongolian The Te Carlo method which implements the "demand VS commodity" matching measure. Set R_i in this system represents the distance between the characteristics of a specific product i and the maximum demand of customers; $g(R_i)$ represents when the passing level reaches R_i, the corresponding evaluation score in the matching space can improve TopN list for recommended products [7], and $f(R_i)$ is the demand line of various current customers The distribution density function of the conditional parameters is then

$$\langle g \rangle = \int_0^\infty g(r)f(r)dr$$

According to the theory of probability and statistics, $\langle g \rangle$ is the mathematical period of random variable $g(R_i)$. When the recommendation system will provide the TopN recommendation list to the customer, the records extracted each time are $r_1, r_2, \ldots \ldots . r_N$, then the values of N extractions are $g(r_1), g(r_2) \ldots, g(r_N)$ Arithmetic mean of (r_N)

$$\bar{g}_N = \frac{1}{N}\sum_{i=1}^{N} g(r_i)$$

They represent the recommend ability of a product (usually, the arithmetic mean is the integral $\langle g \rangle$ estimated value, or approximate value). This algorithm divides the samples of the product space X to be recommended into the arithmetic mean of X1, X2, …, XN, Law: For example, (E(X)＜∞) then;

$$P\left(\lim_{N\to\infty} \bar{X}_N = E(X)\right) = 1$$

That is, the recommend ability of a product change with the arithmetic mean of X samples. When the number of sub-samples when N is sufficiently large, it converges to its expected value E(X) with probability 1 based on this kind of thing .In fact, the information sample of a single product may meet customer needs with low satisfaction, However, with the increase in product samples and the richness of customer demand clues, “demand VS business” The available information in the overlay space of "product" is constantly increasing, and this algorithm can achieve rapid Match search service.

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SYSTEM SIMULATION EXPERIMENT RESULTS

This system was simulated by simulating an online marketing environment.

The simulation environment demonstrates the actual effect of the system through virtual shopping. After 10 test cycle, email test customers asking them to provide feedback on the old and new systems. conducted an online comparative survey on user satisfaction; sent 400 copies of the online questionnaire and receives 327 replies were received, of which 297 were valid replies.

Table 1 gives a comparison of customer satisfaction surveys. From the 7 main survey items it can be seen from the comparison: Compared with the old system, the new system has greatly improved customer satisfaction

Table 1 Comparison of customer satisfaction surveys

Satisfaction survey items	New system (%)	Old system (%)
Recommended product acceptance level	74	43
Attractiveness of recommended products	57	23
Recommendation timeliness	71	33
Product timeliness	82	57
Product information availability	63	42
Save time by retrieving the products you need	77	51
Overall satisfaction	69	46

At the same time, because it can track customer demand clues, this system has good adaptive ability; compared with offline data mining and other methods used by traditional recommendation systems ,Recommended product selection based on online monitoring methods is faster and more timely (Since the actual recommendation implementation is implemented using online advertising, customers cannot evaluate The speed

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of generation of the recommendation list, so the experiment was conducted in the server: Recommendation Top10 In the product speed test, the new system's running speed increased by more than 37% on average)

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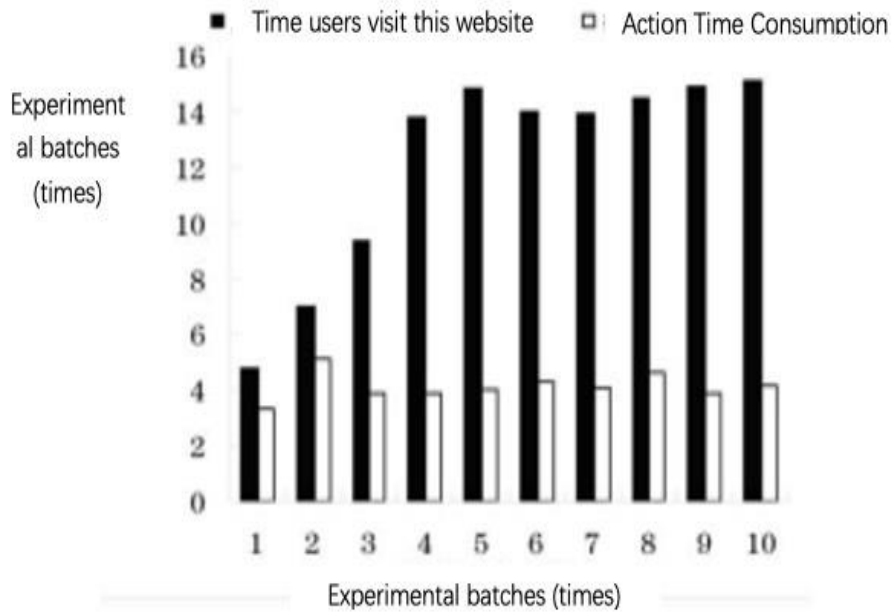

Figure 3 Experimental results of customer attention level

Figure 3 shows that on average, within 10 monitoring periods, customers received the recommended product list. The average time spent on the table is compared with the average browsing time. This experiment proves that this system can through short-term demand clue analysis, you will be able to attract customers to browse more of this website. information, greatly increasing customer attention, thus improving online sales performance.

CONCLUSION

This article gives the basics of an e-commerce recommendation system based on demand clues. Models, data structures, key algorithms and operational processes. The system uses demand cues Collect current customer demand information through monitoring to predict demand trends. Improved the real-time and timeliness of the system; and overlay space through demand VS products

Matching and retrieving recommended product lists improves customer satisfaction. Simulation experiment proves The system has good performance and has certain application value. Future research goals are to Further improve the accuracy of demand clue monitoring and expand the utilization field of customer demand identification. Domains, and looking for faster “demand vs. goods” matching algorithms.

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