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Construction of E-Commerce Intelligent Recommendation System based on User Behavior Mining

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Abstract: The electronic commerce appearance is to a great extent because computer technology development with gradually mature, the electronic commerce transaction is that carries in-line therefore electronic commerce cannot be separated from computer technology. Under this era, this manuscript proposes the novel E-commerce intelligent recommendation system based on user behavior mining. Based on content system recommendation, it is the product which liked in the past the different candidate product and the user carries on the comparison, and then recommended the similarity highest product to the user. In the most multi-criteria based recommendation systems, the decision criteria are represented by the project attributes, the items are represented as vectors of the multiple attributes. With the integration of the NN and fuzzy set theory the revised model is then finalized. The experiment result proves the effectiveness of the model and our future research will be more focused on the systematic verification and more theoretical comparison analysis.

Keywords: E-Commerce, Intelligent Recommendation, System, User Behaviour Mining.

1. INTRODUCTION

In electronic commerce technology including the computer technology, networking, communication, safety work and so on a series of the basic synthesis application technology, but this all technologies take the computer technology as the premises. In the other words, the electronic commerce premise and the core condition are the computer networks. The electronic commerce appearance is to a great extent because computer technology development with gradually mature, the electronic commerce transaction is carries in-line therefore electronic commerce cannot be separated from computer technology. The security of the computer systems can enhance the integrity and confidentiality of e-commerce is the basis for long-term development. Computer technology is the tool that brings together members of general e-commerce, such as connecting customers and businesses. It is precisely because of the primary computer technology, buyers and sellers to cross the obstacles in space, for fast transactions. So computer technology and e-commerce is very close and e-commerce on the basis of computer technology to achieve rapid with the reliable and efficient trading system.

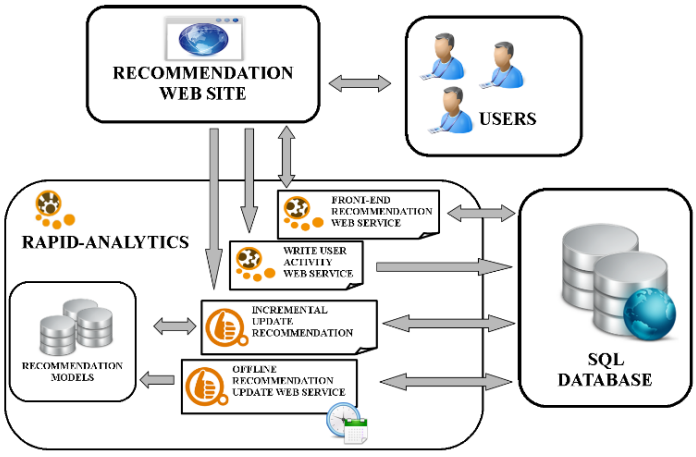

Figure 1. The E-Commerce Intelligent Recommendation System Organization

The research on the evolution of e-commerce system is going from a single domain and a key technology research to an integrated, systematic and in-depth research process to enhance the practical significance of e-commerce system evolution complexity research, the relevant disciplines or theories to be effective integration, to seek a more extensive theoretical support and the method breakthrough. E-commerce system is a product of natural science and social science staggered movement is a coupling of a variety of complex process, in all its internal system with self-organizing process that occurs throughout the activity reflects the electronic commerce activity main body (such as people, organizations, etc.) and object (such as trust and control, etc.) of duality. On

the one hand, the electronic commerce system has the contact with nature, with socialization production and productivity performance of collaborative commerce operation management carrying reasonable organizational productivity of general functions and on the other hand, electronic commerce has associated with production relations and the social system of social attributes. Therefore, this paper will be organized based on discussion of the following aspects. (1) In the process of e-commerce, the parties to the transaction must be able to express their true identity, in order to ensure this with the need for digital certificate technology, the establishment of the security certification center to develop a series of security protocols to achieve. (2) EDI has the general suitable feasibility and the validity in the general processing electronic commerce business, and is the new electronic information technology and the trade activity will unify well, will be big regarding these information volume of the goods handled, the complex degree will be high, the security, the reliability, the integrity, timeliness request very strong will carry the B2B application to have high the unique superiority. (3) The proper integration of the fuzzy clustering and neural network will help to enhance the mathematical references.

2. THE REVIEW OF THE RECOMMENDATION SYSTEMS

SuperRank not only satisfied with the use of online mall from the site can directly capture the data (called the objective attributes), such as commodity prices, but also the use of natural language processing and data mining technology heart the comments on each online mall theme extraction, emotional tendencies to judge, and integrated clustering as "customer satisfaction," the subjective attributes.

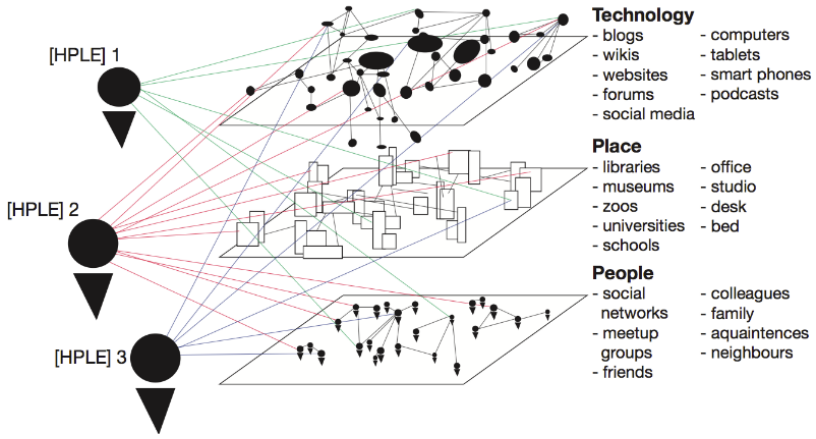

Figure 2. The Components of the Recommendation Systems

Already very was mature based on the content recommendation algorithm to the information gain and the information filtration two aspect researches now has very many all is demonstrated first based on the content recommendation system to the product the text information carries on the analysis, discovers the similarity quite high product to carry on the corresponding recommendation. In based on in the content recommendation system, we describe frequently the product content with some key words. Based on the content system recommendation, it is the product which liked in the past the different candidate product and the user carries on the comparison, and then recommended the similarity highest product to the user. In the most multi-criteria based recommendation systems, the decision criteria are represented by the project attributes, the items are represented as vectors of the multiple attributes, and each attribute has multiple attribute values as the follows.

- Nearest neighbor search based on similarity of some attribute value utility. The attribute value utility describes a user's preference for an attribute value. There are two types of attribute values: continuous and discrete. For different data types, there are different methods of extracting attribute values.
- Based on the combination of attribute values when utility maximization is searched, only the similarity of some attribute value preference belonging to attribute value combination is compared, the number of attribute values involved in similarity calculation is reduced, and the ultra-high dimension problem of the primary collaborative filtering is solved.
- Some hybrid recommendation system is based on the content of collaborative filtering algorithms. It is using the user information to realize the traditional collaborative filtering calculation. The algorithm of user similarity has nothing to do with the common grade product information, but through calculated based on the content the user data. This algorithm not only can solve data sparseness in collaborative filtering system, and when the product is similar to the user data will be directly recommended as is no longer only when the product is similar user data users hit points can be recommended.
- Based on the content and collaborative filtering algorithm, a unified probabilistic method is proposed to solve the problem of sparse data by analyzing the user's favorite data by shallow semantic analysis as

dividing the information into related topics, and then predicting the basic user's favorite topics. Utility regression model is based on the user has been playing too much information with users and products related to the establishment of user models, through regression analysis to estimate and predict the user requirements for a particular product characteristics.

However, there are some limitations of the existing multi-standard collaborative filtering recommendation system. (1) The tradition mainly is the choice and project i similarity sorting depends on front based on the project coordination filtration algorithm N project to gather as a project i close neighbor. But as a result of the traditional algorithm, only is considered the user the interest, has not carried on the filtration to the information, recommends the information cannot guarantee the quality. Based on above consideration, this algorithm in selection project most close neighbor's time, according to the user interest and the information time-limited quality synthetic evaluation and i carries on the most primary neighbor's selection to the project. (2) From other aspects of recommendation performance, the proposed fusion method is more flexible than the model fusion method, and is more conducive to the promotion of recommendation efficiency and the interpretation of the group recommendation results. However, the recommendation results from the recommended fusion often lack novelty, and when the group size is large, the recommendation efficiency is lower. (3) Collaborative filtering recommendation system requires the system user of each attribute score for the project to obtain basic attribute weights and attribute values utility based on the standard, according to the similarity search for nearest neighbor attribute weights or attribute value utility which increases the burden on users.

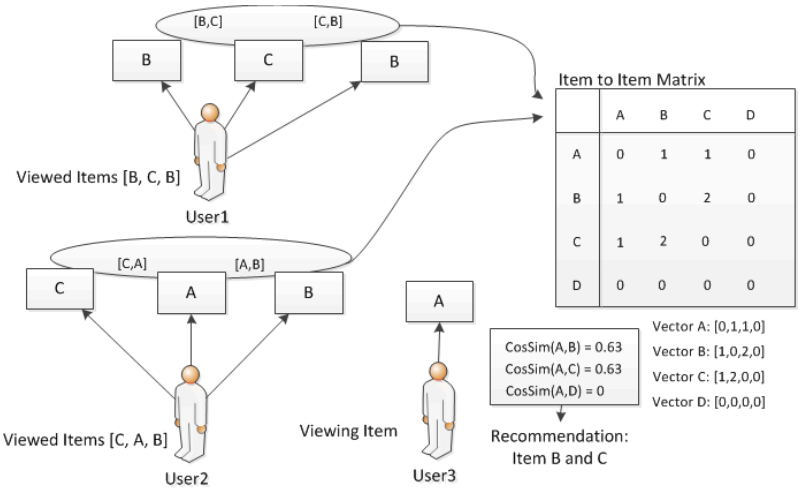

Figure 3. The Sample Recommendation System Architecture Flow

3. THE PROPOSED METHODOLOGY AND SIMULATION

P2P already became the computation technology the research hot spot, it was considered was the future restructures the distributional architecture the key technologies.P2P may apply in many domain as like the CPU cycle sharing, prompt intelligence transmission, joint operation module and data sharing and so on. To solve this problem, people will mixing core electrodynamics global searching characteristic of neural network, a variety of chaotic neural network model is put forward, and most of them by fetching the feedback items in the Hopfield net themselves showed a transient chaos dynamics behaviour in order to avoid fall into local minimum point. In a distributed e-commerce environment, the same kind of general product knowledge or customer knowledge is differentiated by some different ontologies. So the ontology mapping is very important in knowledge integration between enterprises and knowledge sharing of the modern e-commerce.

BMBP provides three kinds of evaluation method: full automatic evaluation, semi-automatic evaluation and preliminary screening. The highest degree in process automation of fully automated the assessment, the process is relatively complex. Compared with those of full automatic evaluation in quantitative conditions for training, training network to fill in quantitative terms in the book of tender numerical input network for processing, then the processing result and qualitative conditions of filled to the next step to the system as preliminary screening do not need training network that just to meet the limit constraint of the tender is submitted to the system. Here mainly discuss fully automated assessment from the following aspects.

- On the basis of the general semantic P2P network (such as Helios structure), this paper introduces the theory of the ontology matching in the field of electronic commerce, and realizes the large-scale, highly efficient, collaborative and semantic P2P collaborative recommendation community search mechanism. It includes the community knowledge broadcast, the ontology mapping the node member identification and the primary major request pass and so on.

- The concept of semantic similarity of the ontology concept in the community is revised by using the factor of recommendation rate of influence and the rate of the recommending feedback to consider the purchase rate and dynamically added or exited.

Therefore this article in signal-to-noise ratio SNR =90 structure white noise chaos neural network model, and selects the suitable parameter, causes the neuron to display the transition condition chaos behavior. Below but actually the branch chart and the biggest Lyapunov index time evolution chart analyzes this model through the neuron dynamics characteristic, and we firstly define the system as the formula one.

$$\frac{\partial y(k)}{\partial u(k)} = sign\left(\frac{y(k)-y(k-1)}{u(k)-u(k-1)}\right) \tag{1}$$

Where the $sign\left(\frac{y(k)-y(k-1)}{u(k)-u(k-1)}\right)$ represents the functional term, the process of ontology mapping is the most important is the discovery of the semantic association, semantic association including semantic similarity and semantic relevance of research. They are two different concepts. Semantic similarity reflects the extent of the two concepts to replace each other can be used for similarity calculation between ontology to achieve the purpose of the recommended the same commodity knowledge.

Neural network has a strong learning ability, learning process, including the stage of transmission and error propagation phase. After the input layer receives the input signal, the network produces the output through the operation, adjusts the weight and the width value according to the difference between the output layer signal and the teacher signal until the difference between the output layer signal and the teacher signal E small child pre-set error allowable value and the finalized model is represented as the formula 2~4.

$$f(x) = \begin{cases} 1 & if \quad \sum_{i=1}^{n} x_i w_i > 0 \\ 0 & if \quad \sum_{i=1}^{n} x_i w_i \le 0 \end{cases} \tag{2}$$

$$f(x) = \frac{1}{1+e^{-x}} \tag{3}$$

$$E = \frac{1}{2}\sum_{j}\left(t_{pj} - o_{pj}\right)^2 \tag{4}$$

In the bid evaluation model based on BP neural network, BP neural network as the role of the "experts", the number of groups of that sample tender after normalization processing value as the input vector of BP network model, the sample of the tender evaluation result as the output of the BP network model, training the neural network to obtain the bid evaluation experts experience, knowledge, subjective judgment and the tendency, the importance of indicators that the BP network model of the set of the weights values is to network with adaptive learning knowledge of right internal representation and we define the standard for references.

$$u_i = \bigwedge_{j=1}^{3} A_j^i\left(x_j(k)\right) \tag{5}$$

Where the *(k)* is the key term that should be taken into consideration, we use relative quite small exponential decay, the full use mixes the dynamic characteristic which I stores to carry on the search, enables the network to be possible to jump out of the partially the most superior trap, will have the possibility to obtain combines the optimized question the overall optimal solution that uses the quite big exponential decay in the restraining stage as overcomes speed question which the small exponential decay brings, reduces the restraining time. In BMBP, BP neural network plays the role of "experts" in the evaluation of bids. Using the learning ability of BP neural network, the trained neural network acquires the experience, knowledge, subjective judgment and tendencies of the experts and then enters the tender of the conditions of value we get the evaluation of the evaluation results.

$$\frac{\partial E_p}{\partial w_{ji}} = \frac{\partial}{\partial w_{ji}}\left[\frac{(\mathrm{t_{pk}} - \mathrm{o_{pk}^L})^2}{2}\right] = \frac{\partial}{\partial o_{pk}^L}\left[\frac{(\mathrm{t_{pk}} - \mathrm{o_{pk}^L})^2}{2}\right]\frac{\partial o_{pk}^L}{\partial Net_{pk}^L}\cdot\frac{\partial Net_{pk}^L}{\partial o_{pj}} \tag{6}$$

$$\frac{\partial E_p}{\partial w_{ji}} = \frac{\partial}{\partial w_{ji}}\left[\frac{(\mathrm{t_{pk}} - \mathrm{o_{pk}^U})^2}{2}\right] = \frac{\partial}{\partial o_{pk}^U}\left[\frac{(\mathrm{t_{pk}} - \mathrm{o_{pk}^U})^2}{2}\right]\frac{\partial o_{pk}^U}{\partial Net_{pk}^U}\cdot\frac{\partial Net_{pk}^U}{\partial o_{pj}^U} \tag{7}$$

As shown in the formula 6~7, the revision process of the network structure is well demonstrated, where the $\frac{\partial}{\partial w_{ji}}\left[\frac{(\mathrm{t_{pk}} - \mathrm{o_{pk}^L})^2}{2}\right]$ is the term one and the $\frac{\partial}{\partial w_{ji}}\left[\frac{(\mathrm{t_{pk}} - \mathrm{o_{pk}^U})^2}{2}\right]$ represents the term two. In order to can not only make full use of the chaotic dynamic characteristics of the search, and will not affect the network convergence speed, to the idea of the subsection exponential simulated annealing strategy, white noise chaotic neural network

model was improved. Typically, simulated annealing algorithm from the search phase shifted to convergence phase of the bifurcation point is relatively stable shown as the figure 4.

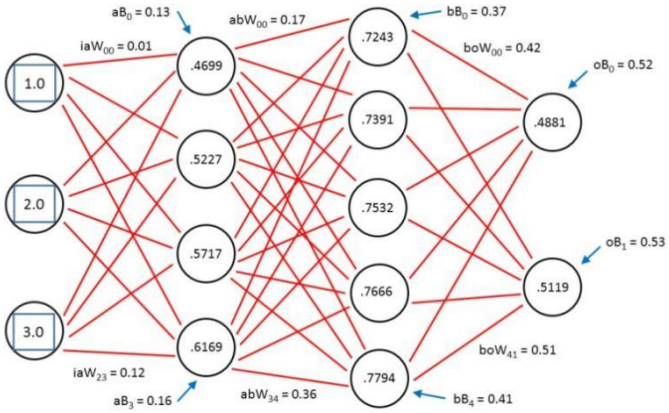

Figure 4. The Revised Neural Network Form for the Systematic Reference

As a comprehensive evaluation system, the evaluation of the quantitative and qualitative conditions and in the BMBP, as the bidder completes the description in accordance with the conditional values and converts the qualitative condition values into quantitative values, for quantitative conditions, the dimension and value of the nature of different, for the cost-type conditions, the smaller the better; for the benefit-type conditions, the bigger the better and can be defined as the formula 8.

$$\Delta w_{ji}(t+1) = \eta(-\frac{\partial E_p}{\partial w_{ji}}) + \alpha \Delta w_{ji}(t) \tag{8}$$

New optimization strategy, which can make full use of the dynamic characteristics of the chaotic search, the algorithm can jump out of the local optimum "trap", and can speed up the pin in degree, increase the search precision. Simulation analysis and the experiment, this model can effectively reduce the number of iterations of the network operation improve the network search at the same time efficiency in solving basic combinatorial optimization problems are better able to obtain best solution, shows more excellent performance.

Usually in e-commerce sites, users to purchase products or score relative to the total quantity accounts for only a limited and for 1% of the total number of the following, this leads to the user project scale sparse data sets. In such a large amount of the data and evaluation data under the condition of extreme thin, on the one hand, difficult to successful positioning neighbors user sets which effect the precision of the recommendation; On the other hand, on the whole user space calculation process of similar users inevitably become the bottleneck of the algorithm and input the data usually contains large number of users and items, the system extension is difficult that delivers the recommend quality decline shown as the figure 5.

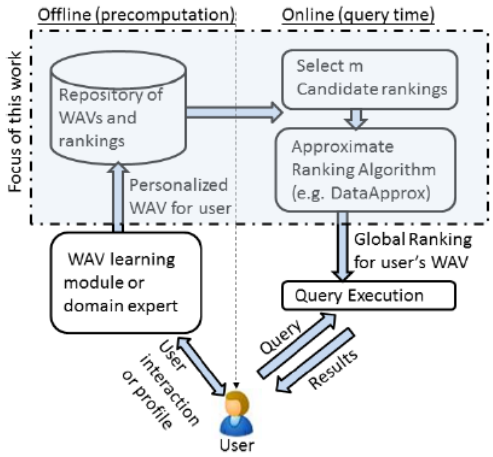

Figure 5. The Demonstration of the Recommendation Quality Reduction

An under this basis, we can consider using the fuzzy set theory to provide theoretical support. Clustering analysis is an important means of data processing and tools, by the sample in accordance with some similarity criteria are divided into different categories, so that people find interesting content. Clustering techniques have

been extensively processed for large datasets, and researchers have applied them to the improvement of general collaborative filtering scalability problems, and the objective function can be defined as the follows.

$$Quality = \frac{1}{n}\sum_{i=1}^{n}\frac{\sum_{p_l \in C_i}\left\|p_l - cc_i\right\|^2}{\left|C_i\right|} \tag{9}$$

The clustering method based on distance, the static characteristics of vector data clustering has good effect, however, because the data in this paper, we study user click behavior has obvious dynamic: users continuously from one movement to skip to the next action. If consider using vector sequence and each component said the corresponding action occurrences, and then the method based on distance, than K-means, this is likely to lose user behavior of dynamics and influence the clustering effect defined as follows.

$$v_i = \frac{\sum_k (u_{ik})^m x_k}{\sum_k (u_{ik})^m} \tag{10}$$

$$\mu_{li} = \begin{cases} \mu_{A^l}(x_i), & x_i \in A_\alpha^l \\ 0, & else \end{cases} \tag{11}$$

Where the v_i and μ_{li} represents the potential clustering center, respectively. This article applies BYY theory in the Markov tear gathers the model, proposed this tear gathers the model the harmony function, and infers its gradient algorithm, solves at the same time this model parameter study the model automatic selection question. General immune algorithm generally consists of the following steps.

- The population of antibodies is defined as the solution of the basic problem, as the affinity between the antibody and the antigen corresponding to the evaluation of the problem solution, the higher the affinity, the better the solution. The initial antibody population, corresponding to a random solution of problem.
- In order to obtain the diversity, the optimization and the optimization of the solution and the deletion of the non-optimal solution were promoted.
- It will need to solve the problem of abstract to fit the immune antigen form of system processing, as antigen recognition, on the other hand, corresponding to problem solving.
- Using the morphological space model in artificial immune theory, the personalized recommendation problem can be explained by the core morphological space method, and then the classical collaborative filtering algorithm is improved by using the existing results of artificial immune theory.

The model order of complexity and the Web page cardinal number has the close relation and the page are more, the matrix computation is more complex, matrix sparse is also more serious. Makes the improvement to the algorithm is only to take the training regulations in the diary records the page carries on the serial number, but is not carries on the serial number to the entire website page as this may reduce when the cluster effectively page cardinal number improvement algorithm efficiency based on the listed standards.

$$d_E(A_{(\alpha)}^l, \underline{A_{(\alpha)}^l}) = \sqrt{\sum_{x_i \in A_\alpha^l}\left(\mu_{li} - \mu_{\underline{A_{(\alpha)}^l}}(x_i)\right)^2} \tag{12}$$

$$d_H(A_{(\alpha)}^l, \underline{A_{(\alpha)}^l}) = \sum_{x_i \in A_\alpha^l}\left|\mu_{li} - \mu_{\underline{A_{(\alpha)}^l}}(x_i)\right| \tag{13}$$

$$\varepsilon(x_i, x_j) = \frac{1}{m}\sum_{t=1}^{m}\left(\mu_{x_i}(x^t) - \mu_{x_j}(x^t)\right)^2 \tag{14}$$

Search engine users of the core different dynamic behavior is essentially different between the data set O sequence will show a number of different behavior patterns. In order to represent this heterogeneity, we assume that different user behavior patterns belong to different clusters, and the number of clusters is K; then, the user action sequence is modelled as follows.

$$F_k = \frac{S_k}{\sum_{i=1}^{n}(u_{ik})^m} \tag{15}$$

$$\sum_{l=1}^{c}\mu_{ik} > 0, \forall x_i \in X \tag{16}$$

This paper will study the bayesian harmony of theory is applied to Markov hybrid model is proposed for the harmonious degree of the model function and adaptive gradient algorithm, and can then better solve parameter learning at the same time automatic model selection problem. Based on the improved clustering algorithm, the

K-medoids, the users are clustered according to the user rating, and the score-based user neighbors are obtained. K-medoids clustering is carried out by standardizing the basic original attributes of users that combined with the comprehensive cloud model of attribute evaluation, user rating clustering, user attributes clustering of neighbors and the set, to the target user recommendation project shown as the following figure.

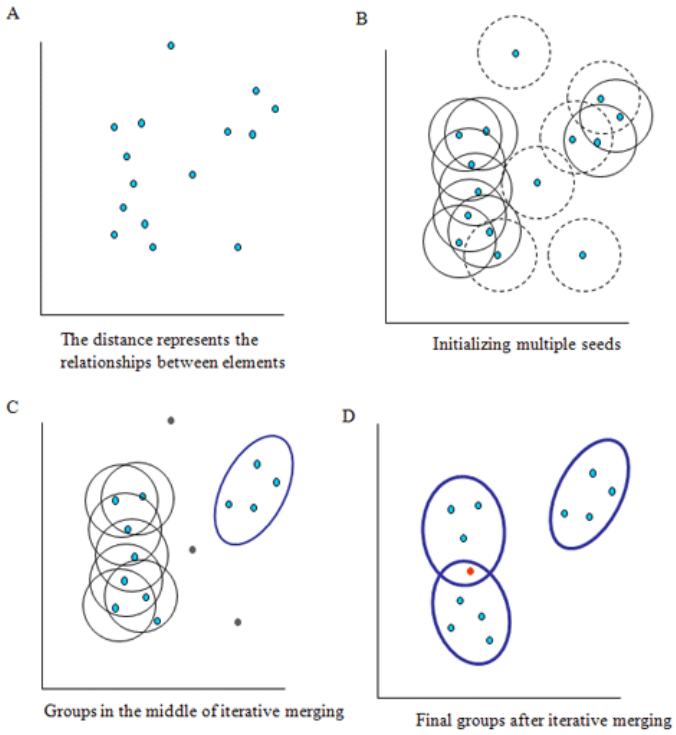

Figure 6. The Sample Cluster Demonstration for Reference

User is an important component of network user's behavior is bound to be on the performance of network such as network capacity, quality of the service, etc. Uses from the top method, uses user classification system which establishes, establishes the context main body, in the rich this domain approves together the glossary, use description logic, through the concept between relational description concept semantics, inquired into between concept intrinsic connection, and establishes the primary correlation inference strategy, strengthens its semantic inference ability. When in view of OWL facing magnanimous context information, the memory and the inquiry efficiency low question, the use relations database creation context memory system, designs OWL to the RDB split-second-selection algorithm. Structurized or half-structurized way, use linear logic carries on the description to the user behavior static attribute and the dynamic evolved characteristic, the establishment has the increase learning capability, the extendibility strongly, the flexibility good context sensation user behavior model and simultaneously uses the OWL construction based on the main body user interest model.

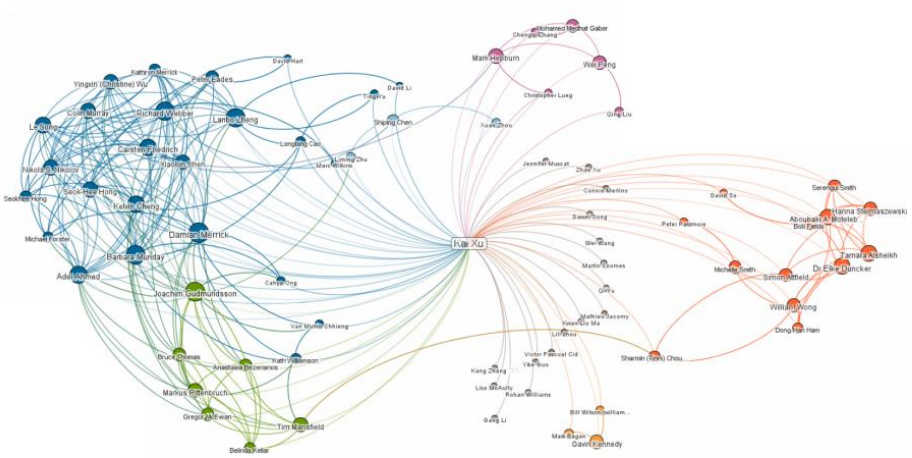

Figure 7. The User Behavior Pattern

Feedback credibility measures the trustworthiness of the general system to then provide the trust value of the recommendation trust value, that is, when the feedback credibility of the server is low, the recommendation trust value provided by it is false when the feedback reliability is high, it is believed that the recommended trust value is trustworthy in the calculation of the entity trust, the feedback credibility is used as the weight of the recommendation trust value. In order to simplify the analysis to be possible from, a two factor obtaining, if the user most cared about cost and QoS as the user is not irrevocable by chance has the uncertainty under the specific goal and the situation, therefore, the user appraised by chance the model the construction in fact is the research based on the indefinite information auto-adapted feedback decision question. In the traditional analysis method, the motion proxy after obtains the integrity user by chance structure, through certain time decision that found the best service strategy, in the figure 8, we show the simulation result.

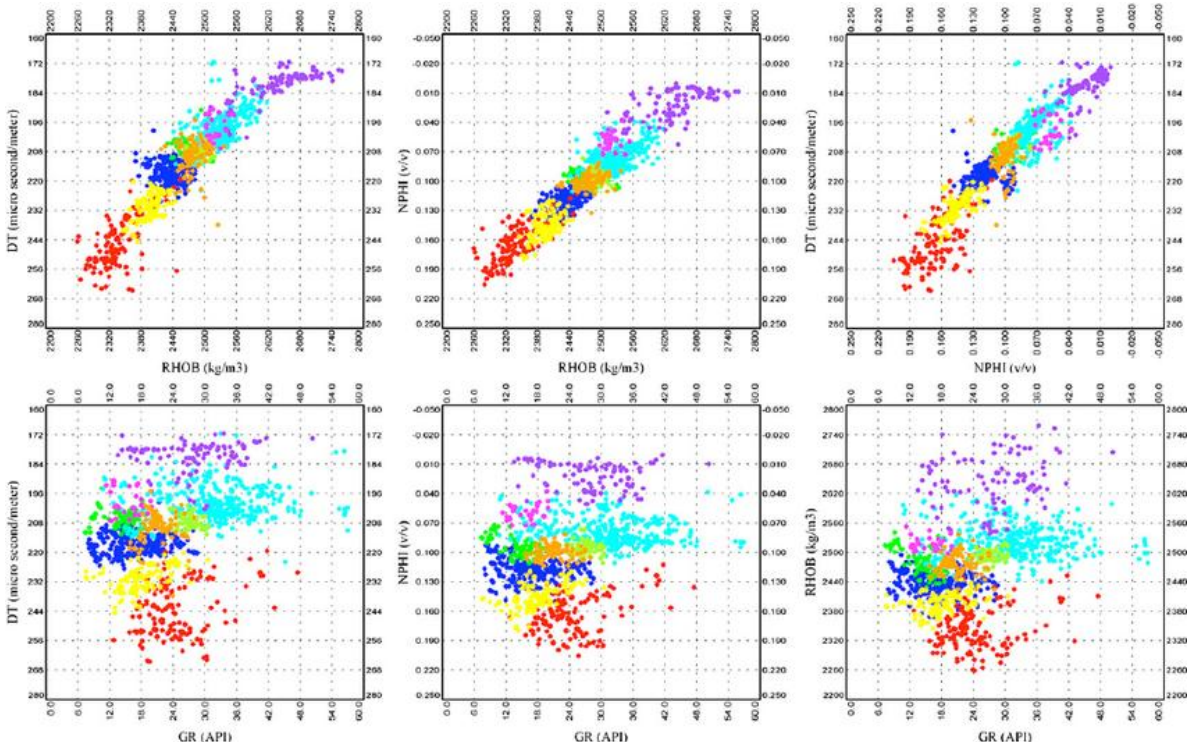

Figure 8. The Overall Systematic Performance Demonstration

4. CONCLUSION

This manuscript proposes the novel E-commerce intelligent recommendation system based on user behavior mining. The system uses the trust computation and does not use the trust computation the success to lead all to differ alternately not in the big way, after but period of time, in uses the trust computation in the system, along with trust computation thorough, and the system distinguishes the malicious user and the malicious service side gradually, and strengthens in the system decision-making to the malicious user's service control, thus, the system success leads along with the time increasing to enhance unceasingly alternately. Because but it has not used the trust computation the system to be unable to distinguish the malicious user, causes its success to lead to maintain basically alternately at malicious user and in the validated user visit ratio. With the integration of the NN and fuzzy set theory the revised model is then finalized. The experiment result proves the effectiveness of the model the future research will be more focused on the systematic verification.

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