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An Advanced Recommender System for Intelligent B2B e-Services.

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ABSTRACT

E-services is a next phase of e-commerce and e-business which provides business services to a wide range of customers using web. Recommender System is one of the most important tools in the e-services. The ultimate aim of the recommender system is to generate the recommendations about the products or items accurately for the customers for which they are interested in. Even though in these recommender system the user ratings and user profiles are not represented accordingly. It is very hard for this system to extract the data properly and generate recommendation about the items accurately. The proposed work is to generate a system which uses fuzzy preference algorithm. Initially, not only the user ratings but also other parameters such as low price, high discount and maximum number of purchase of the product is also considered. These are used to construct the tree structure for the recommendation. The tree structures are then merged together using the similarity analysis algorithm and fuzzy preference algorithm in which all the attributes about the items or products are taken into consideration. This work also generates the group recommendations about the items from a large amount item sets for various applications includes biological domain.

Keywords: Fuzzy Preference, Recommender System, Tree Structure

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INTRODUCTION

The enormous amount of information available in the web provides great opportunity in developing the business to business e-services.

Hence the recommender system acts as a platform for providing suggestions to e-services. The process of obtaining ratings and suggestions from the users is the critical components in this system. Recommender system uses different criteria to extract and analyze the data which can be used to indicate the well-matched group of products. The most commonly used techniques are Collaborative Filtering, Content-based and Knowledge-based techniques. Because of the complicated tree structure of the user profiles recommender system is rarely used. To overcome these problems fuzzy algorithm is being used here.

Here all the data are collected together and the tree structure is constructed by considering all the attributes of the items or products. The trees are then merged together to get the best product from the list of several products. Finally the products are recommended in group which enables the users to select the accurately.

This will reduce the problem of information overload because of the abundant data present in the web. The use of fuzzy preference tree algorithm helps to reduce the complex set of data about the user profiles [1,2].

Related Works

Michael G. Adomavicius and A. Tuzhilin [3], present the overview of recommender system and explain about the categories of recommendation methods. These are classified into three main categories- Collaborative filtering, Content-based and Hybrid methods. This also explains various limitations of the recommender system and discusses the possible extensions that could be used to improve the performance of the current system and make it applicable to even large number of applications.

In the work of C.Porcel *et al* [7], fuzzy linguistic modeling was discussed to develop a recommendation system for the research resources. Due to the rapid growth of internet a large amount of data are created and delivered through the electronic media. This will create huge problem for the users to obtain the resources and they need tools to assist them. One such tool is the recommender system which aims to reduce the problem of information overload. More flexible information is required when the users take part in the process. This problem is handled by fuzzy linguistic modeling. This system helps the researchers to obtain the information automatically about research resources. It is developed by using some filtering tool and fuzzy linguistic modeling called multi-granular fuzzy linguistic modeling which helps to assess various qualitative concepts. Experimental results show that this system is effective and feasible.

Y. Cao and Y. Li [9], propose a system for developing an intelligent recommender system to reduce the problem of information overload about the products provided by the web through e-commerce enterprises. As there are large amount of products in the internet it will be difficult for one system to generate the recommendations. According to the salient features of the products, the personalized recommendation system should be developed and professional recommendation system should be formed for different products. This system proposes fuzzy-based system based on the customer needs obtained from the system-user interaction.

Proposed Work

The ultimate aim of the proposed system is to generate the recommender system which will highlight the user preferences and rating more accurately to produce the recommendations. This uses similarity analysis algorithm and fuzzy preference algorithm to extract and produce the finite results.

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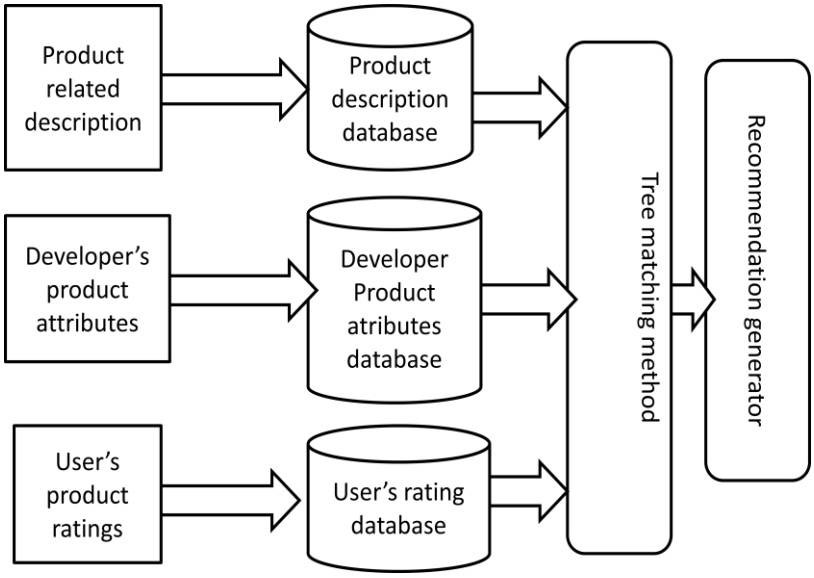

Fig. 1 Architecture of the Proposed System

The proposed system presents tree matching method and item based similarity analyzer for recommendation. Suggestions are made not only based on the users ratings but also include items attributes. It is not appropriate to consider only the users rating for suggestions. Thus the proposed system focuses on the attributes such as average ratings, maximum discount, minimum price and maximum number of purchase. All these criteria taken together are merged using conceptual similarity algorithm and recommendations are produced by using fuzzy preference tree merging algorithm.

The best products which are extracted from the large amount of item set is then recommended in groups. The group recommendation includes the products from different categories which are best in the market. This will help the customers to purchase the product easily and effectively.

The Figure 1 explains the proposed system architecture in which product-related description are stored in one database, developer product attribute in other and the user rating from the user is stored in another database. By using the tree merging algorithm the products are merged to generate the recommender system. This will solve the problem of complex tree structures and produce accurate results. Two algorithms are used here. They are as follows:

1. Similarity Analysis Algorithm:
2. Fuzzy Preference Algorithm

Algorithm 1: Similarity Analysis Algorithm
Input: Two trees Tu[a], Tp[b], Ma
Output: Extracting similar parts of two trees
Case1: Both trees are childless
smT1 (Tu[a], Tp[b]) = sm (A(tu[a]), A(tp[b]))
Case2: Only User tree has child.
smT1 (Tu[a], Tp[b]) = g.sm (A(tu[a], A(tp[b]))+(1-g).$\sum_{t=1}^{na}$.w_{at}.smT(Tu[a],Tp[b_t])
Case 3: Only item tree has child
smT1 (Tu[a], Tp[b]) = g.sm (A(tu[a], A(tp[b]))+(1-g).$\sum_{t=1}^{na}$.w_{bt}.smT(Tu[a_t],Tp[b])
Case 4: Both user and item tree has children
smT1 (Tu[a], Tp[b]) = g.sm (A(tu[a], A(tp[b]))+(1-g).smT (Ru[a_t], Rp[b])

Pseudo Code
BEGIN Procedure
Step1:
map setMa1←{(tu[a],tp[b])}

if child[tu]=null and child[tp]=null consider Case 1
else if child[tu]≠null and child[tp]=null consider Case 2
else if child[tu]=null and child[tp]≠null consider Case 3
else if child[tu]≠null and child[tp]≠null consider Case 4
End if
Step 2:
addNa←{tu[a1], tu[a2], ..., tu[an]} Np←{tp[b1], tp[b2], ..., tp[bn]}
Step 3:
for s=1 to na and t=1 to nb do
new map set $M_{s,t}$
$Rw_{s,t}$ ←smT (Tu[a_s], Tp[b_t], $Ma_{s,t}$)
Match (NaUNp, Rw)→M
When (tu[a_s], tp[a_t])€M
Ma_1 ←Ma_1U $M_{s,t}$
smT_2←0, map area Ma_2←null
Step 4:
for t=1 to n_p do
Create new map area $M_{b,t}$
Find max similarity
sm_t ←w_t.smT (Tu[a], Tp[b], $M_{b,t}$)
end
Step 5:
If smT_2 is less than sm_{t1} then map child [item] to user
for t=1 to n_b
Create new map area $M_{t,a}$
sm_t←w_t.smT (Tu[a], Tp[b], $M_{t,b}$)
End if
Step 6:
if sm_{tq}=max sim{smT_1, smT_2, smT_3} then
return max similarity tree
End if
END PROCEDURE

Algorithm 2: Fuzzy Preference Algorithm
Merge (T_u, n_p, P_{up}, $M_{u,p}$)
Input: T_u – Fuzzy Preference tree, np – product tree node, P_{up} – the user's selection value to the product,
Output: The maximum similarity tree matching between T_u and product tree $M_{u,p}$

Pseudo Code
BEGIN Procedure
Step 1:
If $M_{u,p}$ has leaf then Create a tree node x
    Insert(x, T_u)
    tree T_{np}←Copy Tree (n_p)
    SeNodeVal (T_{np}, P_{up})
    Insert (x, T_{np})
    T_u←x
else
    nm←GetMpapedNode (np, $M_{u,p}$)
End if
Step 2:
if nm ≠ null
if A(nm) ≠ A (np) then
tree T_{np}←CopyTree (np)
SetNodeVal (T_{np}, P_{up})
Insert (parent (nm), T_{np})
else

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Step 3:
if nm has no children then
let P_u be ($f_{1, unm}$, $f_{2, unm}$, ..., $f_{x, unm}$)
let nm.count be c
let P_{up} be (f1, $_{up}$, $f_{2, up}$, ..., $f_{x, up}$)
$f_{b,unm} \leftarrow (f_{b,unm}.c+f_{b,unm}) / (c+1)$, b=1,2,..,x
nm.count←c+1
else
for each child node np_c of np do
merge (T_u, np_c, P_{up}, $M_{u,p}$)
else
nm←GetMappedNode (parent (np), $M_{u,p}$)
Step 4:
if nm≠null then
tree T_{np}←CopyTree (np)
SetNodeVal (T_{np}, P_{up})
Insert (nm, T_{np})
else
n_t←SearchMapDescendant (np, $M_{u,p}$)
nm←parent (n_t)
remove (np, n_t)
tree T_{np}←CopyTree (np)
insert (nm, T_u)
$T_u \leftarrow T_{np}$
Merge (T_u, n_t, P_{up}, $M_{u,p}$)
End if
End procedure

EXPERIMENTS AND RESULTS

The performance of the proposed system is evaluated in comparison with the parameters of the existing system. The data sets of both the systems are taken in to consideration. The performance of the proposed system is evaluated using the following metrics.

Evaluation Metrics:

To analyze the accuracy the following metrics are considered.

- Recall: It is the fraction of favored products that are suggested.
- Precision: It is the fraction of suggested items that are favored.
- F Measure (F1): It combines recall and precision which is the harmonic mean of recall and precision.

$$\text{Recall} = \frac{\{\text{Favoured}\} \cap \{\text{Suggested}\}}{\{\text{Favoured}\}}$$

$$\text{Precision} = \frac{\{\text{Favoured}\} \cap \{\text{Suggested}\}}{\{\text{Suggested}\}}$$

$$F1 = \frac{2 * \text{Recall} * \text{Precision}}{\text{Recall} + \text{Precision}}$$

Figure 2 shows the performance analysis of existing and the proposed system. The above evaluation metrics are calculated for both existing and proposed system. Based on the value of recall, precision and F1 it is noted that the proposed system has more recall, precision and F1 values than that of existing system. Therefore the accuracy of the recommender system is improved.

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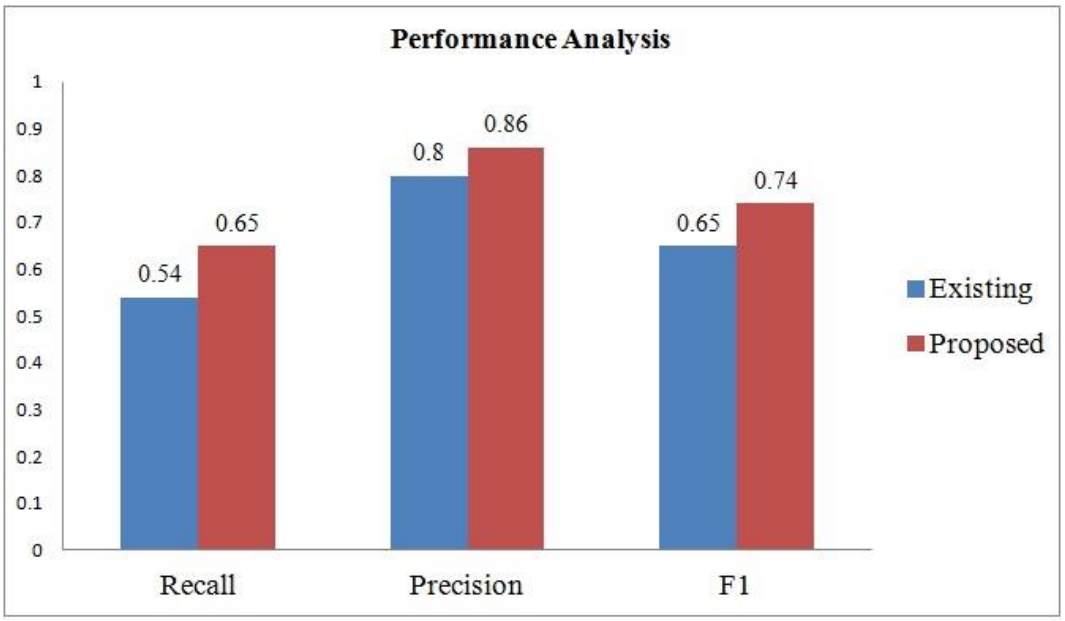

Fig. 2 Performance Analysis of Existing and Proposed System

CONCLUSION

In this paper, we have developed a recommendation system which generates the recommendation to the online users about the items or products effectively. The project presents efficient method for modeling fuzzy tree structured user preferences, present a tree combining method, and, based on the above methods, develop an innovative fuzzy preference recommendation approach. The proposed profile reflects user preferences effectively, and the recommendation approach demonstrates excellent performance for tree-structured items as compared to the other existing systems.This recommendation system can be applicable for finding the best item like drugs and medicines in biological domain.

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