Content-based recommender system for online stores using expert system

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***Abstract*—This paper deals with a content-based recommender system for online stores using the expert system. We propose an algorithm which adapts the content based on user preferences and the content viewed by the user. The main goal of the recommender system is to propose and deliver suitable content to the user. One of the goals of the proposed recommender system is to decrease the cold start effect. At the end of the paper, the proposed system is experimentally verified.**

Keywords— content-based system, recommender system, online store, expert system, adaptivity

I. INTRODUCTION

Nowadays, there are a lot of online stores which offer many products for various types of users. Users have different preferences and during a visit to the online store, it is suitable to offer them items which are the most relevant for these users. Currently, there are few approaches for adaptive web pages, which can adapt the content [1] [2] [3] [4] [5] [6] [7] [8].

In this paper, we will focus on web pages which contains products, typically e-shops.

II. METHODOLOGY

We propose content-based recommender system for recommending suitable content for online stores. Structure of the proposed system is visually shown in Fig. 1:

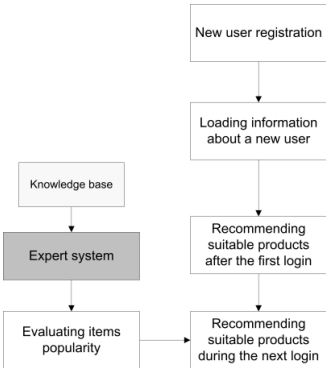

Fig. 1. Structure of the proposed system

Main parts of the proposed system are more described in the following subsections.

A. Loading information about a new user

In the first step, a new user is created. For the proposed system the following data are stored during a registration of a new user:

personal information (name and surname), login information, birth date, favorite categories of products.

B. Recommending suitable products after the first login

The prerequisite for this step is that the new user u_a has the basic information he filled in the registration. This makes the algorithm able to determine the user's similarity with other users (eg by computing Pearson correlation coefficient). The result is a set of P users who have similar interests as u_a users.

The algorithm is shown in the following steps:

1. Selecting a set of P users who have the same birth year as user u_a and there is at least one item view entry.

2. For the user in set P and user u_a, the vector of favorite categories is specified.

3. Calculating the similarity of users in set P with user u_a.

4. Users whose value of similarity is less than or equal to zero are excluded from the set P.

5. Items viewed by a user from the P set are selected by categories that are of interest to the user u_a.

6. These items are sorted according to the frequency of their occurrence and are recommended to the user u_a.

C. Recommending suitable products

To further deliver personalized content to u_a, a collaborative filtering system is used.

Description of the algorithm:

1. The algorithm retrieves all data for viewing items by all users in the system.
2. Each record is rated by an expert system (described below) from 1 to 5. This value indicates the popularity of an item by the user.
3. The algorithm then determines the similarity of user ua with other users using the Pearson correlation coefficient. It takes values from -1 to 1. The value of -1 indicates that the vectors are completely different, the value 1, on the contrary, that the vectors are the same.
4. For those items viewed by users with similarity to u_a greater than 0, a prediction of interest in this book is

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determined as
user similarity × item valuation by this user

5. Each item can be ranked more than once because it was viewed by more similar users. In this case, the algorithm works with the highest predictive value of interest.
6. Finally, all items are sorted from the highest prediction of interest and are recommended to the u_a user.

D. Evaluating the popularity of items using expert system

During the user's visit to the online store, the system (online store) stores information about date and time of item viewing, user ID, item ID, and category ID. The collaborative approach requires that each item viewed is evaluated by the user to determine the popularity of an item. We are using an expert system to evaluate the popularity of items.

The knowledge base of the proposed expert system contains three input linguistic variables and one output linguistic variables.

Input linguistic variables are: INP1 - the viewing time of the items, INP2 – how many times an item has been viewed by the user, INP3 - how many items of the same category the user was viewing.

Output linguistic variable is: OUT – the popularity of an item.

Here is an example of IF-THEN rule of knowledge base:

```
IF (INP1 IS SHORTLY) AND
(INP2 IS A FEW) AND
(INP3 IS LITTLE) THEN
OUT IS SMALL
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The expert system is created in the LFLC (Linguistic Fuzzy Logic Controller) tool [9].

III. Verification

For experimental verification, the online store contains books were selected.

In the first step, the user User1 registers in the online store using the registration form – with login user1, birth date: 21.1.1990 and favorite categories of products: detectives, adventure, fantasy.

Once a new user logs on to the system, the algorithm will deliver the first personalized content. The recommended books after the first login for User 1 are shown in Table I.

TABLE I. Recommended books after the first login

Category	Book ID	Book name
Detectives	10	Pentagram
Detectives	1	Double cross
Detectives	9	Bat
Adventure	24	Hero Nik
Adventure	22	Calling the genus
Adventure	28	Five weeks in a balloon
Fantasy	68	Snow like Ashes
Fantasy	7	The Hobbit or There and Back Again
Fantasy	63	Listener

Once a user views several books, they are recommended for books based on a collaborative filtering system. The recommended books for User1 are shown in Table II.

TABLE II. Recommended books

Category	Book ID	Book name
Detectives	5	Finders Keepers
Detectives	128	Wolf and dagger
Detectives	105	The Hound of the Baskervilles
Adventure	28	Five weeks in a balloon
Adventure	30	Twenty Thousand Leagues Under the Sea
Adventure	22	Calling the genus
Fantasy	112	Stardust
Fantasy	114	Throne of Glass
Fantasy	64	Faja

IV. Conclusion

In this paper, the content-based recommender system for the online store was proposed. The recommender system uses a collaborative filtering system for recommending suitable items and expert system for evaluating the popularity of items. The system also proposes an algorithm for showing items from similar users after the first login to decrease the effect of cold start problem.

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