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An improved electronic books recommender system

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Article Info

Abstract
Recommender system has the ability to capture users' interest and provide interested recommendations. This makes it easier to be applied in books recommendations domain in order to provide books of interest to student. In this study, the existing system studied fails to generate books recommendations based on user category interest which lead to uninterested recommendations. In this paper, an improved electronic books recommender system is proposed that recommends books to students. The system incorporate a mechanism to generate recommendations to student based on the previous books ratings and readings. It then enables recommendations of books based on categories since students may be interested in the books of the same category related to their respective courses of study. This makes it possible for the system to recommend customised books to the students based on their interests. The experimental evaluation conducted indicated that, the proposed system results demonstrated that, most of the students of the selected domain are averagely satisfied with the functionalities of the proposed system.

Keywords: Collaborative Filtering, Recommender System, Student Interest, Books, Customised Recommendations

1. Introduction

Recommender systems help users in finding items that they would like to buy or consider based on the huge amount of data at its disposal. This system saves a lot of time and effort of users typically involve in issuing different queries about the items of interest [1]. Example Amazon, Facebook and other commercial and social networking websites utilised these systems. It parses a huge amount of data to predict a user's preference based on similarity with other group of users. This system is categorised into Collaborative Filtering, Content-based Filtering, and Hybrid filtering [2]. These groups of recommender systems used many algorithms that could be applied on data to predict a user preference. The algorithms include User-based, Item-based and Model-based. These algorithms are typically used to provide good and interested recommendations to users.

Nowadays, the Computer science student's of Usmanu Danfodiyo University find it difficult to meet their respective reading materials corresponding to their various courses in the library which may resulted to failure in their semester's examinations. This occurs as result of large amount of electronic reading materials which makes it difficult for them to find the books of their interest such as operating systems books, software engineering, compiler construction, web design books, programming language books and many other more. This is due to the fact that, the system fails to generate book recommendations based on user category interest.

In this paper, an enhanced electronic books recommender system is proposed that recommends books to students. The system incorporate a mechanism to generate recommendation to student based on the previous books red and rated. It then provides customised recommendations of books based on categories since students may be interested in the books of the same category. This makes it possible for the system to recommend books to the students based on their interests. The experimental evaluation conducted indicated that, the proposed system results demonstrated the satisfaction of the students with the functionalities of the system.

2. Related Works

Rajpurkar, Bhatt and Malhotra [3] presented a book recommender system that recommends book to buyers. The system recommendations are done by combining the features of content filtering, collaborative filtering and association rule mining in order to recommends interested books to buyers. It considered some book parameters such as book content and quality by doing collaborative filtering on ratings of the other buyers. However, the system fails to recommend books to specific buyers such as secondary school students.

Almu and Mohammed [4] developed an electronic based books recommendation system based on collaborative filtering technique that recommends books to senior secondary schools students. The system provides recommendations according to the external examinations syllabi of the schools. The performance of the proposed system is evaluated based on the relevant of the books recommended to the students. However, the system is unable to provide recommendations to students beyond secondary schools.

Patil and Namdeo [5] proposed a hybrid book recommendation system based on data mining techniques for recommending books to users. The system displays books according to readers' preferences in a hierarchical way with a view to categorising readers' interest into different genres, so that new books can be appropriately presented based on users' needs. It then incorporates users' interest and books properties in order to generate best and efficient book recommendations. However, the system fails to generate recommendations to a new user.

Parekh, Mishra, Alva and Singh [6] presented a website-based personalized hybrid book recommender system using genetic algorithm. The system utilises various aspects of sending recommendations apart from the regular communal and content-based filtering approaches. It is hybrid in nature that integrates the outputs produced by every recommender at the basis of genetic algorithm. It also uses web scraping as a form of web content mining to help solve many limitations related to the filtering methods. The proposed system has higher capabilities than the existing one. However, the developed system is not suited for books customers with category interests that may prefer reading categorised books.

Rana and Deeba [7] presented a book recommendation system that uses Collaborative filtering with Jaccard Similarity to generate accurate recommendations to users. The system utilises Jaccard Similarity to compute the similarity between books rated by the user and the books available in the Book Crossing dataset. After similarities computations, all the books are sorted and the most similar ones to the books rated by the user are recommended. However, the system is unable to generate recommendations when there are none common ratings for the books items.

Rao, Jayaprakash, Thevar and Ravale [8] proposed a book recommendations system with the relevant text audio book generation that recommends books to books lovers. The system relies on dataset from Good books users consisting of ratings and item features to provide recommendations. The book audio generation is incorporated to improve the readers' literacy by controlling the way they want to listen, read and learn the book. However, the system ignores payment gateway which enable users to buy interested books with ease.

Gandhi, Patwal, Kumar, Kumar and Saxena [9] developed electronic book recommendation system using content-based filtering, which help user to get the best book of interest. The system utilises different parameters such as popularity based

model, same author and publisher of given book name, books popular yearly, average weighted rating based and correlation based to generate good recommendations to users. However, the system fails to generate customised recommendations to target users such university students.

Thus, considering the existing literature above, none of these presented systems provide customised recommendations to University student based on the books related to their respective course of studies. This forms the basis of our research work.

3. Proposed Work

In this section, an Improved Electronic Books Recommender system is presented.

3.1 System Architecture

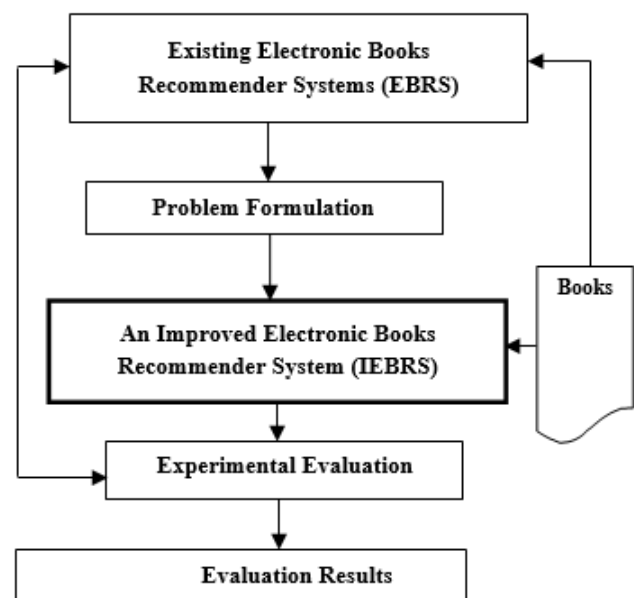The general scheme for the study framework is depicted in Figure 1.

Fig 1: Scheme of the Research Framework

3.2 Recommendation Approach Adopted for the Proposed IEBRS

EEBRS is a hybrid Books Recommender System that uses both books readings and ratings to recommend interested books to target students.

3.2.1 Books Representation

The book ratings are normally expressed in the form of mxn called user-item rating matrix shown as in Equation (1).

$$R_{m*n} = \begin{bmatrix} r1,1 & r1,2 & \cdots\cdots\cdots & r1,n \\ r2,1 & r2,2 & \cdots\cdots\cdots & r2,n \\ \vdots & & \vdots & \vdots \\ rm,1 & rm,2 & \cdots & rm,n \end{bmatrix} \quad (1)$$

Where,
R_{m*n} is the utility matrix
n is number of books
m is number of student.
rm,n is number of ratings giving to books by the students.

3.2.2 Similarity Computation

The measure used to find the similarity between two books,

where each book is represented by a vector containing student ratings is the cosine similarity and it is expressed as in Equation (2).

$$sim(i,j) = \cos(i,j) = \frac{\vec{i}.\vec{j}}{|\vec{i}|.|\vec{j}|} \qquad (2)$$

Where,
$\vec{i}$ is a vector representing the ratings for book i
$\vec{j}$ is a vector representing the ratings for book j.
After the similarity computation, the next step is to select the number of active books neighbours to predict rating score of the unrated book. The active book neighbours are selected by using the top-N approach [10]. The approach selects the top-N of books neighbours by using the similarity values from Equation (2).

3.2.4 Recommendations Generation
The prediction of books rating that may be interested to the target student is achieved using Equation (3).

$$p(u,i) = \frac{\sum_{N \in \text{similar To}(i)} * (S * R_u,N)}{\sum_{N \in \text{similar To}(i)} * (Si_N)} \qquad (3)$$

Where,
(p,u) is the predicted rating that student will give to a book

R_u, N is the rating student given to a book N
S_i is the similarity between book (i) and N.

3.3 System Procedure
The following are the steps that enable the system to recommend books to the student based on their interests:
Step 1: Register if not register before
Step 2: Login if already registered
Step 3: Read and rate [1...5] some books of your choice available
Step 4: Capture the records of the books red [interest] and rated
Step 5: Utilise the captured books records for similarity computations
Step 6: Select the top-N books neighbours from the computed similarity values
Step 7: Use the selected neighbours to recommend books to the student.

3.4 Recommendation Interfaces
3.4.1 Books Categories
This interface displays the electronic books according to the categories of student interest such as software engineering as shown in Figure 2.

Fig 2: Categories of Software Engineering Books

3.4.2 Book Rating
This interface allows student to rate a book and record the
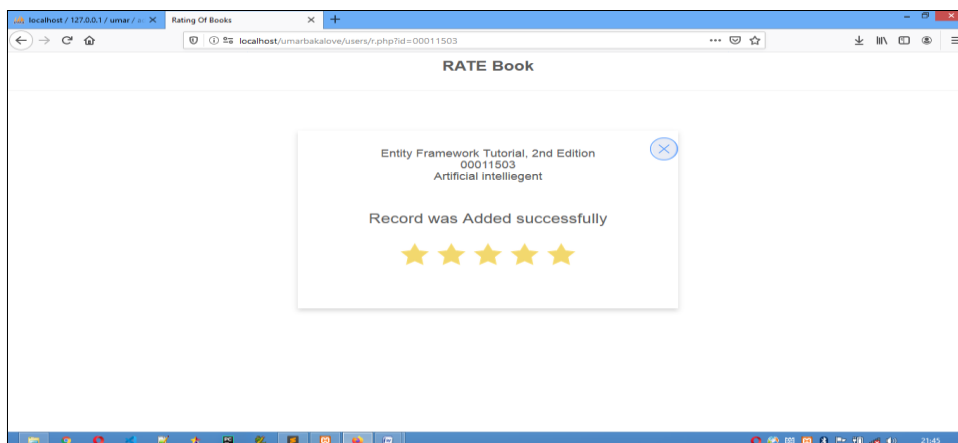
rating automatically as shown is Figure 3.

Figure 3: Student Books Rating

3.4.3 Books Recommendations
This is the interface that enables the system to recommend interested books to the target student as shown in Figure 4.

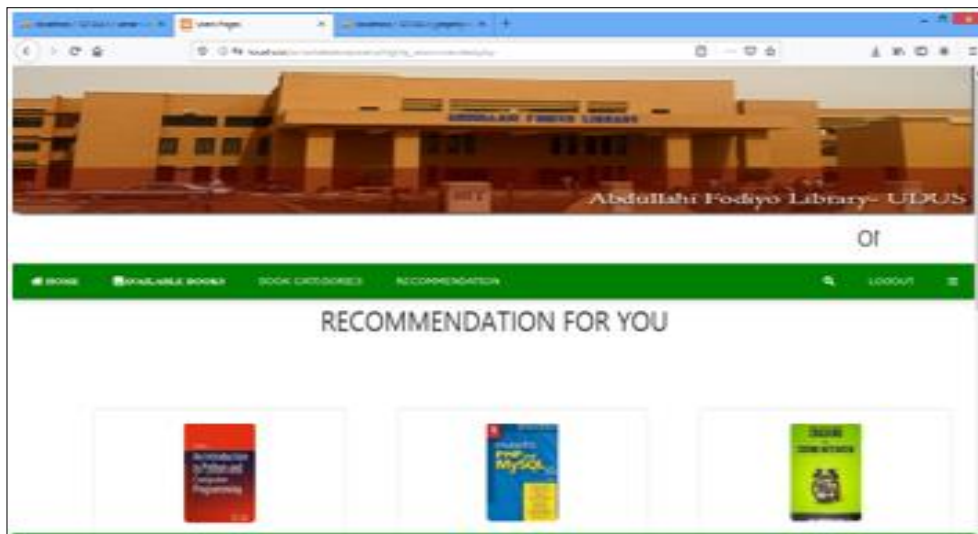The recommended books can also be used for reading and downloading.

Figure 4: Recommended Books

3.5 Experimental Evaluation
3.5.1 Experimental Environment
The computer system used for the experimental evaluation possesses the following requirements: Windows 8, 64-bit operating system, Intel (R) Core ((TM) i3-3120M CPU @ 2.5GHz) and the memory size of 4.0GB. The software technologies used for the implementation and experimentation are MYSQL database, Hypertext Mark-up Language (HTML), Cascading Style Sheet (CSS), Java Script (JS) and Hypertext Pre-processor (PHP).

3.5.2 System Evaluation
The performance of the proposed IEBRS is evaluated using some students of the selected domain, where each student is allowed to use the proposed system and decide it is relevance to target task. To capture the student feedbacks, the questionnaire was administered to fifteen (15) students after using the system to perform some tasks. It is made of (10) questions which requires the students to evaluate specific features of the proposed system. Each question is based on a 4-Level Likert scale with values 1 for 'Very Dissatisfied', 2 for 'Dissatisfied', 3 for 'Very Satisfied', 4 for 'Satisfied'. All the values corresponding to the scale selected by the students are added together and then divided by the maximum value which is then multiplied by 100(%) to obtain the score in percentage for each student.

4. Experimental Results
This section describes the experimental evaluation results of the proposed IEBRS as well as the presentation and the description of the results obtained from the study.

Table 1: Student Evaluation Results

S/No.	Students	IEBRS Scores (%)
1	S1	76
2	S2	80
3	S3	63
4	S4	83
5	S5	74
6	S6	83
7	S7	72
8	S8	75
9	S9	82
10	S10	69
11	S11	78
12	S12	59
13	S13	80
14	S14	76
15	S15	64

From the result of the student evaluation in Table 1, S1-S15 indicated the number of students that rated the proposed IEBRS system. The result from the table was converted into a bar chart in Figure 5.
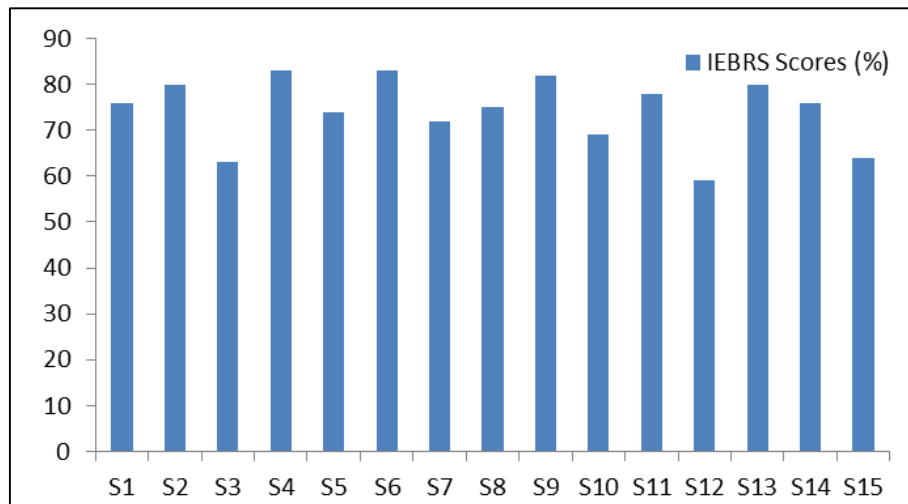
Fig 5: IEBRS Student Assessment Scores

Figure 5 indicated that, student (S15) assessed the proposed system with a lowest score of 64% while the student (S6) assessed the proposed system with a highest score 83%. The mean assessment the entire student scores is 73.5%. The results obtained indicated that, the students are averagely satisfied with the results given to them while performing their various tasks on the proposed IEBRS system.

5. Conclusion
The IEBRS is developed to assist students to find interested books related to their respective course of studies. It works with ratings and reading records of the student to suggest related books from huge books records available at it is disposal to give better recommendations. The system has been tested and assessed by some student of the selected domain in real practical scenario. The assessment conducted indicated that, most of the student averagely accepted the system based on assessment scores obtained in this study.
However, as a future work, the study should focus on dealing with unwanted books recommendations by the student. It is also suggested that, a chat forum should be incorporated to enable smooth interaction between students of particular course of study.

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