

A Personalized Web Based E-Learning Recommendation System to Enhance and User Learning Experience



Nidhi Joshi, Rajendra Gupta

Abstract: The key aim of the data mining techniques is to help the user by reducing the effort for exploring the data, recovering the patterns, and implementing applications that help to find the knowledge specific contents, decision making, and predictions. This research work develops a recommendation system by using the merits of data mining algorithms. They are used for designing web-based e-learning recommendation systems. This model aims to understand the user behavior and contents requirements of the learner. This purpose is solved by obtaining the information from the data source and producing the suggestions of suitable content to the learner. The concept of web content mining and web usage mining has been combined together for performing the required work. This technique involves the genetic algorithm and k-means clustering algorithm for designing the presented model. In this work the k-means clustering algorithm has been used to track user behavior and the genetic algorithm has been used as a search algorithm to find the necessary resources in the database. Finally, the presented system is implemented and its performance is measured. The estimated results demonstrate that the presented model enhances the accuracy of recommendations and also speeds up the computations. A related performance calculation has also provided to justify this conclusion. The obtained results demonstrate that this technique is acceptable for new generation application designs.

Keywords: recommendation system, web usages mining, web content mining, e-learning resource prediction, weighted recommendation system, results explication, performance calculation.

I. INTRODUCTION

In recent years the academics and their learning techniques are rapidly changed due to, the origin of innovative and new technologies in the education domain. Using these technologies the accessibility of learning resources are enhanced so that user can access these resources from anywhere and anytime. Therefore the popularity of e-learning is growing day by day. New learners not only are joining these networks frequently, but the data is also growing in these platforms much rapidly. Therefore traditional face-to-face style teaching is replacing by e-learning systems. On the other hand, the students could have similar interests, behavior and may have different levels of expertise. Hence they cannot be treated in a uniform manner. Therefore it is important to provide a personalized system that can automatically adapt the interests and levels of learners [1].

In this paper, the concept of e-learning has extended to offer personalized resources to the learners. Therefore an e-learning recommendation system is proposed. The presented recommendation system is based on user behavior, past data usage history, and the available contents. The e-learning systems basically contain a huge amount of content, but incorrect use of keywords can change the results. The correct selection of keywords is actually required during a search of information. So many times uncertainty in keywords may affect searching. A web event also has its semantic uncertainty. This uncertainty of the keyword system is seen as the uncertainty of web events [2]. Therefore this work involves the different techniques of web mining and data mining to understand the needs of the end-user. Using this technique the issue of finding the relevant content among the huge quantity of results and incorrect keyword-based search results can be prevented and used to preserve their time for finding appropriate contents. The searching of words is also time-varying, so the recommendation system also is changeable for current user behavior through his /her clickstream. So that generated recommendation to the client is a real-time basis.[3]. Keeping this entire problem PERS targeted the following objectives.

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1.1 OBJECTIVES

The discovery of knowledge in any huge data source is a complicated task. The number of visitors to the internet has created potential challenges of information overload which hinders timely access to items of internet on the internet. Some of the information retrieval systems have partially solved this problem but personalization of information is absent [4]. In order to find an effective and accurate the following intermediate objectives have established.

1. Scrutiny on web mining and their applications:

In this phase different web mining techniques, algorithms, recent contributions, and applications are being requested. This will help to address the core components of the system design and obtaining an effective solution for targeted aims.

2. A model for web browsing behavior identification and recommendation design: In this phase, the web usage mining and their techniques are explored. By using the obtained outcomes from the first phase, the design of a new recommendation engine is requisite. This helps to understand the user behavioral attributes in specific domain knowledge and web usage behavior.

3. Optimizing the recommendation by involving the user context and contents requirements: The core intention of the proposed technique is to improve the user experience for navigating the web-based applications for finding the contents, products, and services. That personalizes the user behavior of web navigation, the interest of domain, probability of user behavior, fluctuation and probability of content availability for recommending the most appropriate content to the user. This technique accomplishes the web usages based recommendation model in an optimized manner for user context understanding, and its performance improvements.

4. The performance exploration of the proposed system: In this phase, the proposed system is implemented and their performance with respect to the corresponding technique is evaluated.

World Wide Web is a rich source of information and knowledge. Every day new information and new dimensions are updated on the web applications for serving the products and services. In this context, internet users are always worried about finding the appropriate products and services according to their interests. Therefore the proposed work is intended to design and develop an enhance recommendation system which examines the user's behavioral pattern and web navigation habits and according to their behavior the particular services and products are to be recommended, thus the proposed work is also useful for enhancing the recommendation experience in various cross-domain applications.

1. User behavior and the content requirements:

User behavior and the user's content requirements are time-varying in nature. Therefore explications of the current user's requirements are to be evaluated for improving the performance of web systems.

2. Recommendations according to user requirements and other similar behavioral requirements:

In various applications where the recommendation systems are being used the contents, products or services are recommended

according to the popularity of products the actual requirements of the user are not much effective in such applications. In this work, the technique is suggested which not only considers the one point observation it includes multiple factors for demonstrating the user requirements and semantics.

- 3. Cross recommendation design according to the user's behavior:** Sometimes user interest and behavior are similar for various correlated domains and subjects such as story reading, watching movies and listening songs. These habits or behavior can also be utilized for one another. Such kinds of recommendation systems are known as cross recommendation systems. The work is basically intended to develop an efficient and accurate cross recommendation engine.

II. RELATED WORK

Many of the recommendation models on the web work on the concept of rating, reviews, opinion, complaints, remarks, feedback and comments to extract the behavior and timing of the user [5]. By using these concepts some models focus on the movie recommendation system [6]. Some helped tourist to predict traveling [7] [8]. A few works contributed to a video recommendation system [9]. Majorly till now, work has done on the E-commerce field [10] and also suggest are provided to the user on the social network [11]. The research work has covered nearly all domains like a movie, video, travel, e-commerce, social network. Nowadays users are facing problems in the E-learning domain. Learning is the basic need of everyone, but a huge volume of data on the web causes many problems to extract interested and required data by the user. Natasa Hoic-Bozic [12] presented a contemporary blended learning model within e-course. This model combines on LMS (learning management system) and the E-learning activities recommendation system (ELARS) to enhance the learning experience.

Linging Wu [13] proposed a semantic recommendation for educational resources based on Semantic web and pedagogics. Now the need for personalization is required so Daminda Herath [14] tried to use web mining techniques to give a recommendation based on their navigation behaviors, web contents, performances, and profiles. The collaborative filtering and content filtering are used to make it personalized. Learning is a basic requirement of elementary school and junior schools mainly. Richa Patel [15] worked to predict the user browsing activity & recommend the user next pages likely to be interesting. Some research work has developed keyword concept, Timing Hue [16] did the co-word analysis and collected keywords in articles from the academic journals to mean co-relation keywords. The field of news recommendation used as teaching material for teacher is also not untouched [17].

III. PROPOSED WORK- TFR SYSTEM

The aim of this research is to design and implement an accurate recommendation system for the e-Learning web portal system. The core concept, designed methodology, and algorithm are also discussed in this section.

3.1 Basic elements of system

The recommendation system is a kind of seed generation method which is used to suggest a list of most likely product or service which matches the behavior of the target user. The recommendation systems are mainly designed for e-commerce platforms for suggesting the suitable products to consumers. Therefore the recommendation systems use the knowledge of previous user behavior, interest, and personality of user. Personalization in learning are more useful for learners [19], so the personalization is helpful to improve the existing techniques. In this context, we proposed a new “**Tri-factor recommendation (TFR) system for the E-Learning portal**”. In order to develop TFR-system, the concepts of web usage mining and text mining techniques are involved. The web usage mining techniques help to understand the user behavior of web navigation using the web access log file observation. This examination is also helpful for personalizing data and user behavior. On the other hand, the technique of text mining is helpful to understand the data available in the E-Learning portal according to the interest of the end-user.

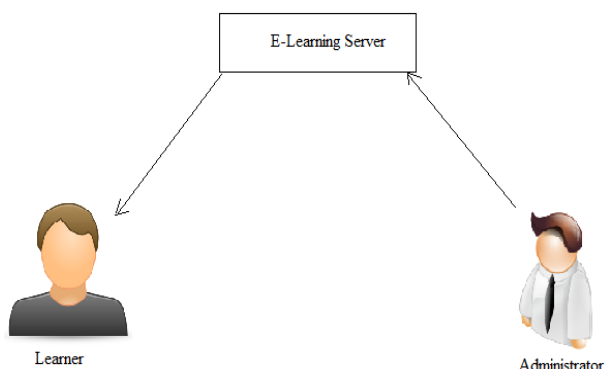


Fig 1 Basic elements of System

By considering all the factors listed above, a recommendation system is proposed in this work. This model consists of three main stack holders for the system:

1. E-learning server (infrastructure)
2. Administrator
3. Learner or end user

Figure 1 demonstrates the involved infrastructure and the actors of the system. These are the base component for the system. The activities of the users and infrastructure help to provide the required service i.e. learning using the web portal. The model contains the following components:

A. Learner or end user

The learner or end-user is the entity who is going to use the developed system or eLearning portal. Therefore that is the target user for whom the entire system is crafted. The end-user is responsible to create their account and find the contents from the learning site by browsing the topics or using the retrieval engine (using the search system).

B. Administrator

The administrator is the entity who is responsible for managing the server resources and the e-learning web portal. Therefore an administrator is responsible for uploading contents, managing topics and their sub-topics with contents.

C. E-Learning server

The e-learning server is the infrastructure server that is used to deploy the e-learning portal. In addition to that, it contains the algorithms and techniques which are used for exploring data, their organization, and also for retrieval of data according to the user query relevant records form the digital documents.

3.2 Methodology

The proposed system architecture is modeled using different data mining and web mining techniques. The initial system architecture of the proposed recommendation system is reported in figure 2. The model is described using the figure 2. It incorporates two different kinds of data sources. The first one is provided by the end-user and second is hosted into the webserver as the E-learning web portal. Both kinds of information are used for exploring and processing the user request or user query. Finally, the model returns the recommendations which can helpful for providing the content according to the user requirements. The following components are involved in this system.

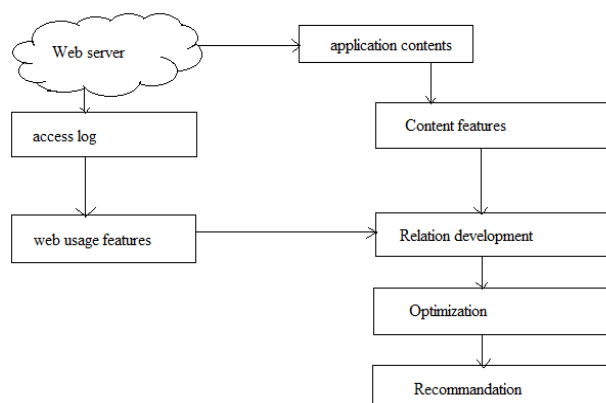


Fig 2 Recommendation Architecture

Web server: A web server is used to host web applications. The applications stored in the webserver can be dynamic in nature or static. The web servers have the ability to process or execute the code blocks of dynamic web applications and return the web pages. The generated web pages by the servers using the code blocks are accessible using the HTTP or HTTPS protocols using the web browsers.

Access log: The web server involves a number of background processes, therefore it needs to be audit the working of the server. Thus the web servers are enabled to report every event done in the server. Web server prepares different kinds of logs i.e. error log, access log, information log, and others. The access log is also known as the web access server log or web usages log. The web access server log files are maintaining each and every event performed by the end-user i.e. resource request and server response or the provided data/resource. The web server access logs are maintained on the server for each individual application hosted on the server. Therefore by using the available data on server log files are helpful for understanding the users and their interest, behavior and application trends. The web access server log files include a time stamp, request IP address, URL, protocols, and other application-specific

information. A simple web access log example is given in table I.

Table I Access Log Example

Example.com - - [06/Oct/2019:00:00:09 -0700] "GET / HTTP/1.1" 200 5258 http://www.example.com/academic_programs.htm "Mozilla/4.0 (compatible; MSIE 4.01; Windows 95)" example.com - - [06/Oct/2019:00:00:11 -0700] "GET /images/bullets/bsqs.gif HTTP/1.1" 200 489 http://www.example.com/ "Mozilla/4.0 (compatible; MSIE 4.01; Windows 95)"

Web usage features: The feature of data is the low dimensional representation of data. Therefore it contains only the essential part of the information that helps to recognize the pattern or target data. The example web access log as demonstrated in Table I shows the attributes available in the web access log file. All the features in the access log file are not used for designing the proposed recommendation system. Among some of the features are need to be selected for utilizing the proposed recommendation system. But before the extraction of the essential features from the web access log we need to preprocess the data. The preprocessing techniques are frequently adopted in different data mining applications. The preprocessing techniques are aimed to refine the information and reduce the noisy contents from the web access log file.

Therefore the following filtered information is obtained from the entire log file.

1. User IP address
2. Time stamp
3. Requested URL
4. Method

Remaining all the data from the web access log is remains as it is.

Application contents: The e-learning system contains a number of different topics, subtopics, and their contents. All the contents of this application are available in web document (web page) formats. During the retrieval and processing of user requests for content search, these topics' contents are omitted as search results.

Content features: The entire process handled in this modeling is provided for finding relevant content as well as recommending the contents which much relevant to the current user's context. In this context to reduce the data processing efforts, the content features from all the e-learning documents are extracted and organized with the target files. To select the features from the target document (web pages) the word frequency is used [7]. The word frequency of the target word in a document is computed using the following formula:

$$WordFrequency = \frac{targetwordcount}{totalwordsindocument} \dots\dots (1)$$

The computed word frequency is used to select the words from the given document as feature set, therefore the target web document and their features are used in the following manner, as given in table II.

Table II. This table is showing feature extraction from Web pages

Web pages	Features extracted
Datamining.jsp	Data, database, attributes ...
ComputerGraphic.jsp	Images, graphics, dimension,...

Relation development: In this phase, the extracted content features and the resource URL is used for finding the keywords which are relevant to each other. The URLs which contain the keywords available in the feature set are used for finding the related URLs and contents. The following algorithm is used for processing the data keywords and the target URLs.

Table III Relationship algorithm

Input: List of web page URLs WU_n , List of all extracted features F_m
Output: related links R_l
Process: <ol style="list-style-type: none"> 1. <i>for</i> ($i = 1; i \leq n; i++$) <ol style="list-style-type: none"> a. $temp = WU_i$ b. <i>for</i> ($j = 1; j \leq m; j++$) <ol style="list-style-type: none"> i. <i>if</i> ($temp.contains(F_j)$) <ol style="list-style-type: none"> 1. $R.add(WU_i, F_j)$ ii. <i>endif</i> c. End for 2. Return R_l

Table III provides a list of URLs with the relevant keywords which indicates the keywords can be found in the given URL.

After that, it is required to apply the search to the given system. Therefore we need to implement the search system in existing system architecture the extended architecture of the existing system is given in figure 3. The extended system architecture contains some additional components for finding accurate recommendations for the e-learning system. Therefore the entire data model is defined in two major modules:

1. **Search outcomes:** Relation development among the extracted keywords from the e-learning web pages and the target URLs are established using the algorithm given in table III. The outcome of this process is a data structure that contains the following attributes as demonstrated in table IV.

Table IV This table is presenting Relationship features

URLs	Respected Keywords
/e_learning/3d.jsp	Computer animation
/e_learning/computer_graphics.jsp	Computer animation
/e_learning/image_formation.jsp	Computer animation
/e_learning/object_detection.jsp	Computer animation

Query Keywords: The keywords which are used by the end-user for finding the contents from the e-learning system. So the query contains a phrase or a set of keywords that is a search on the existing web page database.

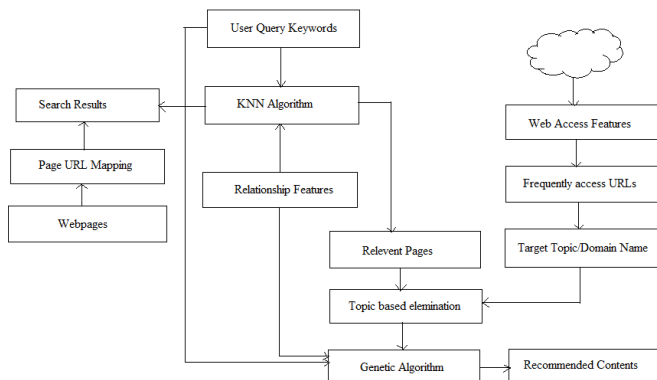


Fig 3 Extended system architecture

KNN (k-nearest neighbor) algorithm: The KNN algorithm is a distance-based classification perspective. This technique finds the difference between two given sequences of data, in which the first of them is query sequence and the second one is database sequence. By using distance computation it distinguishes, how many features are different from each other. If maximum sequence attributes are similar then the distance is minimized otherwise it obtained as higher [8]. For computing the distance among two sequences the following formula can be used.

$$D(x, y) = \sqrt{\sum_{i=1}^n (x_i^2 - y_i^2)}$$

Where $D(x, y)$ is the distance measured

x_i and y_i are the query sequence and database sequence

Therefore the following process is used for finding the user input query sequence.

Table V- KNN based search

Input : relationship features R_l , user query keywords Q
Output : relevant content page RP
Process: 1. $[PageURL, Keywords] = readRelationship(R_l)$ 2. $for(i = 1; i \leq keywords.length; i++)$ a. $D(Q, Keywords) =$

```


$$\sqrt{\sum_{i=1}^M (Query_i^2 - keywords_i^2)}$$

        b.  $if(D \leq 0.25)$ 
            i.  $RP.Add(PageURL)$ 
        c. End if
    3. End for
    4. Return RP
    
```

This process returns the query-relevant web pages from the e-learning application. Also enable navigation with the results the mapping between web page URL and search results data is performed. After that, the search technique works according to the user input keywords.

On the other hand, it needs to suggest or recommend web pages or web content for the user context. Therefore user web page recommendation is also employed with this methodology.

2. **Recommendations:** In order to recommend the web pages for the end user again the relationship features are used. The web pages which are obtained by the KNN algorithm are combined in this stage. Also, the filtration of the data is performed. To filter the data the following processes are included with the system.

Web access log features: The web access log is previously established and the required features from the weblog data are extracted. These weblog features are used here for finding the user behavior and domain of interest. Therefore the frequency of the different web pages which are accessed by the current user is evaluated. To compute the frequency of the user accessed web pages the following formula is used.

$$webpageaccessfrequency = \frac{C_A}{C_p}$$

where C_A is the count of a web page from a domain

C_p is the total number of web pages accessed

The top visited subjects/domain/topics are identified from the web page frequency of visits. Using the identified topic names the web pages of relationship features and the KNN search process are eliminated and remaining web pages are used in further for finding the most suitable recommendations.

Optimization: After the elimination of web pages from the combined set of search results and relationship features the optimization process is applied. To optimize the recommendations the user query and the combined data are used with the genetic search process. The genetic algorithm is a naturally inspired algorithm. It works on the following four steps [9]:

1. **Selection:** The genetic algorithm is to work with the population. Here the term population is used for the initial solutions available for search. In our context, the combined set of web pages that are filtered using subjects criteria is used as the initial population. The algorithm selects the N/2 solution among them

- randomly for evaluation with the next steps.
- Crossover:** After random selection of the available solutions the cross over operation is performed. The crossover helps to design a new set of solutions from the selected solutions. The newly generated solutions are evaluated in the next phase.
 - Mutation:** The crossover based generated solutions are used with the mutation operator. Using these solutions is repaired and new solutions are tested for finding the fit solutions. If the solutions are repairable then it is repaired using the insertion, deletion, replacing the attributes otherwise the solutions are removed for next phase scrutiny.
 - Update:** In this phase, the fitness of all the solutions is estimated using the fitness function. The higher fitness values-based solutions are preserved and the remaining solutions are removed. The obtained fit solutions are updated as the population for next-generation evaluation. Here the distance function is used as the fitness function of the algorithm [10].

Recommendations: The genetic algorithm continuously works on the population to find the best-fit solutions. After reaching the termination conditions the algorithm is stopped working and generates the final outcomes. The outcome of the genetic algorithm is given here as the final recommended URLs for the end-user.

IV RESULTS AND DISCUSSION

This section includes the details about the evaluation of the TFR content recommendation system for the e-learning web portal. Therefore, the accuracy and error rate is measured first to know the system performance and their resource preservation ability is measured in terms of time and space utilization.

4.1 Accuracy

Here in terms of accuracy, the working of the TFR content recommendation system is to be examined. The accuracy of a data mining system is evaluated by using the total patterns correctly recognized over the total samples produced for prediction. Therefore, the following formula is used for computing accuracy:

$$accuracy = \frac{total\ correctly\ classified\ samples}{total\ sample\ to\ be\ predict} \times 100$$

This formula is used for predicting the possible useful content for the target profile user. Therefore, similar behavior contains are used for the recommendation system. Therefore a sequence of web pages accessed by the user is used for predicting the next possible web page. When the predicted data URL is matched with the considered sequence next web page then the recommendation is captured as accurate otherwise an error component is considered. The experimental observations for the different samples are demonstrated in figure 4 and table VI. This Table contains the obtained system performance for two different perspectives, namely the proposed recommendation model and the existing recommendation model. The performance of both models is demonstrated in terms of percentage precision. The X-axis of this diagram contains the different set of samples which are used for experiments. The Y-axis shows the obtained accurately predicted values in terms of percentage. According to the

obtained performance in terms of accuracy the TFR technique perform superior than the traditional recommendation model based on the simple collaborative filtering based precision.

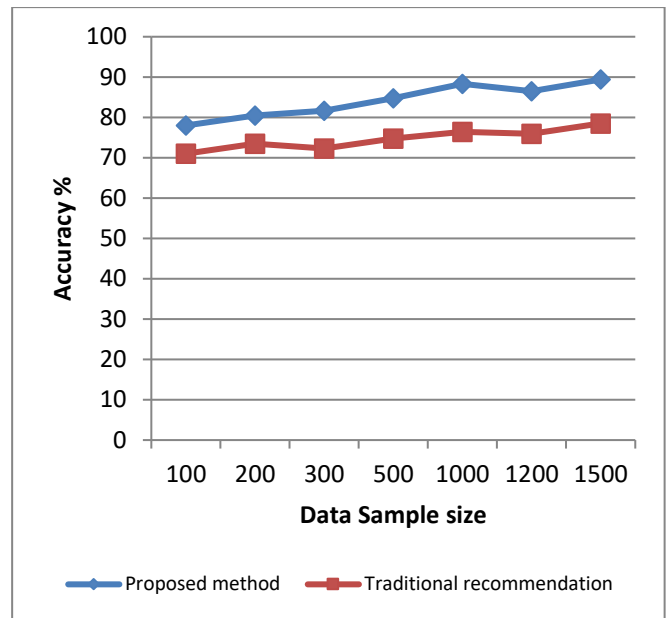


Fig 4 this graph is representing accuracy graph

Table VI- This table is showing accuracy of system over traditional system

Sample size	Proposed method	Traditional recommendation
100	78	71
200	80.5	73.5
300	81.66	72.33
500	84.75	74.75
1000	88.32	76.39
1200	86.49	75.92
1500	89.4	78.51

4.2 Error Rate

The error rate of a data mining model is the measurement of misclassified or unpredicted outcome over the total data samples produced for prediction. Thus it is the ratio of total incorrectly recognized sample and the total sample produced for recognition. That can also be computed using the following formula:

$$errorrate(\%) = \frac{total\ misclassified\ sample}{total\ sample\ to\ classify} \times 100$$

Or

$$errorrate(\%) = 100 - Accuracy(\%)$$

Table VII this table is giving data of TFR system on error rate measured against the traditional system of recommendation

Sample size	Proposed method	Traditional recommendation
100	22	29
200	19.5	26.5
300	18.34	27.67
500	15.25	25.25
1000	11.68	23.61
1200	13.51	24.08
1500	10.6	21.49

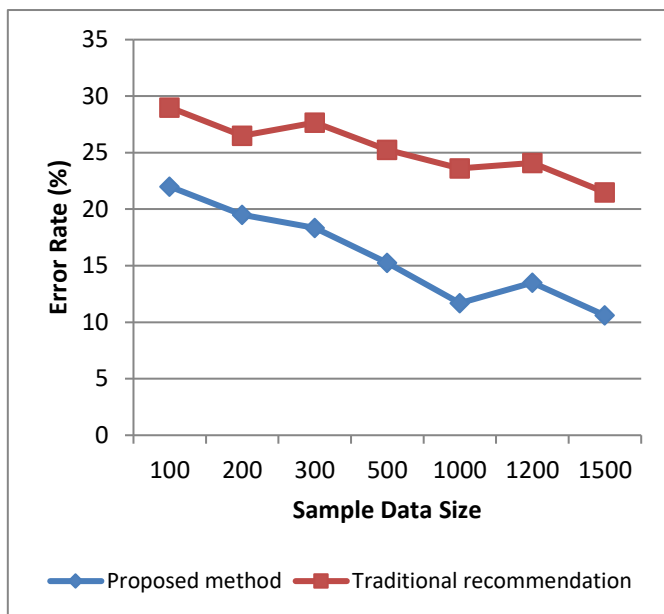


Fig 5 this graph is representing error rate obtain after evaluation on mentioned formula. On X axis sample data size is presented and on Y axis error rate is shown.

In order to measure the performance of both the system in terms of error rate, a similar strategy is used. Thus the error rate of the proposed and traditional system is also measured in percentage. The observed experimental error rate of the system reported in terms of values in table VII, whose graphical representation is used for demonstrating performance in terms of a line graph. In this line graph, X-axis consist of the different size of samples used for experimentation, where the Y-axis contains the obtained performance in terms of percentage. According to the obtained performance, the proposed technique produces less amount of error as compared to the traditional technique. Thus the TFR model for the E-learning recommendation system is performing superior to the traditional E-learning model.

4.3 Memory Usages

Memory is an essential parameter for measuring the efficiency of a computational algorithm. This parameter is also known as the memory usages or space complexity. Basically here the process for computing memory is done by using the JAVA technology. In JAVA the process memory usages are computed using the total assigned memory to the process and the actual memory currently not utilized during process execution. Thus, the following formula can be used for measuring memory usage.

$$\text{memoryusage} = \text{memoryassigned} - \text{totalfreememory}$$

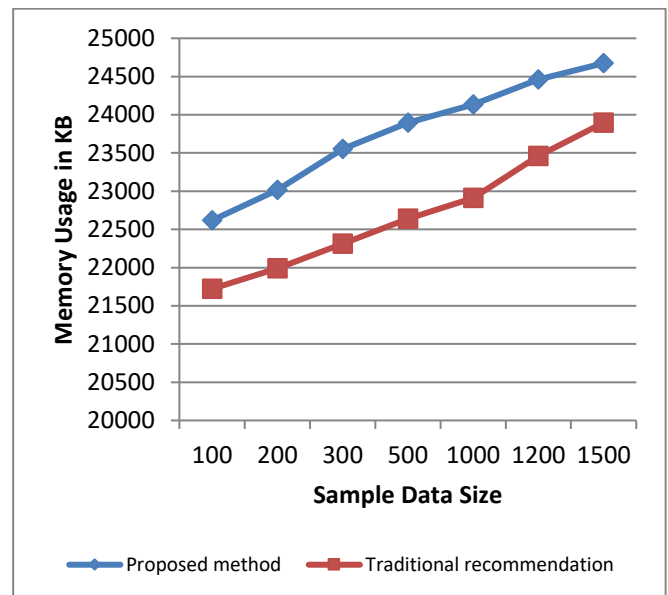


Fig 6 The X axis of this line graph shows the sample data size and the Y axis shows the observed memory utilized by the algorithm during experiment.

Table VIII the experimental outcomes of memory usages are shown in this table.

Sample size	Proposed method	Traditional recommendation
100	22618	21722
200	23017	21989
300	23551	22312
500	23894	22638
1000	24132	22909
1200	24459	23461
1500	24674	23896

The memory usages using the java based technique is measured here for both kinds of recommendation system. The observed experimental outcomes are reported in table VIII.

The values observed in this table contain the peak values which are we found during the observations, therefore an only a limited amount of experimental outcomes are reported. Their line graph representation is given in figure 6. The X-axis of this line graph shows the sample data size and the Y-axis shows the observed memory utilized by the algorithm during the experiment. The mean memory usage value is demonstrated here. According to the performance in terms of memory usages, the proposed technique consumes additional memory as compared to the traditional collaborative filtering based recommendation model. Because it needs to behold more data as compared to the traditional method, therefore the TFR technique is computationally cost-effective as compared to the traditional model.

4.4 Time Consumption

The time consumption of the algorithm is also termed as the time used or the time complexity. The total time utilized for computing the required outcomes is known here as time consumption.

Table IX this table presents time consumption during the initialization and execution of the used algorithm.

Sample size	Proposed method	Traditional recommendation
100	269	309
200	298	351
300	352	387
500	389	418
1000	442	462
<i>timeconsumed = Endtime – algoritstarttime</i>		
1200	480	497
1500	512	549

The time consumption of the proposed demonstrated models is described using the time difference between algorithm initialization time and the end time of algorithm. The following formula can be used for this task.

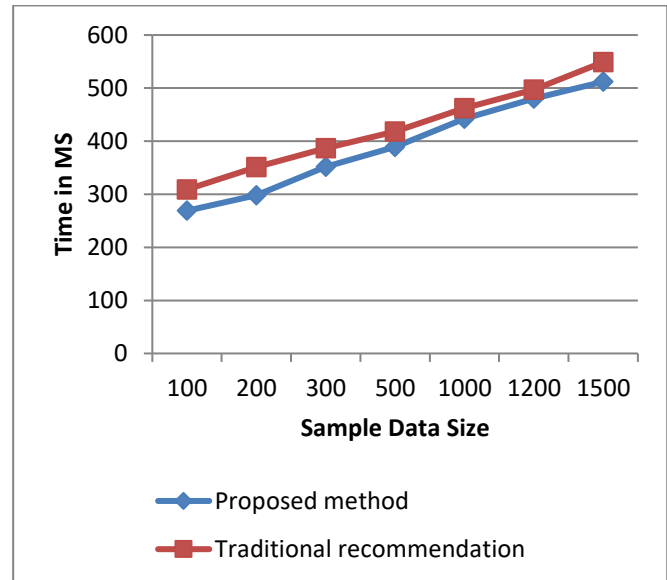


Figure 7 The X axis of this line graph contains the dataset sample size and the Y axis shows the time consumed for execution. The measurement of time is in millisecond (MS).

The time consumed during algorithm execution for both the techniques are demonstrated in table IX. The table contains observed execution time for processing the data to generate the recommendations. The graphical representation of this data is explained in figure 7 in terms of a line graph. The X-axis of this line graph contains the dataset sample size and the Y-axis shows the time consumed for execution. The time measured here in terms of milliseconds (MS).According to the obtained values, the proposed system demonstrates low time as compared to the traditional model for processing the data for prediction.

V CONCLUSION AND FUTURE WORK

This research work consists of three factors (TFR) web access log, web usage mining, and user behavior. The TFR system includes KNN and genetic algorithm for searching content and optimizing results to generate a recommendation to end-user (learner). KNN is used to record the behavior of users. A genetic algorithm is used to optimize the search result and provide better recommendations to the learner. Also, this work is evaluated with a traditional E-learning recommendation system with respect to the accuracy, error rate, and memory usage and time consumption. This research work improved the learning experience of users. As the parameters of accuracy, error rate, memory usage, time consumption are found superior to the existing techniques for recommending the contents and material in the e-learning applications.

5.1 Conclusion

The recommendation systems are the application of data analytics. Therefore different data mining algorithms concepts are being used for designing the recommendation systems. Initially, the recommendation systems are designed for providing the suggestions of products in e-commerce web platforms, but due to the ability of the recommendations that are being used in various domains of applications for finding the possibility and prediction. It is then started to recommend in the field of E-learning.



In this presented work E-learning web portal content recommendation system design is the core area of research. Additionally, by involving the different existing concepts a new recommendation model is proposed for design and implementation. This TFR system is basically employed on the e-learning web platform for understanding the requirements of end learners and suggesting the relevant educational material according to their behavioral identification.

In this context, the TFR technique involves the classical recommendation design concept such as user profiling, behavior identification, and categorization. As well the system involves the web concept mining technique for exploring and categorizing the concept of the web portal. Using this technique the search space is reduced and the performance of the proposed system scaled in terms of time and memory resource expenses. Finally, the web usage techniques are utilized to combine the obtained knowledge for target user behavior identification and obtaining precise recommendations. Therefore the implementation of two popular data mining algorithms is performed in this work namely the k-means clustering algorithm and the genetic algorithm as the search solution.

The proposed system for supporting the e-learning platform as a recommendation engine is developed using JAVA technology. In this context, Net Beans IDE is used for designing and implementing the proposed system. It preserving the performance of the proposed system for relative execution, the MySQL server is also used. Finally, according to the computed performance, the summary of the performance is prepared as given in table X.

Table X This table representing the overall performance summary of TFR system.

S. No.	parameters	proposed technique	existing technique
1	time consumption	269 – 512 MS	309 – 549 MS
2	memory usages	22618-24674 KB	21722 – 23896 KB
3	accuracy	78 - 89.4 %	71 - 78.51 %
4	error rate	10.6 – 22 %	21.49 – 29 %

According to the demonstrated performance summary in table X the proposed technique is found superior to the existing techniques for recommending the contents and material in the e-learning applications. Thus the proposed solution is acceptable for real-world solution development.

5.2 Future Work

The research work is aimed to provide an accurate and efficient recommendation system for e-learners which is able to understand the end-user behavior and precise

requirements to deliver the required contents. The required recommendation model is designed and implemented successfully. Therefore the following future extensions of the work are proposed.

Nowadays the video-based content is also being used in e-learning platforms therefore it is required to enhance and extend the current model for video-based learning content recommendations.

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