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# ***Cloud Based Collaborative Filtering Algorithm For Library Book Recommendation System***

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***Abstract - Library book recommendation system is an automated system which helps to carry out the library's everyday work in a productive manner. A library is a website where the admin develops a system to store and retrieve books can from the database. This cloud-based library recommendation system makes use of a collaborative filtering algorithm where the admin adds the books based on categories and also recommend the top-rated (5-star rating) books to the user. The user can sign in into their account using the autogenerated password which is sent to their authentic email ids. Although after the user can perform many functions such as update his/her profile and also view the books in a subject-wise manner. Each category recommends one or more top-rated books to the user where the user can find the related books faster without wasting much time in searching the book. The user can even have a live chat with other users to take suggestions over the respective books. He/she can also place a borrow and return request to the admin to ship the book and also allow the user to rate the book and give user feedback which he/she is borrowed. Overall, our system is been developed using the collaborative filtering methodology to recommend the books to all age group category which can reduce the human effort of the user where he/she going to a public library in search of books. This system is free of cost and reliable and also provide the books directly to their house just by placing the borrow request.***

***Keywords— Recommendation system, Library system, Collaborative filtering algorithm.***

## I. INTRODUCTION

Data mining is characterized as a process for extracting useful data from any larger collection of raw data. Data mining means the extraction of data from a vague set a database. Data mining is a method in which the raw data becomes usable information. Data mining relies on efficient data collecting, storage and computer processing. To gather concrete patterns and trends, data mining involves exploring and analysing broad blocks of information. It can be used in a variety of ways, such as selling the database, controlling credit risk, detecting fraud, filtering spam messages, or even discerning user feelings or opinions. The process of retrieving data breaks down into five stages. Firstly, companies are gathering data and loading it into their data centres. Next, they store and manage the data, either in-house or cloud servers. Administrators access data and decide how they want to arrange it. The system then sorts the data based on the

performance of the user, and eventually, the end-user presents the data in an easy-to-share format, like a graph or a table. Warehousing is a big part of data mining. Warehousing is when organizations centralize data into one database or system. Information processing programs, based on what information users want or receive, break down trends and associations in the information.

Library Management System is a web application that manages a library's repository. This helps preserve databases of whole book purchases available in the library. A library that is easy to use and meets a librarian's single requirement. Several features help librarian keep track of books available, as well as books published. This system is a web-based application built by asp.net technology that lets the user use a recommendation engine to get the top-rated books from the database. The admin can add categories, books into the database and also use information can be stored into the database and the data can be retrieved whenever necessary. In this system, the data mining technique is used to fetch data from the database. And different types of recommendation engine are used to recommend books to the users.

This system helps us keep track of different categories such as; books, journals, magazines, etc. A simple way to approach to new books subject-wise. Keep a record of complete book details such as; the name of the book, author name, name of the publisher, date/year of publication, date of purchase of the book. A comfortable way to check-in, and then check-out. An automatic perfect reckoning for late returns. Related search criteria for a title. Different forms of reports such as; the total number of books, number of books published, number of journals etc. A quick way to know how many books a predetermined consumer gets. A convenient way to the book rank.

## II. OBJECTIVES

The library management system used for library book recommendations. Here admin will add books and categories. Admin can handle user-sent book borrowing and return requests. Admin can view feedbacks, users and chat histories. User can post feedbacks, request to borrow a return book

based on their interest. Users can live chat between different users, and view recommendation and update profiles.

### III. LITERATURE SURVEY

Yash Trivedi.Et.al [1] developed “SmartBook Recommendation System for Library Books: LibX” (July 2018) in this system they have developed the library system that can be accessed in a remote place like in the schools and colleges for faculties and students. In this system, they have used information filtering methodology which predicts the ratings and the user feedback the drawback of this system is that there is no proper recommendation system which can recommend the books to the users.

Khalid Anwara.Et.al [2] implemented “Machine Learning Techniques for Book Recommendation” (January 2019) in this paper they have used machine learning techniques which help them to improvise their recommendation system using supervised learning and also clustering methods to fetch the data. The program focuses mainly on the sellers and e-commerce platform consumers growing revenues.

Satish Kolhe.Et.al[3] implemented “classification of library resources in recommender system using machine learning techniques” (January 2018) in this system they have used the set rule extraction technique to implement the content-based algorithm which classifies the books into different categories and help the user to find the books through the categories and another idea proposed by this system is the books to be placed in a decision tree format so that the users can get the appropriate books, papers etc. this system can be expanded by having a good database and recommendation systems which reduce the time of the users to find books through the categories.

Suhasini Parvatikar.Et.al [4] wrote “Online Book Recommendation System by using Collaborative filtering and Association Mining” (December 2015) In this paper, can be seen clearly that the use of the association mining methods and the collaborative filtering algorithm in this web application, the user rating analysis and also user feedback are obtained. The books are been categorized and recommended the books to the users. The drawback of this system is that any user can give feedback if he/she doesn’t even buy the book this can create an unwanted comment over the book and also confusion over the user.

Nursultan Kurmashov.Et.al [5] gave “On line Book Recommendation System” (February 2016) this system clearly shows that it is implemented to just read the books. The user is asked to fill the registration by adding his favourites and based on his/her favourites the books are recommended to the user. This can be an effective way for recommending the books to the user, on the other hand, the user cannot find the top-rated books of each category and have to search for other books which are time-consuming.

Pijitra Jomsri [6] contributed “Book Recommendation System for Digital Library Based on User Profiles by Using Association Rule” (August 2015) in this paper, the usage of foster information retrieval and association rule method is shown. The two methods used in this paper are the first section is the result of the association law, and the second section is the product of an evaluation using accuracy and recall. In this case, the user may borrow and return the book because it decreases the cost of holding. The disadvantage is that the books can be stored in the categories and the user can find the top book rated books as it also reduces the time.

Noor Ifada.Et.al [7] wrote, “Enhancing the Performance of Library Book Recommendation System by Employing the Probabilistic-Keyword Model on a Collaborative Filtering Approach” (September 2019) This system has many features not usually included in conventional book library recommendation systems. It is mainly developed for the sake of colleges and schools where the user can borrow and return the books. But the drawback of this system is that there is no consideration of the user rating and feedback. Where the user can waste time in searching the books as it is not categorized.

Kanchan Belavadi.Et.al [8] gave “Digital Library: Using Hybrid Book Recommendation Engine” (August 2019) the system shows that it is used for the usage of soft copies such as ppt, pdf etc. where the users can download and read the books. The methodology used here is the hybrid recommendation engine which helps the user get the books as softcopies as per their interest. This system can be improvised by using collaborative filtering algorithm where the librarian stores the books in the database and also collect the user rating and feedbacks after he/she reads the book. The avoid the confusion over the user that which book should be read to get the appropriate information and also reduce the cost and time of the user.

### IV. PROPOSED SYSTEM

In the proposed system, a web application is developed for the library book recommendation. In this system, all books in the library will be given ratings. The library users who borrow the books post their ratings (5-star ratings) and the top-rated books will be displayed to the users in this system. This is an automated system which will help the library user to choose the best version of the book of his/ her area of interest within a few seconds depending on the ratings given to that book. The user can choose the book, borrow the book and even get the book delivered to his/ her address by just sitting in front of a computer. This system uses a collaborative filtering algorithm which filters the books based on the ratings and recommendations to the users. This technique takes the user ratings and the user feedback into consideration to recommend books to the users. Although this system gathers the user's identification and authorisation before shipping the book to the user address.

This system is accurate, reliable and dynamic. The advantages of this system are it is time and cost-efficient and also reduces manual work. Below **figure 1** shows the architecture of the overall system, which will be implemented to achieve the objective of the library to satisfy our goals.

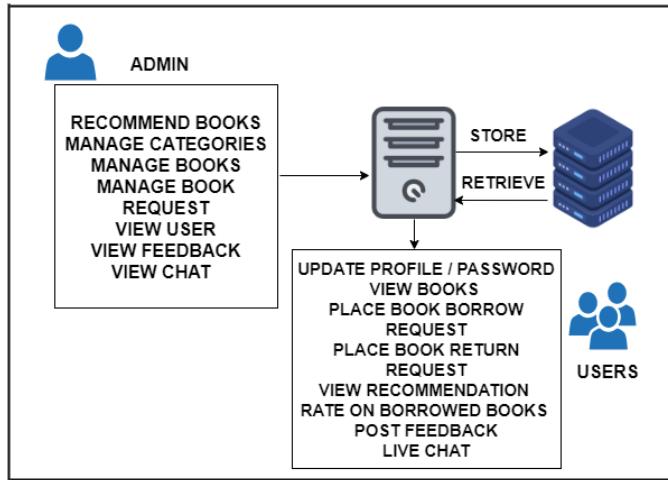


Figure.1 shows the architecture of the proposed system

#### A. Modules Components

Here the purpose of this proposed program is to recommend books to the user and to limit the library management manual work. In this system, there is a combination of two modules, the admin module that recommends the books and also manages the library system and the user module who can view the recommended books and can borrow return the books from his/her place itself.

**Admin module:** Admin can perform various functions like firstly he signs in the system by entering the valid username and password. Then perform various functions like add categories and books based on category. View the active users, admin also manage the request done by the user for borrow and return the books. And also, can view user feedback. Below **figure 2** illustrates the operations or process that can be carried out by an admin.

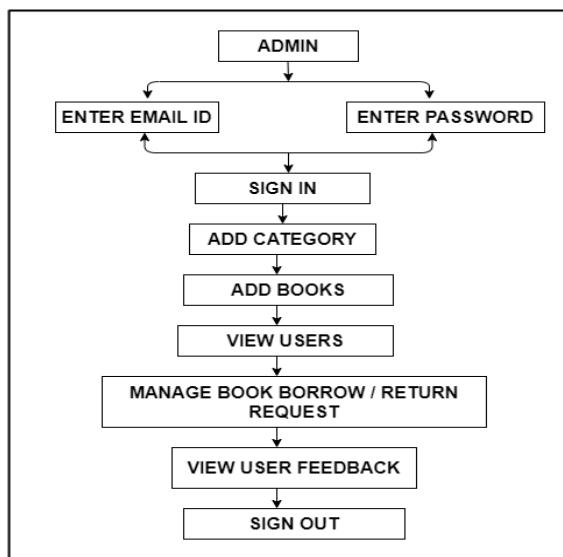


Figure.2 Admin Module

**User Module:** User plays an important role where firstly the user has to sign up if he is not a member of the library then after their registration the user can sign in with the email id and password that is autogenerated in the user email id. After the sign in the user can update its profile, viewbooks based on categories, view recommendation that is the top-rated books will be placed first. The books borrowed by the user is been tracked down using collaborative filtering algorithm technique. The user who has borrowed the books can only give the ratings on the books and the user feedback. At the time of confusion which book should be selected the user can even get suggestions or have a live chat with other online users.

The below **figure 3** shows the operations or the flow of the user that can perform in the system from the signup to the sign-out process.

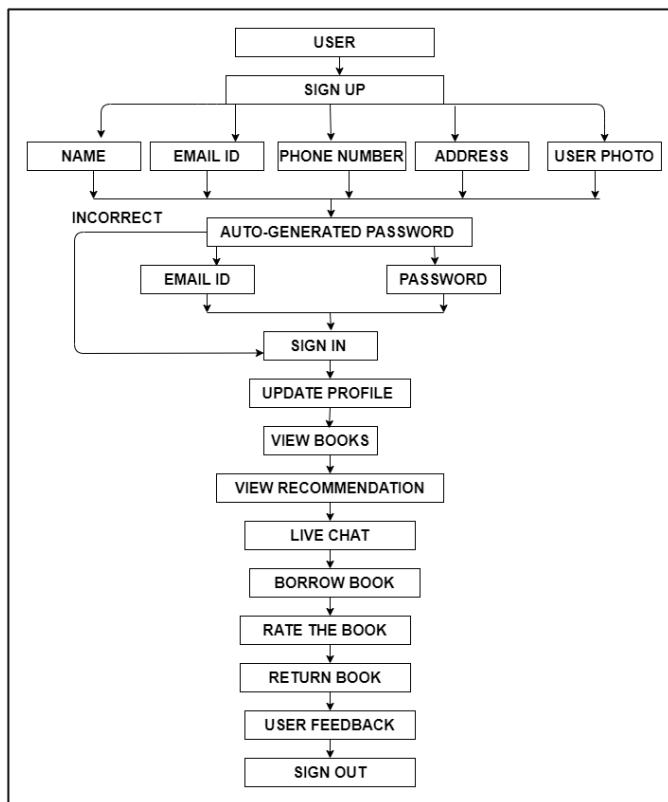


Figure.3 User Module

## V. WORKING SYSTEM

In the concept of the master page and the content page, this system is developed using asp.net technology. It is a **cloud-based system** that can be used in both **mobile and desktop computers**, the only requirement is an active internet connection and a web browser. There are two sections in this library system the **admin and the user**. In this proposed system the admin adds the books **based on categories** e.g. the Epics book category may include a book of Mahabharata and Ramayana. Whereas on the other hand the user login into his account using the **autogenerated password** which is in his/her authentic email id and can find books subject-wise. This can help the user to **find the books faster**. the top-rated books in each category are **recommended to the user**. To recommend books, **collaborative filtering algorithm is used which takes the common ratings given by users to the books**.

On the other hand, the user fills up the signup form if he is a new user and the auto-generation of password comes directly to the user's email id this idea helps in **authentication** and the user also have to enter the 12-digit Aadhar number which helps in **identification** of the user. The user can also have a **live chat** with other users to take suggestion over the books. The user places a **borrow request** and assigns the date of the return of the book. On the other hand, the admin manages the request of the user and ship the book to the user's address. **Only after the book is borrowed and returned to the**

**library, the user can give 5-star ratings and feedback over the book.** The idea behind this is to **reduce unwanted comments** over the book which cause a problem to the user. In case of **negative comments** over the book then the admin has an option to have a chat with the unsatisfied user and suggest another book or even delete the unwanted comments or ratings as it would not affect other users and can maintain the system well.

This entire process can be taken place just by sitting in front of the computer or mobile. Thought behind this system proposed is that, as a saying "**Education has no age**". The books can be available to all age group categories **free of cost** and the process is **faster and reliable** and avoid the effort of going to a public library in search of books. Thus, it saves time and money. **The source of income for the system is the penalties charged for the user in the delay of returning book.**

The below **figure 4** explains that the functions that an admin perform as he can add books based on the categories, can view the active users and the user feedback and can also manage the borrow and return request sent by the user.

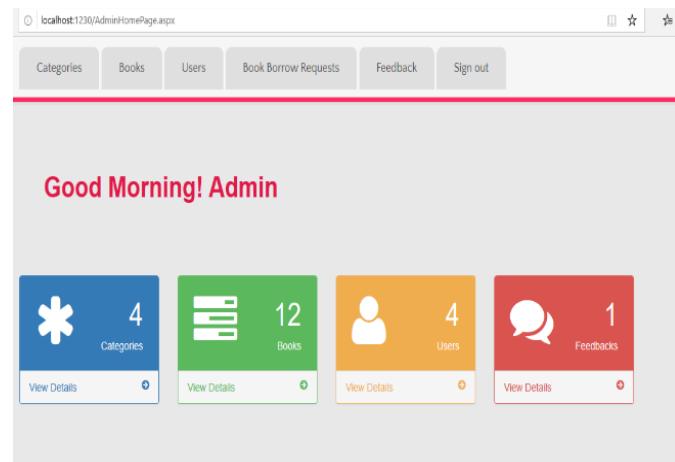


Figure.4 Admin page

The below **figure 5** shows that as the system is a dynamic web page the tasks that the user can perform is that he/she can view the books based on the subject wise categories and also can view the top-rated recommended books based on the ratings given by other users. If still, the user has confusion on the book that he wants to borrow he can have a chat using the live chat module and then can place the borrow and return request just by sitting in front of the computer and the book will be delivered to his/her address itself.

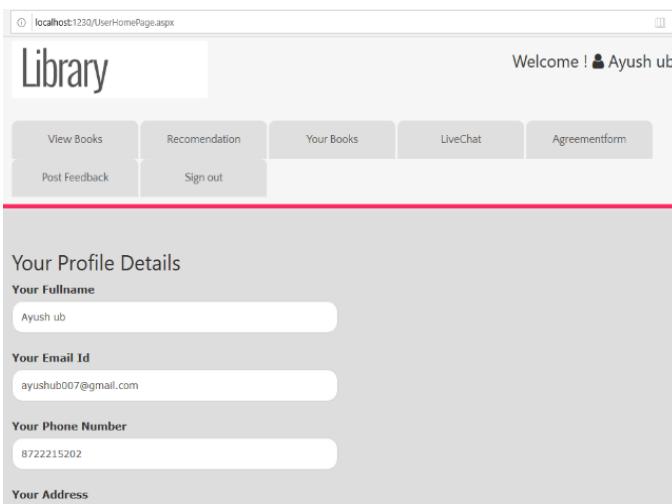


Figure.5 User page

## VI. ALGORITHM

### Collaborative filtering algorithm

Collaborative filtering (CF) is a tool used by recommenders. Collaborative filtering is a method of making statistical assumptions (filtering) about a user's interests by gathering (collaborating) expectations or interest information from other users. Given the huge amount of data the world has now, organisations are searching for ever more efficient ways of using that data. Collaborative filtering is the mechanism of filtering information or patterns using multiple agent methods of communication, perspectives, data sources, etc. Collaborative filtering systems usually require enormous sets of data.

Methods of collective filtering have been extended to many different data forms including data sensing and monitoring. The proliferation of the Internet has made collecting valuable knowledge from all available online knowledge even more difficult. The huge amount of data requires mechanisms for efficient filtering of information.

The below figure 6 shows the **mechanism of a collaborative filtering algorithm** where how the **similar users** read the same book and that book is been recommended to other users. This is an efficient methodology where the users can get the top-recommended books so that much **time is not wasted in searching the books**. In our proposed system, this methodology has been implemented along with the **rating (5-star rating)** where **more than one user** gives ratings and feedback over the same book, and the **top-rated book** among all the other books is **recommended** to users. Each category recommends one or more top-rated book. If two books have similar ratings then the collaborative filtering algorithm **randomly selects a book** which is commonly borrowed by the user. This idea, in turn, helps the users to find the books **faster and in an efficient manner**. The below **figure 6** shows the mechanism of a collaborative filtering algorithm where how

different users borrow the book from the library and gives out ratings and user feedback over the same book. And the book which has a top rating in the category is recommended to the new user.

### COLLABORATIVE FILTERING

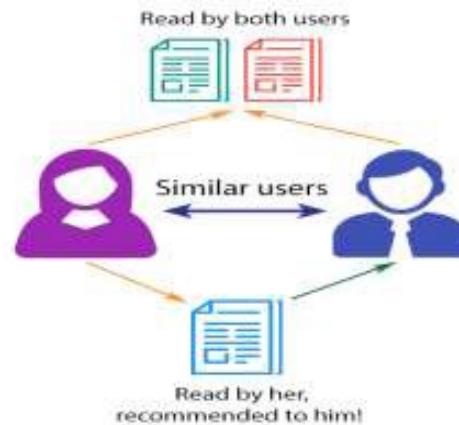


Figure.6 Mechanism of Collaborative Filtering Algorithm

Collective filtering techniques have been generalized to many different forms of data including the sensing and monitoring of data. The growth of the Internet has made it even more difficult to obtain valuable knowledge from all the online knowledge available. The enormous amount of data demands frameworks for effective knowledge filtering.

The below **figure 7** shows the calculation that the average rating given by the associated  $n$  users is equal to the sum of their ratings separated by the number of associated users, which is recommender systems, is a powerful new technology to gain additional value from its databases for a system. These systems help users find items they want to borrow books from a system. Recommender systems benefit users by enabling them to find items based on their interest. Conversely, they help the system by generating more sales.

$$R_U = \left( \sum_{u=1}^n R_u \right) / n$$

Figure.7 Equation of Collaborative Filtering Algorithm

The parameters in the above equation illustrate that  $n$  is the total number of users,  $\sum_{u=1}^n R_u$  is the total number of ratings given by the users,  $R_U$  is the average number of ratings given by the users. The calculation of the equation is used in our proposed system to calculate the ratings given by different users which can help in giving out the recommended books to the users as results.

Recommenders systems are gradually becoming a vital Web-based platform in e-commerce. In this paper, a new algorithm is introduced for suggested systems based on CF and validated

it experimentally. Our findings show that item-based techniques hold the promise to empower CF-based algorithms to scale to large data sets while achieving high-quality recommendations at the same time.

### Apriori Algorithm

Apriori algorithm is an early-stage approach to finding the best products, based on how often it is used. The apriori algorithm is programmed for transaction databases using the bottom-up approach to find products based on how regularly the user explores them. This approach provides results based on the keywords that the user searches for. The Apriori algorithm is used to formulate a college library recommendation method. The program proposed is capable of delivering reliable and personalized services, enabling readers to find books of their interest way quicker. The mining association rules problem can also be broken down into the following two sub-problems: identification of frequent itemset and generation of strong association rules using the frequent item set. The Apriori algorithm was a standard approach suggested for mine association rules. This is fundamentally dependent on the frequent itemset repetition, and it also involves frequent itemset generation and association rule generation.

The key concept behind the apriori algorithm in the field of the library recommendation system is that the program should use the apriori algorithm, which will shape searching on the database based on the relevant book recommendations. Apriori algorithm calculates the frequency weight of searched books to generate a subject or books related to it. Furthermore, the program should do analytics and provide clear and succinct statistics that the librarians and staff can use to generate a monthly report. Apriori algorithm primarily outputs the user-typed books in the search bar. This method is used for transaction-related work which, depending on the regularly used or visited items, gives out the products based on the keyword.

Step 1: Identify all specific sets of items from the data set using the minimal level support value

Step 2: Generate the association rules using the commonly detected item sets together with a minimum level of confidence.

The flowchart in **figure 8** illustrates the process of the Apriori algorithm, it is a sequence of steps to be followed to find the most frequent itemset in the given database. This data mining technique follows the join and the prune steps iteratively until the most frequent itemset is achieved. A minimum support threshold is given in the problem or it is assumed by the user.

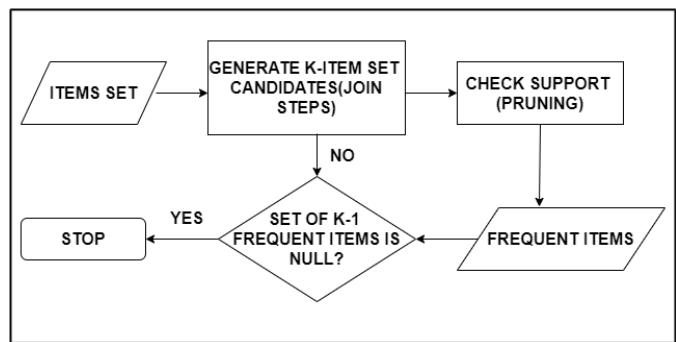


Figure.8 Process of Apriori Algorithm

### Comparison among Two approaches

Based on the concept of a library book recommendation model, the collaborative filtering algorithm filters the books based on the categories or topic wise which in turn helps the user locate the books easily and can also get related books as the book is categorized by category. Whereas the user has to search the book in the search bar in case of an apriori algorithm to locate the book based on his interest. The products are indexed based on keywords and commonly searched products. If the book title is entered incorrectly in the Apriori algorithm, it shows the error message as "title not found" and then the methodology shows the books related to the keywords entered by the user, and some users will consider the books as pointless or interesting.

This method is, therefore, time-consuming and even frustrating when it comes to finding the correct book for the reader based on his interest. Although the collaborative filtering algorithm recommends top-rated books based on categories that are time-efficient processes and create no ambiguity about multiple books. This is why a collaborative filtering algorithm is used in our proposed system that randomly selects the books well into the categories based on the ratings produced by other users and lets the user borrow the book adequate to him based on his interest.

### VII. METHODOLOGY

- Step 1: Admin log in into the admin account
- Step 2: The admin adds books based on the categories
- Step3: Manage to borrow and return request by the users
- Step4: User signup the registration form
- If (password && user-id =auto generation password in user's email) then login into a user account
- Step5: User can view top rated books based on categories
- Step6: User can place borrow and return book request to the admin
- Step7: User who has borrowed the books can give ratings and user feedback on the book

Step 8: User can live chat and also get a suggestion on the book to be borrowed

Step 9: The user who has borrowed the before can only reply to the book suggestion

The sequence diagram of admin module in **figure 9** shows that the admin login into his account by entering the valid credential if it is correct then the sequences flows or get backs with any error message, then after the admin login into his account he can perform operations such as adding categories, adding books categories wise, managing users, recommend books manage to borrow and return request. Admin can view the feedback of the books as well as the live chat where the users discuss regarding the books. This flow of diagram clearly shows that admin plays the main role in this system and can also control the entire system.

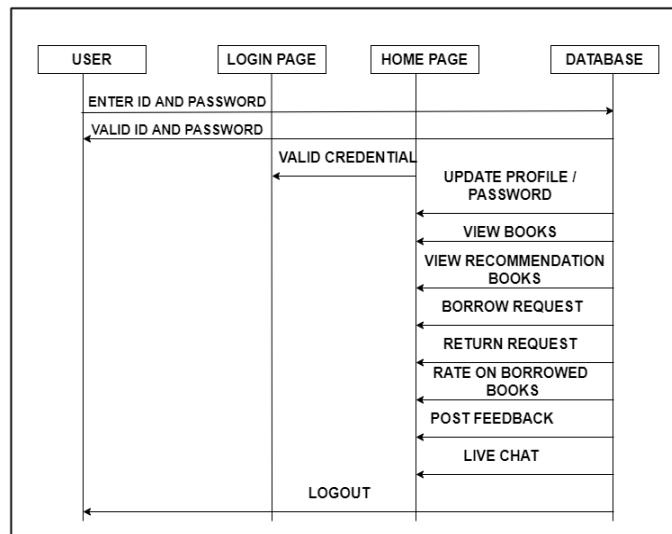


Figure.10 Sequence of user module

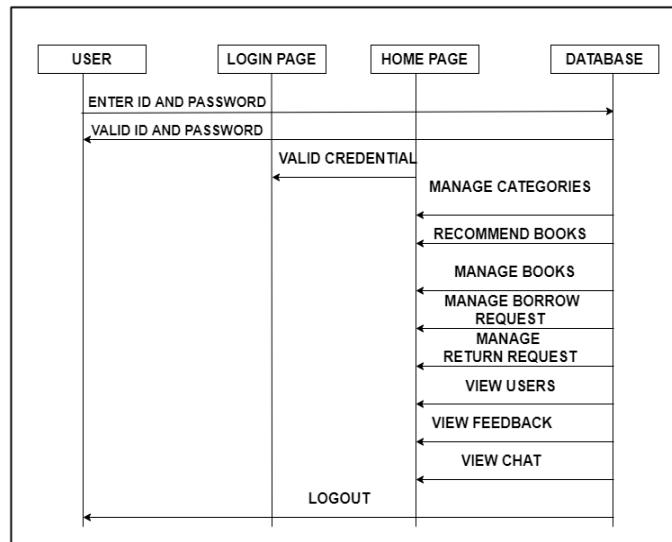


Figure.9 Sequence of admin module

The sequence diagram of user module in **figure 10** shows that user can log in into using the auto-generated password in his authentic email id if it is correct then the sequences flow or get backs with any error message, then after the user login into his account he can perform operations such as updating his/her profile, password etc.. he can also view books based on categories, view top rated recommended books, can place borrow and return request to other users. If the user has any suggestions or confusion over the book, he can use the live chat module. This flow of diagram clearly shows that the user also plays a main role in this system and can also use it wherever and whenever needed just by sitting in front of the computer.

## VIII. RESULTS

A **cloud-based library book recommendation system** has been developed that helps to carry out everyday work of a library just by sitting in front of the computer. The user can find his/her required area of books based on categories. There are mainly two actors in the proposed system i.e. admin and user. Admin plays an important role throughout the process. Admin adds **books based on categories** by describing the book which can help the user to find the books easily. Admin can also respond to the request made by the user for borrow and return options. The user equally plays a role in the system to help the system work smoothly.

Firstly, if the user is new to the system then he/she has to sign up by filling all the information and the **auto-generated password** which come to his/her email id. This idea helps to check whether the user is authenticated. The user also has to upload his/her **photo and Aadhar card** number to show their **identification**. After all the process is finished the user can make use of the library system where they can find books based on categories e.g. if the user is in search of c++ or c book then he can directly look into the computer science category. This helps the user to find the relevant books. There is a **live chat module** developed in the system where the user can chat with other users to get suggestion over the book. The user who has borrowed the book before can only respond to the user suggestion. The idea behind this condition is to reduce unwanted comments over the books. After the book is chosen by the user, he/she can place a borrow request to the admin along with the due date. On the other hand, the admin manages the borrow and return request and ship it directly to the user address itself. Finally, after the book is returned to the library the user has to rate the book (5-star rating) and also can give feedback to the book. the overall idea behind this process is that the top-rated books can be **recommended to users**. Each category recommends one or more top-rated books.

Therefore, the process in the proposed system makes use of a **collaborative filtering algorithm** which take ratings over the same book from different users who have borrowed and returned it. Those ratings are calculated and recommended to other users. This can provide the user with the best book in the category. The key points of this system are that it provides books to all age group categories where they can borrow the book read them and also return the book just by sitting in their home. Rather than going to a public library in search of the book. Overall, this system reduces human efforts and its **time-efficient and cost-free** too. The source of income to run this system is the penalties that should be paid by the user in the delay of returning the book.

In **figure 11** below Item, CF is the filtering of products based on specific items, User CF is the way of filtering products based on user ratings and user reviews, RCF is the method of classifying objects based on real-time, and the optimal form of recommendation is to use all three methods based on ratings and user input based on real-time CF.

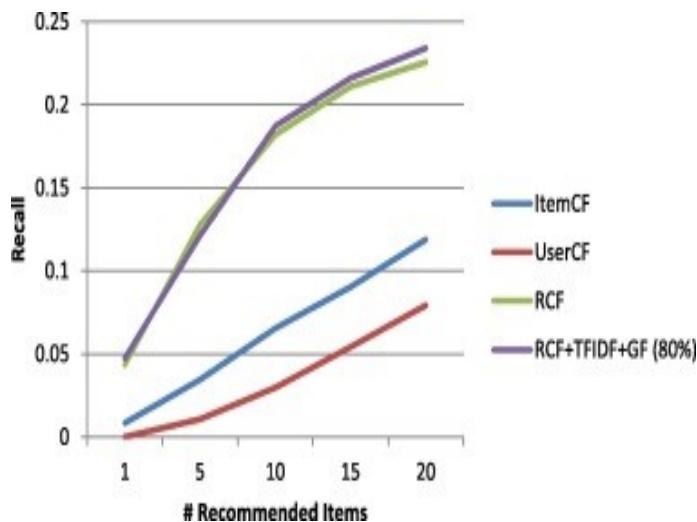


Figure.11 Collaborative filtering technique

**Figure 12** below shows that Collaborative filtering look for items that are similar to the articles that the user has already rated and recommend most similar articles. But what does that mean when said item-item similarity? In this case, do not mean whether two items are the same by attributes like Fountain pen and pilot pen are similar because both are pen. Instead, what similarity means is how people treat two items the same in terms of like and dislike. This method is quite stable in itself as compared to User-based collaborative filtering because the average item has a lot more ratings than the average user. So, an individual rating doesn't impact as much.

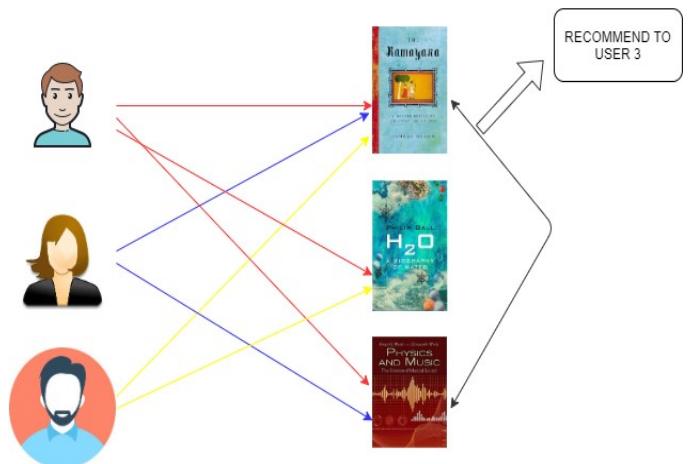


Figure.12 Recommendation technique

## IX. CONCLUSION

This is an automated and dynamic library recommendation system which will help the user to choose the best version of the book of his/ her interest within a few seconds depending on the ratings given to that book. This system is developed using asp.net technology and C# language where the data is been stored are retrieved using a database. The admin adds books in each category and also can manage the borrow and return request sent by the user. The user can choose the book, borrow the book and even get the recommendation over the top-rated book in each category. This helps the user to find the best book. The book is delivered to his/ her address just by borrow and return request sent to the admin just by sitting in front of a computer. Rather than the user visiting a public library and searching for books which are time-consuming and get into confusion which book to be borrowed. Whereas in this system the user can even have a chat with other users to get suggestions over the book and after borrowing and returning the book the user can even give feedback and ratings about the book which helps other users to find the best version of the book.

The overall process of recommending books to the user of all age group category make use of collaborative filtering methodology where different users give ratings on the same book and the average number of rating is been calculated and the top-rated book is been recommended to the user. The system mainly focuses on the easy finding of best books which does not need much time or work. The process of this system is accurate, reliable and cost-free. The income of this system is penalty fee collection when the book is not returned within the due time. The cloud-based library book recommendation system can be used from mobile and pc as its user friendly, authentic and also time and cost-efficient.

## X. FUTURE ENHANCEMENT

There are few suggestions for potential improvement to boost the device capabilities. First of all, this system should have an

OTP generation in real-time at every sign that allows the user to approve it in advance. This system should also be available in the app like format which is easily available to everyone as it is cost-efficient and can help many people or even used in schools of colleges. The system can also have faster delivery of books and also get funds from people and the penalties paid for late return of books by the user to use the money in the maintains of the library. Furthermore, the program should be updated so that more than one author can have one book. Nowadays the program supports only one author per book. Some book has more than one author and can skip user checking the book.

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