Design of a Novel Machine Learning Algorithm to Predict Number of Book Copies Required in Library - A Review

Darshan D M[1], Pavan N S[2], Pramod Bhat[3], Sagar S M[4], Prof. Sunanda[5]

[1,2,3,4,5]*Department of Computer Science and Engineering, DSCE, Bengaluru*

Abstract: "*Libraries store the energy that fuels the imagination. They open up windows to the world and inspire us to explore and achieve, and contribute to improving our quality of life.*" [1.1]

Libraries are the storage of knowledge. The Library Management system is a very useful and needy tool in colleges and institutions. Present Library systems are managed using book-log entry and manual segregation of the books. The library admin has to monitor the book issue and manually work on collecting back the issued books with applicable late fees. With the increase in the issue of books, it is also to search for any log entries. Some institutions and libraries use computerized log-entry. But still, they fail to provide online book search to students and have multi-user interactions like the interaction of students, teachers, library admin in a single platform. With the advancement in technology and everything at the tip of the hand, following the old custom of book-log entry will not be efficient for maintenance of today's Libraries with such a huge collection of books and data. A platform is also required to organize E-books and make them available to the readers. The project aims in designing a multi-user login based web-application with the integration of Machine Learning models to fasten and make library usage handy. This paper is on a literature survey that is carried out to learn and analyze the area of our research. The survey includes studying the various concepts that are involved in the "Design of a Novel Machine Algorithm to predict the number of book copies required in Library". The study covers the analysis and study of various kinds of prediction algorithms associated with book sales or rentals, recommendation algorithms, multi-user website designing with security, optimizing web page performance. Various algorithms have been studied in the research survey including Artificial neural networks, random forests, etc. Various Novel algorithms were also found during the research.

Keywords: ***Library management; Web Application; Prediction model; recommendation model; Multi-User Login***

Introduction

The literature survey was carried out taking into considerations the key requirements of the project which include Web Application with different user credentials. AI model for recommendation system and predictive analysis. Literature survey also aided in one of the major challenge that is payment gateway integration.

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Paper [1] aided us in studying the algorithm and method that can be implemented to predict the number book copies that would be required based on the frequency of the book issue.

Paper [2] referred above aided in understanding that the normal recommendation system that is used in shopping or any other cases can not directly be used in book recommendation system. Instead a tagging and recommend method must be developed for book recommendation system.

Paper [3] helped us in planning the sub-systems and the modules for implementing the project. The paper is equipped with use case diagrams and E-R diagram which aided us in designing of our use cases that are shown in this document.

Apart from the above main papers, many research and journal papers have aided in framing the project idea which are discussed in Literature Survey.

Literature Survey

Following are the papers which were referenced to carry out the literature survey. Following is a brief idea on the author, concept of the paper, model used and also its advantages and disadvantages.

The paper presents the concept of prediction analysis of rental books data. A Novel model is designed called DPA-LRPD Model(Data and Predictive Analysis based on Library rental Book Data)[4] and trained. **Advantages:** It has discovered hidden patterns and knowledge in the data set that aided in predicting future demand. **Disadvantages:** The paper limits and analyses less data and could be improved to gain more knowledge like sentiment and semantic analysis on rental user reviews data. [4]

The paper by Satyendra Kumar Sharma, et al (2019), analyses different algorithms to predict the book sales at Amazon Market Place. Multiple algorithms including Artificial Neural Network algorithm, Decision Tree algorithm and random forest algorithm have been

analyzed. **Advantages:** Review sentiments doesn't have very great impact unless the reviews are more in number. **Disadvantages:** The Study limits with very less predictor variables. Genre, characteristics of book, country can also be considered. [5]

The paper by Takanori Kuroiwa et al(2007), is a research on Dynamic book recommendations using web services and virtual library enhancement which is carried out using Collaborative filtering,Content based methods and XML database. **Advantages:** Using this model we can increase the purchase of book and recommend the desired book to user. **Disadvantages:** The mentioned algorithm must be further investigated for better ease for recommendation system.[10]

The paper by Nursulthan Kurmashov et al(2012) , is a research on Online book recommendation System which is carried out by using Collaborative filtering and Mysql database . **Advantages:** using this algorithm we can recommend books based on users ratings, interest to increase the purchase of book. **Disadvantages:** Mentioned model can recommend books based on only user ratings this cant be implemented in all the cases it varies from user to user.[11]

This paper by Muzaffer Ege Alper et al(2012) , is a research on Personalized recommendation using joint probabilistic model of users. It is done by using a probabilistic personalized model and a latent interest model. **Advantages:** It indicates the interest context of an user which in turn help in designing a personalized recommendation system. **Disadvantages:** As the recommendation varies from user to user we cant predict it properly using this mentioned models so we must implement the other models or enhance the existing model for better ease of the results for better prediction.[16]

The paper by Xiantao Jiao et al(2012) , is a research on A semanamtic tagging system for biomedical Articles which is carried out by using PubMed tagging model. **Advantages: This** Optimised PubMed tagging system has been designed with semantics web technologies, it is more efficient than the system which has complex semantics elements[17] **Disadvantages:** The two kind of TBox and ABox semantics has to be separated to further improve the system performance. Lacks with very less strategies used to implement better quality control of semantic data with large semantic repository.[17]

This paper by Ipek Tatli Aysenur Birturk(2011) , is a research on a tag based hybrid music recommendation which uses relations and multi domain functions for analysis , Latent Symantic Analysis(LSA). **Advantages :** With restpect to LSA it is used to order the words and the morphology. LSA is used for large document categorization and text summarization. **Disadvantages:** Creating a dataset and ontology takes more time. Tags that are less in number can be neglected.[18]

This paper by Kensuke Baba et al(2016) , is a research on predicting the use of books in university library by using synchronous obsolescence . **Advantages:** It was able predict the number as accurately as a diachronic obsolescence algorithm.It is used to predict the loans number accurately in case of incomplete circulation of data[19]. **Disadvantages:** It does not consider differences number loans change among the subject fields which may cause significant difference in future use.[19]

The paper by Craig Silverstein et al(2014) , is a research on predicting the book used for physical storage using a decision tree. **Advantages:** The research could explore several approaches for the building of decision tree to know which approach is better and good. **Disadvantages:** The mentioned algorithm/model is more complicated which is not implemented for large values found in library data set and they slow downs the results.[20]

This paper by Lina Zhou et al(2017) , is a research on the opportunities and challenges that are faced during machine learning on big data. **Advantages:** Many parameters have been studied find the opportunities in machine learning. **Disadvantage:** There are open research issues like cleaning and compressing of the big data. Only a small scale distributed feature selsction is done.[22]

The paper by Shih-Ting Yang et al(2012), is on a model for analysis of book inquiry and and a book recommendation of libraries. It uses the models and algorithms like book-acquisition recommendation model[25], **Advantages:** Using this algorithms a relationship between book categories and the keywords can be developed. It also helps in developing a web based book recommendation[25]

Table Representation of Literature Survey

Ref No	Authors	Concept/Idea of Research	Algorithm/ Model	Advantages	Disadvantages
[24]	Imran et al(2020)	An effective planning of waste management using predictive data analysis.	The model is evaluated with Mean Absolute Error checking(MAE) and also with root mean square and mean absolute percentage error.	It helps to produce waste information very early that Is utilized by the waste management authorities for effective designing.	The research limits with online providing data but can be stretched to do many applications.
[26]	Noor Ifada et al(2019)	A Library recommendation system.	Probabilistic keyword model, collaborative filtering.	It builds a model with book circulation records and keyword data. It employs a probabilistic technique.	The paper could have also worked on attribute model with different attributes combination and could solve the sparsity problem.
[27]	Liu xin et al (2013)	Book recommendation model based on the borrowing records of the users.	Collaborative filtering(CF) algorithm	Focus on how to implement efficient and accurate CF algorithms for the academic library. By transforming the rating information from the borrowing records, we can use the traditional CF algorithms to predict how long the reader will borrow the book	It lacks on on how to evaluate SR under the individual CF algorithms and the blending methods as while we use NN with KNNuser and LFM, SR is just 2.95%. efficient and more blending methods is not studied.

Findings

A) Artificial Neural Network algorithm is best for the prediction of number of book copies required in the library.[1]

B) A tagging-based algorithm must be used for book recommendation system.[2]

C) Dynamic book recommendations using web services and virtual library enhancement [10] aides in increasing the book issue and sales.

D) Studied the framework and the ability to model the users jointly. This would help in designing the personal recommendation system[16]

Conclusions

Based on the survey carried out, many ideas have been brought up which are pointed out in the findings section. Some of the papers have designed concepts and models which can be directly implemented and some others which can be altered according to the problem. The project implementation will be carried out based on the findings and outcome of the research.

The outcome Library Management System project idea is an online Web Application based solution to maintain

majority of the library activities like book search, book issue and return management. The system also has additional features like separate login modules for admin, teachers and students. It also has a ML model for book recommendation to students and to predict and analyse the number of book copies required based on the issue frequency.

The application is aided with the real time data set from College library which will ease the data collection. The model is trained and deployed onto the Web application which is designed with React and Javascript. The complete system will be developed and the prototype will be deployed on a local host.

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