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Exploiting Visual Content of Book Front Cover to Aggrandize the Content Based Book Recommendation System

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Abstract*: In modern e-commerce world Recommendation Systems are playing a key role in supporting customers to take a decision. With this kind of services customers can choose comfortably the products as per their preferences from a long list of available products. It's not only a boon for the customers; it will boost the sales for the organization and generate better revenues. Due to diverse domain characteristics, each domain requires different kinds of recommendation models. Content based recommendation model is one of the recommendation models which purely rely on product features and the current user preferences. This model is more effective for the domains like news, micro-blogs, books, movie plots and scientific papers etc. In this paper we propose a content-based filtering model for book recommender system by utilizing its overall textual features as well as visual features of its front cover. Numerous surveys have demonstrated that book readers are highly inclined to its covers that are visually attractive[1]. Book front cover is the first representative candidate of the book that will reveal the overall sense of the book; hence we considered book front cover as one of the book contents along with the text. Our experiment shows that augmenting the visual features to the existing content-based recommender models performed well.

Keywords: Content Based Recommendation System, Visual Similarity, Convolution Neural Network, Image Captioning.

I. INTRODUCTION

The growth of internet and Web 2.0 technologies leads to information overload by means of Volume, Variety and Velocity. Due to this overloaded information consumers can't figure out the essential information even if they have an access to it. Recommender Systems (RS) are designed to overcome the problem of information overload by helping them to find out the required information. Recommendation Systems are subclass of information filtering[2]. Recommendation Systems assist consumers in better decision making and overcome search difficulties and find the most suitable prices[3].

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Fundamentally Recommender systems are fall into two broad categories one is Collaborative Filtering (CF) and other is Content-Based filtering (CB). The underlying principal of CF techniques relies on the user community preferential patterns. Conversely CB techniques will contemplate the current user preferences. Each one of these approaches is having its own merits and demerits. To mitigate the issues with CF and CB, hybrid approaches are proposed by Combining CF and CB. Apart from this basic classification wide range of variations are proposed in the literature. In spite of the maturity and popularity of CF techniques, considering the content features are utmost importance for the contemporary real time applications. Providing side information to the existing RS will strengthen the effectiveness of RS[4]. CB models interpret features of the items previously rated by a user and create an information filter to recommend. The efficiency of the CB systems is purely depending on the item descriptions. If the item descriptions are readily available in hand, building a CB system is somewhat simpler. Otherwise, RS designers have to develop a content analyzer to distill the item descriptions. Content analyzer fabrication pends on the domain. Each domain needs different kinds of content analyzers to extract the item descriptions. CB systems will ignore the other user preferences and solely considers the current user preferences or ratings. To analyze the current user preferences, CB systems need another component called profile learner. The results obtained from the content analyzer and profile learner are considered for the recommendation this component is called as filter. The outcome of the filter component is either continues or binary judgement computed using a similarity metric. The overall architecture of the basic CB filtering model is described in figure1.

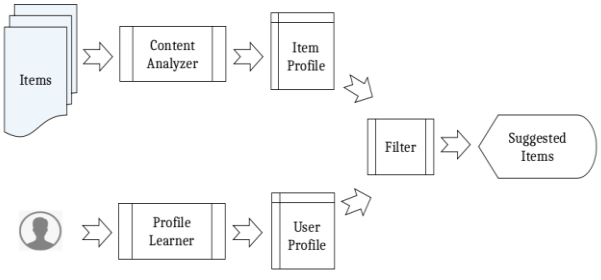

Figure1: Architecture of generic CBF system

Various studies stating that book reading is advantageous. Numerous statistics reporting that 15% greater satisfaction in life for the book readers than non-readers[5]. The Bureau of Labor Statistics most recent American Time-survey found a decline in book reading, especially the largest declines are in the 35–44 age group[6]. There may be different reasons for this downfall in book readership. One way of improve the number of book readers is by proposing a true RS to identify and provide the right book for the right user. Even though, numerous articles have been published in the book RS domain, they are restricted to use CF systems by incorporating the neighbor preferences with user reviews and ratings. In this paper, we proposed a CB book recommendation system by augmenting visual features of the book front cover as side information. Even though a book is composed entirely of text, the book front cover is book's first communication to the user. Multiple studies have shown that readers are strongly attracted towards covers that are visually appealing, intriguing, or "eye-catching"[7].

II. LITERATURE REVIEW

The CB system adopts techniques from information retrieval and information filtering fields[8]. Due to the advancement of these fields and in text-based feature extraction, modern CB systems are paying attention on recommending items having textual content, such as books, documents, web pages, blogs and news articles. In Literature numerous works has been published in CF, CB and Hybrid RS[9]. Benkoussas, Chahinez, et al. proposed a work on CF by exploiting users reviews, ratings from LibraryThing and Amazon collections for book recommendation[10]. Vaz et al. designed an Item-based CF on LitRec dataset by means of cosine similarity and Euclidean distance. In their work, they found that the prediction performance was the best when 10% of author RS and 90% of book RS were merged[11]. Later, they conducted experiments on the LitRec dataset by emphasizing on temporal relevance of ratings and found that the prediction errors are mostly high for the recently given ratings[12]. Kapusuzoglu et al. proposed a book RS using an extended ontology. They ran their experiments on 2791 server logs of an online bookstore. In this extended ontology they considered authors publications and awards. They mentioned that the efficacy of the RS is boosted by using extended ontology particularly with Euclidean distance measure[13]. Pera et al. deployed a personalized Book Recommendations created by using Social Media Data (PBRecS). They used the user's social networking interactions and augmented these community preferences to personalize the book RS[14]. In their later work they introduced BReK12, a unique recommender customized to K-12 readers, which makes personalized suggestions on books that satisfy both the preferences and reading capabilities of its users[15]. Choi et al. proposed a book RS to ascertain the impact of latent preferences of the users in goodreads.com. They stated that the subjectivity of the reviews of the users play a vital role in book selection[16]. Xiao et al. proposed a model to suggest librarians by merging the Reader ratings, bibliographic data, and machine-learning algorithms for monograph selection. They proposed a hybrid book RS to mitigate the challenges with both CF and CB[17]. Rajpurkar et al. deployed a hybrid model by combining CF with CB and at the same time they applied association rules mining techniques to identify the similar books to the user[18]. Alharthi et al. designed a book recommendation model to exploit the detailed book text using natural langue processing techniques, and analyzed the similarities of the books based on the stylometry features of the authors. They leveraged social media information of the users from twitter to made more personalized recommendations[19]. Sariki et al. designed a book recommendation system by incorporating the named entities mentioned in the book text using natural language processing techniques [20]. Li et al. conducted a survey on recommendation techniques for offline data processing by emphasizing on new techniques such as temporal recommendation, graph-based recommendation and trust-based recommendation, serendipitous recommendation, tag recommendation and group recommendation[21].

Sheng Li et al. employed a deep learning recommender model to mitigate the sparsity problem in collaborative filtering landscape. They created a deep feature learning model by combining probabilistic matrix factorization with marginalized denoising stacked auto-encoders[22]. Juntao Liu et al. conducted a detailed survey on RS based on deep learning frameworks. They classified the different deep learning frameworks based on the output of the recommendation framework[23].

Majority of the works utilized the book textual content, table of contents, user's latent preferences from social media[24]. Very few works are carried out on the visual features of a book cover. Fuhu Deng et al. leveraged the combination of user-item rating data and item hybrid features (movie poster visual features) to propose a novel CB movie recommendation model[25]. Chu et al. analyzed the movie posters for movie genre classification. In their work a deep neural network is constructed to jointly describe visual appearance and object information, and classify a given movie poster image into genres[26]. Miriam Martinez et al. investigated peritextual features to analyze the book. In their work they claimed that the peritextual features contain rich character and setting information of a book, as well as those features leaves some clues to predict the genre of the book[27]. Kjartansson et al. used the power of deep learning frameworks and proved that a book can be classified by its cover, achieving 80% top 1 accuracy, 91% top 2 accuracy and 94% top 3 accuracy[28]. Hessel et al. developed a two-stage deep learning framework that recommends fashion images based on other input images of similar style. They used CNN classifier to extract features that are used as input for similarity recommendations[29].

III. PROPOSED WORK

Due to the popularity and maturity of neural networks in image classification, and object detection, in this paper we developed a RS based on deep learning framework which leverages the visual features of the book front cover using deep learning framework. In our work we have used LitRec dataset for book RS[30].

A. **DATASET:**

LitRec is a book RS dataset curated literary book texts from Project Gutenberg and user preferences from Goodreads.com. The dataset details are described in the table-I. The text files given in LitRec are POS tagged and each file contains the copyright details from Gutenberg as header and footer. The user-item interactions of few observations are shown in the table-II.

Table- I: Description of the LitRec Dataset.

Books	2,598
Users	1927
Ratings	16,042
Sparsity	0.993
Ratings / User	17.01
Ratings / book	6.17

Table- II: Sample Details of User-Item interactions.

date	Pgid	user	rating	location	title	filename
20100609	3479	3415823	0	Johns Town	The Metal Monster	The Metal Monster+ Abrham
20100610	1622	3415823	1	Johns Town	The Law and the Lady	The Law and the Lady + Wiki+Collins

As described in the table-II, the user-item interactions file consists of book read date, book-id (Gutenberg), user-id (Goodreads), rating given by the user, user location, title of the book, file name specified in the text files repository and review posted date. We scraped the plain text files from Gutenberg which is not POS tagged and free from the header and footer of copyright text given in the original dataset. To leverage the visual features, we manually downloaded the images from Amazon.com. We used Goodreads API and added more Meta Data to the existing dataset like author name, overall rating for the book, publisher name, publication date and number of pages.

B. ARCHITECTURE

In our proposed work, we used pre-trained Convulation Neural Network model from keras-tensorflow to extract the visual features. For feature extraction, we used VGG16 model trained on ImageNet dataset having 14 million images belonging to 1000 classes. The output of the final layer will classify the given image into one of the object class, but our objective is to get the visual features. In order to get the visual features, we have removed the classification layer from the CNN. The obtained visual features are used for finding the same genre books. The obtained visual features are not that much effective in deciding the genre of the book. Hence, to enhance the efficacy of the existing model we used Microsoft cognitive services API[31]. With the help of Microsoft API, we tried to extract the objects present on the book front cover and used Optical Character Recognition to extract the textual descriptions on the book front cover. Later these textual descriptors and object features are augmented with the CNN extracted features, and then augmented model is able to identify the similar books of the same genre. The architecture of the proposed model is shown in the Figure-2

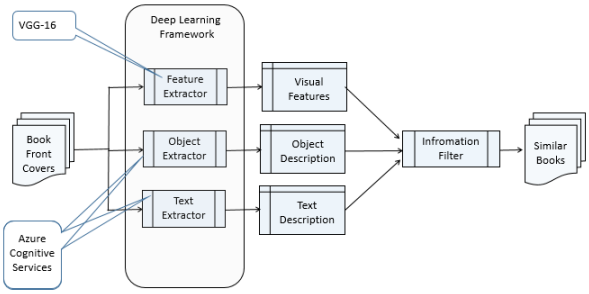

Figure2: Architecture of the proposed framework

IV. RESULTS AND COMPARISON

. The images are transformed to 227 X 227, to fit into VGG16 architecture. The existing dataset does not have the genre of the book, to discover the genre of the book. We have used Goodreads API and extracted the top-5 shelves of each book by discarding some ambiguous tags like currently reading, to read etc. Later, we tried to find ten similar books for each book and compared their genres. Almost for each book out of ten, six books belong to the similar genre. We compared the results before and after augmenting the object and text descriptions. We found that there is a significant amount of change in the precision, recall and F-measure for most of the genres. Figure 4.2 and 4.3 depicts the results obtained in the proposed model. Due to the overlapping behavior of mythology genre with children genre, there is no change in before and after augmentation, and those results are projected in Figure 4.4.

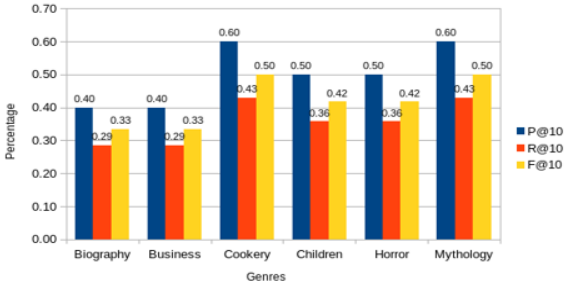

Figure-4.2 precision, recall, F-Measure before augmentation

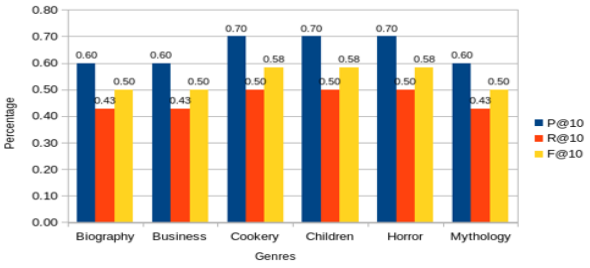

Figure-4.3 precision, recall, F-Measure after augmentation

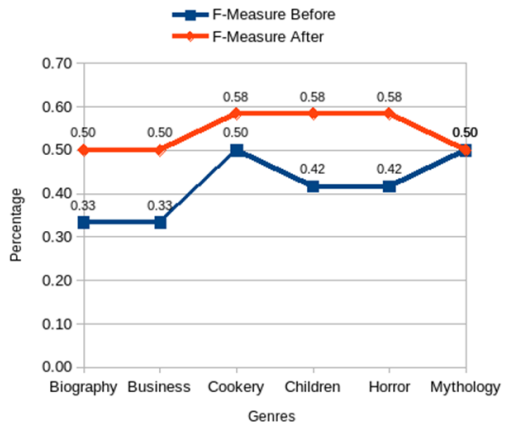

Figure-4.4 F-Measure before and after augmentation

V. CONCLUSION

In this paper, we proposed a framework which leverages the visual features of book front cover to recommend the similar genre of books. Our results showed that, there is a hidden relationship that exists in between the book front cover and its genre which can be exploited using existing deep learning frameworks.

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