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IMPACT OF SERENDIPITY AND DIVERSITY ON RECOMMENDATIONS

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ABSTRACT

Recommender systems are prominent tool for digging the online information to discover contents that are of value to the user. However, emphasizing only on accuracy to asses such systems leads to the problem of filter bubble in the recommendations. Therefore, inclusion of diversity and serendipity is vital for a great user experience. This review paper explored state-of-the-art research on the impact of both diversity and serendipity on recommender systems, examining how these concepts are defined and their balance with accuracy to enhance user satisfaction and broaden their horizons. This study aims to provide concise literature to inform researcher an understanding of not only considering accuracy but also to balance it with both diversity and serendipity in order to increase user engagement.

KEYWORDS: Recommender system, diversity, serendipity, accuracy, user satisfaction

1. INTRODUCTION

Recommender system is a word we are quite familiar with now a days. They are being applied across many areas like music apps, social networking sites, e-commerce websites, online learning platforms etc. they are the part of our daily scrolling, whether we are watching videos on you tube, doing online shopping, planning for holidays, or even playing online games. Their fundamental goal is to suggest the list of items that may be of interest to the user as per his past behaviour, preferences and interest. These system leverages the user data and item related data to make such relevant recommendations. Thus, improving user experience with the application and keeping them engaged. These systems are beneficial for both, the user and merchant as well. The more the user engages with the result, the more items they will click, and the merchant's revenue will increase. How relevant the suggestions are to the user referred to as accuracy of the system. In many of the popular researches [1,2,3], accuracy is frequently used as a measure to evaluate the capability and quality of a recommender system. Accuracy is one of the primary concerns for many of such systems that suggests popular items or that items which we are familiar with. But suggesting items this way may further lead to the problem of filter bubble which exposes the users to limited contents. Apart from accuracy two of the other essential operational and technical goals are serendipity and diversity [4]. Over the time recommender systems have become more sophisticated, an interest is developed toward incorporating diversity and serendipity while keeping in mind the accuracy of the system. focusing only on increasing accuracy may overlook these two goals and makes the user experience dull. In this study we are focusing on these two goals, how they are being worked upon and what are their impacts on recommender systems.

Diversity

Bradely and Smith [5] were among the first to raise the concept of diversity, proposing the inclusion of diversification and developing new algorithm aimed at diversifying recommendations. Diversity refers to the discovering and suggesting the items in the ranked list to be somewhat different and new [4]. Suggesting always a set of related items may not be useful to the user as it limits the exploration and raises the need for diversity. If the recommendation list contains some diverse items, then there are certain chances that user will like some of them. Diversity also has crucial role in user engagement by exposing him to wide range of content.

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CODEN: IJESS7

Serendipity

Serendipity is a term comprising of unexpectedness and relevance. It enables the surprising contents in the user recommendation. Serendipity denotes [6] novelty with an optimistic emotional response, in other words items in the list that adds a surprising element to the user that has been never searched for. Here the surprising terms refers to the item which could be relevant to the user yet it is different form his profile. These contents may conflict with relevance, as they are presented from outside the user's typical profile. This conflict presents challenges in the design of Recommender System as increasing serendipity beyond certain level might not always be the users choice.

2. REVIEW OF LITERATURE

Several studies have investigated the multi-faceted nature of diversity in recommender systems. Numerous algorithms have been proposed to enhance diversity and serendipity in recommender systems.[7] discusses the technique called CFCRT for fulfilling diversity, serendipity and accuracy by dividing the recommendations into diverse clusters and selecting items from these clusters for recommendation. [8] proposed another cluster-based methodology for getting diversity in recommendations and further contributing for better user experience with diverse items. A systematic review [**9**] conducted on serendipitous systems and evaluation techniques. They concluded that for generating serendipitous recommendations model based approaches are mostly used than other methods. Various offline experiments [**10**] are performed to find how diversity, serendipity, novelty are related. Furthermore, they identified that, there is positive effect of diversity on recommendation coverage. A TD based SOG[11] algorithm is proposed that improves both serendipity and diversity and found that an increase in diversity may negatively impact accuracy and either improve or worsen serendipity, depending on the extent of increase in diversity. On the other side, another study [12] in its survey found that serendipity widen the user preference area but did not find its effect on user satisfaction. [13] also agrees that inclusion of user curiosity factor has a positive impact on broadening the preferences but is not related to user satisfaction. Reinforced learning based Multi-Armed bandits [14] model improves the diversity and serendipity to broaden user the preferences. This further resulted in more accurate recommendations. Using side information like timestamp an integrated model [15] is proposed to increase accuracy and aggregate diversity that further help online merchant by selling diverse products while retaining user's interest. Another recent study [16] introduced an approach for serendipity that extends beyond just algorithm. they presented affordance feature repository and viewed serendipity as user experience which is an outcome of user interaction with an environment. Additionally, [17]'s review of hybrid recommender systems suggests that combining different recommendation strategies can be an effective way to achieve both diversity and serendipity. Though serendipity adds unexpectedness and diversity adds variety, it is important to examine the relevance of item or content to the user.

3. DISCUSSION AND FINDINGS

The reviewed literature highlights the need to move beyond accuracy to also incorporate diversity and serendipity in recommender systems. Although accuracy remains important, the weaknesses of pure accuracy-driven approaches are filter bubbles [18,19], lack of diversity[20] and serendipity have become more evident. The concept of serendipity has emerged as a vital factor in enhancing user satisfaction by providing unexpected and relevant recommendations. The study features the importance of diversity and serendipity in mitigating the filter bubble effect. Many studies talk about accuracy and diversity or accuracy and serendipity. However, there aren't many studies that discuss all three. The effectiveness of integrating diversity and serendipity also depends on how user [13] reacts with them. Need to balance accuracy with diversity and serendipity is gaining increasing recognition. More researches are needed to know user preferences and their relation with different aspects of diversity and serendipity for engaging, personalized and satisfying experience. Following are some key findings emerge regarding the impact of incorporating serendipity and diversity into recommender systems:

- *Enhanced User Satisfaction***:** Diversity and serendipity provides a more engaging, exposing and satisfying user experience. By enlarging the range of suggested items and presenting unanticipated yet matching with his taste, these feature serves to a broader range of user preferences and needs. This can lead to increased user engagement and larger session time, and ultimately more revenue for merchant, although some researches says that diversity and serendipity does not affect user satisfaction.
- *Promoting Discovery and Exploration:* Serendipity stimulates for finding and exploration by delivering recommendations beyond the user's typical patterns for selecting items. These unanticipated recommendations can lead to locating helpful contents or items and widens users' interests to explore

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further, as a result enhances their experience with the website or applications. This is particularly beneficial in areas like movies, books, travel and videos where users wants to explore more.

- *Balancing Act with Accuracy:* Although diversity and serendipity are significant criteria for a good recommender system, it must be balanced with accuracy. Emphasising diversity or serendipity without balancing it with accuracy can lead to irrelevant or unpleasant recommendations. Such results may loose user trust, satisfaction and may frustrate him
- *Measurement and Evaluation Challenges:* To measure the impact of diversity and serendipity can be challenging. Many evaluation metrics which are available focuses majorly on accuracy. Researches on proposing new metrics and evaluation methodologies are needed to measure the effectiveness of diverse and serendipitous recommendations.

4. CONCLUSION

Recommender systems have become an integral part of digital platforms. It plays a crucial role in helping users discovering useful content or products that align with his preferences. For recommender system to be sophisticated serendipity and diversity are required to align with accuracy for attracting user. Diversity and serendipity are the desirable feature of a recommender system. Both are important for improving user experience as he is encouraged for more exploration, discovering valuable new items and also providing an enriched user satisfaction. Hence incorporation of these two with accuracy and more new metrics for accessing their impact is the growing need of the time.

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