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A SURVEY ON PERSONALITY-AWARE RECOMMENDATION SYSTEMS

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ABSTRACT

With the emergence of personality computing as a new research feld related to artifcial intelligence and personality psychology, we have witnessed an unprecedented proliferation of personality-aware recommendation systems. Unlike conventional recommendation systems, these new systems solve traditional problems such as the cold start and data sparsity problems. This survey aims to study and systematically classify personality-aware recommendation systems. To the best of our knowledge, this survey is the frst that focuses on personality-aware recommendation systems. We explore the diferent design choices of personality-aware recommendation systems, by comparing their personality modeling methods, as well as their recommendation techniques. Furthermore, we present the commonly used datasets and point out some of the challenges of personality-aware recommendation systems.

INTRODCUTION

Personality Computing is the interdisciplinary study feld that focuses on the integration of personality psychology theories with computing systems. It has been proven that leveraging personality theories could help overcoming user modeling challenges. Personality computing has been applied in many domains and research directions, and the number of scientifc publications within the scope of personality computing has dramatically increased within the last decade. The integration of user personality traits into the computing system has created new research

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directions, such as automatic personality recognition (APR), and helped to accelerate existing research directions as well, such as human-robot interaction (Cai et al. 2020) and social computing (Dhelim et al. 2021b) research. Personality computing has also enabled recommendation systems to understand user preferences from a diferent perspective. A new type of recommendation system that leverages the user's personality trait to improve the recommendations had emerged. This group of systems is known as personality-aware recommendation systems. This new type of recommendation systems has proven efective in solving the challenges of conventional recommendation systems.

LITERATURE REVIEW

In the recent few years, we have witnessed a rapid proliferation of personality-aware recommendation systems. While all of these recommendation systems incorporate the user's personality traits in the recommendation process, however, these systems use different recommendation techniques, and they are designed to recommend diferent content. Therefore, in this paper, we conduct a comprehensive survey of the literature of personality-aware recommendation systems. Few works surveyed some research direction in the feld of personality computing. In 2014, Vinciarelli and Mohammadi (2014a) surveyed the publications that used the user's personality in computing systems, and they coined the term personality computing. In 2017, Kaushal and Patwardhan (2018) surveyed the literature on APR from online social networks. Similarly, in 2019, Mehta et al. (2020b) surveyed the literature on deep-learning-based personality APR. However, as far as we know, we are the frst who survey the literature of personality-aware recommendation systems The main focus of the current survey is personality-aware recommendation system. Specifcally, we cover all the works that use the user's personality information for recombination services. We focus on works published between 2009 and 2021. We adapted PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) framework guidelines (Moher et al. 2010) to select publications related to personality-aware recommendation systems. As shown in Fig.1, initially, 669 related papers between January 2009 and April 2021 were identifed after searching Google Scholar, Elsevier, IEEE Xplore digital library, ACM Digital Library, and Springer. for articles related to the following research queries:

"personality computing", "personality-aware", "recommendation system", "personality recommendation", "personality-based", "social recommendation", "social computing", "personality collaborative fltering", "personality content fltering", "social computing", "social-aware", "personality modeling", "user personality". The searches were limited to articles written in English. 956 additional articles were identifed as related works by following the citations map of the initially identifed articles. After removing duplicated papers, a total of 1625 articles were gathered in the identifcation phase. In the screening phase, based on the title and abstract screening 1205 articles were excluded for not meeting the inclusion criteria. The majority of these articles either use personality information for other tasks, or they did not use personality information for recommendation. 285 articles were excluded in the eligibility phase after full- text reading. Finally, 135 articles were qualifed for fnal inclusion.

EXISTING SYSTEM

- Yang et al. [4] proposed a recommendation system of computer games to players based on their personality traits. They have applied text mining techniques to measure the players' Big-five personality traits, and classified a list of games according to their matching with each dominant trait. They have tested their proposed system on 2050 games and 63 players form Steam gaming network.
- While Wu et al. [5] presented a personality based greedy re-ranking algorithm that generates the recommended list, where the personality is used to estimate the users' diversity preferences.
- Ning et al. [6] proposed a friend recommendation system that incorporates the Big-five personality traits model and hybrid filtering, where the friend recommended process is based on personality traits and the users' harmony rating.
- Ferwerda et al. [7] studied the relationship between the user's personality traits and music genre preferences, they have analyzed a dataset that contains personality test scores and music listening histories of 1415 Last.fm users.
- Similarly in [8] they conducted an online user survey where the participants were asked to interact

with an application named Tune-A-Find, and measured taxonomy choice (i.e. activity, mood, or genre), individual differences (e.g. music expertise factors and personality traits), and different user experience factors.

- Similarly, Hafshejani et al. [9] proposed a collaborative filtering system that cluster the users based on their Big-Five personality traits using K-means algorithm. Following that, the unknown ratings of the sparse user-item matrix are estimated based on the clustered users.
- Dhelim et al. [10] discussed the benefits of capturing the user's social feature such as personality traits that are represented as a cyber entities in the cyberspace. Similarly, Khelloufi et al. [11] showed the advantages of leveraging the user's social features in the context of service recommendation in the Social Internet of Things (SIoT).
- Zarrinkalam et al. [12] presented a graph-based link prediction scheme that operates over a representation model built from three categories of information: user explicit and implicit contributions to topics,relationships between users, and the similarity among topics.
- Trikha et al. [13] investigated the possibility of predicting the users' implicit interests based on only topic matching using frequent pattern mining without considering the semantic similarities of the topics.
- While Wang et al. [14] proposed a regularization framework based on the relation bipartite graph, that can be constructed from any kind of relationships, they evaluated the proposed system from social networks that were built from retweeting relationships.

DISADVANTAGES

1) The system less effective since it is not implemented by user interest mining, personality computing.

2) The system doesn't implement Collaborative filtering (CF) method.

PROPOSED SYSTEM

In the proposed system, product recommendation could be formulated as link prediction in HIN [3]. For example, in this system, given the user's previous rating and topical interest represented in a HIN, the

exists between the user and the product (the ball). One of the main challenges of link prediction in HIN is how to maintain a reasonable balance between the size of information considered to make the prediction and the algorithm complexity of the techniques required to collect that information. Since in practice, the networks are usually composed out of hundreds of thousands or even millions of nodes, the method used to perform link prediction in HIN must be highly efficient. However, computing only local information could lead to poor predictions, especially in very sparse networks. Therefore, in our approach, we make use of meta-paths that start from user nodes and end up in the predicted node (product nodes in our case), and try to fuse the information from these meta-paths to make the prediction.

ADVANTAGES

1) Propose a product recommendation system that infers the user's needs based on her/his topical interests.

2) The proposed system incorporates the user's Big-Five personality traits to enhance the interest mining process, as well as to perform personality-aware product filtering.

3) The relationship between the users and products is predicted using a graph-basedmeta path discovery, therefore the system can predict implicit as well as explicit interests.

PERSONALITY MODELS AND RECOMMENDATION SYSTEMS

Historically, recommendation systems are divided into three main categories, collaborative fltering approaches, content fltering approaches and hybrid fltering approaches. Collaborative fltering is inspired by the fact that "people who agree on the past, probably will agree in the future". In practice, in order to recommend new items to a given user ux, collaborative fltering systems determine a group of users that have a similar rating with user ux, these users are called the neighbors of user ux. After fnding the group of neighbors, the system fnds the set of items that share a high rating among these neighbors, and subsequently recommend these items to user ux. While content fltering approaches, compute the similarity between previous matched items and the suggested items, regardless of the neighbors' ratings. Finally, hybrid approaches use a combination of these two techniques. Similar to the conventional recommendation systems, ersonality-aware recommendation systems also use similar recommendation techniques, the only diference is that they add the user's

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personality information in the recommendation process.

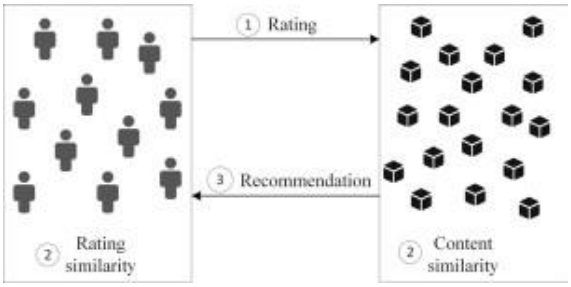

Fig 1: Conventional recommendation systems

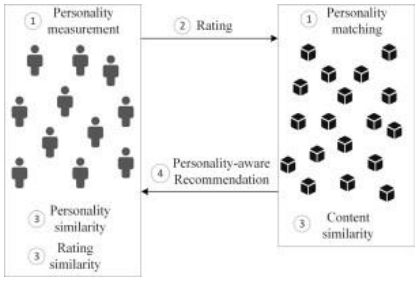

Fig 2- Personality-aware recommendation systems

In Figs. 1 and 2, we show the main diferences between conventional and personality-aware recommendation systems. Conventional recommendation systems mainly have three stages. Firstly, the rating phase, where the users express their interests by rating some items. The second stage is the fltering phase, either collaborative fltering, content flter or hybrid fltering as mentioned above. Finally, at the recommendation phase, the system recommends the items yielded by the fltering phase. As shown in Fig. 2, personality-aware recommendation systems add two more phases before the rating phase and change the fltering stage as well. Personality measurement phase, the system assesses the personality type of users using a personality assessment questionnaire that the users need to answer during registration, or by applying an APR scheme on the user's previously available data, such as online social network data. While in personality matching phase, the system tries to match user personality type with relevant items by computing the matching likelihood between the user and these items. The matching is computed based only on the personality information of users and some personality features of the item, such as a product brand in product recommendation or personality type of actors in the case of movie recommendation. Personality matching is performed either using lexical matching by linking textual description of the items with the associated personality types, or using a fne-grained rules that can match items with personality types. It is worth noting that at personality matching phase, the system does not have any information about the user's ratings, which help to alleviate the efects of cold-start problem, one of the most

challenging problems in the literature of recommendation systems. Personality-aware recommendation systems also change the fltering phase, by incorporating the personality information in similarity measurement to determine the neighbors of each user. The primary objective of fltering phase in the conventional collaborative fltering is to determine the set of neighbors that have similar ratings with the current user, a process known as neighborhood formation. In personality-aware recommendation system, the similarity between the users is computing based on their personality trait similarity or using a hybrid personality-rating similarity measurement, and the resulting set of neighbors are similar in terms of personality traits to the studied user.

CONCLUSION

To the best of our knowledge, this survey is the frst that focuses on personality-aware recommendation system. We have reviewed the literature of the recent works in this domain, and show the main diferences between diferent works, in terms of personality model, as well as in terms of the used recommendation technique. The vast majority of personality-aware recommendation systems leverage Big-Five personality model to represent the user's personality. Personality-aware recommendation systems have the upper hand when compared with the conventional recommendation techniques, especially when dealing with cold start and data sparsity problems. However, with the understanding of the user's personality advantage comes the challenge of preserving the privacy of the user personality information, and also the challenge of maintaining a high personality detection accuracy

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