

Smart Recommender Systems for Healthcare Domain: Review and Challenges

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Abstract

Large amount of clinical data spread across various sites on the Internet obstructs users from extracting useful information which can be used for enhancing the healthy life style. Similarly, overload of medical information (e.g. medicines prescriptions, test reports, treatment) has created many problems to medical professionals in building patient oriented decisions. To overcome information overload issue on Internet, Recommendation System has been developed in various fields as a competent tool. There is need to incorporate recommender system in healthcare domain which will be helpful to end-users (patients) and medical professionals in making précised and efficient health related decisions. Now days, the application of recommender system for healthcare has become a critical research topic because of its remarkable benefits in generating relevant personalized recommendations and assisting patients in taking correct health related decisions. In this article, we discuss overview of existing research on recommender systems in healthcare domain. A general idea about three recommendation techniques such as content-based, collaborative filtering (CF)-based, and hybrid methods is explained in context of healthcare domain. Examples of various recommender systems include as food/diet recommendation, drug recommendation, lifestyle recommendation, and healthcare professional recommendation. Finally the research issues need to be addressed are listed.

Keywords: Recommender Systems; Healthcare; Collaborative Filtering; Similarity Measures; Big Data; User Ratings; Decision Support System

Introduction

Due to tremendous growth of online information, people face difficulty in getting high quality and important information. Recommendation system has considered being an effective information filtering tool and has been employed in various applications such as e-commerce, news, music etc. Now days recommender systems are widely used in healthcare domain i.e. Health Recommender System (HRS) to provide medical recommendations. Medical information of patients' health status in form of diagnosis, reports, and treatments can be used for their well-being enhancement. Recommender systems should use this information for helping both patients and medical professionals to take healthcare related decisions. HRS mainly enhances patients' understanding of

health situations and encourages them to pursue a healthier lifestyle. Similarly HRS supports healthcare professional for better and accurate disease predictions and treatments [1-3].

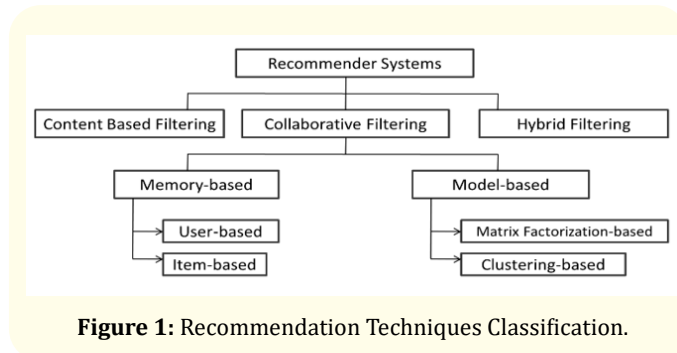
HRS performs analysis of patients' health conditions and recommends them diagnosis, exercise, diet, medicines etc. HRS sends the necessary critical information to patient at correct time with accuracy and privacy of patient details. It helps to reduce the cost of health-related decision making [4].

Basic recommendation techniques

Collaborative filtering (CF)

Collaborative filtering suggests items to user based on principle as: If users have same interests in past history then they can have

same taste. In view of Health Recommender System (HRS), collaborative filtering can be used as: If patients have same disease symptoms or health circumstances, then there is possibility to have similar medication and healthcare services [5].



Content-based filtering (CB)

Content based filtering checks the items similar to what user has liked in past and match the user profile accordingly. In context of HRS, this technique will propose healthcare facilities as per patients' health or disease condition that are similar to what recommended to patient in past [6-8].

Hybrid filtering

The main idea behind hybrid filtering is to combine above recommendation methods to take advantage of both and avoid the drawbacks of them. CF mainly has cold-start problem when new item is included in system and has no prior user ratings for it but content based handles this problem by generating predictions using available information/content of this item [7].

Open issues for research

- **User profile creation:** In HRS, correct user information should be gathered in order to generate relevant and accurate recommendations. This information includes health conditions, disease treatment, diagnosis, nutritious diet etc. Hence it is very significant to verify standard data formats, validity/genuineness of data for assuring quality of data [9].
- **Early disease detection:** Many times patients are suffering from chronic diseases or cancer where the disease is perceived at late stages. It actually lowers the possibility of curing the disease entirely. HRS can be used to offer health education functionality which will enhance awareness about disease [10].

- **Effect of bad recommendations:** In HRS, bad recommendations can affect patients' physical and mental health. Due to negative impact of bad recommendations, the recommendations must be accurate with high quality data and expert opinion [11].
- **Unavailability of high quality public dataset:** The research in HRS is still in initial stage. The datasets used in HRS mainly faces the issues as non-public data, low quality data, lack of generalized data.

Conclusion

Recommender systems are the most interesting research topic now days in various domains such as e-commerce, social network, tourism, Internet of Things, healthcare etc. Recommender systems are used to provide different services to users which help them in accurate decision making. Recommender systems are utilized in various real-time applications. Health recommender systems (HRS) provide diagnosis, drug/food/ treatment/lifestyle recommendations to patients for healthy and fit living. In this article, three basic techniques of recommender system are described along with open issues for research that must be addressed. Collaborative filtering is the most popular and commonly used technique for generating personalized recommendations.

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