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Medicine Recommender Systems

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Abstract: *Nowadays, a vast amount of clinical data scattered across different sites on the Internet hinders users from finding helpful information for their well-being improvement. Besides, the overload of medical information (e.g., on drugs, medical tests, and treatment suggestions) have brought many difficulties to medical professionals in making patient-oriented decisions. These issues raise the need to apply recommender systems in the healthcare domain to help both, end-users and medical professionals, make more efficient and accurate health-related decisions. In this article, we provide a systematic overview of existing research on healthcare recommender systems. Different from existing related overview papers, our article provides insights into recommendation scenarios and recommendation approaches. Examples thereof are food recommendation, drug recommendation, health status prediction, healthcare service recommendation, and healthcare professional recommendation. Additionally, we develop working examples to give a deep understanding of recommendation algorithms. Finally, we discuss challenges concerning the development of healthcare recommender systems in the future.*

Keywords: Medical Diagnostic System, Hospital System, Trace Medical History, Patients Record, Patients Debases Book

I. INTRODUCTION

Hospitals have access to vast amount of data about patients and their health parameters. Thus, there is a need for convenient way for medical professionals to utilize this information effectively. An example would be the access to aggregated information from existing database on a specific problem at the point of care when it is necessary. Moreover, there are more drugs, tests, and treatment recommendations (e.g. evidence-based medicine or clinical pathways) available for medical staff every day. Thus, it becomes increasingly difficult for them to decide which treatment to provide to a patient based on her symptoms, test results or previous medical history. On the other hand, all these data can be used to strive personalized healthcare which is currently on the rise and predicted to get a major disruptive trend in healthcare in the upcoming years. Therefore, a recommendation engine for medical use could be employed to fill this gap and support decision making during therapy. Based on a patient's current health status, prehistory, current medications, symptoms and past treatments, the engine can look for individuals with similar parameters in the database. At the end, the recommender system would suggest the drugs that were most successful for similar patients. With the help of such a system, the doctor will be able to make a better-informed decision on how to treat a patient. IBM's artificial intelligence machine Watson Health [8] is already able to find a suitable treatment for patients based on other patients' outcome and evidence-based medicine. IBM claims that 81% of healthcare executives familiar with Watson Health agreed that it has a positive impact on their business. This demonstrates that using technology and analytics become increasingly important in healthcare. In this paper, we review the existing medicine recommendation system solutions, and compare them based on various features. The goal is to demonstrate the existing solutions for the healthcare providers in order to improve the medicine selection process and select an appropriate medication for the patients. The rest of this paper is organized as follows: The methodology for the literature review is presented in Section 2. In Section 3, we discuss the findings. Section 4 presents the limitations. Finally, Section 5 concludes the paper and presents the future work.

II. LITERATURE REVIEW

Recommender systems aim to provide users with personalized products and service to deal with the increasing online information overload problem. Various recommender system techniques have been proposed since the mid- 1990s, and

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many sorts of recommender system software have been developed recently for a variety of applications. Most of the recommender technologies are applied to the e- government area, e-business area, e-commerce/shopping area, e-learning area, e-tourism area and so on. However, medicine area includes rare recommender technologies, and this will focus on the design of the medicine recommender system and mining knowledge from medical case data commonly used recommendation techniques include collaborative filtering (CF), content-based (CB), knowledge-based (KB) techniques and hybrid recommendation technologies. Each recommendation technology has advantages and limitations: CB mainly generates recommendations by using traditional retrieval

Methods and machine learning methods, but CB has overspecialized recommendations; Collaborative filtering (CF)-based recommendation techniques help people to make choices based on the opinions of other people who share similar interests, while CF has sparseness, scalability and cold-start problems. Knowledge-based (KB) recommendation offers items to users based on knowledge about the users, items and/or their relationships. Usually, KB recommendations retain a functional knowledge base that describes how a particular item meets a specific user's need. To achieve higher performance and overcome the drawbacks of traditional recommendation techniques, a hybrid recommendation technique that combines the best features of two or more recommendation techniques into one hybrid technique has been proposed. When it comes to a new application area, a new recommendation framework is necessary to solve these problem. Intelligent medical diagnosis has get more and more concern. Some selected techniques for data mining in medicine are discussed in. Data mining technology has been used to predict heart disease, and to diagnosis thyroid diseases. The workshop on health search and discovery

Discusses several challenges and important topics about search and discovery in the medical domain, indicating that information retrieval, personalization, expertise modelling, data mining and privacy preservation are critical to enable advances in health and discovery. These approaches do solve some problems in medical diagnosis and apply new data-driven technologies to the medical field. However, there does not exist a universal model which can 14 work well for all the data and conditions. When faced with different data and application scenarios, it is necessary to build a different model and conduct data analysis. In this paper, we introduce a universal medicine recommender system framework that is designed and implemented to apply data mining technologies to the recommender system that use the potential knowledge We investigate the medicine recommendation algorithms of the SVM (Support Vector Machine), BP neural network algorithm and ID3 decision tree algorithm based on the diagnosis data. Finally, SVM is selected for the medicine recommendation model for its high accuracy, good efficiency and scalability.

III. PROBLEM DEFINATION

Medicine recommendation is one of the most important and challenging tasks in the modern world. As there are many new diseases which are discovered by the doctors sometime a medicine for one diseases can lead to the side- effects which can further lead to the discovery of new diseases. Our goal is to build such a recommendation model which will help the doctors to prescribe a medicine to the patient t even if they have not studied about that before the doctor has to open the framework and has to search about the diseases of the patient it will also help to the inexperienced doctors and patients for using the right drugs high accuracy and efficiency is very critical for such a recommender system.

IV. SYSTEM ARCHITECTURE

Interfaces:

There is a single type of interface as such supported by our system namely

Software Interfaces:

To apply machine learning i.e. Neural Networks a library known as Tensor Flow must be imported in python.in addition another similar library known as Keras is also imported for supporting machine learning algorithms. Other supporting libs are Pandas, NumPy, SKlearn etc. library known as matplotlib is used to plot the data into graphical form. Pycharm or Jupyter Notebook is used to run the algorithms.

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User Interfaces:

The product will exist on a real-life system. The Interface will be a simple and easy to use interface. The user needs to give input of the diseases which they are looking for after that the medicine will be predicted according to the diseases entered the result box will display the result of the fired query.

Hardware Interfaces:

The system has minimal Hardware interfaces. A normal personal desktop or a laptop will be a good choice to run the system. It is recommended for the system to have higher ram and processing power in order to compute and predict quickly.

V. SYSTEM ANALYSIS AND DESIGN

The data for the medicine is very huge and consist various parameters the data has been segregated according to the diseases the data indicates medicine along with the reviews of the patient who used it this data was used to train the model and predict the medicine using machine learning algorithms.

- **Graphical User Interface**: The medicine recommender System takes the input from the user about the diseases user
- is feeling after that it will give different medicines that can be used to cure the diseases.
- **Reliability & Availability**: Our system will be highly available as it does not use any internet or cloud technology. Our system relies on the data that is pre- stored and doesn't require to be connected to third party for resources.
- **Performance**: The performance of our system is high as compared to other models. We have an accuracy of around 70-75 % which is more than any other algorithm that is used.

VI. LIMITATIONS

Our literature review has two main limitations, namely, the paper selection and content. Out of 52 papers, only 13 were reviewed based on the strict inclusion, exclusion and quality criteria we chose. Along with the strict search criteria, the systematic review included papers from a limited number of databases. However, we used six main databases that are well known. Some papers offer little detail on the exact implementation and architecture of the solutions built. This made it more difficult to assess which applications were used to build the system. Also, some papers proposed only a theoretical solution on how to recommend a drug such as [16], but did not implement the solution. On the other hand, some papers did implement the solution such as [2], but no evaluation was made on the performance. Therefore, several questions stay under investigation, such as "how accurate are these recommender systems?" and "does it reduce the symptoms patients have?"

VII. CONCLUSION

This paper presented a systematic literature review for medicine recommendation engines. We reviewed 13 studies that met our strict criteria in six different databases. These studies can be split into two categories: (i) machine learning and data mining-based, and (ii) ontology and rule-based approach. The studies were summarized and evaluated across several parameters: diseases, data storage, interface, data collection, data preparation, platform/technology, algorithm, and future work. Most of the studies that did not focus on any disease, had less information about data storage, interface, data collection, data preparation, platforms and technology, and customized algorithms. For future work, our review suggests to extend the existing solutions by adding recommendations for the dosage of drugs, as well as building highly scalable solutions. Also, based on the evaluation, we identified that none of the studies we reviewed include a graph database in their solution for a drug recommendation system. Graph database such as Neo4j seem to be very suitable for drug recommendation engines because they are highly scalable and consistent which would account for the last of the aforementioned topics for future work. Furthermore, their data model seems to be promising for recommendation systems due to their network structure and ease for querying. Hence, another direction for future research would be the creation of medicine recommendation engines based on graph database

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