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A SMART HEALTHCARE RECOMMENDATION SYSTEM

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ABSTRACT

In this paper, we proposed Healthcare Recommendation System. We proposed two different recommender systems. First is to recommend symptoms wise trustworthy hospitals and second is to recommend treatments of the users who are satisfied with their treatments having similar health profile of the registered users. It is very difficult to find out appropriate hospital on the basis of symptoms for general public, but it is very important to find out appropriate hospital in case of emergency. Therefore, to solve this issue we proposed symptoms wise trustworthy hospital recommendation module. In this recommendation module we will use reviews and ratings given by other patients to the hospitals as well as the treatment details feed by the hospital administrator. Treatment Recommendation for chronic diseases is recommendation module, in which users will enter their chronic diseases and treatment details as well as current health status for other users. To recommend treatment on chronic diseases we proposed content-based filtering using decision treealgorithm. Decision tree algorithm will use user's profile to recommend better treatment, doctors and hospitals.

Keywords*: symptom based searching, treatment recommendation, health status prediction, clinical test data, ratings, review*

1. INTRODUCTION

Today, information technologies have led to number of innovations and developments in number of fields. In this context, Recommender systems (RS) have been a cutting-edge development in the service industry. In the case of web-based services, RS aims to increase reachability of products and to provide alternatives for potential customers. In this context, recommender systems for medical use should be implemented to bridge these gaps and support both, patients and medical professionals, to make better healthcare-related decisions. Recommender systems have been integrated into online retailers, streaming services, and social networks to facilitate users item selection process. Recently, these systems have been widely applied to the healthcare domain (so-called Health Recommender Systems - HRS) to better support medical suggestions. Many variances of RS have been used in online stores and it is substantially being adapted by many organizations on the web.

HRS offer a better personalization that increases the details of provided recommendations and improves user's understanding of their medical ondition. These systems also provide patients with a better experience, improve their health condition, and motivate them to follow a healthier lifestyle. Moreover, they also assist healthcare professionals with disease predictions/treatments. In health services, information systems have assisted to optimize decision making processes and to increase effectiveness of communication channels and infrastructures, such as ERP systems. In the health industry, RS has a significant role in terms of assisting decision making processes about individuals' health.

2. OBJECTIVES

Following are the main objective of health recommendation system:

- To develop an online healthcare recommendation system
- To implement content-based filtering approach for recommendation
- To implement Symptoms wise trustworthy hospitals Recommendation
- To implement Decision tree algorithm for treatment recommendation

3. RELATED WORK

Dongsoo Hau and Minkyu Lee introduced a framework for Personalized Health Service Recommendation Development of the Internet enables numerous healthcare services to be available to many service consumers. As a result, many brokering web sites such as healthcare service portals and search engines are deployed to support users' choice. However, to provide better healthcare to the novice users, systems need more sophisticated mechanism for healthcare recommendation. Healthcare Service Recommendation Framework (HSRF) that considers health status and various contexts of each user. HSRF arranges healthcare services based on medical similarities between user and services.

Stefanie Mika proposed Challenges for Nutrition Recommender Systems. Obesity or being overweight in general often leads to other more severe diseases. With more than half of the population in the western countries being overweight or even obese, systems are developed to help users make healthier food choices by recommending healthier recipes or food items according to the user's needs or likes and dislikes. But there are many challenges designing such systems. In this paper we try to identify the difficulties encountered and discuss ways to deal with them.

Luis Fernandez-Luque, Randi Karlsen and Lars K. Vognild introduced Challenges and Opportunities of Using Recommender Systems for Personalized Health Education. The use of computers in health education started more than a decade ago, mainly for tailoring health educational resources. Nowadays, many of the computer-tailoring health education systems are using the Internet for delivering different types of health education. Traditionally, these systems are designed for a specific health problem, with a predefined library of educational resources. These systems do not take advantage of the increasing amount of educational resources available on the Internet. One of the reasons is that the high availability of content is making it more difficult to find the relevant one. The problem of information overload has been addressed for many years in the field of recommender systems. This paper is focused on the challenges and opportunities of merging recommender systems with personalized health education. It also discusses the usage of social networks and semantic technologies within this approach.

4. SYSTEM DESIGN

There are three main aspects that need to be considered in recommender systems: usage context, users, and items. Usage context describes the environment where all elements (e.g., items, users, and their relationship) interact with each other. Users are the end-users of recommender systems, and items are the elements that users are looking for. In the healthcare domain, additional aspects concerning the mentioned elements should be considered to generate more precise recommendations.

Usage Context:

The usage context in HRS consists of contextual factors and multi-factorial goal settings that can influence on how items are recommended or presented. The inclusion of contextual information in the sequence of recent contexts of a user can help to better understand contexts that led to the user's current preferences. For multi-factorial goal settings, different domain specific criteria should be considered when evaluating an item.

Users :

HRS are able to support two types of users: end-users and healthcare professionals. End-users could be healthy users or patients. For each end-user, the system has to save a user profile describing his/her health condition. The information helps HRS identify appropriate medications for the user. Healthcare professionals can be doctors, nurses, physicians, clinicians, or pharmacists.

Items:

HRS can offer recommendations concerning different categories, such as treatments/medications for a specific disease, symptoms wise hospital recommendation.

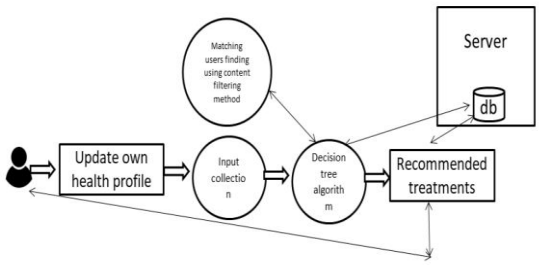
A. Treatment Recommendation:

In this paper, we proposed a healthcare recommender system in which patients will do registration and upload their current treatment details. The treatment details will be stored in database. The treatment details stored is a raw data and need to pre-process for recommender model. System will generate or calculate data for required attributes of decision tree algorithm. The attribute score will be calculated in the database automatically using stored procedure. As we are processing the data using stored procedure, the time required to preprocess the data is reduced. Following are the attributes of decision tree algorithm

- BP
- Sugar

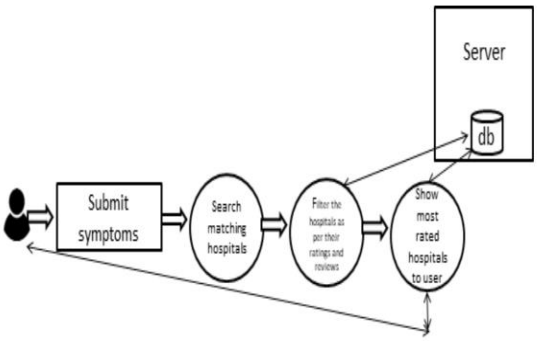
- Kidney
- Heart
- Treatment type
- Treatment_side_effects
- Treatment_Positive_Comments
- Treatment_Negative_Comments
- Total_Patients_Taking _the_treatment
- Treatment_Sideffects_for_BP_Patients

Our proposed content-based filtering method will find out similar profile users and similar user's treatments. The treatments will be sent to decision tree algorithm to decide whether to recommend the treatment.



B. Hospital Recommendation

In this module, we are collecting ratings and reviews for all the hospitals from patients. The hospital will register their facilities, symptoms based treatable diseases etc. The keywords of symptoms and diseases will be stored in database. When user enter symptoms, the keywords will be extracted by the NLP algorithm and on the basis of keywords we will find out matching probable diseases and recommend hospitals accordingly. The hospitals will be ordered by the reviews and rating score.



5. SYSTEM IMPLEMENTATION

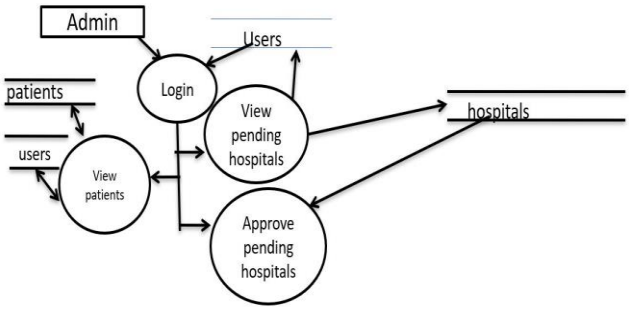
In this application we have implemented healthcare recommender system which will be very helpful for patient suffering from chronic diseases. There are three types of users in our application.

Users

- Admin

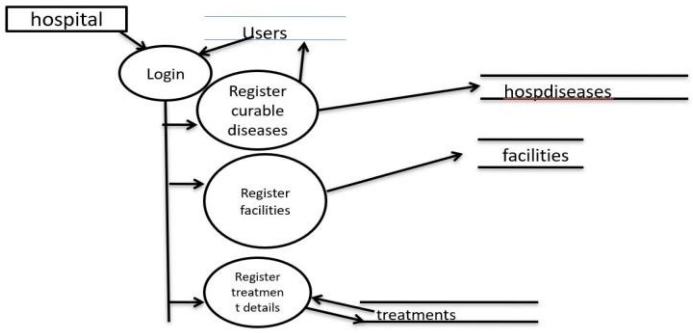
- Hospital
- Patient
- Admin :

In our application, there is a web admin who will be responsible to approve hospitals. Admin will check hospital verification document and approve pending hospitals. The hospital will be able to logged-in into the system after approval. Admin will be able to view hospital details and patient details.



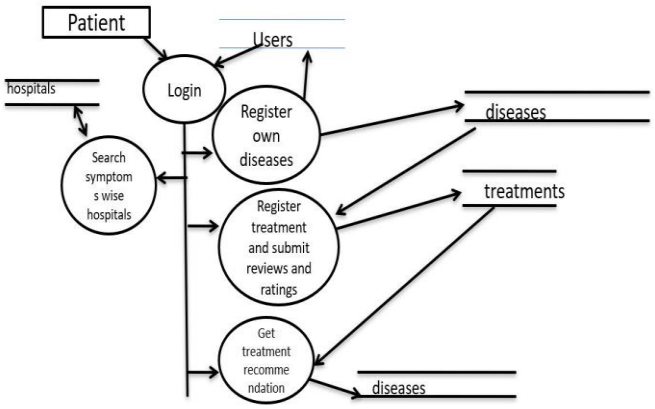
Hospital :

Hospital admin will upload their facilities, services and treatable diseases with symptoms. Along with this hospital admin will register various treatments for registered diseases.



Patient :

Patient will do registration by his own, Logged-in into the system with the help of userid and password. Patient will register his chronic diseases and current treatments. After registration of current treatments he will submit his review against that treatment. The review will be classified using sentiment analysis with the help of NLP and wordnet. The polarity for particular treatment will be stored in database. On the basis of patient's current diseases we will fetch possible treatment using **content filtering.** But the treatments will be sent to decision tree algorithm to decide whether the selected treatments should be recommended to the particular patient or not. The decision tree algorithm will classify the input treatments into two classes one **is recommend** class and another is **not recommend** class.The treatments that are classified into recommend class, will be shown to the patients.



Sentiment Analysis:

Sentiment Analysis is a subfield of Natural Language Processing (NLP) that attempts to understand the meaning of Natural Language. Understanding Natural Language might seem a straightforward process to us as humans. However, due to the vast complexity and subjectivity involved in human language, interpreting it is quite a complicated task for machines. Sentiment Analysis of Natural Language captures the meaning of the given text while taking into account context, logical structuring of sentences and grammar roles.

Sentiment Analysis is a crucial part of Natural Language Processing (NLP). In the ever-expanding era of textual information, it is important for organizations to draw insights from such data to fuel businesses. Sentiment Analysis helps machines interpret the meaning of texts and extract useful information, thus providing invaluable data while reducing manual efforts.

Sentiment analysis is one of the complex methods that consist of five important phases for examining sentiment data.

The phases include:

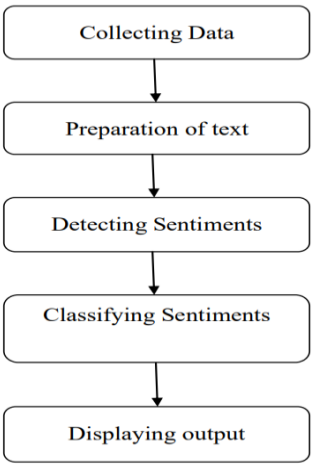
i. Data collection

ii. Preparation of text

iii. Sentiment detection,

iv. Sentiment classification,

v. Displaying output



Decision Tree:

Decision tree is the most powerful and popular tool for classification and prediction. A Decision tree is a flowchart like tree structure, where each internal node denotes a test on an attribute, each branch represents an outcome of the test, and each leaf node (terminal node) holds a class label.

Decision trees classify instances by sorting them down the tree from the root to some leaf node, which provides the classification of the instance. An instance is classified by starting at the root node of the tree, testing the attribute specified by this node, then moving down the tree branch corresponding to the value of the attribute as shown in the above figure. This process is then repeated for the subtree rooted at the new node.

The reasons for using decision tree methods are:

- Decision trees are able to generate understandable rules.
- Decision trees perform classification without requiring much computation.
- Decision trees are able to handle both continuous and categorical variables.
- Decision trees provide a clear indication of which fields are most important for prediction or classification.

Decision Tree Algorithm:

- Set dataset=Load csv dataset
- Set X_Train, Y_train,X_Test, Y_Test = Split_Train_Test(dataset)
- Train decision tree algorithm
- Set algorithm_input=FETCH_INPUT()
- Set input[]=convert treatment raw data into numeric format
- Clf=Initialize decision tree object
- Predict Grade=clf.predict(Input)
- Return predicted output
- If output is 1 then recommend the treatment to user otherwise don't recommend the treatment.

6. CONCLUSION

Healthcare recommendation system is an information service system that connects patients and hospitals: on the one hand, it helps patient discover hospital as per symptoms; on the other hand, it helps hospital to provide quick service to patients who visit the hospital. This system has emerged as tools to support patients and healthcare professionals to make better health-related decisions. In this paper, we have given insights into recommendation scenarios offered by these systems, such as health status prediction, treatment recommendation and hospital recommendation. For each recommendation scenario, various algorithms have been employed, which are based on recommendation techniques or machine learning techniques (e.g., filtering, decision tree, natural language processing).

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