HYBRID MODEL FOR BEHAVIOUR - BASED RECOMMENDER SYSTEM: A HEALTHCARE PERSPECTIVE

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ABSTRACT
As medicine moves ahead, there is indigence for sophisticated decision support systems to make real-time predictions. It provides the ability to sense and acclimate to the needs and inclination, and provides decision support for domain experts and individuals. This paper elaborates the feasibility of providing personalized recommendation for healthcare. A healthcare system must ensure information quality, influences perceived usefulness and perceived usability, both mediated by the trust. Besides, researchers often measure information quality in terms of relevance, accuracy, timeliness, completeness, and consistency. This research work tries to enhance the information quality by analyzing the Personal Health Record to provide individual based personalized recommendation, prediction based on the behavior and disease, predicting the patterns that forecast the incidence of disease in human races. The proposed model will learn from the personal health record samples by employing multi-class supervised machine learning technique to generate accurate predictions. This approach recommends life style modification based on the behavior of the user using hybrid filtering; thereby enhance the health of our communities and the nation.

KEYWORDS Healthcare, machine learning, user profile generation, recommendation, personal health record, hybrid filtering.

I. INTRODUCTION
In the recent era peoples are routinely engaged in relationship whereby they influence and are influenced by other humans which prompts the change in the way of life and environment. Most diseases are prone to increase due to changes in the demographic, changes in lifestyle and the environment, and health damaging behaviours of the individuals. The prevalence and incidence of these issues can be rectified based on the life style modification [1-3]. Early detection and prevention plays a vital role to reduce the incidence and the risk factors of the health issues. Thus prevention and avoidance of them serves as an essential public health and health economics issues in the 21st century. Many public and private sectors have initiated to contribute towards various aspects of health care.

According to WHO [4], “A good health system should deliver quality services to all individuals, when and where needed.” The nature of service differ from country to country, but in all cases oblige an improved health care efficiency, reliable information on which base to take decisions and policies, safety and social benefits [5]. An extensive literature was done from the end-user perspective to analyse the factors for success and failure of the various health care services [6]. Though, the services offer several features, still lack in the success. The primary reasons come under the following categories like information qualities in terms of accuracy and relevance are poor, low trust and high risk as the information are not trustworthy and authenticated [7-10]. The main goal of this research is to provide a solution for the rectification of the above enounced issues, for the betterment and benefit to the people and the society.

This research aims to present a feasible approach for hybrid model that can analyze medical data and processes, and provide decision support for domain experts and individuals. The proposed model learns from the personal health record using supervised learning model for diagnosis and prediction. The need recommendation is provided for the individuals using the hybrid approach which combines demographic, behavior and collaborative filtering. This approach recommends life style modification based on the behaviour of the individual user using hybrid filtering; thereby enhance the health of our communities and the nation. The experimental results show that the proposed approach improves predictive accuracy, precision and recall. The rest of the paper is organized as follows. Section II, reveals the profound and extreme investigation of the healthcare system. Section III, expounds the proposed methodology. Finally, we concluded the paper in section IV and outlined some of the future work.

II. HEALTHCARE SYSTEM
Healthcare is a noteworthy and rapidly thriving industry with the prime goal of imparting health awareness and health education to the general population. It is often confused with restorative care. Medical care is a part of health care and deals with treatment of illness. On the other hand Health services provide only the curative medical services [11]. The healthcare is the dynamic research area which requires the usage of several fields like data mining, web mining, artificial Intelligence, machine learning, natural language processing, web personalization, recommender system and security.

Healthcare system acts as a gateway to bolster qualitative, credible and timely information sharing for the purpose of patient care and treatment. It assists physicians and other health professional with clinical decision making task. An effective health care system should also be easy to use and understand. As most health care systems are moving towards the patient centred approach [10], it is needed to evaluate such a system from the end user point of view and experiences (Davies, 2005). A review forecast the user’s expectation towards PHR systems, such as information quality in terms of accuracy and relevance, trustworthy and authentication [12].

A. Recommendation System
Recommender system has been focus of intense research for years. It has been successfully employed in many commercial applications like online shopping, movie, songs and video, news, tourism, and restaurant [16]. Recently these fields are popularly used in medical applications. It combines ideas from user profiling, information filtrating and machine learning to deliver user a more intelligence, personalized and meaningful information.
From the patient’s point of view, personalization has always been an important aspect of quality in healthcare. Every user wants a care with responsive to individual patient preferences, needs and values. Such personalized care can be used for decision-making [17]. Anna et al. proposed a literature review about personalized medicine and elaborated the portfolio of modern tool that medicine and healthcare can use [18]. Teng et al. [19] throws light on the potential benefits derived from personalized healthcare.

B. Risk factors and prevalence of major health issues

India has facing a rapid health transition with rising prevalence of non-communicable diseases for the past 15 years. There is adequate evidence to prove that NCDs account for almost half of the death rates in India and replaces communicable diseases for the high morbidity and mortality in the country [1].

Health damaging personal behaviours are the main causes for these chronic diseases [15]. However, the social conditions in which people live and work also plays vital role. Risk factors includes behaviour like tobacco usage, alcohol usage, lack of physical activity, unhealthy diet, obesity, stress and environmental factors lead to the major disease burden of NCDs. These determinants are modifiable and controllable, so that incidence of NCDs can be reduced. A survey report [13], elaborated the behaviour risk factors for the major NCD includes, tobacco smoking, Alcohol Consumption, Fruits and Vegetables Consumption, Physical Activity. Fig. 1 shows the various composition of the chronic disease.

Hence it is necessary to reduce the incidence and impact of these disorders by providing personalized care with early diagnosis and prompting healthy life style. This research aims to enhance the information quality by analysing the Personal Health Record to provide the solutions as; Individual based personalized recommendation. Prediction based on the behaviour and disease, predicting the patterns that forecast the incidence of disease in human races.

III. MATERIALS AND METHODS

Non-communicable disease is the significant public health issues in India with the issues of both malnutrition and over nutrition. The better approach to lessen the adverse effort of NCD is to prevent them by early diagnosis and promoting healthy lifestyles. This paper introduces an approach to predict and diagnosis non communicable diseases and recommends personalized life style modification. The fundamental objective of this research is to present an intelligence learning model that is capable of crunching vast amounts of electronic personal health records and identifying patterns, which can deliver relevant, high-quality data in real time. The Electronic Personal Health Record (also known as Electronic Medical Record) is an electronic version of the patient medical record. It records patient like demographic, cognitive, psychological, social, behavioural and functional measurements. It is a patient centred approach, where the medical records and other information are accessed, maintained and managed by the patients [20, 21]. Such PHR has the potential to support decision making and enables the health care system towards the personalized medical model [22]. This proposed approach consists of the following phases,

- Training Phase
- User profile generation
- Recommendation

A. Training Phase

The main goal of this research is to develop a supervised learning model which can deal with the multi-class problems, as the problem of medical diagnosis contains multiple categories. There has been broad research on the diligences of supervised machine learning algorithms on medical data [23]. Most research proves that Support Vector Machine (SVM) provides high level of accurate compared to other techniques. As clinical data tends to be dirty, this phase elevates them with necessary pre-processing and normalization techniques. The
proposed model will learn from the data samples by employing multi-class support vector machine technique to generate accurate predictions.

B. User profile generation

Developmental Origins of Health and Diseases have induced the importance of patient medical records and its diligence in prediction and analysis of the disease. Patient medical records are increasing being offered in the form of electronic form, to ensure the availability of the valuable information at the right time [24].

Electronic Personal health records (PHRs) offer users a variety of advantages aimed at patient empowerment. This stage is utilized to generate personal health record by the user in order to provide personalized health information. In case of new user, the profile has to be learned using the training phases otherwise the existing user the profile can be dynamically updated.

The user profile has information that can distinguish one user from a multitude of other users. It is a patient centered approach, where the medical records and other information are accessed, maintained and managed by the patients. PHR has the potential to support decision making and enables the healthcare system towards the personalized medical model. The user profile is designed to permit tracking and monitoring patients with non-communicable diseases. It provide clinical data of the individuals, including,

- Demographic information
- Past medical history
- Family medical history
- Socioeconomic status
- Personal behavioural information,
- Anthropometric Measurement
- Blood Pressure Measurement
- Lab investigation
- Doctors’ report.
- Diagnoses
- Demographic information

C. Hybrid personalized recommendation phase

The recommendation is provided for the individuals using the hybrid approach which combines demographic, behavior (content) and collaborative filtering. These recommendations can support decision making process and improve wellness.

1) Content – based filtering: Content-based filtering recommends items based on a comparison between the content of the items and a user profile. The content of each item is represented as a set of descriptors or terms, typically the words that occur in a document. The user profile is represented with the content of the items and a user profile. The similarity of the content between the item and the user profile is calculated using the formula

\[ \text{sim}(D, P) = \frac{\sum_{w} u_{w} w^{T} \cdot \sum_{w} w^{T}}{\sqrt{\sum_{w} u_{w}^{2} \cdot \sum_{w} w^{2}}} \]  

(2)

2) Demographic information: Demographic information such as age, gender, education, etc. can be used to identify the types of users that like a certain object. The users are categorized based on the personal attributes and then preferences are considered.

3) Collaborative Filtering: Collaborative filtering approach can be used to predict the interest of a user based on the profiles of the other user with similar preferences. Generally user can express the preferences in the form of rating. Based on the rating and user preferences the system provides personalized recommendation to the users.

D. Evaluation Measures

The effectiveness of a recommender system is usually determined by the ratios precision and recall. Precision indicates how well the retrieved documents match a user’s interest. It is the ratio of the number of relevant documents retrieved to the total number retrieved:

\[ \text{precision} = \frac{\text{relevant retrieved}}{\text{retrieved}} \]  

(3)

Recall is the ratio of number of relevant documents retrieved to the total number of relevant documents in the collection:

\[ \text{recall} = \frac{\text{relevant retrieved}}{\text{relevant}} \]  

(4)

These ratios can also be used to determine the effectiveness of a recommender system. Precision provides an indication of the quality of the recommendations. Recall gives an indication of how many documents are recommended from the total number of relevant documents.

IV. CONCLUSIONS

Healthcare service acts as a gateway to support qualitative, credible and timely information sharing for patient care and treatment. This paper proposes a feasible approach for hybrid recommendation system for the medical application. Thus ensuring better quality of care for patients, by responding more appropriately to their individual needs. The primary objective is to ensure the availability of the valuable information at the right time by ensuring information quality. Thus the health care service can be extemporized and it would be within the reach of every citizen. This paper is an attempt to put the research done in a more systematic way and identify directions for future research. In our future work, we have planned to implement our framework using the real-time data collected in order to assist better diagnosis and treatment.

REFERENCES


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