An Intelligent Recommender System Based on Short-term Disease Risk Prediction for Patients with Chronic Diseases in a Telehealth Environment

Raid Lafta (PhD student)
Ji Zhang and Xiaohui Tao (Supervisors)

Faculty of Health, Engineering and Sciences,
University of Southern Queensland,
Australia

{RaidLuaibi.Lafta, ji.zhang, xtao}@usq.edu.au

Abstract

Clinical decisions are usually made based on the practitioners' experiences with limited support from data-centric analytic process from medical databases. This often leads to undesirable biases, human errors and high medical costs affecting the quality of services provided to patients. Recently, the use of intelligent technologies in clinical decision making in the telehealth environment has begun to play a vital role in improving the quality of patients' lives and reducing the costs and workload involved in their daily healthcare. In the telehealth environment, patients suffering from chronic diseases such as heart disease or diabetes have to take various medical tests (such as measuring blood pressure, blood sugar and blood oxygen, etc). This practice adversely affects the overall convenience and quality of their everyday living.

In this PhD thesis, an effective recommender system is proposed that utilizes a set of innovative disease risk prediction algorithms and models for short-term disease risk prediction to provide chronic disease patients with appropriate recommendations regarding the need to take a medical test on the coming day.

The input sequence of sliding windows based on the patient's time series data is analyzed in both the time domain and the frequency domain. The time series medical data obtained for each chronicle disease patient is partitioned into consecutive sliding windows for analysis in both the time and the frequency domains. The available time series data are readily available in time domains which can be used for analysis without any further conversion. Yet, for data analysis in the frequency domain, Fast Fourier Transformation (FFT) and Dual-Tree Complex Wavelet Transformation (DTCWT) are applied to convert the data into the frequency domain and extract the frequency information.

In the time domain, four innovative predictive algorithms – Basic Heuristic Algorithm (BHA), Regression-Based Algorithm (RBA) and Hybrid Algorithm (HA) as well as a structural graph-based method (SG) – are proposed to study the time series data for producing recommendations. While, in the frequency domain, three predictive classifiers – Artificial Neural Network, Least Squares-Support Vector Machine, and Naive Bayes – are used to produce the recommendations. An ensemble machine learning model is utilized to combine all the used predictive models and algorithms in both the time and frequency domains to produce the final recommendation.

Two real-life telehealth datasets collected from chronic disease patients (i.e., heart disease and diabetes patients) are utilized for a comprehensive experimental evaluation in this study. The results ascertain that the proposed system is effective in analyzing time series medical data and providing accurate and reliable (very low risk) recommendations to patients suffering from chronic diseases such as heart disease and diabetes.

This research work will help provide a high-quality evidence-based intelligent decision support to clinical disease patients in significantly reducing their workload in medical checkups which otherwise have to be conducted every day in a telehealth environment.

URL:
https://drive.google.com/open?id=1Q0GrtPrCUf1ev8SdpdsvP2UIzxOpN3G-