Advanced Science and Technology Letters
Vol.120 (GST 2015), pp.68-75
http://dx.doi.org/10.14257/astl.2015.120.12

A Study on Cardiovascula Disease Pattern Analysis for Clinical and Healthcare Recommending Service

Young Sung Cho[1], Song Chul Moon[2], Kwang Sun Ryu[1], Keun Ho Ryu[1,*]

[1] Database and Bioinformatics Laboratory, School of Electrical and Computer Engineering, Chungbuk National University,
Chungdae-ro 1, Seowon-gu, Cheongju, Korea, youngscho@empal.com, {ksryu, khryu}@dblab.chungbuk.ac.kr

[2] Department of Computer Science, Namseoul University, Sunghwan-eub Seobuk-gu, Cheonan-city, Korea, moon@namseoul.ac.kr

Abstract. Nowadays, **t**he clinical and healthcare recommending service is required in medical center for clinical diagnosis of cardiovascula disease, plan of medical treatment. We propose a method of the clinical and healthcare recommending service using cardiovascula disease pattern analysis for medical treatment information. We use SVM(Support Vector Machine) to segment the clinical historical data, to join patient's clinical test data with input vectors of different features, cardiovascula disease code, input factors and finally forms clusters of the clinical historical data based on the electronic discharge summaries data. Then, we make an application on the clinical and healthcare recommending service for cardiovascula disease treatment information of cardiovascula patients to reduce patients' search effort to get the information of curing procedure, the diagnosis for recovering their health and to improve the rate of accuracy for the clinical and healthcare recommending service. We carry out experiments with data set of medical center to measure its performance. We report some of the experimental results.

Keywords: EMR, Cluster Analysis, SVM, SOM

1 Introduction

As new information about the biology of disease emerges, treatments will be developed and modified to increase effectiveness, precision, survivability, and quality of life [1]. A medical treatment service using SVM, technique for clustering analysis of disease pattern to meet the needs of patient to recover their health condition in the research[2]. The clinical and healthcare recommending service is required in medical center for clinical diagnosis of disease, medical treatment service and the plan of medical treatment. It is necessary for them to obtain the service of helping information

ISSN: 2287-1233 ASTL

to recover their health care. The clinical and healthcare recommending service is the purpose of the function of help desk in medical center. It suggests how to cure the disease or how to make the plan to recover their health for patient's medical treatment based on successful clinical treatment history records using electronic discharge summaries data. Medical treatment information is increasing interest in some predictive methods for clinical diagnosis and the clinical and healthcare recommending service. Generally, there are three methods, that have attracted particular attention, logistic regression, classification trees, and SVM. There is an important problem of classification extensively which is studied in several research areas, such as statistical pattern recognition, machine learning and data mining[3][4][5]. We propose a method of the clinical and healthcare recommending service using cardiovascula disease pattern analysis for medical treatment information. Clustering algorithm is kinds of methods of patterns analysis using SVM in clinical data sets. We use SVM to segment the clinical historical data to use patient's clinical test data and finally we make the clusters of the clinical historical data to use the electronic discharge summaries data of EMR with different features, cardiovascula disease code, input vectors to take cardiovascula disease treatment information of cardiovascula disease patients using recommending service in clinical data sets. This proposing method helps patient to find easily how to get the clinical and healthcare recommending service and helps their target patient in the medical center easily. Therefore, patients and medical centers take some benefit from the service. A clinical and healthcare recommending service using SVM, technique for clustering analysis of cardiovascula disease pattern to meet the needs of patient to recover their health condition, it is important to remain as studied as always in the research[2]. We make the solution for medical treatment information using cardiovascula disease pattern analysis. We carry out experiments with data set of medical center to measure its performance of the clinical and healthcare recommending service using cardiovascula disease pattern analysis for medical treatment information based on the electronic discharge summaries data of EMR. We report some of the experimental results.

2 Our Proposal For Clinical and Healthcare Recommending Service Using Cardiovascula Disease Pattern Analysis

The electronic medical record became the basic data for the ways to operate the effective controlling program for hospital management with nurses and patients. Recently most hospitals have adopted some form of electric medical record system that computerizes existing medical records which have been written on a paper without any loss of process structure, scope and content of information. The purpose of increasing the electronic medical record is to make sure documentation of compliance with institutional, professional or governmental regulation. Many public organization for the health care industry can use patients' clinical information as sharing clinical data. For doing clustering about that, we generate the cluster for evaluation of proposing system for clinical treatment plan of cardiovascula patients. At the learning method, we use the SVM which is introduced by V. Vapnik. They are

well founded in terms of computational learning theory and very open to theoretical understanding and analysis[6]. We use SVM learning to segment the clinical historical data, to join patient's clinical test data with input vectors of different features, such as patient-id(varchar), disease code category(varchar), outpatient cure date(date), gender(boolean), age(numeric), hyper blood pressure(boolean), diabets millitus(boolean), smoking(boolean), old myocardial infarction(boolean), ejection fraction(numeric), blood glucose(numeric), total glucose(numeric), triglyceride(numeric), systoric blood pressure(numeric), diastolic blood pressure(numeric), and hyperlipidemia(boolean) etc., cardiovascula disease code, input factors and finally forms clusters of the clinical historical data based on the electronic discharge summaries data. SVMs are a useful technique for data classication. Although SVMs are considered easier to use than Neural Networks, SVMs are originally designed for binary classification, which has classifiers. SVM classifiers can be learned from training data of relevance feaures of causations and irrelevance feaures of causations marked by users. Classication task usually involves separating data into training and testing sets. Given a training set of instance-label pairs (x_i,y_i), i=1, 2, ..., *m* where input pattern $x_i \in {}_{R_n}$ and class $y_i \in \{+1, -1\}$, SVMs, the aim of the SVM is to find the optimal hyperplane that will classify each pattern x_i into the correct class y_i, the support vector machines (SVM), require the solution of the following optimization problem:

$$S = \{x_i y_i\}_{i=1}^{n} \ , \Phi\ (S) = \Phi\ \{\ x_i, x_j\}.$$

In the linear case, the margin is defined by the distance of the hyperplane to the nearest of the positive and negative examples. The formula for the output of a linear SVM is

$$u = \vec{w} \cdot \vec{x} = b.$$

where *w* is the normal vector to the hyperplane and *x* is the input vector. The separating hyperplane is the plane $u=0$. The nearest points lie on the planes $u = \pm 1$. The margin *m* is thus

$$m = \frac{1}{\|\omega\|_2} .$$

A non-linear SVM maps the training samples of application from the original input space into a higher-dimensional space using a kernel function k $(x_i x_j)$ [9]. When applied to two points x_i and x_j , $k(x_i x_j)$, is a generalised form of the inner product $x_i \times x_j$ in Equation (1). It is necessary for us to use the RBF(Radial Basis Function) as kernel fuction in order to do SVM learning as follows:

$$k_{RBF}(x_i, x_j) = \exp\left(-\frac{\|x_i - x_j\|^2}{2\sigma^2}\right). \qquad (1)$$

The Lagrangian maximisation problem becomes:

$$\text{Max} \sum_{i=1}^{n} \alpha_i - \frac{1}{2}\sum_{i=1}^{n}\sum_{j=1}^{n} \alpha_i\ \alpha_j y_i y_j k(x_i, x_j). \qquad (2)$$

$$s \cdot t\ \ \alpha_i \geq 0\ \ i=1,\ldots,n, \sum_{i=1}^{n} \alpha_i y_i = 0.$$

The Lagrangian α_i can be used to solve the above optimisation problem. We take the proposal reflected the survival rate to clinical data sets to join the electronic discharge summaries data of EMR to classify cardiovascula disease pattern via a SVM learning for the clinical and healthcare recommending service. Then we create clusters of the clinical historical data based on the electronic discharge summaries data. The prototyping application is used and the prototyping shows the result to classify cardiovascula disease pattern. The system uses the social variable code such as age, gender, occupation, blood, region and patient's data factors as input vectors including symptoms, signals, clinic, etc, for pre-processing to be possible to provide how to get the clinical and healthcare recommending service with efficiency. The system makes clusters with neighborhood patient-group using a new clustering reflected the survival rate, that is, it classified by the code of classification, which is generated via a SVM learning and patient's cardiovascula disease code in patient information based on clinical historical data. We use the whole clinical data sets. After that, the system using SVM learning[6], provides how to get the clinical treatment information by improved method of performance of the cardiovascula disease code.

2.1 Application for Predictive Pattern Analysis using SVM to segment the clinical historical data

The clustering using cardiovascula disease code for predictive pattern analysis in this paper had better than clustering the data directly. We use SVM to analyze the cardiovascula disease pattern with input vectors of different features, cardiovascula disease code, to build the clinical treatment plan of cardiovascula patients. A SVM classifier can be learned from training data of relevance feaures of causations and irrelevance feaures of causations marked by users. Using the classifier, the system can retrieve more images relevant to the query in the database efficiently. It shows that the interactive learning and retrieval process can find correct feaures of causations increasingly. It also shows the procedural step for generalization ability of SVM under the condition of limited training samples of application.

Table 1. The procedural step for generalization ability of SVM

Step 1. Retrieve by a traditional method.
Step 2. Mark top feaures of causations into two classes: relevance set I+ and irrelevance set IO.
Step 3. Prepare for SVM the training data (xi, yi).
Step 4. Construct classification function using SVM algorithm.

$$\text{Max} \sum_{i=1}^{n} \alpha_i - \frac{1}{2} \sum_{i=1}^{n} \sum_{j=1}^{n} \alpha_i \alpha_j y_i y_j k(x_i, x_j x_i x_j) \quad (1)$$

$$\text{s.t } \alpha_i \geq 0 \text{ i=1,…,n, } \sum_{i=1}^{n} \alpha_i y_i = 0$$

Note: In order to output the similarity distance to the query, we ignored the function sign in the classifier f(x).
Step 5. Calculate the score for each image Ii in the database
Step 6. Sort all feaures of causations by score and return new result.

First, a large set of prototyping for clustering patient data (much larger than the expected number of output count, cardiovascula disease pattern in clusters) is formed using clustering of cardiovascula disease code. From the result of clinical historical data, we find 6 level based on survival rate(%) of patient to recommend the services[4]. We show the result with statistics of percent output for possession of patients based on clinical historical data for the weight. We apply to make clustering of cardiovascula disease code to clinical data sets to join patient's clinical test data with input vectors of different features using the electronic discharge summaries data to classify cardiovascula disease pattern for clinical treatment plan of cardiovascula patients. We make the prototyping application and the result of application is divided to create clusters to be classified cardiovascula disease pattern. The system uses the input vectors as patient's clinical factors such as patient-id(varchar), disease code category(varchar), outpatient cure date(date), gender(boolean), age(numeric), hyper blood pressure(boolean), diabets millitus(boolean), smoking(boolean), old myocardial infarction(boolean), ejection fraction(numeric), blood glucose(numeric), total glucose(numeric), triglyceride(numeric), systoric blood pressure(numeric), diastolic blood pressure(numeric), and hyperlipidemia(boolean) and also, it is including symtoms, signals, system review, ergies, surgical history and family history, etc., to provide how to have clinical treatment plan of cardiovascula patients efficiently. The system creates clusters with neighborhood patient-group using a new clustering of cardiovascula disease code, that is classified by SVM classifier as the code of classification and patient's disease code using electronic discharge summary. The system takes the preprocessing task that is able to use the whole clinical data sets by preferred curing clinical rate of the disease code and then makes cluster of clinical data sets sorted by category of cardiovascula disease code, joined cluster of patient data called by patient DB, neighborhood patient group. As a matter of course, the system uses the whole clinical data sets (medi_rd: called by clinical_record). After that, the system using SVM algorithm, provides how to get the clinical and healthcare recommending service by improved method of performance of the cardiovascula disease code.

2.2 The procedural algorithm of clinical and healthcare recommending service for medical treatment information

The recommending service for medical treatment information is the purpose of the function of help desk in clinical center. It suggests how to cure the cardiovascula disease or how to make the plan to recover their health for patient's clinical treatment based on successful clinical treatment history records. The system searches patient's cardiovascula disease code in patients' information. It scans the preference of curing cardiovascula disease, that is improved method of performance of the cardiovascula disease code, in cluster, suggest the preferred curing clinical treatment of cardiovascula disease code with the highest improved method of performance of cardiovascula disease code selected by the highest improved method of performance of cardiovascula disease code as the average of improved method of performance of cardiovascula disease code. This system provides recommending service for clinical treatment plan by improved method of performance of the cardiovascula disease code predictively. This system generates recommending service for clinical treatment plan efficiently through clustering method using cardiovascula disease code in SVM algorithm based on successful clinical treatment history records. It provides the associated recommending service for clinical treatment plan to the best recommending service with clinical treatment list using electronic discharge summary for clinical treatment plan of cardiovascula patients.

3 Experimental Result

3.1 Experimental data for evaluation

We have the experimental data of 250 patients who have the experience to have had the clinic for cardiovascula disease treatment in clinical center, the data of 7 clinical doctors, the data of 29 category of disease codes about disease category including cardiovascular and heart disease codes used in clinical center. The results of 497 clinical records for clinic is used to do the experiment of the proposal system to evaluate proposing system based on cardiovascula disease. It could be evaluated by MAE in clusters by improved method of performance of the cardiovascula disease code based on successful clinical history records for the clinical and healthcare recommending service. We report some of the experimental results through the experiment with learning data set for 9 months and testing data set for 3 months in a clinical center. We try to carry out the experiments in the same condition of the previous system.

3.2 Experiment and Evaluation

The initial classification of these examples of application had been performed by human inspection. For the support vector machine experiments, for each class of the examples of application were selected randomly for the training set and the remaining in total for the test set. We carry out experiments using MAE(mean absolute error) to measure its performance of proposing system for clinical and healthcare recommending service.

Table 2. The result of MAE by comparing proposal system with other system

Cluster	Proposal(SVM)	SOM	Existing
C1	5.6	7.26	58.29
C2	3.33	13.33	46.67
C3	6.2	9.69	55.79
C4	8.93	13.69	55.36

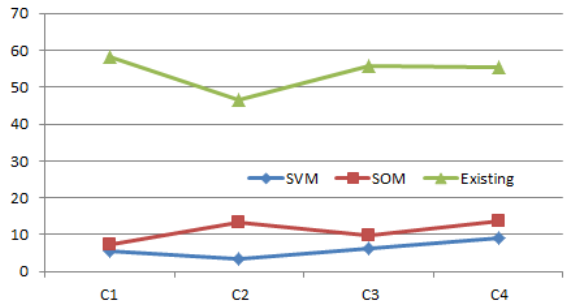

Fig. 1. The result of MAE by comparing proposal (SVM) with other system

The proposing system's overall performance evaluation presents above the result of evaluation of recommending service for clinical treatment plan of cardiovascula patients with clinical MAE rate on the Table 2. The proposed is improved better than the previous systems. We use SVM learning to segment the clinical historical data. We report some of the experimental results as follows. The MAE rate of proposing system is 48.01 %, which is lower than existing system. As a result, we obtained recommender system with improved method of performance the for clinical treatment plan of cardiovascula patients. The result of the proposal using cardiovascula disease code is improved, which is better than the previous system in the performance .

4 Conclusion

Recently almost hospitals have adopted the form of EMR system that computerizes existing medical records that have been written on a paper without any loss of process

structure, scope and content of information. The EMR system plays a key role in providing information for connection between all of systems managed in a hospital as well as gathering information for clinical research or strategic business[1]. Nowadays clinical and healthcare recommending service is required as an application of EMR system to segment the clinical historical data. We reported the result of proposing experiment with SVM was improved more than the existing system. It could make the clinical and healthcare recommending service for each patient's cardiovascula disease based on clinical history data using electronic discharge summary in EMR in HL7 environment. We could simulate the application of SVM to classify cardiovascula disease pattern, generate clinical and healthcare recommending service to be possible to measure the performance of clinical and healthcare recommending service by improved method of performance of the cardiovascula disease code based on successful clinical treatment history records. Thus, we could make clusters with the focus of accuracy and efficiency, and validate the system by our results. Then we could suggest an efficient recommending method for medical treatment information using electronic discharge summary, As a result, we could have the cardiovascula disease pattern analysis using electronic discharge summary for medical treatment information. We carried out experiments with data set of clinical center to measure its performance. We reported some of the experimental results. It is meaningful to present a method of cardiovascula disease pattern analysis for clinical and healthcare recommending service.

Acknowledgments. This research was supported by Basic Science Research Program through the National Research Foundation of Korea (NRF) funded by the Ministry of Science, ICT & Future Planning (No.2013R1A2A2A01068923).

References

1. Cho YS, Ryu KH.: Predictive pattern analysis using SOM in clinical data sets for clinical treatment service. In: IEEE Conference on Computational Intelligence in Bioinformatics and Computational Biology, pp. 1--5 (2014).
2. Linda-Gail Bekker, Landon Myer, Catherine Orrell, Steve Lawn, Robin Wood.: Rapid scale-up of a community-based HIV treatment Service: Programme performance over 3 consecutive years in Guguletu. In: South Africa. South African Clinical Journal, vol 96(4), pp. 315 (2006)
3. Hand DJ.: Construction and assessment of classification rules. Chicester, Wiley (1997)
4. Michie D, Spiegelhalter DJ, Taylor CC.: Machine learning, neural and statistical classification. Ellis Horwood, New York (1994)
5. Weiss SM, Kulikowski CA.: Computer systems that learn. Morgan Kaufmann, San Mateo (1991)
6. C. Cortes and V. Vapnik.:Support vector networks. In: Machine Learning,vol. 20, pp. 273--297. (1995).
7. Chang C. C. and Lin C. J.: LIBSVM: a library for support vector machines (2001)
8. Cios KJ, Moore GM.: Uniqueness of clinical data mining: Uniqueness of clinical data mining. In: Artif Intell Med, vol. 26, pp. 1—24 (2002)
9. Hand D, Mannila H, Smyth P.: Principles of Data Mining. The MIT Press (2001)
10. Collier K, Carey B, Grusy E, Marjaniemi C,Sautter D.: A Perspective on Data Mining. Northern Arizona University, Flagstaff (1998)

