Self Health Diagnosis System for Korean Traditional Medicine with Enhanced ART2

Kwang Baek Kim[1], Hyun Jun Park[2], Doo Heon Song[3]

[1] Department of Computer Engineering, Silla University,
140 Baegyang-daero(Blvd) 700beon-gil(Rd), Sasang-gu, Busan 617-736, Korea
gbkim@silla.ac.kr
[2] Department of Computer Engineering, Pusan National University,
Jangjeon 2-dong, Geumjeong-gu, Busan 609-735, Korea
hyunjun@pusan.ac.kr
[3] Department of Computer Games, Yong-In Songdam College,
Mapyeong-dong, Cheoin-gu, Yongin 449-040, Korea
dsong@ysc.ac.kr

Abstract. In this paper, we propose a self health diagnosis system based on Korea Traditional Medicine that has thousand years of history and popular in Korean general public. The system requires constructing a reliable diseases-symptoms database and classification/learning method. After constructing database based on various government reports and "Engel Pharm" with 60 diseases, 161 representative symptoms, an enhanced ART2 algorithm extracts top five most probable diseases generated by simple user input. The constructed database and test diagnosis results are verified by Korean Traditional medical doctors and verified as reliable in accuracy.

Keywords: Self health diagnosis, Korean traditional medicine, Enhanced ART2

1   Introduction

Korean medicine was originated in ancient and prehistoric times and can be traced back as far as 3000 B.C. It has its own origin and history and the treatment includes herbal medicine, acupuncture, moxibustion, and aromatheraphy. The legendary textbook of Korean traditional medicine, Dong-eui Bo-Gam [1], written in 17th century, was registered to UNESCO Memory of the world in 2009 after year-long verification processes by International Advisory committee of UNESCO. That means Korean traditional medicine is internationally recognized as a sufficiently reasonable and scientific medical treatment as western medicine [2].

However, diagnosis based on Korean traditional medicine is not easy to understand by the public as its inference mechanism is largely metaphorical or abstract. There are few internet services for self-diagnosis, causes and treatment information based on Korea Traditional Medicine like [3, 4] for western medicine and if exists, it is only ad-hoc or in comprehensible.

As [2] pointed out, the main difficulties in building informative pre-diagnosis or self-diagnosis system is to build a reliable symptom-disease database and disease classification system. Recently the government agent [5] published Korean Standard Causes of Death Disease Classification Index (KCD) for such a Korean specialized database build-up.

In this paper, we propose a self health diagnosis system based on Korea Traditional Medicine. The system needs two major engines - database and classification system. The symptom-disease database was refined from the first version [2] and the classification algorithm is also further developed to increase the classification accuracy. The classification system is based on enhanced ART2 [6].

2   Symptom-Disease Database

We collect 739 diseases and 363 related symptoms based on KCD (Korean Standard Causes of Death Disease Classification Index) which replaces diseases of ICD(International Causes of Death) published by WHO with Korean traditional medicine [2]. However, the database used in this paper is refined with respect to various reports submitted to the government about "Diseases Burdensome to Korean Patients" in 2005 and medical contents "Engel Pharm" thus the kinds of diseases considered in this paper is 60. There are 161 representative symptoms and 22 body parts that such symptoms are frequently appeared in the refined database. Again, collected information is verified by doctors in Korean traditional medicine multiple times to reduce conflicts and errors.
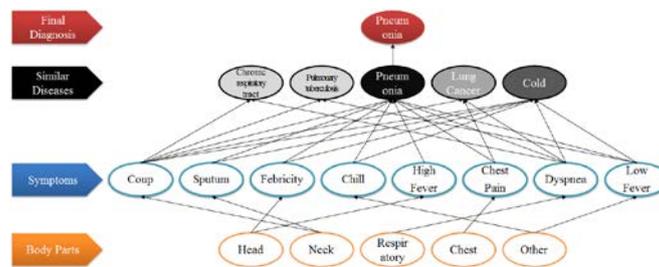

Fig. 1**.** Suspicious Disease Extraction

3   Proposed Self Health Diagnosis System

On user's side, the proposed system asks for the uncomfortable body parts and symptoms. With that answer, the system computes the similarity for diseases collected in the database (60 in total) and shows top five most probable diseases to the requested user. Figure 1 shows a simple diagram for the system's behavior.

The final suspicious disease diagnosis follows the procedure depicted in Figure 1 for example. From the user's input (uncomfortable body part) at the bottom, the system computes the association rate with symptoms that are also given by the user. Then it computes the association rate with diseases in the database by our enhanced ART2 algorithm. Top five most probable diseases (the darker the more probable in this figure) are displayed to the user with computed similarity measure.

For the classification process, the proposed system uses an enhanced ART2 learning algorithm. ART2 is an unsupervised learning algorithm that does not have the target value. From an arbitrary input pattern, ART2 is a solution for the plasticity-stability problem without suffering from the local minima problem [6]. However, it is sensitive to the boundary variables to establish the number of clusters.

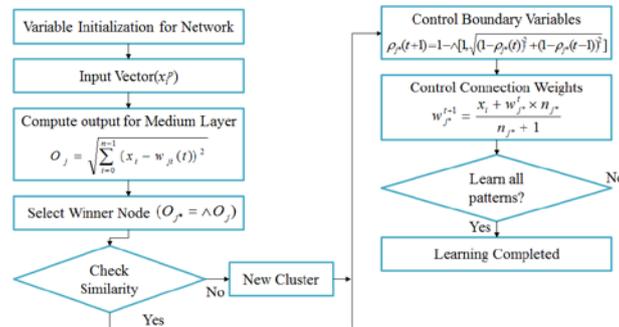The overall learning process by ART2 in this paper is as shown in Figure 2.

Fig. 2. Learning Procedure for the Enhanced ART2 Algorithm

4   Experiment and Analysis

The implementation environment is as following; IBM compatible PC with Intel Pentium IV 2 GHz CPU and 1G RAM is used with JDK 1.6 and Oracle 10g are used in implementation and the system is available for on-line environment using JSP.

Even with enough amount of database used in this paper, 161 symptoms from 60 diseases, one can easily find the power of enhanced ART2 over FCM [7] and enhanced FCM through the result shown in Table 1. The example shown in this paper has input symptoms as sputum, cough, chill, and dyspnea. Such general symptoms are associated with many diseases.

Although three different systems agree with "Cold" as the most probable disease, the difference is other extracted diseases. FCM picks lumbar disc as the third probable one which is not so much related to input symptoms. Enhanced FCM did not commit such error but the overall confidences were relatively low. However, the proposed system extracts the exactly same result with higher confidence. It is the evidence that enhanced ART2 forms more reliable clusters than enhanced FCM inside the system.

Including this example, many test cases were verified by Korean traditional medical doctor.

Table 1. Result from FCM, Enhanced FCM, Enhanced ART2.

FCM		Enhanced FCM		Enhanced ART2	
Cold	65%	Cold	76%	Cold	87%
chronic respiratory tract	50%	chronic respiratory tract	46%	chronic respiratory tract	75%
lumbar disc	44%	pneumonia	36%	pneumonia	62%
pneumonia	39%	tonsillitis	36%	tonsillitis	62%
tonsillitis	39%	asthma	36%	asthma	62%

5   Conclusion

In this paper, we propose a system for self health diagnosis based on Korea Traditional Medicine. The self health diagnosis system consists of two major parts - disease-symptom database and classification/learning algorithm. We construct the database based on KCD (Korean Standard Causes of Death Disease Classification Index) with Korean traditional medicine and used an enhanced ART2 algorithm for classification and learning. From experiment and field expert's review, the proposed system is highly reliable and better in accuracy than the previous FCM based methods.

The system also has fuzzy inference system that compensates the possible misclassification by shortage of information and published for those concerns [2]. Currently this system is available with online access and in the developing phase for the mobile platform.

References

1. Bong, S.K.: A Study on the Preservation and Utilization of Dongeuibogam. Journal of Korea Institute of Oriental Medicine, vol. 15, no. 1, pp. 31--42. (2009)
2. Kim, K.B., Kim, J.W.: Self health diagnosis system with Korean traditional medicine using fuzzy ART and fuzzy inference rules. Intelligent Information and Database Systems. LNCS, vol. 7198, Springer Verlag, pp. 326--335. (2012)
3. Berry D.L., Trigg L.J., Lober W.B., Karras B.T., Galligan M.L., Austin-Seymour M., and Martin S.: Computerized symptom and quality-of-life assessment for patients with cancer part I. development and pilot testing. Oncology nursing forum, vol. 31, no. 5, pp. E75--83. (2004)
4. Mullen K.H. Berry D.L., and Zierler B.K.: Computerized symptom and quality-of-life assessment for patients with cancer part II acceptability and usability. Oncology nursing forum, vol. 31, no. 5, pp. E84--89. (2004)
5. National Statistical Office of Republic Korea, http://www.kostat.go.kr
6. Carpenter, G.A., and Grossberg, S.: ART2: self-organization of stable category recognition for analog input patterns. OPTICS, vol. 26, no. 23, pp. 4919--4930. (1997)
7. Chung, B.H., Chun, T.R., Kim H.C., Kim K.B.: Self Health Diagnosis System using enhanced FCM Algorithm, proceedings of KIICE Conference, pp. 143--149. (2006)