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A Decision Diagnosis Model Based on FCM-CBR Technology for Primary Headache

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Abstract. With the development of computer information technology, its application in the medical field has entered a new stage. More and more technologies and methods for clinical decision support have begun to be proposed. Headache, as a chronic disease, is a common symptom among patients in neurology clinics. Headache, as an external manifestation of pain disorders, its diagnosis researches using information technology on its complex diagnostic indicators and processes are limited. This paper aims to construct a hybrid intelligent data mining model of fuzzy C-means clustering algorithm and case-based reasoning technology for computer-aided diagnosis in typical and atypical primary headaches.

Keywords. FCM, CBR, primary headaches

1. Introduction

Headache is a pain located in the head and neck region, which is one of the most common complaints in clinics. The International Headache Association has defined over 300 different types of headaches in its third edition of the International Classification of Headache Disorders [1]. Researches on computer-aided headache diagnosis based on fuzzy set theory are mainly based on the Health Care Guideline: Diagnosis and Treatment of Headache published by the Institute for Clinical System Improvement (ICSI) [2]. This diagnostic type of clinical guideline is a summary of symptoms in a large population based on evidence-based medicine, which may result in some atypical symptoms not being included in the clinical guidelines for headaches. In addition, there may be overlap between several primary headaches without a clear boundary [3].It is difficult for doctors to distinguish the type of headache. The diagnosis and treatment process of headache patients by doctors is actually both a logical analysis and reasoning based on the knowledge of headache clinical guidelines and it is necessary to combine the reasoning analysis of the above two aspects of doctors. This paper focused on the mixed data characteristics of primary headache and used the Fuzzy C-means Clustering (FCM) algorithm [4] to follow the international classification standards for primary headache. On this basis, Case Based Reasoning

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(CBR) technology [5] is introduced to simulate the case assistance diagnosis of atypical patients by doctors in primary headache, providing research directions for the diagnosis of various types of chronic headache diseases.

2. A Decision Diagnosis Model Based on FCM-CBR Technology for Primary Headache

The computer-aided diagnosis model framework for primary headache based on hybrid intelligence technology is shown in Figure 1. The model first digitizes the diagnostic criteria for primary headache based on the ICHD-III beta version. The second step is to determine whether the patient to be diagnosed as a typical primary headache patient based on the key indicators. If the patient is a typical primary headache patient, the fuzzy C-means clustering algorithm is used to diagnose with more typical symptoms. If not, a diagnostic case library for primary headache data is constructed. The model structure is in Figure 1.

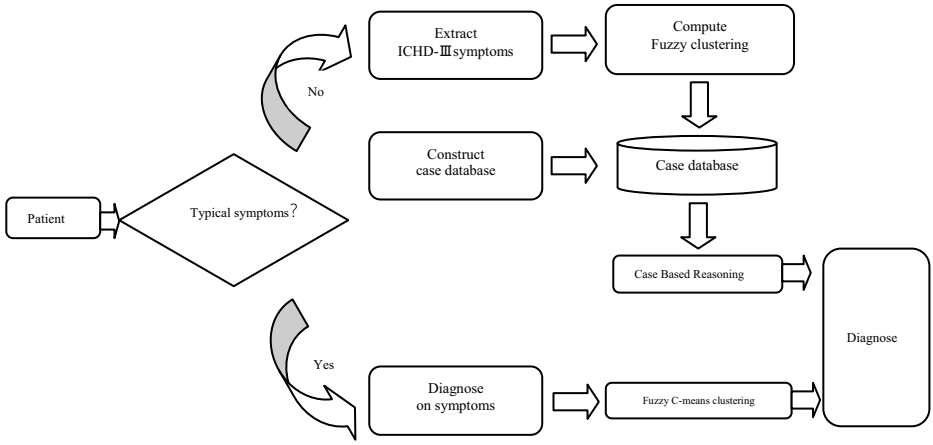

Figure 1. The computer-aided diagnosis model framework.

2.1. Assistant Diagnosis for Typical Primary Headache Based on Fuzzy C-means clustering algorithm

The key to diagnosis of typical primary headache based on fuzzy C-means is that there are many symptoms of primary headache, and the symptom data types are different. Therefore, set the symptom parameters of the fuzzy C-means clustering algorithm based on the characteristics of primary headache symptoms firstly. Then carry out assistant diagnosis based on the clustering algorithm. The steps in detail are as following.

Step 1. The clustering algorithm for diagnosing typical primary headache needs to be divided into four categories according to international classification standards. The symptoms of each primary headache patient can be set according to the standards. The center of the clustering initial matrix and the accuracy of the iteration stop can be adjusted and set.

Step 2. Use the fuzzy C-means clustering algorithm to calculate the values of each fuzzy membership classification matrix, and obtain the fuzzy intervals that may correspond to four headache subcategories for the primary headache patient.

Step 3. Use the fuzzy membership classification matrix to calculate the center values of each fuzzy membership classification, and determine whether to output diagnostic results based on the set accuracy.

Step 4. If the algorithm accuracy meets the set diagnostic accuracy requirements, the primary headache diagnosis result will be output. Otherwise, the fuzzy clustering classification matrix value will continue to be calculated until the accuracy is achieved.

2.2. Assistant Diagnosis for Typical Primary Headache Based on Case-based reasoning technology

The key technologies for the auxiliary diagnosis of atypical primary headache based on case-based reasoning technology are mainly the case weight coefficients and the calculation method of similarity between cases and patients to be diagnosed. The steps are as following.

Step 1. Atypical primary headache involves more uncertain indicators, so all its symptoms will be preserved and organized, and transformed into a database.

Step 2. The neurologist for headache diagnosis are invited to screen atypical primary headache cases and organize the selected cases.

Step 3. Use fuzzy clustering weighted algorithm to calculate weights for the symptoms of selected atypical primary headache cases, mine disease symptom data from all historical cases, analyze case representation methods in the medical record database, and construct a primary headache case database.

Step 4. Store the selected medical records in the medical record database according.

Step 5. For atypical headache patients waiting for diagnosis, the Euclidean distance similarity principle is used to calculate the similarity between the patient for diagnosis and the case library. The results will be learned and corrected again if the medical record are not satisfied.

2.3. Performance Evaluation of Primary Headache with Assisted Diagnosis Model

The evaluation of auxiliary diagnostic performance for primary headache is conducted through the following.

Step 1. The fuzzy C-means clustering algorithm is used separately for auxiliary diagnosis of primary headache on all patient data. And all auxiliary diagnostic results were recorded and their accuracy was calculated.

Step 2. The model of fuzzy C-means clustering algorithm and case-based reasoning technology is used in auxiliary diagnosis for primary headache on all patient. All auxiliary diagnostic results are recorded and their accuracy is calculated.

Step 3. Compare the accuracy of the two above steps.

3. Conclusions

Given the characteristics of headache symptoms and diseases, the current researches on computer-aided diagnosis of headache is mainly based on Fuzzy Set Theory [6]. It is

because the imprecision and cognitive limitations of headache symptoms leading to fuzziness and subjectivity in the reasoning process of doctors. Fuzzy clustering, as a classification function algorithm in data mining, conducts disease diagnosis research by measuring similarity between data objects and calculating fuzzy membership [7-8]. In addition, the disease diagnosis technology centered on case-based reasoning technology can organically simulate human thinking which can effectively compensate for the computer-aided diagnosis of atypical primary headache. Therefore, a hybrid intelligent model combining fuzzy C-means clustering algorithm and case-based reasoning is proposed in the paper to assist in the diagnosis of primary headache. Different computer-aided diagnostic methods are applied for typical and atypical types of primary headache in the international headache classification standard. The next work is to apply the technology in the diagnosis of primary headache to assist doctors in scientific diagnosis.

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