Design of Intelligent Pre-Diagnosis System

X.G. Zheng[#1], C.D. Pan[*2]
[#1]Student & Department of information science and engineering & Wenzhou medical university & China
[*2]Professor & The first affiliated hospital of Wenzhou medical university & China

Abstract

Intelligent pre-diagnosis is the application and practice of artificial intelligence technology in the medical field. It simulates the doctor's consultation and diagnoses possible diseases based on symptoms of the patient. Based on medical diagnosis monographs and literature, this paper summarizes several fundamental diagnostic rules. Based on the basic data of disease, symptom, examination, doctor, etc., the knowledge map suitable for medical diagnosis are constructed and the intelligent pre-diagnosis based on medical knowledge map is studied.

Keywords - *intelligent pre-diagnosis, intelligent triage, auxiliary diagnosis, disease self-examination.*

I. INTRODUCTION

Intelligent pre-diagnosis is developed with the advent of information technology, artificial intelligence technology and network technology. The preliminary clinical application of intelligent pre-diagnosis will guide patients to register and assist doctors in diagnosis. According to current research, intelligent pre-diagnosis should have three functions:

1) The system interacts with the patient in the form of question and answer[1-2], outputs patient's registered department and the disease that the patient may suffer from according to symptoms of the patient, implements intelligent triage service.

2) Provide patients with self-examination of the disease, help patients understand diseases they suffer from, guide patients to register and provide medical consultation service.

3) Provide doctors with auxiliary diagnosis[3-4] of the disease, which could be a diagnostic decision support tool for general practitioners and family doctors.

II. KEY TECHNOLOGY

A. *Construction of knowledge map*

Knowledge map is structured knowledge, which consists of entities and relationships between entities[5-6]. After collecting the basic data of a well-known medical institution in China, the system extracted the following relationships between entities:

- Concurrent diseases of the disease;
- Symptoms of the disease;
- Examination items that should be performed when the patient suffer from a certain disease;
- Diseases that doctors are good at treating;
- Doctor's department;
- Diseases that may occur in a certain body part;
- Examination items that should be done when patients show a certain symptom.

B. *Extraction of symptom-based diagnostic rules*

Based on the research of medical diagnostic monographs and literature, this paper summarizes the following fundamental diagnostic rules[7-10]:

1) Rule 1: In a certain area, 95% of patients with only disease Di have a union set of symptoms SCloud[Si, Sj, Sk, etc.], in the case of exclusion of individual cases (other 5% of patients), we can assume that symptoms the disease Di will show are surely in SCloud in the area.

2) Rule 2: Based on rule 1, the disease Di has a symptom set SCloud[Si, Sj, Sk, etc.]. If a patient Pi has Di, Pi may has N symptoms that are in the SCloud (where N is greater than or equal to zero).

3) Rule 3: Based on rule 1,the disease Di has a symptom set SCloud[Si, Sj, Sk, etc.]. When a patient Pi has a symptom Sp, and if SCloud does not contain Sp, it is considered that Pi does not suffer from Di on the premise of eliminating the concurrent disease.

4) Rule 4: Based on rule 1, when a patient Pi has a symptom Sp, if the symptom set SCloudj of the disease Dj contains the symptom Sp, then we can assume that Pi may suffer from Dj.

Medically, there are complex relationships between disease and symptom：

- The disease has different symptoms at different times (Rule 2);
- The patient has multiple concurrent diseases and several diseases have not show any symptom (Rule 2);
- Symptoms that patients with disease Di have are not in the SCloud of Di if we consider the other 5% patients(Rule 1);
- Intractable disease.

Considering that the premise of solving these problems above is the need of professional medical knowledge and rich experience in diagnosis and treatment, so the starting point of this paper is trying to help most patients complete the self-diagnosis of common diseases and high incidence. The doctor diagnoses concomitant diseases and related intractable diseases at the time of the consultation.

III. SYSTEM ARCHITECTURE AND FLOW

A. *Overall system architecture*

The system is a framework of question, answer, search, statistics based on knowledge map

and reasoning based on diagnostic rules. Through the form of question and answer, the system receives symptoms of the patient, then searches a list of possible diseases that the patient may have on the knowledge map and statistics accompanying symptoms for the patient to choose. The system gradually narrows down the range of possible diseases through continuous symptoms that are input from the patient, and finally outputs a disease that the patient may suffer from.

B. Overall system flow

See the **Fig. 1 System Flow Chart** at the bottom of this paper.

IV. RELATED WORK

A. Function design

1) Disease Self-examination Module: The system outputs diagnostic result based on symptoms that are input from patients, helps them understand diseases and symptoms.

2) Registration Guidance Module: The system pushes treatment department of the disease and a list of doctors who are good at the disease to patients, guides them to register and choose doctors for consultation.

3) Medical Consultation Module: The patient fills in health report to initiate medical consultation with the doctor, and the doctor checks the medical consultation to respond.

4) Auxiliary Diagnostic Module: The doctor takes the diagnostic result output by the system and the health report input by the patient as a reference during the time of consultation, and finally diagnoses the disease for the patient.

See the **Fig. 2 Function Module Diagram** at the bottom of this paper.

B. Database design

See the **Fig. 3 Conceptual Data Model** at the bottom of this paper.

C. Security design

1) Network transmission security: Encrypt privacy-sensitive data (health self-report, diagnosis result, symptoms, etc.) to avoid information theft and prevent sniffing attacks during the transmission.

2) Data storage security: Regularly back up data in the database to prevent data loss caused by power outages, virus infections, etc. and ensure data integrity.

3) System runtime security: A token mechanism is added to the business interface Api to implement the identity authentication mechanism and prevent DDos attacks.

D. Dictionary data collection

The system collected a total of 10139 diseases, 3683 symptoms, 6911 examinations, 879 doctors and 59 departments. With the expansion of the application range, these dictionary data will be continuously increased:

1) Disease: including name, introduction, medical insurance sign ,morbidity, mode of infection, susceptible population, cause, prevention, treatment mode, treatment cycle, treatment department, cure rate, treatment drug, treatment cost, differential diagnosis, etc.

2) Symptom: including name, introduction, cause, prevention, differential diagnosis, etc.

3)Examination Item: including name, introduction, applicable gender, precautions, inspection fee, normal value analysis, medical significance, unsuitable population, risk, inspection process, etc.

4)Doctor: including name, introduction, picture, professional title, professional expertise, department, hospital, etc.

5)Department: including name, type, location, etc.

V. CONCLUSION

In this paper, the following several aspects of work has been done.

1) Basic data such as diseases, symptoms, examinations, doctors, etc. were collected, and a knowledge map suitable for medical diagnosis was constructed based on the collected basic data;

2) Based on the medical diagnosis monographs and literature, several basic diagnostic rules were extracted;

3) Design and implement a intelligent pre-diagnosis system. The system has been put into trial operation, and its functions and performance have achieved the expected goals.

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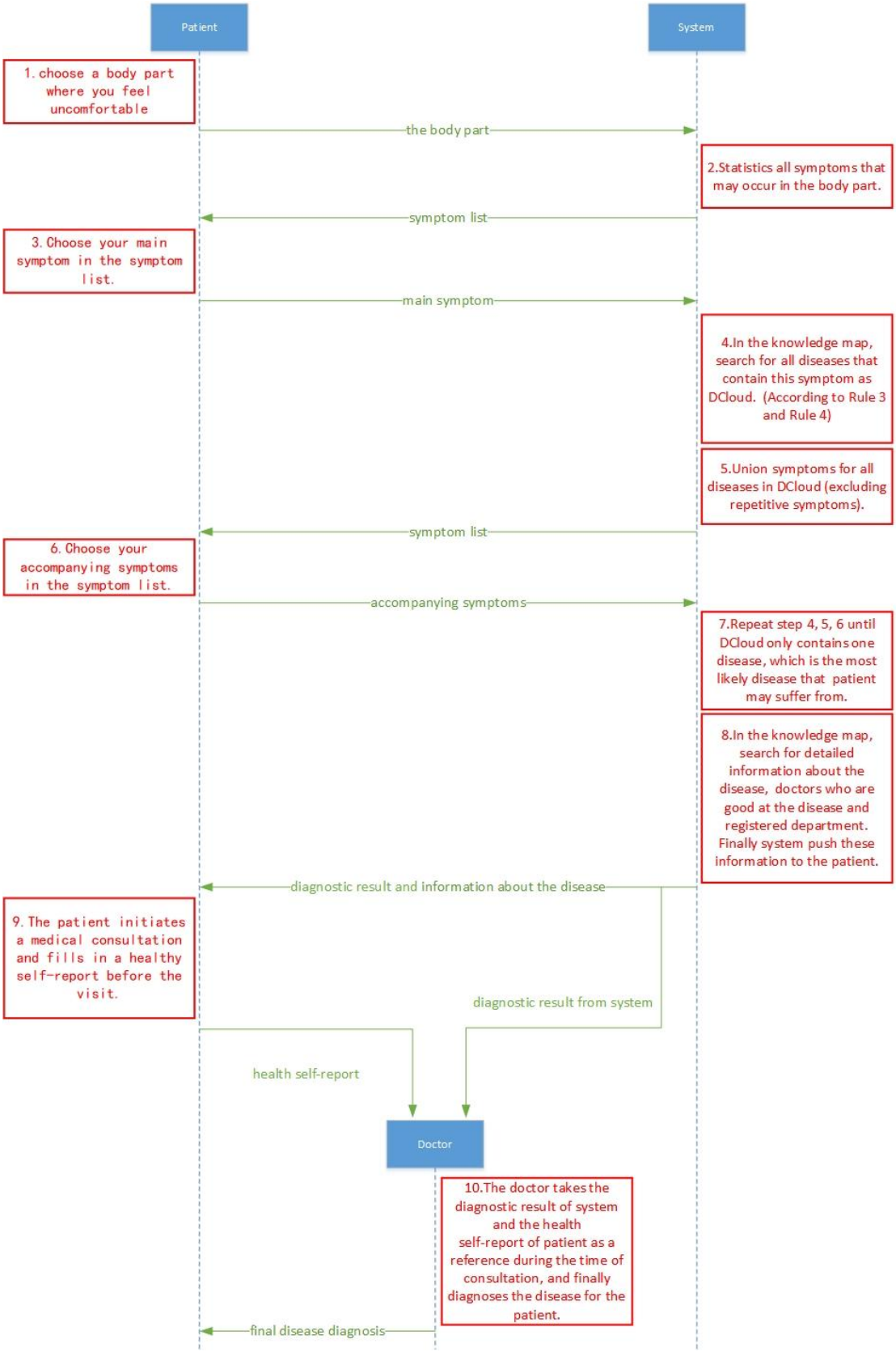

Fig. 1 System Flow Chart

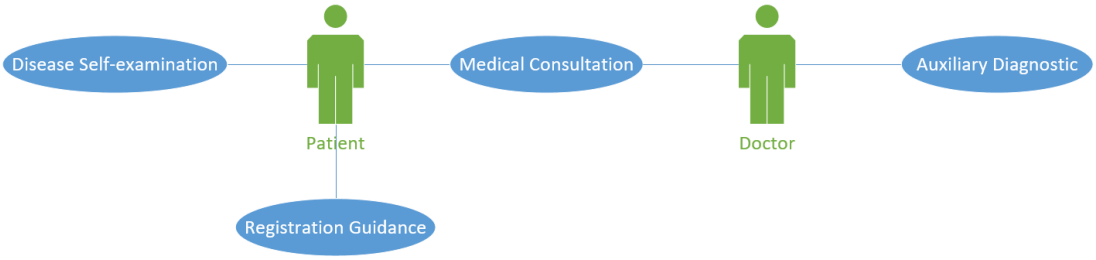

Fig. 2 Function Module Diagram

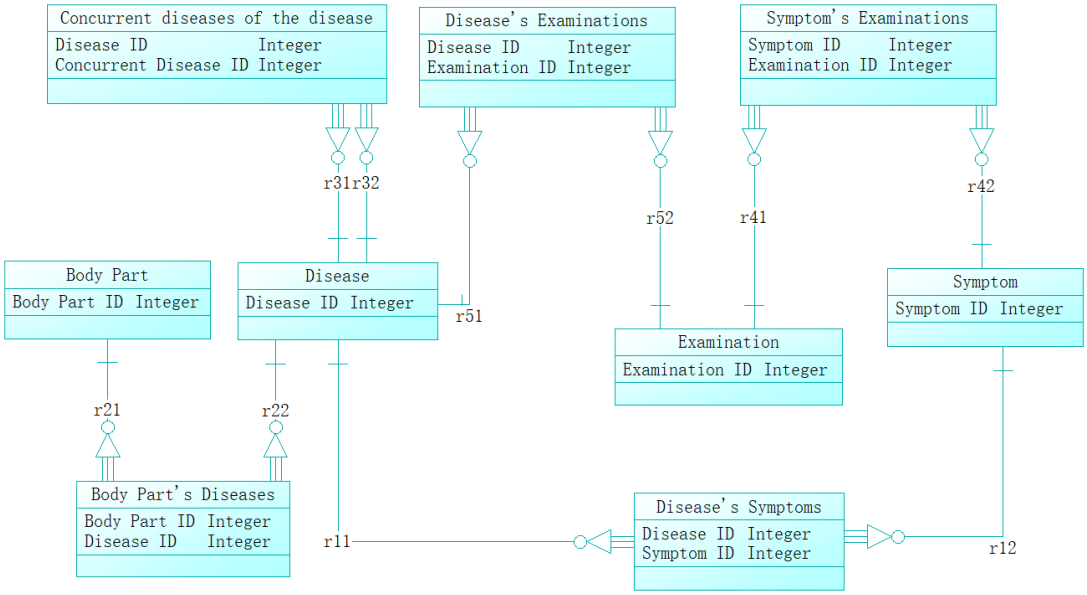

Fig. 3 Conceptual Data Model

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