Implementing the Rule-Based for the Viral Hepatitis Diagnosis System

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Abstract

In medical domain, it is very difficult to get correct diagnosis because there are many possible diseases in each case. The goal of this paper is to develop a medical diagnosis system. This system can provide to identify the Viral Hepatitis diseases that are correspond to the input symptoms. In this system, there are two main components, knowledge base and inference engine. In the knowledge-base, symptoms are represented as the facts in the form of rules. All relevant information, data, rules, cases and relationships used by the diagnosis system are stored in the knowledge base. For controlling the inference engine, forward chaining approach is used for inference the rules that build in knowledge base and decision making for the Viral Hepatitis. The inference engine is used to seek information and relationships from the knowledge base and to diagnose the types of Viral Hepatitis.

1. Introduction

An expert system is one designed to model the behavior of an expert in some field, such as medicine or agriculture. Rule-based expert systems are designed to be able to use the same rules that the expert would use to draw conclusion from a set of facts that are presented to the system. In a rule-based system, the knowledge base consists of a set of rules that represent the knowledge that the system has. The database of facts represents input to the system that is used to derive conclusions, or to cause actions. The interpreter, or inference engine, is the part of the system that controls the process of deriving conclusions. It uses the rules and facts, and combines them together to draw conclusion [6].

Knowledge-based system is an important part of an Artificial Intelligence (AI). Knowledge systems are software system that has structured knowledge about a field of expertise. They are able to solve some problems with their domains by using knowledge derived from the expert in the filed [3].

In medical domain, it is very difficult to get correct diagnosis because there are many possible diseases in each case. Moreover, these possible diseases are complicated. At the same time, it is also very important to get correct diagnosis as soon as possible to save lives of patients.

The medical Expert System has been developed to get correct diagnosis as soon as possible to save lives of patients. Computer-based diagnosis systems will play an increasingly important role in health care organization. Rule-based Expert System has been used to create numerous applications in a wide range of domain such as weather forecasting, medical diagnosis, crop protection systems, fertilizer management.

This paper intends to design and implement a system for diagnosing the Viral Hepatitis using the expert system.

2. Related work

A hybrid medical expert system that supports diagnosis of bone diseases is presented [4]. This paper [5] discusses the use of medical expert systems in Pakistan to analyze the role that such systems can play in improving the health conditions of the people in Pakistan. This paper [2] presents the clinical evaluation of HEPAR, an intelligent system for hepatitis prognosis and liver transplantation decision support in an UCI medical database.

In this paper, we implement the Rule-based for the Viral Hepatitis Diagnosis system.

3. Expert System

Expert Systems are computerized advisory programs that attempt to imitate the reasoning processes and knowledge of experts in solving specific types of problems. They are used more than any other applied AI technology [3].

3.1. Components of Expert System

Expert Systems are intelligent computer programmes designed to simulate the problem-solving behavior of a human being, who is an expert in a narrow domain or discipline.

Some of the important advantages of expert systems [1] are as follows:

(i) Ability to capture and preserve irreplaceable human experience;
(ii) Ability to develop a system more consistent than human experts;

(iii) Minimize human expertise needed at a number of locations at the same time
(iv) Solutions can be developed faster than human experts.

The basic components of an expert system are illustrated in Figure 1.

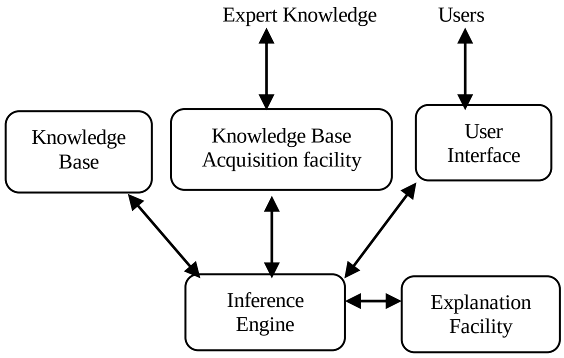

Figure 1. Architecture of Expert System

3.1.1 Knowledge Base

The knowledge the expert uses to solve a problem must be represented in a fashion that can be coded into the computer and then be available for decision making by the expert system. Knowledge bases can be represented by production rules. These rules consist of a condition or premise followed by an action or conclusion (IF condition ...THEN action). Production rules permit the relationships that make up the knowledge base to be broken down into manageable units. During the consultation, the rule base is searched for conditions that can be satisfied by facts supplied by the user.

3.1.2 Inference Engine

The inference engine is a program that performs the reasoning tasks for the system. The inference engine uses the knowledge in the system's database and information provided by the user.

The inference engine works by selecting a rule for testing and them checking if the conditions for that rule are true. The conditions may be found from questions to the user, or they may be facts already discovered during the consultation. When the conditions of the rule are found to be true, then the rule conclusion is true. The rule is then said to have 'fired'. This conclusion will then be added to the knowledge base or may be displayed via the user interface for information.

3.1.3 User Interface

The user interface is for the communication between the system user and the system. There are many input devices for effective communication between the user and the diagnosis system. A diagnosis system user interface will normally take the form of a set of questions, using one or more such input devices, usually followed by some advice from the system. The diagnosis system user interface will not only enable the user to answer questions, but allow the user to ask for explanations.

3.1.4 Explanation Facility

The explanation facility keeps track of the advice and consultations provided as well as the reasoning paths that inference engine used to produce the advice. At any time during an interactive session with the system, the user can ask the system how it arrived at a given conclusion, and the explanation facility will respond with a quick, well-formatted explanation.

3.1.5 Knowledge Acquisition Module

The knowledge acquisition module enables experts to store their knowledge in the knowledge base. It is a program that provides a dialogue between the system and the human experts for the purpose of acquiring knowledge from the human experts. The knowledge Acquisition module places this acquired knowledge in the system's database.

3.2 Rule-Based System

Rule-based systems, that is, the knowledge is stored mainly in the form of rules, as are the problem-solving procedures. The rule-based system itself uses a simple technique. It starts with a rule-based, which contains all of the appropriate knowledge encoded into IF-THEN rules, and a working memory, which may or may not initially contain any data, assertions or initially known information.

(1) if <condition>
then <action>
(2) if <condition1> & <condition2> & <condition3>
then <action1> & <action2> & <action3>

3.3 Inference in Rule-Based Systems: Forward Chaining

There are two approaches for controlling inference in rule based system: forward chaining and backward chaining. They are the most popular control programs, directs the search through the knowledge base. After determining which rules are true and which are false, the search will make the conclusion.

Forward chaining or data-driven inference works from an initial state, and by looking at the premises of the rules (IF-part), perform the actions (THEN-part) as shown in Figure 2, possibly updating the knowledge base or working memory. This continues until no more rules can be applied or some cycle limit is met. Problem with forward chaining is that many rules may be applicable. The whole process is not directed towards a goal.

Forward Chaining is the opposite of backward chaining since it focuses on the premises of rules rather than their conclusions. In this approach we start from available information as it comes in, or from a basic idea, then try to draw conclusions. It is best used to solve problem in which data is to be used as the starting point for problem solving. The computer analyzes the problem by looking for the facts that match the IF portion of its IF-THEN rules.

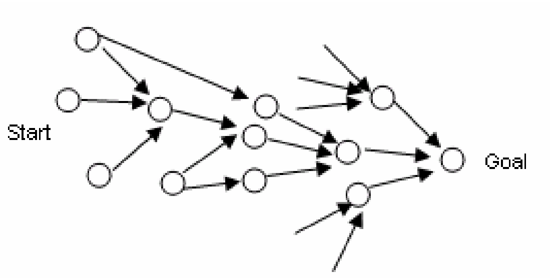

Figure 2. Forward Chaining Concept

4. Implementation of Viral Hepatitis Diagnosis System

In this viral hepatitis diagnosis system, there are two main components, knowledge base and inference engine. The process flow of this system is shown in Figure 3. This system acquires the knowledge from the expert and then knowledge is encoded into knowledge representation. Symptoms, questions and blood tests are represented as the facts in the form of rules. All relevant information, data, rules, cases and relationships used by the diagnosis system are stored in the knowledge base.

For controlling the inference engine, Forward Chaining approach used for inference the rules that build in knowledge base and decision making for the Viral Hepatitis. The inference engine used to seek information and relationships from the knowledge base and to provide the types of Viral Hepatitis result.

The user accompany with symptom comes to the system. For Example, as the user "Ascites", user can be Viral Hepatitis patient because of "Ascites" is concern with Viral Hepatitis. If the user is a Viral Hepatitis patient, user is asked detail questions to classify which type it is. And then, user makes blood testing to classify the type of the Viral Hepatitis.

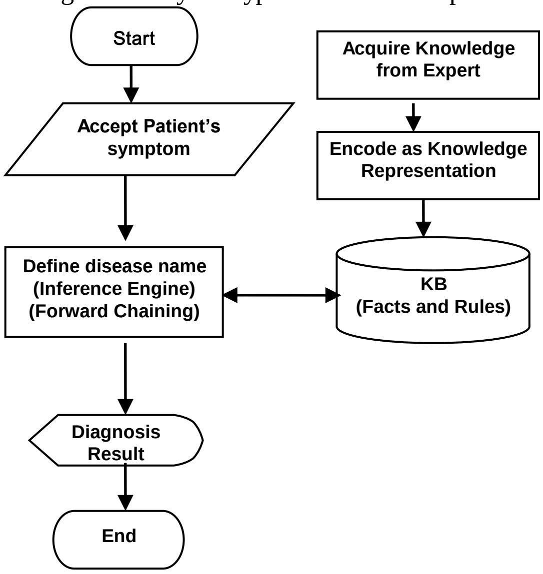

Figure 3. Process Flow of the System

There are three main stages for Viral Hepatitis diagnosis system. Common 35 Viral Hepatitis symptoms are displayed in first stage; user can choose their desire symptoms among them. And then, user needs to choose 10 detail questions asked by the system. Finally, 5 blood tests must be chosen in third stage for diagnosis the Viral Hepatitis. After these three stages the result Viral Hepatitis will be displayed to user. Common symptoms are as shown in Table 1.

Table 1. Symptoms Table

Symptom ID	Symptom
S1	Ascites
S2	Circulatory changes
S3	Endocrine changes
S4	Haemorrhagic tendency
S5	Chills
S6	Headache
S7	Malaise
S8	Anorexia
S9	Distaste for cigarettes
S10	Nausea
S11	Vomitting
S12	Diorrhoea
S13	Arthragia
S14	Skin rashes
S15	Polyarthritis
S16	Loss of Appetite

S17	Jaundice
S18	Dark urine
S19	Abdominal pain
S20	Pale Stool
S21	Pruitus
S22	Weight loss
S23	Blood in stools
S24	Restlessness
S25	Drowsiness
S26	Confusion
S27	Disorientation
S28	Chest Pain
S29	Abdominal distention
S30	Constipation
S31	Indigestion
S32	Insonmia
S33	Itchiness
S34	Sweating
S35	Blackouts

The detail question for Viral Hepatitis's patients is shown in Table 2.

Table 2. Questions Types

Question ID	Question Type
Q1	Drink unsave water
Q2	Eat food prepared by food-handles
Q3	Drink/Eat together with suspected Hepatitis patient
Q4	Have unscreen blood transfusion
Q5	Use unclean needle / Syringe
Q6	Tattooing
Q7	Hair-cut using multiple used blade
Q8	Deep kiss with other person
Q9	Unprotected sex with other person
Q10	Baby whose mother is known hepatitis B/C patient

The blood tests table is shown in Table 3.

Table 3. The type of blood test

BloodID	Blood Test Type
B1	Anti HAV
B2	Anti HBs Ag
B3	Anti HCV
B4	Anti HDV Ag
B5	Anti HEV Ag
B6	Non of these

The inference engine, basically, adopts the forward chaining technique. The basic method of forward chaining arbitrarily starts by firing the first rule in the knowledge base and setting its conclusion to a "True List". The next rule in the knowledge base which uses the first rule's conclusion as one of its premises is fired and the procedure continues until all the rules are fired one after the other [7].

The transcript of a typical forward chaining inference procedure is presented via Table 4, 5 and 6 as follows:

Rule 1

- ⇒ If S1 and S2 and S3 and S4 and S7 Then CheckQuestion
- ⇒ If CheckQuestion Q1 and Q2 and Q3 and Q4 Then CheckBlood
- ⇒ If CheckBlood B1 Then Result is HAV

Rule 2

- ⇒ If S6 and S7 and S8 and S9 and S10 Then CheckQuestion
- ⇒ If CheckQuestion Q1 and Q2 and Q3 Then CheckBlood
- ⇒ If CheckBlood B2 Then Result is HBV

Rule 3

- ⇒ If S11 and S12 and S13 and S14 and S16 Then CheckQuestion
- ⇒ If CheckQuestion Q5 and Q6 and Q7 and Q8 Then CheckBlood
- ⇒ If CheckBlood B3 Then Result is HCV

The "True List" of the inference drawn above is as follows:

HAV: Hepatitis "A" Virus
HBV: Hepatitis "B"Virus
HCV: Hepatitis "C" Virus
HDV: Hepatitis "D" Virus
HEV: Hepatitis "E" Virus

The Symptoms to go on answering the details questions for Viral Hepatitis patients.

Table 4. Symptom Rule Table

Sno	SRule	SymptomID	SResult
1	1	S1	Q
2	1	S2	Q
3	1	S3	Q
4	1	S4	Q
5	1	S7	Q
6	2	S6	Q
7	2	S7	Q
8	2	S8	Q
9	2	S9	Q
10	2	S10	Q
11	3	S11	Q
12	3	S12	Q
13	3	S13	Q

14	3	S14	Q
15	3	S16	Q

Table 5 shows rules of the details questions and investigating the Blood tests.

Table 5. Question Rule Table

Qno	QRule	QuestionID	QResult
1	1	Q1	BL
2	1	Q2	BL
3	1	Q3	BL
4	1	Q4	BL
5	2	Q1	BL
6	2	Q2	BL
7	2	Q3	BL
8	3	Q5	BL
9	3	Q6	BL
10	3	Q7	BL
11	3	Q8	BL

Table 6 shows rules of the Blood tests to classify the type of the Viral Hepatitis Diseases.

Table 6. Blood Tests Rules

Bno	BRule	BloodID	Result
1	1	B1	HAV
2	2	B2	HBV
3	3	B3	HCV
4	4	B4	HDV
5	5	B5	HEV

As an example, the user enters their respective symptoms into the system as follows:

Symptoms: Ascites

Detail question: Drink unsave water

Blood tests: Anti HAV

These symptoms are matched with the Rules in the knowledge base and then output result will be produced. According to the above user input the corresponding disease name, Hepatitis "A" virus, will be displayed as an output result as shown in Figure 4.

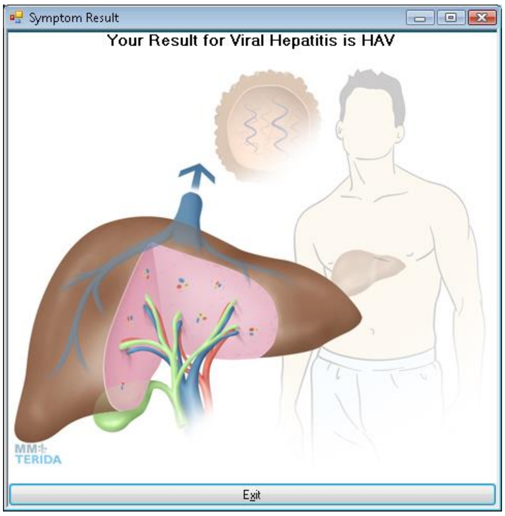

Figure 4. Output Result

6. Conclusion

The system implemented to provide the users for medical diagnosis. The development of medical diagnosis as Expert System support to get the correct diagnosis quickly and to assist the user. This disease diagnosis system can provide efficient and relevant diagnosis to users by using the expert knowledge and the rules form that stored in the knowledge base. The system apply the Rule-based approach, which contains all of the appropriate knowledge encoded into IF-THEN form and Forward Chaining approach used for controlling the inference engine. This engine can be provided for deciding the disease name based on the input symptoms. It decides which heuristics are applied to the problem, access the appropriate rules in the knowledge base executes the rules and determine the conclusion when an acceptable solution has been found.

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