Expert System to Diagnosing Heart Attack Disease Using Certainty Factor Method

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Abstract. Coronary Heart Disease is one of many diseases that cause death and still being a health problem for both developed and developing countries. It is estimated to double in the next two decades, making it the biggest leading cause of death in 2020. The causes of coronary heart disease contain age and sex, with the incidence of males is more than in females but the incidence of females will increase after menopause (the end of the menstrual cycle) around the age of 50 years. This is due to estrogen (steroid compounds) have a protective effect on the onset of atherosclerosis. In this study the author wants to create a system that can detect heart disease by users before ensuring himself to the doctor to diagnose heart disease which is very dangerous. The system that the author will design used the certainty factor method to provide an assessment of the symptoms of user diagnosis. The application was designed with the desktop-based visual studio software assistance that is easy to use by everyone because it is familiar with the windows display design.

1. Introduction

Coronary Heart Disease (CHD) is one of many diseases that cause death and is still a health problem for both developed and developing countries. It is estimated that because of its rapid growth, it will make it the biggest cause of death in 2020.

The causes of coronary heart disease include factors of age and sex, with the incidence of males is more than in females, but the incidence of women will increase after menopause (the end of the menstrual cycle) around the age of 50 years. This is due to estrogen (steroid compounds) have a protective effect on the onset of atherosclerosis, where in people over 65 years of age found 20% of CHD in men and 12% in women. Increasing age will also cause CHD sufferers, because blood vessels undergo progressive changes and persist for a long time. The earliest changes begin at age 20 in coronary arteries. Other arteries begin to modify only after the age of 40, occurring in men aged 35 to 44 years and increasing with age. The results of the study found a relationship between age and cholesterol levels, like total cholesterol levels will increase with increasing age [1].

Expert systems arise from the term of knowledge base expert system. Expert system is a system designed to solve certain problems by imitating the work of experts in answering questions and solving a problem. With this expert system, people can solve complex problems that can only be solved with the help of experts. For expert systems experts also help their activities as highly experienced assistants[2].

The expert system is a division of AI (Artificial Intelligence) which makes special extensions to the specialization of knowledge to solve a problem in Human Expert. Human Expert is someone who expert in a particular field of science, this means that the expert has a specific knowledge or skill possessed by others. Experts can solve a problem that cannot be solved by others efficiently [3].

2. Related Works

Expert systems appear from the term knowledge-based expert system. An expert system is a system that uses human knowledge recorded on a computer to solve problems that usually require human expertise. Expert systems are applied to support problem solving activities. Expert systems are a divison of artificial intelligence (Artificial Intelligence) which is quite old because this system began to be developed in the middle 1960. This system works to adopt human knowledge to computers that combines the knowledge base to replace an expert in solving a problem [4].

3. Method

This expert system application diagnosing heart disease was made for the whole community. This application is expected to be able to help the community understanding the heart disease suffered or to find out whether it is suffering from heart disease or not. This expert system application for diagnosis of heart disease is designed as easily as possible so that users who are still ordinary can use the application easily [5].

There are total two research tools of the application of expert systems for diagnosing heart disease, such as:

1) Hardware

   The Hardware specification that has been used are:

   a) Processor : Intel® Core™ i3 4030u
   b) Memory : 2 GB DDR 3L
   c) Harddisk : 500 GB
   d) Display : 14 Inch WXGA (1366 x 768)
   e) Sound Card : Integrated
   f) Video Type : AMD Radeon HD R5 M230
   g) Keyboard, Mouse, Speaker, Headset.

2) Software

   The software that has been used to making expert system applications for diagnosing heart disease are:

   a) Visual studio 2015 ultimate

b) MySQL

Certainty Factor (CF) is to accommodate the inexact reasoning of an expert proposed by Shortliffe and Buchanan in 1975. An expert (for example a doctor) often analyzes the information available with an expression of uncertainty, to accommodate this we use certainty factor (CF) to describe the level of expert confidence in the problem faced. In expressing the degree of certainty, certainty factor assume the degree of certainty of an expert on a data. This concept then formulated in the following basic formulation [4]:

$$CF[h,e] = MB[h,e] - MD[h,e] \quad \text{.....(1)}$$

Information :

CF = Certainty factor in the H hypothesis influenced by fact E
MB(H,E) = measure of belief to hypothesis H, if given evidence E (between 0 and 1)
MD(H,E) = measure of disbelief to evidence H, if given evidence E (between 0 and 1)
E = Evidence (event or fact)

$$CF[H,E]1 = CF[H] * CF[E] \quad \text{…….(2)}$$

While :

CF(E) = certainty factor evidence E influenced by evidence E
CF(H) = certainty hypothesis factor assuming evidence is known with certainty, when CF(E,e) = 1
CF(H,E) = certainty factor of hypotheses are influenced by evidence e is known with certainty factor for rules with similarly concluded rules:

$$CFcombine\ CF[H,E]1,2 = CF[H,E]1 + CF[H,E]2 * [1CF[H,E]1] \quad \text{…….....(3)}$$

$$CFcombine\ CF[H,E]old,3 = CF[H,E]\ old + CF[H,E]\ 3 * (1\ CF[H,E]\ old] \quad \text{..(3)}$$

Table 1. CF Value

Uncertainty Term	**CF**
Definitely not	-1.0
Almost certainly not	-0.8
Probably not	-0.6
Maybe not	-0.4
Unknown	-0.2 to 0.2
Maybe	0.4
Probably	0.6
Almost certainly	0.8
Definitely	1.0

Combining trust and distrust in a single number has two function, the first certainty factor is used for the level of the hypothesis in order of importance. For example, a patient has certain symptoms that suggest several possible diseases then illness with the highest CF being the first in the order of testing.

4. Result and Discussion

The following are description of the rules in the application of expert systems for diagnosing heart:

a. Symptoms

Table 2. Symptoms

Code	**Criteria**	**Value**
G01	Do you feel tired quickly?	0.5
G02	Does the chest feel painful?	0.3

G03	Do you feel anxious?	0.7
G04	Does your back hurt?	0.2
G05	Does the heart beat faster?	0.8
G06	Do you have sleep disturbances?	0.5
G07	Are your knees, elbows, wrists, hands and feet painful?	0.7
G08	Does the chest feel painful?	0.2
G09	Are you tired easily?	0.1
G10	Does your breath feel short?	0.5
G11	Are you easy to forget?	0.7
G12	Does the head often hurt?	0.4
G13	Is appetite reduced?	0.9
G14	Does the chest hurt or something oppressed?	0.3

b. Result

Table 3. Result

Code	**Result**
H01	Coronary heart disease
H02	Rheumatic Heart Disease
H03	Weak Heart Disease

c. Rules

R1 = if G01 and G02 and G03 and G04 and G05 and G06 then H01
R2 = if G07 and G08 and G09 then H02
R3 = if G10 and G11 and G12 and G13 and G14 then H03

d. Calculation of Coronary Heart Disease

CF G01 = CF(0.8)*CF(0.5)
= 0.4
CF G02 = CF(0.8)*CF(0.3)
= 0.24
CF G03 = CF(0.4)*CF(0.7)
= 0.28
CF G04 = CF(0.6)*CF(0.2)
= 0.12
CF G05 = CF(0.8)*CF(0.8)
= 0.64
CF G06 = CF(0.4)*CF(0.5)
= 0.2

CFcombine1 (CF G01, CF G02) = 0.4 + 0.24 * (1-0.4)
CFold1 = 0.544
CFcombine2 (CFold1, CF G03) = 0. 544+0.28* (1-0. 544)
CFold2 = 0.67168
CFcombine3 (CFold2, CF G04) = 0.67168+0.12 * (1-0.67168)
CFold3 = 0.7110784
CFcombine4 (CFold3, CF G05) = 0.7110784+0.64 * (1-0.7110784)
CFold4 = 0.89598822
CFcombine5 (CFold4, CF G06) = 0.89598822+0.2 * (1-0.89598822)

CFold5 = 0.91679058
Percentage = CFold5 * 100
= 0.91679058*100
= 91.679058%

From the above calculations, the value of the certainty factor from the input of symptoms leading to Coronary Heart Disease is obtained 91.679058%.

The display of cardiovascular diagnosis applications in the form of login views, main menu, disease data, symptom data, rule data, admin added, diagnostics and about. The login view is the first appearance when accessing the diagnosis of heart disease. Login used by users to manage the diagnosis of heart disease. The main menu contains menus - application menus such as, login, main menu, disease data, symptom data, rule data, added admin, diagnosis and about. From the application of the expert system to diagnosis of heart disease, the initial display in the Main Menu display contains another menu and the whole of the display in this application, can be seen in the figure below.

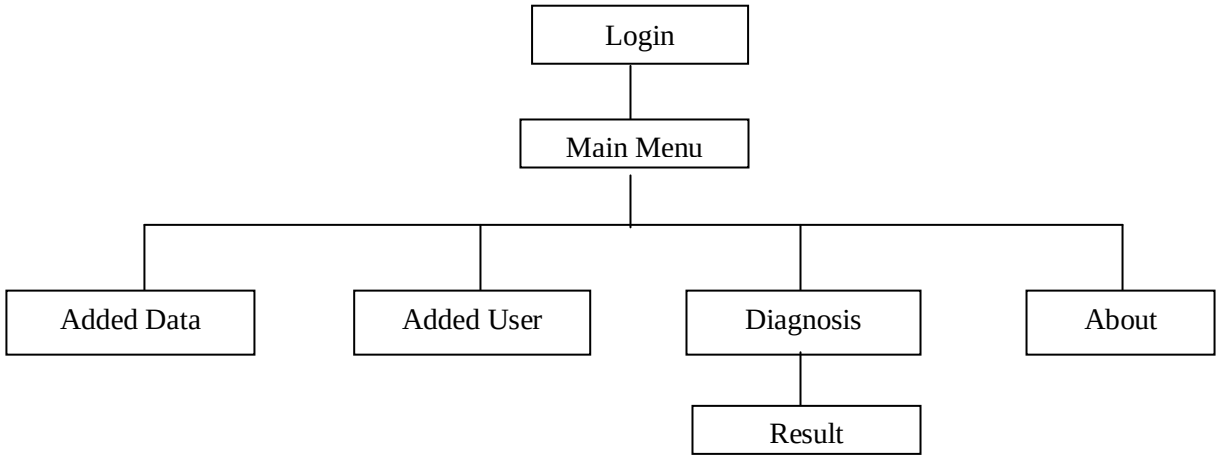

Figure 1. Navigation Architecture Structure

5. Conclusion

Based on the results of designing the cardiac diagnosis application, conclusions are obtained as follows:

a. This diagnosis of heart disease application was designed using a certainty factor method to provide an assessment of the diagnosis of symptoms experienced by users. The application was designed with the rules of the questions that have been applied in the application so the users only need to answer the questions that given by the system.
b. The diagnosis application of heart disease which design by the author can help patients to diagnosing the type of illness suffered before checking up to the nearest hospital.

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