

The Development of Web Based Expert System for Diagnosing Children Diseases Using PHP and MySQL

Hustinawaty¹Randy Aprianggi²

¹(Information System Department, Gunadarma University, Indonesia)

²(Information System Department, Gunadarma University, Indonesia)

ABSTRACT: Children are still developing their immune system, so they are very fragile with the threat virus and bacteria. Thus, the sudden health drops are common, yet very often still causing panic and frustration for parents. Mostly parents will go to the doctor practitioner to consult. However, this effort is often challenged by distance and time, especially to book a meeting with busy doctor or allocate a schedule for busy parents. As the impact of technological advancement in this era, the transfer of medical expert to computer system has been enabled through an expert system. The expert system was developed by using the PHP as the web programming language and MySQL as the databases. The web based expert system enables user to diagnose the children's diseases anytime and anywhere, just by accessing the internet. The method employed is certainty factor method. The diagnosis process will be done by filling the checklists of symptoms on the consultation page based on observation toward the patient. The inputs will be processed by using production rules in accordance to the science and the knowledge of the expert, in this case doctor as medical practitioner. The result of the diagnosis process showed the diseases that has the biggest score in certainty factor calculation, based on the symptoms that observed by the user. Based on the testing of certainty factor calculation to the 10 users, the success rate was 100 percent.

Keywords –Certainty Factor, Children, Diseases, Expert System

I. INTRODUCTION

Health is undoubtedly the most important thing in human activity. Everyone could face health problem, especially children. As in growing process, children usually have weak body immune so they fragile to bacteria and virus. Noted, children health is every parent dream, when we know that they usually getting panic if they found their children in bad state.

Most of parent are not really knowledgeable or beginner in understanding health. They usually hire an expert to do so to compensate, or they could directly consult it with expert or doctor. But, it's not without a problem because the expert or doctor usually has a time limitation. Thus, many of parents should wait in

long line to take turn. In this advanced technology era, it's possible to do transfer knowledge of doctor into computer through an expert system. Besides, the use of internet is becoming a usual thing. Everybody now could easily access many information internet networks. Moreover, many people could use their handphone to access the internet. Thus, it's needed to develop a web based expert system that can diagnose children's diseases so that parent could get fast access of information of their children diseases as basis for parents to take the needed counter measures.

Expert system is one of artificial intelligence (AI) which adopt the way and expert's logic in solving and making the decision or conclusion from a number of facts. The basic of expert system is on how to transfer expert's knowledge to the computer, and how to make decision from the knowledge.

Many researched already done related with developing expert system to diagnose diseases. There is a research conducted using forward chaining method, in order to help parent in diagnosing their children skin related disease [1]. Another research about expert system that using Forward Chaining method to design inferential machine, along with certainty factor which used to solve problem in system output in order to diagnose internal diseases in human [2]. Certainty factor method is fit best to measures whether it's certain or uncertain in diagnosing the diseases. The measurement using Certainty Factor is only once by processing only two data so that the accuracy of data is reliable.

II. WORKING METHODOLOGY

The development starts from analyzing requirements and defining problems of the system. The next step is doing an interview to the expert, medical doctor, currently working at Depok Jaya Community Health Center. This process is to

collect necessary information related to children's diseases from the expert. The knowledge and information from the expert will be transferred into the expert system as the knowledge base. Second process is to plan the system design, which had been done by using UML as the planning tool to portray general limit, functions, and interaction within the system. Thirdly, the system design was manifested into a GUI website. The result of previous planning and design were going to be implemented into the programming languages of PHP and MySQL as system relational database. Lastly, the trial process was being conducted to test whether the expert system running well in diagnosing the children's diseases.

1. Artificial Intelligence

Artificial intelligence is a branch of computer science that makes machine (computer) can do a job as good as human. There are two main parts needed To perform an artificial intelligence application, those are knowledge base and inference engine [3].

2. Expert System

Expert system is a computer programs that adopt analytical skill from an expert in a particular area of knowledge [4]. An expert system is a program of artificial intelligence that combines knowledge base with inference engine. It is part of high-level specialized software or high-level programming language, which is trying to duplicate the functionality of an expert in a particular field of expertise. This program acts as a smart consultant or advisor in a specific environment of expertise, as a result of knowledge that has been gathered from several experts. Thus even a non expert can use the expert system to solve various problems he faced, and for an expert, the expert system can be used as a tool to support his activities that work as an experienced assistant. General-purpose problem solver (GPS) is the first expert system created that developed by Newel and Simon. Until now there are many expert systems that have been created such as MYCIN, DENDRAL, XCON & XSEL, SOPHIE, Prospector, FOLIO, DELTA, etc. [3].

2.1 Expert System Structure

There are two main parts of an expert system, they are [3]:

- Development environment, which is the part that used to incorporate expert's knowledge into an expert system environment.
- Consultation environment, which is the part that used by non expert users to gain knowledge.

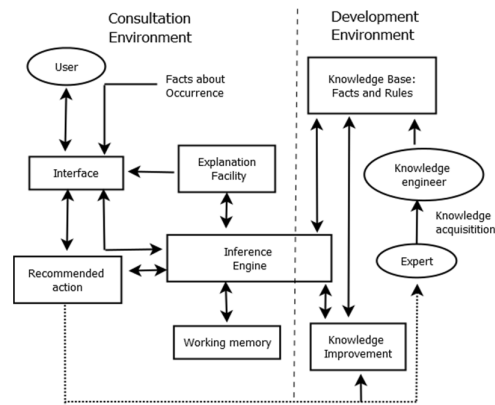


Figure 1 expert system structure

An expert system consists of the following components:

- **User Interface** :User interface is a mechanism that used by users to communicate with the system. The user interface receives information from user and convert it into a form that can be received by the system [5].
- **Knowledge Base** : Knowledge base is a collection of a particular field of knowledge at the level of experts in a particular format [6].
- **Knowledge Acquisition** :The acquisitionof knowledgais the accumulation, transferandtransformation ofexpertisein solvingthe problemofthe sourceof knowledgeinto a computer program [7].
- **Inference Engine** : Inference engine is used to make inferences by deciding which rules filled with objects or facts , filled sort of priority rules, and executed in accordance with the priority rules [8].
- **Working Memory** :Working memory storing a fact which would then be used by the rule [8]. The existence of the facts in the working memory will trigger the execution of the rules with the fulfillment of the premise of the rule [9].
- **Explanation Facility** :Explanation facility serves to explain the reasoning of the system to the user [8].
- **Knowledge Improvement** : Experts have the ability to analyze and improve their performance as well as the ability to learn from its performance [7].

3. Certainty Factor

Certainty Factor (CF)was introduced by ShortliffeBuchanan in MYCIN manufacture.

Certainty factor(CF) is a clinical parameter values given MYCIN to show how much confidence.

The basic equation of Certainty Factor [10] :

$$CF(H,E) = MB(H,E) - MD(H,E)$$

CF(H, E): certainty factor of a hypothesis H which is affected by symptoms(evidence) E. CF value ranges from -1 to 1. A value of -1 indicates an absolute distrust while the absolute value of 1 indicates absolute trust.

MB(H, E): the size of the increase in confidence to hypothesis H affected by the symptoms of E. MD(H, E): the size of the increase distrust the hypothesis H that is affected by the symptoms of E.

An expert system rules often have more than one and consists of several premises connected with AND or OR. Knowledge of the premise can also be uncertain, this is because the value (value) provided by the CF patient when answering questions above premise systems (symptoms) which can also be experienced by the patient or of the value of the CF hypothesis [10].

The equation that will be implemented in this expert system is as follows :

$$CF(R1,R2) = CF(R1) + CF(R2) - [(CF(R1) \times CF(R2))]$$

The CF value of each symptom is given by the expert or the doctor

III. ANALYSIS, DESIGN AND RESULTS

1. System Requirements Analysis

Web Expert System for Diagnosing Children's Diseases designed to adopt expert knowledge in observing and diagnosing patient based on the common symptoms analysis. Thus, the system is transferring medical practitioner's skill to a web expert system. The process of knowledge acquisition was done by interviewing medical practitioners. According to her, there are 10 common children's diseases and symptoms from each disease. The identified diseases were common on the kid within 5-12 year old age range. Then, each symptom will be given a certainty factor value, a value to enhance accuracy of diagnostic process and to hinder the uncertainty. Furthermore, web expert system will propose diseases prevention treatment and solution based on the 10 diseases that have been determined before.

Assessment was also being conducted to analyze the significance of Web System Expert

developed. Other than interviewing the expert, the interview was also conducted to the potential target users. The interview was being conducted to the father who has a 6 years old son in Pondok Kelapa, Bekasi. According to him, the application is very helpful for first step precautionary and disease prevention. As children usually have weak immune system that is still developing, thus the fluctuation of health is common. They usually exposed to certain type of health issues during their growth process. However, parents sometimes unaware or uneducated on identifying the illness and prevention mechanism needed, thus often results in distress and panic.

2. Knowledge Base Design

2.1 Knowledge Acquisition

Knowledge Acquisition is a process of transferring expertise knowledge from one sources that to a computer program. In this level, information collected will be used as a source of knowledge. In the development of expert systems in the child's illness, the collection of information was done by interviewing a doctor at Depok Jaya Community Health Center. The information is also available from the books, and related articles from the internet. The information obtained in the form of diseases information that often affects children aged 5-12 years in Depok City Health Center, along with the symptoms of their illness, prevention and solution.

2.2 Knowledge Representation

In the development process of the Web Expert Systems for Diagnosing Children's Diseases, the production rule was used as a model of knowledge representation. The decision table and decision tree will be planned in advance that will later be used in the production rules. Below, there will be shown decision table and decision tree of Tuberculosis, which is one of 10 selected diseases. Table 1 is the decision table of Tuberculosis.

Table 1 Decision Table of Tuberculosis

No.	Symptom	Disease
1	Cough for more than 3 weeks	Tuberculosis
2	Coughing up blood	Tuberculosis
3	Fever more than a month	Tuberculosis
4	Sweating at night	Tuberculosis
5	Decreased appetite	Tuberculosis
6	Weight loss	Tuberculosis
7	Puff	Tuberculosis
8	Chest Pain	Tuberculosis

Figure 2 is the decision tree of tuberculosis disease. 1,2,3 – 8 attributes is the symptoms of tuberculosis that can be seen on the previous decision table of tuberculosis. In the decision tree was explained that the system define the patient diseases based on disease symptoms of the patient that being selected by the user.

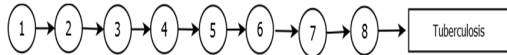


Figure 2 decision tree of tuberculosis

Based on the decision table and the decision tree produces the production rules of Tuberculosis as follows:

IF Cough for more than 3 weeks AND Coughing up blood AND Fever more than a month AND Sweating at night AND Decreased appetite AND Weight loss AND Puff AND Chest Pain

3.Certainty Factor Calculation Testing

Certainty factor Calculation testing results is done by calculating manually selected symptoms checklist form diagnostic page. The symptoms that were check listed on this page are yellow is he yes, yellowish skin, dark yellow urine water, nausea, and heart burn puke, as shown infigure3.

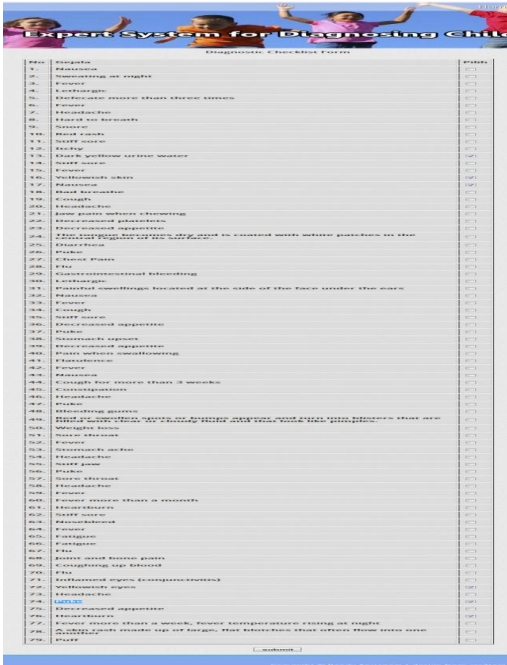


Figure 3selected symptoms on diagnostic form page

After the user finished selecting the symptom soft he disease on consultation page, the system will look for the id of symptom son the symptom table, as shown in table 2.

Table 2 Symptom Table on Database

<u>Id_symptom</u>	<u>nm_symptom</u>
J001	<u>Yellowish eyes</u>
J002	<u>Yellowish skin</u>
J003	<u>Dark yellow urine water</u>
B004	<u>Nausea</u>
B005	<u>Puke</u>
F002	<u>Heartburn</u>

Then, the id symptoms will be used to find the CF value of each symptom and its relation with the diseases in the table rule_relation. One symptom can be owned by several diseases. The disease which has similar symptoms of other diseases will save same id_symptoms but with different CF values, adjusted with data from experts as shown in table 3.

Table 3Rule_relation Table on Database

<u>id_rule</u>	<u>id_disease</u>	<u>id_symptom</u>	<u>cf_value</u>
1	A	A001	0.9
2	A	A002	0.9
3	A	A003	0.8
4	A	A004	0.8
5	A	A005	0.8
6	A	A006	0.8
7	A	A007	0.7
8	A	A008	0.7
9	B	B001	0.9
10	B	B002	0.8
11	B	B003	0.8
12	B	B004	0.8
13	B	B005	0.8
14	B	B006	0.9
15	B	B007	0.9
16	B	B008	0.9
17	B	B009	0.9
18	B	B010	0.9
19	C	C001	0.9
20	C	C002	0.9
21	C	C003	0.7
22	C	C004	0.8
23	C	C005	0.7
24	C	C006	0.7
25	C	C007	0.7
26	C	C008	0.8
27	C	C009	0.8
28	C	C010	0.8
29	D	D001	0.9
30	D	D002	0.9

Then the system will calculate the diseases CF value based on the selected at the time of consultation. Table 4 shows that one symptom can be owned by some diseases but with a different value of CF.

Table 4 CF Value of Selected Symptoms on Database

<u>Id_disease</u>	<u>Id_symptom</u>	<u>cf_value</u>
B	B004	0.8
B	B005	0.8
C	B004	0.8
C	B005	0.8
F	B004	0.9
F	B005	0.9
F	F002	0.8
G	B005	0.7
J	B004	0.8
J	B005	0.8
J	F002	0.8
J	J001	0.9
J	J002	0.9
J	J003	0.9

All of selected symptoms will be calculated manually to see the CF value of disease

that has relation with the symptoms as shown table 5 below.

Table 5 Diseases' Certainty Factor Calculation Manually

Id_disease	Cf_total
B	CF(A) = CF(1) + CF(2) * [1-CF(1)] = 0.8 + 0.8 * [1-0.8] = 0.96 CF Total = 0.96
C	CF(A) = CF(1) + CF(2) * [1-CF(1)] = 0.8 + 0.8 * [1-0.8] = 0.96 CF Total = 0.96
F	CF(A) = CF(1) + CF(2) * [1-CF(1)] = 0.9 + 0.9 * [1-0.9] = 0.99 CF(B) = CF(3) + CF(A) * [1-CF(3)] = 0.8 + 0.99 * [1-0.8] = 0.998 CF Total = 0.998
G	CF Total = 0.7
J	CF(A) = CF(1) + CF(2) * [1-CF(1)] = 0.8 + 0.8 * [1-0.8] = 0.96 CF(B) = CF(3) + CF(A) * [1-CF(3)] = 0.8 + 0.96 * [1-0.8] = 0.992 CF(C) = CF(4) + CF(B) * [1-CF(4)] = 0.9 + 0.992 * [1-0.9] = 0.9992 CF(D) = CF(5) + CF(C) * [1-CF(5)] = 0.9 + 0.9992 * [1-0.9] = 0.99992 CF(E) = CF(6) + CF(C) * [1-CF(6)] = 0.9 + 0.99992 * [1-0.9] = 0.999992 CF Total = 0.999992

Based on the table in table 5, it can be seen that the disease with id_symptom J (hepatitis) has the biggest total value of CF, which is CF 0.999992. The system calculation has the same results with the manual calculation.

3.1 The Testing of Manual and System Calculation

To support the results of testing credibility of certainty factor calculations above, there is a retest made by filling of symptoms from 10 people user. This test is used to see whether the disease shown by the system is the disease that has the biggest CF value on manual calculation as shown by table 6.

Table 6 Comparison Between Manual and System Calculation

No.	Patient	Symptoms	Manual	System	Error (e)
1.	Rihan	Cough for more than 3 weeks, coughing up blood, fever more than a month, Sweating at night, decrease appetite	Tuberculosis (0.99992)	Tuberculosis (0.99992)	0
2.	Naura	Joint and bone pain, red rash, bleeding gums, nosebleed	Scarlet fever (0.9998)	Scarlet fever (0.9998)	0
3.	Sherin	The tongue becomes dry and is coated with white patches in the central region of its surface, diarrhea, constipation, fatigue, stomach ache	Thyphoid fever (0.99946)	Thyphoid fever (0.99946)	0
4.	Sabrina	Yellowish eyes, yellowish skin, dark yellow urine water, heartburn	Hepatitis (0.9998)	Hepatitis (0.9998)	0
5.	Kevin	Jaw pain when chewing, painful swellings located at the side of the face under the ears, stiff jaw,	Mumps (0.999)	Mumps (0.999)	0
6.	Fajar	Red or swollen spots or bumps appear and turn into blisters that are filled with clear or cloudy fluid and that look like pimples, itchy, lethargic, flu	Chickenpox (0.9982)	Chickenpox (0.9982)	0
7.	Dafa	Cough, flu, stiff sore, sore throat, headache	Upper Respiratory Tract Infection (0.99992)	Upper Respiratory Tract Infection (0.99992)	0
8.	Aneka	Pain when swallowing, hard to breathe, bad breathe, sore throat	Tonsil (0.99998)	Tonsil (0.99998)	0
9.	Leon	A skin rash made up of large and flat blotches that often flow into one another, inflamed eyes (conjunctivitis), decreased appetite, cough, fever	Measles (0.99988)	Measles (0.99988)	0
10.	Keyla	Defecate more than three times, heartburn, nausea, stomach upset	Diarrhea (0.9996)	Diarrhea (0.9996)	0

$$e = \frac{\text{Manual} - \text{System}}{\text{Manual}}$$

e is the value of system error in calculating CF. The percentage of system CF calculation error can be calculated by this following equation:

$$\bar{E} = \sum_{i=1}^{10} \frac{ei}{10} \times 100\% = \frac{0 + 0 + 0 + 0 + 0 + 0 + 0 + 0 + 0 + 0}{10} \times 100\% = 0 \times 100\% = 0\%$$

Based on the calculation above, the percentage of system calculation error is 0%. So, the success rate for CF calculation of this system is 100% - 0% = 100%.

IV. CONCLUSION

The black box testing was being conducted to test the system functions. The test result was no error found or functions were running well. Thus, the percentage of success function in the system was 100 percent. Other than the previous test, the calculation on certainty factor was also being conducted. The calculation was done by manually calculate the diseases that has been inserted by 10 users. The result of the test proved that all the manual calculation has a similar total CF value, equivalent with the one that was given by the system. The result shown the accuracy rate of the system was 100 percent.

The Web Expert System developed will be able to be used as a fast solution for user to early detect the children's diseases. The expert system was developed with web as the basis, which will ease the user to access the application anytime and anywhere. The system will give the user information on the prevention and treatment of the diseases of their children.

This credible web based expert system will be very useful to be a first step or precautionary step in identifying the disease and suggesting necessary treatment for the illness.

REFERENCES

[1] M. Yusof, M. Aziz, A. Ruhayaand Fei, and S. Chew, The Development of Online Children Skin Diseases Diagnosis System, *International Journal of Information and Education Technology*, Vol. 3, No. 2, 2013.

- [2] AdhiSadewoBroto, *PerancangandanImplementasiSistemPakarUntukAnalisaPenyakitDalam*, Final Thesis Submitted in Partial Fulfillment for the Degree of Bachelor Degree in Electrical Engineering, Diponegoro University, Semarang, 2010.
- [3] Sri Kusumadewi, *Artificialintelligence (teknikdanaplikasinya)* (Yogyakarta:GrahaIlmu, 2003).
- [4] E. Turban, *Decision support system and expert systems*(USA:Prentice Hall InternationalInc, 1995).
- [5] RaymondMcleod, and George P. Schell, *Casebook for Management Information Systems, 6th ed* (London: Prentice Hall, 1995).
- [6] Sri Hartati, and Sari Iswanti, *SistemPakardanPengembangannya* (Yogyakarta: GrahaIlmu, 2008).
- [7] Muhammad Arhami, *KonsepDasarSistemPakar* (Yogyakarta: Andi, 2004).
- [8] J. Giarratano, and G. Riley, *Expert Systems: Principles and Programming* (Massachusetts: Thomson Course Technology, 1998).
- [9] Peter Jackson, *Introduction to Expert Systems.3rd ed.* (London: Addison-Wesley, 1999).
- [10] Kusrini, *AplikasiSistemPakar* (Yogyakarta: ANDI, 2008).