Journal of Applied Engineering and Technological Science
Vol 4(1) 2022 : 32-41

EXPERT SYSTEM FOR DIAGNOSING DISEASES IN TODDLERS USING THE CERTAINTY FACTOR METHOD

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Received : 20 July 2022, Revised: 22 August 2022, Accepted : 23 August 2022
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ABSTRACT
Disease is an abnormal condition in the body that causes body misalignment. There are various types of diseases that threaten humans, both parents and children. This disease can be caused by germs, bacteria, viruses, toxins, organ failure to function, and also by inherited/hereditary diseases. The difficulty of parents to find out the disease suffered by their children is one of the problems of parents today. So, we need a system to help with this predicament. The purpose of making this application is to provide information quickly and accurately in solving problems to help consult about diseases in toddlers aged 0-5 years. In addition, to find out ways to make programs that are expert systems using programming languages for artificial intelligence applications, namely PHP and Mysql, the certainty factor method is applied in web form. Using the certainty factor method is a decision-making strategy that starts from the section premise to conclusion. The result of system implementation is that the user chooses from the symptoms that already exist in the system based on the existing symptoms then processed, from the process the system provides information on diseases in children suffered by toddlers. From the results of testing this expert system has been able to diagnose diseases in children. After the diagnosis, the types of diseases and solutions will appear. Diagnosing disease in children by using this certainty factor is expected to make it easier to diagnose disease in children.
Keywords : *Certainty Factor, Diagnosis Of Disease Under Five, Expert System*

1. Introduction

Early detection of disease can prevent and help treat disease appropriately(Hasibuan et al., 2017). In correctly identifying the disease depends on the method used in diagnosing the disease. Expert systems can assist in diagnosing diseases and explain the methods used by considering the handling capabilities and integration with expert systems(Ginting, N. S. W., & Anita, 2018)(Nia Nofia Mitra & Nurcahyo, 2020).

An expert system is a computer-based system that uses facts and reasoning to solve problems that can usually be solved by experts in a particular field(Sinaga & Simanjuntak, 2020)(Batubara et al., 2018). This system can be used as an experienced assistant such as knowing the type of disease in children under five with symptoms that are only considered symptoms(Riadi, 2017)(Laila, 2016).

Toddlers who are very susceptible to germs and are less sensitive to the symptoms of a disease, especially diseases that often suffer, especially in the tropics, become a fear for parents who are still very unfamiliar with health(Sibagariang, 2008)(Fanny et al., 2017)(Borman et al., 2020). If there is a health problem in a child, parents are more likely to entrust it to a doctor or midwife who already knows more about health, regardless of whether the disorder is low or chronic(Kirana et al., 2019)(Alim et al., 2020). However, with the convenience of having a doctor or midwife, sometimes there are also weaknesses, such as limited working hours (practice) and the number of patients who have to wait in long queues at no small cost or because of long distances(Ramadhanti & Eviyanti, 2021)(Gozzal & Indarti, 2017). In this case, parents need an expert who can make it easier to diagnose the disease early so that they can take early prevention(Yanto et al., 2017).

Because of this, we need an application that can be accessed anywhere, able to diagnose disease and can help parents in studying the symptoms of disease in toddlers(Sari, 2013)(Kristian Siregar & Paska Marto Hasugian, 2021). This program is in the form of an expert system that can be overcome by adopting the expertise of an expert doctor into a computer-based system that is

able to carry out diagnoses like an expert doctor(Setyaputri et al., 2018). To handle the uncertainty factor in diagnosing diseases in toddlers, the researchers used Certainty Factor (CF) for handling uncertainty problems and was web-based(Ariasih, 2020). The use of this method can provide accurate results obtained from calculations based on the weight of the symptoms selected by the user, able to provide answers to problems that are not certain of the truth such as the problem of diagnosing disease risk and with this method will describe the beliefs of an expert by giving a confidence weight in accordance with the knowledge of an expert(Aldo & -, 2019).

2. Literature Review

a. Toddler

Toddler is a child who has reached the age of one year or more, which is popular with the understanding of the age of children under five years. Toddler is a general term for children aged 1-3 years (Toddler) and preschoolers (3-5 years). At the age of toddlers, children are still fully dependent on their parents to carry out important activities, such as bathing, defecating and eating(Nurajizah & Saputra, 2018).

b. Types of Child's Disease

Childhood is a period that is vulnerable to disease. At this time, the child's immune system is not fully formed so that the child is susceptible to infection with a disease. The new child's immune system is fully formed at the age of 3 years. Therefore, parents should know the various diseases that can occur in children. Caused by infection or non-infection. Several diseases are based on a disturbed system that can attack children at an early age(Julianti et al., 2021).

Here are some types of diseases experienced by toddlers:

1. Varicella
2. Malaria
3. Tetanus
4. Measles
5. Typhoid fever or typhus
6. Dengue
7. Diarrhea
8. Marasmus or Malnutrition
9. ARI
10. TB or Tuberculosis
11. Step or febrile seizure
12. Pneumonia
13. ADHD or attention deficit hyperactivity disorder
14. Milk allergy
15. Hirschsprung
16. Allergies

c. Expert system

According to (Darnila et al., 2022), an expert system is a system that utilizes human knowledge captured in a computer to solve problems that usually require human expertise. According to experts (Pujianti & Sitti, 2020) is a computer program that simulates the judgment and behavior of humans or organizations that have expert knowledge of experience in certain fields.

d. Certanty Factor Method

The certainty factor was introduced by Shortliffe Buchanan in making MYCIN(Windaputri et al., 2020).Certainty factor (CF) is a clinical parameter value given by MYCIN to show the amount of confidence. In dealing with a problem, answers are often found that do not have full certainty. Uncertainty this can be a probability or an event that depends on the outcome or event(Maulina, 2020). Uncertain results are caused by two factors, namely uncertain rules or uncertain user answers to a question posed by the system. This is very easy to see in the disease diagnosis system, where the expert cannot define the relationship between the symptoms and the cause with certainty and the patient cannot feel a symptom with certainty. In the end, many possible diagnoses were found.

The certainty factor is a method used to measure a person's belief. The input is in the form of certainty from experts and certainty from users. The development team for this method noted that doctors often analyze the information with phrases such as “probably”, “almost certain”. This method is similar to fuzzy logic, because uncertainty is represented by the degree of confidence, while the difference is in fuzzy logic when calculating for a rule with more than one premise, fuzzy logic does not have a confidence value for the rule so that the calculation only looks at the

smallest value for the AND operator or the largest value. for the OR operator of each premise in the rule. In contrast to the certainty factor, each rule has its own belief value, not only the premises which have a belief value(Kusumanagara et al., 2021). Certainty factor shows a measure of certainty to a fact or rule.

CF [h,e] = MB [h,e] – MD [h,e]
CF [h,e] = certainty factor
MB [h,e] = the value of confidence in the hypothesis h, if given evidence e (between 0 and 1)
MD [h,e] = the value of distrust of the hypothesis h, if given evidence e (between 0 and 1)
Formula :

$$CF = \frac{MB(h,e) - MD(h,e)}{1 - \min(MB(h,e), MD(h,e))}$$

3. Research Methods

The research methods used in this research are:

a. Literature Study, in this literature study, researchers look for references from various sources such as books, journals, and articles related to the research topic.
b. Interviews, researchers interviewed experts related to children's diseases so that they got the types of childhood diseases, the symptoms felt and how to prevent and treat these diseases.
c. System development methods, in the development of this expert system there are several ways that are used, including:
   1) Knowledge acquisition stage, at this stage, processing the data that has been obtained such as types of diseases and symptoms and making a knowledge base such as Measles has symptoms such as fever above 400 C, lazy to eat, dry cough, watery eyes, rash appears, colic and spots in the mouth or throat.
   2) The system design stage, at this stage a system design will be made based on user needs and based on the previously created knowledge base, from the knowledge base it will produce diagnostic results in accordance with the rules made.
   3) Implementation stage, at this stage a system will be created using a web programming language(Fonda et al., 2021).
   4) The testing phase, for testing will be tested on several users related to the system is in accordance with the needs of the user, and will be tested based on the knowledge base that has been made is appropriate or not, and will also be tested for symptoms and types of diseases obtained from expert, it is appropriate or not(Irawan et al., 2021).

Knowledge Acquisition

Based on the knowledge of the expert, the knowledge base will be made in the form of a table, while the knowledge acquisition table is as follows:

Table 1- Knowledge Acquisition

No		IF	MB	MD	NO		IF	MB	MD
1	Measles	Fever above 40°C	0.8	0.2	9	Tuberculosis	- Fever	0.8	0.2
		- Lazy to Eat	0.4	0.2			- Cough	1	0
		- Dry Cough	0.6	0.2			- Body weakened	1	0
		- Watery eyes	0.8	0.2			- Coughing up blood	1	0
		- Rash Appears	1	0			- Loss of appetite	1	0
		- Koplik spots appear in the mouth, cheeks or throat	0.8	0.2			- Sweating at night	1	0
2	Malaria	- Fever	1	0			- No weight gain	1	0
		- Headache	0.8	0.2	10	Allergy	- Cough	0.4	0.2

		- Stomach ache	0.2	0			- Diarrhea	1	0
		- Hard to sleep	0.6	0.4			- Throws up	1	0.2
		- Fast Breath	0.4	0.2			- Loss of consciousness	0.2	0
		- Fussy	0.8	0.4			- A rash appears	0.4	0.2
		- Vomit	0.6	0.4			- Sneeze	0.4	0.2
		- Bloody CHAPTER					- Hard to breath	0.4	0.2
		- Shivering	0.6	0.4			- Swelling of the lips, tongue and face	1	0
		- Sweating a lot	0.6	0.4	11	Varicella / chicken pox	- Fever	0.8	0.2
		- Loss of appetite	0.4	0.2			- Headache	0.6	0.2
3	Tetanus	- Fever	0.8	0.2			- Sore throat	0.2	0
		- Lazy to Eat	0.2	0			- No appetite	0.4	0.2
		- Convulsions					- Small red spots appear	1	0
		- Diarrhea					- Appears vesicles or lumps filled with clear fluid	1	0
		- Stiff	0.8	0.2	12	Marasmus	- Lethargic	1	0
		- Pain when swallowing	0.8	0.2			- Diarrhea	0.6	0.2
		- Muscle spasms	1	0			- Dry and rough skin	1	0
		- Heart rate increases	0.8	0.2			- Distended stomach	1	0
4	Step	- Fever	1	0			- Drastic weight loss	1	0
		- Convulsions	1	0	13	Pneumonia	- Fever	0.8	0.2
		- Stiffness in the feet and hands	1	0			- Lethargic	0.8	0.2
		- Legs or arms protruding	1	0			- Cough	1	0
		- Eyes glaring/blinking	1	0			- Breath sound	1	0
		Fever above 40°C	1	0			- Vomit	0.4	0.2
5	Typhoid fever	- Nosebleed					- Shivering	0.4	0.2
		- Headache	0.8	0.2			- No appetite	0.6	0.2
		- Stomach ache	0.6	0.2			- Easy to feel tired	0.4	0.2
		- Hallucinations	0.2	0			- Stuffy nose / runny nose	0.4	0.2
		- Diarrhea	0.6	0.2			- Out of breath	1	0
		- Sore throat	0.4	0.2			- Feeling pain in the chest	0.8	0.2

		- bloody CHAPTER					- Crying more often than usual	0.8	0.2
		- Small red spots	0.4	0.2	14	Hirshsprung	- Bloated	1	0
		- Loss of appetite	1	0			- Fussy	0.8	0.2
		- Easy to feel tired	0.8	0.2			- Constipation	1	0
		- Fever	1	0			- No appetite	0.8	0.2
		- Enlargement of the liver and spleen					- Disrupted growth and development	0.4	0.2
6	Diarrhea	- Fever	0.4	0			- No weight gain	0.4	0.2
		- Lethargic	0.8	0.2			- No chapter within 48 hours after birth	1	0
		- Bloated	0.2	0	15	ADHD	- Careless	0.4	0.2
		- Nausea want to vomit	0.2	0			- Not focused on doing something	1	0
		- Frequent defecation	1	0			- Difficult to follow instructions	0.8	0
		- Diarrhoea	1	0			- His attention is easily distracted	1	0
		- Constipation	1	0			- Not paying attention to details	1	0
		- Cramps in the stomach	0.8	0.2			- Often looks like he's not listening to conversations or directions	0.8	0
		- No appetite	0.6	0.2	16	Cow's Milk Allergy	- Diarrhea	1	0
		- Continuous CHAPTER					- Vomit	0.8	0.2
7	ARI	- Fever	0.8	0.2			- Out of breath	0.4	0.2
		- Headache	0.8	0.2			- A rash appears	0.6	0.2
		- Cough	1	0			- Cramps in the stomach	0.6	0.2
		- Easy bruising					- Wheezing / wheezing	0.6	0.2
		- Muscle ache	0.2	0			- Itching of the mouth and lips	0.8	0.2
		- Red eye	0.6	0.2			- Rash and itching around the mouth	0.8	0.2
		- Sneeze	0.4	0.2			- Swelling of the lips, tongue and face	0.8	0.2

		- Stuffy nose or runny nose	0.6	0.2
		- Sore throat to hoarse voice	1	0.2
8	DHF	- Fever	1	0
		- Headache	1	0
		- Nauseous	0.6	0.2
		- Very restless	0.4	0.2
		- Vomit	0.6	0.2
		- A rash appears	1	0
		- Mild bleeding in the nose or gums.	0.6	0.2

Table 2-Value of certainty condition

No	Condition	MD Value
1	sure yes	1
2	Almost sure	0.8
3	Most likely	0.6
4	Possible	0.4
5	Almost Possible	0.2
6	Don't know	0

4. Results and Discussions

The expert system is built using a website-based programming language. The following is a display of the expert system for diagnosing toddlers disease, which can be seen in the image below:

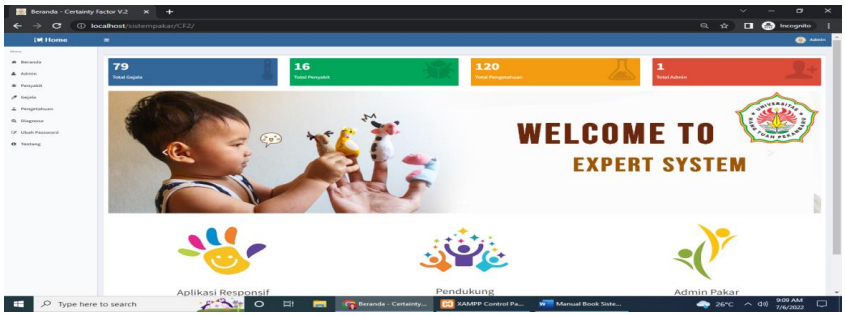

Fig 1. Home Page

The picture above is for the admin home page, where the admin can manage the disease menu, symptoms, knowledge base, and can also do consultations.

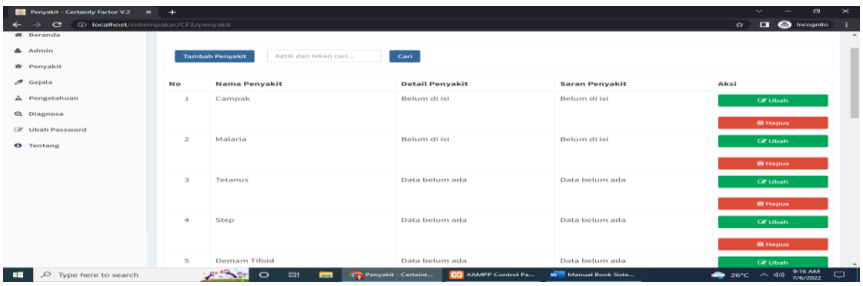

Fig 2. Disease Type Page

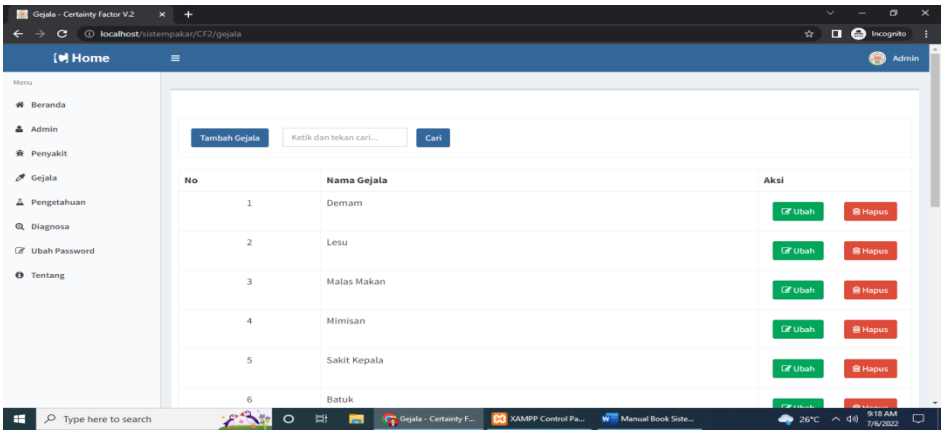

Fig 3. Symptoms page

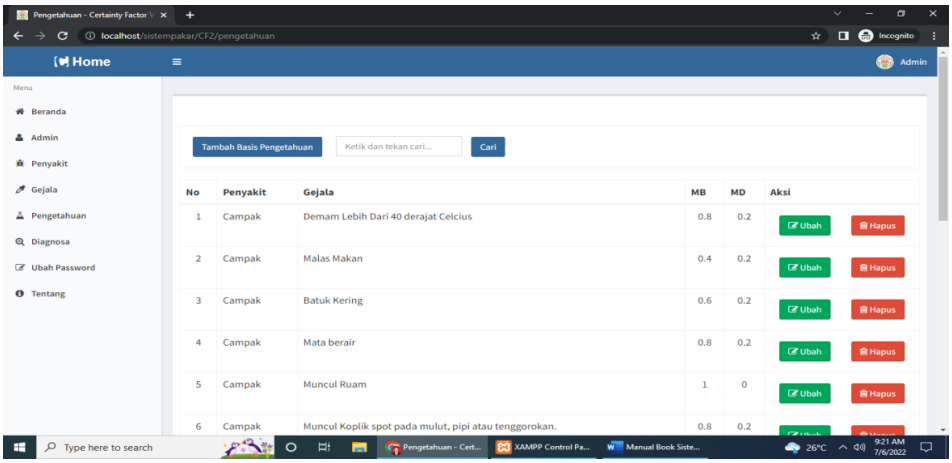

Fig 4. Knowledge base page

In the picture above, the knowledge that has been taken from the experts will be input, which here also has a certainty value for each symptom as seen in the MD and MB percentages.

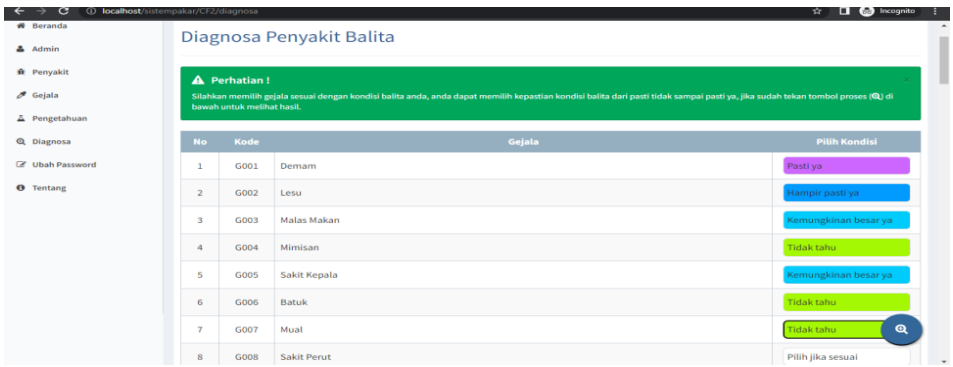

Fig 5. Consultation page

On this page the user is expected to choose several types of existing symptoms, and choose the certainty value that is on the right according to the condition of the symptoms experienced.

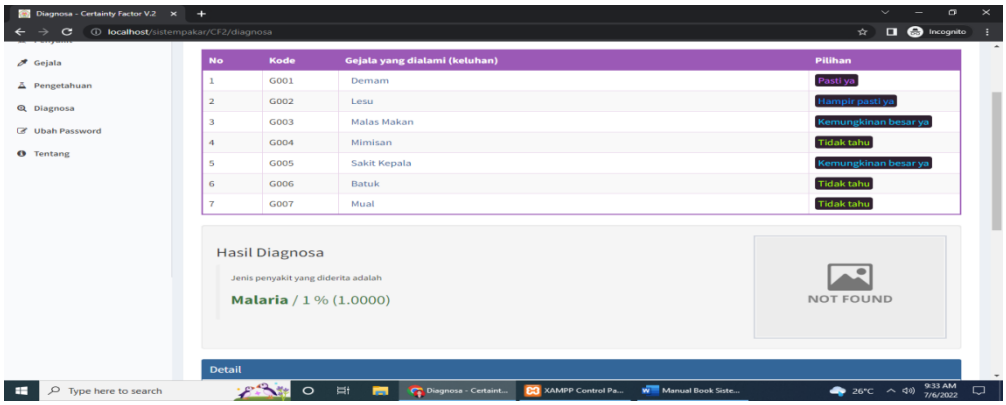

Fig 6. Diagnostic Results

From the results of the diagnosis, it was found that the user was experiencing malaria with a value of 1, namely Definitely, based on the knowledge base obtained. The following is an example of a program manual calculation (using Rule 1):

Table 3 - CF values of symptoms in measles

No	Symptom	Disease	CF
1	Fever above 40°C	Measles	0.8
2	lazy to eat	Measles	0.4
3	Dry Cough	Measles	0.6
4	Watery eyes	Measles	0.8
5	Rash Appears	Measles	1
6	Koplik spots appear in the mouth, cheeks or throat	Measles	0.8

Then the CF value of Measles is obtained by:
CF(A) = CF(1) + [CF(2) * (1 – CF(1)] = 0,8+[0,4*(1-0,8)] = 0,88
CF(B) = CF(3)+[CF(A)*(1-CF(3)] = 0,6+[0,88*(1-0,6)] = 0,95
CF(C)= CF(4)+[CF(B)*(1-CF(4)] = 0,8+[0,95*(1-0,8)] = 0,99
CF(D)= CF(5)+[CF(C)*(1-CF(5)] = 1+[0,99*(1-1)] = 1
CF(E)= CF(6)+[CF(D)*(1-CF(6)] = 0,8+[1*(1-0,8)] = 1
So the CF of Measles is 1 or 100%

5. Conclusion

From testing on expert systems for diagnosing diseases in infants, it can be concluded that the system can produce conclusions according to the manual calculation, namely measles with a CF value of 100% or 1. Based on testing results made in accordance with the knowledge base obtained from pediatric disease experts. Users can see the results of the diagnosis and how to treat it. Based on the manual calculation of the program with the system, the certainty factor method is able to provide results based on the weight of the symptoms that have been selected by the user on the system and can provide answers in cases where the truth is not certain as in this study, namely diagnosing children's diseases.

Acknowledgement

The author would like to thank RISTEK-BRIN which has provided financial assistance related to this research, and thanks also to the academic community of Hang Tuah University Pekanbaru who have always supported in conducting this novice lecturer research.

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