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Expert System To Diagnose Disease In Toddlers Using *Dempster Shafer* Method

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ABST RACT

Children, especially toddlers at the age of two months to five years old are more susceptible to disease. Limited information about diseases that attack children makes it difficult for parents to predict the disease that will suffer from their children. Therefore we need an expert system that can predict the disease suffered by children, and the method used in this study is the *Dempster Shafer* method. The *Dempster Shafer* method can be implemented into an expert system to combine separate symptoms (evidence) in calculating the probability of a disease. Based on the test results using 250 test data, the accuracy of the expert system for diagnosing diseases in children under five years old using *Dempster Shafer* method is 94%.

1. Introduction

Health ranks highest in supporting the continuity of every human activity, especially for children or toddlers. Children, especially toddlers at the age of 2 months to 5 years are more susceptible to disease. At that age, toddlers are susceptible to diseases from an unhealthy environment. The limited information about diseases that affect children under five makes it difficult for parents to predict the diseases that their children will suffer from. For parents who have just had children, this is a new thing for them. Parents usually prefer to entrust the diagnosis of the disease to a doctor who is an expert on health. For some people, the cost of consulting a specialist is not cheap so many parents decide to take care of their child on their own. Due to delays in handling the disease, it makes the disease more severe and more difficult to cure [5].

In this case, parents need an expert who can make it easier to diagnose the disease early so that they can take early prevention which if it takes time if they consult an expert doctor. Because of this, we need a tool that can diagnose children's diseases in the form of an expert system [2].

Expert system (*expert system*) is a branch of artificial intelligence (*Artificial Intelligence*) and is also a field of science that emerged along with the development of computer science today. This expert system is a computer system that can match or imitate the ability of an expert. This system works to adopt human knowledge to a computer that combines a *knowledge base* with an inference system to replace the function of an expert in solving a problem. Expert systems as artificial intelligence, combine knowledge and facts and search techniques to solve problems that normally require the expertise of an expert [3].

2. Literature Study / Hypotheses Development

A. Expert System

Expert system is a branch of artificial intelligence (*Artificial Intelligence*) and is also a field of science that emerged along with the development of computer science today. This expert system is a computer system that can match or imitate the ability of an expert. This system works to adopt human knowledge to a computer that combines a *knowledge base* with

an inference system to replace the function of an expert in solving a problem. Expert systems as artificial intelligence, combine knowledge and facts and search techniques to solve problems that normally require the expertise of an expert [3].

B. *Dempster-Shafer* Method

The *Dempster Shafer* method was first introduced by *Dempster* , who conducted an experiment with an uncertainty model with a *range of probabilities* as a single probability. Then in 1976 *Shafer* published *Dempster's* theory in a book entitled *Mathematical Theory Of Evident. Dempster Shafer's Theory Of Evidence* , shows a way to give weighting beliefs according to the facts collected [9].

Dempster Shafer is a mathematical theory for proof based on *belief functions* and *plausible reasoning* , which are used to combine separate pieces of information (evidence) to calculate the probability of an event [7].

There are various kinds of reasoning with complete and very consistent models, but in reality there are many problems that cannot be solved completely and consistently. This inconsistency is the result of the addition of new facts. Such reasoning is called *non- monotonic* reasoning . To overcome this inconsistency, it can use reasoning with the *Dempster- Shafer* theory .

In general, the *Dempster-Shafer* theory is written in an interval [7], namely :

[*Belief,Plausibility*]

1. *Belief* (Bel) is a measure of the strength of *evidence* in supporting a set of propositions. If it is 0 then it indicates that there is no *evidence* , and if it is 1, it indicates certainty.
2. *Plausibility* (Pls) will reduce the level of certainty of the *evidence* . *Plausibility* (Pls) is denoted as:

Pls(X) = 1 - Bel(X)

In the *Dempster-Shafer* theory *, it is* known that there is a *frame of discrement* denoted by . This frame is the universe of talks from a set of hypotheses. The goal is to relate the confidence measure of the elements of . Not all *evidence* directly supports each element. For this reason, it is necessary to have a probability density function (m). The value of m defines not only the elements of , but also all of its subsets. If it is known that X is a subset of , with m1 as its density function, and Y is also a subset of with m2 as its density function, then the combination function of m1 and m2 as m3, with the formula as in the equation:

$$m3(Z) = \frac{\sum_{X \cap Y = Z} m_1(X).m_2(Y)}{1 - \sum_{X \cap Y = \emptyset} m_1(X).m_2(Y)}$$

Keterangan :
m3(Z) = *mass function* from *evidence* (Z)
m1 (X) = *mass function* from *evidence* (X)
m2 (Y) = *mass function* from *evidence* (Y)
Zm1(X).m2(Y) = there is a slice of m1 and m2
Ø Zm1(X).m2(Y) = no slice result (empty slice (Ø))

C. Related Research

Research conducted by Dasril Aldo and Septa Eka Putra (2020), In this study, the accuracy of the shallot pest and disease expert system is divided by the amount of data that matches t amount of test data used and then multiplied by 100%. Of the 10 test data obtained 9 data whc results are the same as the sample data. In the eighth sample, there are two types of diseases identified, namely P02 and P04 where the *Dempster Shafer* calculation will take the results of the calculation of the largest value which results in the discrepancy of the expert diagnosis

32

results with the expert system. The results of the probability calculation using the *Dempster Shafer* method obtained an accuracy value of 95% which is implemented in this system with knowledge representations in the form of rules and symptoms.

3. Methodology

A. Research Stages

The research will be carried out in several stages which can be seen in Figure 1.

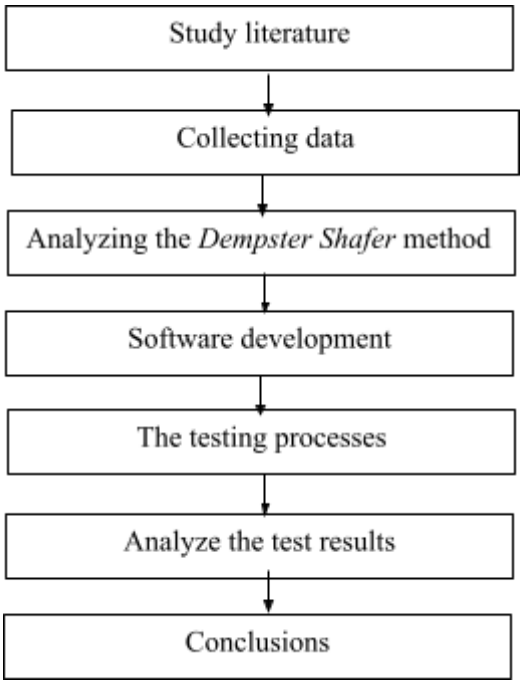

Figure 1. Research Framework

The explanation of Figure 1 is as follows:

1. Study literature of the *Dempster Shafer* method
In the first stage, a literature study was conducted on the method to be used, namely the *Dempster Shafer* method . This stage also analyzes previous studies related to the method that will be used in this study.

2. Collecting data
The data used in this study are primary data and secondary data. The author will collect data that already exists directly at the Tanjung Enim Health Center. Then the author will also conduct interviews with experts, in order to obtain information and data related to the problem under study. Then the data will go through pre-processing of data and recap in the form of excel formatted files so that they are ready to be used for this research.

3. Analyzing the *Dempster Shafer* method
The third stage after the data has been collected and has gone through pre-processing of the data is to analyze the *Dempster Shafer* method using data on diseases in children under five.

4. Software development
Software development in this study uses the *Rational Unified Process* (RUP) . In general, the steps that will be carried out in software development are the inception, elaboration, construction, and transition phases. The reason for using the *Rational Unified Process* is to ensure that the resulting software meets user requirements and can be completed on time.

5. Carry out the testing process
The process of testing the system in this study is to use the *Average* method , namely by testing the accuracy of the diagnostic results.

6. Analyze the test results

After testing the system, the next step is to analyze the test results. Are the results of the system in accordance with the purpose of manufacture, whether the resulting system can function properly and whether the system can provide accurate results.

7. Making conclusions

Make conclusions on the software that has been built.

4. Result and Discussion

A. Implementation

This expert system will implement the *Dempster Shafer* method for the disease diagnosis process. The following displays the results of the system implementation :

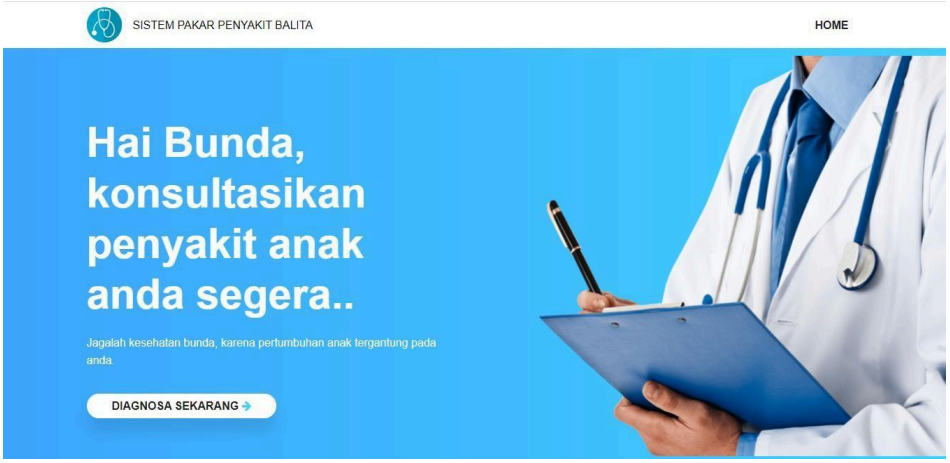

Figure 2. Expert System Home Page Interface

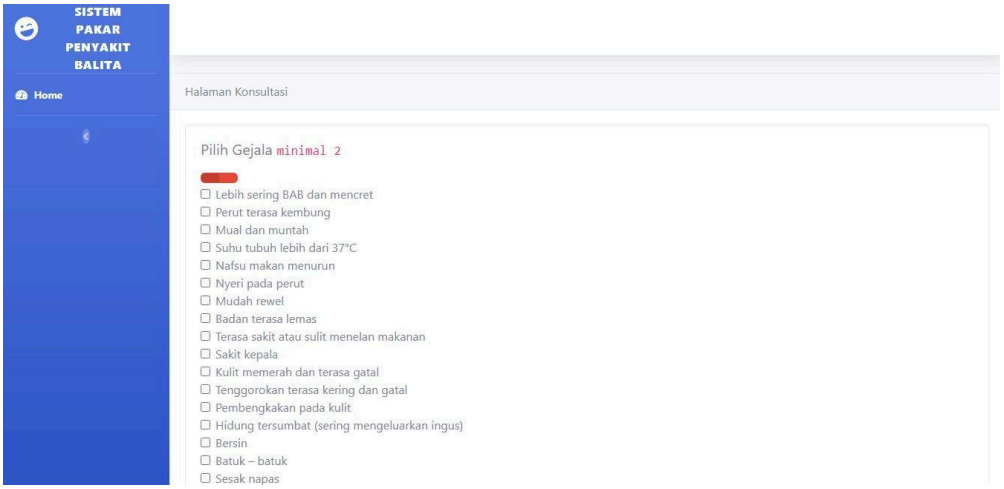

Figure 3. Consultation Page Interface

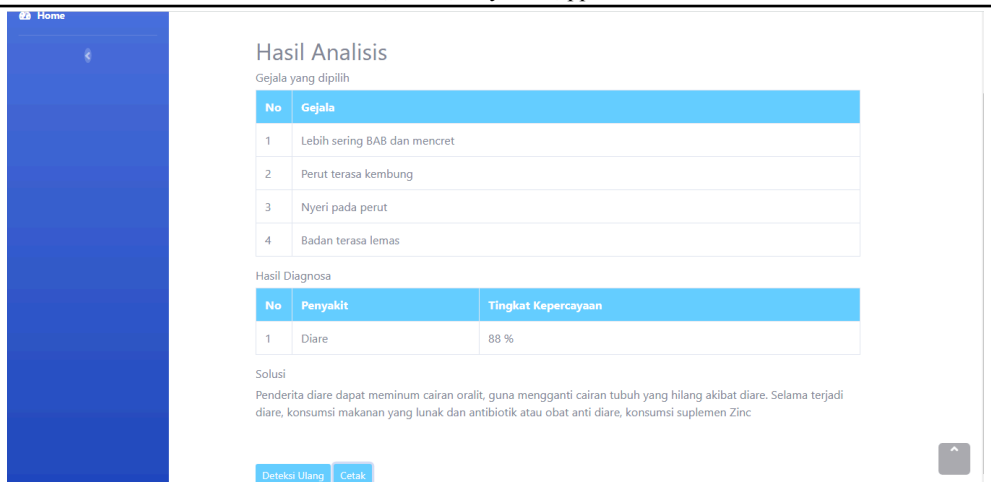

Figure 4. Disease Diagnosis Results Page Interface

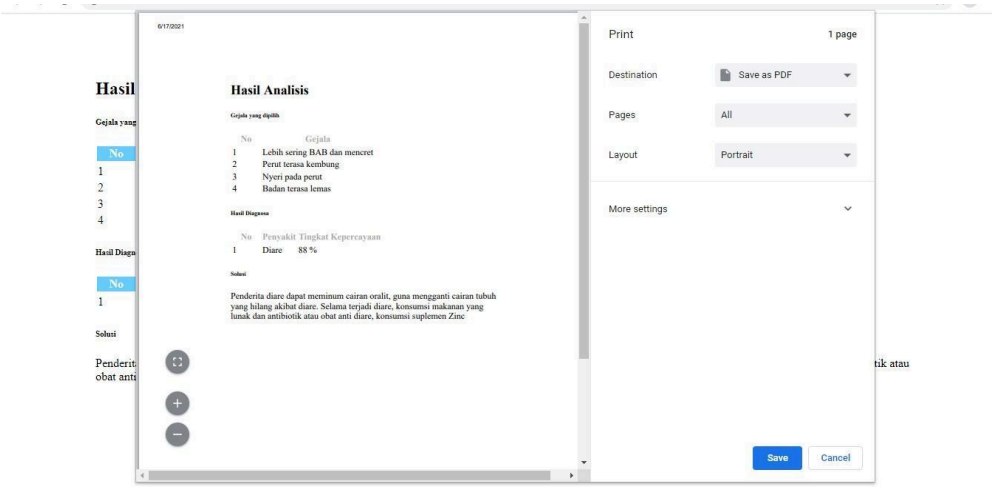

Figure 5. Print Page Interface for Disease Diagnosis

Based on the results of tests that have been carried out on the suitability of software design and software implementation, it can be concluded that the units and interfaces built can run well. This is indicated by the conclusion that the scenario results in the test cases all give the same conclusion, which is accepted.

B. Research Analysis

Testing of the data on the diagnosis of disease in children under five with test data using the *Dempster Shafer* method has been successfully carried out. Previously, the author had explained in advance about the *Dempster Shafer* method to experts , because in the calculation of the *Dempster Shafer* method it was necessary to have a weighted value for each symptom to diagnose a disease. The weight value was successfully obtained from the results of interviews with experts. The analysis of the results of testing the accuracy of the system can be seen in table 1.

Table 1. Analysis of System Accuracy Test Results

Test Result		
Total Test Data	**Amount of "Appropriate" Data**	**Percentage Acuracy**
250 data	235 data	94%

As a result, there are as many as 235 test data that are suitable and there are 15 test data that are not suitable. The 15 test data whose output does not match the results of this expert's provisions are most likely due to other considerations used by experts that the system cannot know because it requires human logic in it. Based on the calculations that have been done, the accuracy value for the expert system for diagnosing diseases in toddlers using the *Dempster Shafer* method is 94%.

5. Conclusion

Based on the research that has been done on the expert system research on diagnosing diseases in toddlers using the *Dempster Shafer* method , the conclusions obtained are:

1. An expert system for diagnosing diseases in toddlers using the *Dempster Shafer* method has been successfully developed. This system can be used as a user to make it easier to diagnose diseases in toddlers and also early treatment solutions for these diseases.

2. The results of system testing on 250 expert system test data in diagnosing diseases in toddlers are quite good, with an accuracy value reaching 94%.

The further development of this software is that it can be developed using other expert system methods as a comparison with the *Dempster Shafer* method so as to produce a better expert system.

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