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Diagnosis Of Malnutrition In Children Using The Dempster Shafer Method

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ABSTRACT

Malnutrition is a serious problem that can interfere with a child's physical growth, cognitive development, and general health. This study aims to develop a web-based expert system that is able to diagnose malnutrition in children using the Dempster Shafer method. Conventional methods in diagnosis often face challenges such as uncertainty and subjectivity, so a more accurate and efficient approach is needed. The Dempster Shafer method was chosen because of its ability to overcome uncertainty by combining various sources of information to produce a more precise diagnosis. This research was conducted at the Djoelham Regional General Hospital, Binjai City, with a focus on children aged 0-12 years. The expert system, which is designed using the PHP programming language and MySQL database, is expected to replace the role of an expert in providing initial diagnosis, making it easier for parents and health workers to take quick and appropriate actions. The results of this study show that the expert system developed is able to provide malnutrition diagnosis to children with good accuracy, so that it can be used as a tool in handling malnutrition problems more effectively.

INTRODUCTION

Nutritional health in children is the main foundation for optimal growth and development, as well as overall well-being. Adequate nutrition not only supports a child's physical and cognitive development, but also affects mental health, endurance, and academic achievement. Malnutrition is a condition in which a person does not get enough nutritional intake to maintain optimal health and body function. This can be caused by a lack of nutritious food intake, a lack of essential nutrients such as protein, vitamins, and minerals, or the body's inability to absorb nutrients properly. The impact includes low body weight, physical weakness, stunted growth, and a high risk of disease and infection. Malnutrition often occurs in vulnerable pupulations such as children.

Conventional methods in diagnosing malnutrition in children are often limited by the occurrence of uncertainty, lack of data, and subjectivity in assessment. These limitations can result in inaccurate diagnoses and delays in the necessary treatment measures. The expert system promises solutions to improve accuracy and consistency in diagnosing malnutrition in children. By using structured knowledge and the right algorithms, expert systems can assist doctors or healthcare professionals in the decision-making process, taking into account a variety of relevant factors.

The Dempster Shafer *method*, as one of the approaches in chance theory, offers a robust framework for addressing uncertainty and complexity in the diagnostic process. By efficiently combining various sources of information, this method can improve the accuracy and reliability of diagnosing malnutrition in children. The *Dempster Shafer* method is one of the methods in the branch of mathematics and is commonly used to calculate probabilities. This method is used to combine separate pieces of information to calculate the probability of an event.

Several studies have been conducted to diagnose malnutrition in children. One of them is Ison Alvian Nawawi's (2018) research entitled " Application of *the Dempster Shafer* Method to Diagnose Malnutrition in Children (Case Study: Pujokerto Health Center)". The expert system with *the Dempster Shafer* method was chosen because this method determines the solution to malnutrition diseases in children. With this website-based expert system, it will make it easier for parents to get information about the diagnosis of malnutrition in children as the beginning of prevention before going to a nutritionist and specialist doctor, because by using this diagnostic expert system application will be more efficient in its use. For the software development method, Rapid *Application Development* or RAD is used which consists of data collection

Requirements Planning, *Design Workshop* and *Implementation* (Nawawi, Ikhsanto, and Perdana 2018).

METHOD

The research method is an overview of the steps so that research can be carried out in a structured manner, so a framework is prepared from the beginning to the achievement of the final result as follows:

Table 1. Research Framework

Stages	Activities
Preparation	Definition
	Setting Goals
	Collecting and Studying Literature
	Determination of Research Methods
Discussion and Analysis	Dempster Shafer Analysis
	Determining Possible Outcomes
Trial	Dempster Shafer System Test Using the Web

The activity at this stage is to define important issues surrounding *the Dempster Shafer* Method. After defining the main problem, the following step is to understand and analyze the problem with the aim of clarifying and determining *the scope* of the problem so that the goal is achieved. The data collection method used at this stage is decision research, namely by collecting reading materials in the form of theoretical scientific papers as a basis or theoretical framework according to the title and problem presented and literature studies can be produced by *browsing* on internet sites. In order for the results to be achieved properly, a descriptive analysis method is applied, namely data is collected and then compiled, grouped and analyzed so that a clear picture of the subject matter is obtained. After the data is collected and studied, the next step is to conduct a *Dempster Shafer* analysis using the probabilities that occur as the basis and the representation of rule-based knowledge. At this stage, after knowing the possibilities that occur as the basis of rule-based knowledge reprection. This stage is the last stage by testing the application of the value results through the *Dempster Shafer* method using the web.

RESULTS AND DISCUSSION

Result

The first page when the user accesses the expert system for diagnosing malnutrition diseases in children.

Figure 1. Main Page

Users or system users can choose the symptoms that occur from the test, choose the symptoms they feel so that they can diagnose malnutrition in children.

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Figure 2. Testing Page

Admins can use it and can add diseases that are caused by malnutrition in children.

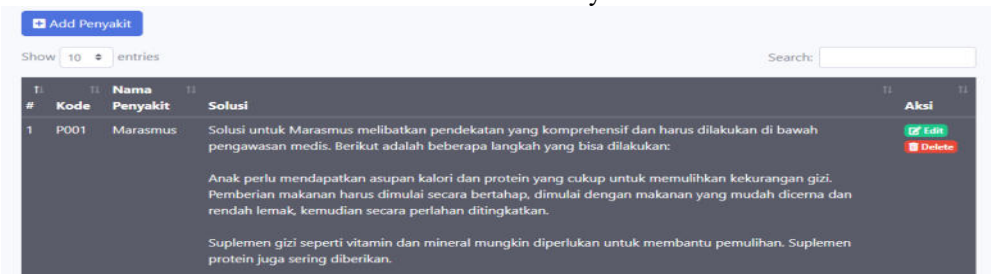

Figure 3. Malnutrition Disease Data

Admins can use it and can add rules for malnutrition.

Figure 4. Symptom Data (Rule) of Malnutrition Diseases

Admins can add between diseases, symptoms and the formation of rules as well as give weight to the symptoms of diseases from malnutrition in children.

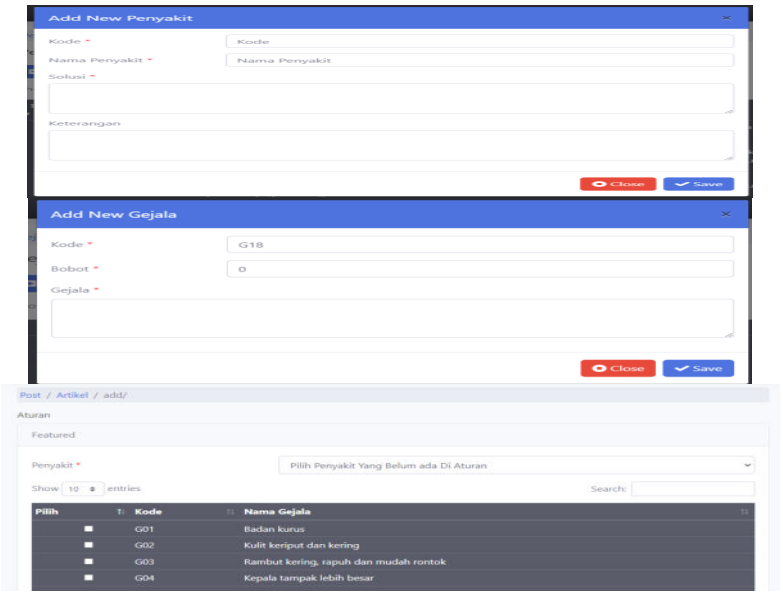

Figure 5. Rules Menu

Results from the calculation of symptoms of malnutrition in children that have been inputted by the *user*

Figure 6. Identification Results Menu

Results of calculation diagnosis from *the Dempster Shafer method*

Figure 7. Menu of Calculation Results Using the *Dempster Shafer Method*

Only admins can access because in the login menu the admin can input data, symptoms, add and delete data.

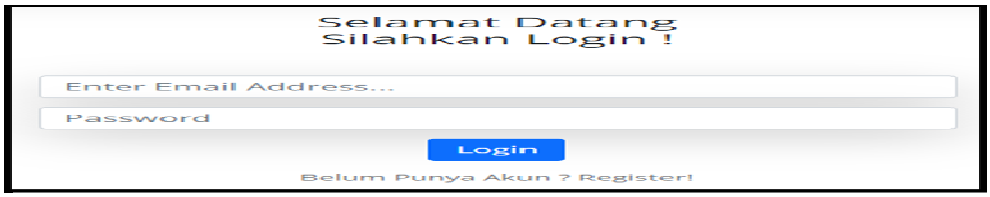

Figure 8. Admin Login Menu

To add or register users who do not have an account

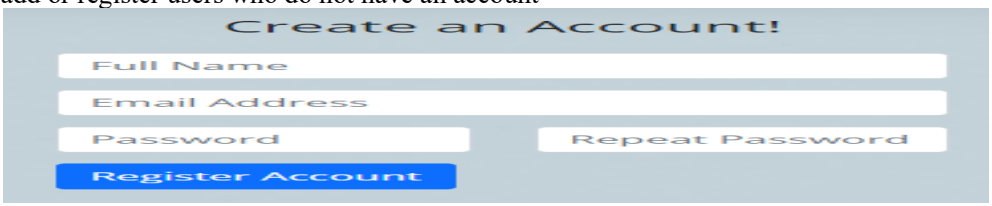

Figure 9. Add Admin Menu

Discussion

Knowledge Base

The value of trust is the possible value of a symptom to a disease. Based on the results of interviews with experts, there are 3 diseases with 17 physical symptoms that can be seen. The following are the symptoms and diseases of malnutrition in children:

Table 1. Types of Malnutrition Diseases

Disease Code	Name of Disease
P1	Marasmus
P2	Kwashiorkor
P3	Anemia

Table 2. List of Symptoms and Values

Disease Code	Symptom Code	Symptom Name	Belief Value	Plausibility Vlue
Marasmus (P1)	G01	Skinny body	0,7	0,3
	G02	Wrinkled and dry skin	0,7	0,3
	G03	Hair is dry, brittle and falls out easily	0,6	0,4
	G04	The head appears larger	0,7	0,3
	G05	Sluggish and limp body	0,8	0,2
	G06	Concave buns	0,5	0,5
Kwashiorkor (P2)	G07	Enlarged abdomen	0,6	0,4
	G08	Swollen body	0,6	0,4
	G09	Growth and development disorders	0,4	0,6
	G10	Hair is dry, brittle and falls out easily	0,6	0,4
	G11	Limp body	0,8	0,2
	G12	Swollen face	0,7	0,3
Anemia (P3)	G13	A rash appears on the skin	0,6	0,4
	G14	Limp body	0,8	0,2
	G15	Feet and Hands feel cold	0,7	0,3
	G16	The face looks pale	0,8	0,2
	G17	Frequent dizziness	0,7	0,3

Dempster Shafer *Calculation*

The following is presented the calculation of *Dempster Shafer* Based on the data of complaints of malnutrition disease symptoms recorded in table III below.

Table 3. Symptoms of Patient Malnutrition Disease

No	Symptom
1	Skinny Body
2	Body Weakness
3	Hair is dry, brittle and falls out easily
4	Face Looks Pale
5	Often experiencing dizziness

The following are the stages of using *the Dempster Shafer* technique for malnutrition in children:

Symptom 01 : Thin body

m_1 (G01) = 0,7

m_1 (ɵ) = 1 - m_1 (G01)

= 1 – 0,7 = 0,3

Symptom 11 : Weakness

m_2 (G11) = 0,8

m_2 (ɵ) = 1 - m_2 (G11)

= 1 – 0,8 = 0.2

Symptom 01 (P1) and Symptoms 11 (P2, P3)

	m_2 (P2,P3) 0,8	m_2 (ɵ) 0,2
m_1 (P1) 0,7	0,7 x 0,8 = 0,56	0,7 x 0,2 = 0,14
m_1 (ɵ) 0,3	0,3 x 0,8 = 0,24	0,3 x 0,2 = 0,06

m_3 (P1) = 0,56 + 0,24 = 0,8

m_3 (P2,P3) = 0,14

m_3 (ɵ) = 0,06

Symptom G03 (P1, P2)

	m_4 (P1,P2) 0,6	m_4 (ɵ) 0,4
m_3 (P1) 0,8	0,8 x 0,6 = 0,48	0,8 x 0,4 = 0,24
m_3 (P2,P3) 0,14	0,14 x 0,6 = 0,084	0,14 x 0,4 = 0,056
m_3 (ɵ) 0,06	0,06 x 0,6 = 0,036	0,06 x 0,4 = 0,024

m_5 (P1) = 0,48 + 0,24 = 0,72
m_5 (P2,P3) = 0,084 + 0,056 = 0,14
m_5 (P1,P2) = 0,036
m_5 (ɵ) = 0,024

Symptoms of G16 (P3)

	m_6 (P3) 0,8	m_6 (ɵ) 0,2
m_7 (P1) 0,72	0,72 x 0,8 = 0,57	0,8 x 0,2 = 0,16
m_7 (P2,P3) 0,14	0,14 x 0,8 = 0,11	0,14 x 0,2 = 0,028
m_7 (P1,P2) 0,036	0,036 x 0,8 = 0,028	0,036 x 0,2 = 0,007
m_7 (ɵ) 0,024	0,024 x 0,8 = 0,019	0,06 x 0,2 = 0,012

m_7 (P1) = 0,57 + 0,11 + 0,16 = 0,84
m_7 (P2,P3) = 0,028
m_7 (P1,P2) = 0,019
m_7 (P3) = 0,036
m_7 (ɵ) = 0,012

Symptoms of G17 (P3)

	m_8 (P3) 0,7	m_8 (ɵ) 0,3
m_7 (P1) 0,84	0,84 x 0,7 = 0,588	0,84 x 0,3 = 0,252
m_7 (P2,P3) 0,028	0,028 x 0,7 = 0,0196	0,028 x 0,3 = 0,0084
m_7 (P1,P2) 0,019	0,019 x 0,7 = 0,0133	0,019 x 0,3 = 0,0057
m_7 (P3) 0,036	0,036 x 0,7 = 0,0252	0,036 x 0,3 = 0,0108
m_7 (ɵ) 0,012	0,012 x 0,7 = 0,0084	0,012 x 0,3 = 0,0036

m_9 (P1) = 0,588 + 0,0196 + 0,0133+0,252 = 0,87
m_9 (P2,P3) = 0,0196 + 0,0084 = 0,028
m_9 (P1,P2) = 0,0084
m_9 (P3) = 0,0057 + 0,0108 = 0,0165
m_9 (ɵ) = 0,0036

It is known from the calculation above that the highest density value of the five density values produced is m9 (P1) = 0.87. So the percentage of the possible value of Marasmus disease is 87%.

CONCLUSION

In accordance with the formulation of the problem made by the author, the resulting application can answer what is the problem in the research, namely, the application of the expert system can solve the diagnosis or problem arising from malnutrition in children made in the expert system using *the Dempster Shafer method*. This expert system can also be easily understood by both users and new users. The construction of this expert system is a tool to quickly find out malnutrition diseases in children and handle these diseases according to the treatment of what diseases are diagnosed by the system. The expert system for diagnosing malnutrition diseases in children that was created is still in the form of a simple program, which can still be developed again to achieve an accuracy of data. This expert system for diagnosing malnutrition diseases discusses 3 malnutrition diseases in children that often occur in patients and can still be developed by adding some diseases or symptoms experienced by patients.

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