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IMPLEMENTATION OF THE CERTAINTY FACTOR METHOD FOR EARLY DIAGNOSIS OF MALNUTRITION IN CHILDREN IN EXPERT SYSTEMS IN POHUWATO DISTRICT

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ABSTRACT

Poor nutritional intake in children (children under five) that is not immediately addressed can develop into malnutrition. Malnutrition is a disease that worries the community a lot, especially in Pohuwato district. In recent years, the government has tried to reduce the number of sufferers of malnutrition from year to year, but the cause is not only due to family economic factors but also due to lack of supervision of children due to the busyness of parents working as fishermen, farmers or laborers. In addition, the limited knowledge of the community, especially parents, in detecting early symptoms of malnutrition experienced by their children. The implementation of the Certainty Factor method can be used to build an expert system to diagnose malnutrition. The results of this study provide initial diagnostic results that describe the level of expert confidence with certainty values through the application of the certainty factor method that has passed through a series of system tests using black boxes with the results in the truth table. This shows that the overall observation of the system has results in accordance with the input. So that, this system is able to help the community in knowing the early symptoms of malnutrition in children.

Keyword: Malnutrition, Expert System, Certainty Factor, Diagnosis, Pohuwato District

1. INTRODUCTION

Document nutrition is a determining factor that affects the development of children under five. Children under five are vulnerable to nutritional and health disorders, the nutritional intake of children must be balanced so that malnutrition does not occur. [1]. Malnutrition is a disease that is quite disturbing to the community, especially in Pohuwato , so it needs special attention by the government. The number of cases of malnutrition in children made the Government immediately budget for this problem [2]. Nutritional problems need to be addressed immediately because they will have an impact on children's growth, productivity, morbidity, mortality and intellectual development. [3]. One of the factors that affect the nutritional status of children under five is the lack of parental knowledge about food intake. [4]. The efforts to screen for malnutrition early through weighing operations on all children are carried out routinely, children who are found to be experiencing symptoms of malnutrition based on the BB/TB index will be immediately validated and referred to a hospital or health center. [5]. Symptoms of malnutrition in children that are not treated immediately turn into malnutrition. The following health profile data in Pohuwato can be seen in table 1:

Table 1. Pohuwato District Health Profile Data [6]

No	INDIKATOR	ANAK BALITA (21-59 BULAN)					
		JUMLAH DILAPORKAN			MENDAPAT PELAYANAN		
		L	P	L+P	L	P	L+P
1	*2*	*3*	*4*	*5*	*6*	*7*	*8*
1	Cakupan Pelayanan Anak Balita	7,523	7,119	14,642	7,129	94,8	476
2	Jumlah balita ditimbang	8,066	7,645	15,711	5,371	4,949	10,320
3	Balita berat badan dibawah garis merah (BGM)				135	123	258
4	Jumlah bayi gizi buruk	30	27	57	30	27	57

Source: District/City Health Profile 2016

In recent years, the government has tried to reduce the number of sufferers of malnutrition from year to year, but the cause is not only due to family economic factors but also due to lack of supervision of children due to the busyness of parents working as fishermen, farmers or laborers. In addition, the limited knowledge of the community, especially parents, in detecting early symptoms of malnutrition experienced by their children. Therefore, it is necessary to design a system that will be easily accessible by the

community and also make it easier for them to consult the symptoms experienced by their children without having to go to the health center or hospital.

In general, research on malnutrition has been carried out by several researchers [8][9][10][11]. In this study, each researcher uses different methods, data, and symptoms, so the results of the research are also different. From several existing studies, the authors apply a different method from previous research, namely the Certainty factor method and the use of different data and symptoms according to the area and city conditions. The similarity with existing research is that they both carry out an initial diagnosis of Malnutrition in children. However, in this study, the authors apply a different method with the intention that this expert system can produce a better system and help the community according to the data and symptoms of malnutrition in Pohuwato.

An expert system is a system that can be applied to support problem solving activities. Several problem solving activities are mentioned, one of which is diagnosis [12]. An expert system is also a system that tries to translate the results of human knowledge into computer devices so that it can solve problems in the same way as experts do. [13]. This research usually addresses problems that tend to seek solutions for counselling and diagnostic outcomes.

To solve the problem and make it easier to diagnose malnutrition in children, we need an expert system that comes from the thoughts of an expert or expert which is applied to a computer application program with the Certainty Factor method which is designed using the PHP programming language and MySQL database. Certainty factor (CF) accommodates the inexact reasoning of an expert. An expert often performs an analysis of information with the phrase "most likely", "almost certain" to take into account the problem at hand [14]. The advantage of the certainty factor method is that this method is suitable in expert systems that contain uncertainty [15].

From this research, it is hoped that the results will be able to accommodate the uncertainty of an expert so that it can be used as a reference to describe the percentage of an expert belief in malnutrition as stated in percent.

2. LITERATURE RIVEW

2.1. Expert System

The expert system is an artificial intelligence development in the form of practical applications [16]. Expert System is one of the methods contained in artificial intelligence that is used to diagnose system errors as problem solving [17].

Another definition which explains that the Expert System is implemented to perform problem solving and make decisions with basic knowledge and rules applied by intelligent systems.

In another journal, it is stated that the Expert System includes a group of artificial intelligence that has special knowledge in solving existing problems. Another opinion which shows that the Expert System is the result of knowledge and search procedures [18]

2.2. Certainty Factor Method

The Certainty Factor (CF) method is chosen when facing a problem. Under certain conditions, the answers are often found that do not have full certainty. To accommodate this, Certainty Factor (CF) is used to describe the level of expert confidence in the problem at hand [19].

3. RESEARCH METHOD

3.1. Method

The method used in this research is descriptive method, which is a research method that aims to solve existing problem solving based on the data, analysing and explaining the data found. The method aims to solve the problem of facts, characteristics and relationships of phenomena studied systematically and factually. In the analysis stage, the author analyses the current system and the proposed system. The method used in this system is the Certainty Factor method which is designed using the PHP Programming Language, MySQL Database in it.

Where in the calculation of the Certainty Factor there are several antennae (in different rules) with the same consequence by calculating the overall CF value of each existing condition. In the concept of Certainty Factor, it is often known by the terms "belief" and "disbelief".

The "Net Belie method proposed by E.H. Shortliffe and B.G. Buchaman

$$CF(Rule) = MB(H,E) - MD(H,E) \quad (1)$$

$$MB(H,E) = \begin{cases} 1 & I \quad if\ P(H) = 1 \\ \dfrac{\min[P(H|E), P(H)] - P(H)}{\min[1,0] - P(H)} & \end{cases} \quad (2)$$

$$MB(H,E) = \begin{cases} 1 & I \quad if\ P(H) = 0 \\ \dfrac{\max[P(H|E), P(H)] - P(H)}{\max[1,0] - P(H)} & \end{cases} \quad (3)$$

Dimana:

CF Rule (H,E) = Certainty Factor
MB(H,E) = Measure of disbelief against hypothesis H, if given evidence E (between 0 and 1)
MD(H,E) = Measure of disbelief against hypothesis H, if given evidence E (between 0 and 1)
P(H) = Probability of the truth of the hypothesis H
P(H|E) = The event or fact that H is true because of the fact of E

A. Flow certainty factor method

There are several stages in determining the results of the certainty factor method;

1. Menentukan bobot dari tiap gekjala
    1. The Establishment of the rule base
    2. CF calculation process (rule)
    3. Calculating the CF value of each rule base
    4. Find the largest value of each rule base.

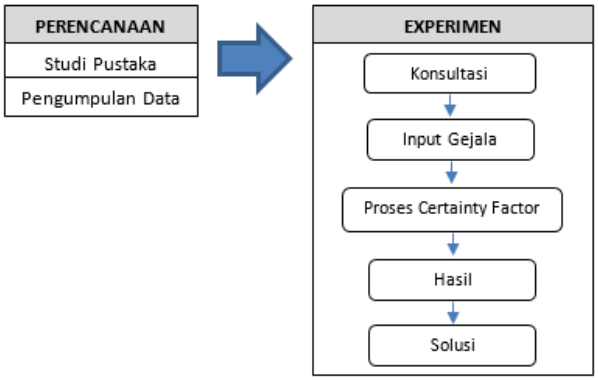
b. Need Analysis

1. The data requirements in this study are in the form of types of disease, symptoms, knowledge base, and treatment solutions. The data was taken directly from experts through direct interviews and asked for references to be used. The data that has been collected is then inputted into the system and then processed using the Certainty Factor method.

2. The functional requirements of the system needed in this study are to determine the results of disease diagnosis based on the results of consultations by inputting symptoms into the system and calculating the certainty factor value so that the certainty value is obtained, then proceed with testing and analysing the results.

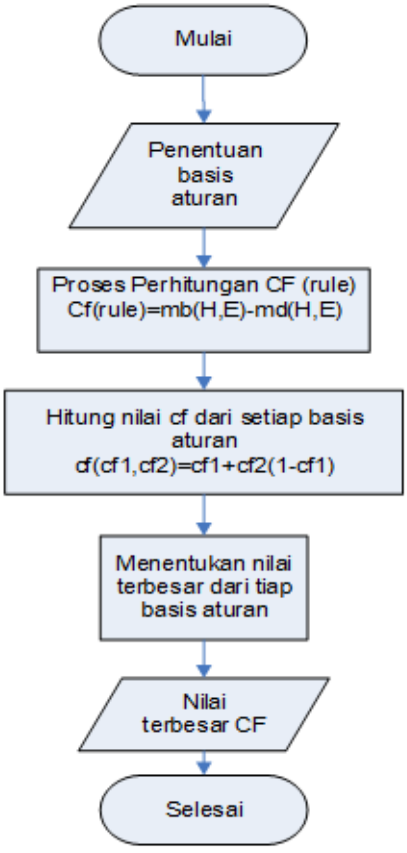
3. System requirements. In order for the system to be designed and run properly, we need a supporting application such as Dreamweaver for web development applications, MySQL for database processing and PHP for the programming language used.

3.2. Research Procedure



Picture 1. Research Procedure

3.3. Flowchart Metode certanty factor



Picture 2. Flowchart System

A. Data Collection

The process of collecting data in this study was carried out in Pohuwato District Health Office. The data collection process was carried out online

because the Covid-19 pandemic made it difficult for researchers to meet directly with doctors and obtain data directly from experts/sources. This change in research patterns is expected to be useful for many people.

B. Data Processing

The following is the result of data processing in the form of a general design:

a.Disease Data Table

The three types of disease include:

Table 2. Disease Data

Code	Disease
P001	Kwashiorkor
P002	Marasmus
P003	Marasmus-kwashiorkor

a. Symptom Data Table

The following types of symptoms are common in toddlers, including 15 symptoms:

Table 3. Disease Symptoms

Code	Symptoms
G001	Whole body looks fatter due to edema (swelling)
G002	If it is swollen, it will leave a mark in the hole
G003	Round and puffy face
G004	Extensive pink rash (crazy street skin disease)
G005	Decreased appetite
G006	Thin hair, reddish in color like the corn hair, easy to fall out
G007	Bloated stomach, swollen back of feet and hands
G008	Fussy and cry a lot
G009	The body is very thin and looks like a skull
G010	Protruding bones and chin
G011	Dry, wrinkled and saggy skin
G012	Can't move normally
G013	Low body temperature
G014	Face looks older
G015	There are infectious diseases (chronic diarrhea and tuberculosis)

Knowledge Base Table

P001 : G001,G002,G003,G004,G005,G006, G007, G008

P002 : G009,G010,G011,G012,G013,G014,G015

P003 : G001,G002,G003,G004,G005,G006,G007, G008, G009,G010,G011,G012,G013,G014,G015

a. System Operation

Main Menu Display



Picture 3. Main Menu

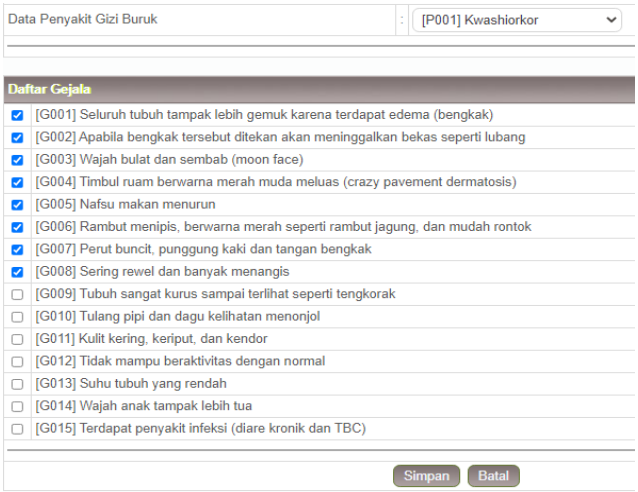
a. Display Types of Malnutrition Disease



Picture 4. List of Diseases

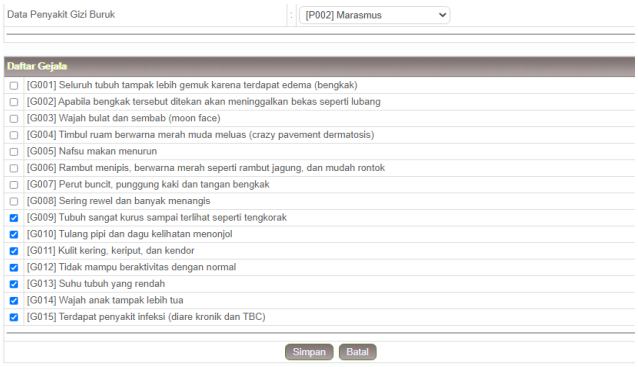
b. Knowledge Base display

The following is a list of symptoms of the disease P001 "Kwashiorkor"



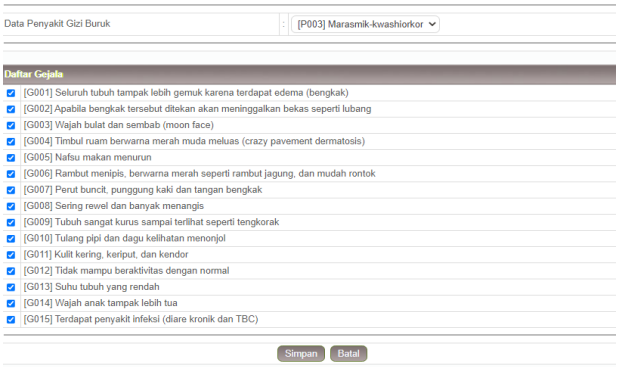
Picture 5. Knowledge Base P001

The following is a list of symptoms of the disease P002 "Marasmus"



Picture 6. Knowledge Base P002

The following is a list of the symptoms of the disease P003 "Marasmus-Kwashiorkor"



Picture 7. Knowledge base P003

b. Calculation Algorithm

Symptom selected: 'G001','G002','G006'

Disease Process : P001.Kwashiorkor

==========

Symptom ('G001','G002','G006')

number of symptoms = 3

process 1

---

mblama ‘= 0.8

mdlama ‘= 0.2

process’ 2

New mb’’ = 0.7

New Mb’ ‘= 0.2

mbsementara’’ = mblama + (mbbaru *(1 - mblama))’ = 0.8 + (0.7 * (1 - 0.8))’ = 0.94’

mdsementara’ ‘= mdlama + (mdbaru’ * (1 – ‘mdlama)) = 0.2 + (0.2 * (1 - 0.2))’ = ‘0.36

proses 3

---

mblama = mbsementara = 0.94

mdlama = mdsementara = 0.36

mbbaru ‘= 0.7

mdbaru’ = 0.3

mbsementara = mblama’ + (mbbaru * (1 - mblama)) = 0.94 + (0.7 * (1 - 0.94))’ = 0.982

mdsementara = mdlama ‘+ (mdbaru * (1 - mdlama)) = 0.36 + (0.3 * (1 - 0.36)) ‘= 0.552

mb = mbsementara = 0.982

md = mdsementara = 0.552

cf = mb - md = 0.982 - 0.552 = 0.43

Disease Process : P003.Marasmik-kwashiorkor

==========

Symptoms ('G001','G002','G006')

symptom number = 3

process 1

---

mblama’ = 0.8

mdlama ‘= 0.2

process 2

---

mbbaru ;= 0.7

mdbaru; = 0.2

mbsementara’ = mblama + (mbbaru * (1 - mblama))’ = 0.8 + (0.7 * (1 - 0.8)) = 0.94

mdsementara ‘= mdlama + (mdbaru * (1 - mdlama)) ‘= 0.2 + (0.2 * (1 - 0.2)) = 0.36

process 3

---

mblama = mbsementara = 0.94

mdlama = mdsementara = 0.36

mbbaru' = 0.6

mdbaru '= 0.3

mbsementara '= mblama + (mbbaru * (1 - mblama)) = 0.94 + (0.6 * (1 - 0.94))' = 0.976

mdsementara' = mdlama + (mdbaru * (1 - mdlama)) = 0.36 + (0.3 * (1 - 0.36)) '= 0.552

mb = mbsementara = 0.976

md = mdsementara = 0.552

cf = mb - md = 0.976 - 0.552 = 0.424

biggest disease = P001.Kwashiorkor

c. System Test

The following is a system test using the black box method

Table 4. Testing the Login Form

Input	Being expected	Observation	Result
User name and password are filled correctly	Will display the Main menu	Displays the main menu	Compatible
Empty/wrong username and password	A message will appear that the User or Password you entered is wrong!!	A message appears that the User or Password you entered is wrong!!	Compatible

Table 5. The Disease Data Input Test

Input	Being Expected	Observation	Result
Click "Add disease data"	A disease data filling form will appear and the disease id is filled automatically	The disease data filling form appears and the disease id is filled automatically	Compatible
Click "save button"	Disease data will be stored in the database	The save button works well and the disease data is saved	Compatible
Click "back button"	Cancel to save and return to disease data view	The data is not saved and returns to the disease data view	Compatible
Click "print and preview"	The data printing form will appear	The data printing form appears	Compatible
Click "show button"	The detailed disease data will appear	The detailed disease data appears	Compatible
Click "Change button"	The "change data" form will appear and the name of the disease to be changed will be filled in automatically	The "change data" form appears and the name of the disease to be changed is filled in automatically	Compatible
Click "Delete button"	A message will appear "are you sure you want to delete?"	A message appears "are you sure you want to delete?"	Compatible
Click the "OK" button on the "Are you sure you want to delete?"	The data will be deleted	The data is deleted	Compatible

The conclusion from the above test is that functionally, the system is in accordance with what was expected where there is no redundancy in the system and the above system is feasible to

use in diagnosing malnutrition in children in Pohuwato.

5. CONCLUSION

The conclusions can be drawn based on the results obtained:

1. The Certainty Factor method is suitable for use in expert systems to diagnose early malnutrition in children under five, because it gives the results in the form of the greatest safety factor.

2. The Expert System diagnoses malnutrition early in toddlers through the application of the Certainty Factor method. The method has passed through system testing using a black box with the results in the truth table so that it can help parents in early diagnosis of malnutrition in toddlers.

For the further research purposes, it is necessary to insert the types of diseases that occur in most patients with malnutrition, because in this study, researchers only included diseases that often occur in Pohuwato. For the maximum results, it is recommended to be accompanied by 2 experts.

6. ACKNOWLEDGEMENT

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