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Expert System for Stunting Diagnosis in Children Using Certainty Factor Method

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A B S T R A C T

The development of information technology has affected many aspects of life, including health and education. In Puskesmas Kotaraja, Jayapura, Indonesia, the diagnosis of stunting disease has become a major focus. With the rise in stunting cases following the COVID-19 pandemic, efficient solutions are needed. Specialized systems with certainty factor methods offer accurate and efficient alternatives. This research builds a specialist system to detect stunts in children based on their experience and beliefs. Through previous system testing and problem analysis, this method has proven to be effective in providing accurate diagnostic solutions with a 98.74 degree of confidence. It is expected that this system will help improve the quality of health care in the puskesmas and reduce the cost of patient consultation.

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INTRODUCTION

The development of technology and information in the last few decades has been very rapid, especially since the introduction of the Internet and personal computers in the 1980s. (Fricticarani et al., 2023). Technological developments have made significant changes in various fields, such as communication, transport, health, entertainment, and education. In the field of health, the use of fast, accurate, and targeted technology is very necessary, especially in diagnosing a disease. Such development can help create technology that is capable of processing and thinking like humans. Artificial intelligence technology is divided into several fields of science, one of which is a system of experts. Implementation of the system of specialists in the area of health can involve the diagnosis of disease, the provision of advice, and the determination of solutions based on existing diagnostic results.(Sagit Sahay et al., 2021). In connection with the existing development, Puskesmas Kotaraja is one of the government agencies that carry out the development of the system to deal with the needs of existing services.

Puskesmas Kotaraja is a puskesma located in Kotarajas, Jayapura, Papua, Indonesia. Puskesmas service hours start from 07:30 to 14:30. This Puskesmas serves the communities in the Wahno Kelurahan region and its surroundings. One of the services provided by Puskesmas Kotaraja is the diagnosis of diseases. One of the diseases that exists in Puskesmas Kotaraja is stunting or other malnutrition. Puskesmas Kotaraja serves about 50 to 65 patients a day for six working days. Stunting can be caused by various factors, such as poor nutrition or lack of nutritional and nutritional intake from the first 1,000 days of life (HPK), recurrent infections, lack of psychosocial stimulation, premature birth, low birth weight (BBLR), environmental factors such as a mother's nutritional status, feeding patterns to children, environmental hygiene, and infection incidence rates in children, as well as genetic and hormonal factors. The diagnosis of stunting in Kotaraja puskesma is usually done by a doctor by asking about the symptoms the patient is experiencing. According to the results of research carried out at Puskesmas Kotaraja, the number of stunting patients found in a week ranges from 1 to 10 patients. The general public's ignorance of Stunting's suffering makes it necessary to charge a doctor's consultation fee. With the large number of patients who have to go to the hospital in advance and the limited working hours of the medical staff, this is one of the obstacles. Therefore, more efficient diagnostic methods are needed and can be done at a lower cost. In the last two years after COVID-19, stunting has seen a dramatic rise in the range of 10.5% by 2022 and 12.8% by 2023 from 10.5%.

An expert system is a system based on the knowledge of an expert in various fields that is applied to a system with the aim of facilitating and assisting the public in solving a problem of a knowledge nature and as a good consultation tool.(Ulan Bani & Nugroho, 2020). An expert system in the face of a problem often finds answers that do not have full certainty. This uncertainty can be a probability that depends on the outcome of an event. Then it requires a proper method to accommodate the uncertainty. Certainty Factor (CF) is a method that defines the belief in a fact or rule based on the degree of belief of

an expert. Certain factors can express a belief in an event (fact or hypothesis) based on evidence or expert judgment.(Rahman Fahindra & Husni Al Amin, 2021). Certainty Factor is performed by calculating the overlap value between the user CF with the expert CF value and yielding the combination CF value (Supriyadi et al., 2022).

Stunting diagnostic systems in children using certainty factor methods can be a good alternative to assisting patients in diagnosing stunting. The reason for using this method is because it can give accurate results obtained from calculations based on the weight of symptoms chosen by the user, able to give answers to uncertain problems of truth such as disease diagnosis problems, and with this method, the specialist describes the belief of a specialist by giving a weight of belief according to the knowledge of the expert. Hopefully, this system can help patients diagnose stunting accurately and efficiently. In the construction of this system, research was carried out using waterfall methods, use case design, hypertext preprocessor (PHP) programming languages, MySQL databases, blackbox testing, and manual testing.

LITERATURE REVIEW

There have been some previous studies related to the topic of this research; firstly, the application of naïve Bayes methods to diagnose stunting diseases. This study aims to help the public detect and provide first-aid if youngsters are exposed to stunting. results that match the design, and the system can run well. With this research expected to advance, the concept of an expert system can increase efficiency in the detection of diseases. From the point of view, this research is using the naïve bayes method, while the research is going to be done using the certainty factor method. (Maulana et al., 2022) Both applications of the stunting diagnosis system in children with the forward chaining method aim at producing the diagnosis process of stunting disease and other malnutrition in humans. From the expert system that has been created, this results in the diagnostic process. This expert system has preventive action or can know the early symptoms that occur. Additional data is needed for other types of malnutrition with clinical symptoms. Previous research and research to be done have the same purpose, and Case Namum has different methods.(Putra et al., 2022).

Three Methods of Case-Based Reasoning in the Diagnosis of Stunting Disease in Balita: This study aims to help the general public diagnose stunting disease accurately and quickly. With the presence of an application of the System of Experts Diagnosing Stuinting Disease at Balita using case-based reasoning in UPT Puskesmas Belawan, a person who feels the symptoms of the disease can make sure the disease experienced is stunting. With this research expected to advance, the concept of an expert system can increase efficiency in the detection of diseases and needs to be done with the addition of data for other malnutrition diseases. Previous research used case-based reasoning, which will be conducted using the certainty factor. (Suherman & Tahel, 2023). The Four System Specialists Diagnose Osteochondroma Disease with Certainty Factor Method This research aims to help the poliklinics in dealing with the

disease. The main conclusion that can be drawn from this research is that system specialists Diagnoses osteocondrome disease by the method of certain factors; this can be applied to a web-based system of specialists so that it can help the general public in early prevention and overcome osteochondromas. With this research expected to advance, the concept of an expert system can increase efficiency in the detection of diseases. Previous research took the case of osteochondroma; the research to be done took the case of stunting. (Hutasuhut et al., 2022)

Five Systems of Experts Diagnosing Cholesterol Disease in Adolescents Using the certainty factor method, the Experts System was created for the purpose of sharing and exchanging information about knowledge, in particular in terms of diagnosing cholesterol using the certainty factor method. The results of this study can diagnose cholesterol after seeing the results of weight calculation and all the symptoms put together, calculated using the certainty factor method and using the more rapid and accurate certainting factor method. Based on the analysis of the problems that occurred with the case discussed about detecting cholesterol disease in adolescents by applying the method of certitude factor detection of cholesterol diseases done with research and interviews with Dr. Gonas Simanjuntak, SpPD on the data of symptoms and diseases cholesterol based on the knowledge of experts, then the data on symptom and disease in the entry into the specialized system by selecting only the data symptoms. Then you'll be able to diagnose the type of cholesterol disease you're suffering from. To maximize results in the diagnosis process, the certainty factor method is applied. With this research expected to advance, the concept of an expert system can increase efficiency in the detection of diseases. Previous research took cases of cholesterol disease in adolescents; research that will take cases of stunting (Marbun et al., 2022)

The Six System of Experts Diagnosing Diseases of Cocoa Plants Using the certainty factor method, this study aims to help farmers diagnose diseases in cocoa crops. By entering or selecting the type of disease that exists, farmers can already know what the disease of the cocoa plant is. With this research expected to advance, the concept of an expert system can increase efficiency in the detection of diseases. Previous research took cases of the disease of the cocoa plant; the research that will take cases of stunting (Meniati et al., 2022)

METHODOLOGY

The phase of this study consists of several main parts, which are as follows: The first step is the identification of problems, which is carried out to find out the problems that will be solved in this study. The second step is needs analysis, performed to gather data through interviews and data collection. In the third step, implementation of CF is done to determine manual calculations and follow the rules of the method Certainty Factor. Fourth step: building a system with databases and PHP. Fifth step Testing is done manually, and blackbox. The last step is journal publication. Further clarification can be seen in Figure 1. The research phase covers a number of steps..

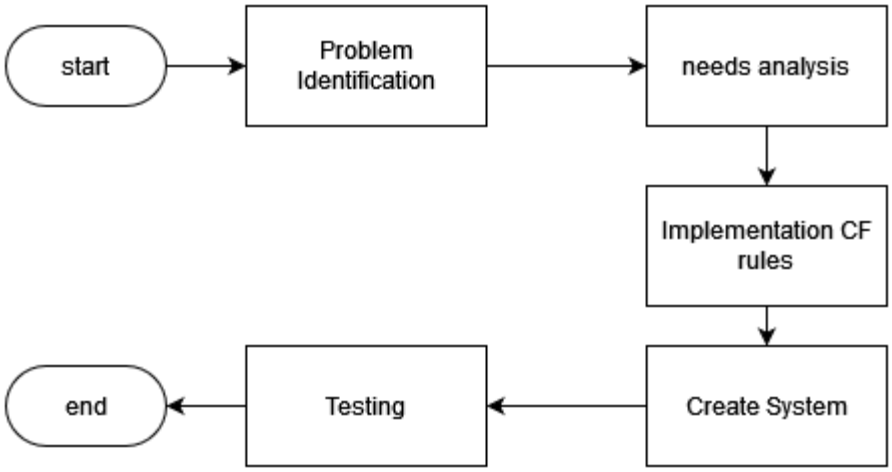

Figure 1. Research Flow

RESEARCH RESULT

A. Certainty Factor Method Abrasion

Based on the knowledge acquired in existing research, the symptoms and diseases present in the specialist system that will be made are as follows:

Table 1. Code of Disease

No	Codes Of Disease	Remarks
1	P001	Stunting
2	P002	Marasmus
3	P003	Kwasiorkor

Table 2. Symptom Code

No	Symptom Code	Remarks
1	G001	Experiencing growth retardation problems
2	G002	Difficult to gain weight and height
3	G003	Having a younger face than his age.
4	G004	Have poor concentration and memory.
5	G005	They tend to be more quiet and not to have eye contact with the people around them.
6	G006	It's a lighter weight for a child of his age.

No	Symptom Code	Remarks
7	G007	The growth phase of teeth in children is slowing down
8	G008	Children are vulnerable to various diseases.
9	G009	Inhibited bone growth
10	G010	Dry skin and hair
11	G011	Loss of fat and muscle mass
12	G012	Chronic diarrhea
13	G013	Easy to be angry
14	G014	Hairdryer and easy to date
15	G015	Decreased cognitive development
16	G016	It's a barrier to psychic growth, to intelligence.
17	G017	Headache
18	G018	Always hungry
19	G019	The body appears to be getting slender.
20	G020	The face looks old.
21	G021	Weight decreases
22	G022	Easy to cry
23	G023	Acute fatigue
24	G024	The muscles are weakened.
25	G025	Skin looks wrinkles
26	G026	Swelling of the thighs, legs, hands, and face
27	G027	Spots and scratches on the skin
28	G028	The stomach's getting bloated.
29	G029	Fingerprints stabbing on the skin when touched

Table 3. Expert Weight Value

Symptom Code	Disease		
	P01	P02	P03
G001	0.6	0.2	0.2
G002	0.4	0.4	0.4
G003	0.2	0	0
G004	1.0	0.2	0.2
G005	0.2	0.2	0.2
G006	1.0	0.2	0.2
G007	1.0	0.2	0.2
G008	0.6	0.6	0.6
G009	0.6	0	0
G010	0.2	0.2	0.2
G011	0.2	0.2	0.2
G012	0	0.4	0.2
G013	0	0.4	0.4
G014	0	0.4	0.6
G015	0.2	0.2	0.2
G016	0.2	0.2	0.2
G017	0	0.6	0.6
G018	0.4	0.4	0.4
G019	0.2	0.2	0.2
G020	0.4	0.4	0.2
G021	0.2	0.2	0.2
G022	0.2	0.2	0.2
G023	0.2	0.2	0.2
G024	0.2	0.2	0.2

Symptom Code	Disease		
	P01	**P02**	**P03**
G025	0.2	0.2	0.2
G026	0	0.2	1.0
G027	0.4	0.2	0.2
G028	0.4	0.4	0.8
G029	0.4	0.4	0.2

Table 4. Interpretation values Measure of Disbelief (MD)

Trust	Measure of Disbelief (MD)
- No. / I don't know.	0
Maybe.	0,4
Big probability.	0,6
Almost for sure.	0,8
Sure.	1,0

Calculation using the certainty factor method begins with CF being weighed on each symptom by the specialist. The patient then chooses the symptoms that match his condition. The next calculation is based on the user's response. Here's a preliminary calculation of stunting detection manually using a certainty factor based on symptoms selected by the patient..

Symptom code	CF Expert	CF *User*	CF(H,E)
G01	1	0.8	0.8
G02	0.8	0.6	0.48
G03	0.6	0.4	0.24
G04	0.8	0.6	0.48
G08	0.8	0.6	0.48
G028	0.6	0.4	0.24
G029	0	1	0

$CF combine_{1,2}$ = 0.8+0.48*(1-0.8)
=0,896
$Cfcombine_{old,3}$ =0,896+0,24*(1-0,896)
=0,92096

$Cfcombine_{old,4}$ =0,92096 + 0,48*(1-0,92096)
=0,9589
$Cfcombine_{old,8}$ =0,9589+0,48*(1-0,9589)
=0,97863
$Cfcombine_{old,28}$ =0,97863+0,24*(1-0,97863)
=0,98376

The percentage degree of certainty of the calculation of symptoms is obtained as follows:

$Cfpercentage = Cfcombine_{old} \times 100\%$
= 0,98376 * 100%
= 98,374

Based on the results of the manual calculation obtained a 98.38% degree of certainty presentation, this suggests that based on the symptoms seen and experienced by the patient, it is almost certain that the patient has a stunting, and the results are comparable to the calculations using the expert system.

B. Expert System Use Case Design

The design method used is the use case diagram, a technique used to describe the interaction between actors and systems in achieving a goal. The overall interaction of acts and activities in the system is described in the use case diagram in figure 2.

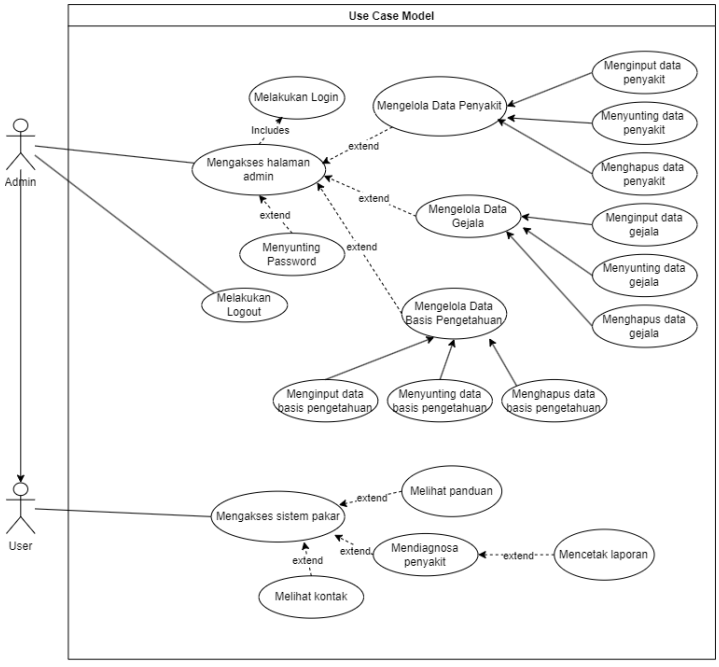

Figure 2. Use case Diagram

Use cases are used to capture the functional needs of the system as well as identify, explain, and regulate all possible occurrences. Use cases can be represented in a simple sequence of steps by having two actors namely admin and user.

C. Design Interface

The expert system is designed using the PHP programming language and the MySQL database. The specialist system is web-based and can be accessed by at least two main actors, the admin and the user. On the expert system, there are several main modules, including the home menu, disease data, symptom data, and knowledge base module.

Figure 3. Home Menu

The home menu is an initial view after the application is accessed through the login page first, and then the user or administrator can access the disease data module, symptoms, knowledge base, and other menus.

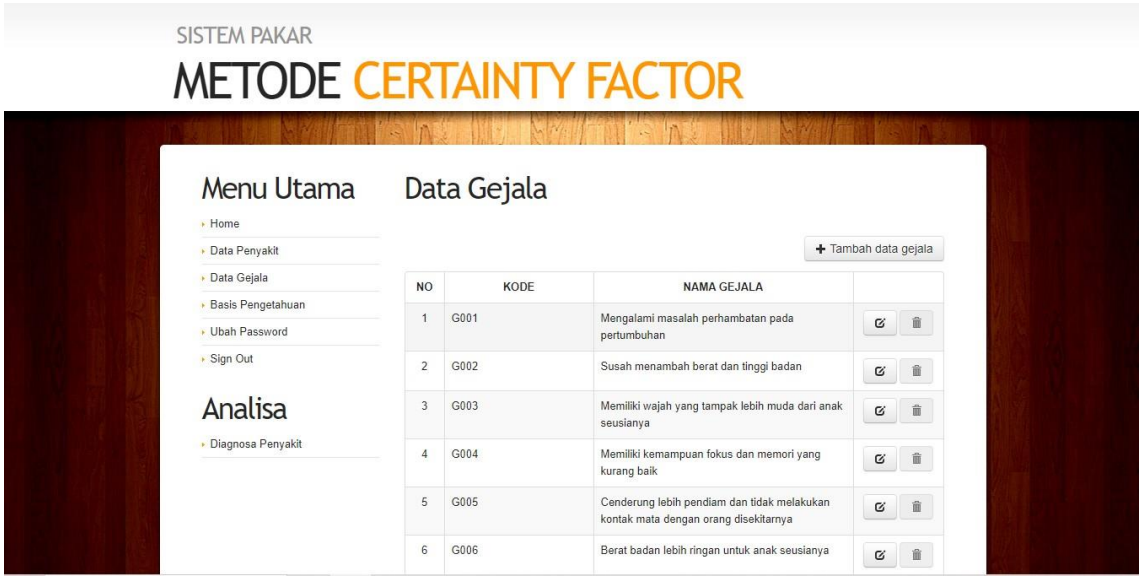

Figure 4. Symptom Form

In this module, the user can choose the same symptoms or those experienced by the patient. Next on Figure 5 is a form of knowledge base.

Figure 5. Knowledge Base Form

The knowledge base form is a form that contains the names of symptoms as well as the MB and MD values, further on the figure 6 is the result of analysis of the expert system.

Figure 6. Results of analysis

DISCUSSION

The development of technology and information in the last few decades has seen tremendous progress, especially since the invention of the Internet and personal computers in the 1980s. These advances have had a significant impact in various fields, including communication, transport, health, entertainment, and education. In healthcare, technology plays an important role in diagnosing diseases quickly, accurately, and precisely. One of the fastest-growing technologies is artificial intelligence, which covers a wide range of fields, such as expert systems. Implementation of specialist systems in the field of health, such as disease diagnosis, provides the possibility of providing advice and solutions based on diagnosis results. Puskesmas Kotaraja, for example, is one of the government agencies that seeks to develop a system to improve health care. In this case, the diagnosis of a disease like stunting is a major concern. Stunting itself can be caused by a variety of factors, and the diagnosis is often made by doctors based on the symptoms the patient experiences. However, obstacles such as patient confinement and medical staff working time constraints become a matter of their own. Therefore, the development of more efficient diagnostic methods at affordable costs becomes important. One of the emerging approaches is the use of specialized systems with the certainty factor method. The certainty factor method has an advantage in managing uncertainty in the diagnosis of disease. By combining expert beliefs and user information, this method can provide accurate diagnosis results. Hopefully, using this method can help patients diagnose stunts more efficiently. In developing an expert system for stunting diagnosis, previous research provided a variety of insights into the methods that could be used. For example, previous research has used Naïve Bayes methods, forward chaining, and case-based reasoning to diagnose diseases. The conclusions of these studies provide a basis for the development of a specialized system with the certainty factor method. In addition, other studies also show the application of the certainty factor method in the diagnosis of diseases, such as in the case of osteochondromas, cholesterol in adolescents, and diseases in cocoa plants. It shows the flexibility of the certainty factor method in a variety of disease diagnosis contexts. In the development of expert systems for stunting diagnosis, the waterfall approach is used using use cases for design as well as PHP programming languages and MySQL databases for implementation. Testing is done using the blackbox and manual testing methods to ensure system quality. Overall, the development of specialized systems with certain factor methods in stunting diagnosis is expected to provide efficient and accurate solutions for patients, as well as improve the efficiency of health care in Puskesmas Kotarya and similar institutions.

CONCLUSIONS AND RECOMMENDATIONS

From the results of the system tests and manual calculations, information about the level of confidence based on the selected symptoms is obtained, and the certainty factor method is thought to be able to provide answers to the above problem case. Therefore, it can be concluded that the research has successfully built an expert system to detect early stunts using the certainty factor method, with an accuracy rate of 98.74%. To further improve the

accuracy of researchers in the same field of science, they can combine the certainty factor method with the forward chaining method or with the equivalent method.

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