

Expert System for Diagnosing Cerebral Palsy in Children with the Case Based Reasoning Method

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Abstract

The rampant influence of technology certainly has positive and negative impacts on the increasingly complex development of health sciences and diseases. Technology in the field of computerization has been widely used in various lines of life. Technology is very helpful in various aspects of life, with the existence of technology humans can create various tools to facilitate human work. Cerebral Palsy is a disease or disorder that often occurs in today's development. Cerebral Palsy is not a fatal disease but a condition that affects the body, its treatment and treatment can help regulate its effects on the body. An expert system is a system that adopts human knowledge to a computer that combines basic knowledge with an inference system to replace the function of an expert in solving a problem. advances in expert systems can overcome this problem by designing a Desktop-based computer system that uses the Java programming language and MySQL database so that it can help users to diagnose disease. Various methods can be used to build expert systems, one of which is the Case Based Reasoning method. Where the process of calculating Case Based Reasoning compares new cases with old cases and divides them into four stages, namely retrieve, reuse, revise and retain, to get the results of the type of disease suffered by the patient in the form of a percentage. In this expert system, the system will ask questions like a patient is having a dialogue with an expert. Then, select yes for symptoms that are felt and no for symptoms that are not felt. The system will make a diagnosis based on the patient's symptoms. Diagnostic results include the type of Cerebral Palsy experienced and treatment options as well as the percentage of patients likely to suffer from the disease.

Keywords: Cerebral Palsy, Expert System, Case Based Reasoning, Cases, Diagnosis.

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1. Introduction

The rampant influence of technology certainly has positive and negative impacts on the increasingly complex development of health sciences and diseases. Technology in the field of computerization has been widely used in various lines of life. Technology is very helpful in various aspects of life, with the existence of technology humans can create various tools to facilitate human work.

Cerebral Palsy is one of the main causes of activity limitations in children [1] . Where children have high myosin muscle fibers compared to normal children. Myosin is a muscle fiber protein that functions to regulate elasticity and contractility in muscles [2] . *Cerebral palsy* is not a life-threatening disease, but a condition that affects the body, due to damage to the brain that cannot be cured or in other words is permanent, but treatment and therapy can help manage the impact on the body [3] .

An expert system is a system that adopts human knowledge to a computer that combines basic knowledge (*knowledge based*) with an inference system to replace the function of an expert in solving a problem [4] . An expert system (Expert System) is a knowledge-based program that provides expert quality

solutions to problems in a specific domain. An expert system is a computer program that mimics the thought process and expert knowledge in solving a particular problem [5].

An expert system is a part of artificial intelligence that contains knowledge and experience that is entered by one or many experts into a particular area of knowledge, so that everyone can use it to solve specific problems [6].

Various methods can be used to build expert systems, one of which is using the *Case Based Reasoning* (*CBR*) method . The *Case- Based Reasoning* method is a weighting technique that compares new cases with old cases and divides them into four stages, namely *retrieve* , *reuse* , *revise* and retain, to get results for the type of *disease* . the patient's heart in percentage form [7] .

In this study, the CBR expert system method or also called case-based reasoning was used. Case-based reasoning is case-based logic for the purpose of solving new problems by adapting solutions that are similar to new cases as well as to previous cases. Expert system research using the CBR method includes: identification of rice plant diseases [8], failure diagnostic systems in freshwater consumption fish farming [9]. This method performs a match of new

cases with existing cases in the case storage database, and finds one or more cases that are similar to case-based reasoning. Case-based reasoning aims to solve new problems by adapting solutions. The previous case and the new case are similar. The new case matches an existing case in the case library, and one or more similar cases are found [10]. There are four steps in the CBR method, namely: Retrieve, Reuse, Retain, Revise [11]. Application of an expert system with the CBR method to select the type of learning for children with mental retardation. Mental retardation or intellectual disability is a deficiency in intellectual conditions characterized by below average intelligence or intelligence. People with intellectual disabilities learn new skills, but the pace of learning is slow [12].

Using an expert system is expected to speed up diagnosing a type of cerebral palsy, so that the type of disease can be easily identified. From the description above, the researcher is interested in developing an application "Expert System for Diagnosing Cerebral Palsy in Children Using the Case Based Reasoning Method Using the Java Programming Language and MySQL Database" as a solution to overcome the problems experienced by the UPTD.

2. Research methodology

The research framework is a concept or stage that will be carried out in a study. So that the steps to be carried out in this design do not get out of the main subject of the discussion and are easier to understand, the sequence of research steps will be made systematically so that they can be used as clear and easy guidelines for solving the problems that will be encountered. The research framework carried out in the research process will be described in Figure 1 below :

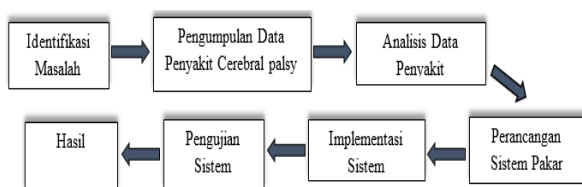


Figure 1. Research Framework

Based on the research stages in Figure 1, each stage can be explained in detail as follows:

1. Field Research (*Field Research*)

Data collection in this field research was carried out by conducting interviews with experts at the UPTD for Disability Services and Inclusive Education, to analyze problems, and obtain the information needed. Carry out direct observation activities at research locations, such as data collection, observation of research objects, and others.

2. Data Collection

Data collection was carried out by observing or going directly to the field by observing ongoing activities at the UPTD for Disability Services and Inclusive Education and followed by interviews with experts so as to obtain data from the agency. Literature study by reading and studying books, journals, and writings related to this research.

Research time

The research was conducted in early March 2022 to collect the data needed at the UPTD for Disability Services and Inclusive Education in the city of Padang.

Research Place

This research was conducted at the UPTD Services for Disabilities and Inclusive Education located on Jl. Jambak Village, Gunung Sariak, Kec. Kuranji, Padang City, West Sumatra

3. Disease Data Analysis

In conducting research, researchers analyze the data that has been collected and analyze the system that will be implemented as a solution to the formulation of the problems that have been obtained. In carrying out the analysis process there are several stages of analysis that must be carried out. These stages are:

Data analysis

After valid data is collected, the next step is to analyze the data. Data analysis is an attempt to understand and process the data that has been collected so that a useful conclusion is obtained in accordance with the objectives of the research .

Process Analysis

Process analysis is the process by which researchers will design an expert system for diagnosing cerebral palsy in children using the case based reasoning method. Where the system is expected to be the right solution to solve problems that occur in the UPTD for Disability Services and Inclusive Education.

System analysis

System analysis is the basis for planning and designing the system to be implemented. System analysis is carried out to find out and obtain information about problems in the system. This system requires some data for later processing and data testing

4. System Design

At the design stage, researchers used UML (Unified Modelling Language) diagrams. However, not all diagrams provided by UML are used in designing this system. Only a few UML diagrams are used, namely

Use Case Diagrams, Activity Diagrams, Class Diagrams, Sequence Diagrams.

5. Implementasi

System implementation is the final stage that the system is ready to operate in actual conditions, so that it will be known that the system created can actually produce the goals desired by the researcher. Before the application is implemented and implemented, the program must be error free in order to ensure that the system can actually run properly. Program errors that may occur include: language writing errors, errors during processing or errors in logic. After the application is free from errors, the application is tested by entering data for the process .

6. Testing

Testing is a stage of research carried out to practice directly the results of the analysis which aims to test the correctness of the system designed by focusing on functionality and data mining applications which include functional errors, interfaces and databases.

Application Testing

1. Applications that have been made are tested by the designer first.
2. The application is used individually by the user / users .
3. The application is used through the Java programming language and MySQL database

Interface Testing

1. First run against the login screen
2. After running the program contains the home page and other attributes.

3. Results and Discussion

3.1 System analysis

System analysis is carried out after carrying out the system investigation stage and before the system design stage. System analysis is the basis for planning and designing the system to be implemented. Basically, there are two parts to the activities carried out at this stage, namely the survey stage of data collection and structured analysis which broadly aims to gain an understanding of the problems, efficiency and considerations that lead to system development. System analysis and system design are interrelated and very important. Therefore this stage must be carried out carefully and thoroughly in order to produce a system that fits the needs and can make it easier for those who use the system.

3.2 Case Based Reasoning Calculation Analysis

Case based reasoning (CBR) is a case based reasoning system that uses experience or previous cases so that it can solve new problems or cases. In looking for cases that have similarities with new cases, that is, each old case will be equated with a new case based on the symptoms experienced. The following similarity search techniques are used:

$$\begin{aligned}
 & \text{Similarity}(\text{problem}, \text{case}) \\
 &= \frac{S_1 * W_1 + S_2 * W_2 + \dots + S_n * W_n}{W_1 + W_2 + \dots + W_n}
 \end{aligned}$$

Where S similarity is the value of similarity, namely 1 (same) and 0 (different), and W weight is the weight given.

Weighting is determined based on learning outcomes or observations in cases. The more influential a symptom is on the case, the higher the weight and vice versa [13]. The following is Table 1.

Symptom Level	Weights/Parameters
Dominant	5
Moderate	3
Common	1

With the determination of weights like the table above, it will be easier to determine the disease suffered by the child based on the weight of the symptoms experienced by the child. Based on the weight, the system can also determine how many % (percent) of possible disease the patient is suffering from based on the total weight of each symptom he experiences. The formula for finding percent is:

$$P \text{ jumlah} = \frac{\text{jumlah nilai Similarity}}{\text{jumlah nilai total bobot}} \times 100\%$$

Where the sum of the similarity values = the sum of the accurate values (similarity is the same, namely point 1) and the sum of the total weight values = the sum of the total weight values (the weight of each symptom).

No	Symptom	Symptom Name	Weight
1.	G01	Stiff and tense muscles (hypertonia) on one or both sides of the body	5
2.	G02	Excessive movement	5
3.	G03	Restrictions in movement (Limited mobility)	5
4.	G04	Abnormal gait	5
5.	G05	Crossed knees	5
6.	G06	The joint is not fully extended	5
7.	G07	Walk on tiptoe	5
8.	G08	Muscles or joints experience stiffness in their flexibility and are unable to stretch	5
9.	G09	Abnormal reflexes	5
10.	G10	Involuntary movement	5
11.	G11	Tremor and unsteadiness	5
12.	G12	Bad posture	5
13.	G13	Unsteady movements like a drunk when walking	5
14.	G14	Rotate and repeat the same motion	5
15.	G15	Slow, writhing movements	5
16.	G16	Sudden movements or seizures	5
17.	G17	Grimacing or drooling	5
18.	G18	Improper motor skills	5
19.	G19	Difficulty walking and maintaining balance	5
20.	G20	Problems with perception when picking up an object	5
21.	G21	Cognitive impairment or impairment in thinking and	5
22.	G22	Difficulty holding back urination or wetting the bed	3
23.	G23	Unresponsive to touch or pain	3
24.	G24	Often looks tired	1
25.	G25	Uncontrolled emotional disturbances	3

No	CP code	CP type
1.	S01	Spastic cerebral palsy
2.	S02	Athetoid cerebral palsy
3.	S03	Ataxia cerebral palsy

Disease Rule Process

IF Stiff and tense muscles (*hypertonia*) on one or both sides of the body) (G01) *AND* Excessive movement (G02) *AND* Limited mobility (G03) *AND* Abnormal gait (G04) *AND* Crossed knee (G05) *AND* The joint does not fully extend (G06) *AND* Walks on

tiptoe (G07) *AND* The muscle or joint experiences stiffness in its flexibility and cannot stretch (Contract) (G08) *AND* Abnormal reflexes (G09) *THEN Spastic cerebral palsy* (S01)

IF Involuntary movement (G10) *AND* Tremor and unsteadiness (G11) *AND* Poor posture (G12) *AND* Unsteady, drunken movements while walking (G13) *AND* Twisting and repeating the same motion (G14) *AND* Slow, writhing movements (G15) *AND* Sudden movements or seizures (G16) *AND* Grimacing or drooling (G17) *AND* Cognitive impairment or impaired thinking and learning (G21) *AND* Difficulty holding back urination or bedwetting (G22) *AND* Poor response to touch or pain (G23) *THEN Athetoid cerebral palsy* (S02)

IF Improper motor skills (G18) *AND* Difficulty walking and balance (G19) *AND* Problems with perception when picking up an object (G20) *AND* Often looks tired (G24) *AND* Uncontrollable emotional disturbance (G25) *AND* Tremor and unsteadiness (G11) *THEN Ataxia cerebral palsy* (S03)

Manual Calculation Testing

Application testing with manual calculations to get accurate weight values in the case examples below: Symptoms selected by the user: G01, G02, G03, G04, G05, G08, G13, G14, G23

1. *Rule* calculation (R01): G01, G02, G03, G04, G05, G06, G07, G08, G09

$$\text{Similarity (R01)} = \frac{5+5+5+5+5+0+0+5+0}{45} = 0.67 = 67\%$$

2. *Rule* Calculation (R02): G10, G11, G12, G13, G14, G15, G16, G17, G21, G22, G23

$$\text{Similarity (R02)} = \frac{0+0+5+5+0+0+0+0+0+3+3}{51} = 0.31 = 31\%$$

3. Calculation *Rules* (R03) : G11, G18, G19, G20, G21, G24, G25

$$\text{Similarity (R03)} = \frac{0+0+0+0+0+0+0+0+0+0}{29} = 0$$

From the calculation above, it can be concluded that the new cases have the highest similarity value of 0.67 or 67%, namely in R01, it can be concluded that the new cases are symptoms of *cerebral palsy spastic disease* .

3.3 System Testing

Testing of the system is carried out to determine the extent to which the designed system can overcome problems, as well as to determine the relationship between system components. This stage is testing the appearance of the system whether it is running well and as expected

1. Page an Login

The login page is the form used by the admin to enter the application system as shown in Figure 2 . following.

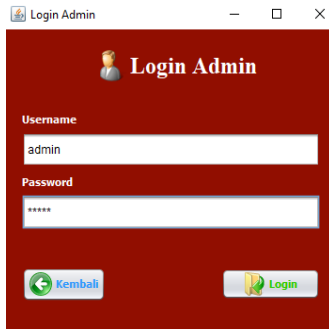


Figure 2 . Admin Login Page

2. Admin home page

The Home admin display will appear after users who use login access as Admi, this view provides menus for inputting data by the admin on the system as shown in Figure 3 . following .

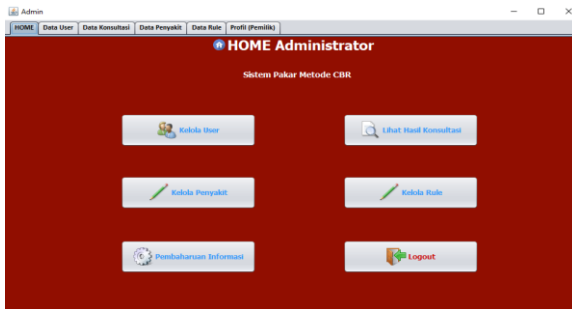


Figure 3 . Admin home page

3. User Data page

The user data page is for inputting, editing, deleting, viewing and refreshing (Refresh) as well as printing user data that has been added by the admin himself. As in Figure 4 . following.

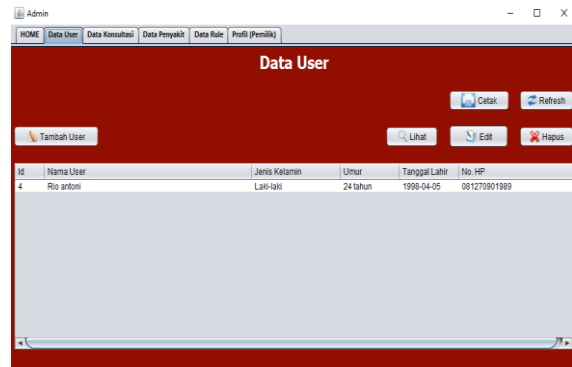


Figure 4 . User Data page

4. Consultation Data Page

The page display on consulting data is to view and print data on the results of consultations carried out by users on the system. As in Figure 5 . following.

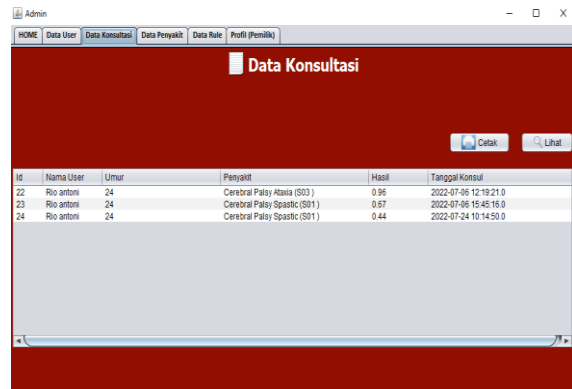


Figure 5 . Consultation Data Page

5. Disease and Symptom Data Page

The display of the disease data page is to display disease data and symptom data can be seen. As in Figure 6 . following.

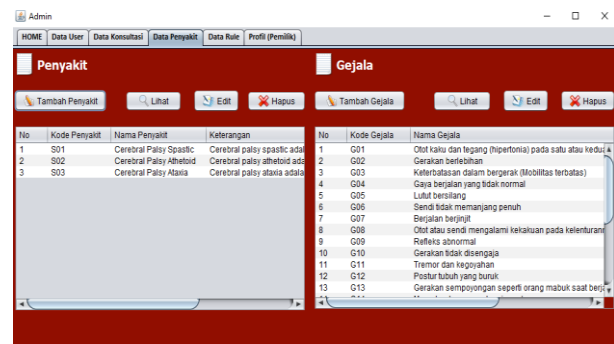


Figure 6 . Disease and Symptom Data Page

6. Data Rules page

On the display of this page the admin can see rule data from diseases that have been entered into the system as shown in Figure 7 . following.

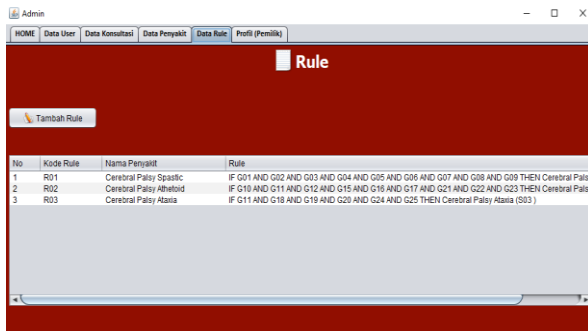


Figure 7 . Data Rules page

7. User Disease Information Page

The disease information page display is a page that contains any abnormalities diagnosed by the system, symptoms, a little information about the disorder, and solutions for the disorder itself. As shown in Figure 8 . following.

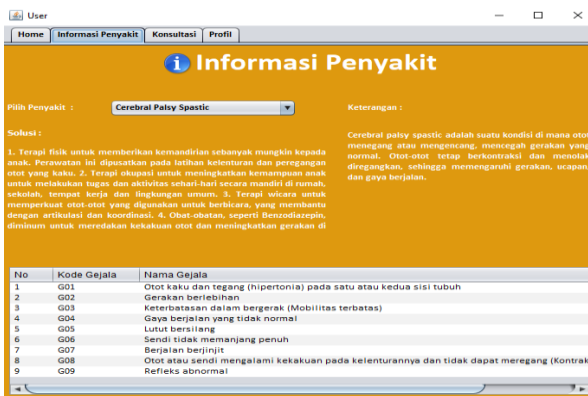


Figure 8 . User Disease Information Page

8. User Consultation Result Page

The appearance of this page appears after the user answers all the questions given, the results of the consultation will appear immediately . As in Figure 9 . following.



Figure 9 . User Consultation Result Page

4. Conclusion

By using the case based reasoning method in the calculation process, the percentage of diagnoses of Cerebral Palsy is getting better and measurable. It is hoped that in the future it can use other methods in solving so that it becomes an alternative comparison to find out which method is the most effective to use.

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