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Diagnostic Expert System for Children with Mental Disabilities with the Certainty Factor Method

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Abstract

Mental retardation is a mental disability which is also known as Intellectual Disability or mental retardation. Intellectual Disability is characterized by significant limitations in intellectual functioning, significant limitations in adaptive behavior, including cognitive, social, and practical adaptive skills. SLB YPAC West Sumatra is one of the special schools that prioritizes quality services for people with disabilities to increase independence. These services need to be carried out to minimize obstacles or disturbances of repetitive, aggressive behavior and other balance disorders. At SLB YPAC West Sumatra, 100% still use experts for their services. With the problems that exist in SLB YPAC West Sumatra which still uses a manual system, an expert system is created that can diagnose children with mental retardation using the Certainty Factor method. By using data on types of mental retardation and some symptoms, it was found that mentally retarded people at SLB YPAC West Sumatra suffer from moderate mental retardation with a CF value of 0.33. This research is expected to help SLB YPAC West Sumatra and service to be faster and also help the performance of employees at SLB YPAC West Sumatra .

Keywords : Intellectual Disability, Expert System, Certainty Factor, Disabled.

1. Introduction

Expert systems are part of Artificial Intelligence (AI), and were discovered by the AI community in the mid-1960s. The basic idea behind an expert system is to make it easier for experts who have specific knowledge to be transferred to a computer. This knowledge is then stored on the computer and can be retrieved by the user when needed. Furthermore, like consultation that occurs in humans, computers can provide input and explanations. It is also reinforced that an expert system is a computer program or software that has the knowledge of an expert in dealing with a problem. This knowledge is used by the system to solve the problem just like an expert [1].

An expert system is a system that seeks to adopt human knowledge into computers, in order to be able to solve problems that are usually done by experts [2]. An expert system is a computer system that matches the decision-making ability of an expert. In this expert system there are main components, namely the knowledge base which contains knowledge and an inference engine that uses responses. This conclusion is the response of the expert system to user requests. The use of a knowledge base system is also designed for intelligent guide action with an expert. Smart guide is designed with expert system technology because it provides many advantages to the developer. The more knowledge that is added to intelligent guides, the better the system will act so that it is more like real experts [3].

An expert system is a system that is designed to be able to imitate the expertise of an expert in answering questions and solving a problem so that it can solve problems and make decisions that are usually done like an expert [4].

Every parent certainly expects to have children with perfect physical and psychological conditions. However, there are so many factors that can affect the development of the fetus from the womb so that when the child is born, he has defects. In addition, there are also children who are born perfect, but due to certain events such as natural disasters or accidents cause them to have physical or psychological deficiencies. These deficiencies result in the emergence of limitations of a child in living life, so that it can be classified as a child with special needs . One form of limitation or disorder that can occur is mental retardation (mental retardation) [5].

Mental retardation is a mental disability which is also known as Intellectual Disability or mental retardation. Intellectual Disability is characterized by significant limitations in intellectual functioning, significant limitations in adaptive behavior, including cognitive, social, and practical adaptive skills, and appears before the age of 18 years [6].

The American Association on Mental Deficiency (AAMD) defines mentally retarded children as children who have an IQ of 84 and below based on tests. Meanwhile, according to the Japan League for Mentally Retarded mentally retarded children are

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children who are intellectually slow with an IQ of 70 and below based on a standardized intelligence test . However, experts in Indonesia have used a new classification , namely: Mild mental retardation has an IQ of 50-70; Medium mental retardation has an IQ of 55-40; and Severe and very severe mental retardation have an IQ of <30 [7].

Certainty Factor (CF) is a method of managing uncertainty in the system. Shortliffe and Buchanan developed the CF model in the mid-1970s for MYCIN, an expert system for the diagnosis and treatment of meningitis and blood infections. Since then , the CF model has become the standard approach for rule-based uncertainty management systems [8] Certainty Factor can express a belief in an event (facts or hypotheses) based on evidence or expert judgment. Certainty Factor uses a value to assume the degree of confidence of an expert in a data. The Certainty Factor method has the advantage that in calculations with this method it can only manage two data at a time so that the accuracy of the data can be maintained [9]

The way the Certainty Factor method works is to show a measure of certainty about a fact or rule. The CF method does reasoning like an expert, and to get a trust value [10].

2. Research methodology

The research framework is a concept or stages that will be carried out in a study. So that the steps taken by the author in this design are not out of the subject of discussion and 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 existing problems. The research framework that the authors conducted in the research will be described in Figure 1 below :

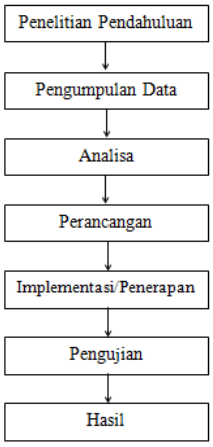

Figure 1. Research Framework

2.1 Data collection

Data collection was carried out by reading and studying books, journals, and writings related to this research. The data collection was carried out using the interview method with the owner of the Permata Gunung Pangilun Padang Pharmacy so as to obtain data from the pharmacy. To get optimal data results, time, place, and methods are needed in a study.

2.2 Data analysis

The data analysis stage is an important stage in the development of a system. At this stage it is carried out to get the facts in the research so as to get accurate data. There are two stages in the analysis process, namely data analysis and system analysis.

2.3 Design

The design stage aims to make the research designed according to its objectives, so that it does not deviate from the research objectives. The process of collecting data will be carried out to support the design of the system as a research object. The design will use ASI as a design model so that it is organized and structured with the design.

2.4 Implementation

This implementation is done to find out the specifications of the computer to run the program and what software is needed. This is the stage of research carried out to practice directly the results of the analysis which aims to test the correctness of the process carried out manually and with the program. The program used in this final production is the PHP programming language and MySql database.

2.5 Testing

Testing is a research stage that is 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, interface¸ and databases.

3. Results and Discussion

Below will be explained about the types, symptoms and solutions or therapies used by mentally retarded children.

Table 1. Table of Types of Mental Disabilities

No	Disease Code	Disease Name
1	P001	Mild mental retardation
2	P002	Moderate mental retardation
5	P003	Severe mental retardation

In Table 1 there are 3 types of mental retardation, namely mild, moderate and severe mental retardation. Furthermore, the symptom data is the symptom data which is summarized from the 3 types of mental retardation.

Table 2 . Table of Symptoms of Mental Disability

Symptom Code	Symptom Name
G001	Have an IQ of 70 – 55
G002	Has a normal facial character like an ordinary child
G003	Has the character of a blank and expressionless gaze
G004	Difficulty thinking abstractly
G005	Experiencing a lag of 2 or 5 levels in the cognitive field compared to normal children at their age
G006	Achievement of intelligence level below average
G007	Reduced ability in areas related to learning
G008	Inability in the academic field that requires motor skills
G009	Has a weak memory
G010	Attention spans don't last long
G011	Disorganized focus
G012	Attention is easily distracted
G013	Fluent in speaking but difficulty in vocabulary
G014	Slow language development
G015	Slow and poorly coordinated motor movements
G016	Difficulty in capturing messages given to children
G017	Difficulty in returning messages that have been given
G018	Difficulty in reflecting back the observed object
G019	Has an iQ of 54 – 40
G020	Has a Mongolian facial character
G021	Has abnormalities in the eyes slanted upward
G022	Has abnormalities in the distance of the eyes far apart with a flat nose bridge
G023	Has a small mouth disorder with a large tongue that tends to stick out
G024	Have abnormalities in the location of the lower ear
G025	Has a habit of parroting
G026	Has a down syndrome character and brain damage
G027	Hardly able to learn academic subjects
G028	Limited language development
G029	Low motor condition
G030	Has lagging behind 9-10 levels in the cognitive field compared to normal children of their age
G031	Has a childish nature
G032	Has a habit of daydreaming
G033	Has unfavorable social characteristics
G034	Still able to distinguish danger and not danger
G035	Have an IQ below 39
G036	When speaking the words and utterances are very simple
G037	The physical condition is very far from the state of a normal child
G038	Unable to self-select
G039	Unable to distinguish danger
G040	In daily activities need help from others

In Table 2, 40 symptoms of mental retardation are obtained, each symptom is initialized with a code G001 to G040 as shown in table 2. Furthermore, disease data and solutions are obtained manually.

Table 3 . Symptom Table

No	Disease Code	Solution
1	P001 Mild mental retardation	1. Speech Therapy 2. Occupational Therapy 3. Cognitive Therapy
2	P002 Moderate mental retardation	1. Integrity Sensor Therapy 2. Self Development Therapy or PMDS
3	P003 Severe mental retardation	1. Physiotherapy Therapy 2. Snouzelen therapy

There are 31 symptoms that are the cause of 5 types of skin problems on the face in Table 2. These symptoms are initialized with the code G01 to G31.

3.1 Formation *Rules* with the *Forward Chaining* Method

a rule is made using the *forward chaining* method , along with *the rules* resulting from processing data on types of skin problems and symptom data in Table 4.

Table 4 . Table *Rules*

Code *Rules*	*rules*
R1	IF [G01] AND [G02] AND [G03] AND [G04] AND [G05] AND [G06] AND [G11] AND [G30] THEN P1
R2	IF [G07] AND [G08] AND [G09] AND [G16] AND [G23] AND [G24] AND [G25] AND [G26] AND [G27] THEN P2
R3	IF [G01] AND [G05] AND [G10] AND [G11] AND [G12] AND [G13] AND [G20] AND [G27] AND [G30] AND [G31] THEN P3
R4	IF [G07] AND [G14] AND [G15] AND [G16] AND [G17] AND [G23] AND [G25] AND [G26] THEN P4
R5	IF [G09] AND [G12] AND [G18] AND [G19] AND [G20] AND [G21] AND [G22] AAND [G28] AND [G29] THEN P5

From the processing results obtained 5 *rules* as shown in Table 4.

3.2 Calculations Using the *Certainty Factor Method*

From *the rules* obtained by the *forward chaining method, calculations are carried out using the certainty factor* method to obtain the expert system confidence level. The following is the calculation of *the certainty factor* using *the rule* from the *forward chaining process* . *The rules* that have been obtained will be given a cf value, as shown in Table 5.

Table 5 . *Rule* Value Table and CF

Code Rules	*rules*
R1	IF [G01 : 0.8] AND [G02 : 0.8] AND [G03 : 0.8] AND [G04 : 0.8] AND [G05 : 0.8] AND [G06 : 0.8] AND [G11 : 0.8] AND [G30 : 0.4] THEN P1
R2	IF [G07 : 0.8] AND [G08 : 0.8] AND [G09 : 0.8] AND [G16 : 0.8] AND [G23 : 0.8] AND [G24 : 0.8] AND [G25 : 0.6] AND [G26 : 0.8] AND [G27 : 0.6] THEN P2
R3	IF [G01 : 0.6] AND [G05 : 06] AND [G10 : 0.8] AND [G11 : 0.6] AND [G12: 0.6] AND [G13 : 0.8] AND [G20 : 0.2] AND [G27 : 0.8] AND [G30 : 0.4] AND [G31 : 0.8] THEN P3
R4	IF [G07: 0.6] AND [G14 : 0.8] AND [G15 : 0.8]

R5	AND [G16 : 0.4] AND [G17: 0.8] AND [G23 : 0.8] AND [G25: 0.6] AND [G26 : 0.6] THEN P4 IF [G09 : 0.8] AND [G12 : 0.8] AND [G18: 0.8] AND [G19 : 0.8] AND [G20 : 0.8] AND [G21: 0.6] AND [G22 : 0.8] AAND [G28 : 0.6] AND [G29 : 0.6] THEN P5

Furthermore, the CF *user value is needed* which is obtained based on the symptoms felt by the patient, the CF *user value* can be seen in Table 6

Table 6 . Values Table CF User

No	Gender	Symptom Code & CF User
1	Woman	G9[0.8]; G12[0.8]; G18[0.8]; G19[0.8]; G20[0.8]; G21[0.4]; G22[0.6]; G28[0.6]; G29[0.6];
2	Woman	G7[0.6]; G8[0.4]; G9[0.2]; G14[0.8]; G15[0.6]; G16[0.4]; G17[0.4]; G23[0.6]; G25[0.6]; G26[0.8];
3	Woman	G1[1]; G5[0.2]; G10[0.6]; G11[0.4]; G12[0.4]; G13[0.6]; G20[0.2]; G27[0.4]; G30[0.4]; G31[0.2];
4	Man	G1[0.6]; G2[0.8]; G3[0.6]; G4[0.8]; G5[0.8]; G6[0.2]; G11[0.4]; G30[0.6];
5	Man	G7[0.4]; G8[0.6]; G9[0.6]; G16[0.4]; G23[0.4]; G24[0.6]; G25[0.6]; G26[0.4]; G27[0.4];

After searching all *the rules* , a calculation is carried out using the fifth *rule* because of all the existing *rules* the conditions that are met are the conditions in the fifth *rule* , then based on the fifth *rule a certainty factor* is calculated as shown in table 7 below:

R5 = IF [G09 : 0.8] AND [G12 : 0.8] AND [G18: 0.8] AND [G19 : 0.8] AND [G20 : 0.8] AND [G21: 0.6] AND [G22 : 0.8] AAND [G28 : 0.6] AND [G29 : 0.6] THEN P05

Table 7 . Sequential Data CF Calculation Table 1

Symptom Code	CF Expert	CF User	CFexpert * CFuser
G09	0.8	0.8	0.8 * 0.8 = 0.64
G12	0.8	0.8	0.8 * 0.8 = 0.64
G18	0.8	0.8	0.8 * 0.8 = 0.64
G19	0.8	0.8	0.8 * 0.8 = 0.64
G20	0.8	0.8	0.8 * 0.8 = 0.64
G21	0.6	0.4	0.8 * 0.4 = 0.24
G22	0.8	0.6	0.8 * 0.6 = 0.48
G28	0.6	0.6	0.6 * 06 = 0.36
G29	0.6	0.6	0.6 * 06 = 0.36

After all the symptoms in Rule 5 are calculated, then proceed with the following equation, namely CF combine. As calculated in table 8.

Table 8 . Sequential Data CF Calculation Table 1

Iteration	Cf combine = Cf1 + Cf2 * (1-Cf1)
1	0.64+0.64 *(1-0.64) = 0.8704
2	0.8704+ 0.64*(1-0.8704) =0.95334
3	0.95334+0.64*(1-0.95334) =0.9832
4	0.9832+0.64*(1-0.9832) =0.99395
5	0.99395+0.24*(1-0.99395) =0.9954
6	0.9954+0.48*(1-0.9954) =0.99761
7	0.99761+0.36*(1-0.99761) =0.99847
8	0.99847+0.36*(1-0.99847) =0.999902

The final step is to find the percentage level of the confidence factor:

Cf percentage = 0.999902 * 100% = 99.99 %

From the process of tracing the rule and calculating the certainty factor, it was found that the patient was identified as experiencing a type of sensitive facial skin problem with a confidence level of 99.99%.

3.3 Results

The results of the expert system can be seen in the application via a computer device with a web browser (Mozilla or Google Chrome), *users* of the expert system can easily consult on facial skin problems experienced, before conducting patient consultations, they are required to create an account first, and continue to consultation. The following is the display of an expert system for diagnosing facial skin problems:

1. Home Page Display

This page will display the main page of the expert system which contains several menus that can be selected by visitors and *users* such as homepage, information, instructions, register, and login. Here's a picture of the home page view :

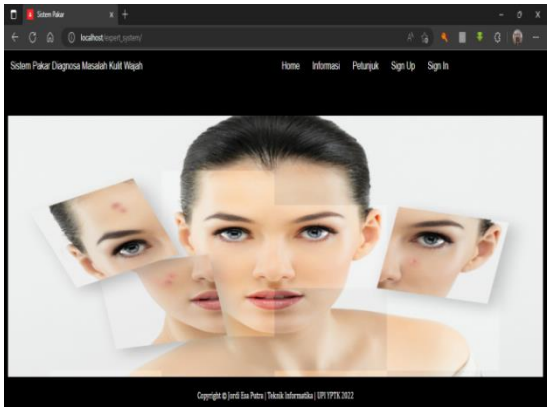

Figure 1Display Main Page

2. Display Instructions Page

The instructions page will appear after visitors press the instructions menu in the header section, the following is the instructions page display:

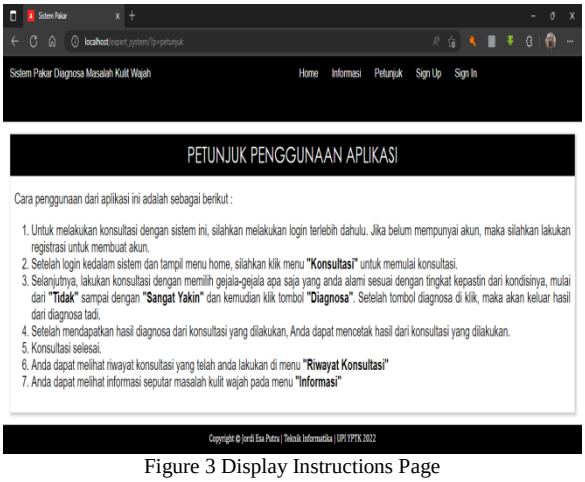

Figure 3 Display Instructions Page

3. Display Registration Page

Sign-up page will appear after the visitor presses the *sign up menu* on *the header section* , the following is the display of the *sign up page* .

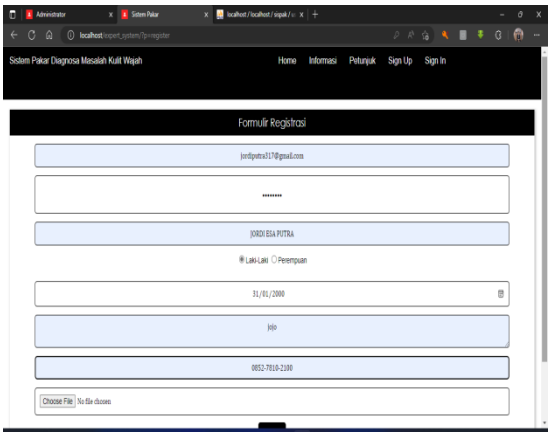

Figure 4 Display of the Registration Page

4. Login Page Display

sign-in page will appear after the visitor presses the *sign-in menu* in the *header section, the following is the sign- in* page display :

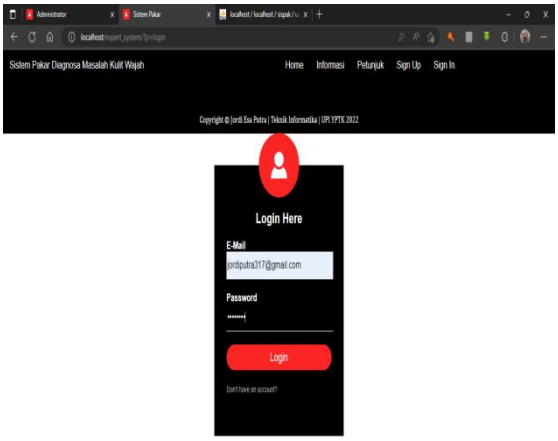

Figure 5 Display of the Login Page

5. Consultation Page Display

The consultation page will appear after *the user* presses the consultation menu in the *header section user* , the following is the view of the consultation page:

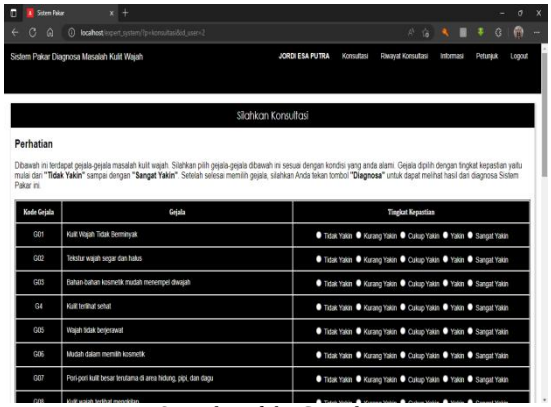

Figure 6 Display of the Consultation Page

6. Display Consultation Results Page

The consultation results page will appear after *the user* consults on the *header section user* , the following is a page view of the results of the consultation:

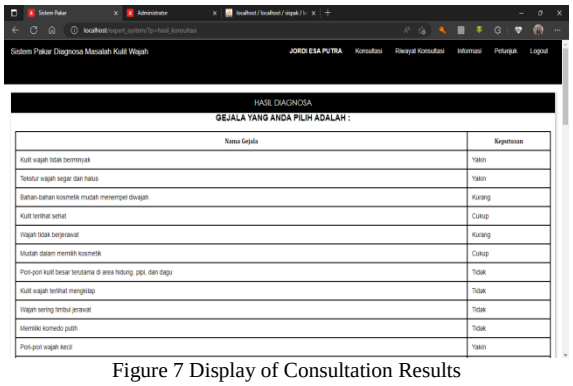

Figure 7 Display of Consultation Results

4. Conclusion

An expert system has been built to diagnose facial skin problems in humans, where this expert system is able to identify 5 types of facial skin problems in humans based on the symptoms experienced. This expert system can be an alternative to consulting to find out the types of facial skin problems and treat them early. This expert system has an accuracy rate of 99.90% based on expert interpretation.

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