Journal of Computer Science and Information Technology
https://jcsitech-upiyptk.org/ojs
20 2 2 Volumes 8 Issue 2 Matter: 33 - 39 e-ISSN: 2502-1486

Expert System for Diagnosing Torch Disease in Pregnant Women with Certainty Factor and Fuzzy Logic Methods

Muhammad Fiqran [1]

[1,2,3] Putra Indonesia University YPTK Padang

Muhammadfiqran0506@gmail.com _

Abstract

TORCH disease is a group of infections of several types of viruses, namely Toxoplasma, Rubella, Cytomegalovirus and Herpes. The main causes of torch viruses and parasites are animals around us such as chickens, cats, birds, mice, pigeons and others. Toxoplasma, Rubella, Cytomegalovirus and Herpes can cause damage to fertility in pregnant women. The egg and cell nucleus in pregnant women are damaged by the virus then the egg shrinks, causing the formation of myomas, blockages or tightening, so that the egg cannot be fertilized and makes it difficult to conceive. Therefore, it is very important to have an early diagnosis so that prevention or treatment can be carried out earlier. The diagnosis process can be done directly to the doctor or midwife, but there are often problems such as: limited time, physical conditions that do not allow you to leave home, financial problems, limited doctors or midwives and others. To make it easier for the public to recognize Torch problems in pregnant women, a system is needed that can help the work of doctors in the initial diagnosis of Torch problems in pregnant women. In this study, certainty factors and fuzzy logic methods were used in diagnosing TORCH problems in pregnant women to calculate the level of accuracy of the type of problem experienced based on the symptoms felt by the user. From testing obtained results in dealing with TORCH problems in mothers with an accuracy rate of 40.00%. The resulting expert system can assist patients in consulting to deal with TORCH problems in pregnant women .

Keywords: Pregnant Women, TORCH, Expert System, Certainty Factor, Fuzzy Logic, Tsukamoto's Fuzzy Logic

Abstract

TORCH disease is a group of infections with several types of viruses, namely Toxoplasma, Rubella, Cytomegalovirus and Herpes. The main causes of TORCH viruses and parasites are animals that are around us such as chickens, cats, birds, rats, pigeons, and others. Toxoplasma, Rubella, Cytomegalovirus and Herpes can cause damage to fertility in pregnant women. Egg cells and cell nuclei in pregnant women are damaged by the virus and then the egg cells shrink, causing the formation of myomas, blockages or adhesions, so that the eggs cannot be fertilized and make it difficult to get pregnant. Therefore, it is very important to make an early diagnosis so that prevention or treatment can be carried out earlier. The diagnosis process can be done directly to the doctor or midwife, but problems often occur such as: time constraints, physical conditions that make it impossible to leave the house, financial problems, limited doctors or midwives and others. To be able to make it easier for the public to recognize TORCH problems in pregnant women, we need a system that can help doctors work in diagnosing TORCH problems in pregnant women. In this study, the certainty factor and fuzzy logic methods were used in diagnosing TORCH problems in pregnant women to calculate the accuracy of the types of problems experienced based on the symptoms felt by the user. From the test results obtained in dealing with TORCH problems in mothers with an accuracy rate of 40.00%. The resulting expert system can assist patients in consulting to deal with TORCH problems in pregnant women.

Keywords: Pregnant women, TORCH, Expert System, Certainty Factor, Fuzzy Logic Tsukamoto .

1. Introduction

An expert system is a computer-based application that is used to solve problems as done by experts. The expert referred to here is a person who has special expertise who can solve problems that cannot be solved by ordinary people [1].

The expert system consists of two parts that must be owned, namely the knowledge base and the knowledge base inference engine. Knowledge base is a database that stores information certain knowledge and rules about a particular subject, whereas the inference engine is the part of the expert system that attempts to use the information provided to find the appropriate object [2]

Expert systems began to be developed in 1960 and 1970 and were only implemented in 1980. The general form of an expert system is a computer program that is created based on a set of rules or rules that analyze a specific problem and analyzes the problem mathematically. Knowledge stored on a computer is known as a knowledge base. In Expert Systems there are two types of knowledge, namely facts and procedures [3]. With an expert system, of course,

Received: 10-2-2022 | Revision: 13-03-2022 | Published: 30-04-2022 | doi: 10.35134/ jcsitech .v7i2.1

people are able to solve problems, where these problems can only be solved and worked on by experts [4]. It can be said that the Expert System helps or becomes an assistant to an expert in carrying out his work [5].

The disease that is the object of this research is the TORCH virus. TORCH disease is a group of infections with several types of viruses, namely Toxoplasma, Rubella, Cytomegalovirus and Herpes. The main causes of TORCH viruses and parasites are animals that are around us such as chickens, cats, birds, rats, pigeons, and others. This virus can also be caused by intermediaries (indirectly) such as eating vegetables, undercooked meat and others. Toxoplasma, rubella, cytomegalovirus and herpes can impair fertility in pregnant women [6]. Egg cells and cell nuclei in pregnant women are damaged by the virus and then the egg cells shrink, causing the formation of myomas, blockages or adhesions, so that the eggs cannot be fertilized and make it difficult to get pregnant.

Usually TORCH attacks the nerves of the brain, lungs, eyes, ears, disrupts the motor function of hydrocephalus and so on. Therefore, it is very important to make an early diagnosis so that prevention or treatment can be carried out earlier. The diagnosis process can be carried out directly to the doctor or midwife, but problems often occur such as: time constraints, physical conditions that make it impossible to leave the house, financial problems, limited doctors or midwives and others [7].

Certainty Factor is a method for proving whether a fact is certain or uncertain in the form of metrics that are usually used in expert systems. Meanwhile, the Tsukamoto Fuzzy method is a fuzzy logic method that has tolerances for existing data and is very flexible. This method is also fast in computing and more intuitive. There is a match between the Certainty Factor method and Tsukamoto's Fuzzy Logic with the problems that exist in Pneumonia, where Pneumonia is difficult to recognize by the public because it is similar to the symptoms of other respiratory tract infections, such as the flu and bronchitis. The Tsukamoto Certainty Factor and Fuzzy Logic methods are very suitable for expert systems that diagnose an uncertain disease [8] .

In previous research done by Aryu Hanifah Aji, M Tanji Furqon and Agus Wahyu Widodo in 2018 with the title Expert System for Diagnosing Diseases of Pregnant Women . Based on this research , this expert system uses the *Certainty Factor* (CF) method. 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. The process of calculating the CF method is carried out by calculating the multiplication value between the user's cf value and the expert's cf value and producing a combined CF value. The highest combined CF value becomes the final decision of the CF method [5] .

This was followed by another study conducted by Hendrikus Daely and Dito Putro Utomo in 2020 with the title Expert System for Diagnosing Hepatomegaly Applying the Fuzzy Logic Sugeno Method in Expert Systems for Diagnosing Diseases in Pregnant Women explaining that to solve the problem, use fuzzy logic. Fuzzy logic is defined input values are converted by the fuzzification unit to the appropriate fuzzy values. The fuzzed measurement results are then processed by the reasoning unit, which uses a knowledge base unit to produce a fuzzy set as its output. The final step is carried out by the defuzzification unit, namely translating the output set into a definite value. In this case the calculation method used is the Sugeno fuzzy method. The Sugeno method's fuzzy inference system is a fuzzy inference method for rules represented in the form of IF – THEN, where the output of the system is not in the form of fuzzy sets, but in the form of constants or linear equations [6] .

2. Research methodology

In order for research to be directed and objectives achieved, the authors form a research framework to clarify the sequence of activities carried out, as follows:

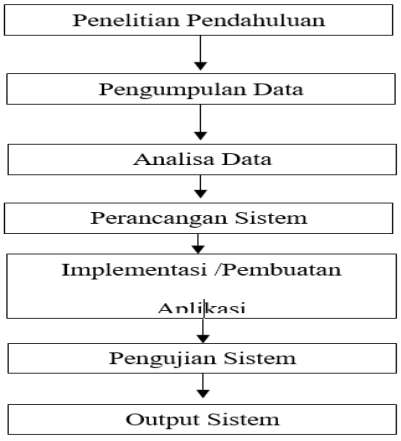

Figure 1. Research Framework

The research stage is a sequence of processes or steps that will be carried out in completing this research. The stages of this research are as follows:

2.1. Preliminary Research

Preliminary research is the first step in conducting research. The research was conducted at the Ibnu Sina Hospital, Bukittinggi. This preliminary research was conducted by interviewing dr. Fauzia Firsianti and dr. H. Erman Ramli, Sp.OG (K) asked questions and analyzed problems and obtained the necessary data

2.2. Data collection

In this study, data were collected from sources by conducting field studies by conducting direct observations and interviews.

2.3. Data analysis

Data analysis that aims to solve problems can find the right solution and avoid the emergence of new problems. The data can be stored properly in a pre-designed database. So that later the data of the participants can be stored in detail and well structured.

2.4. System planning

In designing the system, object-oriented modeling is carried out by designing the Unified Modeling Language (UML). At this stage, the facts are collected to support the system design. The Unified Modeling Language (UML) will be used as a tool in explaining the flow of program analysis.

2.5. Implementation

System implementation is a stage that is carried out when the designed system is ready to operate. Implementation is carried out with the aim of confirming the results of the system design, so that users can provide input (feedback) on system development.

2.6. System Testing

System testing is a stage that is carried out when the repetition process has been completed and the system is ready to be used to find out whether the designed system is running correctly and is free from errors.

2.7 System Outputs

Presents the output display from the results of the variable analysis that has been processed before

3. Results and Discussion

3.1 Analysis

The number of diseases in the expert system for diagnosing TORCH disease is at 4 levels:

Table 1. Disease Data Table

No	Disease Code	Disease Name
1	P1	Toxoplasma
2	P2	Rubella
3	P3	Cytomegalovirus
4	P4	Herpes

Table 1 presents data on TORCH disease in pregnant women with coding starting from P1, namely Toxoplasma to P4, namely Herpes.

Table 2. Symptom Data Table

No	Symptom Code	Skin Type Name
1	G1	Body temperature
2	G2	Weight
3	G3	Blood sugar
4	G4	Platelets
5	G5	Like constant spots during pregnancy
6	G6	The fetus does not develop normally
7	G7	Molar pregnancy
8	G08	The fetus dies in the womb of seven to eight months
9	G09	Miscarriage occurs
10	G10	Babies are born having glucose
11	G11	blindness
12	G12	Cloudy cornea
13	G13	Damage to the brain or calcification of the brain
14	G14	Harelip
15	G15	Deaf
16	G16	Endocrine disorders, eg hypo
17	G17	It's hard to talk
18	G18	Continuous miscarriage
19	G19	Head enlargement, head shrinkage, transparent body or swollen feet and hands
20	G20	Yellow skin
21	G21	Pneumonia
22	G22	Damage to cells in the central nervous system
23	G23	Mental decline is like deafness and nearsightedness
24	G24	Blisters on the skin
25	G25	Red blotchy skin surface
26	G26	*Attacking the body in the genitals, shaped like pimples or canker sores at the mouth of the vagina or vein*

Table 2 contains the symptoms of TORCH disease as many as 26 symptoms with codes ranging from G1 to G26

Table 3. Table of *Fuzzy* Variables

Code	Variable	Fuzzy Set	Domain
G1	Body temperature	Low	[35 -36.5]
		Normal	[36.5 – 38]
		Tall	[38 – 39]
G2	Weight	Low	[11 -12]
		Normal	[12 – 14]
		Tall	[14 – 16]
G3	Blood sugar	Low	[95 – 100]
		Normal	[100 – 120]
		Tall	[120 -140]
G4	Platelets	Low	[100,000 - 200,000]
		Normal	[200,000]

Table 3 presents the *fuzzy variables* starting with the code G1, namely Body Temperature, up to G4, namely Platelets.

Table 4. Non *Fuzzy Set Confidence Table*

Non Fuzzy set	Membership Degree
Very sure	1
Certain	0.8
Sure enough	0.4
Not sure	0.2

Fuzzification

Body temperature

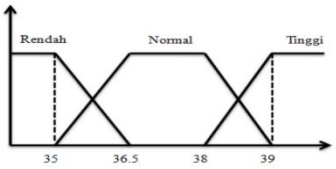

Figure 2. Body Temperature Variable Curve

$$\mu\,[\text{Suhu Rendah}] = \begin{cases} 1 & ; x \le 35 \\ 36.5 - x \,/\, 36.5 - 35 & ; 35 \le x \le 36.5 \\ 0 & ; x \ge 36.5 \end{cases}$$

$$\mu\,[\text{Suhu Normal}] = \begin{cases} 0 & ; x \le 35 \\ x - 35 \,/\, 36.5 - 35 & ; 35 \le x \le 36.5 \\ 1 & ; 36.5 \le x \le 38 \\ 39 - x \,/\, 39 - 38 & ; 38 \le x \le 39 \\ 0 & ; x \ge 39 \end{cases}$$

$$\mu\,[\text{Suhu Tinggi}] = \begin{cases} 0 & ; x \le 38 \\ x - 38 \,/\, 39 - 38 & ; 38 \le x \le 39 \\ 1 & ; x \ge 39 \end{cases}$$

Weight

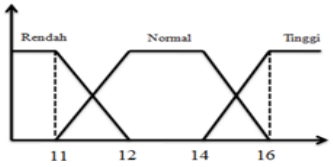

Figure 3. Body Weight Variable Curve

$$\mu\,[\text{Berat Badan Rendah}] = \begin{cases} 1 & ; x \le 11 \\ 12 - x \,/\, 12 - 11 & ; 11 \le x \le 12 \\ 0 & ; x \ge 12 \end{cases}$$

$$\mu\,[\text{Berat Badan Normal}] = \begin{cases} 0 & ; x \le 11 \\ x - 11 \,/\, 12 - 11 & ; 11 \le x \le 12 \\ 1 & ; 12 \le x \le 14 \\ 16 - x \,/\, 16 - 14 & ; 14 \le x \le 16 \\ 0 & ; x \ge 16 \end{cases}$$

$$\mu\,[\text{Berat Badan Rendah}] = \begin{cases} 0 & ; x \le 14 \\ x - 14 \,/\, 16 - 14 & ; 14 \le x \le 16 \\ 1 & ; x \ge 16 \end{cases}$$

Blood sugar

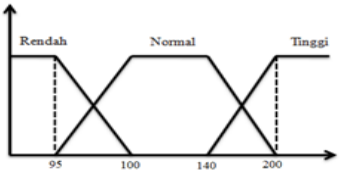

Figure 4. Blood Sugar Variable Curve

$$\mu\,[\text{Gula Darah Rendah}] = \begin{cases} 1 & ; x \le 95 \\ 100 - x \,/\, 100 - 95 & ; 95 \le x \le 100 \\ 0 & ; x \ge 100 \end{cases}$$

$$\mu\,[\text{Gula Darah Normal}] = \begin{cases} 0 & ; x \le 95 \\ x - 95 \,/\, 100 - 95 & ; 95 \le x \le 100 \\ 1 & ; 100 \le x \le 120 \\ 140 - x \,/\, 140 - 120 & ; 120 \le x \le 140 \\ 0 & ; x \ge 140 \end{cases}$$

$$\mu\,[\text{Gula Darah Tinggi}] = \begin{cases} 0 & ; x \le 120 \\ x - 120 \,/\, 140 - 120 & ; 120 \le x \le 140 \\ 1 & ; x \ge 140 \end{cases}$$

Platelets

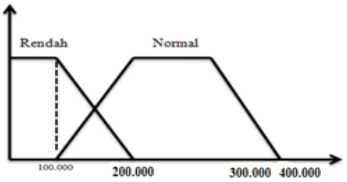

Figure 5. Platelet Variable Curve

$$\mu\,[\text{Trombosit Rendah}] = \begin{cases} 1 & ; x \le 100.000 \\ 200.000 - x \,/\, 200.000 - 100.000 & ; 100.000 \le x \le 125.000 \\ 0 & ; x \ge 125.000 \end{cases}$$

$$\mu\,[\text{Trombosit Normal}] = \begin{cases} 0 & ; x \le 100.000 \\ x - 100.000 \,/\, 200.000 - 100.000 & ; 100.000 \le x \le 200.000 \\ 1 & ; 200.000 \le x \le 400.000 \\ 400.000 - x \,/\, 400.000 - 200.000 & ; 200.000 \le x \le 400.000 \\ 0 & ; x \ge 400.000 \end{cases}$$

rules

R1 IF body temperature G1 (HIGH) AND blood sugar G3 (HIGH) AND like constant spots during pregnancy G5 AND the fetus does not develop normally G6 AND molar pregnancy G7 AND the fetus dies in the womb seven to eight months G8 AND a miscarriage occurs G9 THEN Toxoplasma P1 CF=0.667

R2 IF body temperature G1 (HIGH) AND weight G2 (LOW) AND the baby is born with glaucoma (G10) AND blindness (G11) AND cloudy cornea (G12) AND brain damage or calcification of the brain (G13) AND cleft lip (G14) AND deaf (G15) AND endocrine disorders, for example hypo (G16) AND difficulty speaking (G17) THEN Rubella (P2) CF=0.333

R3 IF blood sugar G3 (HIGH) AND platelets G4 (LOW) AND continuous miscarriage (G18) AND enlarged head, reduced head, transparent body or swollen feet and hands (G19) AND yellow skin (G20) AND pneumonia (G21) AND damage to cells in the central nervous system (G22) AND mental deterioration such as deafness and low vision (G23) THEN Cytomegalovirus (cmv) (P3) CF=0.642

R4 IF body temperature G1 (HIGH) AND body weight G2 (LOW) AND platelets G4 (LOW) AND blisters on the skin (G24) AND red spots on the skin surface (G25) AND attacks the body on the genitals, shaped like pimples or canker sores in the mouth vagina or vein (G26) THEN Herpes (P4) CF=0.214

Sample case

A patient has the following symptoms, body temperature 38.8ºC, blood sugar 130 Mg/dl, such as persistent spots when pregnant SURE, the fetus does not develop normally SURE, pregnant molar SURE, The fetus dies at seven to eight months of gestation SURE, There is a miscarriage of SURE.

Step 1 is fuzzification :

Body temperature G1

μ(low temperature) = 0

$$= \frac{36.5 - x}{36.5 - 35} = x$$

μ(normal temperature) = 0

$$= \frac{x - 35}{36.5 - 35} = x$$

$$= \frac{39 - x}{39 - 38} = x$$

μ(high temperature) = 1

$$= \frac{x - 38}{39 - 38} = \frac{38{,}8 - 38}{39 - 38} = \frac{0{,}8}{1} = 0{,}8$$

G3 blood sugar

μ(low blood sugar) = 0

$$= \frac{100 - x}{100 - 95} = x$$

μ(normal blood sugar) = 0

$$= \frac{x - 95}{100 - 95} = x$$

$$= \frac{140 - x}{140 - 120} = x$$

μ(high blood sugar) = 1

$$= \frac{x - 120}{140 - 120} = \frac{130 - 120}{140 - 120} = \frac{10}{20} = 0{,}5$$

user confidence :

Like constant spots when pregnant G5
Sure (0.8) = 0.8

Fetus does not develop with Normal G6
Sure (0.8) = 0.8

Molar pregnancy G7
Sure (0.8) = 0.8

The fetus dies in the womb of seven to eight months G8
Sure (0.8) = 0.8

The occurrence of miscarriage G9
Sure (0.8) = 0.8

Step 3 is to enter the value in the rule

R1 = IF G1(0.8) AND G3(0.5) AND G5(0.8) AND G6(0.8) AND G7(0.8) AND G8(0.8) AND G9(0.8) THEN TOXOPLASMA P1 CF=0.667

Z = min(0.8; 0.5) = 0.5
CF = min(0.8; 0.8; 0.8; 0.8; 0.8)=0.8

Defuzzification

$$z = \frac{\sum_{i=1}^{n} Wizi}{\sum_{i=1}^{n} Wi} = \frac{(0{,}667 \text{ x } 0{,}5)}{0{,}667} = \frac{0{,}3335}{0{,}667} = 0.5$$

CF calculation

CF(Toxoplasma) = 0.8

Table 5 . Merger Table

Defuzzification	CF calculation	Defuzzification x Calculation of CF
0.5	0.8	0.4

(Defuzzification x Calculation of CF) x 100% = 40%

Conclusion: patients diagnosed with TOXOPLASMA with a final score of 40%

3.2 Design

Figure 5. Use Case Diagram

3.3 Implementation and Testing

1. User Main Page Display (Patient)

This page displays menus that can be accessed by the patient after the patient has logged in.

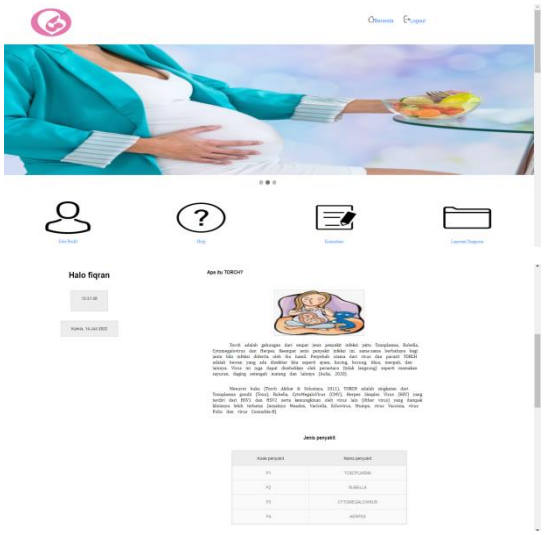

Figure 6. Home page

2. Consultation Page Display

This page displays questions asked to the user (patient), there are two types of questions in this system

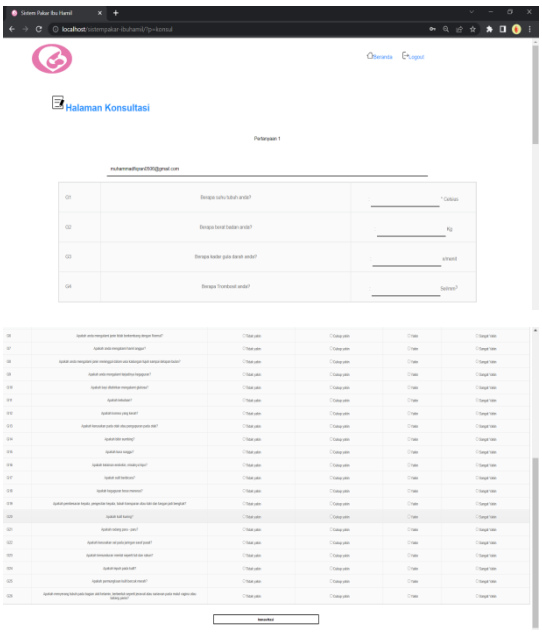

Figure 7. Patient Consultation Page (*User*)

3. Diagnostics Report page

This page displays the conclusion of the user's (patient) answer after the consultation, the report can be printed.

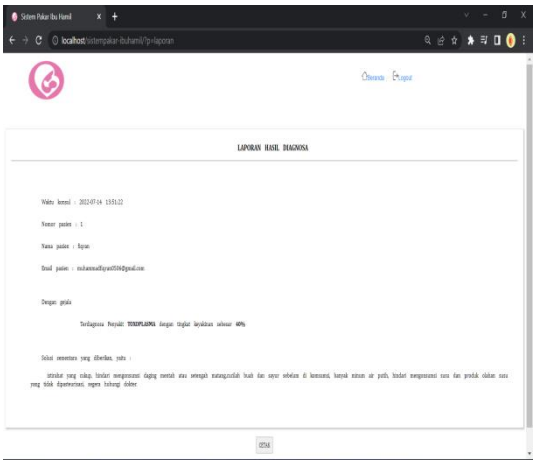

Figure 8. Patient Diagnostics Report Page (*User*)

4. Conclusion

By using *certainty factor* and *fuzzy methods Logic* in the calculation process makes the percentage of TORCH disease diagnoses in pregnant women better and measurable. It is hoped that in the future the methods used will be even more varied so that the results or outputs given will be even better. From this expert system application research, it is hoped that it

will be useful for ordinary people before they go to consult with experts or doctors

References

[1] I. Gunaawan and Y. Fernando, "EXPERT SYSTEM DIAGNOSIS OF SKIN DISEASES IN CAT," vol. 2, no. 2, pp. 239–247, 2021.

[2] Walker, EG, & David, D. (2020). Application of Backpropagation Neural Networks in the TORCH Virus Diagnostic Expert System. SISFOTENIKA, https://doi.org/ 10(1), 87-102. 10.30700/jst. v10i1.947

[3] Yanti, SN, & Budiyati, E. (2020). Web-Based Expert System Application for Diagnosing Covid-19 Virus in Humans Using the Forward Chaining Method. Pamulang University Informatics Journal, 5(4), 451-458. DOI: http://dx.doi.org/10.32493/informatika.v5i4.4944

[4] Dewanti, M., Muchbarak, A., & Widiyatun, F. (2021). Expert System for Determining Diet Menus for Patients with Diabetes Mellitus. JRKT (Journal of Applied Computational Engineering), 1(02). DOI: https://doi.org/10.30998/jrkt.v1i02.4092

[5] Dian, R., Sumijan, S., & Yuhandri, Y. (2020). Expert System in Identification of Tooth Decay in Children Using Forward Chaining and Certainty Factor Methods. Journal of Information Systems and Technology, 65-70. DOIs: https://doi.org/10.37034/jsisfotek.v2i3.24

[6] E. Gunawan and D. Walker, "Application of Backpropagation Neural Networks in the TORCH Virus Diagnosis Expert System Application of Backpropagation Artificial Neural Networks in the TORCH Virus Diagnosis Expert System," vol. 10, no. 1, pp. 87–102, 2020, [Online]. Available: http://sisfotenika.stmikpontianak.ac.id/index.php/ST/article/view/947/690 .

[7] E. Aulia, "Application of the Certainty Factor Method in Diagnosing Torch Viruses Using a Forward Chaining Inference Machine," *Maj. Science. inf. and Technol. Science.* , vol. 7, no. 2, pp. 182–188, 2020, [Online]. Available: https://ejurnal.stmik-budidarma.ac.id/index.php/inti/article/view/2384 .

[8] TA Chasshidi and MR Putra, "Expert System for Diagnosing Pneumonia Using Certainty Factor Method and Tsukamoto Fuzzy Logic Based on WEB," *J. KomtekInfo* , vol. 8, no. 2, pp. 118–128, 2021, doi: 10.35134/komtekinfo.v8i2.106.

[9] AH Aji, MT Furqon, and AW Widodo, "Expert System for Diagnosing Diseases of Pregnant Women Using the Certainty Factor (CF) Method," *J. Pemmb. Technol. inf. and Computing Science.* , vol. 3, no. 5, pp. 2127–2134, 2018, [Online]. Available: http://j-ptiik.ub.ac.id/index.php/j-ptiik/article/view/1556 .

[10] H. Daely and DP Utomo, "Hepatomegaly Diagnostic Expert System Applying Sugeno's Fuzzy Logic Method," *KOMIK (Conference Nas. Technol. Inf. and Computer)* , vol. 4, no. 1, pp. 211–214, 2020, doi: 10.30865/komik.v4i1.2682