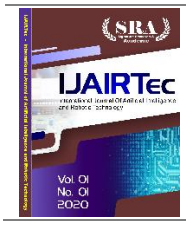

International Journal of Artificial Intelligence and Robotic Technology (IJAIRTec)

PISSN: 2775-5800 EISSN: 2775-5797
Volume: 2 Number: 3 pp. 103-114, December 2022
https://journal.sracademicpublishing.org/

EXPERT SYSTEM FOR HEPATITIS DISEASE DIAGNOSIS USING FUZZY TSUKAMOTO METHOD BASED ON WEBSITE IN RSUD PRINGSEWU

Elvia Fajarwati[1], Niva Kurnia Sari[2]
[1]Departement of Informatics Engineering, STMIK Surya Intan, Lampung
[2]Departement of Information Systems, Faculty of Technology and Computer Science, Bakti Nusantara Institute, Lampung
[1]Ibrahim Syarif Street No.107, Cempedak, Kotabumi, North Lampung, Indonesia
[2]Wisma Rini Street No. 09 Pringsewu, Lampung, Indonesia
Email: nivakurniasari1@gmail.com, elviafajarwati12@gmail.com

Article Info
Article history:
Received October 22, 2022
Revised November 23, 2022
Accepted December 8, 2022

Keywords:
Expert systems,
Fuzzy Tsukamoto,
Hepatitis

Abstract
The liver is a vital organ in humans, which functions as the formation and secretion of bile, and as a detoxification of poisons. Hepatitis is difficult to detect at an early stage but handling hepatitis at an early stage will greatly help the recovery of patients. With the increase in the number of Hepatitis sufferers besides being caused by an unhealthy lifestyle, it is also caused by the delay in handling when experiencing initial symptoms. So, this study aims to design an Expert System to diagnose hepatitis with a website-based Fuzzy Tsukamoto method so that it can facilitate access to information for people who need information about hepatitis. Website-based system design using the Fuzzy Tsukamoto method because it is considered flexible enough and has a tolerance to data that is not appropriate and based on natural language. Expert system as a tool in determining whether the patient is suffering from hepatitis or not with the Tsukamoto fuzzy method. The results of the discussion can be concluded that this system is designed with a simple model so that it can be used by the community.

I. INTRODUCTION

Information technology also develops in line with the development of human civilization. The development of information technology includes the development of infrastructure, such as hardware, software, data storage technology, and technology. The development of IT affects many fields such as health, education, government, and others. At present the development of information technology has penetrated into various sectors including health. Although the world of health and

medical is an information-intensive field, the use of computer technology is relatively lagging behind.

One of the problems faced by society today is the delay in medical treatment for people with hepatitis because most patients check their condition after the disease has been detected at an advanced stage. To overcome the problem of worsening the health condition of patients, it is necessary to have routine checks and prevent the risk of chronic disease attacks, but this is not done by some people for several reasons including heavy routines, high cost of examination and fear of the diagnosis of chronic diseases. In this study a system is designed that can be used by the public to detect abnormalities in organs, especially the liver.

Hepatitis is the first sequence of various liver diseases worldwide. Hepatitis virus is an infectious disease that spreads widely in the body even though a striking effect occurs in the liver. 5 categories of viruses have been found to be causative agents namely Hepatitis A Virus (HAV), Hepatitis B Virus (HBV), Hepatitis C Virus (HVC), Hepatitis D Virus (HDV), Hepatitis E Virus (HEV). Viral hepatitis infection can develop into cirrhosis or hardening of the liver even liver cancer. The problem is, most hepatic infections cause no symptoms and only 10-30 years later when the infection is severe. (Sulaiman 1995, http: //www2.kompas. com) [1].

According to the professor of hepatology at the Faculty of Medicine, University of Indonesia who is also the head of the Hepatitis working group at the Ministry of Health, Alli Sulaiman, virushepatitis infects around 2 billion people worldwide. Every year more than 1,300,000 people die from hepatitis and its complications. The prevalence in Indonesia is around 10-15 percent of the population or around 18 million people. Of the number infected, less than 20 percent did treatment. The other 80 percent did not carry out earlier examinations to medical experts (http://www2.kompas.com)[2].

In the process of diagnosing the system, one of the fuzzy tsukamoto methods is used to simplify the system in producing disease detection classification results based on the symptoms experienced by the user, so that prevention and treatment can be done immediately before the illness becomes more severe. With an expert system, the user will get a diagnosis according to the symptoms experienced and contained in the system, these symptoms have been through the results of interviews with experts and some patients with hepatitis. Expert system applications are prepared by acquiring expert knowledge in solving problems. Based on this description, the purpose of this study is to design an application of the Expert System to Diagnose website-based hepatitis as an ingredient for research so that people easily get access to expert information through applications designed specifically about the diagnosis of hepatitis. Based on the background of the problem formulation of this research is how to design an expert system to diagnose hepatitis with a website-based tsukamoto fuzzy method at Pringsewu General Hospital?

II. THEORY BASIS

2.1. Expert system

Expert systems that are computer programs as imitators of thought processes and expert knowledge to solve a specific problem [3]. The implementation of expert systems is widely used for the benefit of society because expert systems are seen as

a way of storing expert knowledge in a particular field into a program, so that they can make decisions and do reasoning intelligently [4].

2.2. Fuzzy Tsukamoto

Tsukamoto's method is an extension of monotonous reasoning. In the Tsukamoto method, each consequent rule in the form of IF-Then must be presented with a fuzzy set with a monotonous membership function. As a result, the output of the inference results of each rule is given explicitly (crisp) based on α-predicate (fire strength). The end result is obtained using a weighted average [5]. In general, the form of the fuzzy Tsukamoto model is: If (X IS A) and (Y IS B) Then (Z IS C)
Where A, B, and C are fuzzy sets.
Suppose the following 2 rules are known,
IF (x is A1) AND (y is B1) Then (z is C1)
IF (x is A2) AND (y is B2) Then (z is C2)

In its inference, Tsukamoto's method uses the following stages.

1. Fuzzyfication
2. Fuzzy knowledge base formation (rule in the form of IF ... THEN)
3. Inference Machine Use the MIN implication function to get the α-predicate value for each rule (α1, α1, α1, ... αn).
4. Defuzzyfication
   Use the Average method. [6]

3.3. Hepatitis

The liver has a vital role in the human body, one of which is maintaining the needs of organs in the body, especially the brain. Because liver functions are complex and diverse, liver health needs to be considered so that the body stays healthy [7]. Hepatitis is an inflammatory disease in the liver. In general, the causes of liver disease can be caused by unhealthy lifestyles but other factors are the condition of a liver abnormality which is inherited from birth or at birth, a disorder and abnormalities in metabolic processes, infected with viruses or bacteria, malnutrition or nutrition, alcohol dependence and other addictive substances and addictions and smoking habits can also be a cause of liver disease [8]. Health of the liver is very important for the human body. The liver as an organ that has the main task as a toxin neutralizer in the body makes poisons that have been entered through our body from food or the environment capable of being neutralized by the liver. Damaged liver can disrupt the ability of the human body to break down red blood from toxins or poisons contained therein [9].

Common types of liver disease include hepatitis, cirrhosis, liver cancer or hepatoma, liver abscess, non-alcoholic cholecystitis and fatty liver. Based on data from WHO, the disease that has the most cases of attacking the human liver is Hepatitis and Cirrhosis. Acute liver disease will affect liver functions, but liver disease can be known clinical and physical symptoms that arise in patients. Clinical symptoms can be seen from what is felt by the patient, while physical symptoms can be seen from the patient's body condition.

There are many and complex symptoms of liver disease, and liver disease has similar symptoms with several diseases. This needs to be considered because people have difficulty recognizing the common symptoms of liver disease with other

diseases. In Indonesia alone, hepatitis is a concern of the Ministry of Health. Based on data from the Pusdatin (Data and Information Center) of the Ministry of Health, the number of people suffering from hepatitis doubled from 2007 to 2013. In 2013, there were an estimated 1.2% of Indonesia's population suffering from hepatitis. Based on the data, in 2013 Indonesia's population numbered 248,422,956 people, so it could be said that if 1.2% had hepatitis, there were around 2,981,075 inhabitants of Indonesia who suffered from hepatitis. The number shows the number.

Indonesian residents who contracted hepatitis. Whereas for Cirrhosis, based on data from WHO in 2012, Indonesia has a standard age of 52.7 mortality rates for men and 16.6 for women. WHO says 90% of people with Hepatitis C can recover within 36 months. This is of course with fast and appropriate handling. The large number of people with Hepatitis and the standard age level of death Cirrhosis can be reduced by means of one of them is to recognize the initial and general symptoms of liver disease that allows facilitate the public in knowing symptoms of liver disease early. By knowing the symptoms of liver disease early, people can take measures to prevent the occurrence of acute liver disease.

III. METHOD

In designing this system using the waterfall method is a method that is often used by system analyzers in general. The essence of the waterfall method is the execution of a system carried out sequentially or linearly. So if step 1 has not been done, then step 2 cannot be done. If the second step has not been done, then step 3 cannot be done, and so on. Automatically step 3 will be done if steps 1 and 2 have been done. In the waterfall method through stages such as:

a. Needs Analysis
   This step is an analysis of system requirements. Collecting data at this stage by conducting a study, interview and literature study. System analyst by digging as much information as possible from the user so that it will create a computer system that can perform tasks desired by the user. This stage will produce a user requirment document or it can be said as data that relates to the user's desire in making the system. This document will be the system analyst's reference to translate into the programming language.
b. System Design
   Stages where the pouring of mind and system design to the solution of existing problems by using system modeling tools such as data flow diagrams (data flow diagrams), entity relationship diagrams (entity relationship diagrams) and structure and discussion of data.
c. Writing Program Code
   Writing program code or coding is a translation design in a language that can be recognized by a computer. Performed by programmers who will translate transactions requested by the user. This stage is the real step in working on a system. In the sense that the use of computers will be maximized in this stage. After the coding is complete, the system will be tested for testing. The purpose of testing is to find errors in the system and then be corrected.
d. Program Testing

The final stage is where the new system is tested for its capabilities and effectiveness so that the system's shortcomings and weaknesses are obtained which are then reviewed and improvements to the application become better and more perfect.

e. Program Implementation and Maintenance
The software that has been submitted to prospective new student applicants will surely change. These changes can be due to an error because the software must adjust to the environment (peripherals or new operating systems).

IV. DISCUSSION

The stages of the Tsukamoto fuzzy method can be described as follows:

1. Fuzzification Process
In this process, the input value (crisp) is changed to a fuzzy value. Formation of fuzzy sets with membership functions. In this study, the exact value is the score value of each predetermined symptom. Score scores will be entered into the membership function according to the domain rules of each symptom. The score and domain score are made by the knowledge engineer with expert approval. The data is obtained from the research shown in table 1.

Table 1. Domain Rules for Each Symptom

Code Symptoms	The Hepatitis of Symptoms	Level	Domain	Score Value
G01	Fever	Normal	0 – 50	0
		Is being	25 – 75	60
		Heigh	50 – 100	95
G02	Nausea and vomiting	Normal	0 – 60	0
		Is being	50 – 70	53
		Heigh	60 – 80	79
G03	Right-sided abdominal pain	Normal	0 – 65	0
		Is being	60 – 80	63
		Heigh	65 – 85	83
G04	Vomiting until liver swelling occurs	Normal	0 – 15	0
		Is being	10 – 20	12
		Heigh	15 – 30	29
G05	Headache	Normal	0 – 60	0
		Is being	40 – 75	55
		Heigh	60 – 80	79
G06	Yellow eyes	Normal	0 – 30	0
		Is being	10 – 50	21
		Heigh	30 – 80	77
G07	Colored urine	Normal	0 – 45	0
		Is being	30 – 60	41
		Heigh	45 – 75	73
G08	Fatigue	Normal	0 – 80	0

		Is being Heigh	40 – 90 80 – 100	69 99
G09	Appetite decreases	Yes	0 – 100	90
G10	Joint / muscle pain	Yes	0 – 100	90
G11	Weak / lethargic	Yes	0 – 100	90
G12	Easy body bruising	Yes	0 – 100	90
G13	Yellow skin	Yes	0 – 100	90
G14	Flu-like symptoms such as fever, whole body pain	Yes	0 – 100	90
G15	Easily tired	Yes	0 – 100	90
G16	Frequent nosebleeds	Yes	0 – 100	90
G17	Pale stool color	Yes	0 – 100	90
G18	Bad appetite	Yes	0 – 100	90
G19	Gastric Pain	Yes	0 – 100	90
G20	Dark urine	Yes	0 – 100	90
G21	Heart Swelling	Yes	0 – 100	90

Each has a domain as shown in Figure 1.

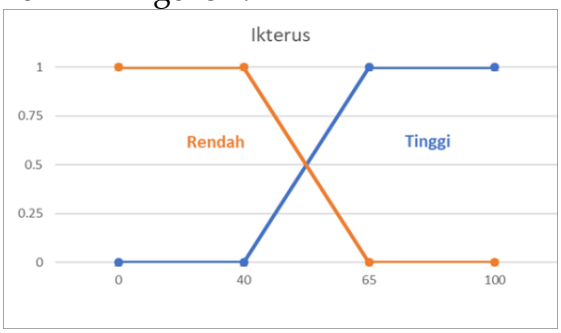

Figure 1 Membership function for jaundice symptoms

The membership functions in the low and high sets can be formulated as follows:

$$\mu \text{Low}(x)=\begin{cases}1 & (x \leq 40)\\ \frac{65-x}{25} & (40 < x < 65)\\ 0 & (x \geq 65)\end{cases}$$

$$\mu heigh(x)=\begin{cases}0 & (x \leq 40)\\ \frac{x-40}{25} & (40 < x < 65)\\ 1 & (x \geq 65)\end{cases}$$

Information:
μ = degree of membership
x = set of objects

The output variable in this example is the diagnosis of whether or not hepatitis is detected. This variable consists of 2 fuzzy sets namely Yes and No. The set yes and no is shown in Figure 2.

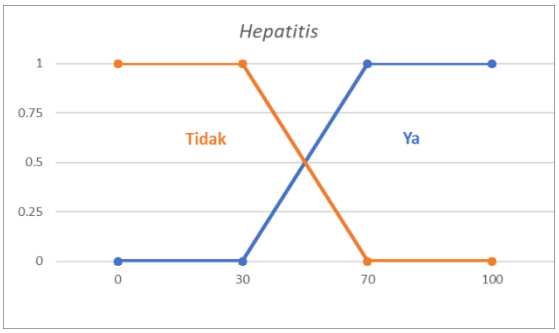

Figure 2 membership function for hepatitis

Set membership function Yes or No shown in the following formula:

$$\mu yes(x)=\begin{cases}1 & (x \le 30)\\ \frac{x-30}{40} & (30 < x < 70)\\ 0 & (x \ge 70)\end{cases}$$

$$\mu No(x)=\begin{cases}1 & (x \le 30)\\ \frac{70-x}{40} & (30 < x < 70)\\ 0 & (x \ge 70)\end{cases}$$

2. Establishment of the Rule
   The results of the fuzzification calculation are then interpreted against the rule. The implication function in the Tsukamoto fuzzy method is MIN. to calculate the alpha-predicate must represent all existing rules using the formula MIN (fuzzification). Example rule used in hepatitis is low IF G1 AND low G2 AND G3 Low AND G4 low THEN Not detected. The formula can be implemented to become:

   alpha_predikat1 = MIN (low G1, low G2, low G3, low G4).
   = min (0.25, 1)
   = 0.25

   See the set decreases at output
   (65-Z1) / (65-40) = 0.25
   Z1 = 45

   alpha_predikat3 = MIN (low G1, low G2, low G3, low G4).
   = min (0.25, 0.75)
   = 0.25
   (100-Z1) / (100-40)
   (z-40) / (100-40) = 0.6
   z3 = 60

alpha_predikat4 = MIN (low G1, low G2, low G3, low G4).
= min (0.25, 0.75)
= 0.25
See the set decreases at output
(Z1-30) / (100-30) = 0.25
Z4 = 35

Defuzzification
z = (0.25x45 + 0.25x45 + 0.6 + 60 + 0.25x35) / (0.25 + 0.25 + 0.6 + 0.25) = 90.6 / 1.35 = 67,111

Thus, patients suffer from hepatitis C with a value of 67,111

The process of identifying problems starts from disease data, symptom data and treatment data for hepatitis.

Table 2. Types of hepatitis

No	Code Disease	Name Disease
1	P01	Hepatitis A (HAV)
2	P02	Hepatitis B (HBV)
3	P03	Hepatitis C (HCV)
4	P04	Hepatitis D (HDV)
5	P05	Hepatitis E (HEV)

Table 3. Symptoms of Hepatitis

No	Code of Symptoms	The Symptoms of Hepatitis
1	G01	Fever
2	G02	Nausea and vomiting
3	G03	Right-sided abdominal pain
4	G04	Vomiting until liver swelling occurs
5	G05	Headache
6.	G06	Yellowish eyes
7.	G07	Urine is cloudy
8.	G08	Fatigue
9.	G09	Decreased appetite
10.	G10	Joint / muscle pain
11.	G11	is weak / lethargic
12.	G12	The body is easily bruised
13.	G13	Yellow skin
14.	G14	Flu-like symptoms such as fever, whole body pain
15.	G15	Easy to get tired
16.	G16	Frequent nosebleeds
17.	G17	Pale stool color

18.	G18	Bad appetite
19.	G19	Gastric Pain
20.	G20	Urine is dark
21.	G21	Swelling of the Heart

Information:
P : Type of hepatitis.
G : Symptoms of hepatitis.
So that the decision table can be made as follows:

Table 4. Decision for determining hepatitis

Symptoms Code for Hepatitis Code Types of Hepatitis	Symptoms Code for Hepatitis Code Types of Hepatitis				
	P1	**P2**	**P3**	**P4**	**P5**
G1					
G2					
G3					
G4					
G5					
G6					
G7					
G8					
G9					
G10					
G11					
G12					
G13					
G14					
G15					
G16					
G17					
G18					
G19					
G20					
G21					

System Design

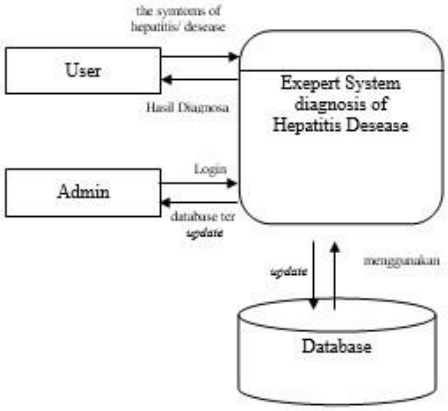

Figure 3. Context Diagram

c. Design of Symptoms of Hepatitis Pages

Fever
Nausea and vomiting
Right-sided abdominal pain
Vomiting until liver swelling occurs
Headache
Yellowish eyes
Urine is cloudy
Fatigue
Decreased appetite
Joint / muscle pain
is weak / lethargic
The body is easily bruised
Yellow skin
Flu-like symptoms such as fever, whole body pain
Easy to get tired
Frequent nosebleeds
Pale stool color
Bad appetite
Gastric Pain
Urine is dark
Swelling of the Heart

Figure 4. Design of Symptom Pages

Implementation

Figure 5. Display of the Main Page

Display Information Menu

Figure 6. Display Information Menu

Display the Cause Form

Figure 7. Display the Cause Form

Display Solution Form

Figure 8. Display Solution Form

Display General Symptoms Diagnosis Form

Figure 9. Display of General Symptoms of Diagnosis Form

V. CONCLUSION

Based on the discussion above it can be concluded that this study produces an expert system that can help diagnose the type of hepatitis with the fuzzy tsukomoto method that is by entering the symptoms experienced then will produce a diagnosis of what type of hepatitis the patient is experiencing. Suggestions given for this study are security settings for password encryption are still simple, expected to be developed again with more complex encryption methods so that the login system gets stronger. Other criteria need to be added so that the data obtained is more accurate. Further development can be carried out with other methods such as the K-Nearest Neighbors Algorithm and the Forward Chaining method.

REFERENCES

[1] Sulaiman 1995, http://www2.kompas.com/ ver1/ Health/0710/19/o32215.htm/)

[2] http://www2.kompas.com/ver1/Kesehatan/071 0 /19/o32215.htm/

[3] D. Permadi, "Expert System for Diagnosing Liver Disease," J. PROSISKO Vol., Vol. 5, no. 1, pp. 17–26, 2018.

[4] Hartati, Sri. Iswanti, S. 2008. Its Expert and Development System. Yogyakarta: Graha Ilmu.

[5] Kusumadewi. 2010. Liver Disease Diagnosis Expert System Using Android-Based Fuzzy Tsukamoto Method. Brawijaya University

[6] Sutojo. 2011. Liver Disease Expert System Using Website-Based K-Nearest Neighbors Algorithm. Gorontalo: Ichsan University

[7] Pujiyanta. 2012. Expert System for Diagnosing Hepatitis with the Fuzzy Tsukamoto Method. Yogyakarta: Ahmad Dahlan University

[8] P. Amanda and H. Mustafidah, "Expert System for Diagnosing Liver Disease Using the Forward Chaining Method (Expert System for Diagnosing Liver Disease Using Forward Chaining)," Tek. Inform. Univ. Muhammadiyah Purwokerto, vol. I No. 4, pp. 143–155, 2011.

[9] P. Widodo, "Rule-Based Classifier for Detecting Liver Disease," Bianglala Inform., Vol. II, no.1, pp. 71–80, 2014.