



Expert System Diagnosing Gastric Disease Using Hybrid Method

Firna Yenila^{1,*}, Suci Wahyuni²

¹²Universitas Putra Indonesia "YPTK" Padang, Padang, Indonesia

Article Information

Article History:

Accepted by the Editor: June 28, 2022

Final Revision: June 25, 2022

Published Online: June 30, 2022

Keyword

Gastric
Expert System
Certainty Factor
Forward Chaining

Correspondence

E-mail: firmayenila@upiypk.ac.id*

ABSTRACT

The gastric is a vital organ that must be maintained by maintaining a balanced life. The lack of time to discuss with patients, the causes of stomach disease is frequently overlooked. Need a new way to consult with patients without seeing the time. Expert consul is an application based on knowledge such as an expert system. This research was proposed to provide education to system users who have problems with the stomach. So that treatment can be obtained quickly and the stomach's condition can be better. This research includes a system designed by incorporating an expert's expertise into a system by combining the forward chaining method by describing the conditions experienced by patients in the form of sequential questions and the certainty of factors that provide some of the patient's belief in experiencing these conditions, which are used as desires in decision making. The result of the expert system using the hybrid method obtained consultation results with a 76 % certainty level, indicating that the patient was quite certain of having the disease that was conveyed in accordance with the knowledge that had been adopted by the expert so that the patient received the right therapy early before further consultation with experts.

This is an open access article under the CC-BY-SA license



1. Introduction

In many different sectors, health must be taken into consideration. Ineffective work output from activities will be caused by ill health [1]. The current lack of public interest in health is increasing the death rate. One of the diseases that is frequently overlooked by the general public due to a variety of factors is a stomach disease [2]. The stomach is a vital human organ that has a negative impact if it is not properly and correctly maintained. One way to avoid the causes of gastric disease is to apply knowledge about the stomach [3].

Gastric disease is one of the most frightening diseases among people because it can increase the rate of sudden death if not treated promptly. One of the efforts that the community must make to avoid this is to improve their lifestyle and educate themselves on the definition of body health [4].

Gastric disease is one of the most feared diseases and cannot be ignored because it can spread to other vital organs, resulting in fatalities such as kidney, heart, and liver damage [5]. Many factors contribute to gastric disease. In addition to an unhealthy lifestyle, gastric disease is dominated by psychological factors that result in the central nervous system of the brain which has something to do with the stomach causing hormonal instability changes in the body which results in stretching of the gastric wall cells in producing excessive acid [6]. This is psychologically linked to the movement of the stomach or the way the stomach

processes food, which is linked to the nervous system in the stomach [7]. Furthermore, anatomical changes caused by stomach injuries are one of the factors that contribute to gastric disease [2].

Many people suffer from gastric disease as a result of the community's lack of health awareness, particularly regarding the stomach, and the implementation of a lifestyle that is not balanced, practical, or even in accordance with the Recommended Dietary Allowances (RDA) that has been applied by WHO [8]. Many people in today's digital age have little knowledge of gastric disease, which appears to be neglected and slow to treat. Early symptoms of gastric disease should be treated appropriately to allow undesirable things to occur [9]. Aside from a lack of public knowledge about gastric disease, seeing an expert can be a difficult task for some patients due to a variety of factors such as limited consultation time, distance from the location of consultation, and one of the most important factors that occur is the cost incurred by the patient at the time of consultation [10]. Yogi explained that by applying the certainty factor value in the form of a percentage of the patient's belief in suffering from progeria disease with a value of 78% with a confident level of confidence, the expert was able to provide the right therapy for the user in this condition [11].

This is the standard set out in the problems in this study. It is hoped that this research will be able to diagnose and treat the symptoms of gastric disease quickly and appropriately so that patients do not have to wait long for solutions and healing therapies. The system developed is in the form of an artificial intelligence (AI) system that adapts knowledge directly from experts to obtain accurate information. This expert system for diagnosing gastric disease is expected to assist the public in determining the disease based on symptoms.

This system is specially designed by collaborating with two methods (Hybrid), namely the forward chaining method by sequentially reading the conditions experienced by the patient continuously to provide solutions to patients similar to consulting an expert. The certainty factor method is then used to reinforce the patient's level of confidence in experiencing the disease by giving points in each case discussed with the patient. The intended level of confidence is to apply a percentage of the patient's belief value to the symptoms felt in order to provide a representation of the value of what the patient feels.

The method is provided in the hope that the patient will be able to properly and correctly explain the information provided, allowing the solutions provided to be more focused and the therapy provided to be in accordance with the existing conditions. The patient is given a solution in the form of conclusions or conclusions derived from expert knowledge that is incorporated into the system and can be obtained in the form of softcopy or hardcopy at any time depending on the condition of each patient.

2. Method

The arrangement in this research has a clear flow at each stage of the research, which is the work step carried out in order to get the results based on what the expert conveys. This research involves work details that aim to produce more targeted and maximum results. Figure 1 depicts the research cycle.

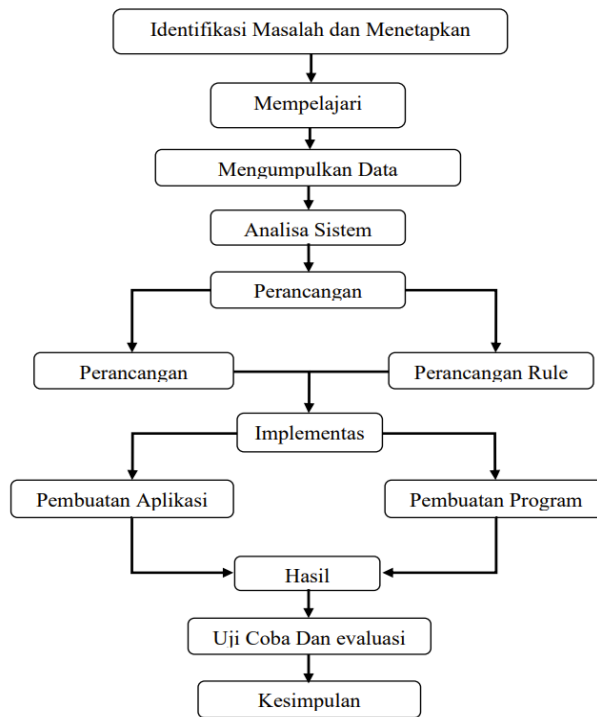


Figure 1. Centroid Distance

The expert system is a type of artificial intelligence that works to adapt an expert's expertise that is poured directly into a system in order to make it easier for patients to consult about their condition at that time [12]. The expert system is another type of artificial intelligence application that draws on the expertise of several experts who are integrated into the application. The expert system makes it simple for the community to find the best solution to any problem, especially those involving health [13].

Forward chaining is an expert system method that aids experts in translating information into the system by representing the situation being experienced, such as telling the symptoms and conditions felt by system users, and then processing the situation through the rules of the solution determination process to arrive at the desired conclusion [14]. Forward chaining is a forward-flowing method that focuses on the problem at hand and the desired results. Because the system analyzes problems continuously, this forward chaining method simplifies decision making [13].

Certainty factor is defined as one method to prove whether a fact is declared definite or uncertain in the form of a matrix that is typically used in making decisions that can be used as a reference in taking action by an expert [15]. The work process on the certainty factor provides a level of confidence in the symptoms that the patient is experiencing in the system. Each symptom has a weight assigned to it by an expert in internal medicine health. The solution search process in the certainty factor is carried out by tracing the initial symptoms to tracking in determining the correct diagnosis status. This method's calculation is carried out by determining the possible relative frequencies that carry the following formula [16]:

$$p = \frac{n(A)}{n(S)} \times 100\% \dots\dots(1)$$

Description:

P : Proportion

n(A) : Many of the symptoms detected in disease A.

n(S) : Many of the symptoms of disease A.

The proportion value is used to determine the status of the diagnosis results obtained in the process of developing the rules used to build information under the following conditions [16]: (1) If the proportion in the calculation is equal to 100 percent in the study, the results of the diagnosis state that they are definitely in the patient experiencing this condition. (2) If the proportion value obtained is $\geq 56\%$ and $< 100\%$, then the diagnosis status obtained is that it is probably have the disease. And (3) if the value of the proportion obtained is $< 56\%$, the status of the diagnosis results from the results of the consultation is declared dubious.

3. Results and Discussion

Several issues were discussed in the study based on the background exposure, including gastric disease. The authors gain clarity on some knowledge that should be included in an expert system about gastric disease after conducting interviews with expertise in the field of internal medicine and taking references from books and e-books about gastric disease. Table 1 shows the various diseases that can be identified from the stomach around the world.

Table 1. Types of Disease

Disease Code	Disease
P001	Gastritis
P002	Dispepsia
P003	Gastro Eksofagus Reflux disease
P004	Gastric Cancer

Patients who have gastric indications for any disease will experience a variety of symptoms. These signs serve as a guide for spotting the disease in its early stages. As a rule in this expert system for diagnosing gastric disease, this symptom data is entered into the database as question data, which is accompanied directly by the rules for each symptom that has a certainty value from the expert concerned. To avoid data redundancy, disease symptoms are processed in order, and the same symptoms are automatically realized with each other. Table 2 shows the existing symptom data.

Table 2. Symptoms of Gastric Disease

Symptom Code	Symptom
G001	Stomach pain
G002	Nausea and vomiting
G003	Indigestion
G004	Flatulence
G005	Decreased Appetite
G006	Black feces
G007	Weight loss
G008	Pale
G009	Weak
G010	Cold sweat
G011	Frequent burping
G012	Fullness in the stomach
G013	Uncomfortable after eating
G014	Pain in the upper stomach
G015	Liquid out from stomach
G016	Pain and soreness in the stomach

G017	Frequent nausea
G018	Constantly defecating
G019	Mushy and watery feces
G020	Cramps in the stomach
G021	Fever
G022	Feeling sore
G023	Dehydration
G024	Body feels weak
G025	Difficulty swallowing
G026	Chest pain
G027	Out of breath
G028	Swelling of the abdominal area
G029	Get full quickly
G030	Vomiting blood

The disease data and symptoms that can be taken from this case are as shown in Table 3.

Table 3. Diseases and Symptoms

No	Diseases	Symptoms
1	Gastritis	Stomach pain
		Nausea and vomiting
		Indigestion
		Flatulence
		Decreased Appetite
		Black feces
		Weight loss
		Pale
		Weak
		Cold sweat
		Frequent burping
2	Dyspepsia	Fullness in the stomach
		Uncomfortable after eating
		Pain in the upper stomach
		Liquid out from stomach
		Pain and soreness in the stomach
		Frequent nausea
		Constantly defecating
3	Gastro Esophageal Reflux Disease (GERD)	Mushy and watery feces
		Cramps in the stomach
		Fever
		Feeling sore
		Dehydration
		Body feels weak
		Difficulty swallowing
		Chest pain
		Out of breath
		Swelling of the abdominal area
		Get full quickly
4	Gastric Cancer	Vomiting blood
		Stomach pain
		Nausea and vomiting

Indigestion
Flatulence
Decreased Appetite
Black feces
Weight loss
Pale
Weak
Cold sweat
Frequent burping
Fullness in the stomach
Uncomfortable after eating
Pain in the upper stomach
Liquid out from stomach
Pain and soreness in the stomach

The forward chaining process is carried out by tracing several symptoms based on what system users are experiencing. The search is carried out in accordance with the list in Table 2, and then the certainty factor process is carried out. This case must be weighted before it can be used in data processing, as a weighting of the assessment is required in its calculation. The weight of this assessment is given during the discussion with the patient, so that patients can provide information about the percentage value they feel the symptoms conveyed by the system. The following levels of certainty were used in this study. Table 4 is the certainty factor.

Table 4. Certainty Factor

No	Description	User Point
1	Definitely not	0
2	Unknown	0.2
3	Maybe	0.4
4	Probably	0.6
5	Almost certainly	0.8
6	Definitely	1

These evaluation points serve to provide assurance to each user who consults the system. Its purpose is to give weight to the information provided. Previously, the expert also gave points for each symptom, making it simple to calculate the patient's condition at the time. Table 5 contains the expert's point scoring table.

Table 5. Points of Certainty Factor

Symptom Code	Symptom	Point
G001	Stomach pain	0.5
G002	Nausea and vomiting	0.6
G003	Indigestion	0.7
G004	Flatulence	0.5
G005	Decreased Appetite	0.6
G006	Black feces	0.8
G007	Weight loss	0.5
G008	Pale	0.5
G009	Weak	0.6
G010	Cold sweat	0.4

G011	Frequent burping	0.5
G012	Fullness in the stomach	0.6
G013	Uncomfortable after eating	0.4
G014	Pain in the upper stomach	0.5
G015	Liquid out from stomach	0.6
G016	Pain and soreness in the stomach	0.6
G017	Frequent nausea	0.5
G018	Constantly defecating	0.6
G019	Mushy and watery feces	0.5
G020	Cramps in the stomach	0.5
G021	Fever	0.4
G022	Feeling sore	0.3
G023	Dehydration	0.2
G024	Body feels weak	0.5
G025	Difficulty swallowing	0.6
G026	Chest pain	0.8
G027	Out of breath	0.6
G028	Swelling of the abdominal area	0.7
G029	Get full quickly	0.5
G030	Vomiting blood	0.8

In this research, discussion is required to determine the results of the research conducted so that solutions are obtained in accordance with the problems discovered during the consultation regarding gastric disease. The problem under consideration was developed using a hybrid method, which combines two methods to achieve the desired solution, the two methods used are forward chaining and certainty factor. The two methods are used in processing symptoms based on the initial condition's diagnosis using a rule with a single premise/symptom. Table 6 shows an example of how to obtain CF values using the rule table, user point values, and expert point values.

Table 6. Consultation Rules

No	Rule
1	IF G001 AND G002 AND G003 AND G004 AND G015 THEN P001
2	IF G001 AND G007 AND G012 AND G005 AND G015 THEN P001
etc	

The point value given by the user into the expert system will determine how the rule is processed. depending on one type of point value that the user provided to the system in the scenario depicted in Table 7.

Table 7. Points of Consultation

Symptom Code	Symptom	Point
G001	Stomach pain	0.8
G002	Nausea and vomiting	0.9
G003	Indigestion	0.3
G004	Flatulence	0.7
G015	Liquid out from stomach	0.8

The expert then assigns a point value to each symptom in accordance with the following Table 8 before performing the calculation process with the certainty factor.

Table 8. Points from Experts

Symptom Code	Symptom	Point
G001	Stomach pain	0.5
G002	Nausea and vomiting	0.6
G003	Indigestion	0.7
G004	Flatulence	0.5
G015	Liquid out from stomach	0.6

The following step must be a calculation process, as in the equation in the certainty factor, by comparing the weight values of each rule obtained by experts and users during consultation to determine the certainty value of these conditions. The following is the equation in question:

$$\begin{aligned} CF(H,E) &= CF(E)*CF(rule) \\ &= CF(user)*CF(expert) \end{aligned}$$

The final step is to add the CF values from each rule. Add CF 1 to CF 5 to the equation.

$$CFCOMBINE(CF1,CF2) = CF1+ CF2* (1 - CF1)$$

$$CFCOMBINE(CF1,CF2) = 0,8 + 0,5 * (1 - 0,8)$$

$$= 0.8 + 0.1$$

$$= 0.9 \text{ CFold}$$

$$CFCOMBINE(CFold,CF3) = 0.9 + 0.6 * (1 - 0.9)$$

$$= 0.9 + 0,06$$

$$= 0,96 \text{ CFold}$$

$$CFCOMBINE(CFold,CF4) = 0,96 + 0,8 * (1 - 0,96)$$

$$= 0,96 + 0,032$$

$$= 0.99 \text{ CFold}$$

$$CFCOMBINE(CFold,CF4) = 0.99 + 0.6 * (1 - 0.99)$$

$$= 0,99 + 0,006$$

$$= 0.99 \text{ CFold}$$

Percentage of confidence = CFCOMBINE * 100%, or 0.99 x 100%, or 99% based on symptoms associated with gastritis, the algorithm claims that individuals who have this ailment have a 99 percent confidence level of accuracy and a confidence value of definitely. The steps in the user's search for solutions were determined by the conditions they encounter. The user immediately discusses the circumstances being encountered with the system to start the implementation process. This is a step taken by the user, similar to directly consulting with experts to obtain knowledge or therapy related to the patient's gastric health. Patients are expected to login first into the system, which aims to store user information in accordance with the code of ethics, to make it easier for them to use. The initial layout of the system with the user directly is as shown in Figure 2.



Figure 2. System Initial View

Consultation will be started by clicking on the menu display in the system. Then the user will be directed to the display in Figure 3.

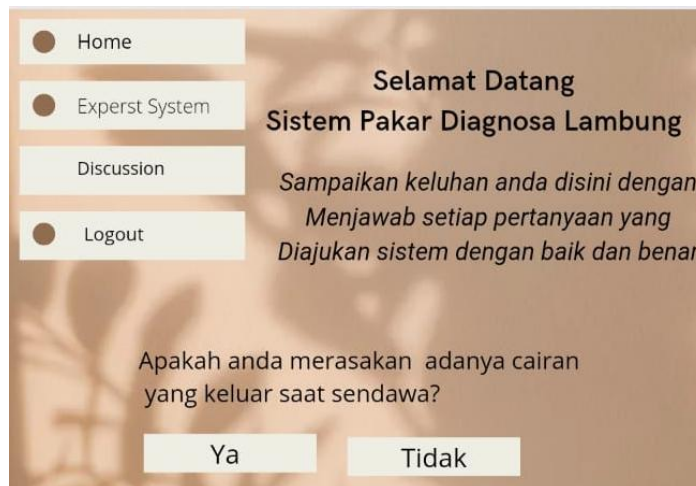


Figure 3. Initial Discussion

In Figure 3, the user is asked to answer several questions based on the patient's condition; if the patient answers No, the system returns to the initial menu, if the patient answers Yes, the question is continued by providing the percentage of the patient's confidence level who has this condition. Every question posed by the system must be properly and correctly answered in order to obtain the desired solution, as shown in Figure 4.

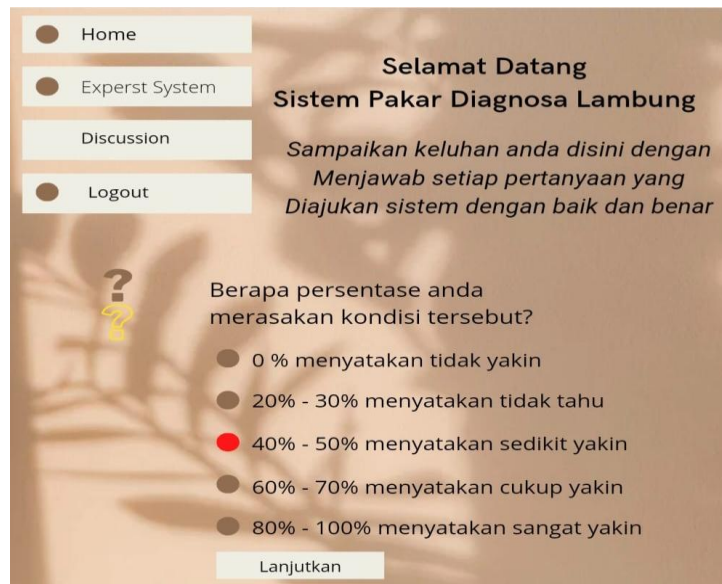


Figure 4. Percentage of Confidence

When the user clicks on the continue command, the results of the consultation will be displayed. It can be obtained in softcopy and hardcopy by selecting the print command. It can be used by the patient as an initial action that experts can consider when providing the appropriate medicine and therapy.



Figure 5. Conclusion

4. Conclusion

Based on the analysis that has been carried out on the gastric disease expert system, it can be concluded as follows: (1) There are several factors that contribute to gastric disease; therefore, education about gastric disease is the first step in dealing with it early. The expert system developed facilitates the initial analysis of patients with gastric disease and provides an overview of the causes of gastric disease in accordance with expert recommendations. The built expert system can detect and provide solutions to the community in the form of early therapy to overcome gastric disease or brief knowledge about gastric conditions and types of gastric diseases encountered. (2) The reasoning used in this study employs the Forward Chaining method,

which explains the flow of the patient's disease in a structured manner based on the conditions experienced at the time of the consultation, and the certainty factor method, which states the value of confidence in each of the symptoms submitted, with the goal of providing firmness to the patient's condition at that time. One of the Hybrid method tests provides a confidence value of 99% based on what the user feels, so that with the amount of accuracy provided, it is able to provide new knowledge to patients with gastric disease and experts can provide appropriate therapy quickly. And (3) this reserach provides results in the form of softcopy and hardcopy that can be used as a reference for patients with gastric disease based on the time required.

References

- [1] D. S. Chaniago, "Aplikasi Kesehatan Menentukan Jenis Penyakit Lambung Dengan Mengambil Beberapa Gejala Menggunakan Metode Fuzzy - Mamdani," *J-SISKO TECH (Jurnal Teknol. Sist. Inf. dan Sist. Komput. TGD)*, vol. 4, no. 1, p. 32, 2021, doi: 10.53513/jsk.v4i1.2604.
- [2] N. M. N. Nirastiti, N. Qomariyah, and E. R. Purnama, "Potensi Ekstrak Teripang (*Holothuria leucospilota*) sebagai Anti Tukak Lambung pada Mencit (*Mus musculus*) yang Diinduksi Miras Oplosan Potency of Sea Cucumber (*Holothuria leucospilota*) Extract as an Anti-gastric Ulcer in Mice (*Mus musculus*) Induced," *LenteraBio*, vol. 9, no. 3, pp. 168-175, 2020.
- [3] Y. E. . Mawartika, "Implementasi Metode Case Based Reasoning untuk Mendiagnosa Penyakit Lambung Implementation of Case Based Reasoning Method for Diagnosing Gastric Disease," *J. Ilm. Bin. STMIK Bina Nusant. Jaya*, vol. 3, no. 02, pp. 39-46, 2021.
- [4] K. Adhistry, M. N. Maulida, and N. R. Oktadini, "Pendeteksi Asam Lambung Dengan Menggunakan Sistem Sensor pH," *J. Kep. Sriwi.*, vol. 8, no. 2, pp. 60-65, 2021.
- [5] Jefi, Hendri, N. Afni, A. Salim, and Y. I. Maulana, "Penerapan Algoritma Naive Bayes Dalam Memprediksi Penyakit Lambung," *J. Inf. Syst. Informatics Comput.*, vol. 5, no. 2, pp. 524-531, 2021, doi: 10.52362/jisicom.v5i2.659.
- [6] H. Marfalino, T. Novita, and D. Djesmedi, "Sistem Pakar Diagnosa Penyakit Saluran Pencernaan Pada Manusia Dengan Metode Cased Based Reasoning," *J Sains Infor. Ter.*, vol. 1, no. 2, pp. 83-88, 2022.
- [7] M. S. Puspita, "Hubungan Kuantitatif Struktur Aktivitas (HKSA) Turunan Senyawa Khrisin Sebagai Antikanker Karsinoma Lambung," Bhakti Kencana University, 2021.
- [8] A. Arbainah, S. Syaharuddin, and M. Mutiani, "Utilization of Wasaka Museum as a Learning Resource on Social Studies," *Kalimantan Soc. Stud. J.*, vol. 1, no. 2, p. 121, 2020, doi: 10.20527/kss.v1i2.2027.
- [9] Y. Kusprayogi, H. F. Nashori, and R. A. R. Kumolohadi, "Pengaruh Islamic-Integrated Cognitive Behavioral Therapy Terhadap Peningkatan Kesejahteraan Subjektif Mahasiswa Penderita Gangguan Lambung," *Seurune, J. Psikol. Unsyiah*, vol. 4, no. 2, pp. 150-168, 2021.
- [10] A. Anggilina and A. Eviyanti, "Web-Based Expert System for Diagnosing Gastric Disease Using Bayes Theorem Method," *Procedia Eng. Life Sci.*, vol. 1, no. 2, 2021, doi: 10.21070/pels.v1i2.944.
- [11] Y. Wiyandra, F. Yenila, and R. A. Mahessya, "Sistem Pakar Kerusakan Sepeda Motor Matic dengan Metoda Hybrid," *J. KomtekInfo*, vol. 8, no. 2, pp. 145-153, 2021, doi: 10.35134/komtekinf.v8i2.110.
- [12] A. Y. Aditama, N. Mardiyantoro, H. Sibyan, and M. Hidayat, "Penerapan Metode Certainty Factor Pada Sistem Pakar Diagnosa Penyakit Ayam Kedu Berbasis Web," *Device*, vol. 12, no. 1, pp. 43-50, 2022, doi: 10.32699/device.v12i1.2799.
- [13] D. D. Darmansah, I. Chairuddin, and T. N. Putra, "Perancangan Sistem Pakar Tipe Kepribadian Menggunakan Metode Forward Chaining Berbasis Web," *JATISI (Jurnal Tek. Inform. dan Sist. Informasi)*, vol. 8, no. 3, pp. 1200-1213, 2021, doi: 10.35957/jatisi.v8i3.1033.
- [14] E. Rianti, F. Yenila, and H. Marfalino, "Sistem Deteksi Gingivitis Gigi Menggunakan Certainty Factor," *J. Teknol.*, vol. 11, no. 2, pp. 50-56, 2021, doi: 10.35134/jitekin.v11i2.51.
- [15] A. Supani, H. Deviana, and Salma, "Sistem Pakar Diagnosa Gangguan Rahim Dengan Metode Certainty Factor Berbasis Web," *Semin. Nas. Inov. dan Tren*, pp. A82-A87, 2014.
- [16] N. Sari, M. Nasution, and M. H. Munandar, "Sistem Pakar Diagnosa Penyakit Mata Manusia Menggunakan Metode Certainty Factor Berbasis Web," *J. Tek. Inform. UNIKA St. Thomas*, vol. 11, no. 1, pp. 171-177, 2021, doi: 10.54367/jtiust.v6i1.1275.