Published online on the journal's webpage: **http://journal.ittelkom-pwt.ac.id/index.php/dinda**

Journal of Dinda

Data Science, Information Technology, and Data Analytics

Vol. 3 No. 1 (2023) 24-30 E-ISSN: 2809-8064

An Expert System for Diagnosing the Impact of Traffic Accidents using the Forward Chaining Method

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Abstract

Unexpected events that we often hear about are traffic accidents caused by many factors. Accidents also cause impacts in terms of health. This study aims to provide information regarding the effects of traffic accidents in terms of health based on some visible symptoms that emerged from the victim's body at the scene using an expert system. The Expert System is designed on a website-based application. The forward chaining method is used to get a conclusion based on the facts. The results of this research users gain knowledge about the impact of traffic accidents and the diagnosis on the victim's body that is close to the knowledge of experts with accuracy 87.5%. The website is designed to be used as a guide for users to be able to provide appropriate first aid to accident victims.

Keywords: Forward chaining, artificial intelligence, traffic accident, expert system, website

1. Introduction

Traffic accidents are events that we cannot predict when and where they will occur. There are so many impacts caused by accidents, one of the fatal impacts is death [1]. Based on data obtained from the Banyumas Traffic Police Unit, there were 1.588 traffic accidents in Banyumas in 2021. As many as 1.890 people suffered minor injuries, 18 suffered severe injuries, and 200 died. The figure states that the number of accidents in 2021 has increased from the previous year.

Table 1. Factors of mishandling accident victims

Factor	Percentage
Kesalahan pertolongan	50%
Terlambat memberikan pertolongan	50%

Table 1 shows two factors that cause traffic accident victims to get worse: errors in assistance and delays in providing help. Therefore, this study created a website that can provide first aid information quickly and precisely to traffic accident victims using a forward chaining algorithm. The forward chaining algorithm is used because of the way the algorithm works in analyzing data based on experienced data [2]. This method was chosen because several studies using expert systems in various fields have succeeded in finding results using the forward chaining method.

According to Hafiz et al. (2018), in a previous study with the title Expert System for Web-Based Bone Disease Diagnosis Using Forward Chaining Method. The study concluded that the expert system created by researchers using Webview and implemented through the application could run well. The results of the application's feasibility test show that appearance, user convenience, and system performance run smoothly [3]. In addition, the research entitled Application of an Expert System for Diagnosing Dental Diseases Using the Forward Chaining Method (Haryanto et al. 2019). The research worked at the UPTD Health Center Bangil Health Center. Concluded that the expert system created made it easy for patients to consult [4]. However, in previous research, there are still not many expert systems applications in traffic accidents. So in this study, we do it as first aid when an accident occurs.

Therefore, this study aims to create an expert system for diagnosing the impact of traffic accidents using a website-based forward chaining method. So that first aid can be done appropriately.

Received: 31-07-2022 | Revised: 24-08-2022 | Published: 01-02-2023

2. Research Methods

2.1 *Data Collection*

Some of the facts and information used in solving the problems discussed in this study were obtained by:

a) Interview
The author interviewed to obtain some information related to traffic accident cases and their impact on the Banyumas Satlantas and related to several symptoms of the diagnosis determined by several health experts.

b) Study of Literature
The author carries out Literature Studies by looking for references from related journals and the web. In this case, the author chose a web journal about the experiential system by the method of forwarding chaining.

2.2 *Expert System*

Expert systems are one part of the artificial intelligence (AI) that emerged in the development of computer science [4]. Expert systems apply science from humans to computers so that they can think like experts and solve various kinds of problems in various fields [5]. This expert system can be used as an assistant for experts in various fields to help them solve problems [6].

2.3 *Forward Chaining Algorithm*

The forward chaining method is a tracking method that runs forward by collecting various facts and information obtained so that an appropriate conclusion is obtained [7]. Several systems can be completed using this method, including:

a) Expert system with one or more conditions.
b) For each condition, the system will look for rules based on knowledge to obtain conditions in the IF section.
c) Each rule will cause new conditions based on the conclusions needed in the THEN section. This new condition will later be added to other conditions that existed before.
d) Any conditions added will be directly processed by the system. Suppose the condition is the suitable condition for the desired conclusion. In that case, the system will repeat step two and research the rules in the knowledge base [8]. However, if no new conclusions are found, the session will end.

3. Results and Discussion

3.1 *Data Analysis*

At this stage, the author makes a rule on the symptoms and impacts of the accident.

a) Rules of the symptoms [9].

Table 2. Rule symptoms

Code	Symptoms
I01	Bleed
I02	Regular wound shape
I03	Unconscious
I04	Difficult to move
I05	Memory loss
I06	Bruised skin
I07	Swollen
I08	Nausea and vomiting
I09	Severe pain
I10	Pain when touched
I11	Blurred vision
I12	Festering

b) Rules on Diagnostics

Table 3. Diagnosis rules

Code	Diagnosis
R01	Concussion
R02	Faint
R03	Fracture
R04	stabbed
R05	Torn skin
R06	Bruises
R07	Scratches
R08	Panic Attack

c) Formation of a rule system of diagnostic experts caused by symptoms in an accident. Details of the expert system rules can be seen in Table 4.

Table 4. Expert system rules

Symptom	Diagnosis
I01(Concussion)	R03: Unconscious
	R05: Memory loss
	R08: Nausea and vomiting
I02 (Faint)	R03: Unconscious
	R11: Blurred vision
I03(Fractures)	R04: Difficult to move
	R09: Severe pain
I04 (Impaled)	R01: Bleed
	R02: Regular wound shape
I05(Torn Skin)	R01: Bleed
	R07: Swollen
I06 (Bruise)	R06: Bruised skin
	R10: Pain when touched
I07 (Blisters)	R01: Bleed
	R12: Festering

d) Decision Tree [10].
The decision tree is set up to know the flow of symptoms and diagnoses that will boil down to the results of the decisions. Details of the decision tree can be seen in Figure 1.

e) Decission Table
The decision table in this study references the agonizing incidence of accidents with various symptoms. The real possibility is done to identify the events that will occur. Details The decision table can be seen in Table 5.

3.2 *Flowchart Penggunaan Website*

The flowchart is used as a work step on the system when the user runs the expert system website. The flow of using the website can be seen in Figure 2.

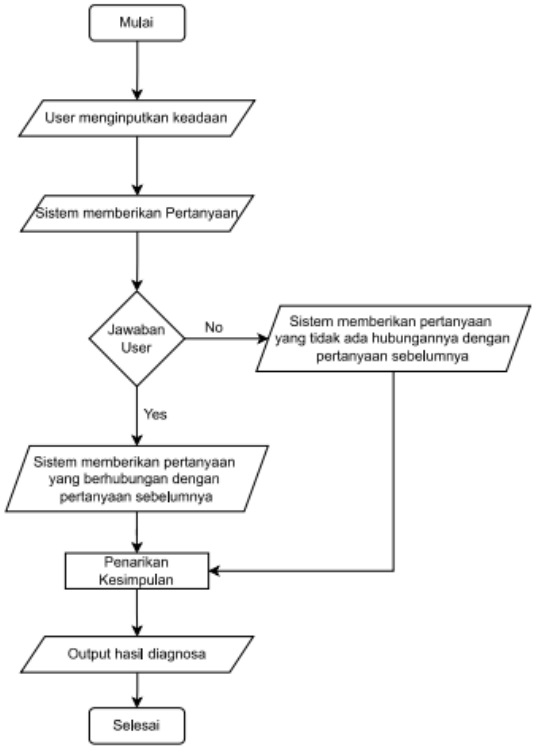

Figure 2. Flowchart of the use of the expert system website

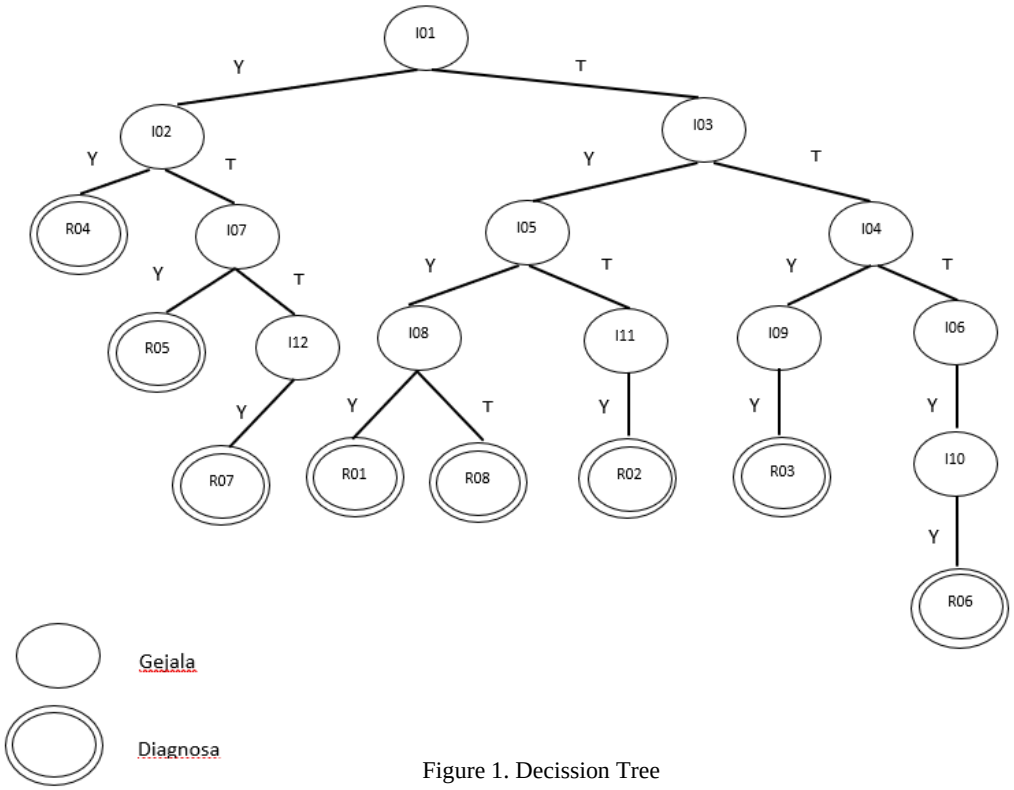

Figure 1. Decission Tree

Table 5. Expert-based decision matrix

Diagnosis		Symptoms											
		Bleed	Regular wound shape	Unconscious	Difficult to move	Memory loss	Bruised skin	Swollen	Nausea and vomiting	Severe pain	Pain when touched	Blurred vision	Festering
Diseases	Code	R01	R02	R03	R04	R05	R06	R07	R08	R09	R010	R011	R012
Concussion	I01			V		V			V				
Faint	I02			V								V	
Fracture	I03				V					V			
Stabbed	I04	V	V										
Torn skin	I05	V						V					
Bruises	I06						V				V		
Scratches	I07	V											V
Panic Attack	I08			V		V							

Table 6. Test the accuracy of the system

No	Testing	Symptom	Answer	Diagnostic results	Diagnosis Results according to Experts
1	Test 1	Bleed Unconscious Memory loss Nausea and vomiting	No Yes Yes Yes	Concussion	Concussion
2	Test 2	Bleed Unconscious Memory loss Blurred vision	No Yes No Yes	Faint	Faint
3	Test 3	Bleed Unconscious Difficult to move Severe pain	No No Yes Yes	Fracture	Unknown
4	Test 4	Bleed Regular wound shape	Yes Yes	Stabbed	Stabbed
5	Test 5	Bleed Regular wound shape Swollen	Yes No Yes	Torn skin	Torn skin
6	Test 6	Bleed Unconscious Difficult to move bruised skin Pain when touched	No No No Yes Yes	Bruises	Bruises
7	Test 7	Bleed Swollen Festering	Yes No Yes	Scratches	Scratches
8	Test 8	Bleed Unconscious Memory loss Nausea and vomiting	No Yes Yes No	Panic Attack	Panic Attack

3.3 *System Accuracy Testing*

This test is obtained based on the results of tests with health experts on victims of traffic accidents. Researchers allow experts to conduct experiments and be adapted to the expert's diagnosis. Based on accuracy testing with a match between diagnosis and symptom and compared between facts collected by the authors and health experts, it showed the system's accuracy at 87.5%. The accuracy results were obtained because there were still differences in test three (Table 6), where the author diagnosed that the result of the symptom was a fracture. In contrast, the results of the health expert could not determine the exact diagnosis of the symptoms that appeared.

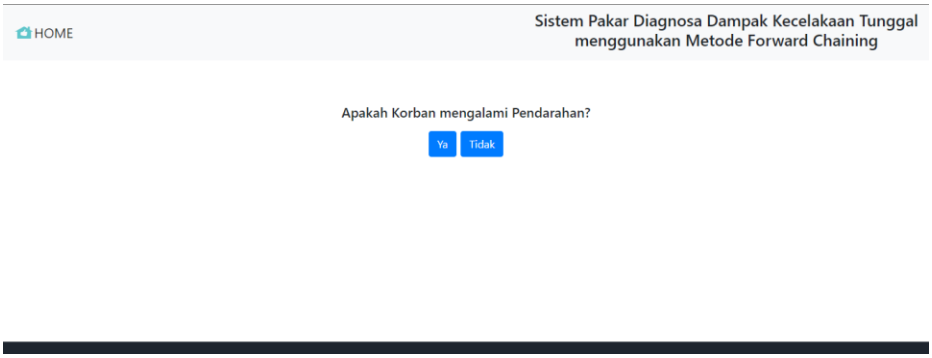

Figure 3. Symptom 1

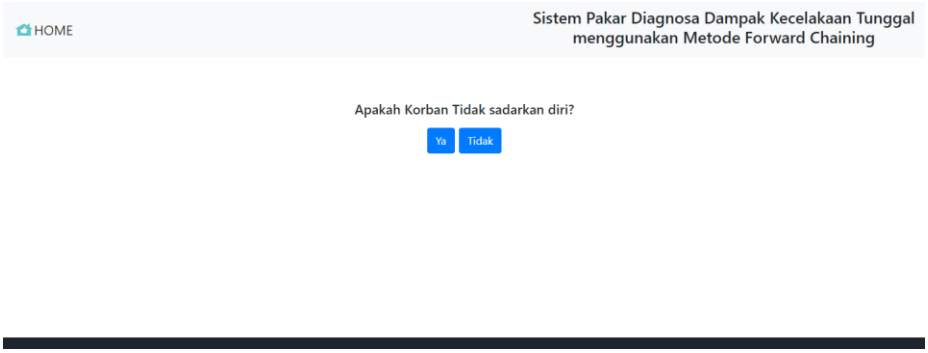

Figure 4. Symptom 2

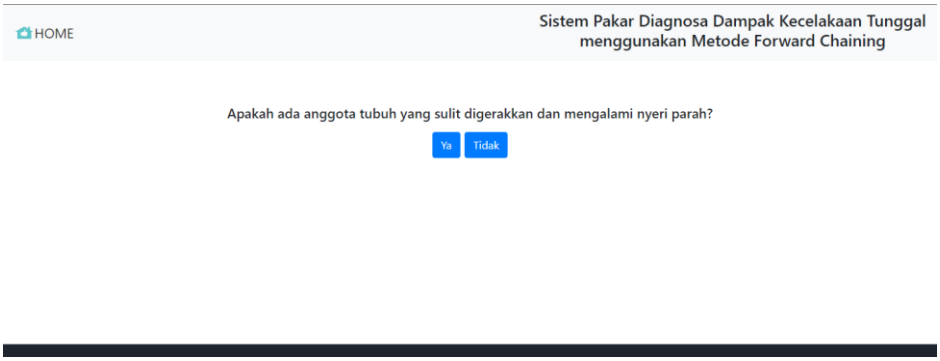

Figure 5. Symptom 3

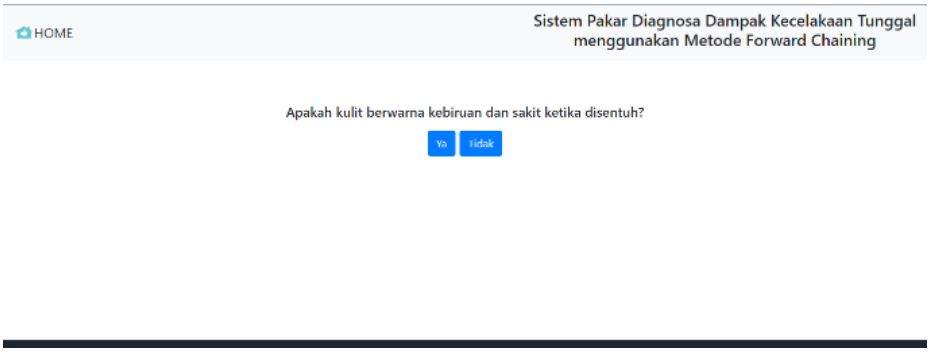

Figure 6. Symptom 4

Figure 7. Diagonostic Results

Figure 8. Diagnostic Printouts

3.4 *Interface Website*

The following explanation displays a web view if the user is diagnosed with a bruise.

a) Display of symptoms
The symptom display shows input from the user before performing the diagnosis. The user is directed to fill in some of the symptoms experienced on the appearance of symptoms. Details of the symptom display can be seen in Figures 3 to Figure 6.

b) Diagnostic interface
The diagnostic interface is used as information related to the results of the diagnostic conclusions. The diagnostics view includes information on the disease and the solution that the user should perform. Details of the display of diagnostic results can be seen in Figure 7 and Figure 8.

4. Conclusion

Based on the problems that have been discussed and resolved by the author, several conclusions can be drawn, including:

1. The expert system used by the author with the forward chaining method makes it easy for users to find the right first aid to be done to accident victims.
2. The expert system makes it easy to find the correct diagnosis from the health field based on the symptoms and injuries that appear in accident victims.

3. The system has an accuracy of 87.5% based on matching diagnoses of symptoms concluded by researchers with experts in the field of health. In addition, the following research suggests that there are still some obstacles to the system, one of which is better accuracy in concluding results because the data entered is less specific.

Acknowledgments

The author would like to thank all parties who are willing to be involved and cooperate in the process of completing this research from beginning to end.

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