
Application of Dempster Shafer to Diagnose Cholecystitis Based on Web

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Abstract

Cholecystitis is an inflammation of the gallbladder. The gallbladder is an organ where bile is stored, which is a fluid that plays an important role in the digestion of fat in the body. Data processing at Bangkatan Hospitals is currently still done by means of patients coming to the hospital and heading to the receptionist to carry out the process before meeting an expert (doctor), it makes patients have to queue and wait their turn to meet the doctor. The current lack of knowledge and information from the community/patients causes delays in handling the early symptoms of cholecystitis. This makes this research carried out by building an expert system that is able to diagnose cholecystitis. With the dempster shafer method, it is expected to be able to provide a high level of accuracy. From the calculation process using the Dempster Shafer method, it can be concluded that the disease suffered by the user is Acute Cholecystitis with a density value of 0.571 or 57.1%.

Keywords: Dempster Shafer, Cholecystitis, Expert System.

INTRODUCTION

Cholecystitis is the most common condition, it causes 90% of biliary diseases, and is the fifth leading cause of hospitalization at a young age. Data processing at Bangkatan Hospitals is currently still done by means of patients coming to the hospital and heading to the reception to carry out the process before meeting an expert (doctor), it makes patients have to queue and wait for their turn to meet the doctor. The current lack of knowledge and information from the community/patients causes delays in handling the early symptoms of cholecystitis.

According to Titien Sumarni et al (2006) The gallbladder (Cholecystitis) is a pear-shaped organ located on the lower surface of the right lobe of the liver. It is from the gallbladder that the cystic duct, 3 to 4 cm long, runs backwards and downwards to join the common hepatic duct and together form the common bile duct.

There are 2 types of cholecystitis, namely:

1. Acute Cholecystitis

According to Pangakalan Ide (2015, p.3) Acute cholecystitis is inflammation of the gallbladder wall, usually as a result of gallstones in the cystic duct, which suddenly causes attacks of excruciating pain.

2. Chronic Cholecystitis

Chronic cholecystitis is inflammation that occurs after a person has had acute cholecystitis for several times. Normally, bile should exit the gallbladder through its pathway to the small intestine. If bile flow is blocked, bile builds up in the gallbladder and then causes swelling, pain, and infection.

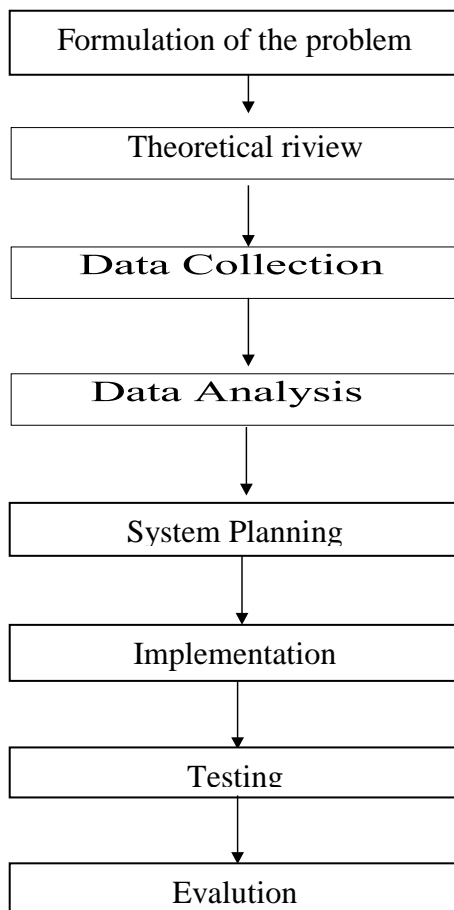
The aims of this research are as follows:

- a. To design and build a Cholecystitis diagnosis system using the Dempster Shafer method
- b. To make it easier for patients to consult without having to come to an expert
- c. To find out how the dempster shafer method works in diagnosing cholecystitis

According to Siswanto (2010, p.1) Expert System is an AI program with a knowledge base (Knowledge Base) obtained from the experience or knowledge of experts or experts in solving problems in certain fields and supported by an Interference Engine/Inference Engine that performs

reasoning or tracking of something. the facts and rules of the existing knowledge base after a search is carried out, so that a conclusion is reached.

RESEARCH METHODS



Based on the picture above, it can be explained that there are several stages used in making this application program, namely as follows:

Problem Formulation

This stage is the initial stage of research, namely by determining the background of the problem, objectives, and benefits of the research carried out by limiting the problem so that it does not get out of the focus of the discussion or thesis preparation.

Theory Study

This stage is to find information, sources related to the problems faced, both from literature studies, journals and the internet as a support and basic foundation for thesis writing.

Data Collection

This stage intends to collect research data such as symptoms and diseases of cholecystitis obtained from literature studies such as journals and books, observations and interviews with experts. Then the data for the Dempster Shafer method were obtained from journals and books.

Data Analysis

Data analysis is a process or effort to process data into new information so that the characteristics of the data become easier to understand and useful for solving problems, especially those related to research. At this stage, data analysis will be carried out using the Dempster Shafer method, the data will be calculated so that the results of the diagnosis of cholecystitis will be obtained.

System Design

Design is a depiction of the design and sketching or arrangement of several separate elements into a unified system that can be designed.

Implementation

At this stage, the implementation of the system is carried out in accordance with the design or concept that has been prepared in the previous stage. The form of system implementation is making an expert system application to diagnose cholecystitis using the Dempster Shafer method. The Dempster Shafer method is a mathematical theory that is used to prove based on belief functions and plausible reasoning. This method is used to combine separate pieces of information (evidence) to calculate the probability of an event.

System Testing and Testing

At this stage, after the implementation stage has been completed, at this stage testing the system is carried out whether the system can run as expected or not. Testing with 2 stages, namely testing the system performance using BlackBox Testing, and testing the expert system validation calculation process using the Dempster Shafer method. In addition, the author also calculates using accuracy, the accuracy value in question is to determine the percentage of accuracy in the classification process for the tested data, the level of accuracy is calculated by the formula:

Evaluation

This stage draws conclusions and suggestions that can be made in the preparation of the thesis. With the conclusion, the results of the entire thesis will be known and it is hoped that with suggestions there will be improvements and other benefits.

Shafer's Dempster Method

According to the journal Arthur P. Dempster and Glenn Shafer. Dempster Shafer is a mathematical theory that aims to prove based on belief function and plausible reasoning, which is used to combine separate pieces of information (evidence) to calculate the probability of an event (Kurniawati Pratama, 2014).

In general, the Dempster-Shafer theory is written in an interval:

[Belief,Plausibility]

Belief (Bel) is a measure of the strength of evidence in supporting a set of propositions. If it is 0 then it indicates that there is no evidence, and if it is 1, it indicates certainty. Where the value of the belief is (0-0.9). Belief function can be formulated and shown in equation (1):

$$Pls(X) = 1 - Bel(X) = 1 - \sum_{Y \subset X} m(Y)$$

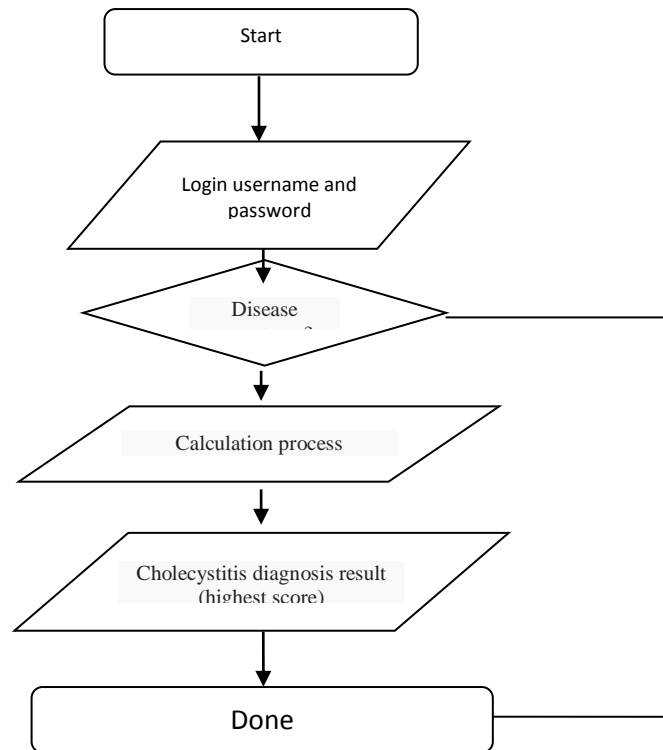
If it is known that X is a subset of , with m1 as a density function, and Y is also a subset of with m2 as a density function, then the combination function of m1 and m2 as m3, can be formed:

$$m_3(Z) = \frac{\sum_{X \cap Y = Z} m_1(X).m_2(Y)}{1 - \sum_{X \cap Y = \emptyset} m_1(X).m_2(Y)}$$

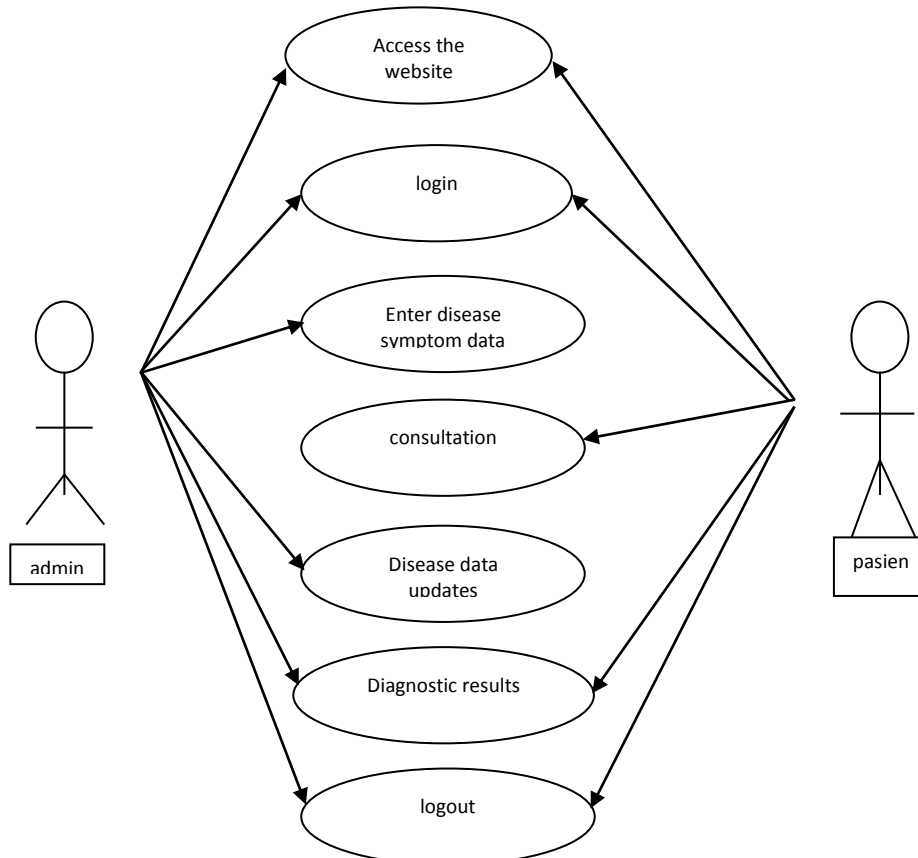
System planning

In designing an expert system to diagnose cholecystitis, the author uses the Dempster Shafer method in solving the problem. The design of this system includes:

Disease Diagnosis Flowchart



Picture 1. Disease Diagnosis Flowchart



Picture 2. Use Case Diagram Of The Disease

RESULTS AND DISCUSSION

In this study the data needed for research to be calculated using the Dempster Shafer method.

Table 1. Cholecystitis Disease Data

Code	Disease Name
P01	Acute cholecystitis
P02	Chronic cholecystitis

Table 2. Data on Symptoms of Cholecystitis

Code	Symptom
G01	Stomach pain that feels sharp and gets worse when you take a deep breath
G02	Nausea,vomiting,bloating,and loss of appetite
G03	Fever
G04	Skind and eyes turn yellow
G05	Lump in stomach
G06	Stools that are claycolored/pale
G07	Gallbladder tissue dies and rots
G08	Gallbladder rupture
G09	Infection of the abdominal cavity due to rupture of the gallbladder (peritonitis)
G10	Accumulation of pus (abscess) in the gallbladder

Table 3. Disease Knowledge Base

Kode	Gejala	P01	P02
G01	Stomach pain that feels sharp and gets worse when you take a deep breath	*	*
G02	Nausea,vomiting,bloating,and loss of appetite	*	
G03	Fever	*	
G04	Skind and eyes turn yellow	*	
G05	Lump in stomach	*	
G06	Stools that are claycolored/pale	*	
G07	Gallbladder tissue dies and rots		*
G08	Gallbladder rupture		*
G09	Infection of the abdominal cavity due to rupture of the gallbladder (peritonitis)		*
G10	Accumulation of pus (abscess) in the gallbladder		*

Application of the Method

The data needed in the process of analyzing expert systems to diagnose cholecystitis with the Dempster Shafer method are pure data obtained from interviews by internal medicine experts by taking diseases and symptoms that are often suffered by sufferers.

Table 4. Rule Base (Rule)

Disease Id	Disease Name	Sympton / Rule
P01	Acute cholecystitis	G01, G02, G03, G04, G05, G06
P02	Chronic cholecystitis	G01,G07, G08, G09, G10

In the research that the author did, there were each symptom that we had to convert to a certain value so that the calculation process could be carried out. To get the value of each symptom the author assumes based on expert knowledge.

Table 5. Value for each symptom

Disease Code	Disease Name	Symton Id	Rate each symptom
P001	Acute cholecystitis	G01	0,80
		G02	0,60
		G03	0,72
		G04	0,65
		G05	0,75
		G06	0,71
P002	Chronic cholecystitis	G01	0,80
		G07	0,70
		G08	0,65
		G09	0,82
		G10	0,73

In fact, the type of acute cholecystitis disease can have the same symptoms as chronic cholecystitis, or in other words a symptom can be a symptom of cholecystitis in some patients. There are 4 symptoms of acute cholecystitis that will be calculated, namely:

- G01 Stomach pain that feels sharp and gets worse when taking a deep breath
- G02 Nausea, vomiting, bloating, and loss of appetite
- G07 Gallbladder tissue is dead and rotting
- G08 Gallbladder rupture

The first thing to do is look at G1 and G2.

a. Symptom 1 (G01 = Abdominal pain that feels sharp and gets worse when taking a deep breath)

Symptoms 01 are for Acute Cholecystitis (P01) and Chronic Cholecystitis (P02) with:

$$m_1\{P01,P02\} = 0,80$$

$$m_1\{\theta\} = 1 - 0,80 = 0,20$$

Symptoms (G02 = Nausea, vomiting, bloating, and loss of appetite) Symptoms of G02 are symptoms for Acute Cholecystitis (P1) with:

$$m_2\{P01\} = 0,60$$

$$m_2\{\theta\} = 1 - 0,60 = 0,40$$

Recalculate the new density value for each subset of the function with the density function m3. The combination rules for m3 are as shown in the table below.

Table 6. Acombination rule of m3

	$m_2\{P01\} = 0,60$	$m_2\{\theta\} = 0,40$
$m_1\{P01,P02\} = 0,80$	$\{P01\} = 0,480$	$\{P01,P02\} = 0,320$
$m_1\{\theta\} = 0,20$	$\{P01\} = 0,120$	$\{\theta\} = 0,080$

So it can be calculated as follows:

$$m_3\{P01\} = \frac{0,480+0,120}{1-0} = 0,600$$

$$m_3\{P01,P02\} = \frac{0,320}{1-0} = 0,320$$

$$m_3\{\theta\} = \frac{0,080}{1-0} = 0,080$$

c. Symptoms (G07 = Dead and rotting gallbladder tissue)

Symptoms of G07 are symptoms for Chronic Cholecystitis (P2) with:

$$m_4\{P01\} = 0,70$$

$$m_4\{\theta\} = 1-0,70 = 0,30$$

Table 7. acombination rule omm5

	$m_4\{P02\} = 0,70$	$m_4\{\theta\} = 0,30$
$m_3\{P01\} = 0,600$	$\{\emptyset\} = 0,420$	$\{P01\} = 0,180$
$m_3\{P01,P02\} = 0,320$	$\{P02\} = 0,224$	$\{P01,P02\} = 0,096$
$m_3\{\theta\} = 0,080$	$\{P02\} = 0,056$	$\{\theta\} = 0,024$

So it can be calculated as follows:

$$m_5\{P01\} = \frac{0,180}{1-0,420} = \frac{0,180}{0,58} = 0,310$$

$$m_5\{P02\} = \frac{0,224+0,056}{0,58} = 0,482$$

$$m_5\{P01,P02\} = \frac{0,096}{0,58} = 0,165$$

$$m_5\{\theta\} = \frac{0,024}{0,58} = 0,041$$

d. Symptoms (G08 = Ruptured gallbladder)

Symptoms of G04 are symptoms for Chronic Cholecystitis (P2) with:

$$m_6\{P01\} = 0,65$$

$$m_6\{\theta\} = 1-0,65 = 0,35$$

Table 8. Acombination rule of m7

	$m_6\{P02\} = 0,83$	$m_6\{\theta\} = 0,17$
$m_5\{P01\} = 0,310$	$\emptyset = 0,201$	$\{P01\} = 0,108$
$m_5\{P02\} = 0,482$	$\{P02\} = 0,313$	$\{P02\} = 0,168$
$m_5\{P01,P02\} = 0,165$	$\{P02\} = 0,107$	$\{P01,P02\} = 0,057$
$m_5\{\theta\} = 0,041$	$\{P02\} = 0,026$	$\{\theta\} = 0,014$

So it can be calculated as follows :

$$m_7\{P01\} = \frac{0,108}{1-0,201} = \frac{0,108}{0,799} = 0,135$$

$$m_7\{P02\} = \frac{0,313+0,107+0,026+0,168}{0,799} = \frac{0,614}{0,799} = 0,768$$

$$m_7 \{P01,P02\} = \frac{0,057}{0,799} = 0,071$$

$$m_7 \{ \theta \} = \frac{0,014}{0,799} = 0,017$$

Based on these symptoms which have been calculated for Acute Cholecystitis, the strongest density value is $m_7(P02)$ which is 0.768 or if it is used as a percentage it is 76.8%.

CONCLUSION

From the results of research to diagnose cholecystitis using the Dempster Shafer method, it can be concluded that:

1. The Dempster Shafer method can be applied to diagnose cholecystitis so that it can help the general public to diagnose cholecystitis early.
2. With this expert system, based on the accuracy that has been calculated by the Dempster Shafer method, it produces an accuracy rate of 57.1%.
3. There are facilities for admins or experts to manage articles related to this disease, so that after this research is completed, the data can be managed and developed

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