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EXPERT SYSTEM FOR TYPHOID FEVER DISEASE DIAGNOSIS USING A WEB-BASED APPLICATION

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Abstract. Indonesia is one of the tropical countries. High rainfall coupled with population density in the Indonesian region has resulted in various diseases. One of the most common diseases in Indonesia is typhoid fever. The incidence of typhoid fever in Indonesia is estimated at an average of 900,000 cases per year with more than 20,000 deaths. The expert system is the latest innovation in detecting an initial condition. Expert systems can be implemented in the health sector, one of which is a system of expert diagnosis that is useful for diagnosing diseases with symptoms of fever in humans by looking at the characteristics and symptoms experienced by patients. This study aims to diagnose typhoid fever caused by symptoms of fever in patients. This research method is a development research method using the sanders method which includes problem definition, system analysis, system design, and system implementation. The results of this study, this method provides an accurate assessment with a percentage reaching 72.2% can be used as a reference for the accuracy of diagnosis to prevent typhoid fever.

Keywords: Expert systems, Fever and Typhoid fever

1. Introduction

In this globalization era, the usage of information technology has been very rapid. The usage of technology will change the point of view and mindset in life. The utilization of information technology has been developed in any fields, among of them are in education, business, health, or other fields. In the world of health, the utilization of information technology is also a factor that can help to conduct activities like giving service, selling, and marketing of a hospital. One of the diseases that often appear is the disease caused by infection and tropical parasite [P. F. Aprilliani and H. Mustafidah, 2017]. Tropical area has helped the life of various pathogen groups like protozoa, worm, and mosquito which settle in the human organs. One of the disease that is included with infection and parasite that often happens in Indonesia is the Typhoid fever.

The incidence of the typhoid fever in Indonesia is estimated at an average of 900,000 cases per year with more than 20,000 deaths. Based on the case study of the typhoid fever in Indonesia, it shows morbidity rate that is tend to increase every year with the average of 500 per 100.000 people [E. Apriyadi and I. Sarwili, 2018]. The people that suffer from the tropical disease of course need a doctor to diagnose the disease they suffer. The situation can be prevented if the people have a little knowledge about health. Expert system is very helpful in preventing a tropical disease. Expert system works by analyzing a symptom that is suffered by a patient [H. Sujadi and E. Suhaeni, 2016]. The output of the analysis is that the patient gets a symptom diagnosis of the typhoid fever disease.

This research describes about the expert system that can help to detect a disease in the earlier stage in order to overcome and get the right medication. Beside that, the expert system for diagnosis is also able to help a lot in identifying a disease and describing what treatment method should be applied (Patra

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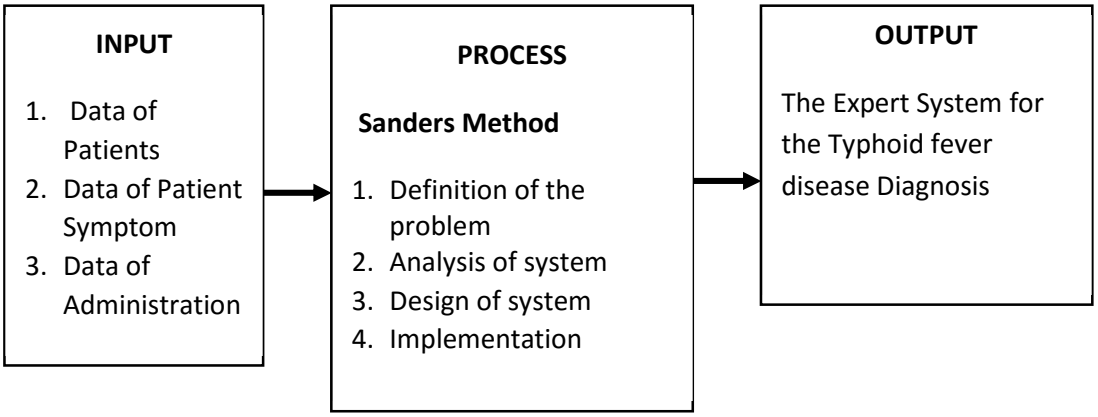
et al,2010). The expert system is considered to be able to help the medical experts in diagnosing a disease and giving a good health service to the patients and also can decrease the number of queue in a hospital (Adewole et al, 2014).

Based on the background above, the main solution in realizing the degree of health in Indonesia is applying an expert system to the Typhoid fever with the WEB based fever initial symptom.

2. Research Methodology

2.1. Conceptual framework

The research conceptual framework that is used in the making of the expert system to the typhoid fever disease with WEB based fever initial symptom



Picture 1 Conceptual Framework

The research conceptual framework describes that in the input stage, the researcher will input the data of patients, data of patient symptom obtained from expert, and data of administration clerk that manages the process of expert system. In the process stage, the researcher conducts the research by using Sanders Method which is introduced by Sanders in Jogiyanto book (1995). In the output stage, the expert system will conduct a counting of the patient symptom data result by using Dempster-Shafer method to obtain the patient symptom diagnosis result.

2.1.1. Definition of the Problem

Jember Regency is one of the regencies in East Java province that is located in the eastern area and included in the area of Besuki Residency [T. Hidayat, 2014]. Jember is one of the cities with a high number of the typhoid fever sufferers. Health Department of Jember Regency found 15.994 cases of the typhoid fever during January until December 2012. The research [M. L. Hafi, 2014] states that the Typhoid fever disease will settle and persist in Jember in a long period of time.

2.1.2. Analysis System

In analysis system, there are some attributes that is used as a base to help to detect the typhoid fever, which are :

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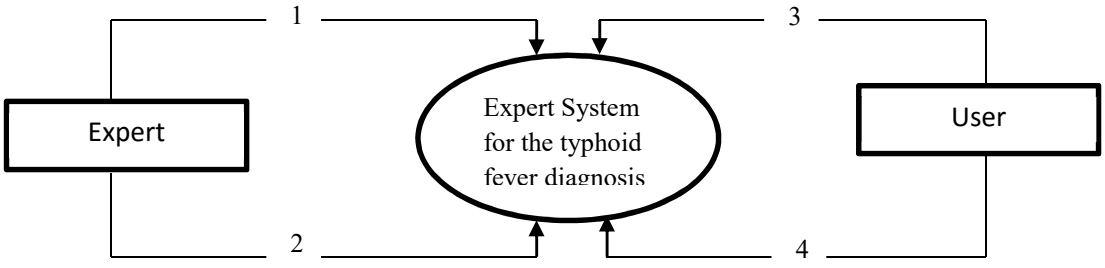
Table 1. Attributes of the Typhoid fever symptom

No	Symptoms	Typhus	Expert Result
1	Fever	yes	0,3
2	Liquid feces	yes	0,4
3	Aches and pains in the muscles	yes	0,3
4	Red rash on skin	no	0,1
5	Headache	yes	0,5
6	Nausea and Vomiting	yes	0,6
7	Weak and lethargic	yes	0,6
8	Stomachache	yes	0,4
9	Decreasing appetite	yes	0,6
10	Dehydration	no	0,1
11	Stomach pain	yes	0,7
12	Skin color and whites of the eyes turn yellow	no	0,1
13	Pain in the back of the eye	yes	0,4
14	Tongue looks dirty	yes	0,8
15	Slimy liquid feces	no	0,1
16	White colored feces	no	0,1
17	Nosebleed	no	0,1

The table above explains that some of 'yes' attributes show the happen of typhoid fever disease that is often experienced by patients and in those attributes there are also the values obtained from the expert so that the researcher uses the table as a guidance to make the application. So, the researcher finishes by using Demptser-Shafer method.

2.1.3. Design of System

In this stage, it explains about the design of system of this research



Information :

1. Input symptom about disease
2. Show the list of the disease symptom
3. Answer question existed in expert system
4. Give the result of typhoid fever disease diagnosis

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2.2. Dempster-Shafer Method

This method is introduced by Demptster. In Dempter-Shafer method, the uncertainty model has been conducted with range probabilities. In 1976, Shafer published the Dempster theory in a book titled Mathematical theory of Evident. Demptster-Shafer method Theory of Evidence shows how to give weight of confidence based on the obtained facts. This theory can distinguish between uncertainty and ignorance. Dempster-Shafer theory is a representation, a combination, and a propagation of uncertainty where this theory has some characteristics that even though it is institutively suitable with the way of thinking of an expert, it has a strong basic of mathematic. Generally, the Dempster-Shafer theory is written in an interval: [Belief,Plausibility]. Belief (Bel) is the measurement of evidence strength in supporting a set of propositions. If it values 0, it indicates that there is no evidence. If it values 1, it indicates that there is a certainty. Plausibility (Pls) will reduce the level of certainty of the evidence. Plausibility values 0 until 1. If there is belief in X', it can be said that Bel (X') = 1, so that the formula above the value of Pls (X) = 0.

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

Mean while, Plausibility (Pls) can be notated as follows

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

dimana :
Bel (X) = *Belief* (X)
Pls (X) = *Plausibility* (X)
m (X) = *mass function* dari (X)
m (Y) = *mass function* dari (Y)

3. Experiment and result

Because the tracing process applies Dempster-Shafter method, counting the diagnosis Dempster-Shafer value is chosen by using belief value that has been determined in every symptom. Pl(Θ) = 1 – Bel where the Bel value (belief) is a weight value input by expert. For example, a patient comes and shows that he/she has symptom like fever, pain in stomach, weak and lethargic, and tongue looks dirty.

- Symptom 1 : fever
  Θ = 1 – 0,3
  = 0,7
- Symptom 2 : pain in stomach
  Θ = 1 – 0,7
  = 0,3
- Symptom 3 : weak and lethargic
  Θ = 1 – 0,6
  = 0,4
- Symptom 4 : tongue looks dirty
  Θ = 1 – 0,8
  = 0,2

With the appearance of those 4 symptoms; fever, pain in stomach, weak and lethargic, and tongue looks dirty, a new density counting must be conducted for some combinations (m5). To make the counting easy, the sets of the formed part is input into the table. The first column is fulfilled with the first symptom (m1). The second column is fulfilled with the second symptom (m2). The third column is fulfilled with the third symptom (m3). The fourth column is fulfilled with the fourth symptom (m4). So that m5 value is obtained as the combination result of m1, m2, m3, and m4.

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Table 2. Dempster-Shafer method calculation

	{T}	0,3	Θ	0,7	{T}	0,6	Θ	0,8
0,7	{T}	0,21	Θ	0,49	{T}	0,42	Θ	0,44
0,3	{T}	0,09	Θ	0,21	{T}	0,18	Θ	0,24
0,4	{T}	0,12	Θ	0,18	{T}	0,24	Θ	0,12
0,2	{T}	0,06	Θ	0,14	{T}	0,12	Θ	0,16

so that it can be counted :

$$m5\,\{T\} = \frac{(0{,}21) + (0{,}09) + (0{,}12) + (0{,}06) + (0{,}42) + (0{,}18) + (0{,}24) + (0{,}12)}{(0{,}49) + (0{,}21) + (0{,}18) + (0{,}14) + (0{,}44) + (0{,}24) + (0{,}12) + (0{,}16)} = \frac{(1{,}44)}{(0{,}98)} = 0{,}722$$

From the counting result of m5 density value combination above, it can be seen that the value of {T} is higher than the other symptoms with the density 0,722. It is because the density value is more than 0,5 so that it can be detected as the typhoid fever disease.

System testing conducted answers all questions given by system with the answer Yes or No.

Picture 3. Form Filling Patient Complaints

After all questions are answered the system will display the diagnosis results and the percentage of disease reporting.

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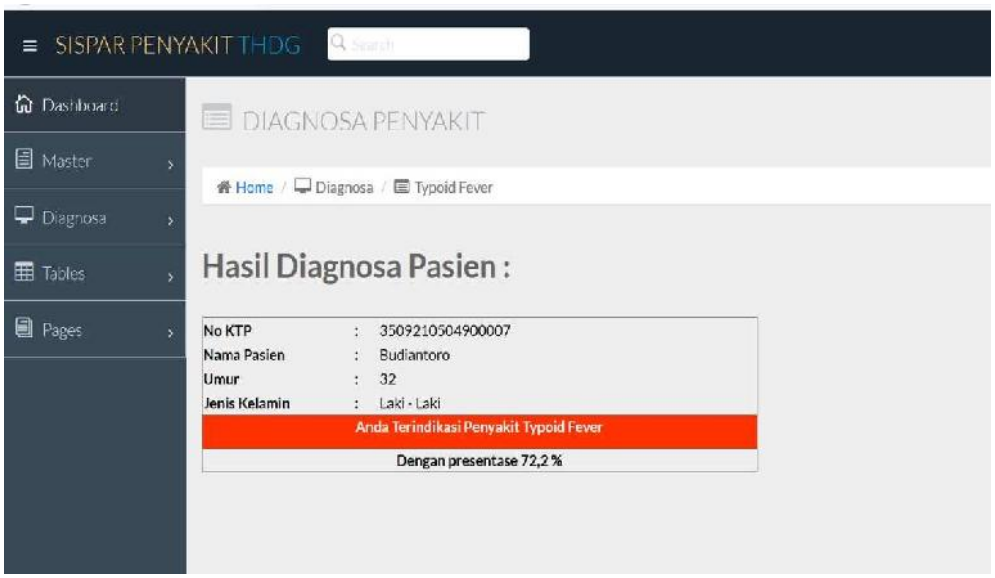

Figure 4. Diagnosis Results Form

4. Conclusion

Based on the conducted discussion, it can be concluded that Health Department of Jember Regency has found 15.994 cases of the typhoid fever. The typhoid fever disease will settle and persist in Jember in a long period of time. There are 17 attributes of the disease symptoms in the analysis of system need. Dempster-Shafer method is an uncertainty model in analyzing an expert system. The method gives recommendation of an accurate counting to be regarded as a reference of a precise diagnosis to detect the typhoid fever disease.

Suggestion

a. It needs to be developed to become an android based expert system.
b. It needs to add a detection using laboratory result so that the precise of diagnosis become more accurate.

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