

Web-Based Expert System for Diagnosis Mycetoma Using Dempster-Shafer Methods

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Abstract

Health is very important and valuable for humans, because without good health, every human being will experience difficulties in carrying out their daily activities. Mycetoma disease, also known as fungal infection and flesh-eating disease, affects people who live in rural or remote areas and have limited access to health care and medicines. So to overcome this problem, we need an expert system that is able to diagnose mycetoma based on the symptoms suffered. The expert system for diagnosing mycetoma using the Dempster Shafer method is designed as a tool for early identification of mycetoma. The Dempster Shafer method was chosen because data collection (weight) for the Dempster Shafer calculation is relatively easy to do just by giving an expert's trust value for a symptom. The calculation process for obtaining conclusions is also relatively easy to do because in the calculations the Dempster-Shafer theory only involves the probabilities of all possible diseases from each symptom.

Keywords: Expert System, Mycetoma, Dempster Shafer

INTRODUCTION

Health is very important and valuable for humans, because without good health, every human being will experience difficulties in carrying out their daily activities. Ironically, at this time there are still many who are less sensitive to health problems that show mild symptoms they suffer and consider trivial the symptoms they cause and think they will heal by themselves. Until the time comes, these symptoms are very disturbing to the body physically, so the sufferer has just checked himself into the doctor, but often it is too late because these symptoms have reached a more serious stage of the disease. One of them is an infectious disease caused by bacteria and viruses. [4]

Mycetoma disease is known as a fungal and flesh-eating infection that can damage the skin, muscles and even bones if it enters a person's body. This disease grows slowly in the body over many years. Even though this disease is actually not too fatal or fatal for someone, this disease can destroy the lives of sufferers. [9]

The disease affects people living in rural or remote areas where they have limited access to health care and medicines. So to overcome this problem, we need an expert system that is able to diagnose mycetoma based on the symptoms suffered. An expert system is an application or computer program designed to make decisions like those made by an expert. Where the source of knowledge in the expert system is the result of the thought of an expert who is an expert in his field [9]. So that users can consult an expert system, it is appropriate to consult directly with an expert in Skin and Gender Specialist. Because research on the expert system for diagnosing mycetoma has never been studied, the authors are interested in taking up this topic.

The expert system for diagnosing mycetoma using the Dempster Shafer method is designed as a tool for early identification of mycetoma. This diagnostic expert system has input in the form of symptom data and an overview of mycetoma. Mycetoma initially appears as a small wound, but over time it can enlarge, expand the wound and cause those affected to become disabled or even unusable. If the mycetoma is not treated, it can spread to other areas of the body. Early detection and treatment can also reduce the disability caused by mycetoma and can cure the condition. Treatment or therapy if you have been infected with mycetoma is carried out for a long time and can be expensive. If exposed to Actinomycetoma or mycetoma caused by bacteria and mild symptoms can be treated with antibiotics.

And if infected with Eumycetoma or mycetoma caused by fungus, it is usually treated with antifungal drugs. Often, however, treatment is ineffective and requires surgery or amputation to remove severely infected tissue.

Previous research using the Dempster Shafer method, namely D.T. Yuwono, A. Fadlil, and S. Sunardi, "Implementation of the Dempster Shafer Method in Expert Systems for Diagnosing Personality Disorders". The resulting accuracy is 85%. and the use of the Dempster Shafer method has been carried out in diagnosing the disease caused by Salmonella bacteria. This study uses 8 types of disease and 23 symptoms of the disease. The end result of the expert system using this method is a disease with a certainty value of 77.2% [5]. This method has a high degree of certainty in diagnosing a disease.

Method

Expert System

An expert system is a branch of AI (Artificial Intelligence) that makes users widely specialized to solve expert human-level problems [10]. An expert is a person who has expertise in a particular field who has special abilities that other people do not know and can do in the field he has. Expert systems are widely used in various fields of industry, business, medicine, military, agriculture, tourism, education, communication and transportation and so on.

In general, an expert system (Expert System) is a computer application that is shown to help make decision or solve a problem in a specific field. This system works in the field of knowledge by analyzing what has been defined in advance by an expert according to his expertise, this system is called an expert system because it has knowledge, experience in solving a problem [1].

Mycetoma

Mycetoma disease is a clinical syndrome characterized by a triad of swelling, formation of sinuses and granules caused by the Eumycetes fungus and Actinomycetes bacteria. These two diseases need to be distinguished considering that the course of the disease, treatment, response to treatment, and the prognosis are very different.

Although in some literature it is stated that this disease is rare in Indonesia, we need to know more about this disease. Treatment for eumycetoma for 1-2 years or older, with ketoconazole 400 mg/day, or itraconazole 300 mg/day, or amphotericin-B

50 mg/day intravenously in an adult weighing 70 kg has shown good results in some cases. [11].

Dempster-Shafer Method

Dempster Shafer is a mathematical theory for proof based on belief functions and plausible reasoning, which are used to combine separate pieces of information (evidence) to calculate the probability of an event. This theory was developed by Arthur P. Dempster and Glenn Shafer. In general, Dempster Shafer's theory is written in an interval [2].

Belief (bell) is a measure of the strength of evidence in supporting a set of propositions. If it has a value of 0 then it indicates that there is no evidence, and if it has a value of 1 it indicates certainty.

Plausibility (Pl) denoted as:

$$Pl(s) = 1 - Bel(-s)$$

Plausibility is also worth 0 to 1. If you are sure of $\neg s$, then it can be said that $Bel(-s) = 1$, and $Pl(-s) = 0$. Plausibility will reduce the level of trust in the evidence. In Dempster Shafer's theory, we recognize that there is a frame of discernment denoted by m . This frame is the universe of discussion from a set of hypotheses.

Example: $\Theta = \{K01, K02, K03\}$

with:

P01 = mild mycetoma;

P02 = moderate mycetoma;

P03 = severe mycetoma;

The aim is to relate the measure of trust with the elements of Θ . Not all evidence directly supports each

element. For example hot may only support {P01, P02, P03}.

For that we need a density function (m). The m value defines not only the elements of Θ , but also all of its subsets. And it must show that the sum of all m in the subset Θ is equal to 1. Suppose there is no information whatsoever to choose the four hypotheses, then value of $m\{\Theta\} = 1.0$

Suppose it is known that X is a subset of Θ , with m_1 as the density function, and Y is also a subset of Θ with m_2 as the density function, then we can form the combination function m_1 and m_2 as m_3 , using the rule known as Dempster's Rule of Combination [3].

$$m_i(Z) = \frac{\sum_{x \cap y = z} m_{(i-2)}(X) \cdot m_{(i-1)}(Y)}{1 - \sum_{x \cap y = \emptyset} m_{(i-2)}(X) \cdot m_{(i-1)}(Y)} \quad , i = 3, 5, 7, 9, \dots$$

information:

$m_1(X)$ is the massfunction of evidence X

$m_2(Y)$ is the massfunction of evidence Y

$m_3(Z)$ is the massfunction of evidence Z

The research process will be carried out through several steps starting from the study of the literature to drawing conclusions which will be illustrated by the research flow chart according to Figure 1.

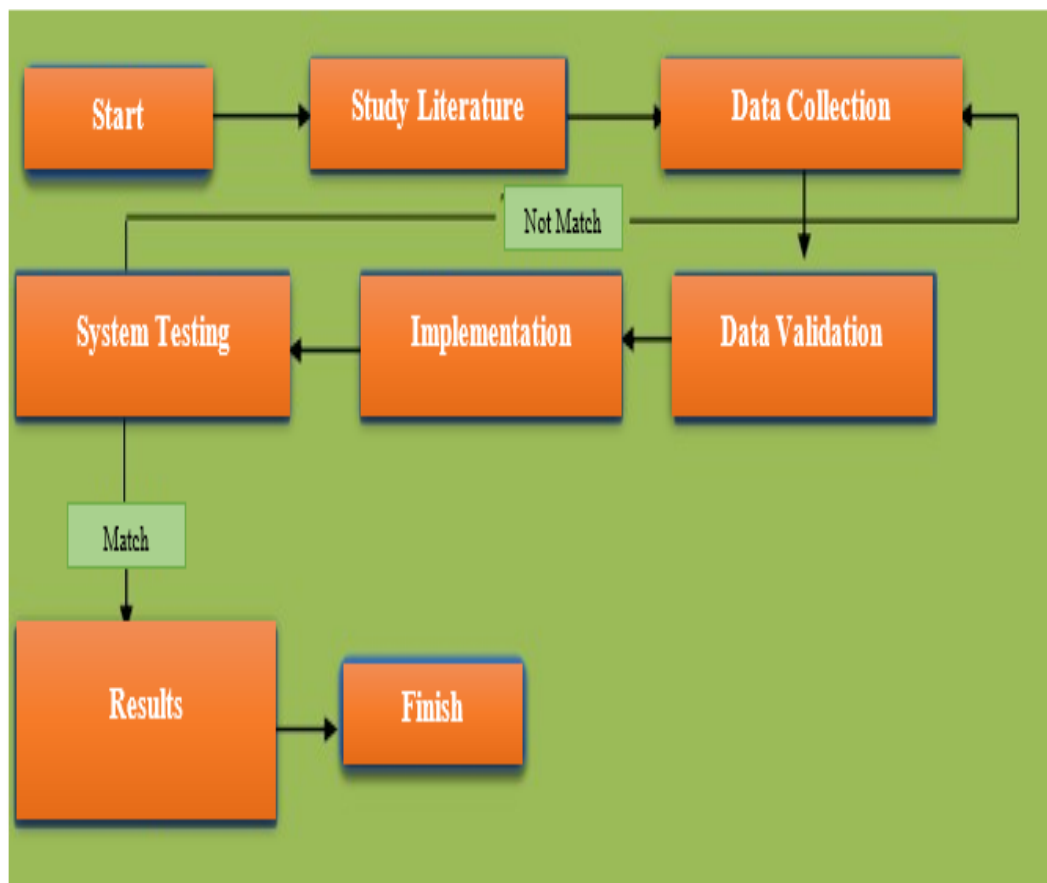


Figure 1. Mycetoma expert system research process

Below is a system architecture overview of the overall system work process. The general architecture of this system can be seen in Figure 2.

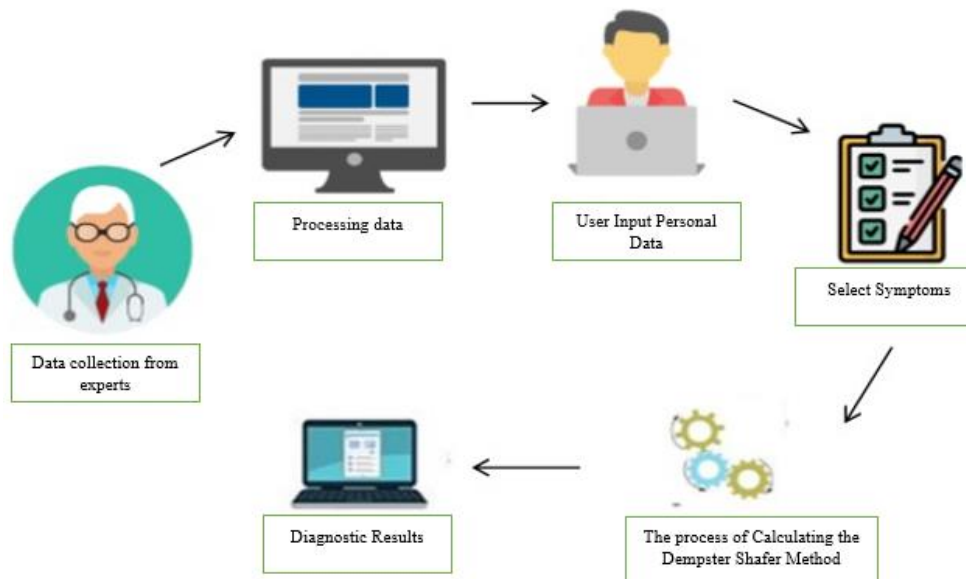


Figure 2. System Architecture

Based on the general architecture, it can be explained in Figure 2 which can be concluded that the flow of the system design is: Research must meet directly with skin and genital specialists, then be able to obtain data from these experts. Then the data can be processed with the help of researchers and can be used as an information base in a device that can be designed. After the system is designed, the user can fill in the identity of the data themselves, and be directed to the user to carry out the test. Users can choose the questionnaire form that has been provided by using the available checklist input. Then the data will be used in the search process using the dempster-shafer method. Then the system will display the results of the diagnosis of the disease which will be displayed to the user.

RESULTS & DISCUSSION

The knowledge base is a component that contains knowledge that comes from experts, contains a set of facts and rules [1]. The following is the formation of mycetoma level rules, mycetoma symptoms, and belief values obtained from the results of interviews with Dermatology and Venereology Specialists based on the percentage likelihood that a person will experience mycetoma symptoms.

Table 1. Mycetoma Belief Symptoms and Value

Code	Symptoms	Belief Value
G01	Redness of the Skin	0.4
G02	A painless lump appears under the skin	0.6
G03	Erosion (skin redness, swelling, blistering, and pain when pressed)	0.6
G04	Swelling	0.8
G05	Itching or swelling in the infected area	0.8
G06	Burning, sore or sore sensation in the infected area	0.8
G07	The lump becomes an open infection and appears as several small holes or ulcers that contain fungus	0.95
G08	The bumps are red	0.8
G09	Lumps filled with fluid like small grains	0.85

G10	Lumps filled with blood	0.85
G11	Widening of the infected area	0.8
G12	Lumps filled with pus	0.8
G13	The lump is painful	0.8
G14	Loss of body function	0.85
G15	Deformity of the infected area	0.9
G16	Affects hairless skin (face, trunk, arms, legs)	0.85
G17	Located on the hand (wrist to the end of the hand)	0.8
G18	Attacks the palms or soles of the feet	1

The discussion in this research is to try out the Dempster Shafer method to be able to diagnose mycetoma with the symptoms experienced by patients so that the Dempster Shafer method can be implemented into an expert system.

Data on the Dempster Shafer method requires an expert to determine a belief value (density value), then with the belief value there will be a plausibility value. The system process is in the form of a selection of symptom data found in patients. Suppose a patient has the symptoms listed in table 2 as follows:

Table 2. Suffering Symptoms		
Symptoms Code	Symptoms	Weight
G01	Redness of the Skin	0.4
G02	A painless lump appears under the skin	0.6
G07	The lump becomes an open infection and appears as several small holes or ulcers that contain fungus	0.95
G09	Lumps filled with fluid like small grains	0.85
G12	Lumps filled with pus	0.8

a. G01 Symptoms: Redness of the Skin

$$m1\{P01\} = 0.4/1 = 0.4$$

$$m1\{\emptyset\} = 1 - 0.4 = 0.6$$

b. G02 Symptoms: A painless lump appears under the skin

$$m2\{P01\} = 0.6/1 = 0.6$$

$$m2\{\emptyset\} = 1 - 0.6 = 0.4$$

Based on the two calculations above, a combination of m1 and m2 is obtained as shown in Table 3.

Table 3. M3 Combination Rules for Testing of Theoretical Calculations

m1	m2	
	m2 {P01} = 0.4	m2 {θ} = 0.4
m1 {P01} = 0.4	{P01} = 0.4 x 0.4 = 0.16	{P01} = 0.4 x 0.4 = 0.16
m1 {θ} = 0.6	{P01} = 0.4 x 0.6 = 0.24	{θ} = 0.6 x 0.4 = 0.16

So that m3 can be calculated as follows:

$$m3 \{P01\} = \frac{0.16+0.24+0.16}{1} = 0.56$$

$$m3 \{\theta\} = 0.16/1 = 0.16$$

c. G07 Symtopms: A painless lump appears under the skin

$$m4 \{P01\} = 0.95/1 = 0.95$$

$$m4 \{\theta\} = 1 - 0.95 = 0.05$$

Similar to G01 and G02, then based on the two calculations mentioned above, a combination of m2 and m3 is obtained as shown in Table 4.

Table 4. M5 Combination Rules for Testing Examples of Theoretical Calculations

m3	m4	
	m4 {P01} = 0.95	m4 {θ} = 0.05
m3 {P01} = 0.56	{P01} = 0.56 x 0.95 = 0.532	{P01} = 0.56 x 0.05 = 0.028
m3 {θ} = 0.16	{P01} = 0.16 x 0.95 = 0.152	{θ} = 0.16 x 0.05 = 0.008

Based on the 5 symptoms entered, the density value is P02, namely Mild Mycetoma with a confidence level of 0.71976 or a percentage of 71.97%. Figure 4.8 is a display of the results of the consultation if the 5 symptoms are included as shown in the figure. The results shown are that the patient has a mild mycetoma with a probability of 71.97%. This proves that the results of testing theoretical calculations are in accordance with the calculations on the expert system implementation results.

In this study, the system was built using the PHP and Mysql programming languages. In this system there is a built-in system page display, which is as follows:

Hallo Edy Sukanto

Selamat Datang di Sistem Pakar

Silahkan pilih apa yang anda rasakan Edy Sukanto

Nama Lengkap anda!

Edy Sukanto

☐ Kemerahan Pada Kulit
☐ Muncul benjolan tanpa rasa sakit dibawah kulit
☐ Erasi (kulit kemerahan, bengkak, melepuh, dan nyeri saat ditekan)
☐ Pembengkakan
☐ Gatal atau pembengkakan didaerah yang terinfeksi
☐ Sensasi terbakar, perih atau sakit didaerah yang terinfeksi
☐ Benjolan menjadi infeksi terbuka dan timbulbeberapa lubang atau borok kecil yang
☐ Benjolan berwarna merah
☐ Benjolan berisikan cairan seperti butir-butiran kecil
☐ Benjolan berisikan darah

☐ Benjolan berisikan darah
☐ Melebarnya daerah terinfeksi
☐ Benjolan berisikan nanah
☐ Benjolan terasa nyeri
☐ Area gelap pada kulit
☐ Demam
☐ Hilangnya fungsi tubuh
☐ Kelainan bentuk terhadap daerah yang terinfeksi
☐ Menyerang kulit tidak berambut(wajah, badan, lengan, tungkai)
☐ Terletak pada tangan (pergelangan sampai keujung tangan)
☐ Menyerang telapak tangan atau telapak kaki
☐ Berbau busuk
☐ Bersifat basah
☐ Lesi timbul didaerah predileksi (seperti benjolan , luka, dan lecet)
☐ Fistula (gangguan pada fungsi tubuh)

Diagnosa

Figure 3. Disease Diagnosis Page

The disease diagnosis page display is a display that contains the symptoms of the disease suffered by the user. Where when the user opens nn this page, several symptoms will appear and the user will select or give a checklist for the symptoms he is suffering from. After the user selects or gives a checklist on the symptoms suffered, the user selects the diagnosis button on that page and the results of the diagnosis of the disease will appear based on the symptoms being suffered which can be seen in Figure 3 above. Figure 4 is a page of the results of the diagnosis

HASIL DIAGNOSA PENYAKIT

Nama Pasien : Edy Sukanto

Terdeteksi penyakit **Mycetoma Sedang** dengan derajat kepercayaan **68.62%**

Keterangan :
 Segera lakukan pengecekan ke dokter, ada kemungkinan pemeriksaan lebih lanjut

Gejala yang dialami :

1. Kemerahan Pada Kulit
2. Muncul benjolan tanpa rasa sakit dibawah kulit
3. Erasi (kulit kemerahan, bengkak, melepuh, dan nyeri saat ditekan)
4. Pembengkakan
5. Benjolan berisikan cairan seperti butir-butiran kecil

Lihat Riwayat



Figure 4. Diagnostic Results Page

CONCLUSION

The process of diagnosing a disease must be carried out by an expert or specialist who understands or understands the disease. In diagnosing mycetoma, a system or application is needed that can make it easier for patients or the public to make a diagnosis. Comparison results of the system test with 6 patient medical record data taken from the Dermatology and Venereology Specialist Clinic showed that the accuracy of the system was 83.3% with the suitability of 5 of the 6 patient sample data tested.

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