Recommendation System of Self-Medication for Mild Digestive Diseases with Dempster Shafer Method

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Abstract—**Pain is a state of body discomfort. To cure diseases, people usually go to the doctor, but now if the disease is mild it can be treated with self-medication. Therefore, Self-medication (Swamedikasi) recommendation system needs to be built specially to lessen and solve the mild disease problem, in this case, is digestion. The recommendation generated using an expert system with Dempster Shafer method. The application's output will display the possibility of mild disease in digestion system that suffered by user based on the existing symptoms. The application also shows the possibility of symptoms from the legible disease that suffered by the user. The trust value obtained by using the Dempster Shafer method.**

Keywords-Recommendation System; Swamedikasi; Expert Systems; Dempster Shafer

I. INTRODUCTION

To treat an illness, patients usually go to the doctor or health center. But the doctor usually has many patients who want to be treated so that patients sometimes have to queue first. This condition seldom makes the patients feel the pain that worsen disease. Whereas it may not severe if treated immediately.

Self-medication means treating all complaints to oneself with over-the-counter medicines at a pharmacy or medicine store on their own initiative without medical advice [1]. Self-medication or self-medication can be done to deal with minor ailments, such as headaches, fever, toothache, diarrhea and other minor ailments. When you feel dizzy or have a fever, you can immediately take paracetamol in the box medicine, of course after knowing the rules of use. Or to be safer, you can ask the pharmacy about the rules for using the medicine so that the use of medicine that you want to consume is clearer.

Due to the increasing practice of self-medication and for self-medication to be safer, appropriate recommendations are needed. For convenience in obtaining recommendations, automated and web-based recommendation systems are suitable.

The Dempster Shafer method is a mathematical method that is able to provide trust value [2]. Therefore, researchers designed and implemented a recommendation system. The design of self-medication recommendation system that is intended to be made is expected to transfer the knowledge of a pharmacist in diagnosing the mild disease in digestion system along with medications that can be recommended for the user with a measure of trust using the Dempster Shafer method.

The formulation of the problem raised from the background above is:

1) Able to overcome the absence of medical staff to deal with a sick person.

2) Able to make a self-medication recommendation system for digestive ailments.

3) Able to apply the Dempster Shafer method into the recommendation system.

4) Apply to provide medicine recommendations that are in accordance with the symptoms of the disease suffered by the patient.

II. LITERATURE REVIEWS

Many research relating to recommendation systems using expert systems have been conducted. The examples of these can be read on [3]–[11]. From those research, only one that uses Dempster Shafer to implement the expert system, which is [9]. In addition to the method used to implement the expert system, our research is applied to mild digestion sickness and the expert here is a pharmacist.

III. METHODS

A. Data Collection Methodology

Data were collected from various sources. The method to do the data collection performed in this study are:

1) *Interview:* Data collection is carried out by conducting discussions and question and answer sessions with pharmacists and other health experts.

2) *Literature study:* Literatur studies are conducted to study material related to research so that the data collected for analysis can be more accurate. Literature studies are carried out in the form of library media in the form of books or via the internet.

B. Identification of Problems

The main problem that occurs to apply the Dempster Shafer method to the self-medication recommendation system for the digestive system and how to provide recommendations for the types of medicine that are appropriate to the symptoms of the disease suffered by the user. The problems contained in this research can be developed with a web-based system, namely the Recommendation Systems of Self-Medication. This system will help solve the problem because it is computerized and calculate the Dempster Shafer method.

C. Application Development

The system development method that is to be used in designing this expert system follows the stages in the development of the waterfall model which is commonly called the classic life cycle [12]. The stages in the waterfall model are as follows:

1) Communication system requirement that will be developed.

2) Planning is the planning stage of how the system is made.

3) Modeling is a stage of system design or modeling. At this stage, the DFD, ERD, database design and design of the system interface design are carried out.

4) Construction is the stage of system implementation. Based on the design that was made at the modeling stage, further, development will be carried out at the construction stage. At this stage, the design at the modeling stage is converted into a form that is understood by the machine using the programming language.

5) Deployment at this stage, the system that has been created will be carried out testing by users so that the suitability of the results of the identification of needs will be obtained, as well as expectations and objectives of developing expert system applications.

IV. SYSTEM DEVELOPMENT

In developing the system using the Waterfall method, this resulted in development phases. An explanation of each of these phases can be seen below.

A. Development Phase

In this first cycle, it focuses on the main purpose and functionality of the system being developed.

1) *Communication Phase*

In this first communication phase, the researcher discussing system requirements that will be developed with stakeholder.

2) Planning Phase

In this first planning phase, the researcher analyses the requirements of the developed system. The analysis is carried out by means of interviews and discussions with the project owner. The results obtained are anyone who will use the system later, and how the system works. Users involved in the system can be seen in Table 1.

TABLE I.   LIST OF USERS WHO USE THE SYSTEM

No.	User
1	Medical Expert
2	Admin
3	Consulting user

The next step is to define and analyze the system functional requirements which aim to determine what can be done by the developed system. Functional requirements are:

a) The login process for all users both experts, admin and consulting users.

b) Medical Expert which includes processing disease data, symptoms, types of medicine, medicine, relationships between diseases and symptoms, relations between types of diseases and medicine and processing data density.

c) Admin which includes processing user data, diseases, medicine, symptoms, types of medicine, and drugs.

d) Consulting user which includes consultation and information regarding diseases, types of medicine and medicine.

3) Modeling Phase

In this first phase modelling the researcher makes the design process in the form of a data flow diagram (DFD) level 0 based on the results of the analysis that has been carried out. The purpose of making a DFD level 0 is to describe what features or functions the system has developed.
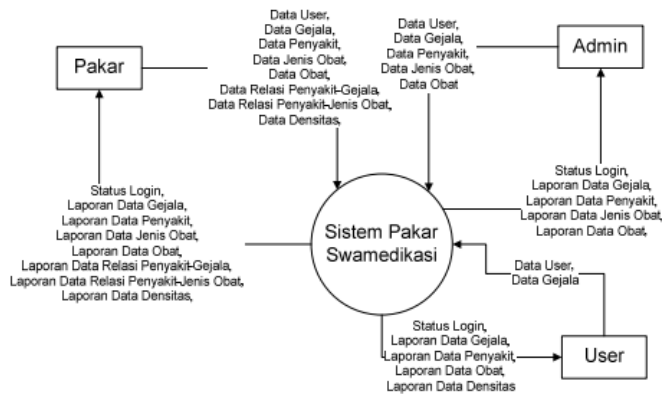

Figure 1.   DFD Level 0

Next, the researcher makes a DFD Level 1 to describe the activities that occur in the system. There are main activities, namely uploading employee attendance data and generating employee pay slips. DFD Level 1 can be seen in Figure 2.

DFD Level 1 design is also needed to explain in detail the DFD Level 2 carried out in the system to achieve the objectives of the DFD Level 0 that have been described previously. DFD Level 2 can be seen in Figure 3 to Figure 6.
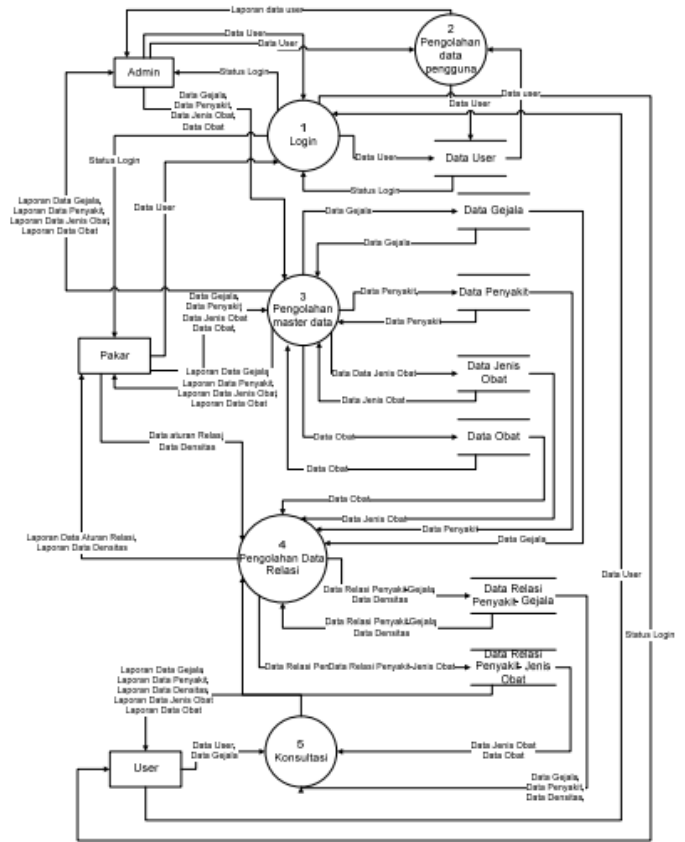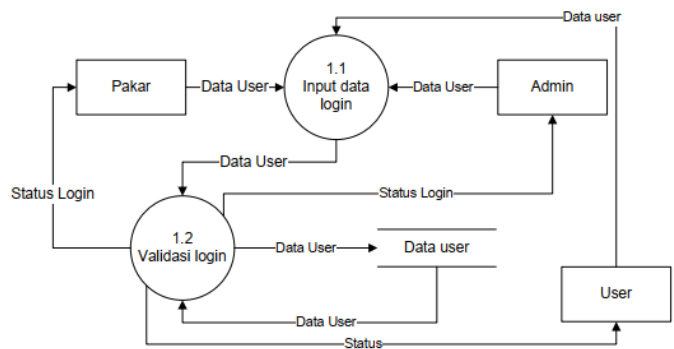

Figure 2.   DFD Level 1

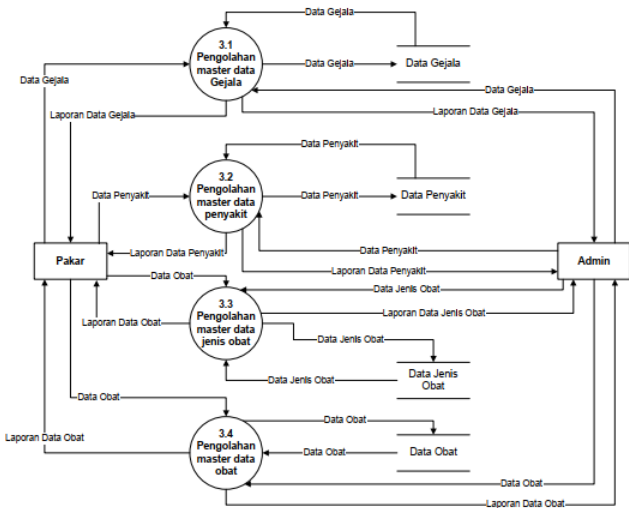Figure 3.   DFD Level 2 Login Process

Figure 4.   DFD Level 2 Master Data Processing

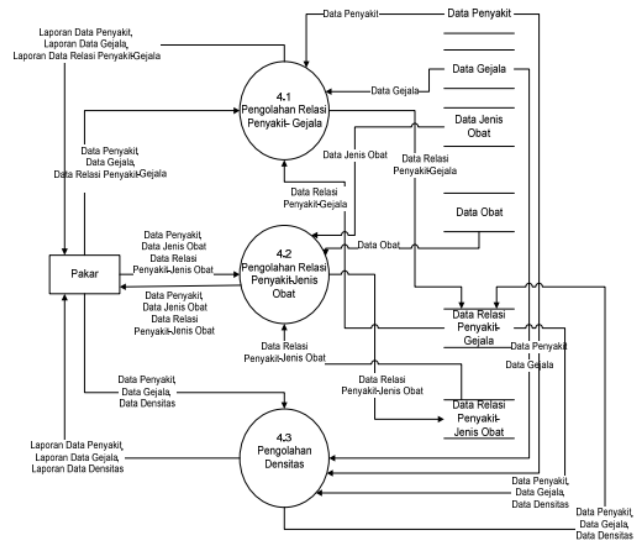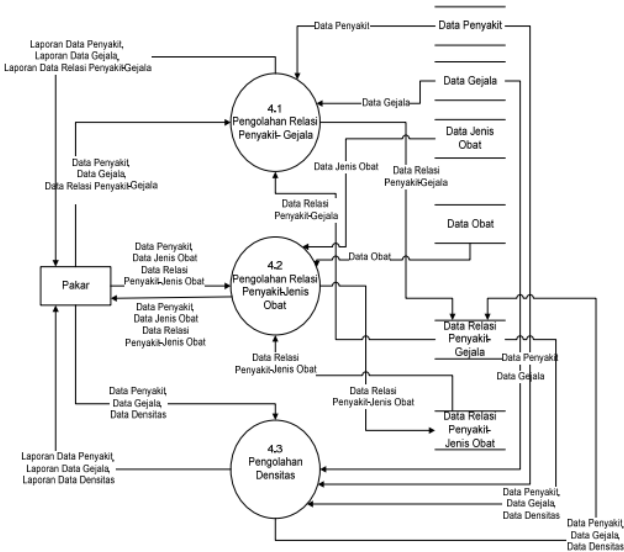Figure 5.   DFD Level 2 Processing Relation Rules

Figure 6.   DFD Level 2 Processing Relation Rules

Next, the researches make an ERD diagram to create an overview of the system database design can be seen in Figure 7.
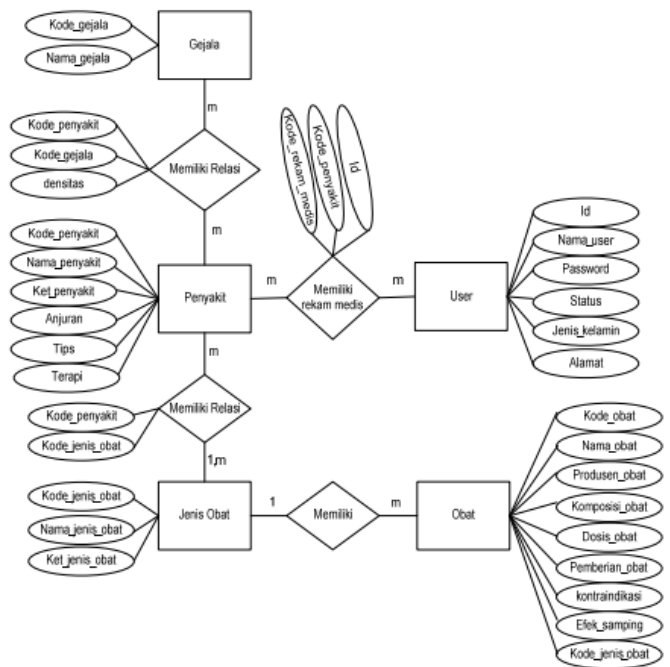

Figure 7.   ERD Diagram

Next, the researcher made a database design and relation database to show relationships that occur between one table and another table can be seen in Figure 8.
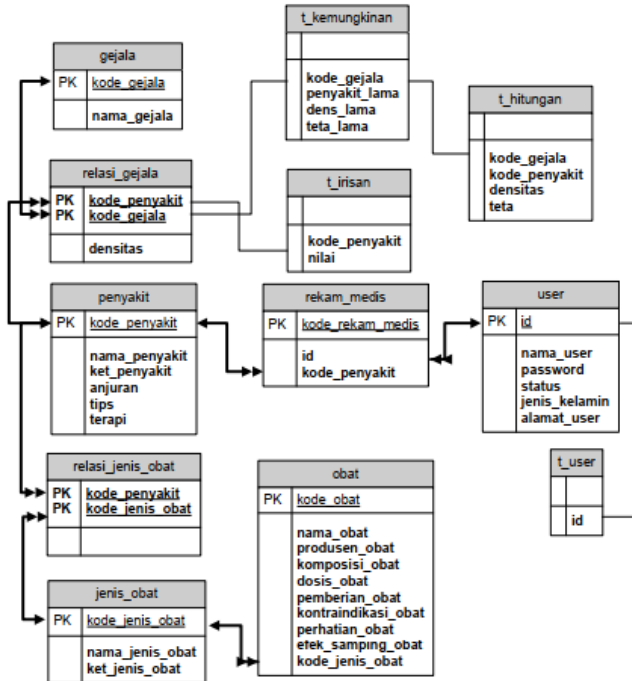
Figure 8.   Relation of Database

4)   Construction Phase (Coding)

In this phase, the researcher implements the design results into the program code using the PHP programming language and MySQL database. The interface of the implement results can be seen in Figure 9 and Figure 10.

Figure 9.   Main Page

Figure 10.   Main Page

5)   Deployment Phase

In this Phase, the system that has been created will be tested by the user so that the suitability of the results of the identification of needs will be obtained, as well as the expectations an objectives of developing expert system application

B.   Testing System Phase

In this testing using phase using black box method, which is a system testing method that focuses on the system functionality that has been built and takes into account the results of the system, what is expected.

This system testing scenario is done by users by accessing the application through the local web server (localhost). After that, the user fills out the questionnaire given. This can be seen in Table 2.

TABLE II.   SYSTEM TESTING SCENARIO

No	Test class	Testing techniques	Test class criteria
1	Authentication	Black Box	The system is able to log in to admin, experts, and users. Then save the session when the user logs in and turns off the session when the user has logged out so that the system cannot be opened again unless the user logs in again.
2	Processing data systems by admin and experts	Black Box	The system can manipulate data in the form of adding, changing and deleting data and rules on the knowledge base.
3	Data processing by general users	Black Box	The system is able to receive, read and display data from public users again.
4	Consulting data processing	Black Box	The system is able to display a list of symptoms for selected users, receive answers and be able to

			analyze the disease suffered by symptoms chosen by the user
5	Display report	Black Box	The system displays reports on the results of consultations to users in the form of disease data along with explanations.

No.	Statement	Yes	No
1	The available symptoms are in accordance with digestive system disease data		
2	Diagnosis results are in accordance with the results of symptoms entered by the user		
3	The solution given is in accordance with the disease diagnosed		

Testing is grouped into three namely testing for functionality, interface, and content expertise. Functionality testing can be seen in Table 3, 4 and 5, interface testing can be seen in Table 6, and content expertise can be seen in Table 7.

TABLE III.   FORM OF FUNCTIONALITY SYSTEM TESTING BY USERS

No.	Statement	Yes	No
1	The registration/registration process can run		
2	The login process can run		
3	The system can display a list of symptoms for the user to choose when starting the consultation		
4	The system displays the results of the consultation		
5	The logout process with the logout menu can run		
6	The system can display existing content according to the menu selected by the user		

TABLE IV.   FORM OF FUNCTIONALITY SYSTEM TESTING BY ADMIN

No.	Statement	Yes	No
1	The process of manipulating user data can be done		
2	The process of manipulating master data on the disease can be done		
3	The process of manipulating the master data on symptoms can be done		
4	The process of manipulating master data types of drugs can be done		
5	The process of manipulating the drug data master can be done		

TABLE V.   FORM OF FUNCTIONALITY SYSTEM TESTING BY MEDICINE EXPERT

No.	Statement	Yes	No
1	The data manipulation process can be done		
2	The process of manipulating master data on the disease can be done		
3	The process of manipulating density data can be done		

TABLE VI.   FORM OF INTERFACE SYSTEM TESTING

No.	Statement	Ss	S	Ks	Ts	Sts
1	The interface of the display system is attractive and user-friendly					
2	The system has an easy navigation					
3	The menus on the system are functioning					

TABLE VII.   FORM OF CONTENT EXPERT

V.   RESULT AND DISCUSSION

The self-medication system for mild disease self-digestion in the digestive system was developed with an expert system, where obtained a solution using the Dempster Shafer method.

The digestive system minor ailments handled by the system include diarrhea, worm infections, food poisoning, colic, constipation, and stomach pain. The relationship between symptoms and digestive system disease is illustrated in the decision table in Table 8.

TABLE VIII.   DECISION TABLE

No.	Statement	A	B	C	D	E	F
1	The frequency of defecation (BAB) increases (> 3 times a day)	*		*			
2	Thirsty / feeling very thirsty after repeated bowel movements	*					
3	Limp, nervous, sunken eyes	*					
4	Decreased skin turgor (if long pinched back)	*	*				
5	Abdominal pain/cramps				*	*	*
6	Abdominal pain lasts long and increases				*	*	
7	There are reddish spots on the skin/skin rash		*	*			
8	Difficulty breathing			*			
9	Just consuming less / less mature food		*	*			
10	Difficulty in defecation (difficult bowel movements)					*	
11	Not complete in defecation & hard stool					*	
12	An enlarged abdomen occurs					*	
13	Less consumption of fiber					*	
14	There is blood in the stool					*	
15	Only taking drugs such as laxatives, antacids containing aluminium, antidepressants, anticoligic	*					
16	Abdominal pain occurs after and before consuming food						*
17	Removing gas without realizing it						*
18	Chills, fever & muscle aches		*				
19	There are ribbon worms inside the stool		*				
20	Experiencing jaundice (skin & yellow skin strain)		*				

Information:

* = Included in the disease

A = Diarrhoea

B = worm infection

C = Food Poisoning

D = Colic

E = Constipation

F = Gastric Pain

Calculations using the Dempster Shafer theory require the probability of a density (m) function. Density is a value of trust in a symptom of an illness. Assumptions of density values are obtained from experts (Pharmacists) that give the density value to a symptom. The list of density values for each symptom is illustrated in Table 9.

TABLE IX. DENSITY VALUE

No.	Name of symptoms	Density
1	The frequency of defecation (BAB) increases (> 3 times a day)	0.9
2	Thirsty / feeling very thirsty after repeated bowel movements	0.6
3	Limp, nervous, sunken eyes	0.6
4	Decreased skin turgor (if long pinched back)	0.6
5	Abdominal pain / cramps	0.9
6	Abdominal pain lasts long and increases	0.7
7	There are reddish spots on the skin/skin rash	0.8
8	Difficulty breathing	0.6
9	Just consuming less / less mature food	0.8
10	Difficulty in defecation (difficult bowel movements)	0.9
11	Not complete in defecation & hard stool	0.8
12	An enlarged abdomen occurs	0.8
13	Less consumption of fiber	0.9
14	There is blood in the stool	0.6
15	Only taking drugs such as laxatives, antacids containing aluminium, antidepressants, anticoligic	0.6
16	Abdominal pain occurs after and before consuming food	0.7
17	Removing gas without realizing it	0.6
18	Chills, fever & muscle aches	0.9
19	There are ribbon worms inside the stool	0.9
20	Experiencing jaundice (skin & yellow skin strain)	0.6

VI. CONCLUSION

Based on the activities carried out by the author during the design to the implementation of the self-medication recommendation system for minor diseases of the digestive system, some conclusions can be drawn as follows:

1) This study managed to overcome the absence of medical personnel to treat someone who is sick, especially someone who suffers from a mild digestive system by providing a diagnosis of the disease that is experienced along with drug recommendations according to the results of the disease diagnosed.

2) This study successfully designed a self-medication recommendation system for digestive ailments.

3) This study successfully implemented the Dempster Shafer method into a self-medication recommendation system for digestive system minor diseases.

4) This study succeeded in providing a diagnosis of minor diseases of the digestive system based on symptoms that are felt and inputted by the user, and are able to recommend drugs that are suitable for diagnosed diseases.

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