



Expert System to Diagnose Human Heart Disease Using Web-Based Forward Chaining Method

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ABSTRACT

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People do not realize that the heart is an organ that plays an important role in the circulatory system, and are very dangerous if the heart is experiencing problems or disturbances. But there are still many people who do not know the symptoms caused when the heart is having problems. In fact one of the causes of high mortality in Indonesia is due to heart disease. The purpose of this study is done to provide an update to the user to know the symptoms of heart disease as well as solutions. The method used in this study, is to use the Forward Chaining method. Expert systems will be created using PHP and MySQL database driven website.

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1. Introduction

Heart disease is one cause of high mortality in Indonesia. Millions of people are not even aware of their body's health, especially heart health. Many people who do not know the traits or symptoms of heart disease. Lack of medical staff, especially cardiologists, as well as the limited working hours doctor becomes a problem of lack of public awareness for a medical examination. Based on the above problems the authors intended that the general public can know the least about the symptoms of heart disease and her health.

The system to be used is an expert system, which is where the expert system (Expert System) in general is a system that seeks to mimic the ability of human knowledge into a computer or program, to solve a problem in a particular field. (Handayani and Sutikno, 2008). Expert System is also a useful method of Artificial Intelligence to emulate the way of thinking, worldview, reasoning an expert in taking a decision based on the situation that occurred [3]. Expert referred to here is people who have special skills that can solve problems that can not be resolved layman. For example, doctors, mechanics, psychologists, and others.

Researchers will use the PHP programming language and MySQL as the database server. And also use the Forward Chaining method where the user is accessing the program will be given the form of questions has been provided within the database and the user must answer the question, after the question is answered will be seen diagnosis and suggestions to help the user.

forward Chaining a method of tracking the future, from a collection of facts already known and ends at the conclusion. Forward Chaining is a search technique that starts with the known facts, and then match these facts with the IF part of IF-THEN rules. If there is a fact that is matched by the IF, then the rule can be executed. The results of this process will get a final conclusion after no longer rules the premise fit the facts.

Research on heart disease has been done, and use a variety of methods and different applications, but for the period between 2017-2019 a little more difficult to search a journal written by students of the State University. Thus the authors refer to studies of previous cardiac diagnosis expert system. Journal this referenced written by Fajar Agung Nugroho, the problem is there is no system that helps people to





provide information about heart disease, it is expected that the system created to help people to know the symptoms and heart disease [1]. In a journal written by Eka Wahyudi, and Sri Hartati, the problem is trying to classify heart disease such as heart failure, Coronary Heart Disease, Heart Hypertension, and the other for the diagnosis of heart disease which categories might happen to patients and will be classified in a Case-Based Reasoning system [2]. Research journals written by S Dwi Joko Raharjo, the problem is lack of knowledge about the importance of keeping the heart and the heart, it is expected that the system can help be a solution made public [3].

In a journal written by Cindy Pamela Cornelia Munaiseche, Vivi Peggie Rantung, Hiskia Kamang Manggopa, and dr. Nancy Silvia Bawiling, the problem is finding the symptoms of heart disease that is displayed in the form of a question, and is created using PHP and MySQL applications [4]. In the next journal written by R. Chitra, and V. Seenivasagam, the problem is the absence of a system to make a prediction of heart disease using data mining, settlement is done by creating a system that can predict heart disease with data mining method [5].

2. Research Methods

There are phases when doing research, as follows:

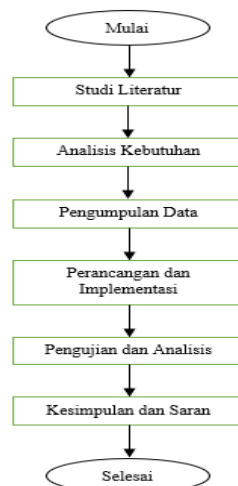


Fig 1. flowchart Research

The early stages of this study is to collect data about expert systems, disease, and the method in the journal reference. Next is analyzing the requirements needed in research. After analysis, data collection so that the facts there can be used as an information system making, by means of observation and interviews to experts. The next stage of testing and analysis, the system has been designed to be carried out tests to determine the feasibility of the system. Currently in testing, if results are not accurate then it will do an analysis on the system that has been made. If testing is successful then it will be concluded and advice in the future.

A. Expert System Flowchart

Stages of making workflow system:



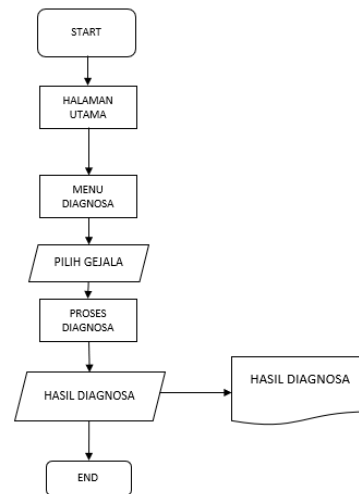


Fig 2. Expert System Flowchart

In Figure 2, explained the flow course of the application of expert systems, ranging from the main page, and user entry into the diagnostics menu, then the user make the selection of symptoms - symptoms that match or experienced user, then the data will be processed using forward chaining method, and after the diagnosis would appear, and the user can print the results.

B. Expert System

Expert system (*Expert system*) Is a system that seeks to mimic the ability of human knowledge into a computer or program, to solve a problem in a particular field. (Handayani and Sutikno, 2008). Expert System is also a way of mimicking the way of thinking, worldview, an expert reasoning (such as doctors, engineers, and others.) In taking a decision based on the situation that occurred [3].

C. Forward Chaining Method

Method *forward Chaining* is a logical reasoning based on the facts for the conclusion of the facts obtained. Forward Chaining method executed by the facts obtained in data collection to be able to draw a conclusion. One inference techniques that originated from the fact that is obtained can be regarded as a Forward Chaining. This method can also be called using if-then rules where the premise (if) to the solution (then). How to get a conclusion with Forward Chaining is using rules that premise or her statement in accordance with the facts obtained to get new facts and continue the search process until the conclusion could be concluded that actual or until no more premises in accordance with the facts. Any rules can only be executed once.

D. Data Collection

This study collecting data using the following methods:

1. Literature review

Library Studies done by collecting reading sources such as journals, books, and research in accordance with the study authors carefully.

2. Interview

Interviews conducted with expert physicians, to obtain data or information that is useful for research.

E. Diagram Usecase

Use Case Diagram is a design or picture of the actions performed by the system to interact with the actors.



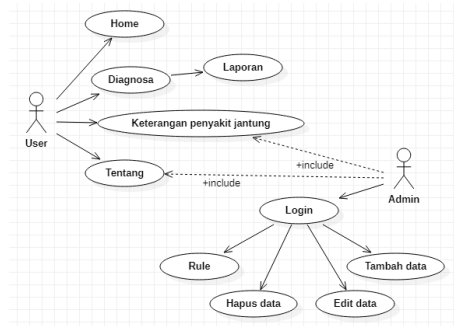


Fig 3, Use Case Diagram

The design is as follows:

- a. Users can access the data portion of disease, diagnosis, about, and diagnosis.
- b. Admin has full permissions on the system used.

3. Results and Discussion

A. Knowledge Base

Before developing the application program, the authors do data collection. This interview was conducted to experts, experts here are doctors, to obtain information in the form of data that will be useful in the development process of the application program writer. Here is the data obtained from the information on data collection that is dynamic, so it can be changed to be better updated, in order to improve the development of the system.

Table 1,
table Disease

Diseases code	Disease name
P01	Coronary heart
P02	Congenital heart
P03	arrhythmias
P04	Heart valve
P05	Heart failure

In Table 1 presented 5 data to be used as the data for heart disease.

Table 2.
Table Symptoms

Symptoms Code	Symptoms Name
G01	Chest tightness
G02	Out of breath
G03	The left shoulder does not feel good
G04	A cold sweat
G05	Experiencing pain for> 15 minutes
G06	Ischemia (lack of oxygen)
G07	Irregular heartbeat
G08	agitated
G09	fainting
G10	Dizziness head section
G11	Heart was pounding
G12	Limp
G13	Back feels unwell
G14	Body feels tired
G15	coughing up blood
G16	Excessive nausea
G17	Pain on his head
G18	Bluish skin
G19	Swelling in the legs
G20	stress





Symptoms Code	Symptoms Name
G21	Easily tired because of the strenuous activity
G22	Difficulties during exercise
G23	Often awake at night
G24	Sleep use pillows stacked area head
G25	High cholesterol
G26	excessive coughing
G27	sweaty hands
G28	Shortness of breath at night
G29	No appetite
G30	Chest feels uncomfortable
G31	Shortness of breath on exertion

In Table 2 presented several symptoms of heart disease are used in the application.

Table 3.
Table Rule (Rule)

code Rule	Symptoms code	Diseases code	Disease	Score
R01	G01, G02, G03, G04, G05, G06, G13, G16, G25, G30	P01	Coronary heart	$1/10 \times 100\% = 0.1$
R02	G01, G02, G07, G18, G11, G21, G22, G27, G29, G30	P02	Congenital heart	$1/10 \times 100\% = 0.1$
R03	G02, G04, G07, G08, G09, G12, G17, G27, G30	P03	arrhythmias	$1/9 \times 100\% = 0:11$
R.04	G01, G08, G09, G12, G14, G15, G19, G20, G26, G28, G31	P04	Heart valve	$1/11 \times 100\% = 0:09$
R.05	G02, G04, G08, G09, G12, G17, G20, G23, G24, G28, G31	P05	Heart failure	$1/11 \times 100\% = 0:09$

The data presented in Table 3 *rules* used in determining the outcome of the analysis of heart disease refers to symptoms that occur are useful in determining disease that runs in the system.

Table 4.
Table Value User Conditions

Information	Score
Very sure	1
Sure	0.8
sure enough	0.6
slightly sure	0.4
Not sure	0.2
No	0

In Table 4 described the value of the condition of the user, if the user is sure the symptoms are selected, then its value is 0.8 but if the user is not sure the value is 0.2.

B. System Analysis

User consultation testing of the system are made, where the user selects 6 selection in accordance with the symptoms of coronary heart disease user conditions, can be seen in Table 5.

Table 5.
Coronary Heart Case

No.	symptom	Condition
1	Chest tightness	Very sure
2	Out of breath	sure enough
3	The left shoulder does not feel good	Sure
4	A cold sweat	sure enough
5	Pain > 15 minutes	Sure
6	Chest feels uncomfortable	Sure

Of the above options, the system will calculate a manner as shown in Table 6.

Table 6.
Calculation

No.	Calculation	result
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1	0.1 x 1 x 100	10
2	0.1 x 0.6 x 100	6
3	0.1 x 0.8 x 100	8
4	0.1 x 0.6 x 100	6
5	0.1 x 0.8 x 100	8
6	0.1 x 0.8 x 100	8
		46%

Then the calculation results in Table 6 added up and indicated with a value of coronary heart disease by 46%.



Fig 4, Results Calculation System

Can be seen in the case of the above example, the manual calculation and calculation system produces the same answer.

C. Display Interface

Display design expert system using forward chaining method can be seen as follows.

a) home page



Fig 5. Home page

In home shows the initial view of heart expert system, which contains home, diagnostics, the list of diseases, about.

b) Diagnosis page



Fig 6. Diagnosis page

On this page you must select the appropriate conditions experienced symptoms, conditions can be selected from very confident to not.

c) Page Disease

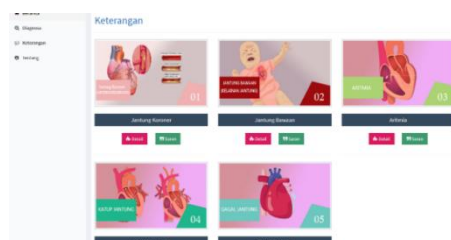




Fig 7. Page Disease

It displays all the list of diseases that used to make the diagnosis.

d) Diagnosis Results Page

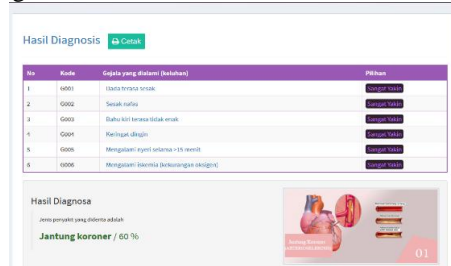


Fig 8. Diagnosis Results Page

This page displays the results of the diagnosis that has been made in the diagnosis page, users can also print out a diagnosis on the printed page.

D. Examination

a) testing Accuracy

Comparison between the diagnosis made by the diagnosis system Books of reference. Here is a comparison table:

Table 7.
Table Validity of Data

Symptom	Diagnosis System	Reference Book I	Reference Books II
G01, G02, G03, G04, G05, G06	Coronary Heart Disease (60%)	Coronary heart	Coronary heart
G08, G09, G12, G15, G20, G26	The heart valve (54%)	Heart valve	-
G02, G04, G07, G12, G17, G27	Arrhythmia (66%)	arrhythmias	arrhythmias
G01, G07, G11, G21, G22	Congenital heart (50%)	Congenital heart	-
G04, G08, G12, G17, G23, G24, G31	Congestive heart failure (53%)	Heart failure	Heart failure

From table 7, there are two (2) books referenced in testing the validity of the data. Among them is the book entitled "Clinical practice guidelines Clinical Pathway and Cardiovascular Disease Blood" by Dr. Firdaus Isman et al [6]. And the book "Pharmaceutical Care For Coronary Heart Disease Patients: Focus Acute Coronary Syndrome" by the Directorate of Community and Clinical Pharmacy DG of Pharmaceutical and Medical Devices, Health Departemen [7]. This reference book is written in Table 7 as "Reference Book I" and "Reference Book II".

b) testing Systems

In this study, the test system is performed using black box testing. Black box testing is testing against the needs of existing functions in a program.

Table 8.
Black Box Testing

No.	examination	Expected results	Test result
1	Check all user ditaksbar menu	All menu displays the desired page	valid
2	Check the form of diagnosis	Answer button works fine	valid
3	Check the diagnostic results page	The diagnosis was successful and functioning properly	valid
4	Checks knowledge button in admin page	Creating a relation of knowledge to diagnose	valid
5	Check the edit button on the page symptom	If the save button is clicked, the system will change the data already in the store	valid
6	Check the plus button on the page symptom	If the save button is clicked on the form plus the data already filled in all, the data in the content will increase, if there is not yet filled it will display a warning to fill out the form that has not been filled.	valid
7	Check the delete button on the page symptom	If the delete button is clicked, then the data will be deleted from the database	valid

Based on the above table it can be concluded that the method of black box testing runs in accordance with the expected results.





The next test was to use the application J Meter to analyze and measure the performance of the system. Specifications laptops using Intel Core i3 processor and 4GB of RAM (GigaByte). Testing is done by simulating virtual users from 200 to 1200 samples or thread within 60 seconds. Here are the results of testing using the J-meter:

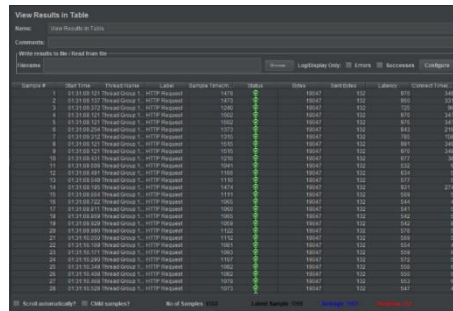


Fig 9, J Testing Meter

The data were entered into the table 9 as follows:

Table 9.
Performance Testing System

No.	Thread (user)	Throughput (ms)	Average (ms)	Deviation (ms)
1	200	3300	1069	170
2	400	6600	1096	159
3	600	9700	1100	215
4	800	13100	1254	242
5	1000	15900	1344	265
6	1200	17800	1524	350

thread is the number of virtual users that do simulation accesses the server, Throughput is the number of requests has been processed per unit of time (seconds) is calculated starting from the beginning of the first sample to sample of the last Average is the average response time for all the samples, while the deviation is a measure of how much time response around the average, the smaller the value the more consistent data. After getting the test results of Table 9, then made a diagram as in Figure 11.

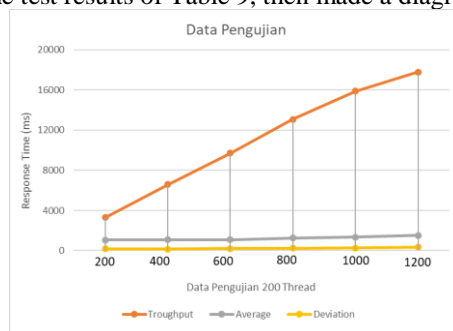


Fig 10. Diagram Testing Data

In figure 10 it is known that in 200 threads or virtual users can access the system with a response time of 3300 / ms or 3.3 / sec, with Rata - (Average) by 1069 from the system response time and also Deviation of 170 Pengiriman data. The higher the value the better throughput performance of the server, the more demand, the more servers can accommodate the load virtual users (threads).

The relationship of Throughput, Average and Deviation independent from each other. Thus, the higher the user data that are tested, the better the throughput of existing, while Deviation should not exceed Average. If the deviation exceeds the avarage there will be an interruption in data transmission.

4. Conclusion





Based on the results of the discussion, testing, regulation, research on heart disease diagnosis expert system using Forward Chaining method, several conclusions can be drawn as follows:

- a) This expert system can help provide information to the importance of health care.
- b) Forward Chaining method applied very well in expert systems, and provide useful information for users.
- c) Display applications are very simple and can provide information and solutions for users.
- d) After testing the black box, it can be concluded that the application is running as expected. Besides testing the system performance using applications A Meter shows that the system can handle a large number of users up to 1200 users.

5. Conclusion

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