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Expert System for Diagnosing Gastric Disease Using the Forward Chaining Method

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ABSTRACT

Health is the most crucial aspect of life, as it signifies a state of well-being and vitality. Gastric diseases pose a significant health concern, often requiring prompt and accurate diagnosis for effective treatment. In this study, an expert system utilizing the forward chaining method is developed to aid in diagnosing gastric diseases. The system aims to streamline the diagnostic process, providing users with timely and reliable results to facilitate early intervention and management of stomach disorders. Through the integration of technology and medical expertise, this system offers a valuable tool in enhancing healthcare delivery and improving patient outcomes in the realm of gastric health. The research findings highlight the effectiveness of an expert system employing the forward chaining method in diagnosing gastric diseases. The system demonstrates the capability to efficiently identify and assess symptoms related to stomach disorders, offering users a reliable and accessible platform for obtaining accurate diagnostic results. By leveraging current knowledge base rules and user-provided symptom data, the system enhances the diagnostic process, potentially reducing both time and costs associated with diagnosing gastric diseases. This study underscores the significance of technological advancements in healthcare, particularly in the realm of gastric health, by providing a valuable tool for early detection and management of stomach disorders.

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INTRODUCTION

Gastric diseases are a significant health problem with a wide-ranging impact on the world's population [1]. According to World Health Organization (WHO) data, gastric diseases, including gastric ulcers and acid reflux disease, affect millions of people worldwide each year [2]. The prevalence of gastric diseases tends to increase, especially in countries with more unhealthy lifestyles, poor diets, and high stress levels [3].

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At the local level, the prevalence of gastric diseases is also an important concern in the context of public health. Statistical data from local health agencies can provide an overview of the number of cases of gastric diseases, the trend of increasing or decreasing cases, as well as the dominant risk factors in the area [4]. In addition, information on the availability of medical services related to the diagnosis and treatment of gastric diseases at the local level can also be an important consideration in the development of solutions such as expert systems to support early diagnosis and effective treatment [5].

Technology that is capable of carrying out activities or thought processes like humans is also developed along with technological developments that keep up with the times [6]. This technology is also known as artificial intelligence. Expert systems are part of artificial intelligence, which consists of a collection of components that channel information or knowledge from one or more experts into a system or machine that can be used to assess and also provide decisions/consultations in solving problems for those who need experts. Apart from that, the availability of this expert system helps the public gain knowledge about internal medicine, especially gastric diseases [7].

Gastric disease should not be ignored because if left unchecked, it can cause other diseases that can cause death if not treated immediately [8]. Unhealthy diet, excessive mental stress, and bacterial infections often cause gastric disease. There are several diseases that generally attack the stomach, including Gastroesophageal Reflux Disease (GERD), Carcinoma/Gastric Cancer, Acute Ulcers, and Chronic Ulcers [9].

There are still many people who don't know about stomach disease because not many people know about stomach disease, so many people ignore the symptoms. A system that has expertise such as a specialist in gastric diseases is really needed to solve the problem. The scarcity of gastric disease specialists in certain locations may also be a barrier to finding out gastric disorders. To meet the public's need for treatment of gastric diseases, an expert system is needed that is able to diagnose gastric disorders. To do this, software engineering uses the forward chaining method to diagnose stomach diseases/disorders [10].

The aim of this research is to design an application that can help people overcome stomach diseases, where in some areas there is still a lack of specialist doctors, lack of knowledge, so that costs can be minimized and the time required is also short.

This research shows the great potential benefits of developing an expert system application for diagnosing gastric diseases. This application can help in early diagnosis, proper treatment, and increasing public awareness about the importance of gastric health. This expert system can improve the accessibility of gastric disease diagnosis services for the general public, especially in areas that have limited access to medical specialists. With this system, users can easily access information and get a quick and accurate initial diagnosis [11].

The development of an expert system application for diagnosing gastric diseases using the forward chaining method has great potential in improving the accessibility of health services, early diagnosis, and public knowledge about gastric health conditions. This application makes it easy for users to identify symptoms, get accurate information, and receive the right diagnosis based on the symptoms inputted. With a user-friendly design and guaranteed diagnosis accuracy, this application can be an effective tool in supporting efforts to prevent and treat gastric diseases. Recommendations from this research are to continue developing and improving this expert system application through the integration of the latest technology, updating symptom data and medical knowledge, as well as further testing to ensure the reliability and accuracy of diagnoses. In addition, it is recommended to conduct wider socialization about the existence of this application so that it can provide maximum benefits to the community in an effort to maintain gastric health preventively and proactively [12].

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METHODS

Forward Chaining Implementation

The implementation of the forward chaining method in an expert system application for diagnosing gastric diseases involves steps such as the construction of a knowledge base with symptom-diagnosis relationship rules, input of symptoms from the user, forward chaining inference to match symptoms with rules, determination of diagnosis based on collected facts, output of diagnosis to the user, consultation and additional recommendations, and periodic evaluation and updating of the system [13]. With this approach, the system can provide accurate diagnoses and help users in handling gastric diseases [14].

Inference Method

The inference method is a way of thinking and reasoning used by the system to reach a conclusion [15]. Analyzing a particular problem, this method will find the best answer or conclusion. To begin reasoning, the rules in the knowledge base must be compared with the data in the database. One method of interference is Forward Chaining. The forward chaining method is used to analyze disease symptoms which can make decisions in determining the name of the disease [16]. Forward chaining, also referred to as interference starting from some known facts, is a decision-making method that starts from the facts by looking for symptoms that match the assumptions that lead to the conclusion. To find new facts, searches are carried out using rules whose assumptions are in accordance with known facts. This process is continued until the goal is met or until there are no more rules whose assumptions match the facts that have been discovered [17].

The following image shows the basic concept of the function of the forward chaining method:

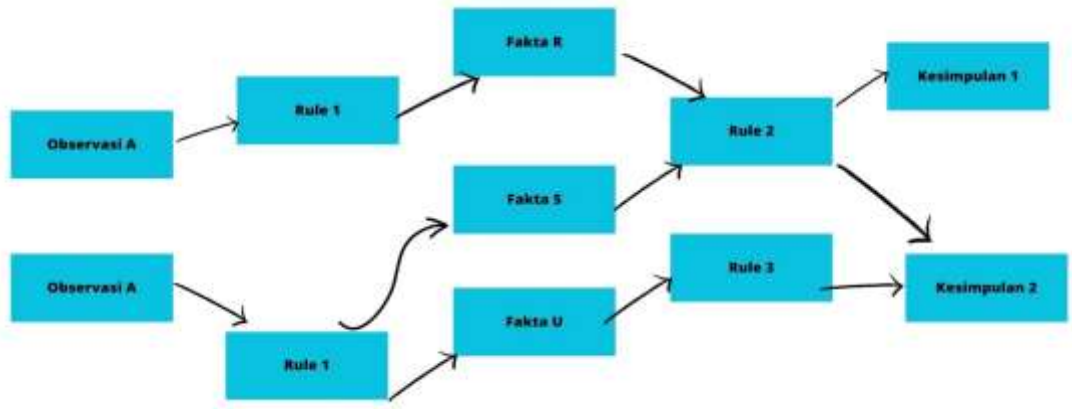

Figure 2. Basic Concept of Forward Chaining Method Function

Validation And Verification

To validate and verify the expert system application in the field of gastric diseases, the steps that can be taken include collecting data on symptoms, diagnoses, and accurate solutions, forming an expert panel consisting of specialist doctors, validation sessions with application usage guides, evaluating the diagnosis results by the expert panel, discussions to discuss validation results and feedback, and making revisions and improvements based on input from experts. By involving medical experts in this process, the expert system application can be ensured to provide diagnoses that are in accordance with medical standards and reliable in helping users overcome gastric diseases [18].

Clinical test

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Clinical trials of expert system applications in providing diagnoses of stomach diseases, here are some steps that can be taken [19].

1. Clinical Study Design: Determining the parameters to be measured, such as the accuracy rate of diagnoses, time required to provide diagnoses, and user satisfaction.
2. User Sample Recruitment: Ensure that the user sample includes diverse characteristics such as age, gender, and medical history.
3. Trial Session: Provide clear usage guidelines and monitor the trial process.
4. Data Collection: record the time taken to deliver diagnoses and user satisfaction levels.
5. Data Analysis: Comparing the app's diagnosis results with expert diagnoses to determine the level of agreement.
6. Interpretation of Results: Interpret the clinical trial results to determine the effectiveness and reliability of the expert system application in providing diagnoses of gastric diseases.
7. Publication and Dissemination: Disseminate the results to the community and related parties to increase understanding of the expert system application.

RESULTS AND DISCUSSION

Problem Definition

There are several cases that are frequently encountered, but in certain areas there is a lack of gastric disease experts. This is known because many people still have difficulty dealing with problems related to gastric pain, it takes a long time to reach experts (specialists), which results in quite a long time to be able to treat or get a solution. Due to difficulties in treating stomach problems, serious problems can occur that result in someone losing their life. The solution to make it easier to find symptoms and solutions for gastric diseases is to provide guidance on symptoms and solutions for the stomach, therefore a system for diagnosing gastric diseases was formed.

The process that will be carried out in the gastric disease diagnosis system is as follows:

1. A database was created which was used to store all symptoms obtained from an expert.
2. After that, an application will be created that will identify the problem and provide a remedy for the stomach ailment.
3. User will input symptoms. And the system will display the results of the input symptoms.
4. The system will provide fast and accurate advice in dealing with the stomach disease you are facing.
5. The system will provide accurate information that comes from an expert in the field of gastric engineering.

The disease codes, symptoms and solutions that occur in the stomach:

Table 1. Diseases, symptoms, disease codes and solutions.

Disease	Symptom	Symptom Code	Solution
Gastroesophageal Reflux Disease (GERD)/ Gastric Acid (P01)	1. Causes pain in the pit of the stomach. 2. Experiencing nausea can lead to vomiting. 3. Hot feeling in the chest.	No Fig GC	Consume milk, consume ginger, eat small portions slowly, don't sleep after eating, elevate your head when sleeping, stop

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			smoking (for smokers)
Gastric Cancer (P02)	1. Flatulence and frequent belching. 2. Heartburn. 3. Get full quickly when eating. 4. Nauseous vomit. 5. Increased stomach acid.	G-d No Ge Fig GF	Stop smoking, do chemotherapy, do radiotherapy, exercise regularly, avoid foods that trigger cancer, eat foods high in fiber
Advanced Stage Gastric Cancer (P03)	1. Anemia/lack of blood. 2. Vomiting blood. 3. Jaundice. 4. Weight loss. 5. Pain in the upper abdominal area	Gg Gh Gi Gj Go	Do chemotherapy, do radiotherapy, consume foods high in fiber, exercise regularly, at least 30 minutes/day, avoid foods that trigger cancer, stop smoking and drinking alcohol, and to be more certain, it is recommended to have a direct examination from a doctor.
Acute Ulcer (P04)	1. Vomit 2. Difficulty breathing 3. Weight loss 4. The color of the feces changes to black 5. Bloated 6. Heartburn	Fig Mt Gj No G-d No	Take drugs to reduce and inhibit stomach acid production, for example the drugs famotidine (pepcid) and cimetidine (tagamet), limit or avoid caffeine intake, avoid spicy, fried and sour foods, reduce stress, eat small portions, but often, avoid drugs. medications that can irritate the stomach lining, such as NSAIDs or aspirin,
Chronic Ulcer (P05)	1. Feeling of fullness in the upper abdomen after eating 2. Reduced appetite 3. Nauseous vomit 4. Stomach feels bloated 5. Abdominal pain in the solar plexus 6. The color of the feces changes to black 7. Weight loss.	Gl GM Fig G-d No No Gj	Sleep regularly, avoid spicy, oily and sour foods, eat regularly, sleep regularly, don't think too much, avoid coffee, tea, alcohol, detox regularly 1 day every week, do relaxation therapy to avoid stress, consume drugs that contain H2 antagonists such as , ranitidine, famotidine, cimetidine.

Decision Tree

A decision tree is a graph that will show which objects to link together with which labels ("yes" or "no"). The reason to use it is to make it easier to understand. The following is an example of a decision tree with descriptions of gastric disease symptoms and codes for a gastric disease diagnosis system.

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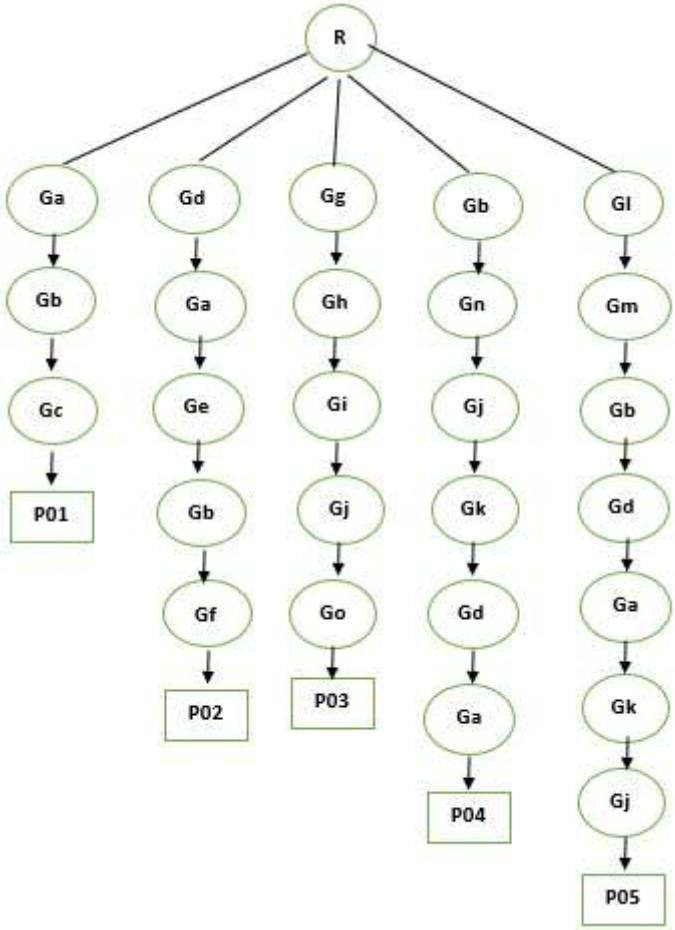

Figure 3. Decision tree

Rule or Rules

After describing the decision tree, below are the rules that have been described in the decision tree.

Table 2. Rule or Rules

No	Rule
1	**IF** Ga **AND** Gb **AND** Gc **THEN** P01
2	**IF** Gd **AND** Ga **And** Ge **AND** Gb **AND** Gf **THEN** P02
3	**IF** Gg **AND** Gh **AND** Gi **AND** Gj **AND** Go **THEN** P03
4	**IF** Gb **AND** Gn **AND** Gj **AND** Gk **AND** Gd **AND** Ga **THEN** P04
5	**IF** Gl **AND** Gm **AND** Gb **AND** Gd **AND** Ga **AND** Gk **AND** Gj **THEN** P05

Calculating the Value of Forward Chaining

An example of a calculation using Forward chaining is as follows:

Initial facts/symptoms that occur to users

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Symptom	Symptom Code	Fault Code
Increased stomach acid.	GF	P02
Anemia/lack of blood.	Gg	P03
Get full quickly when eating.	Ge	P02
Vomiting blood.	Gh	P03
Jaundice.	Gi	P03

Queue: R2, R3
Next, determine the value or disease

No	Rule	Nilai
1	R2, R3	
2	R2	P02
3	R3	P03

Conclusion from the example of the initial facts above: The disease that occurs in the stomach is advanced gastric cancer with a damage code (P03)

Calculating Probability Values
In order to know the level of accuracy (%) for a disease, it can be calculated using the following formula:
P = Xn/N x 100%

Information :
P = Level of Probability
Xn = Number of events experienced
N = The total number of symptoms of a disease

For example :
User 1 experienced symptoms in his stomach, as follows:

Table 3. Example of Calculating Probability Values

Gejala	Kode
a. Perut kembung dan juga sering bersendawa.	Gd
b. Nyeri ulu hati.	Ga
c. Cepat kenyang saat makan.	Ge
d. Mual/muntah.	Gb
e. Naiknya asam lambung.	Gf

The symptoms above indicate that the user has stomach cancer.
Gastric cancer has 5 symptoms, but user 1 only experienced 4 symptoms.
So, here's how to calculate the percentage of stomach cancer:
P = 4/5 x 100%

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P = 0.8x 100%
P = 80%
Conclusion: The presentation of gastric cancer is 80%, so you can find a solution by stopping smoking, doing chemotherapy, doing radiotherapy, exercising regularly, avoiding foods that trigger cancer, consuming foods high in fiber.

Implementation
Main Page Form

Figure 4. Main Page Form

Symptom Input Form

Figure 6. Symptom Input Form

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Diagnosis Results Form

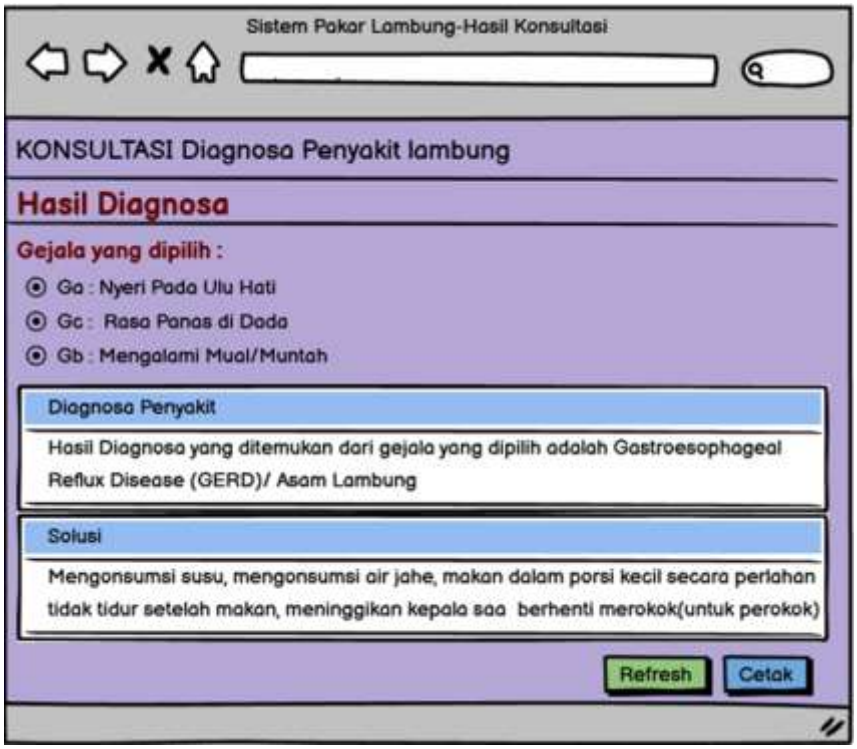

Figure 7. Diagnosis Results Form

CONCLUSION

An expert system for diagnosing gastric diseases using the forward chaining method produces the conclusion that this system can help people deal with gastric diseases more efficiently. This expert system can help diagnose gastric disorders in areas where there are not many specialists. The system uses a forward chaining method, which collects information about user symptoms and uses current knowledge base rules to make decisions. This expert system is expected to reduce the costs and time needed to diagnose gastric diseases.

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