Journal of Advanced Health Informatics Research (JAHIR)
Vol. 3, No. 1, April 2025, pp. 1-8
ISSN: 2985-6124, DOI: 10.59247/jahir.v3i1.332

Expert System For Diagnosis Of Gerd Disease Forward Chaining Methods

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ARTICLE INFO

Keywords:

Forward Chaining;
Expert System;
Diagnosis;
GERD;
Peptic Ulcer

ABSTRACT

This study presents the development of an expert system for diagnosing gastric diseases using the forward chaining method. The system is designed to assist patients in identifying possible conditions such as Gastroesophageal Reflux Disease (GERD), dyspepsia, and peptic ulcer based on reported symptoms through a web-based interface. The diagnosis process relies on a rule-based knowledge system that maps symptoms to disease categories and provides preliminary results along with simple treatment recommendations. The implementation demonstrates that the system can facilitate early screening and improve patient awareness. Nonetheless, it remains limited to common gastric diseases and depends on subjective symptom reporting. Accordingly, the system is intended as a supporting tool for early detection and patient guidance, rather than a substitute for clinical examination.

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1. INTRODUCTION

Gastric diseases, such as gastritis, gastroesophageal reflux disease (GERD), dyspepsia, and peptic ulcers, are significant health problems in Indonesia, affecting individuals across all age groups. Lifestyle factors such as irregular mealtimes, inadequate rest, and suboptimal personal hygiene have been linked to increased susceptibility to these disorders [1], [2]. Common symptoms include persistent abdominal pain, chest discomfort or burning, nausea, bloating, vomiting, and belching. These symptoms, if left untreated, can lead to chronic conditions or serious complications, such as bleeding ulcers or stomach cancer [2].

Early detection of gastric disease is crucial, yet often delayed. Many patients struggle to identify their own condition or interpret ambiguous symptoms. This delay often hinders timely medical intervention. In response, digital health technologies have advanced rapidly, offering potential tools for early screening. Among these systems, expert systems (knowledge-based decision support systems) have been widely applied in medical diagnosis, mimicking expert-level reasoning and helping triage patients or suggest next steps, including prompting physician consultations if necessary [3] [4].

Expert systems have proven useful in various medical fields. For example:

1. Case-Based Reasoning has been successfully used to diagnose bowel disease, with strong test accuracy and case alignment [5].
2. Naïve Bayes classifiers have supported the diagnosis of hypertension in the context of structured systems [6].

3. In otolaryngology (ENT), diagnostic frameworks built using forward chaining integrated with software engineering practices (e.g., Extreme Programming) offer technical rigor and domain relevance [7].
4. Dentistry-focused systems utilizing certainty factor logic have demonstrated reliable performance for dental disease detection [8].
5. Dengue fever diagnosis has utilized backward chaining with certainty factors, demonstrating effective rule-based inference [9].
6. Dermatology-related diagnosis has also been supported by expert systems, such as the Case-Based Expert System for Diagnosing Scalp Disease proposed by Nosa & Putra [10].

A well-known and accessible example of an expert system applied to gastric disease is the work of Andriani et al. [1], who developed a web-based expert system using forward chaining to diagnose various gastric conditions, providing a solid foundation for this research. Furthermore, Miftahurrochman et al. [2] underscored the importance of Helicobacter pylori infection in the gastric disease landscape in Indonesia, highlighting the high risk of chronic gastritis and gastric cancer in populations where the pathogen is prevalent.

Overall, this body of work demonstrates: Strong justification for expert systems in disease diagnosis (especially for early detection or triage); Forward chaining is a validated and effective inference mechanism in medical domains, including gastric disease; Web-based interfaces enhance accessibility, enabling lay users to engage in early screening and guidance [1].

Objective of this study: Based on these foundations, this study aims to design and implement a web-based expert system for the early diagnosis of gastric diseases, supported by the forward chaining inference method and based on clinical rules. This system aims to help patients identify potential gastric diseases early, offer structured advice and referrals, thereby contributing to timely treatment while upholding the ultimate authority of professional medical diagnosis.

2. METHODS

The author uses the forward chaining method to collect data with the stages used in this study to diagnose gastric diseases as shown below:

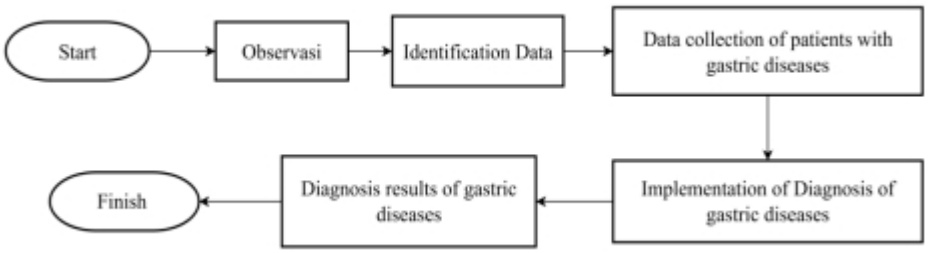

Fig. 1. Research Stages

2.1. Research Design

This study uses a rules-based expert system approach with the forward chaining method. This method was chosen because it has been shown to be effective in symptom-based diagnosis, such as in childhood diseases [11], eye [12], lupus [13], and degenerative diseases of the elderly [14]. The workflow of the system is shown in Figure 2 (Gastric Disease Diagnosis System Flowchart), which depicts the steps from symptom input to the inference process.

2.2. Data Collection

Data on gastric symptoms and diseases were obtained through medical literature and expert input. Symptoms used include abdominal pain, nausea, vomiting, bloating, and heartburn. This data is then compiled into a knowledge base in the form of rules. A similar approach is used in studies of the diagnosis of lupus [13] and epilepsy in children [15], where symptom data form the basis of the system's rules.

2.3. Knowledge Representation

The knowledge base is represented in the form of IF–THEN rules, which link symptoms to possible gastric diseases. This rule is shown in Figure 5 (Rule for Disease and Symptom Diagnosis). Similar structures are also applied in the diagnosis of pet diseases [16], [17], as well as degenerative diseases of the elderly [14].

2.4. Inference Process

Inference is carried out by the forward chaining method, starting from the symptoms that the patient inputs through the diagnosis analysis form (Figure 8). The system traces the rules progressively until a suitable diagnosis is found. This mechanism is similar to the implementation in the diagnosis of childhood diseases [11] and epilepsy [15], which starts the process from symptoms to the outcome of the diagnosis.

2.5. Explanation Of Research Scheme

The initial stage begins with observation of patients with gastric disease in an agency to obtain the necessary data. Then data identification and data collection of patients with gastric diseases are carried out so that the implementation process can be carried out to obtain the results of diagnosing gastric diseases using the forward chaining method.

3. RESULTS AND DISCUSSION

This research uses an expert system to diagnose patients who have stomach diseases with the forward chaining method. The picture below is a system workflow that can help patients do checkups without having to see a doctor. This process uses a flowchart system.

3.1. Flowchart

Figure 2 research flow scheme above, helping patients to check the diagnosis of gastric diseases. The first flow is the home view and then enter the account list, if the patient is already registered in the diagnostic application, the patient can enter data in the form of email and password. If the patient is not registered then the patient registers an account.

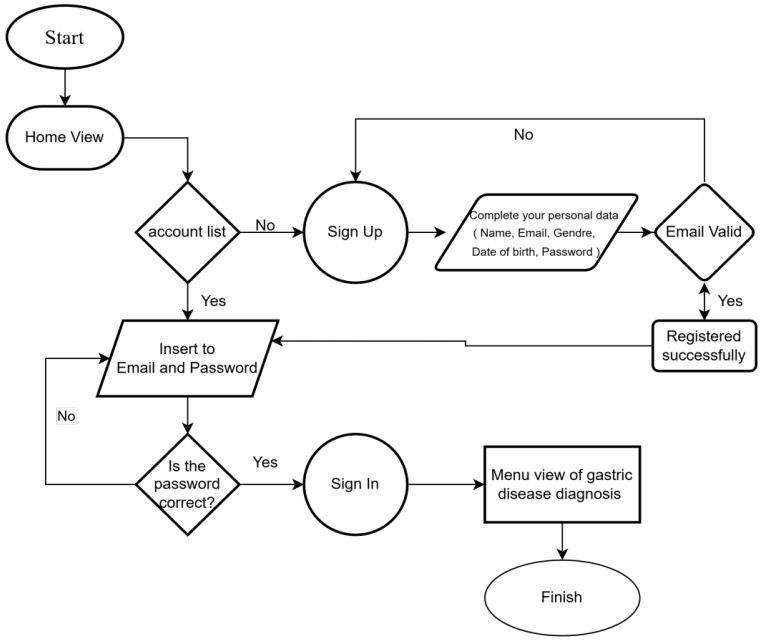

Fig. 2. Flowchart of gastric disease diagnosis expert system

Figure 2 research flow scheme above, helping patients to check the diagnosis of gastric diseases. The first flow is the home view and then enter the account list, if the patient is already registered in the diagnostic application, the patient can enter data in the form of email and password. If the patient is not registered then the patient registers an account.

3.2. Data Collection

This case aims to help patient users to apply the gastric disease symptoms and data system and anyone can use the function in Figure 3 below:

ID PENYAKIT	PENYAKIT
P001	Gastritis
P002	Gerd
P003	Functional dyspepsia
P004	Peptic ulcer disease
P005	Gastroparesis

Fig. 3. Gastric disease diagnosis data collection

The characteristics of the symptoms felt by sufferers can be seen in Figure 4 below:

ID GEJALA	GEJALA
G001	Stomach Pain
G002	Bloating
G003	Black Stool
G004	Stomach Nausea
G005	Experiencing Vomiting
G006	Stomach tightness
G007	Heartburn
G008	Difficulty swallowing food
G009	Feeling of blockage in the esophagus
G010	Sour taste in mouth

Fig. 4. Data on symptoms felt by the patient

Data collection is done by determining a rule to classify data on disease diagnoses and symptoms suffered by patients. The report uses if-then forward chaining with a combination of numbers, letters on the disease ID. The following rules diagnose stomach diseases in humans as shown in Figure 5 below:

ID PENYAKIT	PENYAKIT	ID GEJALA	GEJALA	Aksi
P001	Gastritis	G001	Stomach Pain	
P001	Gastritis	G004	Stomach Nausea	
P001	Gastritis	G005	Experiencing Vomiting	
P001	Gastritis	G006	Stomach tightness	
P002	Gerd	G007	Heartburn	
P002	Gerd	G008	Difficulty swallowing food	
P002	Gerd	G009	Feeling of blockage in the esophagus	
P002	Gerd	G010	Sour taste in mouth	
P002	Gerd	G014	Excessive salivation	
P003	Functional dyspepsia	G015	Flu	

Fig. 5. Rule Diagnosis of Disease and Symptoms

3.3. Implementation

Home View, Patients can use the diagnosis system with a website display without the need to go all the way to the hospital or consult directly with a specialist as shown below:

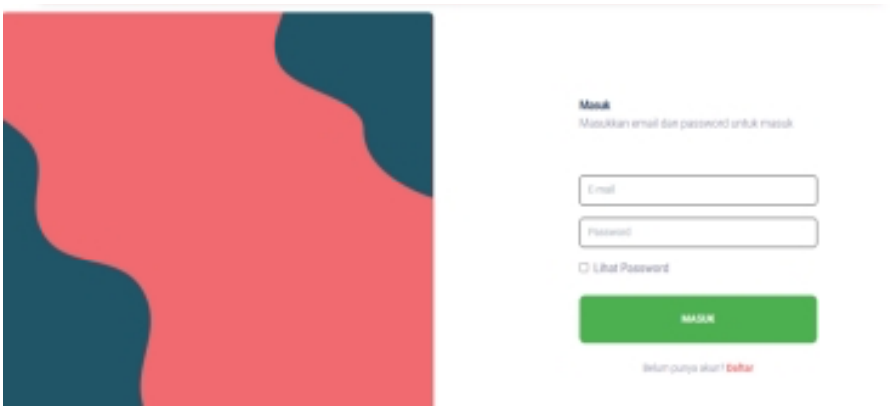

Fig. 6. Diagnostic account login interface

On the initial display, patients who already have an account can directly enter data such as email and password then click the login button, if the patient does not have an account, they can register their data by selecting Register account as shown in Figure 7 below:

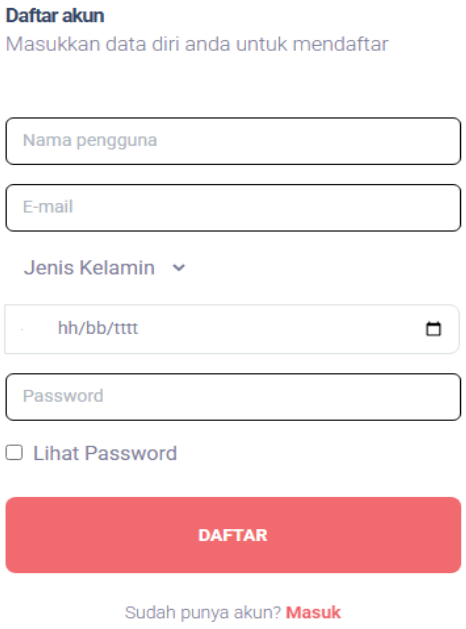

Fig. 7. Patient Account List.

This stage is part of the examination or form of screening between the user (patient) and the disease symptom diagnosis website.

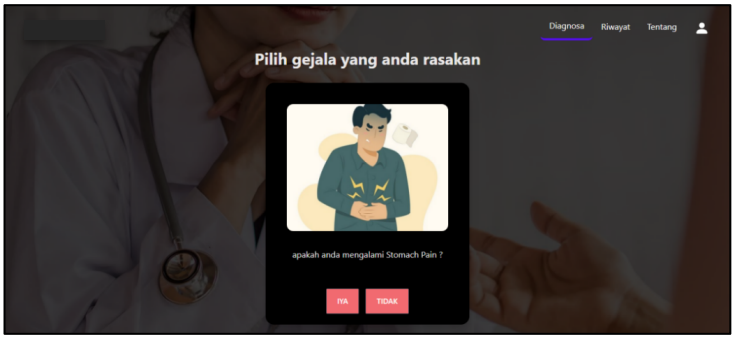

Fig. 8. Patient diagnosis analysis

Figure 8 analyzes the presence of health problems in patients who consult through the diagnostic web. The patient is given questions about pain in the body so that the screening stage can be carried out to get results as shown in Figure 9 below.

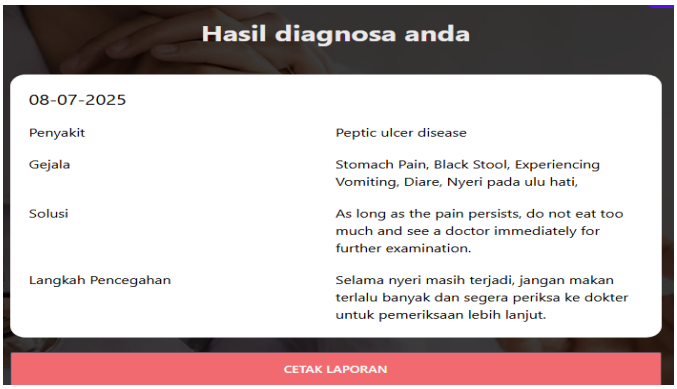

Fig. 9. Patient Diagnosis Results.

The results of the analysis of the diagnosis of the disease suffered by the patient are that the patient suffers from peptic ulcer disease with symptoms of Stomach pain, Black stool, Experiencing Vomiting, diarrhea and heartburn. Solution As long as the pain persists, do not eat too much and see a doctor immediately for further examination.

3.4. Discussion

This research produced an expert system for diagnosing gastric diseases based on the forward chaining method. The system is designed to help patients recognize symptoms and possible stomach diseases without having to consult a doctor directly.

The system workflow is shown in Figure 2. A flowchart of a gastric disease diagnosis system, which depicts the patient's initial steps from the main page of the application to the inference process. The patient first registers or logs in with an existing account (Figure 6. Patient account login view and Figure 7. Patient account list). After successfully entering, patients can fill in the symptom data experienced through the form provided (Figure 8. Patient Diagnosis Analysis Form).

The inference process is carried out by the forward chaining method based on the basis of rules that have been prepared. The rule is presented in Figure 5. Rule diagnoses diseases and symptoms, which links symptom data with possible types of gastric diseases. The system traces these rules until it produces an initial diagnosis.

An example of the diagnosis results is shown in Figure 9. The results of the patient's diagnosis, where the system provides information that the patient has symptoms of peptic ulcers with indications of abdominal pain, nausea, vomiting, diarrhea, and heartburn. In addition, the system also provides early treatment advice, such as maintaining a diet, avoiding spicy or acidic foods, and immediately consulting a doctor if symptoms persist

.With this system, patients can more quickly understand their health conditions and be encouraged to take appropriate medical measures. However, this system only serves as an initial screening tool, so the final decision remains in the hands of medical professionals.

3.5. Clinical Limitations

Although the results of the implementation show benefits for patients, there are several limitations that need to be noted, namely: Limited disease coverage, the knowledge base only covers GERD, dyspepsia, and peptic ulcers. Rare or complex diseases have not been accommodated; Depending on the subjective symptoms, the system uses patient-reported data, which may not always reflect the actual clinical condition; There are no supporting examinations, the system cannot replace endoscopy, imaging, or laboratory tests; Acting as a decision supporter, the system is intended for initial screening and patient guidance, not as a substitute for a professional medical diagnosis.

3.6. Discussion

The findings of this study show that a forward chaining-based expert system can help patients in recognizing potential gastric diseases as well as making decisions to seek further medical examinations. To improve clinical reliability, further research can integrate more comprehensive medical data (e.g. laboratory or imaging results), expand the scope of the disease knowledge base, and improve the interface to make it more interactive and easy to use. Thus, the system is expected to play a more effective role in supporting early detection and patient health education.

3.7. Suggestion

Further research is suggested to expand the knowledge base to include more gastric diseases, integrate clinical data such as laboratory results or imaging to improve accuracy, and improve the interface to be more user-friendly. In addition, trials with a larger number of patient cases and the application of adaptive artificial intelligence methods such as machine learning can be carried out so that the system becomes more reliable, accurate, and useful in supporting early detection and health education for patients.

4. CONCLUSION

This research resulted in an expert gastric disease diagnosis system based on the forward chaining method that is able to help patients conduct initial screening of the symptoms experienced. This system makes it easier for patients to recognize possible gastric diseases such as GERD, dyspepsia, and peptic ulcers, and provide helpful early treatment advice. Despite this, the system still has limitations in disease coverage, reliance on subjective data, and does not replace medical examination. Therefore, this system is more appropriate to be used as a decision support and a means of patient education, while the final diagnosis still requires examination by medical professionals.

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