



Expert System Diagnose Eye Diseases Using Case-Based Reasoning Method with Jaccard 3W Algorithm

M Ibnu Sait

Computer Science Study Program, Faculty of Science and Technology, Universitas Islam Negeri Sumatera Utara, Deli Serdang Regency, North Sumatra Province, Indonesia.

Email: ibnusaitsiregar36@gmail.com

Raissa Amanda Putri *

Computer Science Study Program, Faculty of Science and Technology, Universitas Islam Negeri Sumatera Utara, Deli Serdang Regency, North Sumatra Province, Indonesia.

Email: raissa.ap@uinsu.ac.id

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Abstract: The Case Based Reasoning method is a method that applies 4 stages of the process, namely Retrieve, Reuse, Revise, and Retain. The workings of the system in general are guided by the knowledge base possessed by the system which originates from cases that have been handled by an expert. Then the level of similarity is calculated with the new cases entered by the user using the 3W Jaccard Algorithm, based on the level of similarity of these cases, the system will issue the conclusions drawn. This research resulted in an expert system application to detect eye disease. The method used in calculating the Case Based Reasoning (CBR) method with the 3W Jaccard Algorithm. This application diagnosis types of eye disease based on the results of the largest percentage and can provide a solution to the eye disease you are experiencing.

Keywords: Expert System; CBR; 3W Jaccard; Eye.

1. Introduction

Every year in Indonesia, the number of people suffering from eye diseases is constantly increasing. Some of these diseases include cataracts, blindness, refractive errors, and corneal problems. Eye diseases need to be examined and treated by an ophthalmologist to prevent more serious damage. Eye disease is a disease characterized by disturbances and abnormalities in human vision. A survey conducted by the Indonesian Association of Optometrists (PERDAMI) and Litbangkes Agency of the population over 50 years old from 2014 to 2016 in 15 provinces found a blindness rate of 3% [1]. This blindness is caused by cataracts accounting for 70.80%. The rate of visual impairment due to refractive error is 10.15%. However, the lack of knowledge about the many symptoms of eye diseases and limited information about eye diseases, as well as the financial problems associated with the cost per consultation with the doctor, ophthalmologist, leaving affected individuals unable to receive appropriate treatment.

To improve the treatment of eye diseases, much research and application development of web-based expert systems has been carried out using Case-Based Inference (CBR) method [3][11][12][15]. This method involves using knowledge of previous cases to diagnose new cases. Several studies have used this method to diagnose various diseases, including eye diseases such as sty, dry eye, episcleritis, pterygium, and cataracts [3].

One of the related studies is the one conducted by Natalia in 2019, which used Bayes theorem to develop an expert system for diagnosing eye diseases [1]. However, there is a difference in the approach compared to previous research, in which the authors have built an expert system application to diagnose eye diseases using Case Based Reasoning (CBR) method based on on the site [3]. This application is expected to improve the efficiency of medical services and reduce the damage caused by the symptoms of eye disease, so that the patient can identify the type of eye disease easily and quickly. quickly without having to see a doctor in person. With such an effort, it is hoped to raise public awareness of the importance of early examination and treatment of eye diseases, as well as help those who need to be examined for vision-related diseases to be diagnosed and treated. easier access. Therefore, the authors have built an expert system to diagnose eye diseases by using case-based inference (CBR) based on the website to find out the differences compared to the previous method. With this application, it can improve the performance of medical services and reduce the danger rate

caused by disease symptoms, so that every patient with eye disease can easily and quickly find out what type of eye disease is. eye disease without first visiting a doctor.

2. Research Method

The design of this study is to create a planning diagram of the lesion detection expert system by CBR case-based inference with Jaccard 3w algorithm to detect eye diseases as an extension of the analysis process. demand accumulation. This design is intended to provide an overview and design related to the digital system to be developed. The process of conducting research applying Case Based Reasoning (CBR) method with Jaccard Algorithm 3W machine in detecting eye diseases, specifically through several steps as follows:

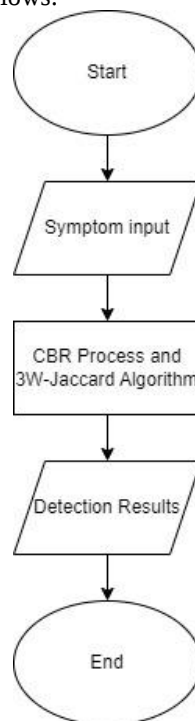


Figure 1. System Flowchart

2.1 Case Based Reasoning

Case-based reasoning (CBR) is a way to solve new problems by reusing existing best-in-class knowledge, then performing the process of adapting that knowledge. with new problems. Case-based inference (CBR) is a method used to implement computer diagnostic systems in real-world applications. The concept of case-based reasoning arose from the idea of using recorded experiences to solve new problems. Decision makers mainly use past problem-solving experiences to solve the problems they are currently facing. CBR can also be used to analyze an issue based on the case in question and to further categorize the case based on past classification experience. The advantage of RBC is that it allows us to use past case examples to gain knowledge and ultimately know the topic. In Case Based Reasoning, there are four stages in the form of retrieval, reuse, modification, preservation [2][6][7][11][13][16].

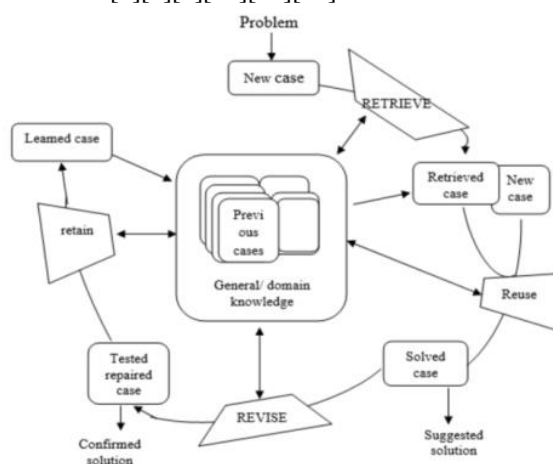


Figure 2. Case Based Reasoning (CBR) Cycle

2.2 Jaccard 3W Similarity Algorithm

Jaccard's 3W algorithm was first developed by Paul Jaccard from Switzerland. In this experiment, the 3W-Jaccard binary algorithm is used to measure the similarity between two RDF (Resource Description Framework) nodes based on the corresponding feature set. Intuitively, the more features two nodes have, the more similar they are. Let x be the size of the feature set that belongs to nodes a and b , y is the size of the feature set that exists only in node A , and z is the size of the feature set that exists only in node B . The 3W-Jaccard similarity is defined to give a higher weight on common features and lower weight on distinguishing features, i.e., features that only exist at node A or B [5]. In the Weighted Jaccard 3W Algorithm, similarity settings are made by giving a weight value to each symptom. This score is 5 (five) for severe symptoms, 3 (three) for moderate symptoms, and 1 (one) for mild symptoms. The system will display the 5 (five) highest value weights from the detection results made by the user. If the results of the similarity calculation are less than 0.6 (zero point six), the user can provide suggestions and input. The data will go to the admin review page to find a solution. The following is the 3W-Jaccard algorithm formula:

$$3W - Jaccard = \frac{3.a}{3.a + b + c}$$

Information:

3 = Numbers for multiplication

a = the similarity value is 1 (new case) and 1 (old case)

b = the similarity value is 1 (new case) and 0 (old case)

c = the similarity value is 0 (new case) and 1 (old case)

Parameters weighting (w):

Severe Symptoms = 5

Moderate Symptoms = 3

Mild Symptoms = 1.

3. Result and Discussion

3.1 Results

3.1.1 Retrieve Process

To run an expert system for diagnosing eye diseases using the Case Based Reasoning method with the 3W-Jaccard Algorithm, we need to enter the localhost/SPKR address, so the program can be used to make it easier for users to determine eye disease based on symptoms and characteristics of eye disease without must ask directly to experts. input by users with facts that exist in the knowledge base. Each symptom has a different weight value. Then the system will carry out the calculation process by entering it into the 3W-Jaccard Algorithm formula. The process retrieve table can be seen in table 1 below.

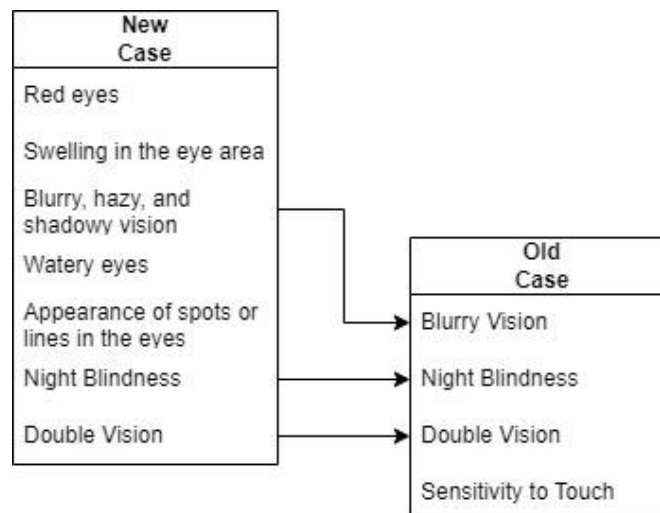


Figure 3. Retrieve Process

There is symptom data that has been previously entered by the admin on the system which is used as a knowledge base consisting of code, symptom name, and symptom weight. The symptoms of eye disease along with their weight values are as follows:

Table 1. Symptoms and Characteristics of Eye Disease

Code	Eye symptoms	Weight
G01	Red eye	3
G02	Dry eyes	3
G03	Watery eyes	1
G04	Blurry, blurry, and ghostly vision	5
G05	Excessive tears	3
G06	Swelling in the eye area	1
G07	Night blindness (Difficulty seeing at night or in dark places)	5
G08	Headache	3
G09	Sensitive to light	3
G10	Spots or lines appear on the eyes	5
G11	convulsions	5
G12	Daydream	1
G13	The eyelids cannot be closed	1
G14	Double vision	3
G15	Vomit	1
G16	Fever	1
G17	Sensitive to touch	1
G18	Great drowsiness	3
G19	Feeling unwell	1
G20	Weakening of the eye muscles	5

As for some types of diseases that are often experienced by the eye are as follows:

Table 2. Symptoms and Characteristics of Eye Disease

No	Eye Disease	Code
1	Cataract	A01
2	Glaucoma	A02
3	Conjunctivitis	A03
4	Refractive error	A04
5	Retinal Disorders	A05
6	Amblyopia	A06

The process of calculating the symptom data that is looking for uses the 3w-Jaccard algorithm formula to find the similarity value to the symptom data from the previous damage:

$$3W - Jaccard = \frac{3.a}{3.a + b + c}$$

$$3W - Jaccard = \frac{3.13}{3.13 + 10 + 1} =$$

$$3W - Jaccard = \frac{39}{50}$$

$$3W - Jaccard = 0.78$$

The calculation process for finding similarity values with the 3w-jaccard algorithm is displayed with 6 (six) other diseases that will appear in the calculation results.

Table 3. Disease Similarity Value

Damage ID	Disease Name	Results
A04	Refractive Abnormalities	78%
A05	Retinal Disorders	75%
A01	Cataract	73.584905660377%
A06	Amblyopia	65.217391304348%
A02	Glaucoma	60%
A03	Conjunctivitis	41.666666666667%

Based on investigations from previous cases, the new case is like the 6 cases with the highest similarity value, namely the type of refractive error with a value of 0.78 or around 78%.

3.1.2 Show program

The system was developed by implementing the PHP programming language and the MySQL database with XAPP and Visual Studio Code as a text editor with the results of the implementation. The screen of the main page includes several menus, namely the login menu for the administrator, the advice menu and the information.

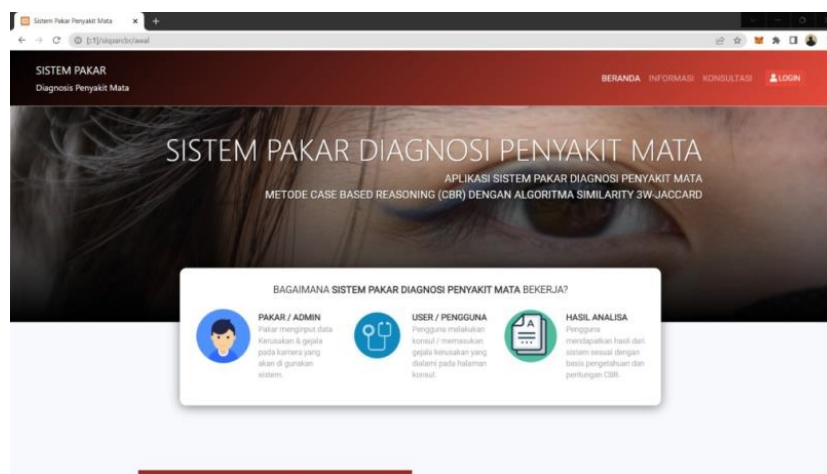


Figure 4. Main Page Display

The appearance of the admin login page when you want to enter the administrator page. Admin can enter a username and password to enter the administrator page.

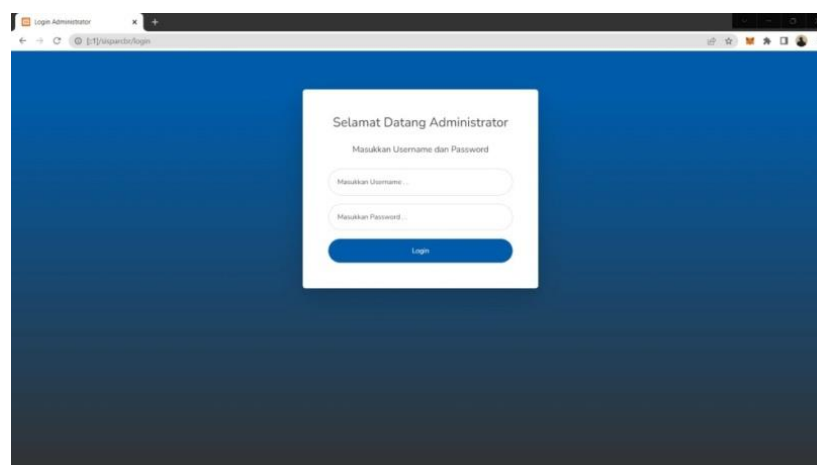


Figure 5. Admin Login Display

The administrator's main page display consists of several menus such as types of disease, symptoms, rules, and consultations. On this page the admin can make changes to diseases, symptoms, and rules such as adding new types of diseases or changing symptoms of eye diseases.

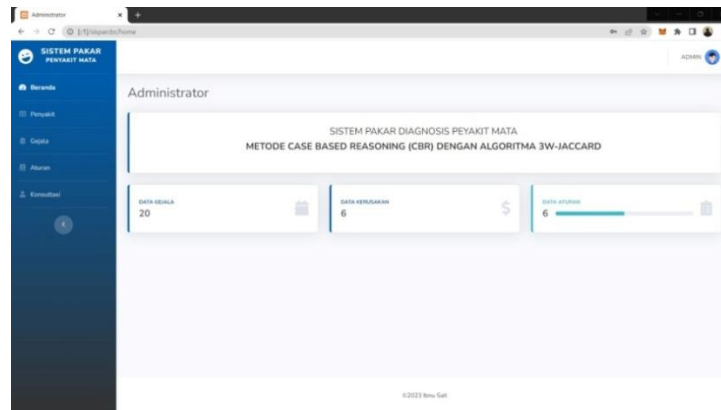


Figure 6. Administrator page display

Consultation page display, on this page people with eye disease can directly consult with the system regarding damage experienced by eye disease by directly selecting the symptoms experienced then just pressing the process button at the very bottom which will then immediately display the results.

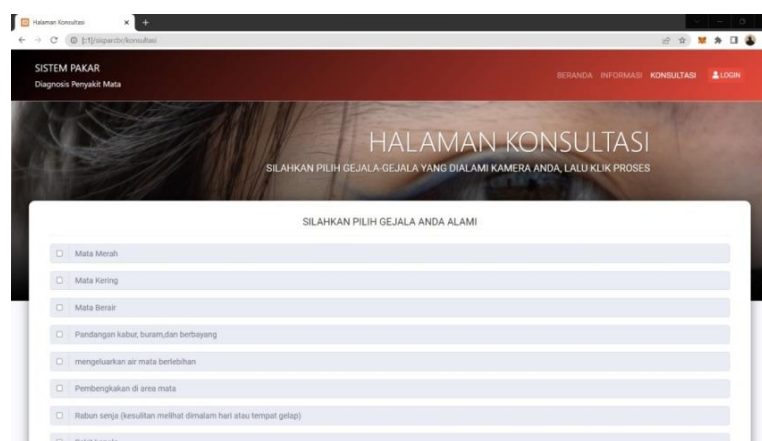


Figure 7. Display of the Consultation Page

The results page display is used to display the results of diseases experienced by the eye based on the symptoms that have been previously selected.

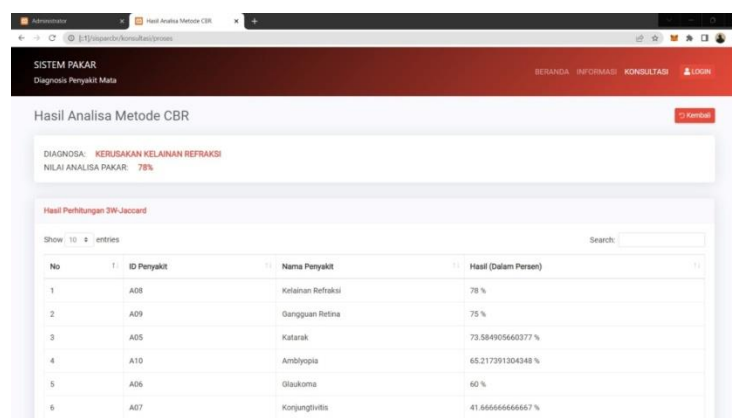


Figure 8. Display of the Consultation Results Page.

3.2 Discussion

In this section, the results of the implementation of an expert system will be presented in diagnosing eye diseases by utilizing the Case Based Reasoning method in collaboration with the 3W-Jaccard Algorithm. In the retrieve process stage, this system facilitates the user to make a diagnosis of eye disease based on the symptoms and characteristics of the disease entered, without the need for direct consultation with a medical expert. Each symptom is assigned a different weight, and the system performs the calculation by applying the 3W-Jaccard Algorithm formula to measure the similarity between the input symptoms and the previous eye disease symptom data. The process of calculating similarity using the 3W-

Jaccard Algorithm produces a similarity score between the entered disease symptoms and documented eye disease symptom data. Through the results of this calculation, the system displays a similarity score expressed in the form of a percentage. For example, in a new case situation with the input symptoms, the highest similarity was found with the type of refractive error of 78%. In terms of program appearance, the implementation of this system uses the PHP Programming Language and MySQL database with XAMPP as the local server and Visual Studio Code as a text editor. The main interface of the system is designed with several menu options, including the login menu for the admin, the consultation menu, and the information menu. Admin could make modifications to the types of diseases, symptoms, and regulations through the administrator page. On the consultation page, users can directly consult their complaints by selecting the symptoms they are experiencing and seeing the resulting diagnostic results. Diagnostic results are displayed through a special page that displays results based on symptoms that have been previously selected. Through this implementation, the expert system for diagnosing eye diseases has succeeded in providing solutions for users to diagnose eye diseases efficiently and quickly based on the symptoms they are feeling, without having to consult directly with medical personnel. The application of the Case Based Reasoning method and the 3W-Jaccard Algorithm in this system helps in identifying potential types of eye diseases that may be experienced by users.

4. Related Work

In the domain of computer-assisted medical diagnosis, various approaches and methodologies have been explored to improve accuracy and efficiency in identifying diseases. One particularly relevant approach is Case Based Reasoning (CBR), which draws on past experiences to tackle new problems. In CBR, relevant knowledge from previous cases can be reused and adapted to new situations. This section will provide an overview of related works in the field of medical diagnosis and the application of CBR techniques.

Taufik Rachman (2021) developed an expert system based on forward chaining to diagnose eye diseases. This study focuses on automatic reasoning processes to infer potential disease from observed symptoms. This approach enables early detection and timely intervention, which contributes to better patient care [4]. Edwin Febriansyah (2021) designed a Case Based Reasoning (CBR) system to detect problems with the Kawasaki KLX150 motorcycle. This study uses the 3W-Jaccard similarity algorithm to evaluate the similarity between cases, which facilitates efficient problem solving and decision making in vehicle maintenance [5]. Pratiwi (2013) presents the Case Based Reasoning (CBR) methodology for diagnosing vehicle disorders using the Visual Basic programming language. This system uses past cases to diagnose current problems, which speeds up the repair process and reduces downtime [8].

Jason Aldrian (2022) developed a backward chaining method combined with a certainty factor to diagnose problems with Toyota Innova vehicles. This approach uses rule-based reasoning to infer potential problems based on observed symptoms [9]. Ramadhana and Nababan (2021) used the Certainty Factor technique in the Case-Based Reasoning (CBR) framework to diagnose eye disease in humans. This approach allows a more detailed assessment of symptom relevance and provides insight into potential diagnoses [10]. This research, which was conducted by Umar (2023), introduced a web-based expert system for the initial diagnosis of eye disease by combining the Forward Chaining and Certainty Factor methods. The purpose of this system is to assist users in identifying potential eye conditions based on the symptoms entered, so that medical attention can be provided in a timely manner [1]. Norma Jaya Telaumbanua (2022) proposes a Case-Based Reasoning (CBR) system to detect eye disease. This study emphasizes the use of past cases to assist in diagnosing current problems, indicating the potential of CBR in medical applications [3]. Tarigan (2023) developed a Case-Based Reasoning (CBR) system for diagnosing disease, which shows the flexibility of the CBR approach in various medical domains [6]. Yusmawati (2021) introduced the Case-Based Reasoning (CBR) method for diagnosing diseases in rice plants, which highlighted CBR's adaptability in various contexts [7].

Syahfitri and Hartono (2022) explored the application of Pair Comparison and 3W-Jaccard similarities in diagnosing problems in air conditioning systems. This research shows the importance of similarity assessment in identifying problems [11]. Research conducted by I. Pratama, S. Wibisono, and E. Nurraharjo (2019) utilized the 3W-Jaccard similarity in the Case-Based Reasoning (CBR) system to detect early neurological symptoms, which indicates the potential of this algorithm in various diagnostic scenarios [12]. R. R. Ginting, U. Fatimah, and S. Sitorus (2020) developed an expert system based on Dempster Shafer (DS) to detect problems with camera lenses, which shows the variety of techniques available for specific diagnostic applications [13]. M. Brilliant (2022) implemented a Case-Based Reasoning (CBR) system to detect stunting in children, which confirms the flexibility of the CBR technique in various health domains [15].

All the mentioned studies collectively demonstrated the effectiveness of using various reasoning techniques, such as forward chaining, backward chaining, certainty factor, and 3W-Jaccard similarity, within a Case-Based Reasoning (CBR) framework for medical diagnosis. This methodology proves the potential for increasing accuracy, efficiency, and speed in diagnosing various health problems, including eye diseases. By leveraging experience and commonality assessments, these systems provide valuable insights and support decision-making for medical professionals and patients. This research also contributes to applying the Case-Based Reasoning method with the 3W-Jaccard Algorithm in the diagnosis of eye diseases, through the application of this technique to an expert system designed.

5. Conclusion

Based on the results and discussion that have been produced in this study, it can be concluded that an expert system application has been successfully developed to detect eye disease. The method implemented in the calculation is Case Based Reasoning (CBR) with the 3W-Jaccard Algorithm. This application can diagnose types of eye disease based on the results of the highest percentage of similarities and provide solutions to eye diseases that may be experienced by users. The expert system produced in this study was designed using HTML and PHP programming languages, with data management using the MySQL database. Further development related to this application can involve the ideas that have been generated from this research, to continue to improve the quality and effectiveness of the system in providing eye disease diagnoses.

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