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Implementation of a Forward Chaining Method for Lupus Detection in RSUD Jayapura City

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A B S T R A C T

Implementation of expert system for lupus disease detection at RSUD Jayapura City achieved 100% in functionality testing of 8 forms, showing a high degree of accuracy. The benefits include ease of diagnosis for medical officers and access to information for the public. Integration with Android platforms and forward chaining methods improves diagnostic accuracy, expands use, and increases effectiveness in early identification of lupus disease. This success demonstrates the enormous potential of technology in improving health care and the quality of life of the people.

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INTRODUCTION

The incidence of non-communicable diseases (NCDs) is increasing every year, including lupus. Lupus or autoimmune disease is a condition in which the immune system of a person loses the ability to distinguish foreign substances (non-self) from the cells and tissues of the body (self) causing immune systems to attack healthy cells, tissues, and organs and cause inflammation, it can occur in various organs as well as cause dysfunction in the organs such as the skin, joints, kidneys, blood cell, heart, lungs or other organs. Lupus is chronic or chronic and can be controlled but not cured. Treatment of lupus is aimed at reducing symptoms, preventing recurrence attacks and preventing complications of the disease and its lifelong nature.(Amanda, 2021).

The World Health Organization records the number of people with lupus in the world to date reaches five million people, and every year more than 100 thousand new cases are detected. According to the Online Hospital Information System (SIRS) data of 2016, there are 2,166 hospitalized patients diagnosed with lupus. This trend has doubled compared to 2014, with 1,169 new cases. The high rate of mortality from lupus requires special attention as 25% or about 550 people died of lupus in 2016. The majority of people with lupus are women in the productive age group (15-50 years), although lupus can also affect men, children, and adolescents.(Bugis et al., 2022)

Lupus can attack any organ so the symptoms appear depending on the organ affected by lupus symptoms that are commonly found are RASH or red spots on the skin can appear in various locations, but the most typical RASH appears on both the cheeks and the nostrils whose shape resembles a butterfly and is known as the term Butterfly Rash. Other symptoms are joint and muscle pain and it can be accompanied by or without swelling, for example, in the neck, thighs, shoulders and upper arms, fever is also often experienced by people with lupus or prolonged fatigue although with sufficient rest other symptoms such as sensitive to sunlight or known as photo sensitivity, kidney dysfunction is also a common symptom. The causes of lupus are usually environmental, hormonal, and genetic. Lupus is not a contagious disease and lupus sufferers are mostly women so there are also those who suspect the disease is related to esterogenic hormones(Bella Wibowo et al., 2021).

An expert system is a computer-based system that uses knowledge, facts, and reasoning techniques in solving problems that can normally be solved only by an expert in the field. Based on the research entitled The expert system helps the community in diagnosing lupus disease in the human body. In addition, the existing expert system can provide information on how to treat lupus. Using forward chaining methods that can work process the disease data that has been in input based on the symptoms and characteristics seen in humans and will be processed to find out the disease.(Febry et al., 2022)

LITERATURE REVIEW

A previous research from a number of appropriate sources and does not intersect with the title raised namely Research First (NurJumala et al., 2022) This investigation, entitled "Systems of Rhinitis Diagnostic Experts Using Web-based Forward Chaining Methods", resulted in an application of the forward

chaining method to this expert system that proved to work well and work. The website of the rhinitis diagnostics system can be used well, proved by the accuracy test by the THT specialist. With a total of 66 rules, 62 rules are stated true and 4 rules are declared inappropriate. Thus, the test yielded an accuracy of 93%. This reward is based on the facts. (data driven). This method is run by collecting the facts that exist to draw conclusions. The process starts from the facts through the interface facts toward a goal. Through a web-based system, experts can facilitate early diagnosis of allergic rhinitis disease through access to websites on computer devices as well as mobile internet. The software system is designed using the Hypertext Preprocessor (PHP) programming language and uses the Mysql database. Using the programming languages makes the software system lightweight and easy to access.

Second research (Feraldy Ramadhani et al., 2018) The aim of this research is to help the public to diagnose ISPA disease based on the symptoms suffered. It can also make it easier for the public to diagnose ISPA through the web so it can be accessed anywhere and anytime. The benefit of the research is that the community suffering from ISPA disease can be helped and can be dealt with quickly and accurately with the presence of the application of the ISPA medical system using this web-based Forward Chaining method. As a result of application validity testing, this expert system has a system accuracy rating of 94% out of 100 test data.

Third research (Fitriati & Gibran, 2021) "Expert Diagnostic System of Meningitis Diseases Using Forward Chaining Methods" This research produces a specialist system that results from a diagnosis filled in by the user. The results are based on the symptoms answered by the system's questions. This system of specialist diagnosis of meningitis can help people in obtaining information and solutions about meningitis disease. The method used in this system is forward reasoning or forward chaining. The results on the system were able to diagnose on the basis of symptoms - symptoms that occurred with an accuracy of 76.66% and a kappa value of 0.67.

The fourth study(Amanda, 2021) entitled "Systems of Experts Diagnosing Lupus Disease Using Constraint Satisfaction Problem (CSP)" This study resulted in system analysis to diagnose Lupus disease applying the CSP method concluded that patients have lupus disease with a score of 81.209%. The percentage conclusion proves that the patient is most likely to suffer from lupus. In diagnosing lupus disease can produce accuracy values, as well as provide information about the disease suffered user and how to prevent it to help user in knowing the early symptoms of the disease suffering lupus, so as not to reach the final stage of lupus that ends in death. Women are 6-10 times more likely to get lupus than men, especially between the ages of 15 and 40. Therefore, special and accurate treatment is required to deal with lupus disease. Then the solution is to reduce the excessive workload, not to force yourself to become too tired.

Research Fifth (Febry et al., 2022) "Android Mobile Application with Certainty Factor (CF) Method" The results of this research have been successful in creating an application using Java programming language assisted with

Android Platform SDK. The cumulative results obtained indicative confidence value of Dry Eye, Short Breath due to Lung Inflammation, Persistent Chest Pain for Lupus Disease is 0.968815. The purpose of this research is to create software or Android application using the Certainty Factor method, early diagnosis of an indication of a person using the CF method. Research methodology using the method of interview, gathering information obtained by the researcher, next steps later used with the Method of certainty used to calculate the probability values of MD, MB as well as CF, basically the indication to display the diagnosis summary of Lupus Disease, testing techniques using the technique of Acceptance Testing.

Sixth Research (Bella Wibowo et al., 2021) "Expert System for Diagnosing Lupus Disease Using the Ripple Down Rules Method" The study produced a system of experts using the ripple down Rules method that can be used to perform disease tracking to determine the diagnosis of lupus disease. The application of RDR methods can facilitate and provide a solution to how certain a user or patient suffers from lupus. The existing expert system is currently experiencing problems in the development and maintenance of the system. The problem was caused by the acquisition of expert knowledge that was only carried out at the beginning of the construction of the expert system that was carried on only at the start of the development of the specialist system using the RDR method to solve the problems that occurred. RDR method is a method for acquiring new knowledge from an expert into a system and based on the acquisition of that knowledge the system independently creates new rules, where the new rule position is adjusted to the rule base of existing rules.

METHODOLOGY

In the development of specialized systems, the theory used by Turban Efrain uses the Expert System Development Life Cycle (ESDLC) method.(Leonardo et al., 2022):

a. Assessment At this stage, what is done is: 1. Defining problems 2. Defining the general objectives and scope of the system 3. Verifying the compatibility of the Expert System with problems.
b. Knowledge Acquisition At this stage, what is done is: 1. Determine the source of knowledge 2. Acquire knowledge related to the problem to be discussed 3. Hold meetings with experts
c. Design At this stage, what is done is: 1. Build a design concept 2. Determine a development strategy 3. Choose a programming language to use.
d. Testing At this stage, what is done is to test and modify the knowledge of the system.
e. Documentation At this stage, what is done is to create a diagram and a user dictionary in a document that is useful to the user.
f. Maintenance At this stage, what is done is to perform the maintenance or maintenance of the system that has been created. The methodology of research system specialist diagnosis of lupus disease can be seen in Figure 1.

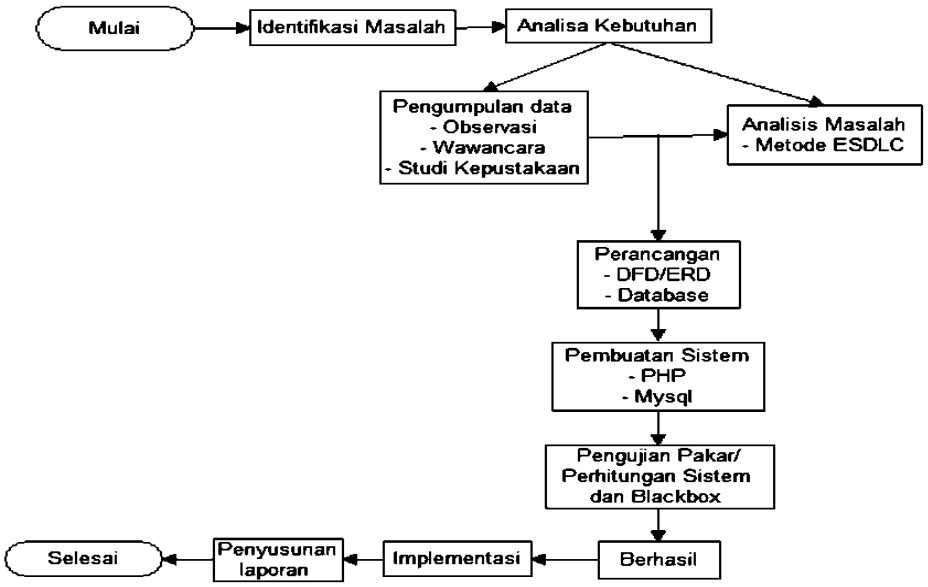

Figure 1. Circuit Research Methods

RESEARCH RESULT

1. Lupus Disease and Symptoms

Samples in this study consist of 4(four) types of lupus disease and 18(eighteen) symptoms of Lupus disease that attack the human body.

Table 1. Lupus disease

Code Disease	Name Disease
P01	Lupus eritmatosus sistemik (*systemic lupus erythematosus/SLE*)
P02	Lupus Kulit (*cutaneous lupus erythematosus/CLE*)
P03	Lupus pada anak (*neonatal*)
P04	Lupus erythematosus yang diinduksi obat (*DIL*)

In table 1 is a sample of the type of disease that frequently attacks humans, in the detection of type of lupus disease can be made a preliminary diagnosis based on the symptoms frequently occurring, As to the lupus symptoms can be seen in table 2.

Table 2. Symptoms of Lupus Disease

Kode gejala	Nama Gejala
G01	It's a butterfly-like rash on the face. (butterfly rash)
G02	Eruption of redness or other symptoms of cystitis
G03	Purple spots on the skin (purpura)
G04	Lymphatic ulcers (Luka didalam mulut, hidung, atau vagina)

G05	Hives (benjolan yang timbul dan nyeri)
G06	Inflammation around the heart or lungs (serositis)
G07	Liver problems after birth
G08	Pain in muscles and joints
G09	Chest pain
G10	Mental disorders and brain function
G11	Heart block
G12	Fever
G13	Anemia
G14	Sensitive to light
G15	Weight loss
G16	Falling hair.
G17	Experiencing extreme fatigue
G18	Low blood cell count

Table 2 is a list of symptoms used by experts to diagnose lupus.

1. Rules Forward Chaining

The first step is to establish rules for the diagnosis of diseases. (Tobing et al., 2019) Lupus is done by building a knowledge base based on the knowledge of lupus disease that is included in the Rules Table Table 3.

Table 3. Symptom Relationship of Lupus Disease

Rule code	Symptom Relationship
R01	If (G01 and G02 and G04 and G05 and G06 and G08 and G09 and G10 and G12 and G13 and G15 and G17 Then P01
R02	If (G01, G02, G03, G04, G05, G06, G08, G14,G16) Then P02
`R03	If (G11 and (G18 or G17 or G14 or G13 or G07 or G03 or G02 Then P03
R04	If (G01, G02, G03, G04, G08, G09, G15, G17) Then P04

Table 3 is a disease determination rule based on forward chaining methods to make it easier to understand then the rule on table 3 is represented in the decision tree on as in figure 2.

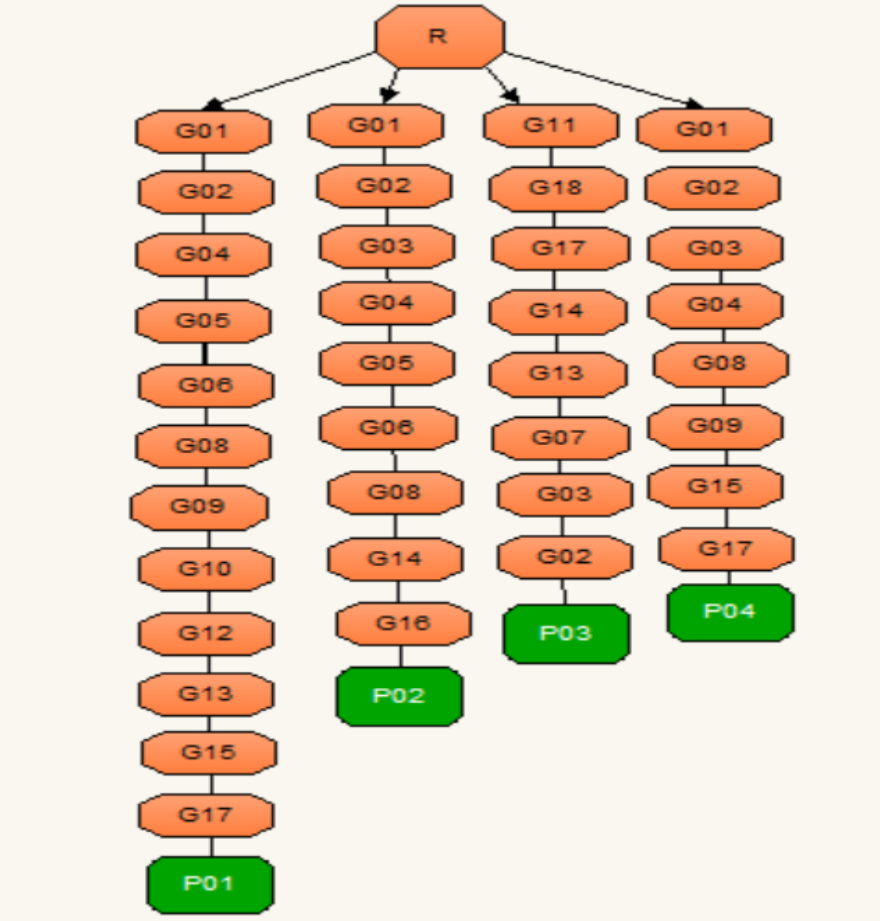

Figure 2. Forward Chaining Method Decision Tree

Figure 2 is a representation of table 3 that is visually created to make it easier to read.

2. User Interface

An expert system application is a type of website-based application that is created using PHP and mysql database programming languages. An expert systems application consists of several main modules namely home, symptom data, Diseases Data, Rulues Data, Diagnosis, Admin Data, Change Passwod and Logout. The Home menu can be seen in Figure 3.

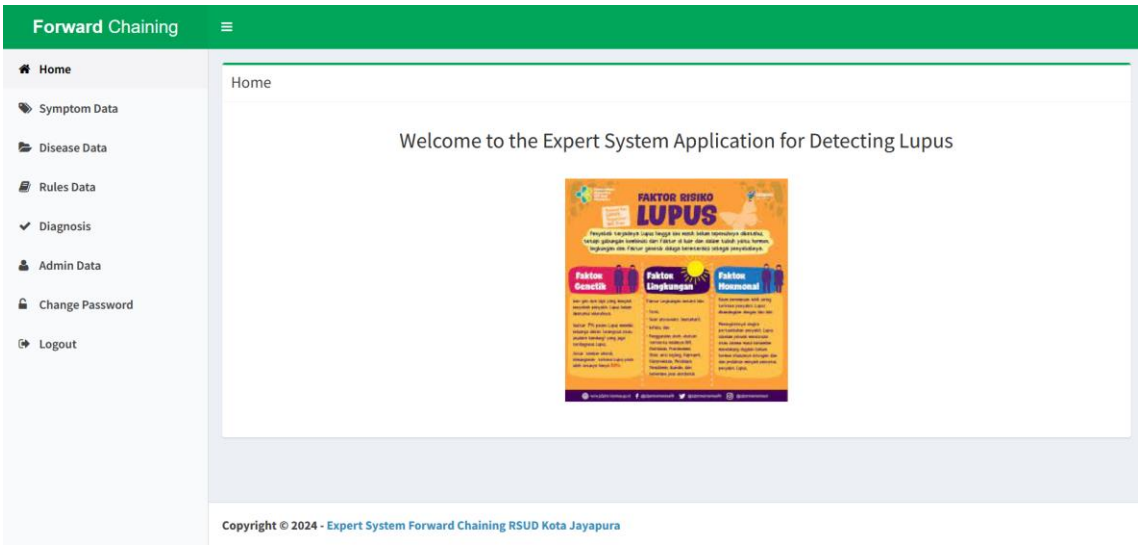

Figure 3. Home Menu

On the home menu shows access to some major modules that can be clicked by the admin like the diagnosis process, further form symptoms can be seen in Figure 4.

Figure 4. Symptom Data Form

In Figure 4 is a form for accessing data on lupus disease symptoms, this form also has a function to edit, find, add and remove symptoms of disease.

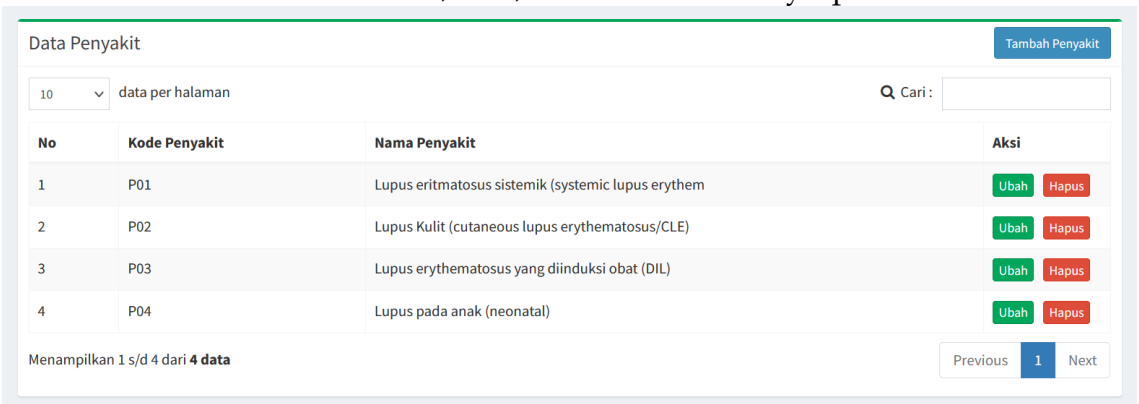

Figure 5. Disease data form

In Figure 5 is a form for accessing disease data on an expert system application, this form is also useful to add, find, update and delete disease data. Next in Figure 6 is the form data rules.

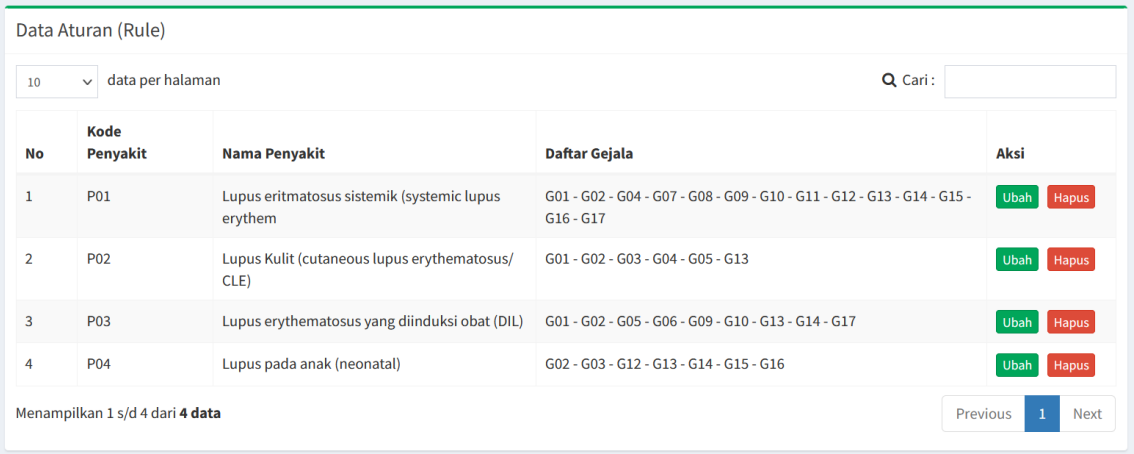

Figure 6. Form data rules

Figure 6 is a useful form for searching, adding, updating and deleting data rules on expert system applications. Figure 7 is a diagnostic form.

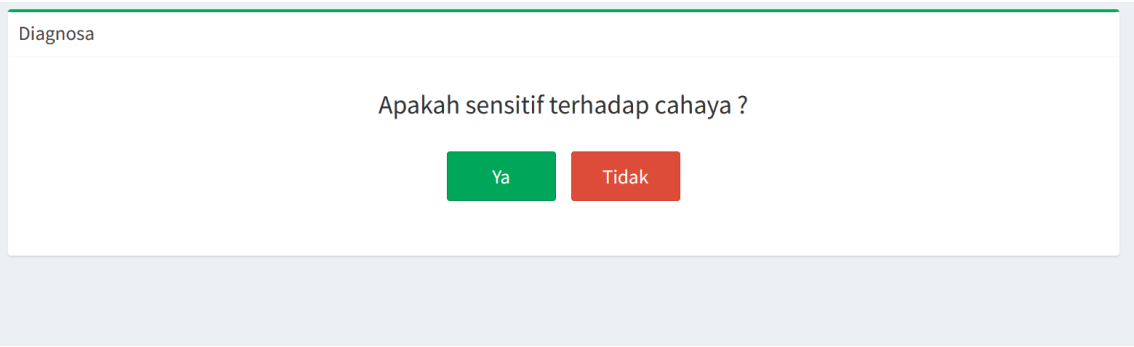

Figure 7. Diagnosis form

In Figure 7 is a form to make a diagnosis against the disease user can choose any symptoms that appear or felt by the patient.

DISCUSSION

The rising incidence of non-communicable diseases (NCDs), including lupus, presents a significant healthcare challenge globally. Lupus, characterized by autoimmune dysfunction attacking healthy tissues, affects millions worldwide, with a substantial portion of cases being women in their productive years. The increasing mortality rate underscores the urgency for effective diagnosis and management. The integration of expert systems into healthcare, as evidenced by various research studies, offers promising solutions. Leveraging forward chaining methods and innovative approaches like the Certainty Factor (CF) method and Ripple Down Rules (RDR) method, these systems enhance diagnostic accuracy and provide timely interventions. Moreover, the development of web-based and mobile applications expands accessibility, enabling early detection and personalized care. The success of these expert systems in detecting lupus, as demonstrated in RSUD Jayapura City, highlights their potential to revolutionize healthcare delivery. By streamlining diagnosis, providing accurate recommendations, and empowering patients with information, these systems not only improve efficiency in healthcare but also contribute to overall community well-being. Moving forward, continued research and development in this field are crucial for refining diagnostic algorithms, enhancing user interfaces, and ensuring scalability across different healthcare settings. Embracing technology-driven solutions offers a pathway towards more effective management of lupus and other NCDs, ultimately improving healthcare outcomes and quality of life for individuals globally.

CONCLUSIONS AND RECOMMENDATIONS

Implementation of an expert system to detect lupus disease at RSUD Jayapura City has brought significant success. In the functionality testing of eight forms, the system achieved 100% in the detection of lupus disease. This success demonstrates the high level of accuracy and reliability of the system in identifying the conditions of lupus disease. The implementation of this specialized system also brings great benefits to medical staff and the community. The specialized systems help facilitate the medical staff in the process of diagnosing and treating lupus disease by providing quick and accurate recommendations. This can save time and resources needed for more complex manual diagnostic processes. In addition, the expert system also benefits the public by providing easier access to information about lupus disease and the measures to be taken to manage their health condition. Thus, the implementation of this specialized system not only improves efficiency in health care, but also has a positive impact on the well-being of the community as a whole. Overall, the successful implementation of an expert system in detecting lupus disease in RSUD Jayapura City shows the great potential of technology in improving health care and quality of life of the people.

The development of a website-based expert lupus detection system that is integrated with the Android platform and forward chaining methods, as well

as in combination with other techniques, improves diagnostic accuracy. This allows for wider use and increased effectiveness in early identification of lupus disease through accessible technologies.

REFERENCES

Amanda, J. (2021). Sistem Pakar Mendiagnosa Penyakit Lupus Menggunakan Metode Constraint Satisfaction Problem (CSP). *Media Online)*, *1*(5), 312–318. https://djournals.com/resolusi

Bella Wibowo, M., Astuti Hasibuan, N., & Suginam. (2021). Sistem Pakar Untuk Mendiagnosa Penyakit Lupus Dengan Menggunakan Metode Ripple Down Rules. In *Journal of Informatics Management and Information Technology* (Vol. 1, Issue 3). https://doi.org/https://doi.org/10.47065/jimat.v1i3.110

Bugis, I. W., Hutagalung, J. E., & Harahap, I. R. (2022). Sistem Pakar Untuk Mendiagnosa Penyakit Lupus dengan Metode Forward Chaining Menggunakan Web. *Building of Informatics, Technology and Science (BITS)*, *4*(2). https://doi.org/10.47065/bits.v4i2.2121

Febry, F., Darusalam, U., Tri, E., & Handayani, E. (2022). Sistem Pakar Diagnosis Penyakit Lupus Berbasis Mobile Application Android dengan Metode Certainty Factor (CF). *Jurnal Teknologi Informasi Dan Komunikasi)*, *6*(3), 2022. https://doi.org/10.35870/jti

Feraldy Ramadhani, T., Fitri, I., & Tri Esti Handayani, E. (2018). *Sistem Pakar Diagnosa Penyakit ISPA Berbasis Web Dengan Metode Forward Chaining* (Vol. 3, Issue 1).

Fitriati, D., & Gibran, I. (2021). *SISTEM PAKAR DIAGNOSIS PENYAKIT MENINGITIS MENGGUNAKAN METODE FORWARD CHAINING* (Vol. 12, Issue 1). https://doi.org/https://doi.org/10.24853/justit.12.1.%25p

Leonardo, F., Sara, K., & Mude, A. (2022). SISTEM INFORMASI PENJUALAN AKSESORIS DAN JASA SERVICE HP PADA ALLIO CELL MENGGUNAKAN METODE WATERFALL. *Simtek : Jurnal Sistem Informasi Dan Teknik Komputer*, *7*(2), 119–123. https://doi.org/10.51876/simtek.v7i2.145

NurJumala, A., Prasetyo, N. A., & Utomo, H. W. (2022). Sistem Pakar Diagnosis Penyakit Rhinitis Menggunakan Metode Forward Chaining Berbasis Web. *JURIKOM (Jurnal Riset Komputer)*, *9*(1), 69. https://doi.org/10.30865/jurikom.v9i1.3815

Tobing, D. M. L., Pawan, E., Neno, F. E., & Kusrini. (2019). Expert System to Detect Disease Rice Plants Using Forward Chaining. *Jurnal Ilmiah SISFOTENIKA*, *9*(2), 10–48.