Expert System Early Diagnosis Of Schizophrenia Using Certainty Factor Methods And Forward Chaining

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Abstrak

Mentall Illness atau gangguan jiwa merupakan gangguan dalam diri seseorang yang mengakibatkan seseorang terganggu dalam proses berfikir, tindakan, hubungan sosial, serta emosi. Skizofrenia merupakan gangguan jiwa berat yang menimbulkan halusinasi, karena tidak normalnya proses berfikir, serta tidak dapat membedakan dunia nyata dan khayalan. Menurut riskesdas 2018, di Indonesia perbandingan antara penderita skizofrenia dan psikolog sangat signifikan perbedaannya, dimana penderita skizofrenia mencapai 7% populasi masyarakat Indonesia atau sekitar 18 juta kasus dibandingkan jumlah psikolog klinis yang hanya 782 orang. Angka pasung pada penderita skizofrenia mencapai 5 juta jiwa, pemasungan terjadi karena kurangnya pemahaman masyarakat mengenai penyakit skizofrenia. Oleh karena itu, sangatlah dibutuhkan sistem pakar yang mampu menggantikan peran psikolog dalam hal membantu masyarakat dalam mengetahui gejala dan penanganan masalah ini. Tipe penyakit skizofrenia dalam penelitian ini yaitu Skizofrenia Paranoid, Katatonik, Residual, Hebefrenik dan Tak Terinci. Tujuan penelitian ini yaitu menghasilkan sistem pakar untuk mendiagnosa dini tipe penyakit skizofrenia serta memberikan rekomendasi solusi pada user. Sistem pakar yang akan dibangun menggunakan metode Certainty Factor dengan penerapan Forward Chaining dalam pengambilan kesimpulan hasil diagnosa, basis pengetahuan dalam sistem ini dapat diupdate sesuai dengan perkembangan pengetahuan. Output sistem ini merupakan diagnosa dini tipe penyakit skizofrenia dan rekomendasi penanganan. Sistem diuji dengan blackbox test, UAT (User Acceptance Test), dan tes akurasi dengan hasil 87%.

Kata kunci: *Certainty Factor, Forward Chaining, Mental Illness, Skizofrenia*

Abstract

Mental Illness is a disorder that causes a person to be disrupted in the process of thinking. Schizophrenia is a severe mental disorder that causes hallucinations, because of an abnormal thinking process, and cannot distinguish between the real world and fantasy. According to Indonesia Basic Health Research (RISKESDAS) 2018, in Indonesia the comparison between schizophrenics and psychologists is very significant, with schizophrenia reaching 7% of the Indonesian population, or about 18 million cases compared to the number of clinical psychologists with only 782 people. People with Schizophrenia that get stocks in Indonesia reach 5 million people, it is because a lack of public do not understanding of schizophrenia. Therefore, an expert system is needed to replace psychologists and helping the community get a skizophrenia *understanding of symptoms and how to treat schizophrenics. Types of schizophrenia in this study are Paranoid, Catatonia, Residual, Hebephrenic and Not Detailed Symptoms. The main objective of this research is to develop an expert system that can diagnose the type of schizophrenia and provide recommendations for users. Expert system that will be built using the Certainty Factor method with the application of Forward Chaining to drawing conclusions from the diagnosis, the knowledge base in this system can be updated in accordance with the development of knowledge. The output of this system is a diagnosis of type of schizophrenia and treatment recommendations. The system was tested with a black box test, User Acceptance Test (UAT), and accuracy test with 87% of accuracy rates.*

Keywords*: Certainty Factor, Forward Chaining, Mental Illness, Skizophrenia*

1. Introduction

Mental Illness is a syndrome or pattern of behavior, or a person's psychology that causes dysfunction at work. The number of problems faced by humans in living their lives, due to the many trials that come and problems that cannot be resolved make the neural network of the human brain disrupted and can cause mental disorders "[1]. According to data from the

WHO (World Health Organization) in 2016 in the world there are about 60 million people affected by bipolar, 47 million people affected by dementia, 35 million people affected by depression, and 21 million people affected by schizophrenia.

Data (Riskesdas, 2018) shows that the total population of Indonesia reaches 265 million people, with the percentage of Schizophrenia mental disorders at 7.0% or around 18 million people, with the number of people living in pasung being 31.5% of all people with Schizophrenia or around 5 million. soul[2]. According to WHO (World Health Organization) in 2015 regarding Global Burden Disease, in Indonesia only 3.5% or 38,260 people from all people with Schizophrenia received good service in mental hospitals and general hospitals with the condition of the Number of Clinical Psychologists according to data. (Ministry of Health RI, 2018) only amounts to 782 people and the number of Psychiatrists according to data (Riskesdas, 2018) only amounts to 773 people. Based on these data, we can know that the treatment for schizophrenia is still minimal, even though based on the opinion of [3] said that "If mental illness is not serious in preventing and disrupting it completely and quickly, it will have an impact on the health of the sufferer. If the patient is not old and the disease is not severe, it is possible that the patient can be cured.

An Expert (Expert) in the treatment of Schizophrenia is a Clinical Psychologist, and a Mental Therapist or Psychotherapist. The limited number of Clinical Psychologists and Psychotherapists in this field as well as problems in terms of space, time for psychologists and related individuals become an obstacle for them to consult each other so that this is considered a problem in the treatment of people with Schizophrenia.

As a solution, the Expert System (Expert System) can be used as an alternative in handling this matter. Expert System is a computer program that uses expert knowledge to achieve high performance in a narrow or small area [4].

In this study, the Expert System that will be built uses the Certainty Factor method. The Certainty Factor method was proposed by Shortlife and Buchanan in 1975 in the manufacture of MYCIN. Certainty Factor is a calculation method to prove whether a fact is certain or uncertain in the form of a metric which is usually used to accommodate uncertainty in the thinking (inexact reasoning) of an expert, this is because an expert often analyzes existing information with expressions such as "probably", "most likely", "almost certain"[5].

Based on the background that has been explained, the author will conduct a study with the title "Web-based Schizophrenia Early Diagnosis Expert System with Certainty Factor Methods and Forward Chaining Tracing" with the output of the type of Schizophrenia suffered by the user and this system is intended to help Psychiatrists, Clinical Psychologists and the public in diagnosing Schizophrenia.

2. Literature Review

Schizophrenia is a severe mental disorder that interferes with brain function. So the patient will feel hallucinations, delusions or delusions. Schizophrenia is commonly known as "crazy".

An expert system or expert system is a system that seeks to adopt knowledge from humans to computers, so that computers can overcome or solve problems as is usually done by experts. A good expert system is designed to be able to solve a particular problem or problem by imitating the performance of an expert or expert. With this expert system, ordinary people can also solve quite difficult problems that can only be solved with the help of experts or experts. For experts, this expert system will assist them in their activities which act as highly experienced assistants [6].

The basic concept of an expert system contains: expertise, expertise, transfer of expertise, inference, rules and the ability to explain. In building an expert system, one must also have a knowledge base which is the knowledge needed to understand, formulate and solve problems [7]. There are two ways to build a knowledge base: Rule-Based Reasoning and Case-Based Reasoning.

Certainty Factor is a theory used to accommodate the uncertainty of an expert's thinking (inexact areasoning), which was proposed by Shortlife and Bucchanan in 1975. An expert (such as a psychiatrist) often analyzes existing information with the expression of

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uncertainty, to accommodate this we use Certainty Factor (Confidence Factor) to describe the level of expert confidence in the problem at hand.

3. Methodology

In this study, the author uses the ESDLC (Expert System Development Life Cycle) model [8], and the following is a picture of the research methodology by applying ESDLC that is adapted to this research:
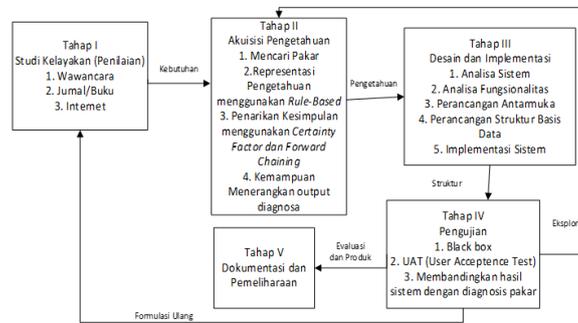
Figure 1. Research Methodology

4. Results and Discussion
4.1. System analysis

To find out if someone has schizophrenia or not, then knowing the severity experienced and the appropriate solution is currently still done conventionally by psychiatrists and clinical psychologists. The following is an explanation of the old system flow with the following flowchart:
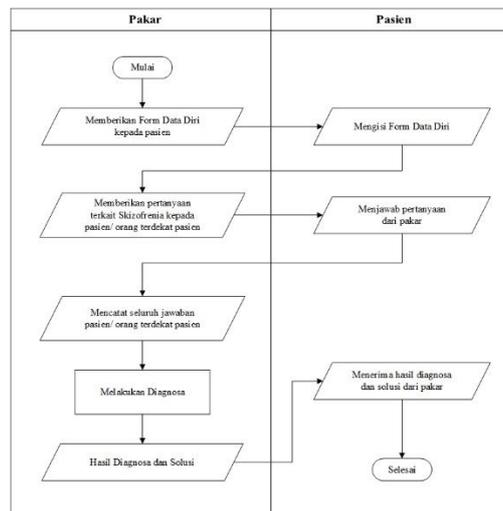
Figure 2. Flowchart of Manual System

The new system that will be built is an expert system that is able to adapt the ability of experts in diagnosing the type of schizophrenia to provide the right solution for the well-computed treatment of schizophrenia. The following is an image of a flowchart or flow of how this system works:
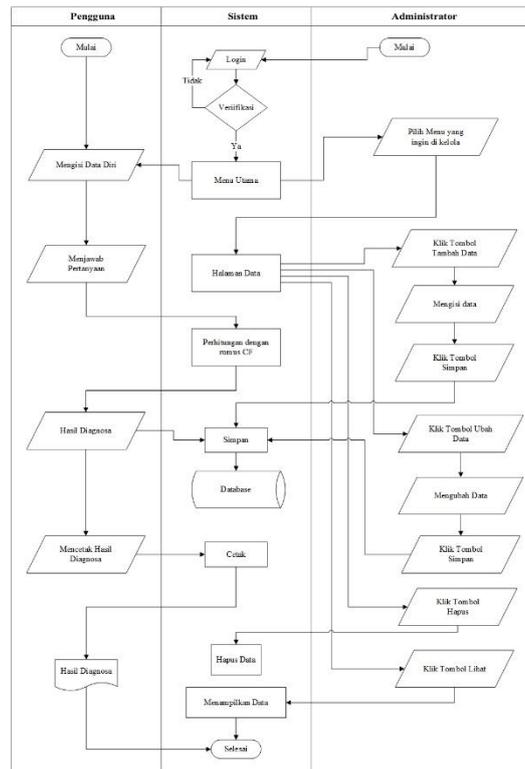
Figure 3. New System Flowchart

4.3. Knowledge Base Analysis

Knowledge base is data obtained from experts for the basis of system knowledge. The following are the data used for the knowledge base:

1) Data Types of Schizophrenia Disease

The data for this type of schizophrenia is data from the PPDGJ-III (Guidelines for Classification and Diagnosis of Mental Disorders) series III and DSM-5 (Diagnostic and Statistical Manual of Mental Disorders) Fifth Edition, the following is a table for data on this type of schizophrenia:

Table 1. Types of Schizophrenia Disease

Disease Code	Type of Disease
S001	Paranoid Schizophrenia
S002	Catatonic Schizophrenia
S003	Hebephrenic Schizophrenia
S004	Residual Schizophrenia
S005	Unspecified Schizophrenia

2) Symptoms of Schizophrenia Disease

Symptom data in this system uses PPDGJ-III (Guidelines for Classification and Diagnosis of Mental Disorders) series III and DSM-5 (Diagnostica and Statisticala Manuala of Mental Disorders) Fifth Edition, which is data on the 2013 update of Mental Illness guidelines. Symptom data for the system This data is divided into 2 parts, namely data on major symptoms in table 2 and data on minor symptoms in table 3:

Table 2. Major Symptoms of Schizophrenia

No.	Symptom
1.	Does the patient often isolate himself from the social environment?
2.	Does the patient have a delusional disorder that makes the patient feel powerful?
3.	Does the patient often feel/hear hallucinations that don't make sense?
4.	Does the patient often speak strange words or chatter?
5.	Is the patient less expressive about things that are experienced?

Table 3. Minor Symptoms of Schizophrenia

No.	Symptom
1.	Is the patient stuporous (significantly reduced reactivity to the environment and in spontaneous movements and activities)?
2.	Does the patient have mutism (unwilling to speak)?
3.	Does the patient experience a decrease or slowing of psychomotor (physical ability and muscle work)?
4.	Has the patient started to leave many of his routine activities?
5.	Does the patient hear hallucinatory voices that threaten the patient or give orders to the patient?
6.	Does the patient often hear whistling, humming, or laughing sounds?
7.	Does the patient exhibit a shy attitude and likes to be alone?
8.	Does the patient have irresponsible behavior for all the bad things that are done?
9.	Does the patient have olfactory, tasting, or sexual hallucinations?
10.	Does the patient have thoughts of his own that repeat or resonate in his head?
11.	Does the patient feel any foreign thoughts from outside entering his head?
12.	Does the patient feel that his mind is being stolen by something outside of him?
13.	Does the patient feel that other people know what is on his mind?
14.	Does the patient feel that he or she is being controlled by some external force?
15.	Does the patient feel that he or she is influenced by some external force?
16.	Does the patient feel helpless and resigned to something external to his body?
17.	Does the patient feel being chased by something that makes him urge?
18.	Does the patient exhibit goalless and emotionless behavior?
19.	Does the patient often giggle to himself?
20.	Does the patient feel so satisfied with himself that he smiles to himself, is arrogant and thinks he is the greatest?
21.	Does the patient often repeat short words?
22.	Does the patient show a rowdy and restless attitude?
23.	Does the patient often display certain body parts that are unnatural and let people see them?
24.	Does the patient often maintain strange or unnatural body positions?
25.	Does the patient begin to show passivity and lack of initiative?
26.	Does the patient move his body irregularly or perform strange actions?
27.	Does the patient feel that he has received miracles or other mystical things?
28.	Does the patient hear whispers commenting on anything the patient is doing?
29.	Do patients discuss what is happening to themselves with themselves?
30.	Does the patient feel any hallucinatory voices coming from any part of their body?
31.	Does the patient have irrational thoughts in politics, religion or social life?
32.	Does the patient feel he has the ability to control the weather or other strange things?
33.	Does the patient communicate with beings from another world?
34.	Does the patient have over-valued ideas?
35.	Does the patient begin to speak unimportantly or is speech impoverished?
36.	Is the patient starting to show poor non-verbal communication? Both in terms of facial expressions, eye contact, and body movements.
37.	Has the patient started not paying attention to body care, either from the way of dressing or cleanliness?
38.	Does the patient often make unmotivated resistance to any orders given?
39.	Does the patient have a rigidity disorder (maintaining a rigid body position and deliberately not moving his body)?
40.	Does the patient's thought process begin to become disorganized and his speech becomes erratic?
41.	Does the patient experience incoherence or irrelevant speech?
42.	Is the patient agitated or restless?
43.	Does the patient have an apathetic attitude and speak very little?
44.	Does the patient withdraw from social interactions?

3) Knowledge Representation

Knowledge representation of system development uses Rule Based and knowledge representation based on data of 49 symptoms and 5 types of disease.

4) Certainty Factor Value Weight Data

The weight of the Certainty Factor value is the value generated from the analysis of an expert based on the belief value of a symptom against a diagnosis. This CF value is the result of the author's interview with 3 experts, by taking the average value of each expert value, the weight data used for this system is as follows:

Table 4. Value of CF (Certainty Factor)

No.	Symptom Code	MB	MD	CF (MB-MD)	No.	Symptom Code	MB	MD	CF (MB-MD)
1.	G001	0,5	0,3	0,2	25.	G025	0,7	0,2	0,5
2.	G002	0,7	0,4	0,3	26.	G026	0,8	0,4	0,4
3.	G003	0,6	0,4	0,2	27.	G027	0,7	0,2	0,5
4.	G004	0,5	0,3	0,2	28.	G028	0,8	0,3	0,5
5.	G005	0,7	0,5	0,2	29.	G029	1	0,4	0,6
6.	G006	0,8	0,3	0,5	30.	G030	0,7	0,2	0,5
7.	G007	0,7	0,3	0,4	31.	G031	0,5	0,3	0,2
8.	G008	0,7	0,2	0,5	32.	G032	0,9	0,2	0,7
9.	G009	0,8	0,2	0,6	33.	G033	0,4	0,2	0,2
10	G010	0,8	0,2	0,6	34.	G034	0,5	0,3	0,2
11	G011	0,8	0,3	0,5	35.	G035	0,7	0,4	0,3
12	G012	0,7	0,2	0,5	36.	G036	0,6	0,3	0,3
13	G013	0,7	0,2	0,5	37.	G037	0,4	0,2	0,2
14	G014	0,8	0,4	0,4	38.	G038	1	0,3	0,7
15	G015	0,6	0,3	0,3	39.	G039	0,4	0,2	0,2
16	G016	0,5	0,3	0,2	40.	G040	0,8	0,3	0,5
17	G017	0,6	0,3	0,3	41.	G041	0,8	0,4	0,4
18	G018	1	0,3	0,7	42.	G042	0,7	0,2	0,5
19	G019	0,5	0,3	0,2	43.	G043	0,6	0,2	0,4
20	G020	0,9	0,2	0,7	44.	G044	0,8	0,4	0,4
21	G021	0,6	0,4	0,2	45.	G045	0,7	0,3	0,4
22	G022	0,7	0,2	0,5	46.	G046	0,7	0,4	0,3
23	G023	0,8	0,4	0,4	47.	G047	0,6	0,4	0,2
24.	G024	0,7	0,2	0,5	48.	G048	0,9	0,2	0,7
					49.	G049	0,6	0,3	0,3

5) Data Range of Diagnostic Statistical Values

The following is data on diagnostic statistics to determine the severity of patients by percentage:

Table 5. Range of Diagnostic Statistics

No.	Percentage Value Range	Description
1.	0-20	Very healthy
2.	21-40	Healthy
3.	41-60	You Have Symptoms
4.	61-80	You Have This Problem
5.	81-100	This Problem Happened to You

And the following is a table for treatment according to the severity of the diagnosis:

Table 6 Handling Solutions

No.	Percentage Value Range	Description
1.	0-20 %	You are perfectly healthy and do not need medication, treatment and therapy.
2.	21-40 %	You are healthy, but must take care to control stress and do not need medication, treatment, and therapy.
3.	41-60 %	If you have these symptoms, start being careful and continue to maintain your lifestyle and keep your mind from stress. You need other people to always accompany and continue to support you, you do not need care and treatment.
4.	61-80 %	You have this problem, you need treatment to a clinical psychologist or mental therapist or psychotherapist, continue to watch your mind, control yourself so that you can still distinguish between real life and your hallucinatory life. Do mental therapy and consult a clinical psychologist to ease the burden and relieve these symptoms.
5.	81-100 %	This problem occurs to you, you really need intensive care to a psychiatrist to get intensive treatment, and you are highly recommended to a Mental Therapist or Clinical Psychologist to always consult your condition.

4.4. Functionality Analysis
At this stage, the functionality analysis is carried out using the following diagrams:
a. Use Case Diagrams
   Use Case Diagram serves to describe the interaction between one or many actors into the system to be created. The following is a use case diagram for this system.
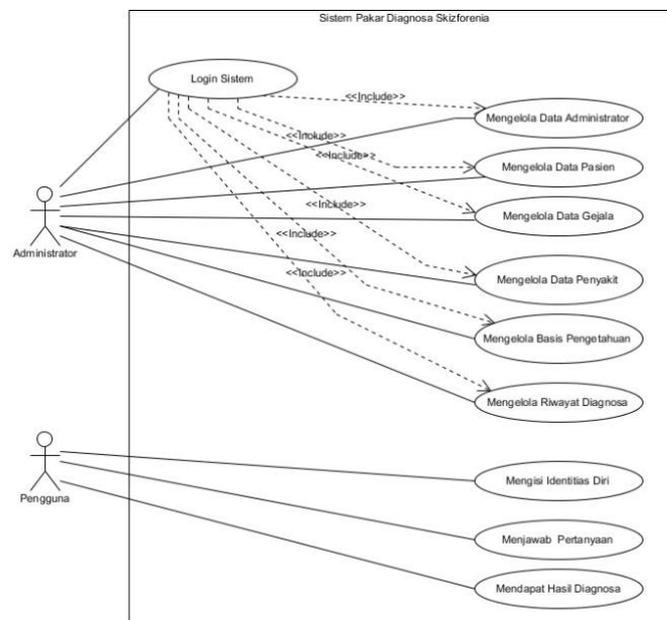
Figure 4. Use Case Diagram

b. *Class Diagram*
   Class Diagram is a relationship between classes and a detailed explanation of each class in the design model of a system, also shows the rules and responsibilities of entities that *etermine the behavior of the system. The following is a class diagram of this system:*
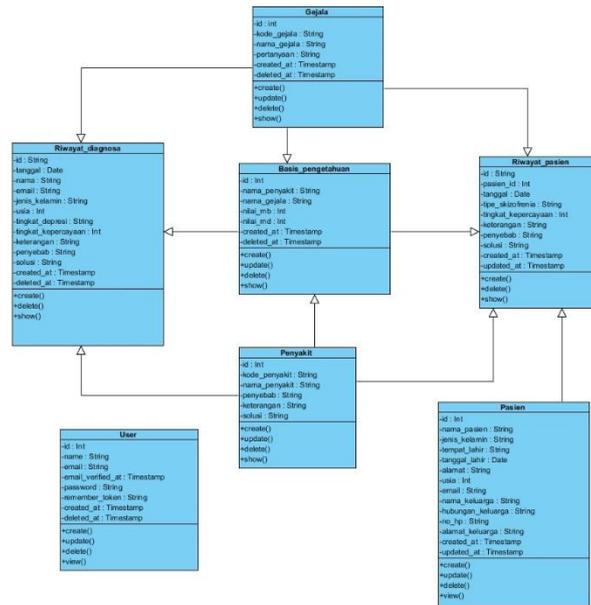
Figure 5. Class Diagram

5. Implementation and Testing

The implementation stage of the Schizophrenia Early Diagnosis Expert System is the fifth stage of the expert system design process, and at this stage the system that has previously gone through the analysis stages is ready to be used by the user. The following is an implementation of each page.

a. Diagnosis Page

After filling in the identity, the patient will answer the questions in the system, here is the Diagnosis page:

Figure 6. Diagnosis Page Display

b. Diagnostic Results Page

The diagnostic results page is the final patient page, which on this page will display all the patient's answers and the results in the form of the level of confidence in the diagnosis, and the solution of the disease:

Figure 7. Diagnose Results Page Display

The test uses two models, namely, UAT (User Acceptance Test) and Comparing the Results of Expert Diagnostics and System Diagnostic Results, here are the results:

1) UAT (Use Acceleration Test)

   User Acceptance Test or UAT is one of the effective methodologies to determine the feasibility and prevent failure in building an information system. UAT is used to determine whether the system is in accordance with user needs or not in this UAT test is divided into 2, namely UAT Expert (to determine the feasibility of the system from the expert side) and UAT User (to determine the feasibility of the system from the side of general users or the community). By using 10 questions and 18 respondents (3 experts and 15 people) the results obtained are: User UAT: 90% in the range (81-100%) or Very Good.

2) Comparing Expert Diagnostic Results and System Diagnostic Results

   In this test, 15 samples of symptom input data were used, and then the diagnostic results from this system were compared with the diagnostic results from experts. Based on 15 samples, the data used showed a correct diagnosis of 13 data and a wrong diagnosis of 2 data.

6. Conclution

Based on the whole process of developing the Schizophrenia Diagnosis Expert System, the conclusions are:

1) The system successfully applies the Certainty Factor method and the Forward Chaining tracing model, this can be seen from the results of the system accuracy which shows the percentage accuracy value of 87% which is in the Very Good range. The accuracy value of this system is obtained from the comparison test of the system diagnosis results with expert diagnostic results.

2) The system is suitable for widespread use because the system has gone through the UAT test or User Acceptance Test to test the feasibility of the system in terms of appearance,

system function, and information provided. This can be seen in the results of the Expert UAT with a value of 90% which is in the Very Good range, and the General User UAT which is also in the Very Good range with the 90% range.

3) The system that has been built has succeeded in help experts in early diagnosis of schizophrenia because the system is categorized as accurate, easy to use and can be accessed anywhere, anytime. This can be seen based on the results of the UAT (User Acceptance Test) and the results of the Comparing Expert System Diagnosis with Expert Diagnosis (Comparing the results of expert system diagnoses and expert diagnostic results).

Suggestions that need to be considered for further system development are:

1) In future research, it is recommended to increase the scope of diagnosis. For example, the system is not only for diagnosing schizophrenia, but also mental illness or other mental disorders.
2) The system can be developed into a mobile application to make it more accessible via smartphones, and more flexible in its use.
3) Using a combination of other methods, in order to compare the best methods in diagnosing schizophrenia.

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