Design and Construction of an System for Diagnosis of Online Game Addiction Using The Forward Chaining and Certainty Factor Methods Based on a Website (Case Study: RSU South Tangerang)

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Abstract − Online games are a type of game that provides a unique pleasure for players, as they can be played not only alone (singleplayer) but also with two or more people (multiplayer) from various locations and countries. Online games are a kind of game that gives players something special because they can be played either singleplayer or with two or more people from different places and countries [1]. According to the APJII 2025 poll, 34.91% of participants spend one to two hours a day playing online games. This suggests that playing online games has ingrained itself into people's daily lives [2]. Because of this, many people can become addicted to online games without realizing it. It might result in adverse bodily effects like exhaustion, weakened immunity, visual issues, anxiety, restlessness when not playing, diminished focus, and emotional shifts (irritability or sensitivity). Therefore, an expert system is needed to diagnose online game addiction as a means of determining the level of addiction. This website aims to determine the level of online game addiction, using the data and the forward chaining method, which aims to generate a conclusion from existing facts. With this method, a conclusion will be obtained, which is then further processed to determine the certainty value. And this expert system requires the certainty factor method to find this certainty value. Given the problems and needs at RSU Tangerang Selatan, this research has produced an expert system for diagnosing online game addiction, which provides ease of use because it is published on a website. This expert system generates output that includes conclusions based on existing facts, the level of online game addiction determined by the certainty factor method, a certainty value ranging from 0% to 100%, and solutions provided by experts.

Keywords – Game Online, Addiction, Expert System, Forward Chaining, Certainty Factor

I. INTRODUCTION

In the present period, science and technology are advancing at a very quick pace. One area of this rapid development is the entertainment industry, which includes gaming. Traditional games are often abandoned in today's society in favor of more contemporary possibilities, such playing online. Only a computer or smartphone with an internet connection can be used to play online games. Positive effects of playing online games include, for instance, enhancing motor abilities through increased focus. Online games have both positive and bad effects; specifically, they can significantly affect their users. Players of online games often develop an addiction to their preferred games. Additionally, it can be lethal for fans to experience a period of overwhelming addiction or enjoyment of the games they play. Games have become everyone's favorite. Both children and adults enjoy playing games. Someone can play games continuously until they lose track of time and even forget about their surroundings. Frequent gaming can impact a person's level of addiction to games [3]. Online games are a type of entertainment that may be played on computers (PCs), laptops, smartphones, and other devices that are linked to the internet. Indonesian society has been greatly impacted by online gaming, especially among teenagers. With 64.5% of the population playing online games, Indonesia is among the nations with the highest percentage of gamers worldwide. [4]

Therefore, a system designed to assess a person's level of online gaming addiction is needed. This expert system is expected to provide information on symptoms and solutions related to online gaming addiction. RSU Tangerang Selatan plays a crucial role in providing comprehensive and affordable healthcare to the public. In this context, there is a need to design an expert system for diagnosing online gaming addiction that can assist patients or the public in diagnosing online gaming addiction based on references and needs. The technology that can be implemented is a website-based expert system using the forward chaining and certainty factor methods. Forward chaining is a method that begins with gathering information related to existing facts, then combining rules to draw conclusions. The Certainty Factor method is used to define a measure of certainty regarding a fact or rule and to describe the expert's level of confidence in addressing a problem.

Playing games is enjoyable. The majority of kids and teenagers used to play games with physical activities, but these days they play games with their devices. Addiction can result from excessive gaming. Addiction to video games can lead to mental and even physical health problems. [5]

Online game addiction is a pleasure in playing because it can provide a sense of satisfaction, so that there is a feeling of wanting to repeat the fun activity when playing online games, an unhealthy and self-destructive habit or behavior where the individual has difficulty

stopping, feels dependent, and wants to repeat the same thing. [6]

Addiction to online games is when someone is so addicted to them that they want to play them all the time, which in the end has a bad effect on their physical and mental health. [7]

According to the background, playing online games can be enjoyable because it can make one feel satisfied. As a result, people who are addicted to these games may find themselves wanting to repeat the enjoyable activity, which is a harmful and self-destructive habit or behavior in which they find it difficult to stop, feel dependent, and want to do it again.

Multiplayer games that can be played online are known as online games. [8]

Addiction is characterized by intense feelings of desire, which leads the addict to search for the item they truly want. [9]

Compulsive behaviors that a person engages in frequently in order to obtain gratification from particular activities are the hallmarks of online game addiction, an illness that is constantly recurrent. [10]

A computerized tool designed to aid in decision-making is called a decision support system. [11]

By offering information or recommendations for specific decisions, a decision support system can and does communicate about semi-structured problems and offer solutions or problem-solving capabilities. [12]

An expert system is a computer program that incorporates human intelligence or knowledge to handle problems similarly to how people do. [13]

An inference technique called "forward chaining" works by reasoning from a problem to its solution. Starting with a set of facts, the procedure looks for rules that support preexisting beliefs or hypotheses before coming to a conclusion. [14]

Expert systems employ forward chaining as a methodology or method to solve problems or make judgments based on information that is already known. It operates by beginning with known facts or data and then drawing conclusions or making decisions based on established rules or knowledge. This approach enables the system to proactively consider multiple options and make choices based on previously applied logic and information. [15]

Trust and mistrust can be combined into a single number using the certainty factor. [16]
Based on data or professional opinion, the certainty factor conveys confidence in an event, whether it be a fact or a hypothesis. It assumes an expert's level of confidence in a piece of data by using a value. [17]

II. RESEARCH METHODOLOGY

2.1 Research Location
The research and implementation of this application took place at the South Tangerang City General Hospital (RSU), a healthcare facility owned by the South Tangerang City government. RSU South Tangerang City plays a crucial role in providing comprehensive and affordable healthcare services to the community. In this context, there is a need

to design an expert system for diagnosing online game addiction that can assist patients or the public in diagnosing online game addiction based on references and needs.

2.2 Research Methods
In this research, the methods used are as follows:
A. Forward Chaining
Forward chaining is a technique in expert systems and artificial intelligence used to draw conclusions based on initial facts. The process begins with known data or premises, and then the system gathers new information through rules (if-then rules) to reach a conclusion.

Forward chaining is an approach method that starts with data or is often called data-driven, namely the process of solving a problem by collecting information and then drawing conclusions. [18]

Table 1. Forward Chaining Rules

No	Rules
1	IF G001 AND G002 THEN KGA01 SCORE = 1
	IF G003 AND G004 THEN KGA02 SCORE = 1
	IF G005 THEN KGA03 SCORE = 1
	IF G006 THEN KGA04 SCORE = 1
	IF G007 AND G008 THEN KGA05 SCORE = 1
	IF G009 AND G010 THEN KGA06 SCORE = 1
	IF G011 THEN KGA07 SCORE = 1
	IF G012 THEN KGA08 SCORE = 1
	IF G013 THEN KGA09 SCORE = 1
	IF G014 THEN KGA10 SCORE = 1
2	IF SCORE <= 4 THEN P-001
	IF SCORE >= 5 AND SCORE <= 6 THEN P-002
	IF SCORE >= 7 AND SCORE <= 8 THEN P-003
	IF SCORE >= 9 AND SCORE <=10 THEN P-004

B. Certainty Factor
Certainty Factor (CF) points for each symptom are assigned by experts in this field. The following are the MB (confidence measure), MB (distrust measure), and expert CF values for online gaming addiction symptoms.

Table 2. Certainty Factor Value

No	CODE	CV Value
1	G001	1
2	G002	1
3	G003	1
4	G004	1
5	G005	1
6	G006	1
7	G007	1
8	G008	1
9	G009	1
10	G010	1

11	G011	1
12	G012	1
13	G013	1
14	G014	1

There are 14 symptoms described in the symptom code, and along with the Cf value, there is also the weight of the MD and MD values.

Table 3 MB and MD Value

Description	MB Value	MD Value
YA	1	0
TIDAK	0	1

There are new rules with scores and CF values that have been converted from scores to CF values.

Table 4. New Rules

Score	CF Value
0 - 4	0
5 - 6	0.3
7 - 8	0.7
9 - 10	1

The manual calculation of the Certainty Factor value from the user selects 11 symptoms from 14 symptoms.

$CV_{Average}$ = (Total Users / Total Symptoms per User) * 1
$CF_{Combined}$ = (Old CF + New CF) * 2
CF_{Final} = Final CF * 100
$CV_{Average}$ = 11 / 14 * 1
$CV_{Average}$ = 0.7
$CF_{Combined}$ = (0.7 + 0.7) / 2
$CF_{Combined}$ = 0.7
CF_{Final} = 0.7 * 100
CF_{Final} = 70%

Table 5. Presentation Results

Level Addiction	Presentase
NOT ADDICTION	0%
MILD ADDICTION	10%
	20%
	30%
MODERATE ADDICTION	40%
	50%
	60%
	70%
	80%
SEVERE ADDICTION	90%
	100%

2.3 System Development

The waterfall model for software engineering was employed in this study. Because it provides a methodical and sequential development process that works well for research with clearly defined requirements right from the start, this model was selected.
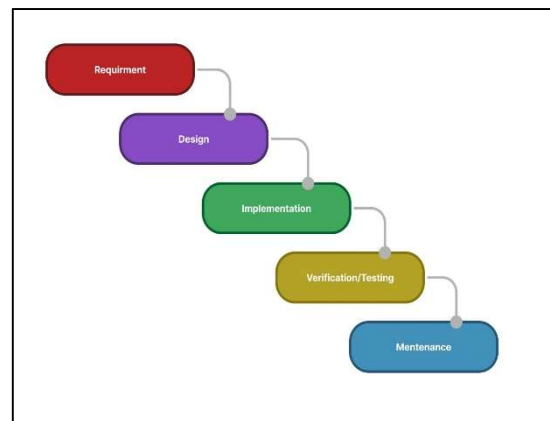

Figure 1. Waterfall Models

The stages in the waterfall model are as follows:

1. Requirements
   The initial stage in system development, which aims to gather comprehensive requirements for analysis and identify program needs. Information can be obtained through interviews, discussions, and surveys.
2. Design
   System design is based on the requirements identified in the previous stage. Software design is carried out before coding is created. The design stage is crucial in system development because the results of this stage will form the basis for the implementation stage.
3. Implementation
   This stage implements the results of the previous stages and converts them into program code.
4. Verification/Testing
   After the system is completed, the next stage is testing. This testing aims to ensure that the system runs properly and meets the predetermined specifications.
5. Maintenance
   After the system has been successfully implemented and tested, the next stage is maintenance. This maintenance is carried out to ensure the system continues to run properly and can address any issues that arise. The maintenance stage consists of several activities, including fixing bugs or errors in the system and upgrading the system by adding new features or improving existing ones.

2.4 System Design

The Unified Modeling Language (UML) approach, a standard visual modeling language used to describe the structure and behavior of software systems in a systematic and structured manner, was used to design an expert system for diagnosing online game addiction. The following is the UML diagram used in this research:

A. Use Case Diagram

In the Unified Modeling Language (UML), a use case diagram is a particular kind of diagram that is used to explain how actors—such as users or external systems—interact with the system under development.

A use case is a type of UML diagram that describes the relationship between a system and an actor. A use case diagram describes the model of the relationship between a
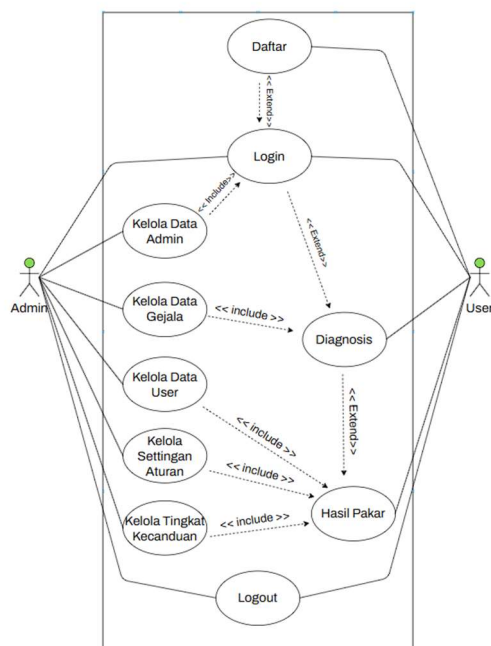
user and the system. [19]

Figure 2. Use Case Diagram

Logging in to access the system is the first of the admin actor's many main use cases. After logging in, the administrator can view, reset, and delete user responses; manage admin data (add/remove access); and manage symptom data (add/edit/remove symptoms). Additionally, the administrator has the ability to manage rule settings to establish inference rules and manage addiction level data to establish mild, moderate, and severe addiction categories.

To access the system, the user must first register and then log in. Once logged in, the user undergoes a diagnosis process by answering questions about their symptoms. The system presents Expert Results, an analysis of their degree of addiction, based on these responses.

B. Entity Relationship Diagram (ERD)

Entity Relationship Diagram models existing data; the main purpose of depicting ERD is to show data objects (entities) and relationships to existing entities so that files can be created.

An Entity Relationship Diagram (ERD) is a data modeling technique that graphically depicts information system entities and the relationships between those entities. [20]
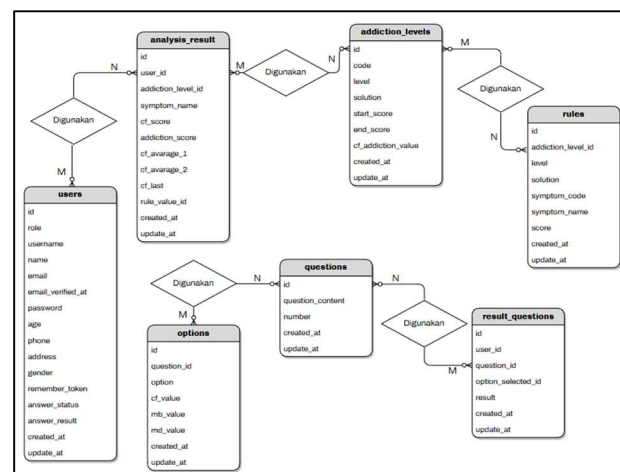

Figure 3. Entity Relationship Diagram (ERD)

The cardinality of this relationship is that many entities from one side are related to many entities from the other side (M:N).

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The questions entity in this relationship has a cardinality of many entities from one side, related to many entities from the other side (M:N).

The result_questions entity in this relationship has a cardinality of many entities from one side, related to many entities from the other side (M:N).

C. Database

The database design aims to manage symptom data, inference rules, users, and diagnostic results in a structured and efficient manner.

A database is a collection of structured data stored in an integrated manner in a system that can be accessed and managed by users or applications. [21]

Table 6. Structure of Database User

No	Field Name	Data Type	Size	Description
1	id	int	11	Primary Key
2	role	int	11	"1","2"
3	username	varchar	100	
4	name	varchar	100	
5	email	varchar	150	
6	email_verified_at	timestamp		
7	password	varchar	100	
8	age	smallint	2	
9	phone	varchar	13	
10	address	text		
11	gender	varchar	20	"Male","Female"
12	remember_token	varchar	100	
13	answer_status	int	11	

14	answer_result	text		"Not Addicted," "Mild Addiction," "Moderate Addiction," "Severe Addiction"
15	created_at	timestamp		
16	update_at	timestamp		

An arrangement of data created to methodically store and manage user information is known as the user database structure. The system can manage access privileges, keep data secure and consistent, and individually identify each user thanks to this framework. An effective user database architecture can facilitate account administration, authorization, and authentication procedures.

Table 7. Analysis Results

No	Field Name	Data Type	Size	Description
1	id	int	11	Primary Key
2	user_id	int	11	
3	addiction_level_id	int	11	
4	symptom_name	text		
5	cf_score	int	11	
6	addiction_score	int	11	
7	cf_average_1	decimal	3.1	
8	cf_average_2	decimal	3.1	
9	cf_last	decimal	3.1	
10	rule_value_id	text		
11	created_at	timestamp		
12	update_at	timestamp		

Processed data is presented in an easy-to-understand manner in the Analysis Results Table. Key indicators, computed values, and the conclusions drawn from the analytical process are often summarized in this table.

Table 8. Addiction Level

No	Nama Field	Tipe Data	Size	Keterangan
1	id	int	11	Primary Key
2	code	varchar	5	"P-001", "P-002", "P-003", "P-004"
3	level	varchar	20	"Not Addicted," "Mild Addiction," "Moderate Addiction," "Severe Addiction"
4	solution	text		"You have a healthy relationship with the game and are able to control your playtime," "Limit your game time, create a balanced schedule between playing games and other activities (sports, reading, or participating in other activities)," "Talk to your closest people/family about your feelings and ask for their support. Limit access to games, find new hobbies, and increase

				social interaction, participate in social activities or join community groups," "Consult with a mental health professional, psychiatrist, or psychologist who can provide the necessary support and therapy."
5	start_score	int	11	"0","5","7","9"
6	end_score	int	11	"4","6","8","10"
7	cf_addiction_value	decimal	2.1	"0.0","0.3","0.7","1.0"
8	created_at	timestamp		
9	update_at	timestamp		

Presenting the degree of addiction of the responders according to the measurement's findings. The information in this table divides respondents into a number of groups, including low, medium, and high, according to the study instrument's results.

Table 9. Rules

No	Field Name	Data Type	Size	Description
1	id	int	11	Primary Key
2	addiction_level_id	int	11	
3	level	varchar	20	
4	solution	text		
5	symptom_code	text		["1","2"], ["3","4"], ["5"], ["6"], ["7","8"], ["9","10"], ["11"], ["12"], ["13"], ["14"]
6	symptom_name	varchar	200	"Preoccupation"," Tolerance"," Loss of control"," withdrawal"," Escaping adverse moods"," Playing for long periods of time"," Deception, Covering-up"," Losing relationships or opportunities"," Persistence despite problems"," Giving up other activities"
7	score	int	11	"1"
8	created_at	timestamp		
9	update_at	timestamp		

These guidelines outline certain connections or trends among the variables under investigation. This table's presentation seeks to facilitate readers' comprehension of the data's interconnection while also providing a foundation for inferences and suggestions pertinent to the study issue.

Table 10. Options

No	Field Name	Data Type	Size	Description
1	id	int	11	Primary Key
2	question_id	int	11	
3	option	varchar	20	"yes","no"

4	cf_value	decimal	2.1	"1.0","0"
5	mb_value	decimal	2.1	"1.0","0"
6	md_value	decimal	2.1	"0","1.0"
7	created_at	timestamp		
8	update_at	timestamp		

Presenting a range of inquiry options to respondents with straightforward Yes/No response options. The purpose of this option structure is to reduce uncertainty and facilitate respondents' provision of responses. Researchers can gauge respondents' propensity toward a statement using the results in this table.

III. RESULTS AND DISCUSSION

3.1 Software and Hardware Requirements

In developing the expert system design for diagnosing online game addiction, the hardware and software used are as follows.

A. Software Requirements
- Microsoft Windows 10 pro
- Microsoft Office 2019
- Vscode
- XAMPP

B. Hardware Requirements
- Processor   : Intel Core i7 – 2600K, 3,4Ghz
- Monitor   : 27 inci
- Memory   : 8 GB
- Hardisk : 500 GB

3.2 Implementation User Interface

The system's user interface (UI) design and implementation are essential to ensuring that users can diagnose online game addiction quickly, accurately, and easily.

Figure 4. Login User

This user login is a page where users must log in first to be able to enter the diagnosis page.

Figure 5. Registration User

This user registration is a page where users must register first to be able to log in.

Figure 6. User Online Game Addiction Survey Page

This online game addiction survey page is where users have to choose the symptoms they are experiencing until the final slide.

Figure 7. Diagnosis Description Page Not Addicted

The user doesn't fall into the category of online gaming addiction. However, the user can identify symptoms based on their diagnosis. Any current experiences can be seen in the diagnosis provided by an expert.
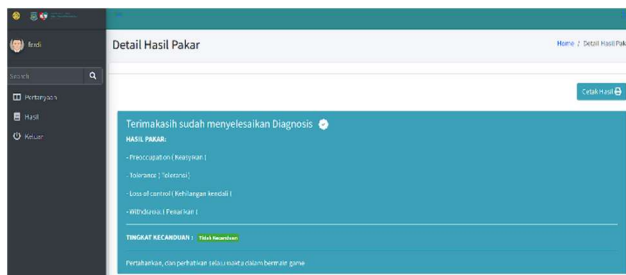
Figure 8. Expert Results Detail Page Not Addicted

In the image above, users can see the details of the expert's results in more depth and know what to do now with the results of the user not being addicted to green.
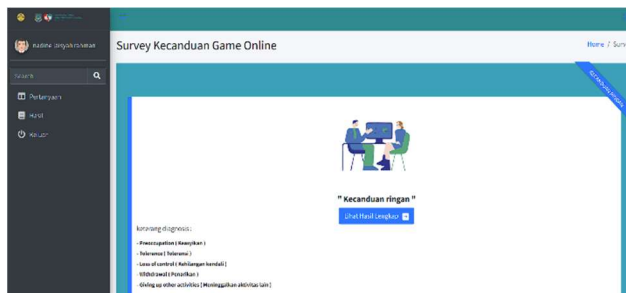

Figure 9. Mild Addiction User Diagnosis Description Page

In the image above, the user is in the mild addiction category. With symptoms consistent with the user's diagnosis, the user can view the diagnostic information provided by an expert.
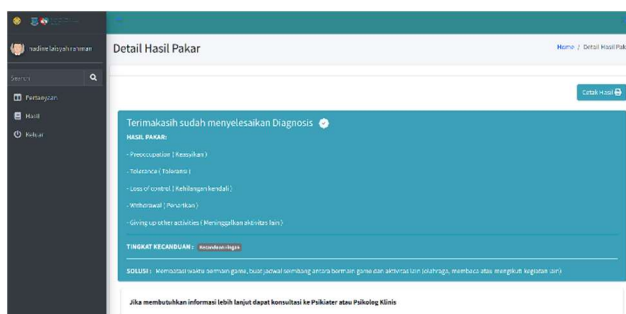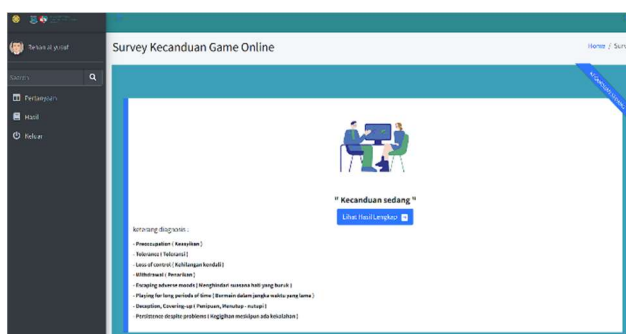

Figure 10. Mild Addiction Expert Results Detail Page

In the image above, users can see more detailed expert results and identify solutions for mild addiction. If users need further information, they can consult a psychiatrist or clinical psychologist, and a PDF of the results can be printed on the symptoms.

Figure 11. Moderate Addiction User Diagnosis Description Page

In the image above, the user is in the moderate addiction category. With symptoms consistent with the user's diagnosis, the user can view the diagnostic results provided by an expert.
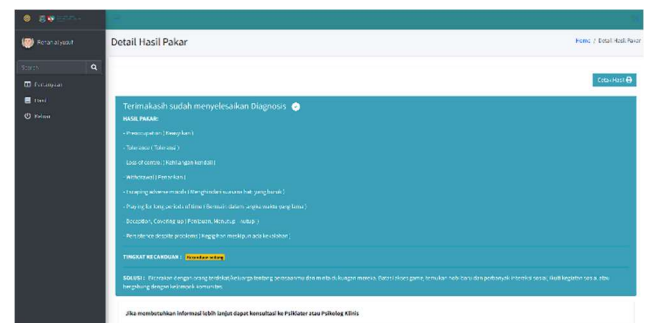

Figure 12. Moderate Addiction Expert Results Detail Page

In the image above, users can see more detailed expert results and identify solutions for moderate addiction. If users need further information, they can consult a psychiatrist or clinical psychologist. A PDF of the results can be printed out, highlighting the symptoms currently experienced, with moderate addiction results highlighted in yellow.
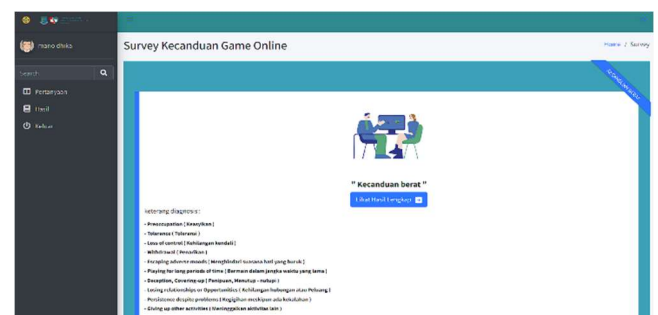

Figure 13. Severe Addiction User Diagnosis Description Page

In the image above, the user is in the severe addiction category. With symptoms consistent with the user's diagnosis, the user can view the diagnostic results provided by an expert.
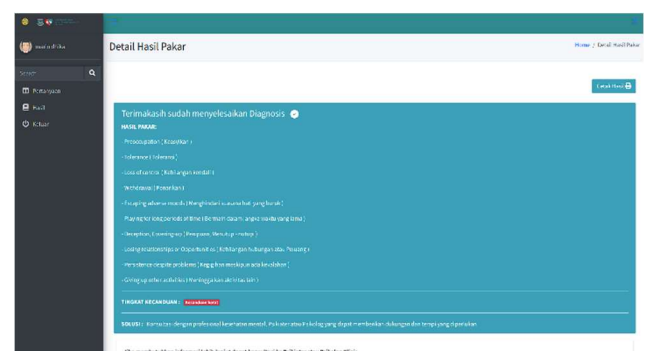

Figure 14. Severe Addiction Expert Results Detail Page

In the image above, users can see more detailed expert results and identify solutions for severe addiction. If users need further information, they can consult a psychiatrist or

clinical psychologist. A PDF of the results, with severe addiction levels highlighted in red, can be printed.

Figure 15. User Results

The user's results indicate a mild addiction to online gaming with a 40% accuracy rate. Here's an example of a manual user calculation.

Example of Manual Calculation Results

$CFaverage = 8 / 14 * 1$

$CFaverage = 0.5$

$Cfcombine = (0.5 + 0.3) / 2$

$Cfcombine = 0.4$

$CFResult = 0.4 * 100$

$CFResult = 40\%$

3.3 Blackbox Testing

System testing is carried out using the Black Box Testing method, which is a software testing technique that aims to ensure that each system feature works according to specifications and user needs.

Table 11. Login User

Cases and Test Results (Correct Data)				
Process	Input	Expectation	Observation Result	Conclusion
Click diagnosis now		The system goes to the user login page	The system goes to the user login page	Success
Click test		The system goes to the user login page	The system goes to the user login page	Success
Click login	Email, *password*	The system enters the diagnosis page.	The system enters the diagnosis page.	Success
Click login	Form not filled in	Displays the message "wrong email or password"	Displays the message "wrong email or password"	Success

Table 12. Testing Registration Account

Cases and Test Results (Correct Data)				
Process	Input	Expectation	Observation Result	Conclusion
Click registration new account		The system enters the user account list page.	The system enters the user account list page.	Success
Click registration	Full name, age, telephone number, address, select gender, email, password	The system adds user accounts	The system adds user accounts	Success
Already have an account? Click enter	The system goes to the user login page	The system goes to the user login page	The system goes to the user login page	Success
Click register	Do not include @	Displays a message when the list is missing the @ symbol "please include an '@' in the email address. ' ' is missing an '@' " (Please include an '@' sign in the email address. ' ' is missing an '@' sign)	Displays a message when the list is missing the @ symbol "please include an '@' in the email address. ' ' is missing an '@' " (Please include an '@' sign in the email address. ' ' is missing an '@' sign)	Success
Click register	Did not fill out the form	Displays the message "please fill out this field"	Displays the message "please fill out this field"	Success

Table 13. User Diagnosis Testing

Cases and Test Results (Correct Data)				
Process	Process	Process	Process	Process
Click next	Choose "Yes" / "No"	Go to the next question	Go to the next question	Succes

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Click previous		Back to previous question	Back to previous question	Succes
Click save answer		Enter the online game addiction survey page	Enter the online game addiction survey page	Succes
Click see the result		Go to the expert results details page	Go to the expert results details page	Succes
Click print result		Download the PDF results and when it has downloaded, go to the PDF page.	Download the PDF results and when it has downloaded, go to the PDF page.	Succes
Click next	Do not select "Yes" / "No"	Can't click next and can't go to the next question	Can't click next and can't go to the next question	Succes

Total Data Result:

= (Correct Data) / (Number of Data) x 100%

= 47 / 47 x 100%

= 100 x 100%

= 100%

3.4 Questionnaire Test Results

Questionnaire testing is an objective test conducted directly in the field. This involves creating a questionnaire regarding the usability of the system being developed and determining whether it meets user expectations.

The testing involved administering a questionnaire to 20 users. The questionnaire consisted of 10 questions, each with a response scale of 1 to 5.

Table 14.Questionnaire Test Results

No	Questions	Score				
		5	4	3	2	1
1	Are you satisfied with the appearance of the online game addiction diagnosis expert system website (South Tangerang Hospital)?	12	6	2		
2	Can this expert system website help you determine your level of online gaming addiction?	15	3	1	1	
3	How accurate is this expert system website in diagnosing online gaming addiction?	12	6	1	1	
4	Can using this expert system website make it easier for you to diagnose online game addiction?	14	5	1		
5	Does this expert system website help you to find a solution to your online gaming addiction?	13	6	1		
6	Is it easy to understand when diagnosing an expert system website?	14	4	2		
7	Can this expert system website help to know about the impact of online game addiction?	12	8			
8	How satisfied are you with diagnosing your online gaming addiction?	11	6	3		
9	Do you really agree that this expert system website can help you diagnose your level of online gaming addiction?	11	8	1		
10	How satisfied are you with the overall website of the online game addiction diagnosis expert system (South Tangerang Hospital)?	16	4			
	Total	130	56	12	2	

Test Result Score:

Number of Respondents x Weighted Score (per Category)

Percentage:

(Test Result Score / Highest Score) x 100%. The following is the calculation of scores per 5 assessment criteria for 20 respondents:

Test Result Score:

= (130 x 5) + (56 x 4) + (12 x 3) + (2 x 2) + (0 x 1)

= 650 + 224 + 36 + 4

= 914

Highest Score:

= 10 (Number of Questions) x 5 x 20 (Respondents)

= 1000

Percentage:

= (Test Result Score) / (Highest Score) x 100%

= 914 / 1000 x 100%

= 0.914 x 100%

= 91.4%

The system is assessed as extremely good and has fulfilled user expectations, according to the computations, which yielded a test outcomes percentage of 91.4%. This high proportion indicates that the majority of respondents thought the system was user-friendly, appropriate for their requirements, and really helpful in assisting with the anticipated activities. As a result, the outcomes of this questionnaire testing can be used to determine whether the system is ready for deployment and further enhancement.

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IV. CONCLUSION

According to the research development of an expert system for diagnosing online game addiction has successfully facilitated users, especially online game enthusiasts, in determining the level of addiction they are experiencing and encouraged them to seek further consultation at South Tangerang General Hospital. By implementing the forward chaining method, the system is able to trace facts such as symptoms and rules that have been determined by experts, while the certainty factor method is used to calculate the level of diagnosis accuracy, with categories ranging from no addiction to severe addiction based on the CF value. The results of the questionnaire testing on users showed a very high level of satisfaction, namely 91.4%, which indicates that this system has been effective, accurate, and well-accepted as an early diagnosis tool for online game addiction.

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