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DETECTING ONLINE GAME ADDICTION USING FUZZY LOGIC WITH THE TSUKAMOTO METHOD

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ABSTRACT

Currently online games are not a stranger to people's lives in various circles, from children, adolescents and adults. The large number of people who are very fond of playing online games, the chance that people will become addicted to playing online games is very large, sufferers of online game addiction will not know the time so they often forget their obligations, in this case teenagers who are still in school become lazy and often skip school In order to become true gamers, so that bad things don't happen, a system model is needed to detect online game addiction. With the existence of this system model, it is hoped that it can provide information and solutions for people who have experienced addiction so that prevention and recovery can be carried out so that it does not have fatal consequences. This system model uses five input variables, namely thinking about games all day and feeling bad when not playing games, increased gaming time and loss of sleep, playing games to forget real life and ignore other activities, other people fail to prohibit playing games and will keep playing games, get annoyed easily and fight with family or friends, while the output variables consist of not addicted, mild addicted, heavy addicted. This study used 86 questionnaires filled in by 86 online game players. Then the results of the research were obtained, namely the level of not being addicted = 65%, mild addiction = 15% and heavy addiction = 20%.

Keywords: *Online Games, Input and Output Variables, Fuzzy Logic, Tsukamoto Method, Game Addiction Symptoms.*

1. INTRODUCTION

As a result of the COVID-19 pandemic which has hit not only Indonesia but also other countries in the world, it has had a huge impact on increasing the risk of online game addiction in children and adolescents [1], [2], [3]. Online games have become a very popular form of entertainment among young people and adults around the world. Along with the advancement of technology in the online gaming industry [4], become more and more interesting and addictive. Although many people can play online games healthily, there are also those who are susceptible to online game addiction which can have an impact on public health based on an empirical study of social media in China [5]. Addiction to online games can also increase depression among teenagers in the Philippines [6]. Online game addiction can also disrupt the balance between virtual and real life, resulting in disruptions in social, academic, and even physical health resulting from the influence of digital game addiction on heart health behavior in middle school students during the COVID-19 pandemic [7].

Addiction to playing online games is very influential in children's activeness in the learning process and mental growth of children, so it is very important to detect addiction to online games [8]. In adolescents, symptoms of video game addiction depend not only on video game play but also on concurrent levels of online communication, and those who are very socially active online report fewer symptoms of game addiction [9]. Empirical evidence consisting of 30 studies shows that in some adolescents, gaming addiction does exist and as the addiction progresses, online gaming addicts spend

more time preparing, organizing, and actually playing the game [10].

The method used to detect online game addiction in this research uses a fuzzy logic model with the Tsukamoto method. Fuzzy logic in the narrow sense is important for the expansion of fuzzy logic because it provides conceptual and methodological foundations, clarity and simplicity[11]. The extended Tsukamoto inference method can solve multi-objective linguistic optimization problems where the consequences are defined as non-monotonic functions as well as monotonic functions, generate intervals instead of unique numbers, and provide linguistic recommendations for type-1 fuzzy set membership functions, making This is new methods that will provide directions for future research [12]. The individual rule outputs of Tsukamoto's Fuzzy reasoning scheme are crisp numbers, and therefore, the functional relationships between the system's input and output vectors can be identified relatively easily[13].

This research aims to detect with accuracy the level of online game addiction and classify the level of risk for a person's online game addiction whether they are addicted to online games or not with 3 levels, namely, not addicted, mildly addicted and heavily addicted using the Tsukamoto method of fuzzy logic. Fuzzy logic models have proven effective in a variety of applications, including in decision making under uncertainty. The Tsukamoto method is an approach in fuzzy logic that is used to overcome problems of uncertainty and complexity in decision making. Therefore, this research will develop a fuzzy logic model using the Tsukamoto method as a tool that can be used to detect online game addiction. The advantage of the Tsukamoto method is that it has tolerance for precise data and is easy to understand. In the Tsukamoto method, each rule is represented using fuzzy sets, with a monotonic membership function. To determine a firm output value, it is sought by changing the input into a number in the fuzzy domain [14].

In this study, we used relevant variables to measure the level of online game addiction. There are 5 input variables used in this research, namely: 1. Always thinking about games all day and feeling restless when not playing games, 2. Game playing time increases each day and sleep loss decreases, 3. Play games to forget about real life and ignore other activities, 4. It can't be forbidden not to play the game and it will still be playing games and 5. When playing games, they tend to be aggressive so they fight with family or friends. Fuzzy logic model research using the Tsukamoto method to detect online game addiction produces three addiction level outputs, namely: no addiction, mild addiction, and heavy addiction.

It is hoped that the results of this research will help in efforts to prevent and overcome online game addiction more effectively. Thus, this research has the potential to provide great benefits in maintaining the well-being of individuals who play online games and society as a whole. Previous research has tried to detect and prevent online gaming addiction with various methods, such as psychological questionnaires and behavioral analysis. However, these methods often have limitations in understanding an individual's level of addiction and risk level with sufficient accuracy.

Besides that, there are several other studies that have been conducted by researchers including, research mapping system model and clustering of fishery products using K-Means algorithm with Web GIS approach [15], optimization and computing model of fish resource supply chain distribution network [16]. robust optimization approach for agricultural commodity supply chain planning [17], mixed integer linear programming model for integrated fish supply chain planning [18], data driven optimization approach to fish resources supply chain planning in Aceh province [19], searching the shortest route for distribution of LPG in Medan city using ant colony algorithm [20], and Implementation of the BFS algorithm and web scraping techniques for online shop detection in Indonesia [21].

2. LITERATURE REVIEW

There are several related previous studies which became a literature review in this study, as research conducted by [22]The research he conducted aimed to describe high school students' understanding of the risks of online game addiction. The sample consisted of 255 high school students selected by proportional random sampling technique. Data was collected using a scale measuring understanding of the risk of online gaming addiction. The results show that middle school students' understanding of the risks of online game addiction is in the medium category with an average score of 198.48 and an achievement score of 55.14%. Therefore, school counselors should increase middle school students' understanding of the risks of online game addiction. The problem of online games is not the only factor that can influence the learning achievement of high school children. Other factors that may influence children's learning achievement include self-motivation, family social support, and the school social environment. Recommendations for parents to supervise their children when using gadgets and

schools can strengthen the rules for using gadgets at school [23]. The results of other research show that gaming disorder can co-occur with various other addictive behaviors (for example, alcohol use disorder or addictive social media use) and research on the occurrence of addictive behavior and drug use is increasing [24]. These findings empirically support a direct link between frequent online gaming and the broad field of behavioral and drug addiction research, thereby opening new avenues for clinical intervention in addicted gamers and potentially improving addiction risk assessment in large populations of frequent gamers [25]. Using current empirical knowledge, it is argued that internet gaming addiction follows a continuum, with etiology and risk factors preceding it, until it develops into a "full-blown" addiction, followed by consequences in terms of negative consequences and potential treatment [26].

Other related research carried out by [27] Application the Tsukamoto fuzzy logic method to an Android-based application, users can find out the level of addiction to playing the Free Fire game. And this application can display the level of addiction based on the player data entered. The Tsukamoto fuzzy method can provide precise conclusions that are as expected. By using the Fuzzy Tsukamoto Algorithm, this research is able to determine the most suitable employees for the company based on the company's criteria, through a process of fuzzyfication, rule making, and defuzzyfication, resulting in a score of 67.41 [28]. From the research results, according to the comparison results of the Fuzzy Tsukamoto method, it shows that this method is the chosen method with an accuracy rate of 99.2% [29]. Research conducted by [30] the Tsukamoto fuzzy system determines job suitability based on Academic Potential Test (APT) ability and Average Achievement Index (GPA), where the greater the GPA value obtained, the greater the work suitability value. From the results of testing the system implementation, it can be seen that the system application in the Fuzzy Tsukamoto algorithm implementation system for Admission of New Middle School Students can carry out the process well and correctly [31].

3. RESEARCH METHODOLOGY

3.1 Description of Problem Formulation

The large number of people who are very fond of playing online games, the chance that people will fall into addiction to playing online games is very large, where with this addiction people who are already addicted will not know the time so they often forget their obligations, in this case children to adolescents who are still going to school becomes lazy and often skips school in order to become gamers, if this is not followed up seriously then this will become a big problem for the nation's next generation. It is undeniable that the lack of public awareness of addiction to playing online games makes people not check their mental health conditions at mental hospitals or psychologists, so that the absence of early prevention results in the condition of addiction getting worse so that it can lead to severe addiction that disturbs a person's psyche. For this reason, a detection system model is needed to check the condition of the level of addiction to playing online games as early as possible, so that people can find out their mental state in playing online games as early as possible quickly and efficiently by using an addiction detection system for playing online games using the Fuzzy Tsukamoto method.

3.2 System Schematic Model

The steps taken in the online game addiction detection system model using the fuzzy logic of the Tsukamoto method are as follows:

1. Start is the process of starting the system.
2. The input of online game addiction symptoms is an input process in the form of how much value is experienced by players playing online games in each symptom variable provided in the system.
3. Determining the degree of membership is the process of determining the degree of membership, where the degree of membership becomes a value in a fuzzy set.
4. Calculating α is a process in which the variables that have been included in the fuzzy set, rules are formed which are obtained by combining each variable with other variables with their respective linguistic attributes. After going through the rule calculation process, the predicate α value is obtained with the implication process. In the Tsukamoto fuzzy method, the implication process is carried out by the MIN process. The rule predicate is obtained by taking the minimum value of the degree of membership in each variable, which has been combined in predetermined rules.
5. Defuzzification is an average calculation process
6. The output of the decision to be addicted to playing online games is the result of a decision to determine whether a player experiences no addiction, mild addiction or severe addiction to playing online games.
7. Done.

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The following is a schematic of an online game addiction detection system using the Tsukamoto method of fuzzy logic

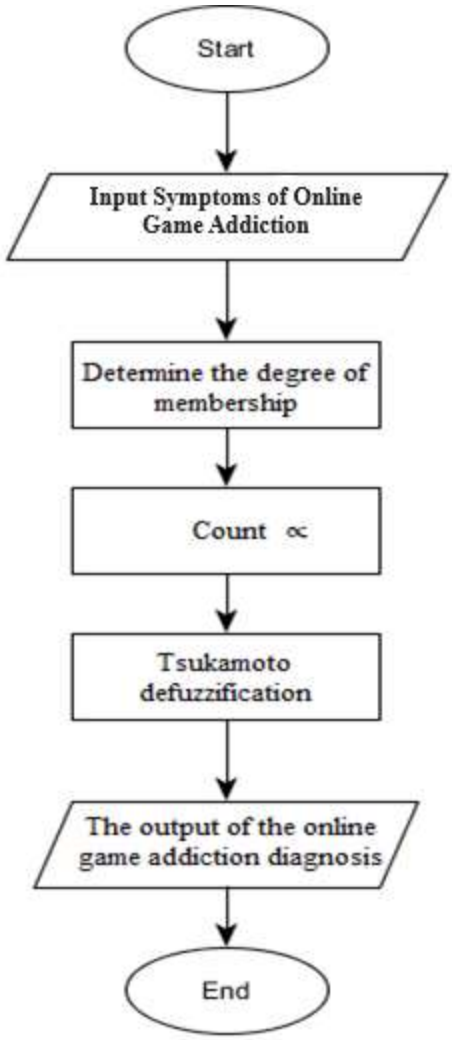

Figure 1: Schematic Of Online Game Addiction Detection System.

3.3 Tsukamoto's Fuzzy Method

The Tsukamoto method is an extension of monotone reasoning. In the Tsukamoto method, each consequence of a rule in the form of IF-Then must be presented with a fuzzy set with a monotonous membership function. As a result, the inference output of each rule is given crisply (crisp) based on the ∝-predicate (free strength). In the Tsukamoto method, the implications of each rule are in the form of causal implications/implications. Input-Output where the antecedent and consequent must be related. Each rule is represented using fuzzy sets, with a monotonous membership function. Then to determine the results (Crisp Solution) a defuzzification formula is used which is called the Centered Average Method or the Center Avarege Defuzzfier Method. Suppose there are two input variables, Var-1 (x) and Var-2 (y) and the output variable Var-3 (z), where Var-1 is divided into two sets, namely A1 and A2. Var-2 is divided into two sets B1 and B2, var-3 is also divided into two sets C1 and C2 (C1 and C2 must be monotone). There are two rules used, namely.

[R1] *IF (*x *is* A1*)* and (y *is* B2) *THEN* (z is C1) (1)

[R2] *IF* (x *is* A2) and (y *is* B1) *THEN* (z is C2) (2)

First, we look for the membership functions of each fuzzy set for each rule, namely the set A1, B2 and C1 from the fuzzy rules [R1], and the sets A2, B1 and C2 from the fuzzy rules [R2]. The fuzzy rules R1 and R2 can be represented in Figure 2 to display a crisp Z value.

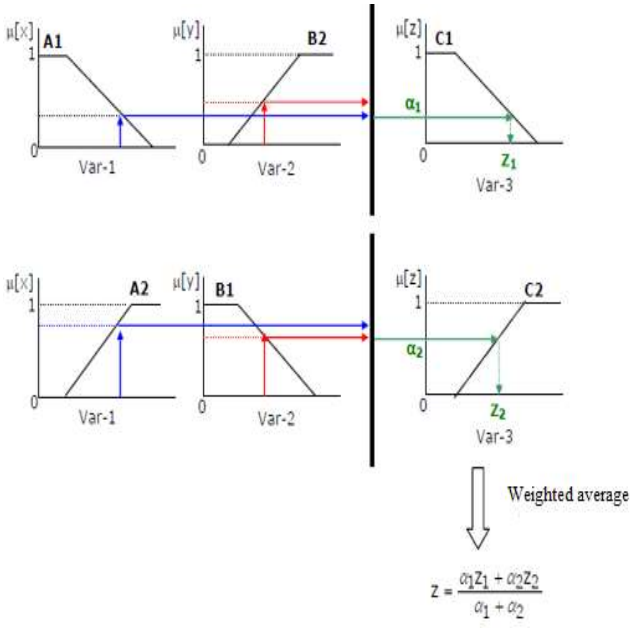

Figure 2: Inference Using The Tsukamoto Method

Because in the Tsukamoto method the operation used is conjunction (AND), the antecedent membership value of the fuzzy rule [R1] is the intersection of the A1 membership value of Var-1 with the B2 membership value of Var-2. According to the theory of set operations, the membership value of the conjunction operation (AND) of the fuzzy rule [R1] is the minimum value between the A1 membership value of Var-1 and the B2 membership value of Var-2. Likewise, the antecedent membership value of the fuzzy rule [R2] is the

minimum value between the A2 membership value of Var-1 and the B1 membership value of Var-2. Furthermore, the antecedent membership values of the fuzzy rules [R1] and [R2] are referred to as α1 and α2, respectively. The values of α1 and α2 are then substituted in the membership function of sets C1 and C2 according to the fuzzy rules [R1] and [R2] to obtain the values of z1 and z2, namely the value of z (estimated production value) for the fuzzy rules [R1] and [R2]. To obtain a crisp output value/Z, it is searched by changing the input (in the form of a fuzzy set obtained from the composition of fuzzy rules) into a number in the domain of the fuzzy set. This method is called the defuzification method (affirmation). The defuzification method used in the Tsukamoto method is the Center Average Defuzzifier method which is formulated in the equation below.

$$Z = \frac{(\alpha_1 z_1 + \alpha_1 z_2)}{\alpha_1 + \alpha_2} \quad (3)$$

The following are the stages of the Tsukamoto Method According to [32]. In his inference, the Tsukamoto method uses the following stages

1. Fuzzification.
2. Formation of a Fuzzy knowledge base (Rule in the form of IF… THEN).
3. Inference Engine uses the MIN implication function to get the α-predicate value of each rule (α1, α2, α3…αn).
4. Defuzzification using the average method (Average)
$$\boldsymbol{Z} = \frac{\sum \boldsymbol{\alpha_1 z_1}}{\sum \boldsymbol{\alpha_1}} \quad (4)$$
5. Defuzzification Process. The final output result (z) is obtained by using a weighting average.
$$\boldsymbol{Z} = \frac{(\boldsymbol{\alpha_1 z_1 + \alpha_1 z_2})}{\boldsymbol{\alpha_1 + \alpha_2}} \quad (5)$$

3.4 Data Collection and Variable Type

Symptom data collection in this study used data from psychiatrists, then the data from the doctor was created in the form of a questionnaire to be distributed to Online Game players which was carried out virtually through the Google Form media by filling out a customized questionnaire based on these symptoms. Filling out this questionnaire was followed by 86 people study in Table 1. The data for this study were taken from a survey for filling out online game addiction questionnaires with variables and fuzzy sets (G1-G5) which became the benchmark for patients in filling out the questionnaire. The following are the five input variables used in this study.

1. G1: Always thinking about games all day and feel restless when not playing games.
2. G2: Game playing time increases every day and loses sleeping time.
3. G3: Play games to forget about real life and ignore other activities.
4. G4: Cannot be prohibited from not playing games and will remain playing games.
5. G5:When playing games, they tend to be aggressive so they fight with family or friends.

While the output variables consist of not addicted, mild addicted, heavy addicted. The following is the data used in this study in Table 1.

Table 1: Research Data

No	Initials	Age	Gender	G1	G2	G3	G4	G5
1	AZ	25	F	7	7	9	5	4
2	DU	21	F	2	4	4	1	2
3	AF	20	M	6	8	7	6	6
4	WH	20	F	4	5	4	6	4
5	TR	23	M	4	8	6	2	3
6	HF	22	F	3	2	2	2	2
7	GK	21	F	7	6	3	3	2
8	UA	21	F	5	3	5	3	5
9	PI	22	F	2	2	3	2	2
10	PT	21	M	7	6	7	7	6
11	UK	24	M	9	9	8	6	6
12	TW	26	F	8	7	2	2	2
13	GD	22	M	9	6	7	4	5
14	KL	21	F	3	3	1	2	3
15	JS	26	M	7	6	4	5	4
16	PZ	28	F	4	4	2	4	2
17	SA	16	F	2	4	3	4	4
18	HY	27	M	2	4	4	1	2
19	CHG	24	F	3	4	2	2	4
20	WZ	21	M	7	6	7	2	3
21	NS	27	F	2	2	2	2	2
22	MHA	20	M	9	9	8	9	9
23	MRS	21	M	5	3	7	6	4

24	DW	24	F	2	2	2	2	2
25	FA	19	F	5	2	4	3	3
26	YV	25	F	7	3	3	2	2
27	GH	18	F	2	4	1	3	2
28	MKB	22	M	2	2	1	2	1
29	MAD	21	M	9	9	9	7	7
..	….	..	..	..	..	..	..	..
86	MAZ	20	F	7	4	6	7	2

4. RESULT AND DISCUSSION

4.1 Fuzzy Inference System Tsukamoto Method

Solving the problem in the online game addiction detection research using the Fuzzy Logic Tsukamoto Method is as follows

1. Determine the input variables for the Fuzzification process.

There are five input variables (G1-G5) used for the Fuzzification process, namely:

G1: Always thinking about games all day and feeling restless when not playing games.
G2: Game playing time increases each day and sleep loss decreases.
G3: Play games to forget about real life and ignore other activities.
G4: It can't be forbidden not to play the game and it will still be playing games.
G5: When playing games, they tend to be aggressive so they fight with family or friends.

2. Determining the Fuzzy Set Value for Each Variable

Fuzzy sets in each variable are divided into three types, namely: never, sometimes, and often. Has a universe of talks [1-9] with domain values in each variable that will be used according to the rules of the Tsukamoto fuzzy method. The fuzzy set for each variable is as follows.

Variable G1, has a Conversational Universe [1-9] with 3 Fuzzy Sets as follows:
a.Never with domain {1-4} including [1,2,3,4].
b.Sometimes with {3-6} domains including [3,4,5,6]
c. Often with {4-9} domains including [4,5,6,7,8,9]
Variable G2, has a Conversational Universe [1-9] with 3 Fuzzy Sets as follows:
a. Never with domain {1-4} including [1,2,3,4].
b.Sometimes with {3-6} domains including [3,4,5,6]
c. Often with {4-9} domains including [4,5,6,7,8,9]
Variable G3, has a Conversational Universe [1-9] with 3 Fuzzy Sets as follows:
a. Never with domain {1-4} including [1,2,3,4].
b.Sometimes with {3-6} domains including [3,4,5,6]
c. Often with {4-9} domains including [4,5,6,7,8,9]
Variable G4, has a Conversational Universe [1-9] with 3 Fuzzy Sets as follows:
a. Never with domain {1-4} including [1,2,3,4].
b.Sometimes with {3-6} domains including [3,4,5,6]
c. Often with {4-9} domains including [4,5,6,7,8,9]
Variable G5, has a Conversational Universe [1-9] with 3 Fuzzy Sets as follows:
a. Never with domain {1-4} including [1,2,3,4].
b.Sometimes with {3-6} domains including [3,4,5,6]
c. Often with {4-9} domains including [4,5,6,7,8,9]
While the output variable G6 of the online game addiction detection system uses the Tsukamoto fuzzy method with the level of addiction or fuzzy set as follows:
a. Not Addicted to Domains {1-5}
b. Mild Addiction to {4-7} domains
c. Heavy Addicted to {5-10} domains
Table 2 below is the value of the Fuzzy Set based on input and output variables and functions

Table 2: Fuzzy Set Value

Function	Variable	Fuzzy Set	Universe of Set	Domain
Input	G1	Never	[1-9]	{1-4}
		Sometimes		{3-6}
		Often		{4-9}
	G2	Never	[1-9]	{1-4}
		Sometimes		{3-6}
		Often		{4-9}
	G3	Never	[1-9]	{1-4}
		Sometimes		{3-6}
		Often		{4-9}
	G4	Never	[1-9]	{1-4}
		Sometimes		{3-6}
		Often		{4-9}
	G5	Never	[1-9]	{1-4}
		Sometimes		{3-6}
		Often		{4-9}
Output	G6	Not Addicted	[1-10]	{1-5}
		Mild Addiction		{4-7}
		Heavy Addiction		{5-10}

3. Representation of G1-G5 Variable Membership Functions

From Table 2 it can be seen that the input variables G1-G5 have three fuzzy membership sets, namely never fuzzy sets, sometimes fuzzy sets, and often fuzzy sets. For the membership function of the G1-G5 fuzzy set, the membership function of the shoulder shape curve is used. The following is a picture of the G1-G5 variable fuzzy set curve.

The following is a picture of the input variable fuzzy set G1-G5

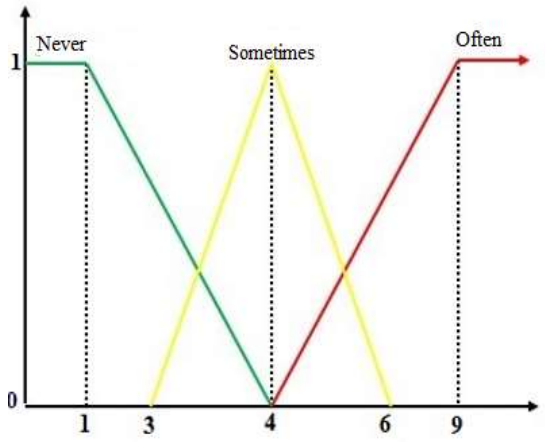

Figure 3: Fuzzy Set of Input Variables G1-G5

Membership Function Never

$$\mu\text{Never}[x] = \begin{cases} 1 & ; x \leq 1 \\ \frac{4-x}{4-1} & ; 1 \leq x \leq 4 \\ 0 & ; x \geq 4 \end{cases}$$

Membership Function Sometimes

$$\mu\text{Sometimes}[x] = \begin{cases} 0 & ; x \leq 3 \text{ or } x \geq 6 \\ \frac{x-3}{4-3} & ; 3 \leq x \leq 4 \\ \frac{6-x}{6-4} & ; 4 \leq x \leq 6 \end{cases}$$

Membership Function Often

$$\mu\text{Often}[x] = \begin{cases} 0 & ; x \leq 4 \\ \frac{x-4}{9-4} & ; 4 \leq x \leq 9 \\ 1 & ; x \geq 9 \end{cases}$$

4. Representation of the Output Variable Membership Function

From Table 2 it can also be seen that the output variables have three fuzzy sets, namely the non-addicted fuzzy set, the lightly addicted fuzzy set, and the heavily addicted fuzzy set. The following is an image of the output variable fuzzy set curve

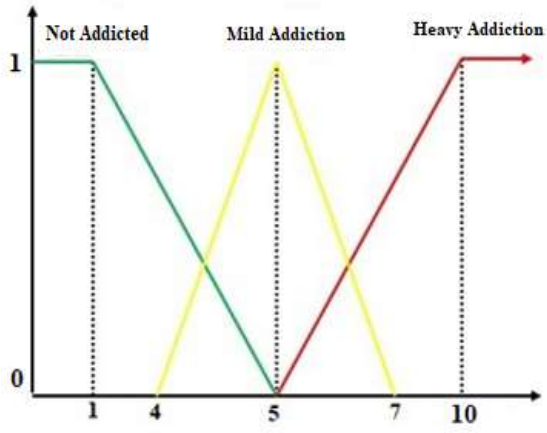

Figure 4: Fuzzy Set of Output Variables

Membership Function Not Addicted

$$\mu\text{Not Addicted}[x] = \begin{cases} 1 & ; x \leq 1 \\ \frac{5-x}{5-1} & ; 1 \leq x \leq 5 \\ 0 & ; x \geq 5 \end{cases}$$

Membership Function Mild Addiction

$$\mu\text{Mild Addiction}[x] = \begin{cases} 0 & ; x \leq 4 \text{ or } x \geq 7 \\ \frac{x-4}{5-4} & ; 4 \leq x \leq 5 \\ \frac{7-x}{7-5} & ; 5 \leq x \leq 7 \end{cases}$$

Membership Function Heavy Addiction

$$\mu\text{Heavy Addiction}[x] = \begin{cases} 0 & ; x \leq 5 \\ \frac{x-5}{10-5} & ; 5 \leq x \leq 10 \\ 1 & ; x \geq 10 \end{cases}$$

5. Formation of Rules

In the Fuzzy Tsukamoto method there is a stage of forming a knowledge base (rule). Formation of rules by connecting input and output variables. Every rule has an intention and a consequence. The operator used in the formation of rules is the and operator. Results of Formation of Rules in Table 3

Table 3: Fuzzy Rules

Rule	Anticedent	G1	G2	G3	G4	G5	Results
R1	IF	Never	Never	Never	Never	Never	Not Addicted
R2	IF	Never	Never	Never	Never	Sometimes	Not Addicted
R3	IF	Never	Never	Never	Never	Often	Not Addicted
R4	IF	Never	Never	Never	Sometimes	Never	Not Addicted
R5	IF	Never	Never	Never	Sometimes	Sometimes	Not Addicted
R6	IF	Never	Never	Never	Sometimes	Often	Not Addicted
R7	IF	Never	Never	Never	Often	Never	Not Addicted
R8	IF	Never	Never	Never	Often	Sometimes	Not Addicted
R9	IF	Never	Never	Never	Often	Often	Not Addicted
R10	IF	Never	Never	Sometimes	Never	Never	Not Addicted
R18	IF	Never	Never	Sometimes	Often	Often	Mild Addiction
R19	IF	Never	Never	Often	Never	Never	Not Addicted
R158	IF	Sometimes	Often	Often	Sometimes	Sometimes	Mild Addiction
R159	IF	Sometimes	Often	Often	Sometimes	Often	Heavy Addicted
R160	IF	Sometimes	Often	Often	Often	Never	Mild Addiction
R161	IF	Sometimes	Often	Often	Often	Sometimes	Heavy Addicted
R162	IF	Sometimes	Often	Often	Often	Often	Heavy Addicted
R164	IF	Often	Never	Never	Never	Sometimes	Not Addicted
R204	IF	Often	Sometimes	Sometimes	Sometimes	Often	Mild Addiction
R205	IF	Often	Sometimes	Sometimes	Often	Never	Not Addicted
R206	IF	Often	Sometimes	Sometimes	Often	Sometimes	Mild Addiction
R207	IF	Often	Sometimes	Sometimes	Often	Often	Heavy Addicted
….	…	…….	……	……	……	……	……
R243	IF	Often	Often	Often	Often	Often	Heavy Addicted

4.2 Application of Fuzzy Logic Tsukamoto Method

At this stage the data case for game player number 1 will be tested, namely an online game player with the initials AZ who is 25 years old and is female who has symptoms of input values with G1 = 7, G2 = 7, G3 = 9, G4 = 5, G5 = 4. Then do the calculation of α predicate. In this case, there are 5 variables to be modeled, namely:

a. Variable G1 is divided into 3 fuzzy sets, namely never, sometimes and often, based on patient number 1 data, the membership function of variable G1 is as follows:

$$\mu G1TP[7] = 0$$
$$\mu G1TD[7] = 0$$
$$\mu G1S[7] = \frac{7-4}{9-4} = 0{,}6$$

b. The G2 variable is divided into 3 fuzzy sets, namely never, sometimes and often, based on patient no. 1 data, then the membership function of the G2 variable is as follows:

$$\mu G2TP[7] = 0$$
$$\mu G2TD[7] = 0$$
$$\mu G2S[7] = \frac{7-4}{9-4} = 0{,}6$$

c. The G3 variable is divided into 3 fuzzy sets, namely never, sometimes and often, based on the patient data no. 1, then the membership function of the G3 variable is as follows:

$$\mu G3TP[9] = 0$$
$$\mu G3TD[9] = 0$$
$$\mu G3S[9] = \frac{9-4}{9-4} = 1$$

d. The G4 variable is divided into 3 fuzzy sets, namely never, sometimes and often, based on patient no. 1 data, then the membership function of the G4 variable is as follows:

$$\mu G4TP[5] = 0$$
$$\mu G4TD[5] = \frac{6-5}{6-4} = 0{,}5$$
$$\mu G4S[5] = \frac{5-4}{9-4} = 0{,}2$$

e. The G5 variable is divided into 3 fuzzy sets, namely never, sometimes and often, based on patient data no. 1, then the membership function of the G5 variable is as follows:

$$\mu G5TP[4] = 0$$
$$\mu G5TD[4] = \frac{4-3}{4-3} = 1$$
$$\mu G5S[4] = \frac{4-4}{9-4} = 0$$

1. Calculation of Rules

[R1] IF G1 Never and G2 Never and G3 Never and G4 Never and G5 Never THEN Not Addicted
$\mu A \cap B = \mu A(x) \cap \mu B(y) = \min\{\mu A(x), \mu B(y)\}$
α_1Predicate = μG1TP[7] μG2TP[7] μG3TP[9] ∩ μG4TP[5] ∩ μG5TP[4] = $\min(0;0;0;0;0).\alpha_1 = 0$ for α Predicate 1 = 0 on the set Not Addictions $\mu(z_1) = 0$

[R2] IF G1 Never and G2 Never and G3 Never and G4 Never and G5 Sometimes THEN Not Addicted
$\mu A \cap B = \mu A(x) \cap \mu B(y) = \min\{\mu A(x), \mu B(y)\}$
Predicate = μG1TP[7] ∩ μG2TP[7] μG3TP[9] ∩ μG4TP[5] ∩ μG5TP[4] = $\min(0;0;0;0;0).\alpha_2 = 0$ for α Predicate 2 = 0 on the set Not Addictions $\mu(z_2) = 0$

[R3] IF G1 Never and G2 Never and G3 Never and G4 Never and G5 often THEN Not Addicted
$\mu A \cap B = \mu A(x) \cap \mu B(y) = \min\{\mu A(x), \mu B(y)\}$
α_3Predicate = μG1TP[7] ∩ μG2TP[7]μG3TP[9] ∩ μG4TP[5] ∩ μG5TP[4] = $\min(0;0;0;0;0).\alpha_3 = 0$ for α Predicate 3 = 0 on the set Not Addictions $\mu(z_3) = 0$

And so on up to rule 243.

[R243] IF G1 Often and G2 Often and G3 Often and G4 Often and G5 Often THEN Heavy Addiction
$\mu A \cap B = \mu A(x) \cap \mu B(y) = \min\{\mu A(x), \mu B(y)\}$
α_{243}Predicate = μG1TP[7]μG2TP[7] μG3TP[9] ∩ μG4TP[5] ∩ μG5TP[4] = $\min(0{,}6;0{,}6;1;0{,}2;0)$. $\alpha_{243} = 0$ for α Predicate 243 = 0 on the set Heavy Addiction $\mu(z_{243}) = 0$

2. Graph of Addiction to Playing Online Games

After carrying out the calculation process, the percentage of addicted to playing online games is obtained which is divided into 3 categories, namely, not addicted, mild addicted, and heavy addicted. The following is a graph of the percentage of addiction to playing online games in Figure 5 below:

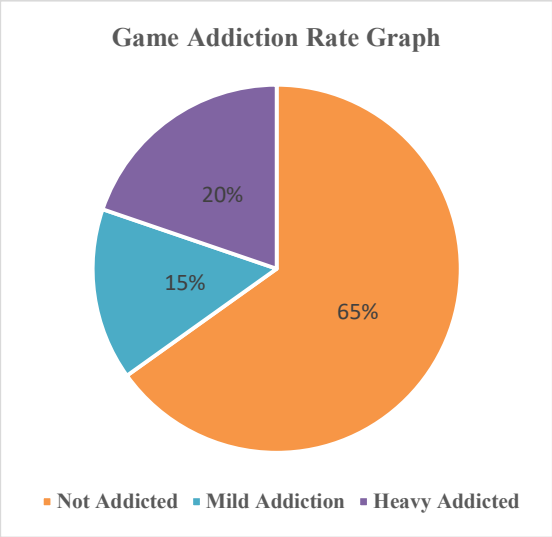

Figure 5: Online Game Addiction Percentage Graph

From Figure 5 above, it can be concluded that 56 people are not addicted to online games, 13 people are mildly addicted and 17 people are seriously addicted out of a total of 86 game players

3. Online Game Addiction Testing Results

From the graphical results of the percentage of addicted to playing online games it can be concluded, based on the test results on the online game addiction detection system for each online game player in Table 4 below.

Table 4: Online Game Addiction Detection Results

Inisials	Age	Gender	G1	G2	G3	G4	G5	Addiction Results
AZ	25	F	7	7	9	5	4	Heavy Addicted
DU	21	F	2	4	4	1	2	Not Addicted
AF	20	M	6	8	7	6	6	Heavy Addicted
WH	20	F	4	5	4	6	4	Mild Addiction
TR	23	M	4	8	6	2	3	Mild Addiction
HF	22	M	3	2	2	2	2	Not Addicted
GK	21	F	7	6	3	3	2	Not Addicted
UA	21	F	5	3	5	3	5	Heavy Addicted
PI	22	F	2	2	3	2	2	Heavy Addicted
PT	21	M	7	6	7	7	6	Heavy Addicted
UK	24	M	9	9	8	6	6	Heavy Addicted
TW	26	F	8	7	2	2	2	Not Addicted
GD	22	M	9	6	7	4	5	Heavy Addicted
KL	21	F	3	3	1	2	3	Mild Addiction
JS	26	M	7	6	4	5	4	Heavy Addicted
PZ	28	F	4	4	2	4	2	Not Addicted
SA	16	F	2	4	3	4	4	Mild Addiction
HY	27	M	2	4	4	1	2	Not Addicted
CHG	24	M	3	4	2	2	4	Mild Addiction
WZ	21	M	7	6	7	2	3	Heavy Addicted
NS	27	F	2	2	2	2	2	Not Addicted
MHA	20	M	9	9	8	9	9	Heavy Addicted
MRS	21	M	5	3	7	6	4	Heavy Addicted
DW	24	F	2	2	2	2	2	Not Addicted
FA	19	M	5	2	4	3	3	Heavy Addicted
YV	25	F	7	3	3	2	2	Not Addicted
MAD	21	M	9	9	9	7	7	Heavy Addicted
…	…..	…..	…	…	…	…	…	……
MAZ	20	F	7	4	6	7	2	Mild Addiction

5. CONCLUSIONS

This online game addiction detection system model uses five input variables, namely thinking about games all day and feeling bad when not playing games, increased game playing time and loss of sleep, playing games to forget real life and ignoring other activities, other people fail to prohibit play games and will continue to play games, get annoyed easily and fight with family or friends, while the output variables consist of: Not addicted, Mild addiction, Severe addiction. The method used to solve the online game addiction detection problem uses a Fuzzy logic model with the Tsukamoto method. This study used 86 questionnaires filled in by 86 online game players. Then the results of his research were obtained using the Tsukamoto method, namely the level of non-addiction = 65%, mild addiction = 15% and severe addiction = 20%. The fuzzy logic model with the Tsukamoto method can be used to detect online game addiction.

Further research is suggested to use other fuzzy logic methods, such as the Sugeno fuzzy method and the Mamdani fuzzy method as a comparison to find out which method is better. This model can be developed by adding more variables and rules, so that this system model is getting smarter.

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