

## Implementation of Fuzzy Sugeno to control NPC's behavior in Game 3D of Tajwid Introduction

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**Abstract** – Game is a popular entertainment medium in almost all levels of society. The quality of the game is determined by some aspects, both artificial intelligence, presented content, and so forth. The artificial intelligence is certainly needed by the game to create action and reaction for fulfilling expected realistic level, especially in Non Playable Player (NPC).

Tajwid is one of important knowledge which must be learned by Muslim in reciting Al Qur'an. They sometimes forget how important to recite Al Qur'an with a full attention, especially in applying tajwid. It is highly significant how to recite Al Qur'an well and correctly based on makhraj in every letter, mushaf, and so forth. Therefore, it is strongly suggested that Muslims must comprehend the concept of tajwid.

For those diverse backgrounds of the problem, the researcher tries to design the game as a learning and knowledge medium to stimulate further curiosity about presenting materials in that game. It is designed by applying the method of fuzzy sugeno which uses three variables to formulate rules as expected input requirement. In this research, the implementation of artificial intelligence is applied in NPC by utilizing that method. The Fuzzy Sugeno method is used as a generation of behavior enemy against the player. This research focused on desktop platforms

**Keywords** : Fuzzy Sugeno, NPC , Ilmu Tajwid, Game

### 1. Introduction

Al – the Qur'an is the word of God which was revealed to Prophet Muhammad as miracles, delivered with the intermediary with the Angel Gabriel mutawatir and reading Qur'aan rated worship to God Almighty. We as Muslims are obliged to keep private is always reading the Qur'an. But sometimes someone forgot about the importance of reading the Qur'an and also do not care to read the Quran with tajwid science. Then it takes a discipline of its own about how to read the Qur'an which is good and right, correspond to each sound of each letter and a series of letters. Because at the time of Prophet Muhammad SAW a collection of verses of the Glorious Qur'an that there are still too simple writings. If it was not the Arabs, impossible anyone could read it. In the present matter, both children and adults at the time of reading the Qur'an is still not paying attention to the science of recitation. Most of them read the Qur'an in ways self-taught, for example, listen to readings of parents or friends. Therefore, it is highly recommended to familiarize private Muslim early on to understand and know about the science of tajwid.

The science of recitation itself is the science that studies how to read Qur'an. While reading the Qur'an, things to be learned like tajwid, makharijul letters, and its meaning. Etymologically, Tajwid is embellish or repaired. According to the meaning of the term, Tajwid is using the letter fits with each sound, as well as following the law assigned readings such as the length of the readings (mad) and the nature of the letter. A person obligated to learn the science of recitation, as required in order to read the Qur'an with tartil.

Gaming is a word in English that has a sense of the game. Games are something that can be played by using certain rules. According to Clark c. Abt [1], gaming is an activity that involves a decision of the player, attempting to reach a destination by delimited by a specific context. The genre of the game is a game based on the categorization of interactions in the game. The large number of genres of games such as Adventure, RPG, FPS, participate to enliven the popularity of gaming entertainment. According to Tom Watson, a Cabinet Secretary in the United Kingdom, children will be a more valuable lesson from a video game rather than watching television.

The author makes the game genre adventure to introduce the science of tajwid in particular legal readings mim breadfruit with Sugeno Fuzzy method in regulating the behavior of NPC (Non Player Character). Where the method is implemented in the Sugeno Fuzzy enemies (NPCS) which will interfere with the player in completing the mission.

## 2. Material and Methods

### 2.1. Game

Game an activity that you do for fun that has rules, and that you can win or lose [2].

Games or the game is something that can be played with certain rules so there is winning and there is losing, usually in the context of not serious with the purpose of refreshing. Game play can be said as one of the community's future lifestyle. Starting from the age of children up to adult any love of video games. It's all because of the game play is fun. (Anggara, 2008) [3].

Early generation gaming is still presented in a simple and initiated by Steven Russel and project called Computer Games in 1962 titled Star Wars. Some twenty years later, many games are built from game 2 dimensional and 3 dimensional games [4].

### 2.2. Tajwid

Read the Qurán is one's own happiness for Muslims. In reading the Qurán must comply with its rules and rules, including a correct the readings of the Qur'an is by studying the iqra ' and the science of tajwid. According to Kurnaedi [5] there is the phrase Al-Imam Ibnul Jazari, "read the Quran with tajwid mandatory law, whoever does not improve reading Qur'aan he sinned because it with tajwid God keep the Qur'an and similarly the Qur'an it until to us".

### 2.3. Fuzzy Logic

The concept of fuzzy logic was introduced by Lotfi Zadeh Astor Prof. [6]. Fuzzy set is a set in which the membership of each element does not have clear boundaries. The underlying concept of fuzzy sets, fuzzy logic implies that the truth of any statement is simply a matter of degree. Similar statements have also been put forward by Lotfi A. Zadeh: "As complexity rises, precise statements lose meaning and meaningful statements lose precision" (Agus Naba, 2009) [7]. Some of the reasons why using fuzzy logic [7]:

1.The concept of fuzzy logic is very simple so it is easy to understand. The advantage compared to other concepts rather than on its complexity, but at naturalness his approach in solving problems.

2.Fuzzy logic is flexible, in the sense that can be built and developed with ease without having to start from "scratch".

3.Fuzzy logic provides a tolerance of not precision data. This is a great fit with facts daily. Everything in nature is not relative precision, even though we observe more closely and carefully. Fuzzy logic is built based on this fact.

4.Modelling/mapping to find data input-output relationships of an arbitrary system of black-box want to do with wearing a fuzzy system.

5.Knowledge or experience of the experts can be easily used to build fuzzy logic. This is the main advantage of fuzzy logic than Artificial Neural Network (ANN). Modelling system with ANN based on input-output data will only produce models that are still well ANN as a black-box, because we know how difficult the work model ANN produced. In modeling system with ANN, no mechanism to involve human knowledge (experts) in training process ANN. If we use fuzzy logic, ordinary human knowledge more easily relative involved in the modeling of fuzzy systems.

6.Fuzzy logic can be applied in the design of the control system without having to eliminate conventional control design engineering that have previously existed.

7.Fuzzy logic based on human language.

### 2.4. Fuzzy Sugeno

Fuzzy Sugeno fuzzy inference method for rules that are represented in the form of IF – THEN, where output (consequently) the system is not in the form of fuzzy sets, but rather in the form of constant or linear equations. This method was introduced by Takagi Sugeno-Kang in the year 1985. Sugeno model using the functions of membership functions i.e. Singleton has a degree of membership in a crisp single and value 0 on crisp (Kusumadewi: 2003) [8].

The fuzzy inference process can be divided into five parts, namely:

- Fuzzification Input: FIS take input input and determine its membership in all of fuzzy sets.

- Operations of fuzzy logic: the end result of this operation is the degree of truth, of the antecedent in the form of a single number.
- Implications: it is the process of getting the consequent or the output of an IF-THEN rule based on the degree of the truth antecedent. The process uses take MIN/the smaller of the two numbers: fuzzy logic operation OR Results and fuzzy set a lot.
- Aggregation: the process of combining the output of all the IF-THEN rule into a single fuzzy set. Basically the aggregation operations fuzzy logic is OR with input is all fuzzy set.
- Defuzzification: the output of Defuzzification is a single number, how to get it there are several versions, namely centroid, bisector, middle of maximum, the largest and the smallest of maximum of maximum.

$$\text{IF } x_1 \text{ is } A_1 \text{ AND... } x_n \text{ is } A_n \text{ THEN } y = f(x_1, x_2.. x_n) \quad (1)$$

## 2.5. Literature review

Yunifa Miftachul Arif et al. who conducted a study entitled the turn of weapon NPC'S in Game FPS using Sugeno Fuzzy. This research discusses how the system changes the weapon automatically on NPC'S based on changes in environmental conditions encountered

Michele Pirovano [10] in his studies "The use of Fuzzy Logic for Artificial Intelligence in Games " fuzzy logic brings many benefits to modeling agents intelligent game. The main benefit is the simplicity of the formula, which paired with the input-output allows developers to integrate into many games easily, which is a great advantage if we consider the schedule tight in the making from the game developer.

## 2.6. Research Methodology

### 2.6.1. Game

This game is an educational game that has the genre of Adventure Games with tajwid content played in single player. The name of this game is Finding Tajwid, his mission is to find content tajwid in game. In this game there are characters as main players which will be run by a user who is an enemy character, the character of the opponent will be executed automatically by the computer. This game more to play while learning and can provide learning about the rules of tajwid readings, mim and sukun.

### 2.6.2. StoryBoard

The story of this game is an adventurer (player) who got the task of collecting items and accomplish the Mission of the game is Finding this Recitation, the player must avoid enemies. In this game the player has to collect as many points up the limits of the points already determined to complete the game.



Figure 1. Story Board

2.6.3. FSM Game

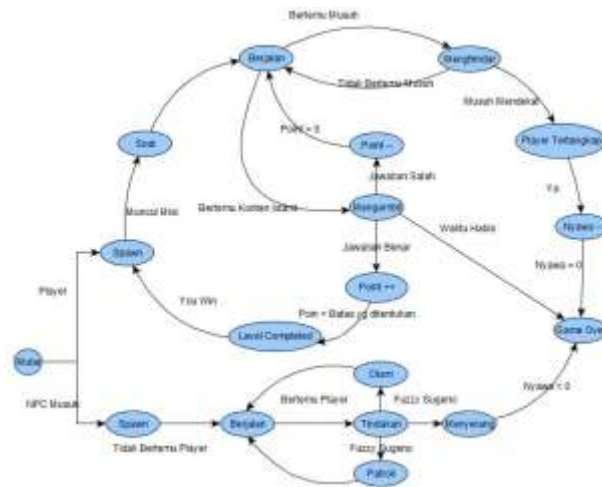


Figure 2 Finite State Machine

2.6.4. Implementation of Fuzzy Sugeno.

Sugeno fuzzy method is used to set the behavior of the NPC in the pursuit of the player.



Figure 3 NPC behavior in Player

2.7. Results and Discussion

This section describes the results of testing the system with the test results of Sugeno Fuzzy towards the behavior of NPCs in the game Finding Tajwid. These will be explained about the test results of the algorithm of Fuzzy Sugeno in 55 attempts the final already in some conditions. Tests performed on one person the player.

Table 1. Experiment results of algorithms



No.	Poin	Jarak	Kesehatan Player	Fuzzy Sugeno	NPC
1.	20	20	20	1	Diam
2.	20	20	40	1	Diam
3.	20	20	60	1	Diam
4.	20	20	80	1	Diam
5.	20	40	20	2	Patroli
6.	20	40	40	2	Patroli
7.	20	40	60	2	Patroli
8.	20	40	80	2	Patroli
9.	20	60	20	2	Patroli
10.	20	60	40	2	Patroli
11.	20	60	60	2	Patroli
12.	20	60	80	2	Patroli
13.	20	80	20	2	Patroli
14.	20	80	40	2	Patroli
15.	20	80	60	2	Patroli
16.	20	80	80	2	Patroli
17.	40	20	20	3	Menyerang
18.	40	20	40	3	Menyerang

19.	40	20	60	3	Menyerang
20.	40	20	80	3	Menyerang
21.	40	40	20	1	Diam
22.	40	40	40	1	Diam
23.	40	40	60	1	Diam
24.	40	40	80	1	Diam
25.	40	60	20	1	Diam
26.	40	60	40	1	Diam
27.	40	60	60	1	Diam
28.	40	60	80	1	Diam
29.	40	80	20	2	Patroli
30.	40	80	40	2	Patroli
31.	40	80	60	2	Patroli
32.	40	80	80	2	Patroli
33.	60	20	20	3	Menyerang
34.	60	20	40	3	Menyerang
35.	60	20	60	3	Menyerang
36.	60	20	80	3	Menyerang
37.	60	40	20	1	Diam
38.	60	40	40	1	Diam
39.	60	40	60	1	Diam
40.	60	40	80	1	Diam
41.	60	60	20	1	Diam
42.	60	60	40	1	Diam
43.	60	60	60	1	Diam
44.	60	60	80	1	Diam
45.	60	80	20	2	Patroli
46.	60	80	40	2	Patroli
47.	60	80	60	2	Patroli
48.	60	80	80	2	Patroli
49.	80	20	20	3	Menyerang
50.	80	20	40	3	Menyerang
51.	80	20	60	3	Menyerang
52.	80	20	80	3	Menyerang
53.	80	40	20	2	Patroli
54.	80	40	40	2	Patroli
55.	80	40	60	2	Patroli
56.	80	40	80	3	Menyerang
57.	80	60	20	2	Patroli
58.	80	60	40	2	Patroli
59.	80	60	60	2	Patroli
60.	80	60	80	3	Menyerang
61.	80	80	20	2	Patroli
62.	80	80	40	2	Patroli
63.	80	80	60	2	Patroli
64.	80	80	80	2	Patroli

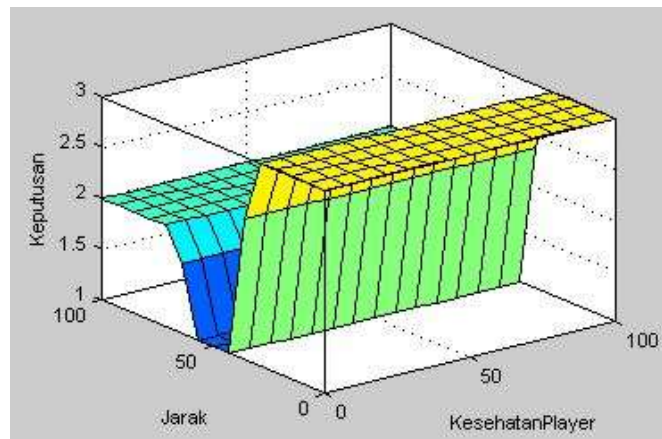
Dari tabel tersebut dapat di lihat bahwa semua *output* sudah sesuai dengan *rule* yang telah di tentukan. Perilaku yang di hasilkan dari *output* tersebut adalah Menyerang yaitu 29,09% , Patroli 34,54% dan Diam sebesar 36,36%.

Pengujian algoritma *Fuzzy Sugeno* dengan tiga variable yang digunakan untuk menemukan *output* perilaku terhadap NPC , contoh *input* Poin = 50, Jarak = 30, Kesehatan\_Player = 45 disimulasikan dalam aplikasi Matlab. Berikut hasil simulasi sesuai dengan *input* diatas:



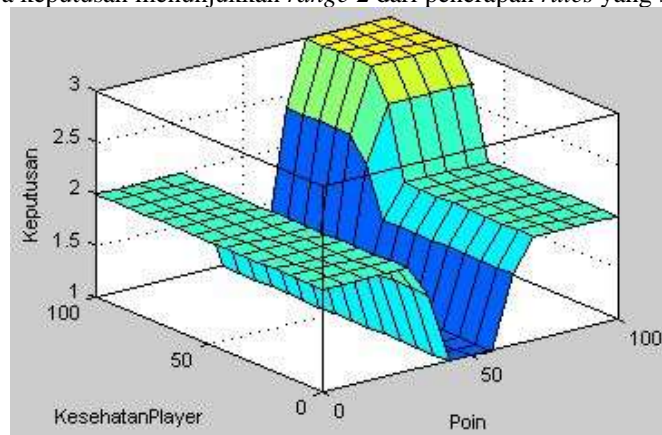
Gambar 4 Tampilan Simulasi *output* pada Matlab.

Sumber gambar 4 adalah dari hasil simulasi *output* pada matlab pada perhitungan *input* Poin = 50, Jarak = 30, KesehatanPlayer = 45, menunjukkan hasil *rules* pada *inputan* poin, jarak dan kesehatanplayer dalam percobaan penerapan *rules* yang sudah di rancang pada tahap sebelumnya. Hasil yang didapatkan sesuai dengan *rules* yang dimasukkan.



Gambar 5 Sumbu kartesian Jarak dan Kesehatan\_Player.

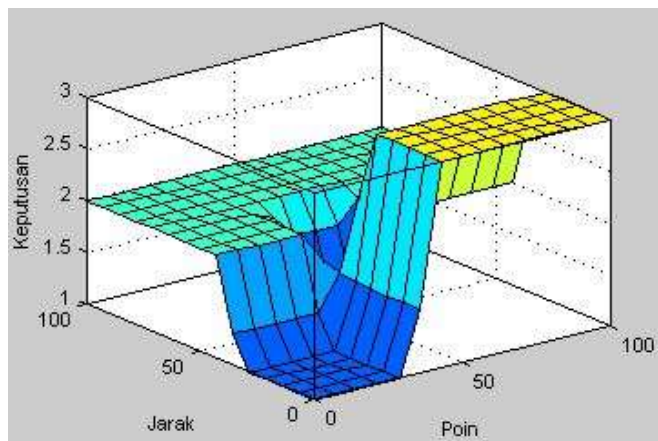
Sumber Gambar 5 adalah dari *output* perhitungan matlab dengan *input* Poin = 50, Jarak = 30, KesehatanPlayaer = 45, menunjukkan hasil dari sumbu kartesian untuk masukan jarak terhadap kesehatanplayer dalam *surface* dimana hasilnya keputusan menunjukkan *range* 2 dari penerapan *rules* yang sudah dimasukkan.



Gambar 6 Sumbu kartesian Poin dan Kesehatan\_Player.



Sumber Gambar 6 menunjukkan hasil dari sumbu kartesian untuk masukan kesehatan *player*. terhadap poin dalam *surface* hasil dari penerapan *rules* yang sudah dimasukkan adalah poin terhadap kesehatan *player* pada nilai sedikit hingga kebesar tidak terlalu berpengaruh terhadap perilaku NPC.



Gambar 7 Sumbu kartesian Poin dan Jarak

Sumber Gambar 7 adalah hasil yang menunjukkan sumbu kartesian untuk masukan poin terhadap jarak dalam *surface* dimana hasil dari penerapan *rules* yang sudah dimasukkan. Kesimpulannya adalah ketika poin terhadap rentang jarak dalam posisi banyak maka akan sangat berpengaruh terhadap perilaku NPC.

## 1.KESIMPULAN DAN SARAN

### 1.Kesimpulan

Berdasarkan hasil dari implementasi dan pengujian yang dilakukan peneliti, maka dapat ditarik kesimpulan sebagai berikut :

1. Algoritma *Fuzzy Sugeno* pada *game Finding Tajwid* diterapkan sebagai pengatur perilaku NPC Musuh terhadap Pemain.
2. Algoritma *Fuzzy Sugeno* dapat diterapkan pada *game Finding Tajwid* dengan menggunakan variabel Poin (Rendah , Sedang , Tinggi) , Jarak (Dekat , Sedang , Jauh) dan Kesehatan Pemain (Buruk , Sedang , Baik).
3. Algoritma *Fuzzy Sugeno* cukup baik ketika diimplementasikan pada *game Finding Tajwid* , hal ini dibuktikan dengan Perilaku musuh terhadap pemain yang di hasilkan dari *Fuzzy Sugeno* adalah Menyerang yaitu 29,09% , Patroli 34,54% dan Diam sebesar 36,36%.
4. *Game Finding Tajwid* ini hanya bisa dimainkan pada *platform windows* saja, belum merambah ke *platform smartphone*.Dan juga hanya memiliki 1 level permainan saja.
5. Pembelajaran ilmu tajwid dalam *game Finding Tajwid* diterapkan pada *item-item* yang ada didalam arena permainan yang berisi pernyataan salah dan benar. Materi yang digunakan adalah materi tentang Hukum Bacaan Mim Sukun.

### 2.Saran

Peneliti yakin dengan penuh kesadaran bahwa dalam pembuatan permainan ini masih banyak kekurangan yang nantinya sangat perlu untuk dilakukan pengembangan demi sumbangsih terhadap ilmu pengetahuan, diantaranya :

- 1.Menambah jumlah level permainan dan materi pembelajaran serta aturan untuk kenaikan level sehingga permainan menjadi lebih menarik.
- 2.Nantinya Permainan ini diharapkan mampu untuk dikembangkan pada *platform smartphone* agar pemahaman terkait wawasan Ilmu Tajwid semakin kian diminati.
- 3.Mengingat *genre* dari *game* ini adalah *game adventure* yang diterapkan sebagai media pembelajaran, diharapkan dalam pengembangan nantinya *game* ini bisa dinikmati oleh siswa-siswa SD/ MI sampai SMP/ MTs dan generasi selanjutnya

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