

# Game History of Raden Patah Using Fuzzy Sugeno Algorithm

Muhammad Galih Panji Saputra

Department of Informatics Engineering, Faculty of Science and Technology,  
Islamic State Maulana Malik Ibrahim University of Malang, East Java 65144  
Indonesia

Email : [galihpanji@kwikku.com](mailto:galihpanji@kwikku.com)

**Abstrak** Game is an entertainment media that is in demand nearly all walks of life. Quality is determined by several aspects of the game, both from artificial intelligence, content is presented, and so forth. Artificial intelligence is required by a game in order to create the action and the reaction to achieve the expected realistic level, especially on the Non Playable Player (NPC). Interesting educational game is one of the breakthrough content that is educational as interesting learning media. This paper describes how to design the process of setting the NPC behavior in a game and also explain how to make an educational game. Game History Raden Fatah is a diversified educational game First Player Shooter (FPS) based on the desktop using the Unity3D engine. Player guided to complete a mission that is the history of how Raden Fatah build up the kingdom of Islam first in Java. Enemy provided an NPC controlled by artificial intelligence that will perform the response actions and reactions of the players. In this study, a method to obtain intelligence on enemy behavior is appropriate used Sugeno Fuzzy Algorithm. Testing is done on the desktop value resulting decision, namely, strike 65.62%, 20.312% idle, escape by 14.06% to 64 different inputs.

**Key-words** : Fuzzy Sugeno, NPC, Game, Game Education

## 1. Introduction

History is the terminology taken from Arabic, 'Syajaratun' meaning tree. The symbolism of the tree provide a snapshot of a growth of human civilization, which began to grow from seed / seed up into a large tree and sustainable. Al-Quran which is a way of life for the people of Islam nearly a third contains a story / a past history of mankind-both devout previous ummah or broken and should be a medium to improve itself for the community as well as reflect on the past.

In today's apparent lack of interest in studying the historical development of Islam both at the time of the prophet and thereafter. In Indonesia the development of the Islamic empire was first performed by Raden Fatah (Bun Jin) is the son of King Brawijaya V and also a student of Sunan Ampel.

Game is a word in English which means game. The game is something that can be played by using certain rules.

Video games are important learning tools that provide immersive, interactive, and creative spaces for students to learn and explore in the 21st century classroom [1].

It can combine game and exercise to get healthy body [2].

then there needs to be an increase in applications aimed at gaming as a medium of learning fun for children. Not only for early ages, even teens was also important to get a bit of learning because not teens are immersed in the game world.

In this study, the researchers raised the theme of making a game that contains content of local culture. In this study, researchers created a desktop-based games or game presents the history content. The game is called "History Raden Fatah" which tells a brief history journey Raden Fatah in building the first Islamic kingdom in Java. Sugeno Fuzzy algorithm is a method of artificial intelligence in this game that is placed on the Non-Playable Character (NPC) as a regulator of behavior.

## 2. Theory and Method

### 2.1. Game

Game comes from the English language that means a game or match. Game is made for fun activities or fun that has rules so that there are no winners and losers [3]. Game has some kind of distinguishing good from its purpose as: Educational Games, Art Games, Educational Games, etc.

### 2.2. Logical Fuzzy

Fuzzy term in the Oxford dictionary is defined as blurred, not clear, defined as no precision, confusing, or unclear. Logic is the rationale, the logic is classically associated with the proposition to a value of 1 (true) or 0 (false). Thus, fuzzy logic is an extension of classical logic and set theory. A variable linguistic truth value "true", unlike classical logic which has logic value of right and wrong. The truth of a statement or a value proposition in fuzzy logic is in the range of the interval [0,1] [4].

#### a. Fuzzy Set

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" [5].

#### b. Membership function

Membership function defines how each point in the input space is mapped into the weight or degree of membership between 0 and 1. In set theory, the input space known as the universe of discourse.

Fuzzy set is the development of a classical set. If X is the universe of discourse and the elements denoted by x, then a fuzzy set A in X is defined by:

$$A = \{x, \mu_A(x) \mid x \in X\}$$

$\mu_A(x)$  is the membership function of x and A. Membership function maps each element of x to degrees of membership between 0 and 1.

### 2.3. Fuzzy Sugeno

Fuzzy Sugeno method is a method for the fuzzy inference rules are represented in the form of IF - THEN, where the system output is not in the form of fuzzy sets, but in the form of a constant or linear equations.

This method was introduced by Takagi-Sugeno Kang in 1985. Sugeno model using Singleton function membership functions which have a degree of membership membership 1 on a single crisp value and 0 on another crisp values [6].

Fuzzy inference process can be divided into five parts, namely :

1. Fuzzification Input: FIS take the feedback input and determine the degree of membership in all fuzzy sets.
2. Operation fuzzy logic: The end result of this operation is the antecedent of a degree of truth in the form of a single number.
3. Implication : It is the process of getting a consequent or output an IF-THEN rules based on degree of truth antecedent. This process uses retrieves the value MIN / smaller of the two numbers: The result of fuzzy logic OR operation and fuzzy sets much.
4. Aggregation: That is the process of combining the output of all the IF-THEN fuzzy rule into a single set. Basically aggregation is fuzzy logic OR operation with input are all fuzzy sets.
5. Defuzzification: Exodus of defuzzification is a single number, how to get there are several versions, the centroid, bisector, middle of maximum, Reviews largest of maximum and smallest of maximum

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

### 3. Implementation System

This research uses Sugeno Fuzzy algorithm to regulate the behavior of enemy NPCs.

#### 3.1. Finite State Machine

Finite State Machine consists of Several states that can transition to one another. Figure 1 shows the behavior of the enemy NPC, Player, and items are modeled by FSM.

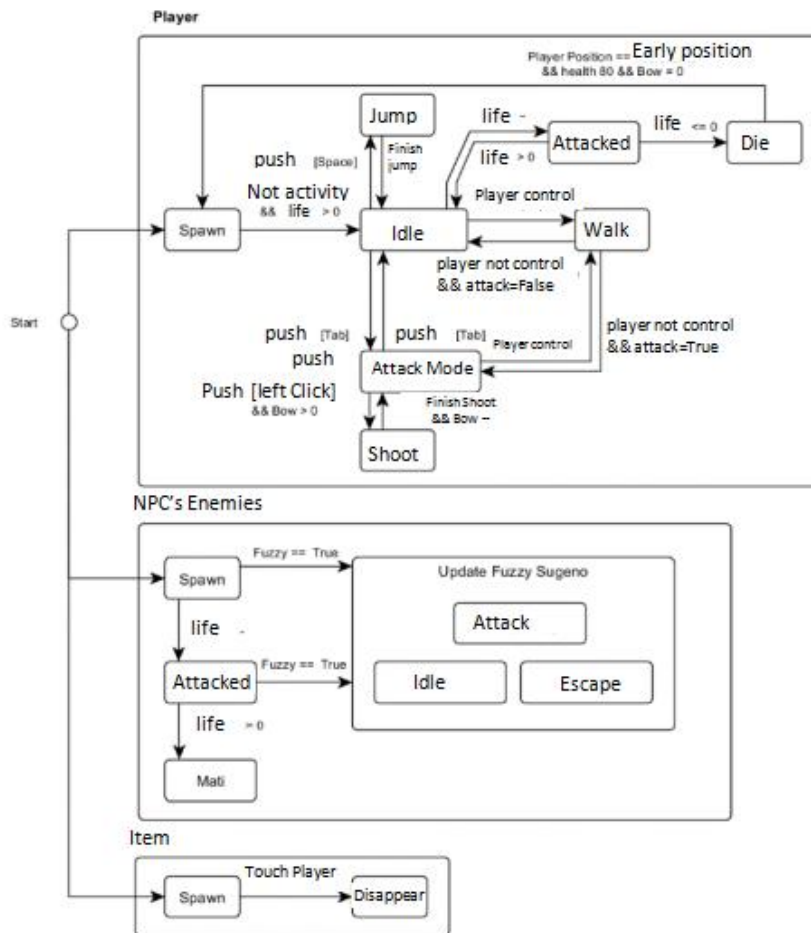


Figure 1. FSM NPC enemies, Player and Item

Here is a state-state on this game:

1. Idle  
The last position without any control or reaction.
2. Escape  
NPC enemies will move away if the result of the fuzzy Sugeno fuzzy gain value.
3. Attack  
NPC will pursue the player if the result of the fuzzy Sugeno scores attack.
4. Shoot  
Player action shoot with a provision that is, having a bow more than 0 and position shooting mode.
5. Jump  
Player will jump when the space key is pressed.
6. Die  
NPC or player lost or equal to zero health.

### 3.2. Fuzzy Design

Fuzzy logic is used to determine the behavior of NPCs to be varied. The method used is fuzzy Sugeno. Of variables are used, the linguistic value of each of these variables are as follows:

- 1.Distance Variable divided into three: Near, Medium, and Long.
- 2.Health Variable divided into three: Bad, Medium, and Fine.
- 3.Player Health Variable divided into three: Bad, Medium, and Fine.

Fuzzy design to produce behavior that varies comprises the distance to the player attributes and health. Of each attribute using the left shoulder joint membership functions, triangular, and the right shoulder. Then it will generate output behavior. As shown in Figure 2.

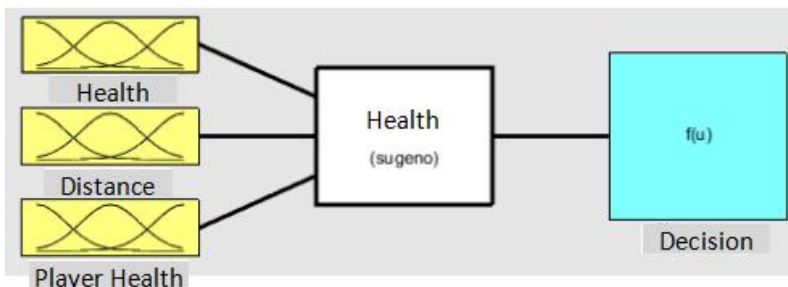


Figure 2. Sugeno Fuzzy Design NPC Enemies

Based on the design, it can be mapped fuzzy fuzzy set. The variable "distance" has three fuzzy sets the Very Near, Near, Medium and Far. The degree of membership (Membership Degree) to the variable "distance player" has a value that is in the interval of 0 to 100. This value is a number of type float, so that to determine the value taken by the size of the vulnerable within the distance from the player to the NPC.

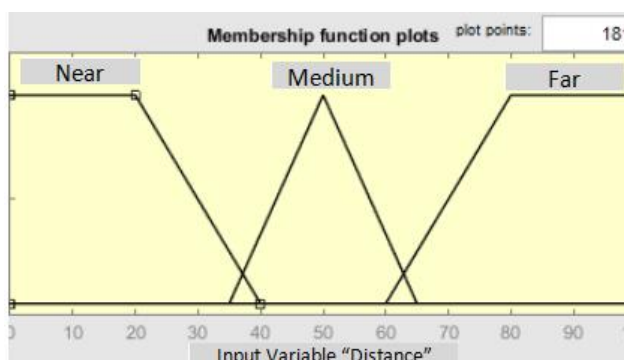


Figure 3. Degree of Membership Variable Input Distance

Variable "health" has four fuzzy set that is sorted, Medium, and Fine. Degree of membership to the variable "health" has a value that is in the interval of 0 to 100. Similarly, the value of the distance variable is a number of type float.

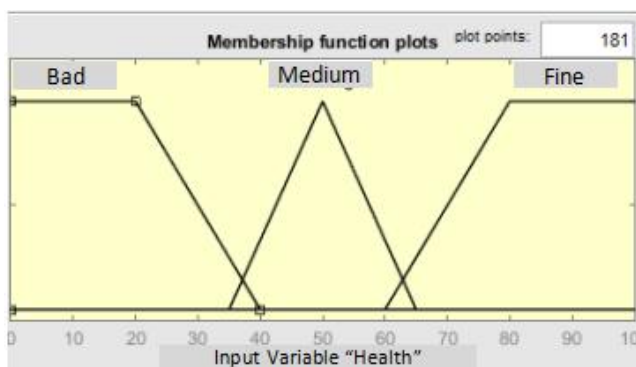


Figure 4. Input Variables Degrees Health Membership

The variable "player's health" has four fuzzy set that is Bad, Medium, and Fine. Degree of membership to the variable "player's health" has a value that is in the interval of 0 to 100. Similarly, the value of the distance variable is a number of type float.

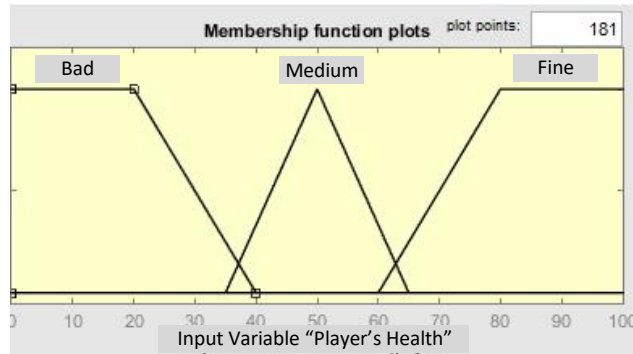


Figure 5. Degree of Membership Variable Input player's health

For the output of the variable "behavior" Enemy NPC, the value of linguistic split into the Attack, Idle, and Escape.

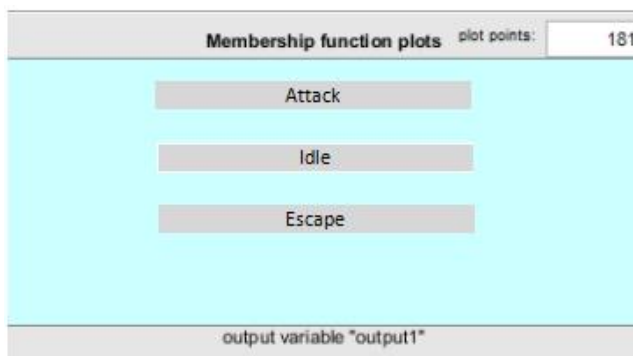


Figure 6. Membership Variable Output Behavior

Membership of the variable "behavior" has a value of linguistic and notation. Attacking linguistic value of 3, 2 Escape, and Silence is 1. The values of the variables "behavior" is constant.

#### 4. Results And Discussion

To get the desired results, it is necessary to test. Testing method aims to determine whether the method used can affect the NPC enemies and produce varying behaviors.

Testing is done to generate an output value varying behavior of NPC enemies. Parameters tested consists of a variable spacing, health and player's Health. For this test took some instances as much as 64 variations of variable spacing, health, and the health of the player.

Based on fuzzy logic test results showing the variation of behavior resulting from a variable input parameter range, health and player's health. Behavior that is generated by the input Healthy = 50, Distance = 30 player's health = 45 is Attacking which will be shown as follows:



Figure 7. Response Strike NPC

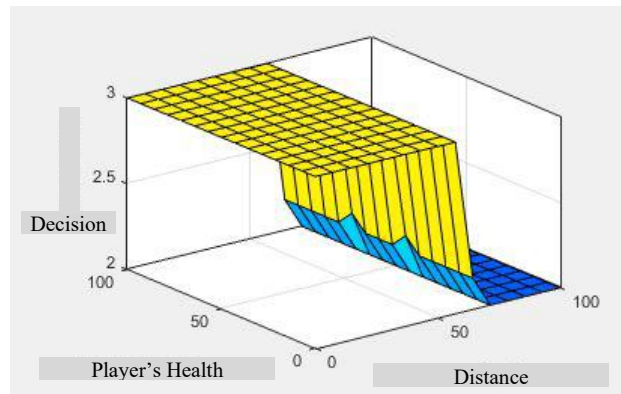


Figure 8. The axis Cartesian Distance to Player's Health

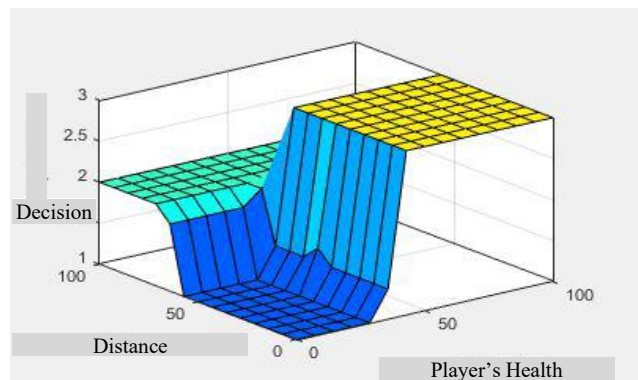


Figure 9. The axis Cartesian Health of the Distance

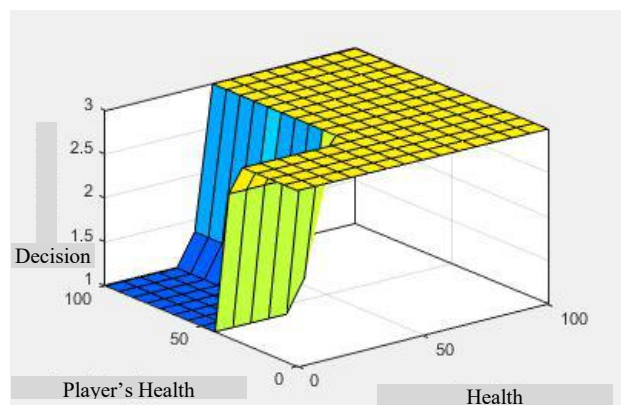


Figure 10. The axis Cartesian Health on the health of the player

## 5. Conclusion

1. Based on the results of the implementation and testing conducted by researchers, it can be concluded that:
2. This research successfully managed to make the game's history as Raden Fatah using the Unity3D game engine and blenders 2.7 as the desktop-based maker of 3D assets.
3. It successfully regulate behavior dynamically applied to the NPC with three variables Fuzzy Sugeno fuzzy algorithm. The percentage of the resulting decisions are attacked by 65.62%, 20.312% idle and escape by 14.06% to 64 different inputs.

## **References**

- [1] Department of Education US, Games for Learning <https://tech.ed.gov/games/>.
- [2] Muhammad Faisal et al (2015), Immersive Bicycle Game For Health Virtua Tour Of UIN Maulana Malik Ibrahim Malang, *Jurnal Teknologi (Sciences & Engineering)* 78:5 (2015) 325–328.
- [3] [http:// www.macmillandictionary.com/ dictionary/ british/game\\_1](http://www.macmillandictionary.com/dictionary/british/game_1) accessed date 3th March 2015.
- [4] Dwi Ana Ratna Wati,( 2011), *Sistem Kendali Cerdas*, Graha Ilmu.
- [5] Agus Naba (2009), *Belajar Cepat Fuzzy Logic Menggunakan Matlab*, Andi Publisher.
- [6] Kusumadewi, S. (2003). *Artificial Intelligence*, Graha Ilmu Publisher.