

Implementation of Finite State Machine Models on the Artificial Intelligence System of Characters in The Game "MMORPG" using RPG Maker

Tengku Syahdina Riyan ^{1*}, A M H Pardede ², Fuzy Yustika Manik ³

^{1,2} Informatics Engineering, STMIK Kaputama,

³ Faculty of Computer Science and Information Technology, University of North Sumatra
mkriyan007@gmail.com ¹, akimmhp@live.com ², fuzy.yustika@usu.ac.id ³

Abstract

Technological developments are the main drivers of global social, economic, and cultural change, including in the rapidly growing gaming industry. The Role-Playing Game (RPG) genre, in which players portray characters in the game's story, is gaining popularity. The application of FSM Models and AI technology in character development and RPG game interaction not only resulted in exciting entertainment, but also inspired similar uses in various fields. With AI, characters interact dynamically with players and environments, and FSM Models govern complex character behavior, the game experience is even more immersive. RPG Maker, one of the popular engines, simplifies the process of creating RPG games with an easy user interface. The implementation of the FSM Model is done through events and switches, directing storylines and character situations with structured logic. This study analyzes the application of FSM Model in MMORPG RPG games. Through the design, testing, and analysis stages, FSM proved effective in creating games that combine entertainment with learning. This game invites players to look for requirements and challenges to proceed to the next level. The result is an MMORPG game played on a PC with a Windows operating system, providing an educational and entertaining gaming experience.

Keywords: Role-Playing Game (RPG), FSM Model, AI, MMORPG game, RPG Maker.

1. Introduction

Technology has become a major driving force of social, economic, and cultural change around the world. One industry that is experiencing rapid development thanks to technology is the gaming industry. One of the most popular genres is Role-Playing Games (RPG), where players can portray certain characters and follow the story presented in the game. The use of FSM Models and AI technology in character development and interaction in RPG games not only creates exciting entertainment, but also paves the way for similar technology applications in various other fields. The use of AI on characters, both Non-Playable Characters (NPC) and other characters, allows them to make more diverse decisions, respond to player actions, and adapt to changing environments [1]. The implementation of the FSM (Finite State Machine) Model is a key aspect in managing complex and dynamic character behavior. The implementation of FSM, makes character state management more efficient and increases character responsiveness to player actions [2]. RPG Maker simplifies the RPG game development process by providing a friendly user interface and easy-to-use tools, even for game developers who don't have a deep programming background [3]. In RPG Maker, the implementation of the FSM Model can be done easily through the use of events and switches that allow the character to move to different states according to the player's actions. Developers can manage the storyline and various circumstances of the characters through logically arranged events.

2. Research Methods

2.1. Previous Research

Previous research in the field of game development with the application of artificial intelligence using Finite State Machine (FSM) Models has made valuable contributions in understanding and developing artificial intelligence systems in the context of games. These studies have explored important aspects of FSM implementation, such as state design, transitions, and character behavior in games. In research conducted by (Westera et al. 2020) shows that the use of artificial intelligence in role-playing games (RPGs) has great potential. The

thorough review conducted by the study identified various AI approaches used in RPGs, including FSM, and provided a deep understanding of the challenges and opportunities that exist [4]. Another study conducted by (Yulsilviana and Ekawati 2019) discusses the application of FSM in regulating enemy behavior in games. The results of this study suggest that FSM can be used effectively to create complex and adaptive behaviors in the context of games [5]. To create an intelligent and adaptive character by adjusting the change of character state based on the input received, so that the character can behave intelligently and adaptively in dealing with situations in the game. Design an effective and efficient FSM to regulate changing character states. This involves determining the right states, transitions between states that are in accordance with the logic of the game, and actions that must be taken by characters in each state (Putro, Sari, and Wahid 2021) [6].

2.2. Game

Games are a form of activity that involves players in a structured system with clear rules and goals. Games often involve interaction between the player and the created virtual environment, in which the player must make decisions and actively participate in order to achieve the goals that have been set. Games generally provide challenges, entertainment, and learning experiences for their players.

2.3. Game Elements

In the game, there are key elements that make up an exciting gaming experience. It includes rules governing interaction, objectives that give direction, environments with the game world, role-playing characters, dynamic interactions, game mechanics that govern behavior, player progressions, and audio-visual aspects that enrich immersion.

2.4. Artificial Intelligence

Artificial Intelligence (AI) is a growing field in the development of computer systems. John McCarthy (1956), one of the major figures in the development of artificial intelligence, defined AI as "the science and engineering associated with the manufacture of intelligent machines" [7].

2.5. Finite State Machine

Finite State Machine (FSM) is a mathematical model used to represent and control the behavior of systems. FSM consists of a number of states that can change based on inputs and changing conditions. FSM is used to describe a logical flow in a system consisting of a series of states and transitions between those states. FSM is used to describe process flows, model interactions with users, and control data processing. One alternative FSM implementation is to use object-oriented programming or often abbreviated as OOP. The advantages of using OOP in FSM are its high flexibility and easy maintenance both on simple, medium, and complex systems. In addition, it also benefits from one of the advantages of OOP is the reuse of code that has been typed (code reusability) so that code typing becomes less [8].

2.6. Black Box

A black box is a method of testing software or systems in which the main focus is to test external functionality without paying attention to or having in-depth knowledge of the internal structure or implementation of that system. In the context of software development or complex technology, black box refers to an outside view of how the system works, where testing is done by sending inputs to the system and observing the output produced, without the need to know the internal details.

2.7. White Box

A white box is a software or system testing method that focuses on examining the internal structure, logic, and code implementation of that system. In white box testing, testers have in-depth knowledge of how the system is designed and implemented, so testing is done by looking at internal details such as logic flow, decision-making branches, and other technical aspects.

2.8. RPG Maker

RPG Maker is software or software used to design and create an RPG genre game. RPG Maker provides an intuitive and easy-to-use graphical user interface, thus allowing users with a variety of backgrounds, including those without in-depth programming knowledge, to create RPG games. The features in RPG Maker allow users to create game maps, design characters, define storylines, add dialogue, and manage other elements such as items, weapons, and enemies.

3. Results and Discussion

This research involves a series of stages in structured data collection. The first step involves an in-depth study of various relevant theories by studying various theories related to RPG games, FSM algorithms and their application to games that will be made based on sources obtained from journals, ebooks, and various websites spread across the internet.

3.1. Game Analytics

The game that is built is a single player game that RPG type can be known as a role-playing game. In this game there is a character (avatar) as the main player, and there are several intelligent Non Player Character (NPC) characters played by the computer. The object of research

in this game is NPC characters who will be given artificial intelligence using the corresponding FSM model. In RPG games, each player must complete all the main quests (missions) in the game. Each mission has a certain level of difficulty and is different such as completing missions in each stage to be able to go to the next stage.

3.2. System Analysis

The game that is built is a single player game type adventure game or adventure game. In this game there is a character (avatar) as the main player, and there are several intelligent Non Player Character (NPC) characters played by the computer. The object of research in this game is the application of FSM algorithms in regulating NPC behavior and response.

3.3. Application of FSM (Finite State Machine) Method

FSM can be modeled with Finite State Diagrams (FSDs). A transitional system is a system whose behavior is presented in the form of states. The system can move from one state to another according to the input given to it. FSM is used to determine NPC behavior based on the conditions (state) possessed by the player. The design of methods and states implements how FSM algorithms can be used in games. Overview of FSD as the basis for implementing FSM in games in figure 1.

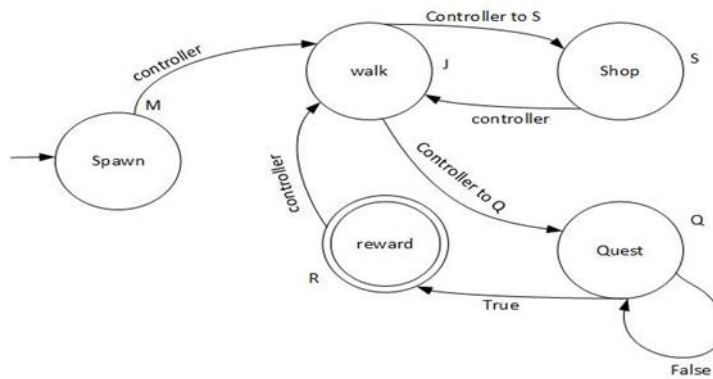


Fig.1: FSD Game MMORPG

A brief explanation of Figure 1 is that the game starts from the state appears until the game over. To facilitate the formulation of each word in FSD, it appears with the symbol letter (M), Road (J), Question (Q), Shop (S), and Gift (R). The initial spawn process will bring the character up and running and can choose access to Questions. In the State question what can be done is to get a reward if you successfully answer, and will repeat again if wrong.

3.4. System Design

A flowchart or flowchart is a depiction of steps and flows that show the sequence of work processes that will build the overall program. The preparation of this flowchart is based on the logical sequence of thinking about how the program runs.

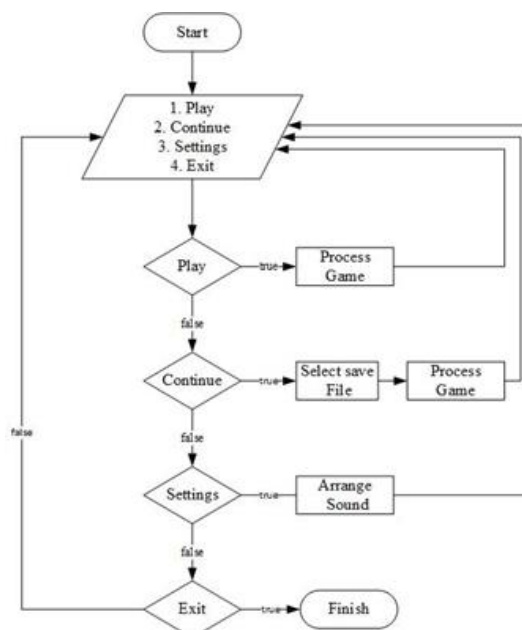


Fig.2: Menu Flowchart

Figure 2 shows the flow chart of the game menu, there will be 4 options, namely Play, Continue, Settings, Exit. In it will occur a process that requires input from the player. Namely the process on the first menu is Main, if the player selects Play then a new game will start from the beginning. The next menu is Continue on this menu the player can continue the game that has been saved before. The third menu is Settings, on this menu players can set in-game buttons and game sounds. The last menu is Exit, is a menu that when selected by the user then the game will exit and finish.

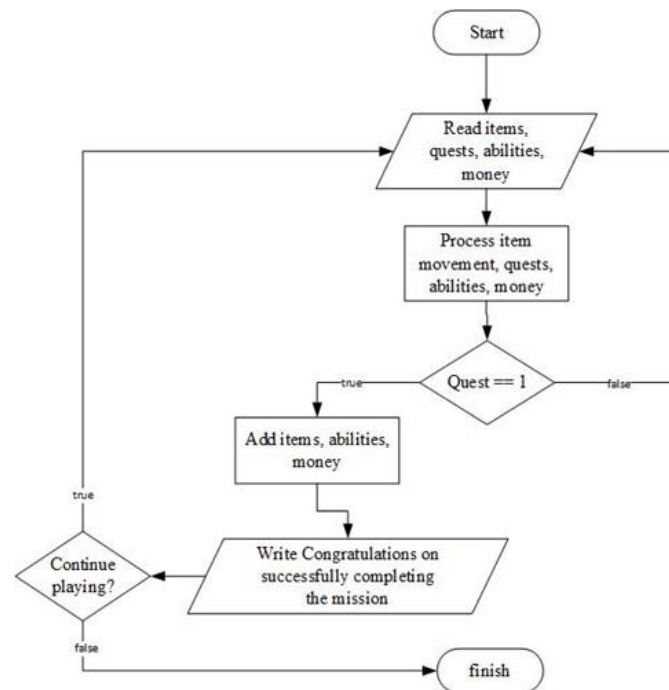


Fig.3: Flowchart MMORPG

The explanation of the flowchart in Figure 3 is:

- a. Process variables to go to the first branching (quest == 1)
The next process is the same as the first process, that is, in this step the player has obtained the quest. The quest process will be taken by the third branch which requires the player to be able to complete the mission, the flowchart will give a mark of "1" for the quest condition is successful and 0 for the quest that fails. In the quest condition, the player will perform a mission/task and if successfully completed, the true condition will be fulfilled and will go to the process of adding value from items, abilities and money characters and giving the output "Congratulations on successfully completing the mission". If the quest or mission carried out by the character fails, then the character will not be able to continue to the next mission and must repeat in the same mission until it is true or successful.
- b. Last fork (Continue playing?)
In the last branching process, players will immediately be faced with choosing "yes" and "no" conditions from the question "Continue playing?". If the player selects "yes" then the game will proceed to the initial process. But if the player chooses "no" then the game will be over

4. Conclusion

After carrying out the design stage and which is then followed by the testing and analysis stage, the conclusions can be drawn:

1. With the Finite State Machine (FSM) method to make an RPG game is very good, because with that players can play while learning by looking for a requirement or challenge in order to continue to the next level. This will also make players unconsciously learn how to do things in order to be sequential in order to achieve a certain goal.
2. The results of this study are in the form of games that can be played on PC devices with windows operating systems that have MMORPG titles.

References

- [1] W. Safitra, A. Faisol, and S. Adi Wibowo, "Application of the Finite State Machine Method to Non Player Character (NPC) Action Strategy Game 'Ouroboros,'" *JATI (Jurnal Mhs. Tek. Inform.*, vol. 4, no. 2, pp. 292–297, 2020, doi: 10.36040/jati.v4i2.2828.
- [2] M. Herlambang, "Penerapan Metode Finite State Machine Pada Game Dreadman," *JATI (Jurnal Mhs. Tek. Inform.*, vol. 3, no. 2, pp. 83–89, 2019, doi: 10.36040/jati.v3i2.870.
- [3] S. N. Wahyuni and C. Andiyoko, "Pembuatan Game Berbasis Pembelajaran Menggunakan Rpg Maker Mv," *J. Comput. Networks, Archit. High Perform. Comput.*, vol. 1, no. 1, pp. 24–28, 2018, doi: 10.47709/cnipc.v1i1.5.
- [4] W. Westera *et al.*, "Artificial intelligence moving serious gaming: Presenting reusable game AI components," *Educ. Inf. Technol.*, vol. 25, no. 1, pp. 351–380, 2020, doi: 10.1007/s10639-019-09968-2.
- [5] E. Yulsilviana and H. Ekawati, "Penerapan Metode Finite State Machine (Fsm) Pada Game Agent Legenda Anak Borneo," *Sebatik*, vol. 23, no. 1,

- pp. 116–123, 2019, doi: 10.46984/sebatik.v23i1.453.
- [6] B. A. Putro, K. A. Sari, and A. Wahid, “Penerapan Metode Finite State Machine Pada Game ‘Escape From Punk Hazard,’” *J. Mhs. Tek. Inform.*, vol. 5, no. 1, pp. 71–78, 2021.
 - [7] J. McCarthy, M. L. Minsky, N. Rochester, and C. E. Shannon, “A proposal for the Dartmouth summer research project on artificial intelligence,” *AI Mag.*, vol. 27, no. 4, pp. 12–14, 2006.
 - [8] A. Badruddin, “Perancangan Dan Implementasi Finite State Machine Pada Game ‘ Castle of Illusion ’ Program Studi Teknik Informatika Perancangan Dan Implementasi Finite State Machine Pada Game ‘ Castle of Illusion ’ Skripsi,” 2019.