

Developing Level Intelligent Agent for Battle of Etam Earth with Finite State Machine (FSM)

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Abstract— Battle of Etam Earth is one of the games developed by Bibir Design Studio for PC platform, tablets and arcade machines. A modern rock paper scissors game that was packed in a duel robot, where there were two players will depend on experience, strategy and luck to be a winner. The AI technology required for this game to be played by one player only. The second players are replaced by game agent. Game agent is constructed by transferring the knowledge of the game master of this game to become the model of a Finite State Machine (FSM). Research about game agent has become the attention of researchers in the field of Artificial Intelligence (AI). Every action-reaction of game that probably would happen, transform into states that will be the behavior of the agent. In this research will show us about the strategy model of the Battle of Etam Earth, which to design the behavioral of the Agent that was used Finite State Machine. Where the game agent is developed into three levels: easy, normal, and hard to make player can improve the experience. Finally, test results through simulation battle, was concluded that FSM could be properly functioned as a pattern of behavior as an intelligence game agent.

Keywords— *The Battle of Etam Earth; Game Agent; Finite State Machine*

I. BACKGROUND

Battle of Etam Earth is one of the games which was developed by Bibir Design Studio for the PC platform and Android tablets. A modern rock-paper-scissors game was packaged in a duel battle robots, which is there are two players who will hone their skill, strategy and luck to be able to come out as a winner. AI technology is needed for this game in order to be played by one player only. The roles of rival players are replaced by the existences of games agent. Game agents were constructed by transferring knowledge from the master game in the form of a Finite State Machine (FSM). Research on this game agent has attracted the attention of researchers in the field of Artificial Intelligence (AI).

Model agent strategies that will be used on this game can be various, for example, a strategy to strike quickly, then in certain circumstances the behavior turns into collecting a large force to attack. Each of agent strategy generally has the final goal to defeat the enemy (player). In this research will show us

about the strategy model of the Battle of Etam Earth, which to design the behavioral of the Agent that was used Finite State Machine.

In the other sides, the game with the agent as rival is being too strong, it would make players feel frustrated and ending the game quickly, otherwise if the agent is too weak, it would cause the players gets boring and no longer interested for playing this game. To overcome this, the game agent is built into 3 levels of difficulty which are called easy, medium, and hard. So that players can improve the experience

II. BASIS OF THEORIES

A. Artificial intelligence

Artificial intelligence (AI) is the intelligence exhibited by machines or software. It is also the name of the academic field of study which studies how to create computers and computer software that are capable of intelligent behavior. Major AI researchers define this field as the study and design of intelligent agents, in which an intelligent agent is a system that perceives its environment and takes actions that maximize its chances of success [1].

B. Game Agent

Game Agent is a software agent. Software Agent is a system that the whole or the part of an environment which it can respond it that is located and acted every time, to do its job and to be able to effect what will be done next.

On the game, the game agent is usually called NPC (Non-Player Character). Autonomous character is kind of autonomous agent which is intended for the use of computer animation and interactive media such as games and virtual reality. These agents represent a character in a story or a game and have the ability to improvise their actions. This is the opposite of a character in an animated film, the action is written in advance, and for avatar in a game or virtual reality, action directed by the player in real time.

C. Finite State Machine

In designing the game for AI, a state machine is the most widely used techniques for decision making problems and, at

the same time with scripting is widely used to design the system in-game decision making. State machine is widely known as a technique for modeling the phenomenon or event based conditions, including dissociation, and interface design. Finite State Machine (FSM) or also known as Finite State Automata, regarded as a technique that is widely used in designing the AI in the game. On the FSM, the term state is a fundamental concept for presenting information relating to the current state of the system before.

In a periodically time, the system is on one state, each of state has its characteristics and behavior of specific actions. The states are inter-connected through a transition state, then each direct transition to the state (condition) hereinafter as the target state. There will always be the initial state which serves as the starting point, then the condition of the current state which stores the previous state information. Input events, which are externally and internally triggered by system, functioning as a trigger, which directs the evaluation process of the rule. If the conditions are possibly fulfilled, then there is a transition from the current state to the next state in accordance with the existing rules [2]. The principle of the components are integrated on the FSM as shown in figure 1.

III. CONTENT OF ANALYSIS

The Battle of Etam Earth Game has the type of game mode: VS mode, the mode which is each of players must choose one type of Etam robot to fight until one robot players come out as the winner and the game ends. Each character has 4 levels of category types of attacks, which is named as Lv. 1 ATK (quick attack), Lv. 2 ATK, Lv. 3 ATK, and Lv. 4 ATK (full charge attack). In each level of this type of attack also has an attack value of points of different combo attacks each type has a move list (attack code) that is different, so that these types of attacks can only be issued if the attacking player with the correct code. Code move list for a combo attack consists of some combination of the symbols rock-paper-scissors game, that is R (rock), S (scissors), and P (Paper) refer to the Fig.2:

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Combo attacks can occur when the player does move list (attack code) correctly. If a player does not perform the properly move, then the combo attacks will not happen (Lv.1

attack will happen), combo-attack would not been happened if the player lost switched (combo broke)

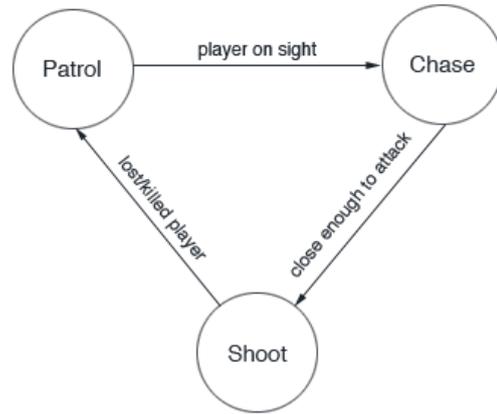


Fig. 1. Simple finite state machine of an AI character

	Lv. 2 ATK	
	<i>Moon Attack</i>	
	ATK	<i>Melee</i>
	Damage	510
<i>Move list</i>		R, S
	Lv. 3 ATK	
	<i>Torpedo Rain</i>	
	ATK	<i>Range</i>
	Damage	580
<i>Move list</i>		P, P, P
	Lv. 4 ATK	
	<i>Destroyer</i>	
	ATK	<i>Range</i>
	damage	650
<i>Move list</i>		S, P, S, R

Fig. 2. Code move list for a combo attack

Remarks of Fig 2 :

- | | |
|-------------------------------------|-------------------------------|
| 1. Enemies control attack in freeze | 9. 70% |
| 2. Combo Lv. 2 / 3 / 4 will happen | 10.No Enemy Combo |
| 3.No combo | 11.Level 4 attack will happen |
| 4. Combo Lv. 3 / 4 will happen | 12.No level 4 attacks |
| 5.No combo | 13.Level 3 attack will happen |
| 6.Enemy of ATK isn't freeze | 14.No level 3 attack |
| 7.Enemy Combo will happen | 15.No level 2 attack |
| 8.30% | 16.Level 2 attack will happen |

A. Design of Finite State Machine

Designing of FSM is based on the events that occur in the activity log and the player attacks the opponent agent. Combo attacks would be carried out by opposing players is a model of FSM state behaviour of agents. FSM is designed with different models for each level of the agent. Its purpose is to create an easy enemy, normal, and hard to be defeated. Here is a model of Finite State Machine which can be applicable to every levels of the agent:

B. FSM Model of Easy Level Enemy

Every FSM designed starts from state up to check the status of enemies attack (see in Figure 2, event number 1), which for certain conditions, an effect of special combo attacks can make the enemy attack into a freeze control (random and can be seen by the other players). This is the right conditions for agents to launch attacks. Generally, the designing of the FSM at the agent level is shown in figure 2.

FSM is designed to make the agent deliberately defeated when an opponent players are about to strike with combo attacks Level 3 or 4, with the percentage of caving is 30% (see in Figure 2, event Number 7 and 8). To facilitate the player, agents are also designed to select random attacks without performing combo attacks Level 3 with random attack percentage is 70% (see Figure 2, event Number 9, 13, and 15)

C. FSM Model of Normal Level Enemy

FSM as normal agents are also designed to yield when the players are about to strike with combo attacks Level 3 or 4. The difference is normal agent would still perform a combo attack when at Level 2, 3, or 4 would be happened (see figure 3, event Number 11, 13, and 16).

Another things that also differentiate, normal agent would choose the strongest attack Level 1 to give a huge battle damage toward opponent players (see figure 3, state after event Number 15)

D. FSM Model of Hard Level Enemy

FSM hard agent is not designed to succumb toward the players. At the time of player is about to strike with combo attacks Level 3 or 4, the agent will break the combo attack (see figure 4, event Number 7).

Hard agents also perform a combo attack when combo Level 2, 3, or 4 will be occurred (refer to figure 4, event Number 9, 11, and 14). Each combo is carried out by hard agent is a combo with the greatest ATK and special attack.

V. CONTENT OF ANALYSIS

The first test on this research was conducted by simulating battle. Testing in battle simulations was conducted to see the effectiveness of agent's FMS model. Tests carried out 2 battles with the implementing agency FSM and is not

(randomly attack), by looking at the number of the agent's wins.

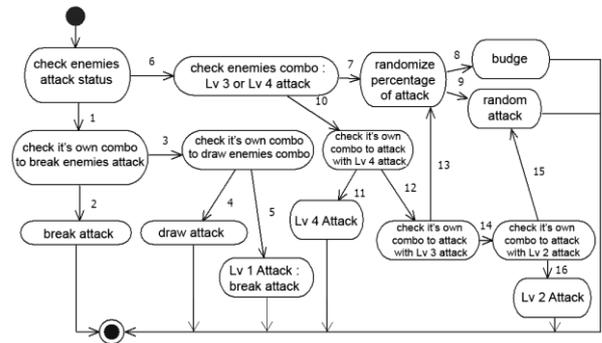


Fig. 3. FSM of easy level enemy

Remarks of Fig 3 :

- | | |
|-------------------------------------|-------------------------------|
| 1. Enemies control attack in freeze | 9. 70% |
| 2. Combo Lv. 2 / 3 / 4 will happen | 10.No Enemy Combo |
| 3.No combo | 11.Level 4 attack will happen |
| 4. Combo Lv. 3 / 4 will happen | 12.No level 4 attacks |
| 5.No combo | 13.Level 3 attack will happen |
| 6. Enemy of ATK isn't freeze | 14.No level 3 attack |
| 7. Enemy Combo will happen | 15.No level 2 attack |
| 8. 30% | 16.Level 2 attack will happen |

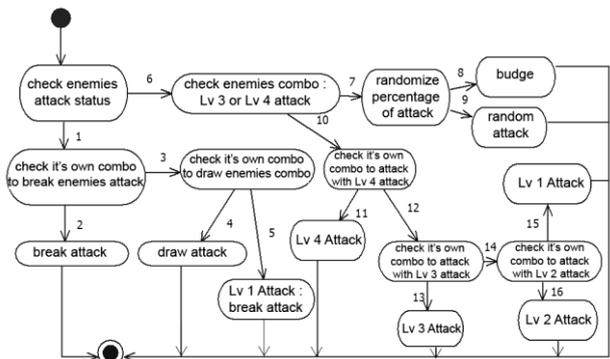


Fig. 4. FSM of normal level enemy

Remarks of Fig 4 :

- | | |
|-------------------------------------|-------------------------------|
| 1. Enemies control attack in freeze | 8. No Enemy Combo |
| 2. Combo Lv. 2 / 3 / 4 will happen | 9. Level 4 attack will happen |
| 3.No combo | 10.No level 4 attacks |
| 4. Combo Lv. 3 / 4 will happen | 11.Level 3 attack will happen |
| 5.No combo | 12.No level 3 attack |
| 6. Enemy of ATK isn't freeze | 13.No level 2 attack |
| 7. Enemy Combo will happen | 14.Level 2 attack will happen |

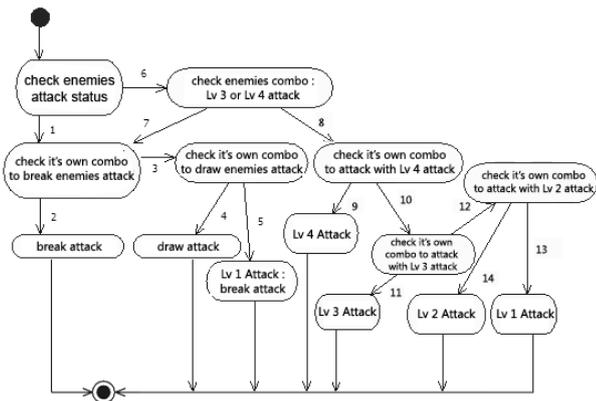


Fig. 5. FSM of hard level enemy

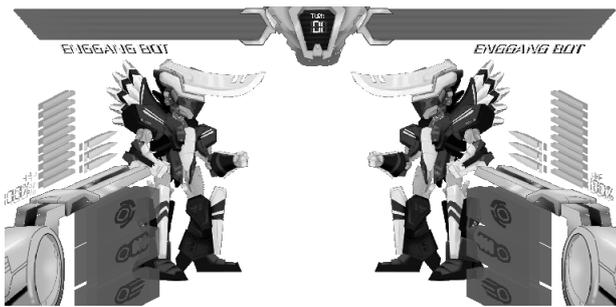


Fig. 6. Battle simulation agent against agent

TABLE I. RESULT BATTLE AGENT VS AGENT

Bout to-	The Result		
	Easy	Normal	Hard
1	Lose	Lose	Win
2	Lose	Lose	Win
3	Lose	Win	Win
4	Win	Lose	Lose
5	Win	Win	Lose
6	Win	Win	Lose
7	Lose	Win	Win
8	Lose	Win	Win
9	Lose	Lose	Win
10	Lose	Win	Win
Total of Wins	3	6	7

TABLE II. RESULT BATTLE AGENT VS PLAYERS

Player-	The Result		
	Easy	Normal	Hard
1	Lose	Win	Win
2	Lose	Lose	Lose
3	Lose	Lose	Win
4	Win	Win	Win
5	Lose	Lose	Win
6	Win	Lose	Lose
7	Lose	Win	Win
8	Lose	Lose	Win
9	Lose	Win	Lose
10	Lose	Lose	Win
Total of Wins	2	4	7

Battle simulation was performed on the first agent (COM1) against the second agent (COM2). In this test was using a robot Enggagig Bot COM1 COM2 against the using of robots were same as in Figure 5. Where discovered both of robots have the same power.

Look at table II, Battle simulation testing performed 10 times and counted the number victory of agents that implement FSM (COM1).

On table II, COM1 with FSM hard model will obtain victory 7 times, FSM will win 6 times on normal model, and FSM on easy model will obtain victory 3 times only. This proves that hard agent is more superior than normal agent, and the normal agent is more superior than easy agent.

Tests were also done in the form of simulated battle against the user (player). Tests carried out on the fight agents that implement FSM against 10 players.

Table III shows that the easy agent to win the battle 2 times only, 3 times winning for normal agent, the hard agent will win in 7 times.

The simulation proves the players are more superior than the easy and normal agent, while the hard agent have the most superior level victory of the user. This proves that the hard agent is more difficult to defeat the players.

VI. CONCLUSION

From the test results of this research can be obtained several conclusions such as:

- To make the game Battle of Etam Earth can be played with 1 player only, then make the game agent as a second player which implements the FSM as a pattern of thinking.
- To create a game in order to avoid the players become boring, then it was made into a level of intelligence game for easy, normal, and hard, with a goal to make the game experience more interesting and not boring. Each game of intelligence agent level was applied the finite state machine (FSM) to form a chart of different thinking, made the agent can be easily defeated by the enemy, until it can be difficult to be defeated.
- The test results were done by the level of intelligence agencies battle simulation. Simulation between agents against the other agents and the agent proves that by applying of FSM is superior than the agent who was randomly attacked and also better than the human player.

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