

APPLICATION OF THEORY OF AUTOMATA IN COMPUTER GAME DESIGNING

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Abstract— The FA is the easiest machine to recognize patterns. A finite-state machine is a model used to represent and control execution flow. A finite-state machine, or FSM for short, is a model of computation based on a hypothetical machine made of one or more states. FSMs are commonly used to organize and represent an execution flow, which is useful to implement in games. We propose a model of Game Designing in this paper by using finite automata. Applications of theory of automata are very imperative now days many peoples implement the concepts of Automata theory in countless areas. Computational theory contains numerous tools to solve the various complex issues easily. For example, in text search from a given paragraph according to the given keywords, Lexical analysis which produce tokens of given statement, in image recognition, DNA computing, Ticket vending machine, Pattern matching, Games designing and communication protocol. But in designing of games it remains unusual. This paper has simple theoretical design of a game Jungle survival using abstract machine model Finite state automata (FA). [1] FA clearly show the whole functionality of complete game.

Keywords— Game theory, Finite automata, Application of automata Theory, FA Implementations, Theoretical Game Design.

I-Introduction

Computational theory is a combination of three theories 1. Automata theory which deals with theoretical models that are abstract machines 1. Turning Machine (TM), 2. Linear Bounded Automata (LBA), 3. Pushdown Automata (PDA) and 4. Finite Automata (FA). FA is a simplest abstract machine in theory of automata. 2. Computability and Logic theory which deals with the limitations of these models 3. Complexity Theory deals with what cost are required to use these models [2]. FA contains five tuples $(Q, \Sigma, \delta, q_0, F)$, Q is a set of states, Σ is a set of alphabets, q_0 is a starting state,

δ is a transition function which shows the all transitions from starting state to final state which is an acceptance state and usually denoted by F . Here is a very smallest application of FA which is switch that is use by the different peoples for different purposes but it has only two states one is "ON" and other is "OFF". Figure 1 shows a simple Finite state automata which is at "OFF" state In the start when it take an input then it goes to the final state which is "ON" state and input here we use 1 when going off to on and 0 when going on to off state.. At "OFF" state get 1 as an input it will become ON. At "ON" state get 0 as an input it will become OFF.

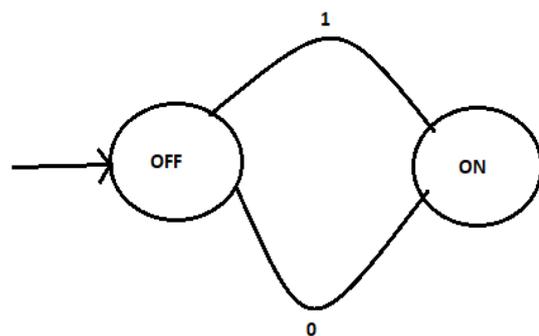


Fig.1. Finite automata for switch.

In this paper we make an effort to design a game Jungle survival with a tool of theory of automata we will use Finite state automata to represent the all states of game and how a man moves from one state to other state. Jungle survival game have two levels and each level have some tasks. He must perform previous tasks after completion of all tasks he

will go to the next level when he completes the both level then game will end and we can exit from game. There are some states in each level to move from one state to other states he need some inputs and we will represent inputs with Σ symbol and state with Q symbol and start state with q0 and final state with F in our paper.

Section 2 of this paper is defined Literature Review, Section 3 of this paper is defined the problem and our proposed solution, Section 4 of this paper is Conclusion & Future Work. Section 5 of this paper is acknowledgement.

II- Literature Review:

Game theory have very interesting concepts in 1950s peoples were showing interest in this field and they were using these concepts of this filled in politics and other problems in war. John Nash at that time state that games are always finite. And every game has some players and actions all player use important actions that are comfortable for them but not for enemies [3]. Decision making was a core concept of game theory which was a mathematical tool that was a very useful for peoples they can easily analysis the problems. Decision maker was use in a situation for example which action play by a player all information of all players action was perform by this tool. From 20th century game theory was used in game designing which plays very essential role [4].there are many examples of game theory that was implemented by decision maker concept like all games that have time limit player should have complete the task in give duration if not then game end. But now people thinking of advance concepts that will design the game in very good and easy manners as compare to the traditional game theory notions. Theory of automata [5] is sub type of computational theory it have very powerful and easy to implement ideas and we can use these concepts in game designing many peoples use these ideas to solve simple and complex problems, Hopcroft, Motwani and Ullman work on theory of computational theory and they have provide a well explained introduction [2]. Finite automata is a simple concept it can be used in hardware as well as in software that's why mostly people use this to solve the particular problems like pattern matching [5], image recognition [6], image compression [7]], text search in paragraph [8], lexical analysis and vending machine [9] and computing game designing [3] [10]

III- THE PROBLEM AND SOLUTION

In this paper we use Finite state automata to design Jungle survival game.

Game Description

This game is related to survival in the jungle. The whole idea of this game is that how a man survives in the jungle. To survive in the jungle, he needs water and food and knife but by default he has only knife and one bottle of water he must search animals and kill them for food and some of them to survive in the jungle. To kill the animals hi must

make the arrows form the trees by the use of knife. This game has two levels in level 1 he just searches the fresh water for drink and hunt the small animals like rabbits and deer for food and some wild animals like Lion, Bear, for survival. In level 2 he also search the fresh water and hunt the animals for food and Must kill the Lion, Bear, Gorilla and Elephant for survival and search the old army headquarter that was built in jungle at war time and the he use the radio to communicate with army and other useable things like sniper gun to kill the wild animals. We assume he know how to hunt how to use bow and arrows and also sniper gun.

Level 1: Man is already in the jungle to complete this level he must complete the all tasks. There are some tasks that are given below man should have to complete these tasks:

- Search the soft trees (Yew, Maple, Pine) that is good to make the arrows and bow Kill and eat the animals 3 deer and drink water, 5 rabbits also drink water.
- Must search fresh water to refill the bottle
- At the end must kill first Bear and then Lion to complete the level.

Conditions for Level 1:

- By default, man has knife as weapon but with knife he can't kill the animals but he can use knife to make bow and arrows that's why he must make bow and arrows and then kill them.
- When He kill the animals for food kill them in any order but after kill one category of animals must eat them and must drink the water and refill the bottle then kill the next animals (kill 3 deer and eat then drink water ,kill 5 rabbits and eat then drink water).
- After killing one animal category must make arrows again.
- Use 2 arrow to kill the 1 Rabbit.
- Use 4 arrow to kill the 1 Deer.
- Use 8 arrow to kill the 1 Bear.
- Use 10 arrow to kill the 1 Lion.
- If Bear hit 5 time to the man the man is dead and game is over.
- If Lion hit 7 time to the man the man is dead and game is over.
- If Deer hit the man 10 time then man is dead game is over.
- If Rabbit bit the man 15 time then man is dead game is over.
- After hunting and eating all animals at the end must kill Bear then at the last Lion to complete level 1.

Level 2: Man is already complete level 1. There are some tasks that are given below man should have to complete these tasks to complete the final level of this game.

- Must search the old army Headquarter that was built in jungle at wars times to use radio for communicate with army and find sniper gun here to kill the wild animals.
- Kill the animals and eat them 6 deer, 10 rabbits

- Must search fresh water to refill the bottle
- Kill the 2 Bear and then 2 lions then 1 Gorilla
- At the end must kill the 1 Elephant to complete the level.

Conditions for Level 2:

- By default, man have Knife, bow and unlimited arrows now not need to make arrows again and again.
- When He kill the animals for food kill them in any order but after kill one category of animals must eat them and must drink the water and refill the bottle then kill the next animals (kill 6 deer and eat then drink water ,kill 10 rabbits and eat then drink water).
- To refill the water, he must search for fresh water.
- Use 2 arrow to kill the 1 Rabbit.
- Use 4 arrow to kill the 1 Deer.
- Use 8 arrow to kill the 1 Bear.
- Use 10 arrow to kill the 1 Lion.
- If Bear hit 5 time to the man the man is dead and game is over.
- If lion hit 7 time to the man the man is dead and game is over.
- If deer hit the man 10 time then man is dead game is over.
- Use 5-gun bolts or 10 more arrows then to kill a Bear to kill Gorilla.
- Use just 10 bolts to kill Elephant
- Bolts only 15 totals if he wastes the all bolts without killing Elephant then game is over.
- If Elephant hit 1-time man must dead game is over.
- If Gorilla Hits 2 time then man must dead game is over.
- If Gorilla Hits 3 time then man must dead game is over.
- If lion hit 5 time to the man the man is dead and game is over. □ If deer hit the man 10 time then man is dead game is over.

After killing and eating all animals and kill the 2 Lions and 2 Bear and Gorilla and at the end must kill 1 Elephant and radio works well and communication is done properly then Level 2 is completed.

Game in the form of Theory of Automata

In this section we define the complete game in the form of five tuples of Finite state automata [11]and diagram.

Formal definition of Finite Automata:

- Q: all states in FA
- Σ : alphabets used in FA
- F: Final state or acceptance state
- q0: initial state or starting state

δ : Transition Function

Finite Automata for complete game:

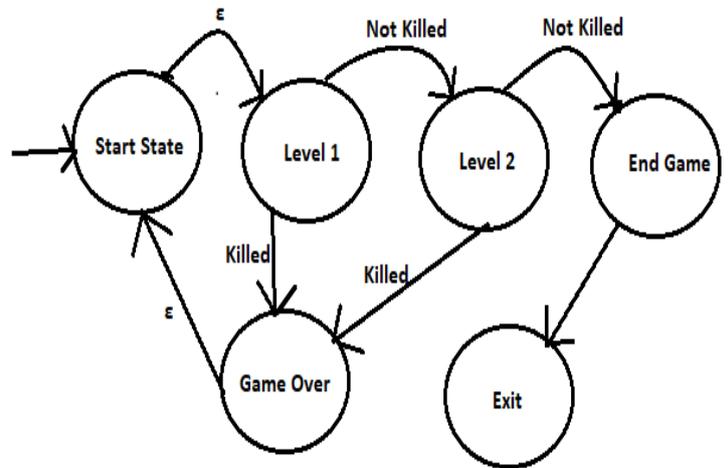


Fig.2. complete Jungle survival game.

Q= {Game start, level1, level2, game over, End game}
 Σ = {NK, K}
 Start state = Game start
 Final state= End game

Table 1: Complete game Transitions Table.

Input \rightarrow t	NK	K	ϵ
States \downarrow			
Game start	\emptyset	\emptyset	Level1
Level1	Level2	Game over	\emptyset
Level2	End game	Game over	\emptyset
Game over	\emptyset	\emptyset	Game start
End game	\emptyset	\emptyset	Exit

Start state with ϵ transition will go Level1 state if man get killed there then go to the game over state also this state with ϵ go back to the start state but if not killed then go to Level2 state and here repeats the same process. If killed go to game over state if not then go to End Game state.

Finite Automata for Level1:

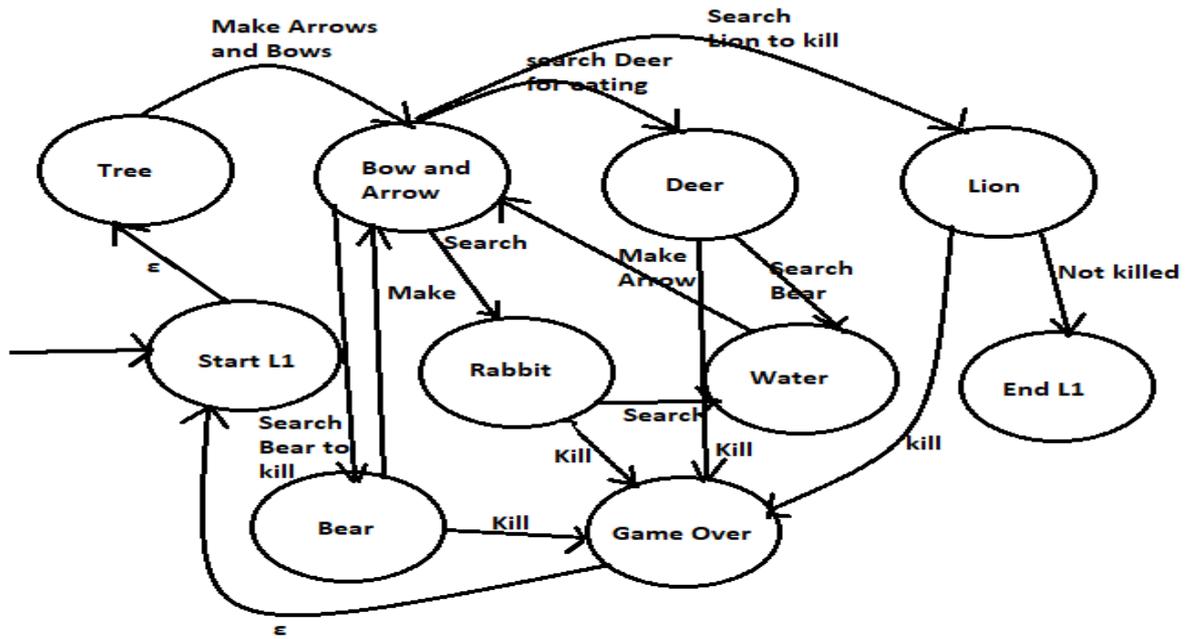


Fig.2. Finite Automata for Level 1.

Q= {start L1, Tree, R, game over, A/B, D, L, W, Br, End L1}
 $\Sigma = \{NK, K, SR, MA, MB, SD, SL, SB, SW, ST\}$
 Start state = start L1
 Final state= End L1

In level 1 start state with empty string go to the soft tree state and the make the bow and arrows for this tree then he can search the deer or rabbits if hi get killed then game over state but if not he will search the water and make the arrows again after that he will kill the bear and the make the arrows again at this state if he get killed then game over state if not then kill the lion and level1 is complete or L1 End.

Finite Automata for Level 2:

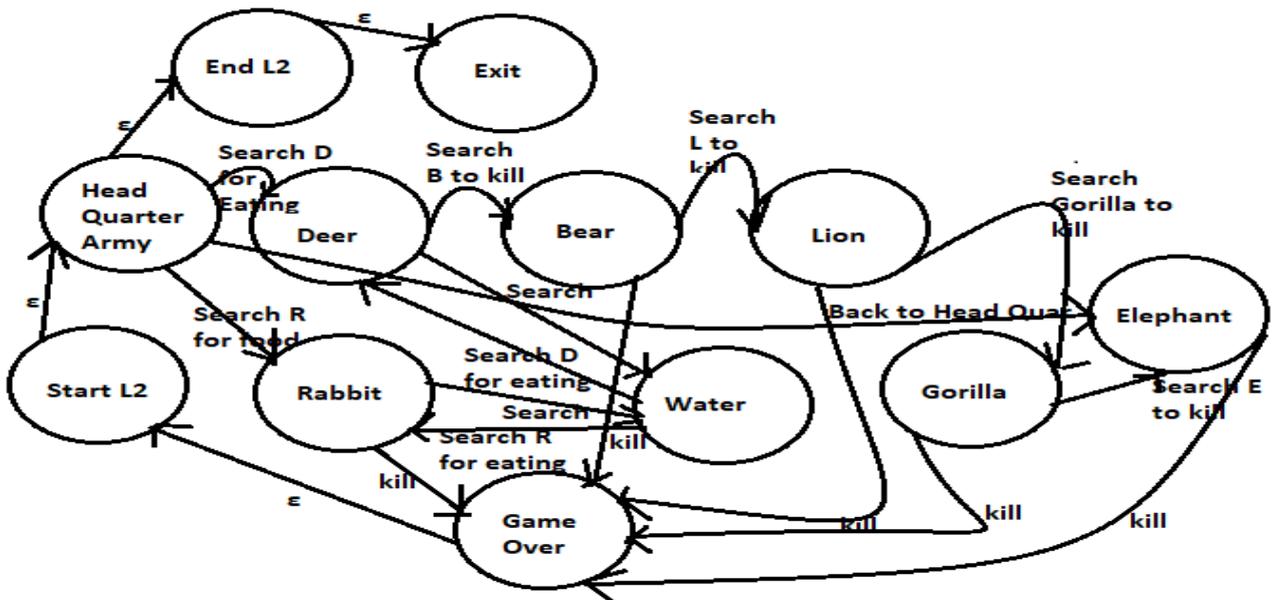


Fig.2. Finite automata for Level 2.

$Q = \{\text{start L2, HQ, R, game over, D, L, W, Br, G, End L2, Exit}\}$
 $\Sigma = \{\text{NK, K, SR, MA, MB, SD, SL, SB, SW, SG, SE,}\}$

Start state = start L2

Final state = End L2

In level 2 start state with empty string go to the HQ state and Find the sniper gun from here then he can search the deer or rabbits if he get killed then game over state but if not he will search the water and make the arrows again after that he will kill the bear at this state if he get killed then game over state if not then kill the lion and then kill the Gorillas and must use sniper gun after that kill the elephant with sniper gun but if he out of bolts before killing the elephant then game over and also if elephant hit him and killed then also game over but if he will not get killed of not out of bolts then must go back to the HQ and communicate with someone for help if communication is conformed then game End state and after that Exit from the game.

IV- Conclusion & Future Work

This paper includes one application of Finite state automata we design a jungle survival game which have two levels and every level have some mandatory tasks that must complete before moving forward we show Finite state automata of each level of the game. There many applications of Finite state automata we can use the Finite state automata almost in every field of human's life. Theory of automata is a very large field it has many tools to solve the problems. We hope this paper will encourage the students of computer science to implement the concepts of automata theory in other fields to solve the problems like we use the Finite state automata. In future we will enhance the levels of this game and also increase the complexity and difficulty level of this game then we will implement this using other powerful concepts of Theory of automata for example Pushdown automata and Turing machine.

V -Acknowledgment

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