2003 International Symposium on Advanced Intelligent Systems
September 25-28, 2003, Jeju, Korea

The Realization of Artificial Life to Adapt The Environment by Using The Markov Model

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Abstract - In this paper, we designed a Artificial Life(AL) that acts the appropriate actions according to the user's action, environments and AL's feeling. To realize this AL, we used the Markov Model. We consisted of the chromosome by Markov Model and obtained the appropriate actions by Genetic Algorithm.

Keywords - Genetic Algorithm, Markov Model, Artificial Life

1. Introduction

In these days, due to the vast internet infra and the powerful computing speed, we easily experience the online virtual environments such as online games, avatar chattings and 3D shopping malls from which many people and companies induce some value-added profits.

The aims of our study are to make the Artificial Life(AL) that sympathizes with human and behaves itself like a real creature in the virtual world. In this paper, we designed a AL that acts the appropriate actions according to the user's action, environments and AL's feeling.

This work was supported by grant no. R01-2000-000-00277-0 from the Basic Research Program of the Korean Science & Engineering Foundation (KOSEF).

To realize this AL, we used the Markov Model. We consisted of the chromosome by Markov Model and obtained the appropriate actions.

GA was proposed by John Holland in early 1970's. It is a search algorithm based on the mechanics of natural selection and evolving genetics. GA has been found to be one of the most flexible, efficient and robust among all search algorithms. Because of these properties, this method is now widely used to solve different optimization problems of a board range.

2. AL's Action Pattern

2.1 The Chromosome Structure

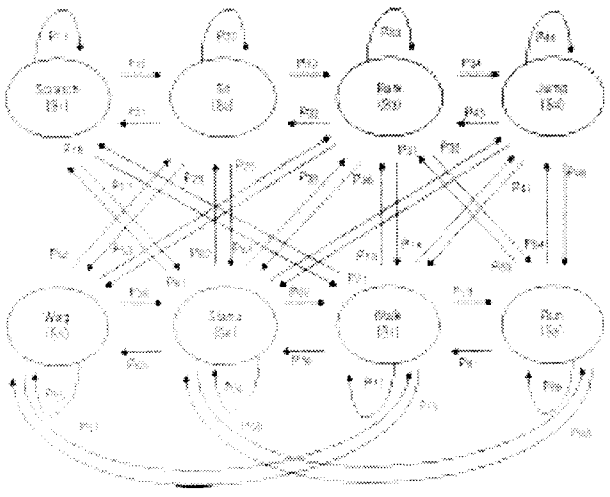


Fig 1. The Markov Model

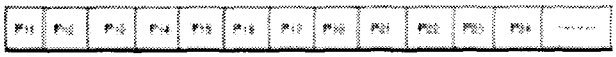


Fig 2. The Chromosome Structure

We used the Markov Model to make the chromosome. The probabilities of between Markov Model's states were regarded as a gene that consists of the chromosome.

Fig 1. shows the probability to move from one state to another state. Fig 2. shows the chromosome structure.

The chromosome structure must be met the next formula because it used the Markov Model

$$\sum_{j=1}^{8} P_{ij} = 1 \ (\ i = 1, \ 2, \ \ldots\ldots 8 \ ) \qquad (1)$$

P_{ij} : the moving probability from ith state to jth state

2.2 Fitness Evaluation

Each chromosome gets the fitness value from the user's action, environments, AL's feeling as shown in Table 1.

state / conditions		state 1	state 2	state 3	state 4	state 5	state 6	state 7	state 8
weather	good	2	-6	-5	7	6	3	8	9
	bad	-2	6	-5	-5	-5	-2	-2	-5
place	In	-7	8	-8	-5	-3	5	4	-7
	Out	2	-4	-4	6	3	-5	8	7
user's action	good	-7	-5	-5	7	8	6	6	8
	bad	-2	7	7	-12	-10	-5	-2	-13
AL's feeling	good	-2	-4	-5	7	8	-2	7	8
	bad	1	5	-5	-10	-9	2	-4	-10

Table 1. Expectation value of the user's action, environments and AL's feeling

The fitness evaluation of each chromosome is calculated by the next formula.

$$F_i = (f_i - f_{\min}) + (f_{\max} - f_{\min})/(K-1) \qquad (2)$$

$$f_i = \sum_{all\ j} (P_{ij} \times T_j) \qquad (3)$$

f_i : the fitness value of ith chromosome

$f_{\min}$: the minimum fitness value among chromosome

$f_{\max}$: the maximum fitness value among chromosomes

F_i : the last fitness value of ith chromosomes

K : the selection pressure

P_{ij} : the moving probability from ith state to jth state

T_j : the expectation value from Table 1

The greatest fitness value of the whole chromosomes becomes K times of the smallest fitness value of the whole chromosomes in this formula and we can keep the balance between the variance of the population and the convergence speed by controlling selection pressure K.

2.3 Crossover and Mutation

The GA operations such as crossover and mutation are used. We selected the 100 chromosomes through the roulette selection according to the fitness value calculated in Section 2.2. Therefore, the selected 100 chromosomes created 100 offspring chromosomes to replace the parent chromosomes through crossover and mutation.

The fitness value changes each time because of the user's action, environments and AL's feeling. The number of the

crossover sites is set at random. The next state is decided at random through the roulette selection.

3. Experimental Results

The block diagram of the simulation system is shown in Fig 3. We used the user's action, environments, AL's feeling as the inputs of our simulation system.

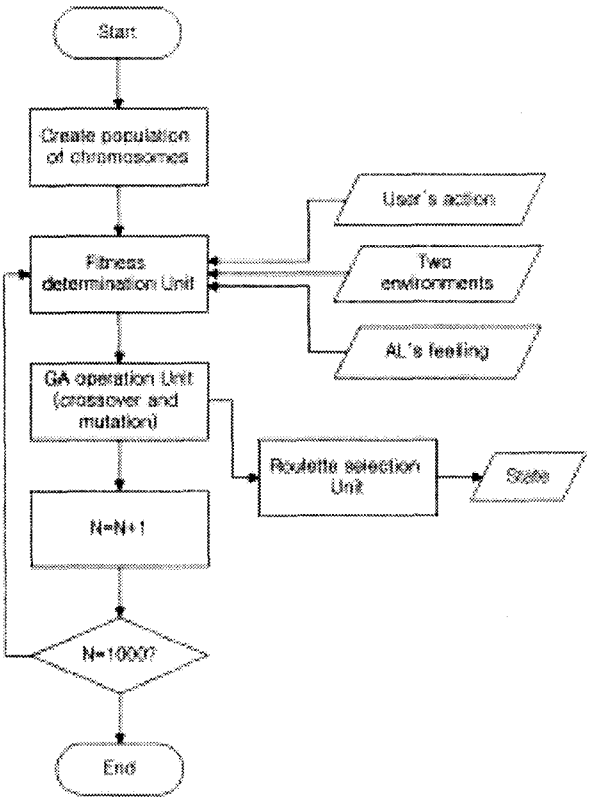
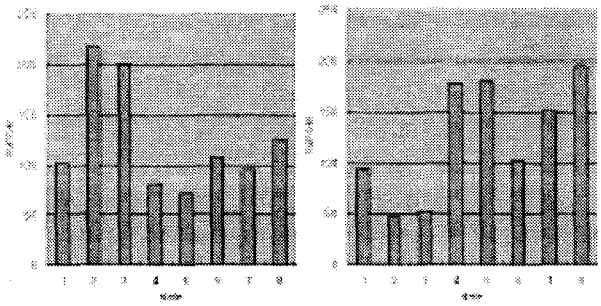


Fig 3. The Block Diagram of the Simulation System

3.1 Simulation I

First, the inputs of the simulation system are two environments(the good weather, the outer place), the user's bad action and the AL's bad feeling. Under there terms, we implemented 1000 times and the result is shown in Fig 4(a).

Second, the inputs of the simulation system are two environments(the good weather, the outer place), the user's bad action and the AL's bad feeling. Under there terms, we implemented 1000 times and the result is shown in Fig 4(b).



(a) (b)

Fig 4. Histogram of the Simulation I

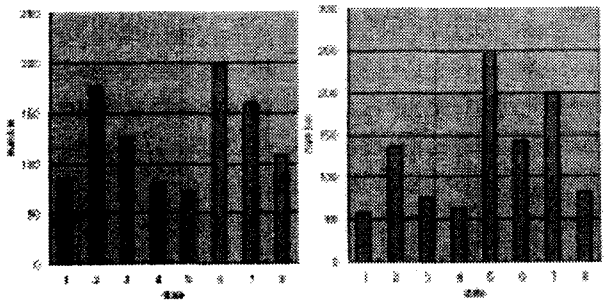
Fig 4(a) shows that the state2(sit) and the state3(bark) have the large value. This means that the AL profusely acted state2(sit) and state3(bark) about the 4 input conditions(user's action, two environments, AL's feeling).

Fig 4(b) shows that the activities(state4, state7, state8) and the familarity(state5) have the large value. This means that the AL profusely acted the activities(state4, state7, state8) and the familarity(state5) about the 4 input conditions(user's action, two environments, AL's feeling).

3.2 Simulation II

First, the inputs of the simulation system are two environments(the good weather, the inner place), the user's bad action and the AL's bad feeling. Under there terms, we implemented 1000 times and the result is shown in Fig 5(a).

Second, the inputs of the simulation system are two environments(the good weather, the inner place), the user's good action and the AL's good feeling. Under there terms, we implemented 1000 times and the result is shown in Fig 5(b).



(a) (b)

Fig 5. Histogram of the Simulation II

In Fig 5(a), it shows that the modesties(state2, state5, state7) have the large value. This means that the AL profusely acted the modesties(state2, state5, state7) about the 4 input conditions(user's action, two environments, AL's feeling).

In Fig 5(b), it shows that the state5(wag) and state7(walk) have the large value. This means that the AL profusely acted the state5(wag) and state7(walk) about the 4 input conditions(two environments, user's action, AL's feeling).

Compared with Fig 4 and Fig 5, Fig 5(a) shows that the modesty(state6) increased because of inner place and Fig 5(b) shows that it increased more the familarity(state5) than the activities(state4, state8) because of the inner place.

In the experimental results, we knew the fact that the AL's action resembles the actual pet(dog)'s action.

4. Conclusion and Future Works

In this paper, we designed a AL that acts the appropriate actions according to the user's actions, environments and AL's condition. To realize this AL, we used the Markov Model, and GA. In section 3, we showed the fact that the AL is appropriate actions by the proposed method. Our ultimate purpose is to realize the 3D cyber space that exists ALs and users

To obtain this purpose, we will study the AL continually that acts with users, environments, another ALs.

5. References

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