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A study of battle strategy for the Robocode

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Abstract: Robocode is an easy-to-use robotics battle simulator that operates across various types of computer platforms supporting Java2. In this paper, we describe an implementation of a Robocode agent that participated in the Robocode Japan Cup 2002. Through extensive simulation of the Robocode battles, several strategies for the battle are investigated. The effectiveness of the proposed strategies is verified by the battles in the Robocode Japan Cup 2002.

Keywords: Robocode, battle strategy, simulation

1. Introduction

This paper describes the implementation of the Robocode agents that participated in the Robocode Japan Cup in 2002. Robocode is an easy-to-use robotics battle simulator that operates across all platforms supporting Java 2. Many sample codes for Robocode are available in the Internet. Fig.1 show the example of actual simulation.

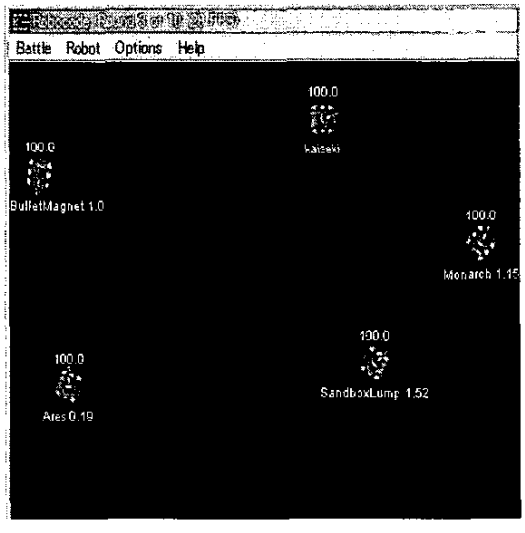


Figure 1: The example of actual simulation

To make a stronger Robocode agent, behavioral analysis of the enemy agent is necessary. One useful analysis is prediction of linear movement of the enemy agent. The other key issue is prediction of the enemy bullet motion. Combinations of these predictions are vital in making a stronger Robocode agent. In this paper, we develop two types of Robocode agents with different behavior prediction schemes: named SENKEI and SENKEI2. In order to evaluate the proposed two agents, we carried out extensive battle on a Robocode simulator. The simulated combat led to one strategy in particular, that may prove useful. To confirm our implementation, we tested the Robocode agent at Japan Cup 2002.

2. Problem description

Fig.2 illustrates the typical structure of the Robocode agent that we used.

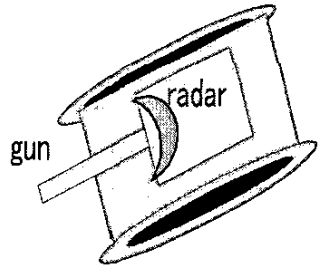


Figure 2: The structure of Robocode agent

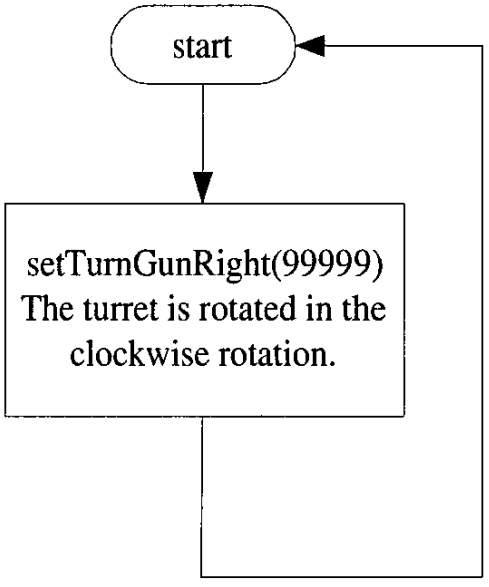
To make a stronger Robocode agent, behavioral analysis of the enemy agent is necessary. One useful analysis is to predict the linear movement of the enemy agent. The other key issue is to predict enemy bullet motion. Combinations of these predictions are vital in making stronger Robocode agents. However, in order to fire at the enemy agent, we needed to search for the enemy using radar. Once we found the enemy, we need to rotate and fire the gun at the enemy according to prediction. However, the above sequence of procedure induces a time lag. The problem considered here is the time lag between the time of discovery and the rotating and firing time. In order to save the time lag due to searching, rotating and firing, we programmed the gun and the radar to rotate in the same direction. By

contrast, in the default setting of the Robocode agent, the direction of the radar and the gun on the tank can rotate independently.

3. Avoidance Method of SENKEI2

Because of the specification of Robocode API, we could not obtain the enemy bullet firing time using radar sensing. In order to predict the bullet firing time, we have to infer it from other information. The information on the enemy agent available from radar is the enemy agent name, its direction, its distance, the angle of its moving direction, moving speed, and energy levels. The energy levels are very useful information since the energy levels change when the enemy fires the bullet. Thus, by checking the enemy energy level, we can infer the firing time.

Once the program detects a change in the enemy energy levels, the avoidance algorithm is started to avoid the enemy bullet. The position of the fired bullet can be predicted easily using the linear prediction method. However, we cannot know the speed of the bullet. In order to just barely avoid the strike, we used 4 different time delays, according to the distance from the enemy agent. The following are flowcharts of the actual implementation of our Robocode agent.



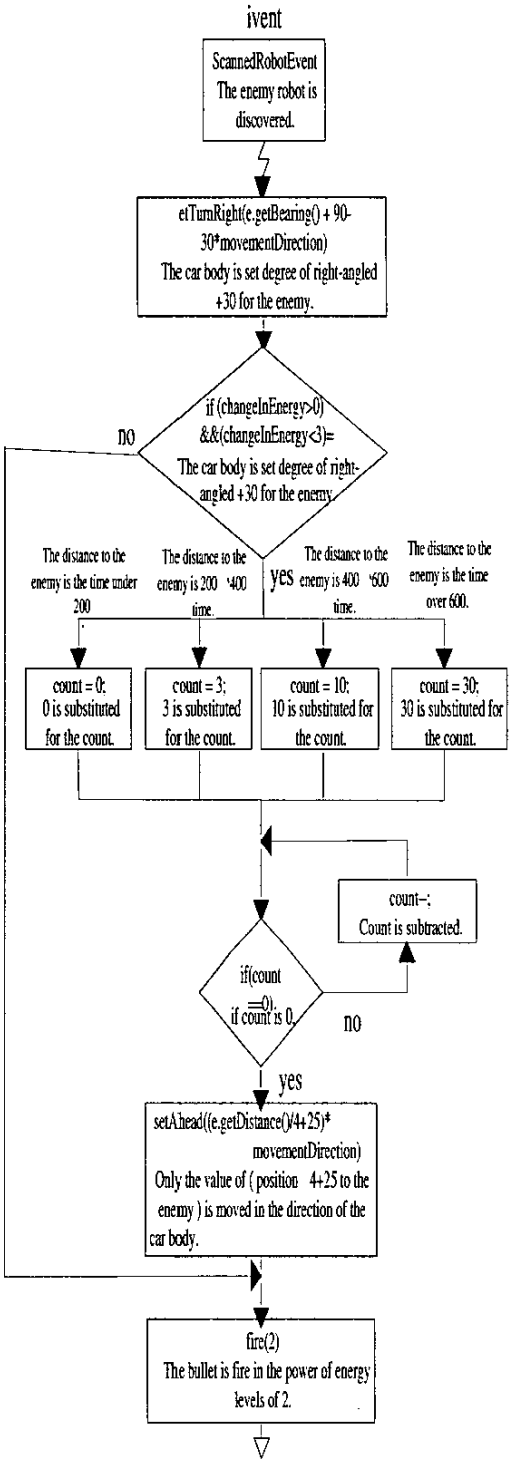


Figure 3: The flowchart of the Robocode agent

To avoid the enemy bullet , the proposed agent can be moved either to the right or left in the direction degree of 90 (right-angle) + 30 degrees from the enemy agent. This algorithm is useful for the inference algorithm, which may then be based on linear prediction. The timing of the avoidance action is estimated by the distance from the enemy.

4. Experiments

Using the developed Robocode agent (SENKEI2), several simulations were tested to check the validity of the proposed method. In the simulation, we used two different types of agent as enemy agents.
We simulated ten rounds of battle against each agent. The detailed features of the agents are shown in Table 1.

Table 1: Features of agents.

The agent name	Features of agents.
Trackire	Continuous fire against the enemy as soon as the enemy agent is found
SENKEI	Firing action is based on the linear prediction of the enemy's motion.
SENKEI2	The bullet avoidance algorithm has been mounted.

5. Experimental Result

Tables 2 and 3 show the results of extensive simulation trials.

Table 2: The result of the SENKEI2 vs. SENKEI fight.

Robot name	Total Score	Survival	Last Survivor Bonus	Bullet Dmg	Survival 1sts
1st:SENKEI2	1632	500	100	860	10
2nd:SENKEI	80	0	0	80	0

Table 3: The result of the SENKEI2 vs. Trackfire fight.

Robot name	Total Score	Survival	Last Survivor Bonus	Bullet Dmg	Survival 1sts
1st:SENKEI2	1686	500	100	905	10
2nd: Trackfire	171	0	0	171	0

6. SENKEI2 in Robocode Japan Cup

Agent SENKEI2 was registered in the league in Robocode 2002 Japan cup to evaluate our implementation strategy. Total ranking of our Robocode agents is summarized in Table 4. The total ranking was scored 11/155 and Survival rate was 89.301. Table 4 the final result of Japan Cup official season league (student division) for SENKEI2

Table 4: The final result of JapanCap official season league(department of the student)SENKEI2

Robot name	SENKEI2
Level	Student
Renewal day	2002-11-22
Registration day	2002-11-18
Manufacture person	Yu
Ranking	11
Survival rate	89.301

7. Conclusion

This paper describes implementation of Robocode agents participating in the Robocode Japan Cup in 2002. The problem considered here was the time lag between finding the enemy and rotating and firing at the enemy agent We take into account the time lag to predict the motion of bullet to avoid collision. In order to save searching, rotating and firing time, two types of agents were developed. Through the extensive battles of the competition, we verified the effectiveness of the proposed avoidance algorithm.

References

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