

RoboCupRescue 2017 – Rescue Simulation League

Team Description

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Abstract: In this paper we will describe the preparations we have made to take part in RoboCup 2017. This year, we implement our codes by using ADK Framework. Concretely, we implemented path planning algorithm to use A-star search algorithm. Meanwhile, we optimize three different agents including ambulance team, fire brigade, police force by Changing task allocation. The preliminary application of office is also to help task allocation.

Key words: ADK Framework; path planning; task allocation

1. Introduction

RoboCup Rescue Simulation System (RCRSS) is a large-scale Multi-Agent System (MAS) of urban disasters. The RCRS server simulates various circumstances imitating a city after a disaster, and provides an interesting test bench for many algorithms and techniques in this field. The aim of Rescue Simulation League is to make use of the virtual agents to rescue buried victims from under blockades, and to extinguish fires in order to decrease the life and financial losses caused by nature disasters. In this process, we need to consider different aspects concise of clustering of algorithm, path planning of algorithm, target allocation command execution and so on. By using ADK Framework, we can only implement algorithm modules including Clustering and Path Planning, ExtAction, Target Selector.

The main contents of this article are listed as follows:

- 1) Using A-star search algorithm to help agents find the shortest path.
- 2) The strategy of Police Forces.
- 3) The strategy of ambulance team.
- 4) Refilling strategy of Fire Brigade.

2. Clustering

In the first beginning, the whole map will be divided into clusters using K-means algorithm, in order to improve search efficiency. The cluster numbers are determined by the number of the three kinds of agents respectively. Because of the bad communication, we find if too many agents are in the same cluster, they may search the same buildings one by one. So, we make sure each cluster will have two to four agents assigned to it to avoid searching repeatly. The Specific quantity is decided by the entity which the cluster owns. For example, if

some cluster owns gas station, which means we can't stand the fire spreading in this cluster. So, more Fire Brigade should be assigned to this cluster to avoid occurrence and expansion of fire.

When agents are assigned to clusters, the sum of the distances that agents would take to reach their assigned clusters should be minimized. So, number of agents in clusters need to be decided, then each cluster choose the exact number of agent which is nearest.

3. Path Planning

Path planning is important for agents. If agents can choose a short path, they will save lots of time on road, so they can spend more time on their task. A-star search is the most widely known best-first search algorithm which we have used for a long time. It evaluates the whole cost from the initial node to the goal. Which is given by the following partial differential equation.

$$f = g(n) + h(n).$$

$g(n)$ is the cost it took from the initial node to get the node n . $h(n)$ is the cost from the node n to reach the goal node. In this platform, we calculate the distance of two node as cost.

Through the World Info, agent can find the shortest path by using A-star search algorithm. And this algorithm is excellent when we test without blockades. However, because of blockades, agents usually be blocked.

In order to solve this problem, we adopt a simple method to judge whether the road is passable. This year, we judge whether the edge is blocked that agent can pass. If edge is blocked, we judge the road is unpassable. Using this method, agent can avoid blockades, however, it is a pity that this method is inaccurate. Sometimes, agent will take a detour although he can pass these roads.

4. Police Forces

The performance of police forces affect the mobility of fire brigades and ambulance teams, and thus, indirectly, their ability to fulfill their tasks. And the efficiency of clearing is affected greatly by the clearing method. Police forces clear roads by specifying the location and rotation of the effective clearing rectangle. Thus, the main challenge is how to optimize the clearing rectangle. So we inherit the previous strategy to make sure police agent moves along the centerline of the planning road toward the target. Its effect is shown in figure 1:

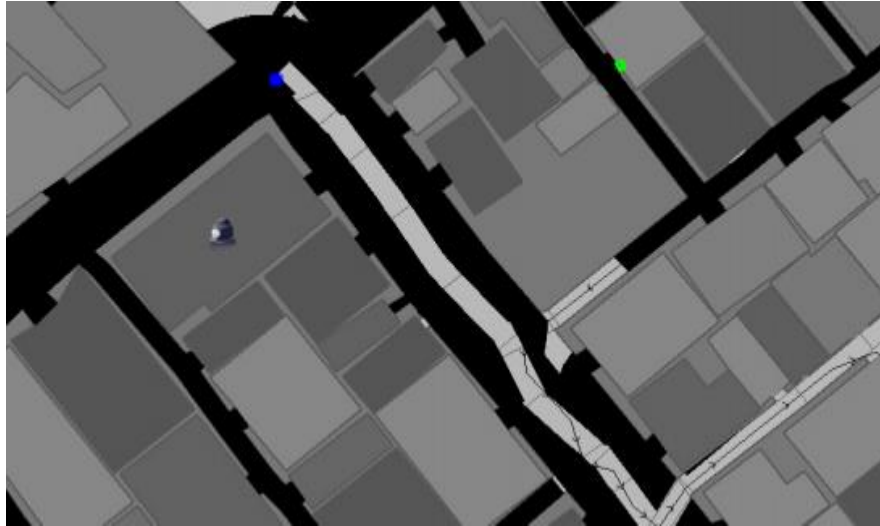


Figure 1: Clearing effects

In addition, the task priority is also important. Firstly, police force should clear the road block around to make sure that if there are road blocks trapped themselves, the police force must clear the blocks to save themselves. Secondly, shelters own the highest priority, the task of shelters must be execute first when a police force is assigned to his partition. Then, clearing the trapped agent, because more agents help increase the rescue efficiency. Finally, clearing the entrance of buildings where residents get trapped .

We avoid two agent choose the same target. If two agent choose the same target, the power of police force will be waste, which is shown in figure 2. Meanwhile, we also want to avoid two agent choose the same path. Sometimes, agents will choose the same path because their target are very close. Unfortunately, we have no idea to solve this problems.

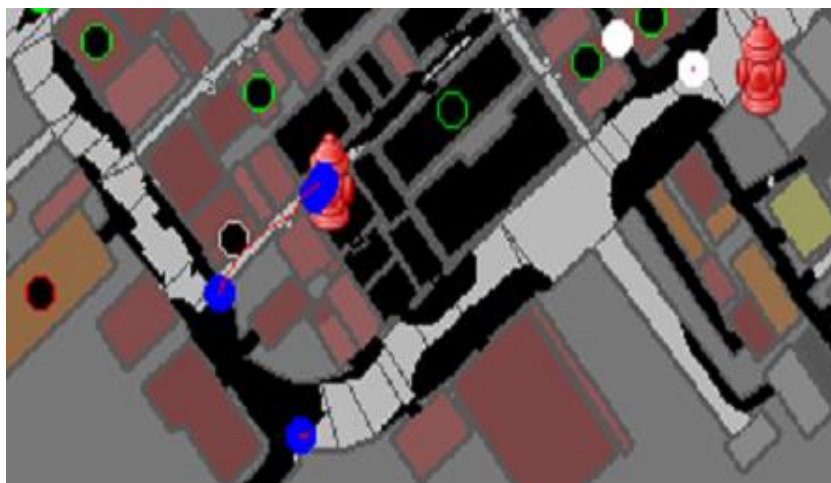


figure 2: two agent choose the same target

5. Ambulance Team

The core task for an ambulance team is to rescue the citizens in the building

as much as possible and send them to the refuge. In RCRSS, more civilians' survive means more score. So when an ambulance team choose a target, several factors such as distance, partition, civilians' healthy degree and surrounding environment for stuck agents need to be considered. So, greedy algorithm is used to select local targets in partition. The steps ambulance team choosing target are as follows:

1. calculate the death time of a civilian T_1
2. calculate the time to remove buriedness T_2
3. calculate the time on road T_3

When $T_1 > T_2 + T_3$, $(T_1 + T_3)$ as degree of priority.

Estimating death time of a civilian is a problem, because we can't receive the HP accurately. As we did before, We use health point (HP) and damage to estimate death time. At the time that the HP changes, we use last data (HP) to subtract damage to get the new data1 (HP). Also, we get a new data2 (HP) the system providing, then we get a mean between new data1 (HP) and new data2 (HP), we would have more exact estimation about HP.

Calculating the time on road is also a problem. In order to estimate it, we get the Straight-line distance to calculate the time. Then the time should multiply coefficient. Until now, we just take a fixed coefficient and we think the coefficient should be variable.

6. Fire Brigades

Each fire brigade can get all hydrants and refuges in the map. Firstly, the Fire Brigade searches for all available options to fill water, if the nearest option is a refuge, the agent heads for it right away. Otherwise, if refuge is too far away from fire brigade, the fire brigade looks for the nearest available hydrant. Unlike refuges, hydrants can be only used by one agent at a time and the refill rate is slow. Fire Brigades going to a hydrant must coordinate together by acquiring the lock to this hydrant. The lock is given to the agent nearest to the hydrant.

7. Office

In ADK Framework, the importance of office is strengthened. This year, office is applied preliminary by our team.

Firstly, for fire brigade, office is used to allocate fire brigades to different fire cluster. In this way, fire suppression efficiency can be global optimum. So, we use office to estimate the whole water that a fire cluster need to allocate fire brigades. This strategy perform better than before when we did not apply office.

Then, for police forces. We avoid office command police force if it is implementing some important task that it choose itself. So, we definite the importance of different clearing task. If police force is completing important task,

office will not command it.

For ambulance team, we plan to use office to allocate ambulance teams to cooperate to rescue victims if one agent can't complete itself. But it is a hard work, many factors need to be considered.

8. Reference

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