Robocup 2016 – Rescue Simulation League Team Description <R.A.S-Roshd (Iran)>

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Abstract. This paper illustrates the main characteristics of R.A.S-Roshd rescue simulation team for this year competition. For this event, we collected our experiences from last IranOpen competition and we follow last international match results in China to gather useful strategies of other teams. At first step we manipulate our last strategies and develop new one. According to the rules, using other team's source code is allowable, so our team use S.O.S source code which published after Brazil competition. At second step, We focused on multi-agent competition that hold last year for the first time. In this way we handle our strategies in greedy algorithm, this algorithm seems to be great one among the others. Because of restriction in TDP pages, we demonstrate main strategies of RAS-Roshd team.

1. Introduction

Robocup Rescue Simulation is a competition and researchment to develop a professional method of Robotics for search and rescue during natural disaster like earthquake and Tsunami. This idea was created from a terrible earhquak in Japan. In this way, the RoboCup Rescue Simulation league decide to hold a challenge to motivate students for researching to design virtual robots to solve this problem, or to build real autonomous robots, which are evaluated in specially designed rescue simulations.

R.A.S-Roshd team has been participated in IranOpen Competition for two years. In last year competition we occupied 5th ranked among all team in IranOpen. After that we qualified for national competition in china, unfortunately because of some registeration issues, we couldnot participate in it. In this year we are really hopeful to become accepted for robocup challenge.

2. Cluster

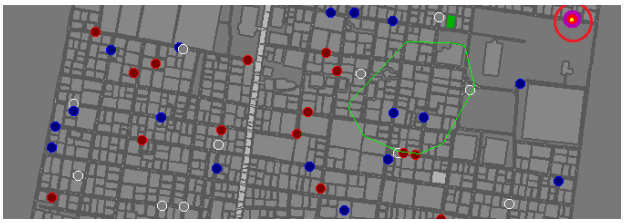
It is common in all metropolis that city is divided to smaller regions and certain number of facilities like ambulance, fire brigade and police are belong to every regions. Last year we divided all maps to 9 section and this method was not very helpful because of this reasons:

1- Size of the map did not have any effects of clusters.
2- Map of the city was not rectangular thus some regions did not have any building or civilian.
3- Distribution of the agents to the map was not logical.

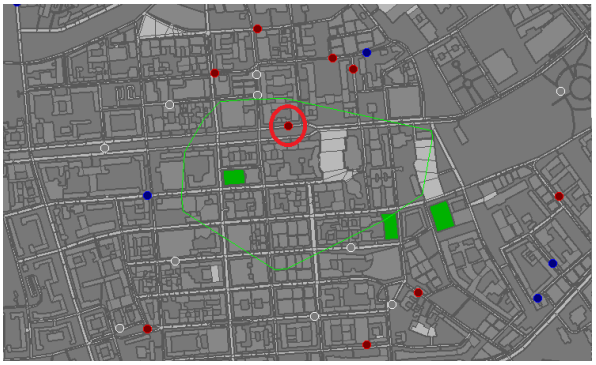
In this year we modify our mistake and use kmeans algorithm[3] to organize clusters of the map, Kmeans algorithm have some advantages like:

- Distribution of agents to the sections is according to their numbers and number of buildings.
- Size of the map increase the number of the clusters and we can handle all place of map more easily.

Figure(1) and figure(2) shows the clusters of ambulance team in Mexico and Berlin, it is obvious that the size of cluster is variable.



Figure(1): Example of cluster in Mexico



Figure(2): Example of cluster in Berlin

3. Search state

Search task has a huge effect on performance of all agents during cycles, finding the site of civilian and fire is significant in first cycles of challenge, thus we depict our

strategy in this state before agent's strategy. To handle this state in best way, we develop 3 different search state akin to Fire Search[2], Civilian Search and Random Search.

3.1. Fire Search

This state is most important among others, because if an agent find the fire site at beginning of the ignition, it will announce to fire brigade rapidly and they can extinguish it before fire distribute to the map. For this state we define this process:

1- Put visible building of agents in arraylist,
2- If any of the visible building has temperature more than 10 degree,
3- Agent will discard its action and move to the building to find the fire.
4- When an agent move to building, its visible building will be change every cycle and the agent choose highest temperature building as target.
5- Agent will move to high temperature building until it find the fire location and sending message to fire brigades.
6- In this process, if any fire zone is reported in their clusters. Agent will seems that the high temperature building is effect of firezone and will not follow the high temperature buildings.

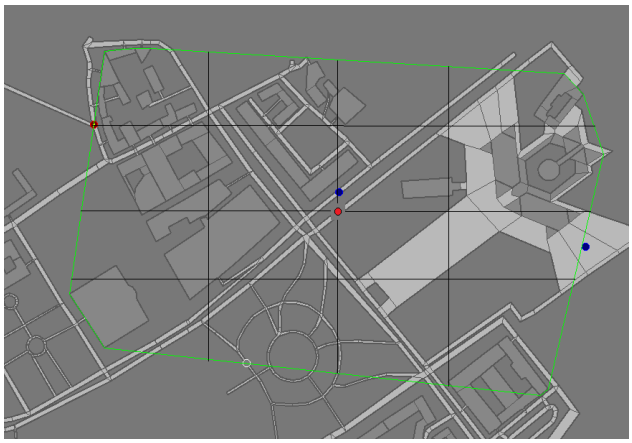


Figure (3): police fire search

Figure(3) shows the fire search task of police forces after precompute task. In this task, one cluster is divided to 16 sections and police will move tho node of this graph. This search state help us to find fire site more easily. During this task, if an police agent feels temperature on building, the above fire search algorithm will run rapidly.

3.2. Civilian Search

In maps we have 2 kinds of civilians, first one is located in roads and they could to arrive themselves to refugees, this state is not related to this kinds of civilians. This state is concern to the civilians that are in building and their building is blocked by blockade. Fire brigade and ambulances cannot reduce blockade thus we devolve this state to police force, police force should check all of buildings entrance which are located in their cluster. Ambulance and fire brigade will help police force if they did

not have other task and there is no blockade in entrance of buildings. It is necessary to mention that, all of building of one cluster will be checked only one time.

3.3. Random Search

This state is the last one among all of other agents, this state will run if agent does not have any other task and it will search their cluster randomly. in this state we develop a unlimited loop that all agents goes to road that is the minimum update time in their clusters.

4. Agent

4.1 Police force agent

Initial task of police force is surviving other agents that are stuck in the blockades. As follows RAS develop a method to do this task in short period of time, the process of this task is illustrated here:

- Define x:

$$x = \frac{number\ of\ fire\ brigade + Ambulane + Refuge}{number\ of\ Police\ forces}$$

- Define average distance d:

$$d = \frac{Average\ distance\ of\ agents\ Exclusive\ of\ Police}{number\ of\ agents\ Exclusive\ of\ Police}$$

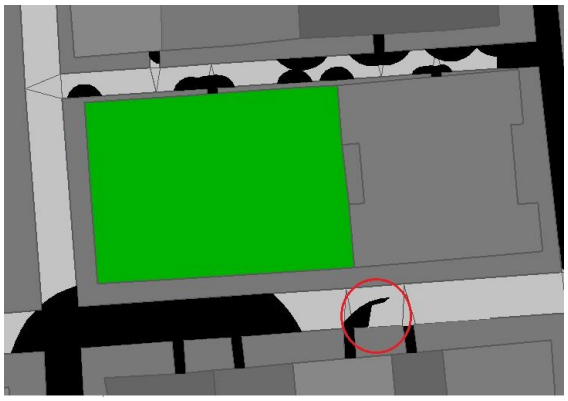
- Develop a loop to find the agents which their distance to each other is lower than d,
- Assign a the nearest police force to these agents that are near to each other.
- The maximum number of agents are assigned to a police force is not higher than x.

This way of rescuing agents is tested in two different competition and the performance of this method evaluated positive on all of the map. This method make free some police forces to do search task at beginning cycles.

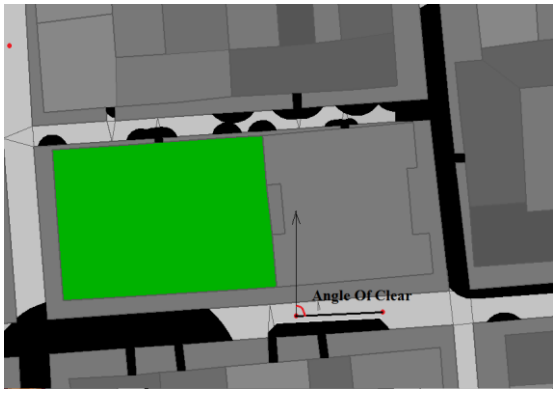
After this task, police forces will divided to their clusters and they will do their common task like fire search, civilian search, open fire zone and etc.

Police force agent has the most effective tasks in challenge, one of this important task is clearing blockade. It was obvious in last year competition that there is a sharp blockade in the road like figure(4), this sharp blockade will make problem in movement of other agent. Thus we decide to create a new method to prevent this event during challenge, in this point of view we add two function:

1- Police agent is forced to check the road which is clear by it self and if it feel some sharp edge or problem in movement, police will send clear task again.
2- In other way police force calculate the angle of two roads than it clear blockade according to this angle, this angle help police force to prevent from creating sharp edge. (figure (5))



Figure(4): sharp blockade in the road



Figure(5): using road angle to clear blockade

4.2 Fire brigade team

Fire brigade are assigned to cluster like police force agents but the percent of free & cluster fire brigade is different.

Building Selector

The most significant parameter in handling of fire brigade is selection of building to extinguish. Hence we spend most of our time on developing a method to select best building and we express our experience in last year competition. Last year we use 4 easy parameter to select building akin to:

1- Fieryness of building
2- Distance of building to agent
3- Distance of building to map center
4- Temperature of building

From last year competition we realize that parameter 3 is not suitable for fire zones that are near the map center, hence we decide to remove this parameter. Parameter 2 prevent from excess moving of agent before extinguishing of building but the high score of it lead to slow motion of agent.

In total it doesn't go well so we decided to add and edit some parameters like:

1- Fieryness of building
2- Fire building location
3- Search extinguished Fire zone
4- Fiery building bulk
5- I.F.N.T.G.S

fire brigade duty explains:

1. fieryness of building we leveled building temperature in 4 different ways: 1. normal (not on fire / doesn't have any color) in situation number 1 fire bridge leave that building and keep doing his routine job if we had situation number 2 and 3 fire bridge should go turn it off but if situation number 2 and 3 were near each other the one that is getting hot (situation number 2) is more important than the hot one (situation number 3) so our fire brigades first have to extinguish the one thats getting hot.

2. Fire building location

This parameter is one of the important ones and I gonna tell you why.

If the fire was in corners of a map is more manageable than the on thats in the center of the map because when fire is in the center it could go many different ways and burn everything in a sec but the ones that are in the corner it have less ways to burn and destroy things.

5. Search extinguished Fire zone[1]

we decided to level up our firefighter skills to whole new level so we gave them a duty to all of them that if they put out the fire in a fire zone , every firefighter of cluster must go and look around the extinguished building to check and getting information about the 5 neighbors of the last building that is extinguished could they find another fire but the others are allowed to do their routine jobs. When our fire agent gets sure about the neighbors that they had checked they can do their routine jobs too.

4. fire building bulk

when we wants to control the fire we most pay attention for some important things

like how big is the fire, where is the fire in the map, is the building near the gas station And ...

In these questions now we want to talk about how big is the fire?

about that we tell our agent to look around and find the biggest fiery building in the fire zone after that they must go and extinguish the biggest building thats is on fire. When the big one extinguished they must start to extinguish the biggest in ones thats stills on fire and its fieryness is 1.You might think of a question thats take a long time to extinguish a bigger fire than a smaller fire BUT the bigger one gonna damage his neighbors more than the smaller one Or if you extinguish a smaller fire and one of his neighbors is bigger and is on fire, when the smaller one extinguished the bigger one will ignite again. Indeed you are waisting your time that is going to cost you very bad things. In this way, at beginning of competition we determine big building of the map, figure(6) shows the big building in map with green color in Berlin map and we utilize this data during extinguishing fire site.

Figure(6): big building of map[1]

5. I.F.N.T.G.S

"I.F.N.T.G.S" is contraction that means IS FIRE NEAR THE GAS STATION in this case everyone knows thats fire and gas station together is very dangerous in real life. The point is this could be a real life too. so we force our firefighter to watch out for these two things when they are close to each other. If had this situation on our map and our agent find and see it, they stop what ever that they are doing and immediately go and extinguish it first, then after they make sure that there are no fire anymore although in the extinguished neighbors. BUT If the fire was too close to the gas station and had a high temperature agents must run away, and leave it alone. Figure(7) shows the example work of fire brigade to extinguish building.

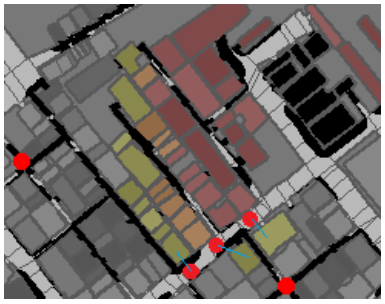
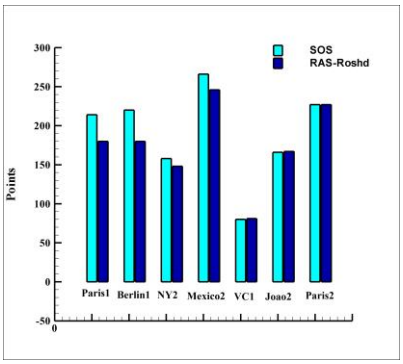


Figure (7): sample configuration of fire bridges to extinguish fiery building

4.3 Results

After programing strategies that mentioned in this paper, we evaluate our code with SOS in last year competition in China. We run about 7 maps of semi final challenge and draw a graph(figure(8)) to realize our weakness. Figure(8) depicts our code problem in fiery and low communication maps and in Ambulance map we did not achieve lower points than SOS.

[1] Big building = the total area of building is more than average area of all building



Figure(8) : Result

6. References

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[6]Farshid Faraji, Robocup Rescue Agent Simulation Agent Competotion, Rules and setup, 2014