Message Management System in SBCe_Saviour Team

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Abstract. This paper describes the implementation of rescue agents. Each agent chooses a target then it finds the shortest path using dijkstra algorithm to reach its target. Police forces use Q-learning Algorithm [2] [3] to find the most important roads to be cleared. To minimize the number of lost messages, we use a central message management system. To perform this management we consider a virtual center which coordinates the stations.

1 Introduction

In present time, with the incoming of hi-tech communication services, the moral communication between human beings for survival takes a new step to a whole new world. For this reason, Robocup Rescue [1] which is a branch of Robocup stepped into the world.

In general we have three types of agents:

- Fire Brigade Agent
- Police Force Agent
- Ambulance Team Agent

The police duty is opening up roads blocked by debris and fire brigades duty is to put out fire to diminish the damage as far as possible. The ambulance duty is to rescue individuals from beneath the debris and transfer them to refuge. If the three teams can cooperate with each other well, the number of rescued civilians increase and the rate of damage decrease.

Our paper consists of five sections. In following section we explain Fire Brigades' behavior to extinguish burning buildings. Afterwards we study the algorithms used by police forces to find the most important roads to be cleared. So they would make transportation easier. Section four talks about the ambulance team and the methods they use to choose a victim to help. In section five we describe a central message management system that determines which message should be sent to other stations or

agents. Finally we explain route planning that helps agents to find an appropriate path to their targets.

2   Fire Brigade Agents

The main duty of Fire Brigades is to extinguish the fires caused by the earthquakes.
To do it more efficiently we use a central control system for the fire brigades. This system coordinates the fire brigades' actions. Each fire brigade's decision is based on its location, number of fire brigades around and its inner state.

Each fire brigade chooses an area and decides about the amount of water and the number of nozzles to extinguish the fire in that area. This decision is based on following parameters:

- The number of buildings on fire within a radius of 30 meters
- The water quantity required to extinguish each building
- Total water quantity
- Predicting the state of each building after pouring water on it
- Direction and speed of the wind
- Number of unburned buildings around each building

The station orders the fire brigades to put out the fire based on priority. Then fire brigades start to move in a single group or in several groups simultaneously to extinguish fires.

The station considers the following standards to assign the priority:

- The area which is on fire
- Number of captive civilians near the area on fire
- The time required to extinguish the fire
- Current time: by considering the current time it should be decided which fire should be extinguished sooner

One of the most important responsibilities of each agent is finding injured civilians and reporting their location to ambulance agents. For this reason when an agent finishes its specific responsibility, it starts searching in its own region. Reporting blocked roads is also a duty of each agent.

3   Police Force Agents

Each agent should pass through different areas of city to perform its duty. Therefore, blocked roads make the agent's work hard, or impossible. The main duty of a police is to open the roads blocked by debris.
We use Q-learning [2] [3] algorithm to implement police force agents. Polices decide about the importance of roads by using what they have learnt.
Standards which are considered for evaluating in Q-learning system are as follows:

- Distance to refuge.
- Distance to burning buildings.

- Number of civilians near building in each road.
- Number of agents in a road.
- Number of help messages received, about a certain road.

Another important parameter which influences each police's reaction is the information it receives from other polices.

Police station assigns some tasks to police forces in order to coordinate them. The station divides the city to several regions and each police will be assigned to a unique region. Each police assumes its region as a graph in which the buildings are nodes and the roads are edges. Then it examines the connectivity of the graph and starts clearing the blocked roads until the connectivity of the graph reach a value which is determined in the previous learning of the police.

In this position the police joins other polices to help them.

4 Ambulance Team Agents

The responsibility of ambulance team is to rescue the civilians and other agents from underneath the debris and to take them to refuge.

The main duty of police forces and fire brigades usually finishes in the first cycles of the rescue simulation, but the ambulance continues until the end of the simulation. So, suitable and efficient function of ambulances plays an important role in the success of the rescue process.

One of the main factors to improve the efficiency of ambulance is to be aware of the exact information about the location and priority of the ones who need help. This information can also be provided by other agents.

For choosing a victim, these parameters should be considered:
- Type of the victim (civilian or agent)
- Present state of the ambulance and victims
- The optimum number of ambulances that should be assigned to rescue a certain civilian
- Being in contact with other ambulances which are in a reasonable distance from a victim
- Estimated time to reach a victim, rescue him and take him to the refuge
- Estimating the damages which may occur to the ambulance with considering the burning buildings on its way
- Next possible chances to rescue other civilian ambulances

By considering former parameters, we can decide on the priority of the victims to be helped. After choosing the best victim, we find an optimized path to reach him. As the other agents are responsible to inform the ambulances, ambulances should also inform other agents if they face burning buildings or blocked roads.

Ambulance center plays the main role in communications between Ambulances and Agents.

5   Message Management System

To get better results from the Agent's activities, it is necessary to have a good coordination among them. So fire brigades would pour the needed amount of water on a building , police forces would make better decisions about important roads, and less civilians would die.

   To achieve this goal in addition to individual decisions of the Agents, they should have communication with other Agents to make decisions.

   To have a better communication we use a central message management system. This system is performed by the stations, in such a way that Agents can contact with each other directly just via "SAY" and any connection via "TELL" should be done trough Stations
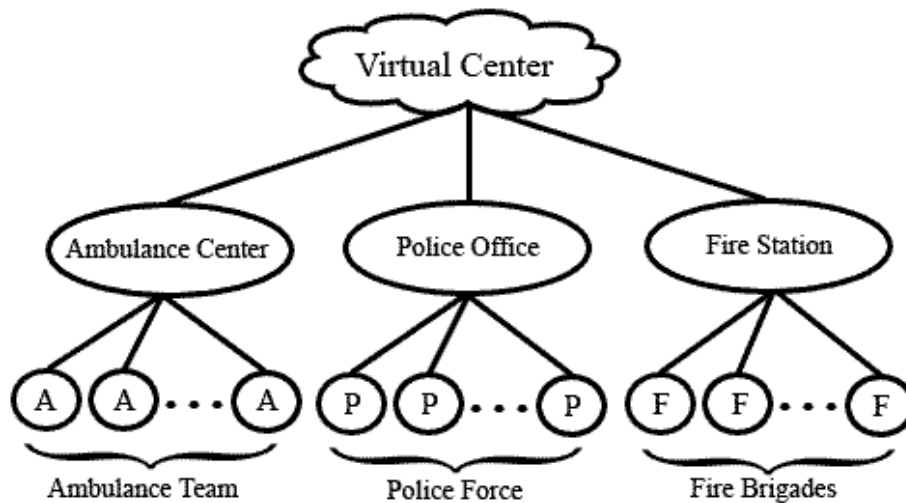

Fig. 1. Message Management System Diagram

   A virtual center is considered, which have the responsibility of coordinating Stations and all the decisions are made there. Implementation of this centre is performed in all three stations by the messages interchanging between them. The results of virtual center's actions determine the messages that each center should send to its Agents.

6   Route Planning

At the beginning of rescue simulation, each agent uses the Floyd algorithm [4] on city's map before earth-quake.

   We assign a weight function (W) to each vertex of our graph (nodes and roads) according to the number of short paths using it. In next cycles police forces use this function to decide which road should be cleared first. Other agents also use this

algorithm to determine the places which are more important in polices' view. These places are more probable to be cleared.

Each agent uses dijkstra algorithm [4], with current location as source, to find shortest paths. In calculating the weight function we add a percent of edge's last updating time to its real cost. So last updated information plays a more important role in our decisions.

7 Conclusion

Since each Agent should do many tasks in a limited time, and if these tasks aren't done properly the rescue process won't be completed successfully, priority is of great importance. For this reason the main part of each Agent's decisions is about determining the priority of its tasks. To reach the optimized state we use learning for making decisions.

The program will find the optimized state by examining different cases. And also it should be able to adapt itself to new conditions and find the new optimized state.

For making decisions about the priority of tasks, the most important parameter is having updated information about current state.

Any Agent is only aware of a limited region around it; therefore it should get rest of the details from other Agents.

For this reason message management is inevitable in implementation of Agents.

8 Further Work

One of the problems worth discussing is neural network. Agents are implemented on this base and in form of multilayer network. Specifications of neurons are determined by training and each agent makes the optimal decision.

References

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