

# Rescue Simulation League Team Description

<CSU\_YunLu—China >

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**Abstract.** Since we participated in the World Competition of RoboCup Rescue in 2006, we have devoted ourselves to working out a better tactic. New ideas and approaches are introduced in this paper. Our contributions to the state of art in Agent Simulation are also depicted in details. There are three parts: tasks of every kind of agents in the rescue, communication between them and strategies in the whole plan.

**Keywords:** RoboCup Rescue; communication; strategies

## 1. Introduction

Our CSU\_YunLu team have taken participate in the RoboCup Rescue competition since 2006. Through these years, we have accumulated much valuable experience.

RoboCup Rescue Simulation is about how human's live is affected by the regional disasters on a grand scale such as urban earthquakes, fires and so on. For instance, earthquakes can destroy buildings and block roads. So we puts forward all kinds of rescue strategies and aims at minimizing the destruction through the development technology others put forward[1]. What's more, every agent must cooperate with each other efficiently so that more civilians can be rescued. At the same time, the fire spread can be controlled and more losses can be avoided in human lives and properties. Therefore, this document will explain the development process of the tactics.

## 2. World Mode

Our system about agent uses a model which can be divided into three regions—the base region, the technical region and the decision region. The base region is in charge of the communication with the core of the rescue simulation server, sending messages as well as gaining visual and auditory information. The technical region is about some basic technologies including planning paths, discovering victims and predicting disasters[2]. The decision region is the pinnacle of intelligence and takes charge of the real-time decision-making according to the competition, making it the key part of the structure of agents.

Then,we can look at a picture below to help us understand better.

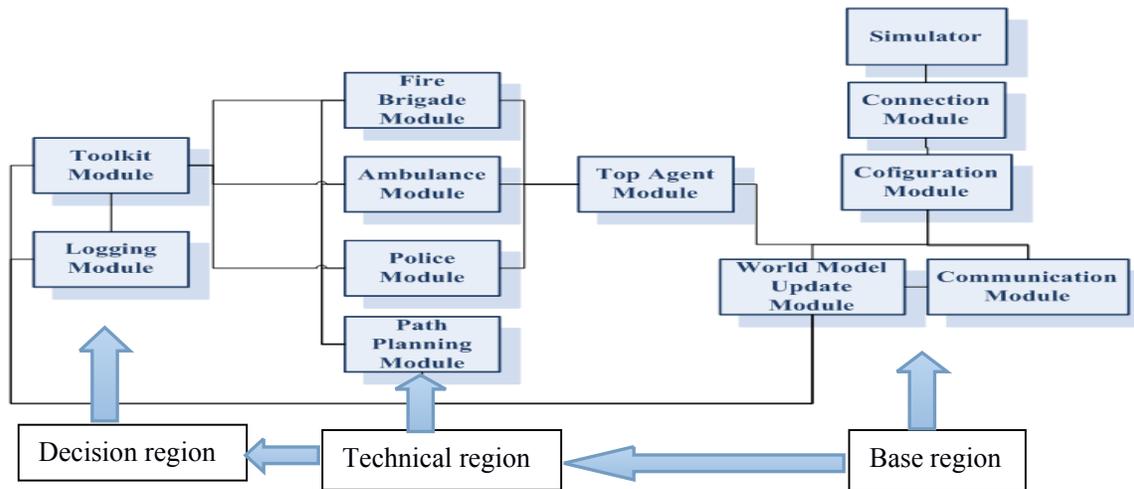


Fig.1 wordel model

### 3. Communication

A successful rescue is a result of teamwork[3]. Natural disasters such as earthquakes will lead to the occurrence of buildings collapse, roads blocked and people trapped in ruins. As a result, we must ensure cooperation between these agents. Only by realizing this, can efficiency be improved. Therefore, great communication as well as cooperation is absolutely necessary[4].

Communication between agents is a process of sending compressed information to the channel and arranging the channel. Then, the kernel handles the information and returns the related behavior. Because the bandwidth of communication channel is limited, the total length of messages sent in a channel is also limited. In order to send messages effectively, a priority queue of messages is implemented. The agent sends the message and its priority to the base region for effective communication. All these messages will be added to the priority queue. At the end of the round, the messages with the highest priority are selected. The number of selected messages depends on the length of the messages and the bandwidth. The messages will be selected when the total length of the messages does not exceed the bandwidth. Then the selected messages are sent to the kernel. The remaining messages that are left in the queue may be deleted or updated depending on their validity.

Communication is based on the fundamental way--sending messages to the channel. The channel, connected to world model, returns coping action through the technical and decision region in order to give reasonable response according to the request of agents. Thus good agent strategies can help the decision mechanism to make the most correct action choice in the shortest time and realize a better rescue.

### 4. Agent strategies

#### 4.1 Ambulance Team(AT)

Its main task as well as the top priority is to search for civilians who were trapped in the building ruins and save them, and then send them to the shelters. Among all behaviors, saving civilians is the highest priority. In all tactics, based on the original behaviors of the AT, we have also realized the following aspects.

Firstly, priorities of different tasks are optimized.

Secondly, when saving trapped civilians, the AT will first judge how far civilians are from the fire and how much serious the fire around them. When civilians are trapped in a burning building and the fire is quite fierce, which means there is low possibility to save them out, the AT will turn to search the next area for civilians so as to make the rescue more efficient.

Thirdly, when many civilians are trapped in the same area, the AT will first choose the civilian closest to it and save him, which can avoid wasting rescue time.

Finally, as only one AT's rescue of the civilians costs much time, we often find that many civilians and rescuers are burned to death or their life is significantly reduced. For this reason, we add gathering action to the AT, making ATs in each area gather together as much as possible. This can improve the rescue efficiency and avoid the above problems.

Through these excellent behaviors, we can save more civilians in the shortest time.

#### **4.2 Police Force(PF)**

Primarily, the tasks of the Police Force (PF) arise from itself, so many tasks are repeated, which wastes too much time. In the tactics, the control system of the PF's tasks is realized by the police station. In this way, repeated tasks will not appear and the work efficiency can be improved.

The PF's main task is to clear obstacles in order to quicken the pace of rescue by providing a usual road environment for ambulances and firefighters. In our tactics, priorities of police to clear obstacles are as follows:

- a. The road with obstacles which blocks agents
- b. The road to the shelters
- c. The road to the burning buildings
- d. The road to the buildings where civilians are trapped

The specific ways to clear obstacles are as follows:

Firstly, in order to make it more efficient to clear the obstacles, the PF also use the collective behavior. Owing to this, we can quickly clear a path, which can avoid the situation where all the roads are being cleared but not clear enough. So precondition is provided for ATs and firefighters.

Secondly, we set the corresponding weights and the priority arrangement according to the priorities above.

Thirdly, we use the path planning to search for the shortest path to the target spot that needs clearing.

#### **4.3 Fire Team(FT)**

The fire team's main task is to put out the fire and avoid the spread of the fire when buildings are burning. To realize this goal, the mission decision-making system needs to firstly acknowledge burning condition, so as to make reasonable arrangement of

firefighters' tasks. In the tactics, firefighters show their advantages in the following two aspects.

Firstly, when many fires begin burning at the same time, the system must decide which fires have to be put out first of all. So some standard is needed for making choices. The standard needed is what we are using now and it's connected with fire group and building group. With the calculation and judgment of these two parameters, we can find the fire which must be put out first in order to avoid its spreads to anywhere else.

Secondly, the buildings are divided into separate areas to be searched for and fires can be put out by gathering firefighters. Original tactics can only put out the fire by gathering firefighters. But fires often occur in some area while the firefighters are putting out fires in other area. Obviously, this condition will make the fires get stronger and out of control. Finally, many buildings will burn out and more civilians will be die. However, when fires are put out according to the areas they are separated in, we can make sure that every area's fire condition is under the watch of firefighters. According to this strategy, firefighters can quickly gather together and put out the fire as soon as possible.

By means of the two behaviors, firefighters can put out fires more efficiently.

## 5. Conclusion

This document introduces the structure and realization measures of our tactics[5]. Firstly, we try to create a complete and current world model based on the communication between agents. Secondly, we add some suitable actions to each agent. Finally, the decision-making system will arrange tasks to each agent based on the most supreme plan in different kinds of disaster environment.

On the way of future development, we will proceed to design good measures. An efficient cooperation team will be set up with the usage of flexible artificial intelligence methods. We must make persistent efforts to realize it.

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