Designing of Rescue Multi Agent System Based on Soft Computing Techniques

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***Abstract*—The goal of rescuer Multi agent's project is to simulate urban unpleasant incidents and events to reduce the rate of detriment of this event. The various rescuer forces attempt to do their best duties. One of the most important problems in multi agent system is communication among agents. Most of the various algorithms in multi agent system so far has share of duties, negotiation, learning and searching need to various forms of communication among agents. In the paper we attempt to rescue the most wounded using Reinforcement learning to be able to gain the shortest time.**

***Index Terms*—Multi agent system, Reinforcement learning, Cooperative, Rescue agents**

I. INTRODUCTION

This paper describes a solution for rescue management in urban unpleasant events simulation. Rescuers, include police force, medical teams and firemen, are simulated in this environment.

The scenario of the simulation is as follow. At the beginning of the simulation, an earthquake occurs in the city, destroys the buildings and causes fire. Some citizens may be buried in the rubbles or caught on fired. If the rescuers can rescue them within a certain threshold time after the incident, they will live and otherwise the victims will die. The fire spreads to other building quickly and collapse of the buildings will create trashes that may obstruct the road. As the result, the rescuer will hardly do find the path to the victim.

This type of scenario was performed in a simulation system that is Virtual sample of real world. The objective of robot rescue is to reduce destructions that are caused by fire and earth as quickly as possible and to minimize the number of causalities among the people and rescuers. In order to reduce the rate of casualties and damages, is not enough to rely on the number of operations that the rescuer, exploration teams and ambulances. It is necessary that the fireman put off fire and the police forces to remove the rubbles from the road. When a building burns in a fire, it is not only hard for the rescue operation but also risky for the health and life of the rescuers. One of the most important problems is the communication among agents in multi agent systems.

The communication can have various forms, for example it can use the effect on the environment, as an option for communication among agents. One form of indirect communication has been studied in some of insects such as ants. They communicate to each other by putting formic acid on the earth [1-2] to form indirect communication. Another way that is common among insects is the use of movements for relation. For example, they have been conveying via a bee dance [3].

In this connection, the use of artificial neural networks such that agents can get information from environment with possibility to give agents some algorithm to improve the attention to some direction in the environment [4]. They choose algorithm that agents can cooperate each other and can send useful messages through a choice of attention to the environment. Rescuer robots estimation was done using genetic algorithms that can consider their ability in put out fire in the directions operating of debris and discover places that have been affected by stronger event.

In the paper, we are trying to use of reinforcement learning algorithm to influence various parameters in communication among agents. The agents are learning by sending a kind of information and we are interested to minimize the shortest time to rescue all possible victim, similar work has been published elsewhere [5-6].

The Paper is structured as follow. In section 2 we consider the short description on robot rescue. Then in section 3 we point to discussion in area of learning. In section 4 we show the analysis by using agent tools. In section 5 we discuss the suggested algorithm. In section 6 we also explain simulation environment briefly, and in section 7 we will point to consider of simulation result.

II. RESCUER ROBOTS (MULTI AGENT)

In our simulation environment is studied the rescue method to the city after an earthquake. In this city there are agents of various and with some different. In this simulation some of houses will destroy or get fire after earthquake, some of roads are obstructed and some of members are buying under the debris. In this environment we have four exploration centers that are related to each other. Any of these centers has three robots that superintend their operation as rescue [7].

III. REINFORCEMENT LEARNING ALGORITHM (QL)

One of the common ways of learning is reinforcement learning [8-9] . In Reinforcement learning, agents do not have any recognition of it's around environment and it only learns optimum behavior with the reward that receives from environment. In reinforcement learning we define one table Q. This table must be rated at state space in return for all of

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possible acts. Any quantity shows how much agent will receive reward totally by doing of special act that achieves to end.

Updating the values of is done as: agent does function that has highest point in Q-table. Then it updates R value equal to value of reward in addition to the highest value of R at the present state multiply γ The table defines the optimum line finally [10-13].

$$Q(state, action) = R(state, action) + \gamma.\max[Q(nextstate.allocation)] \quad (1)$$
$$0 < \gamma < 1$$

IV. Exploration of Problem Space

We use MASE (Multi agent's software engineering) for rescuer robots system analysis. This methodology applies for multi system that it provides to trades communication and graphics.

A. Goal Model

In this methodology first stage is getting of goal model that we get what we want to analyze the necessary requirements of system. According to Figure 1, all sub targets analyze to sub targets that define the works until it achieves of higher goal. Order of sub targets is according to priority that defines to gets to first goal before second goal.

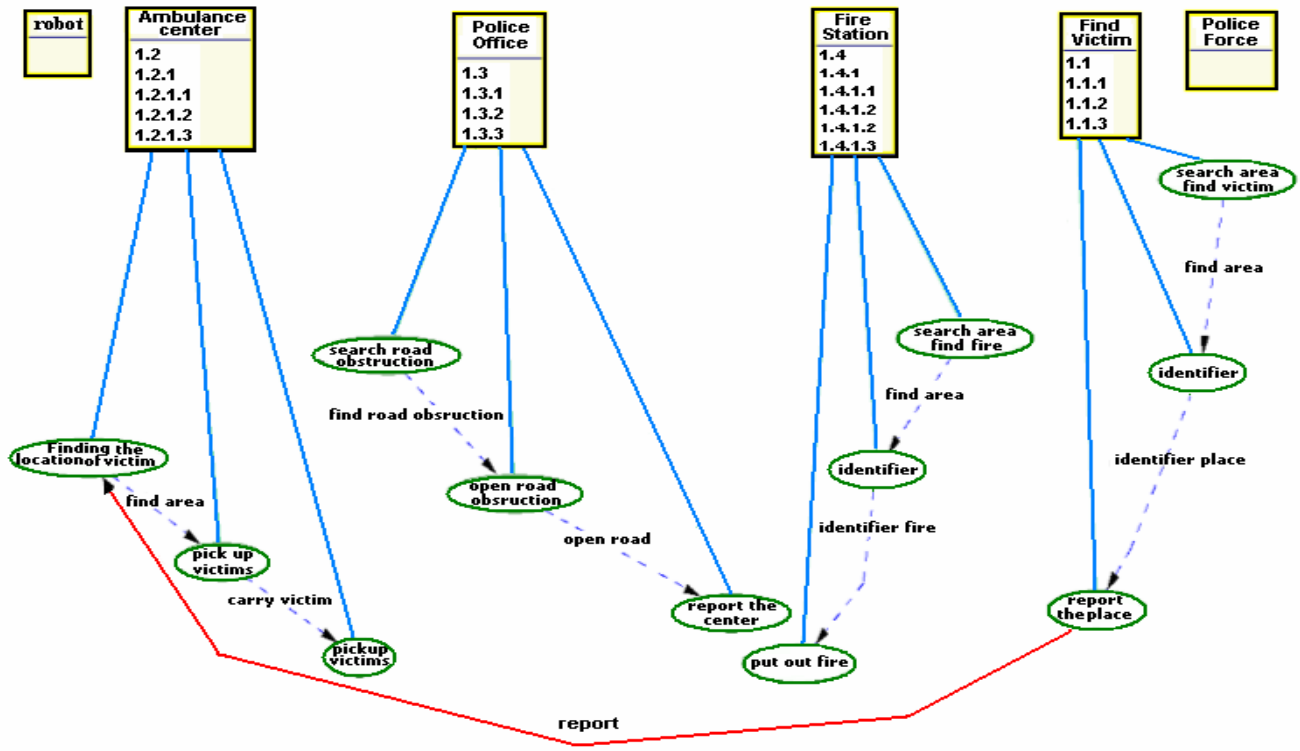

Figure 1. Role model.

We plan for victims rescue four centers. At first, victims finding center, robots send to location for search in. Robots find the wounded and consider the simulation and related report to them send to own related center. According to receipt report ambulance center from victims search center pick up wounded and carry wounded to hospital that at first, it should identify the location for achieving the purpose and then pick up victims and carry hospital. Police center sends robots to find road obstruction and open obstruction to the city area and robots send related report to their center after their operation end. Duty of fire station is find fire and for achieving their target, they send the robots to city area to put out fire and search and find fire.

B. Role model

Role model notice center is identification of necessity role and mutual effect to each other. So getting of role model part is from goal model part.

In this goal model every goal tree leaf has one role in role model part. In goal model part players are four centers that is defined their relations and roles as shown in figure 2 such that the relation among ambulance center and victim search center that search group gives ambulance groups the wounded location report after their works would end.

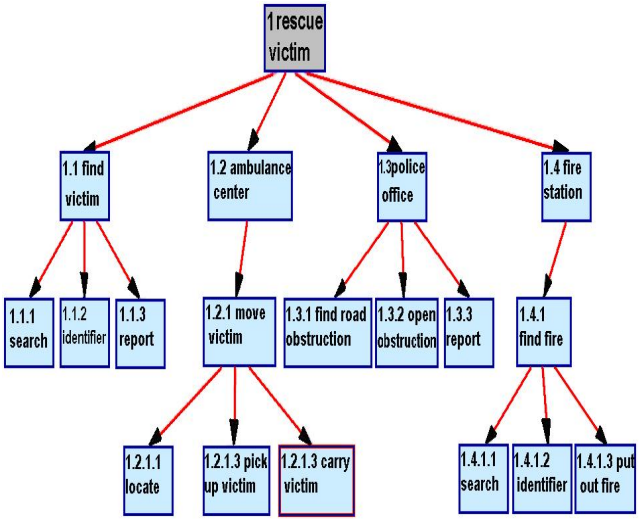

Figure 2. Goal Model.

C. Agent template diagram

When roles defined completes the ways of their analysis and analysis model changes an exact design model that equal to download the goal of this part is exploration of role model that its included to download. For each function roles are defined in figure 3. The agent is located to class body and we actually classify by agents.

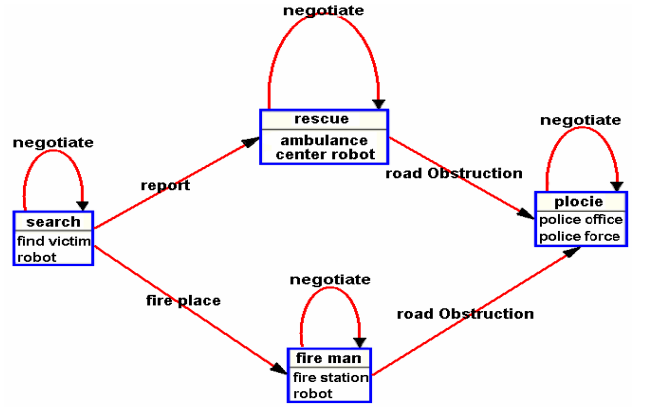

Figure 3. Agent template diagram.

D. Sequence diagram

In this part we define briefly the roles have in role model part and we show that the messages transfer between agents. Ambulance center victims search and police and fireman are related in figure 4.

Finding victim center after reporting receive send it to the ambulance center and while if it receipt from fire place or from its robot, it will authorize fire station.

When fire station receives a report about roads obstruction from robots and it informs police center that act for opening roads obstruction in the place where fire has stronger, it is possible there is more wounded and thus ensure related report to that place.

If ambulance center receives report from the robots related to road obstruction, ambulance center reports it to police center. After opening roads obstruction the police center reports it to submit the center that they had request for opening road after earthquake event, roads are obstructed in consequence of destroyed building and trashes, as a result police forces coming and going will be done difficulty , so it is necessary the roads opening by police force.

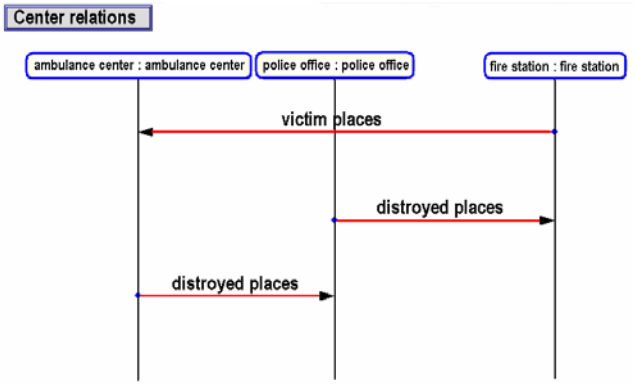

Figure 4. Seq diagram.

One report gives police center and if agents need to pass from environment. According to figure 5, the center selects their forces for opening road obstruction and the way of roads selection is selection of streets that they are in police center part and have the most coming and going.

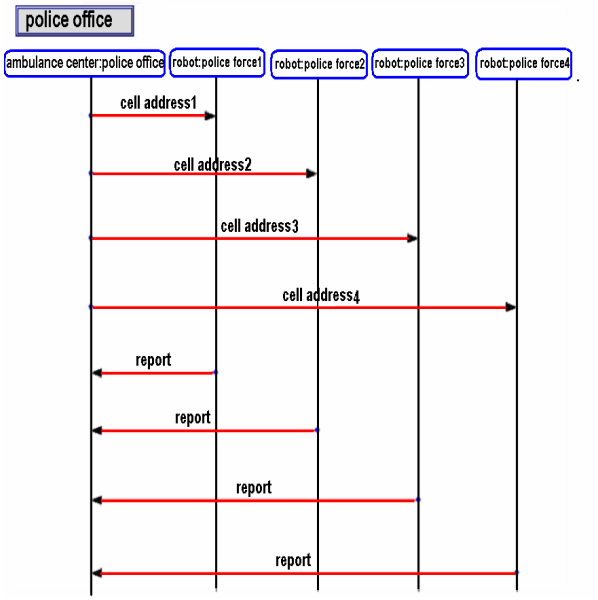

Figure 5. Police Seq diagram.

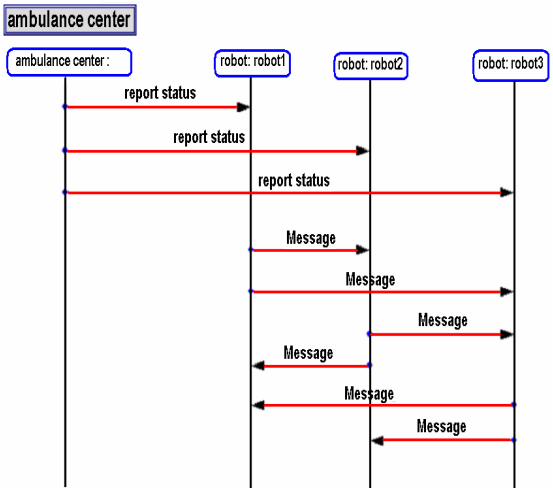

Figure 6. Ambulance Seq diagram.

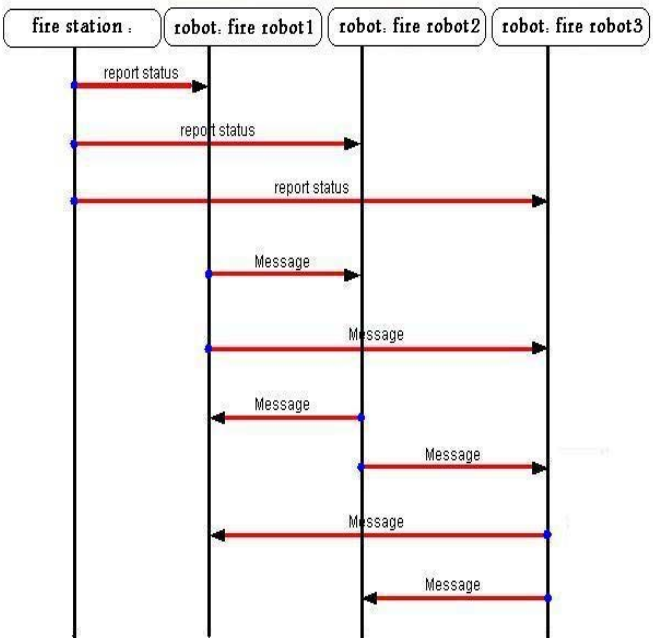

Figure 7. Fire station Seq diagram.

Ambulance robot three supposes that related report to injured place to robots and they being to doing operation. While the robots relate to each other .according to figure7 fire station decides to put out fire and determines to send to each area some fire men. At first, the center chooses to plan the fire area by helicopter and sends the closest unit. When fire reports to other centers, the center considers robots to put out fire.

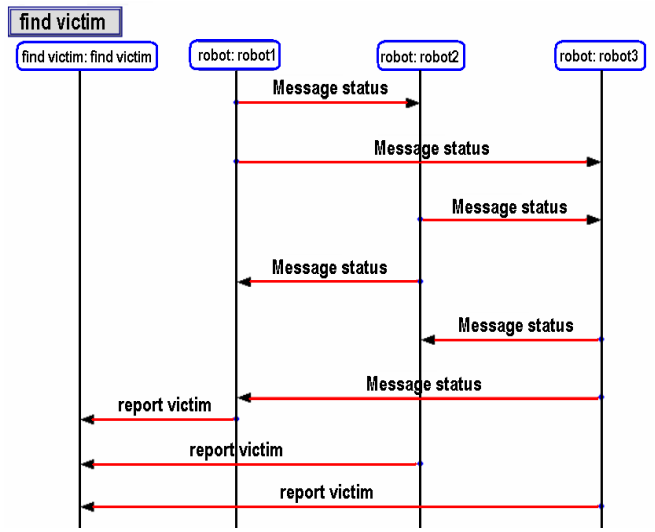

Figure 8. Search center Seq diagram.

According to Figure 8, when search robots put in our supposed environment, which it includes aisle with 6 rooms and have its related plan that begins to search for use of reinforcement learning algorithm. They give other robots messages about the location place when robots locate in one environment, until prevents from interference in works.

The view scopes of robots are 30 meter. The robot put in the aisle, it measures aisle space 10*18*10 meter and related report gives the center about the number of their wounded and percentage of injuries. Another robot two the wounded and percentage of injuries submit the center.

V. Propose Methods

The robot puts in aisle and robots begin to search for rooms. They put the number of finding wounded in the table and the percentage of injuries put in matrix individually.The wounded are dying they define by 3 degree and give them 100 point and the wounded that have percentage of great injuries but there isn't death danger for them with 2 degree and 10 point and the wounded with less hurt determine to 1 degree and 1 point.

In related graph (Figure 9) we give 100 point to each place that it has 3 degree and in other estimates laces of b, c, d and we define the place of the wounded degrees to related reward. Then we find related reward to each with the use of mention formula in section 3. According to reward that we gave edges ‹discerningly is like below that it given ambulance robots.

A→C→C→B→B→B→A→A→A→D

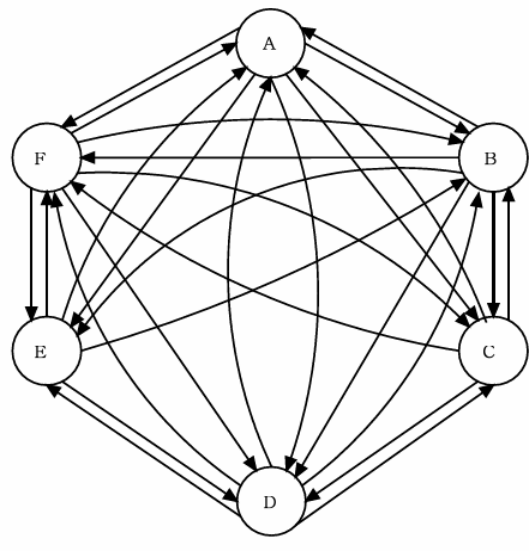

Figure 9. Related graph.

VI. Simulation Environment

We chose our simulation environment because of object oriented and capability of graphic that it is called c++ environment and our robots considered as objects that being to search or part of building and its output is number of the wounded and percentage of hurts.

VII. Results

In this paper some of different discussions have been thought by using of reinforcement learning Between agents. Also getting results the learning was considered to finding of the most wounded in the simulation environment of rescuer robots. In the simulation the effect of optimum communication can see to import of one group agents cooperation victims rescue. The number of finding wounded has shown fig10 each cell by searching robots in comparison with traditional methods has been optimized and it finds more wounded at the shorter time. But it reduces at the some of cells that its reason can know environment unequal simulation, indetermination in environment and produce different result on agent's behavior.

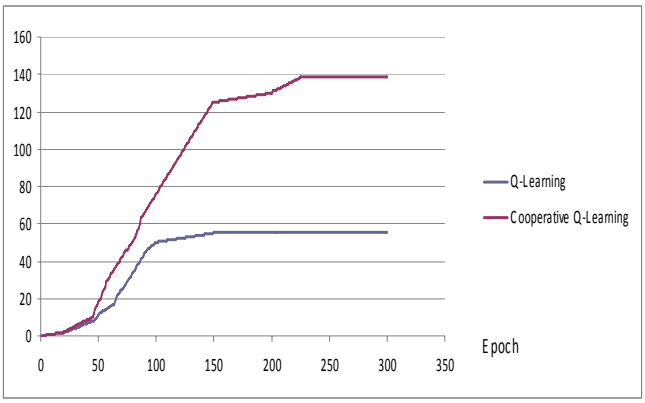

Figure10. Result of simulation with and without Qlearning.

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