RoboCup 2017
Rescue Simulation League Team Description
LarvicSaurus (Perú)

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Abstract

This document describes the algorithms and the strategies used by the LarvicSaurus team and our contributions too the Rescue Simulation Agent Competition. In this year has been made new changes in the code completely. Since the ADF has been started. Therefore, we do not focus on three fundamental modules clustering, path planning and target selector. Making modifications to some techniques like A* and a new clustering based on hierarchies that will be explained in this document.

1 Introduction

Peru is a country that had suffered a large number of earthquakes through the time, as all its shore is touching the Pacific Ring of Fire. Among the cities that had registered the largest amount of seismic activity, is our city, Arequipa. It was because of that we were motivated in participate in prevention of these natural disaster by learning and developing technology that could help predicting them and giving directions on possible actions courses. The LarvicSaurus team began as an investigation group in this area in the year 2014 and its currently conformed by students and graduates of the main universities of Arequipa [3].

The LarvicSaurus team was one of the teams accepted for competition Robocup Rescue Simulation Agents in 2015, which was held in Hefei, China. However, for reasons beyond the control of the team members, could not participate. Later in the same year, the team participated in the Latin American Robotics Competition LARC XIV 2015, in the city of Uberlandia, Brazil, where LarvicSaurus won first place in the category Robocup Rescue Simulation Agents [1].

Later participated in the competition IranOpen 2016, achieving reach the semifinals. Throughout the different competitions the team has increased their motivation to continue improving our work, sharing and exchanging knowledge and experiences with other teams. Our goal as a team is to support the development of technology for mitigation of mass disasters. This year, we are returning to the Latin American Robotics Competition with the objective of keep on our improvement in this research.

2 Modules

Then we will observe the different modules that have implemented as a team. Each of these modules will have a brief description of them.

2.1 Clustering

The clustering of the different entities present in the simulator is a very important task, as it can determine which agents impact what zones. This is specially important when we have a low number of agents and these need to be distributed accordingly across the territory to maximize results.

The main strategy for the clustering of the entities in the precomputation phase has always been focused on the specialization of the clustering per agent, as each type of agent can have a different number of implementations and different goals: As is known, Fire Brigade agents focus more on buildings and refuges, so they can extinguish fire and refill their tanks respectively. Ambulance Teams agents are omerfocused on people and to take them to the refuges, and Police Force agents are more focused on cleaning the blockages to clear the roads.

The first strategy that was implemented was simply based on the K-Means++ algorithm, taking different entities for every type of agent.

The second strategy was based on the application of coefficients to impact the calculation of the distance between the centers calculated by the K-Means++ algorithm and the entities, giving more weight to some important entities for each agent and a lower weight for the other ones. The way priorities were taken into account can be seen at Table 1

Table 1: Priorities per Agent-Type

Entity URN	Fire Brigade Priority	Police Force Priority	Ambulance Team Priority
BUILDING	Medium	Low	Low
REFUGE	High	Low	Medium-High
HYDRANT	Medium-High	Low	Low
GAS_STATION	High	Low	Low
ROAD	Medium-Low	High	Medium-Low
AMBULANCE_TEAM	Low	Low	Medium-High
FIRE_BRIGADE	Medium-Low	Low	Medium-High
POLICE_FORCE	Low	Medium-Low	Medium-High
AMBULANCE_CENTRE	Low	Low	Medium-Low
FIRE_STATION	Medium-Low	Low	Low
POLICE_OFFICE	Low	Medium-Low	Low

The third and final strategy is based in the application of a hierarchy of two levels, making a first clustering level based in some particular entities per agent and then clusterizing the rest of the map based on the result of that previous level. The hierarchy is indicated as it follows:

- Ambulance Team:
  - First Level: Refuges
  - Second Level: Buildings and Other Agents
- Fire Brigade:
  - First Level: Refuges and Hydrants
  - Second Level: Buildings and Gas Stations
- Police Force:
  - First Level: Refuges
  - Second Level: Roads

2.2 Path Planning

In this module, we implemented two different path planning. The first algorithm has been A*, which is a static algorithm to solve the problem of finding the shortest path, which it depends a lot on the objective that you want to reach in the shortest time [2].

Then we made a modification of the A * with weights in which weights of the ambulance, firefighters and police. Which is defined first with the ambulance agent as $\alpha * ambulance * victim\_weight$, the firefighters are given by $\beta * firefighter * burning\_weight$ and finally the police force with $\gamma * police * obstruction\_weight$.

In this modification depends on each agent, the probabilities of $\alpha, ambulance, \beta$, $firefighter, \gamma$ and $police$. Improves outcomes, for example, a police officer must unlock the road that goes to a refuge other than that it will not provide a significant improvement to the outcome.

With the same example above, the algorithm uses the different ways to reach the target that is the refuge, but taking into account that it can release in that way, that is to say, if the roads have a victim or fire, it has greater weight for it to be unlocked that way. This way you can go to a goal while releasing the sub-objectives.

2.3 Target Allocators

Extraction of characteristics that can be obtained from the simulator such as HP, damage, buriedness and other characteristics. In order to use them for the selection of objectives according to the tasks of each agent.

In the case of firefighters, priority is given to extinguishing fires that are located near agent's centers, refuges and gas stations, the latter in order to prevent a strong expansion of fire. It Knowing the tasks and priorities of this agent, proceed to select the buildings objectives taking into account their temperature and the amount of water that has to deal with the fire, having at least 20% of the water capacity.

In the case of the ambulance agent, whose priority is to save civilians and agents, to take them to the nearest refuge. For this, you must select the civil objective or agent taking into account its HP and buriedness (that buried this). Your HP should not be less than 30%.

In the case of the police agent their main priority is to clear blocked paths from the map in which they are working and so other agents can move around the map and achieve their tasks.

Objectives	**Parameters**		
	Min	**Max**	**Percentage**
Buriedness Value	0	200	10%
Damage value of an injury due to collapse	0	10 000	20%
Damage value of a fire injury	0	10 000	20%
Value of HP's level of civilian health	0	10 000	30%

3 Preliminary Results

Our results have compared with the teams that participated in the IranOpen 2017, since this year it has only been mandatory to compete with the ADF. The MRL team has been chosen for its trajectory, the ApolloRescue team, since besides its trajectory and this year it has obtained the third place in the competition. Finally, we have the team RoboAKUT, since it has been the first place of the competition.

Team	**Map**				
	Kobe1	**Paris1**	**Istanbul1**	**Eindhoven1**	**VC1**
LarvicSaurus	85.47	154.63	115.1	101.85	76.75
MRL	84.48	157.79	125.65	105.75	84.50
ApolloRescue	52.76	206.36	121.69	99.38	43.34
RoboAKUT	87.52	164.26	116.69	84.88	72.31

There has also been testing of the last day that has been made in IranOpen 2017. So, it has been compared with the teams that have obtained the top three positions. We can observe these results in the following table:

Team	**Map**		
	Eindhoven2	**Mexico3**	**Berlin2**
LarvicSaurus	121.71	72.12	200.52
ApolloRescue	126.50	50.32	180.20
RoboAKUT	129.54	86.57	179.93
A.T.F.	121.51	77.90	174.19

References

[1] T. Kohonen. Self-organizing maps. *Springer Science and Business Media*, 30, 2001.

[2] N. J. Nilsson P. E. Hart and B. Raphael. A formal basis for the heuristic determination of minimum cost paths. *IEEE Transactions on Systems, Science, and Cybernetics*, SSC-4(2):100–107, 1968.

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