

Allameh Tabatabaei Team Description Paper

RoboCup 2018 Rescue Virtual Robot League

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Abstract. In this essay we are trying to demonstrate the preparations of AllamehTabatabaei team to take part in RoboCup 2018 Rescue Simulation League, Virtual Robot Competition. Due to the changes that have been made by RoboCup team this year, we have used some specific algorithms with also using Gazebo and ROS together to have a simulated environment to get the best result out of this competition.

Keywords: RoboCup, Iran Open, Virtual Robot, Gazebo Simulation, ROS Kinetic, Navigation, Multi-Agent, SLAM.

1-Introduction

In the whole world the fastest way to rescue lives is using something that does not exist such as robots that are autonomous and have been coded by humans. Nowadays the usage of robots in natural disasters is more needed. In this league we are supposed to code for those robots, in a simulated area. Every team can use its own algorithms to get the best result.

In this team description paper we are going to show the algorithms that are used by AllamehTabatabaei team. AllamehTabatabaei institute participated in IranOpen 2017 and RoboCups Rescue agent league in RoboCups2017 Nagoya, Japan.

2-System Architecture

As an OS we have used Ubuntu 16.04. Gazebo is used for our simulation due to the rules. Teams can use Robot Operating System (ROS) to create better modules for SLAM, navigation, etc. to develop a suitable program to manage multi robots. Because of the first time participation in this league, we couldn't have our own base code so we used the SOS newest base code. We had to make some changes in this code with some algorithms that were coded by team members so the robot can get the most out of competition. We used the Pioneer 3AT (P3AT) [Fig.1] model as a robot. For sensors RGBD camera, laser scanner and odometer sensors have been used.



Fig.1. P3AT robot model

3-Mapping

SLAM is considered as the fundamental problem for robots to become truly autonomous. The goal of the process is using the environment to update the position of the robot. So that's why we used SLAM packages.

3.1-Map Merging

Map merging is a necessary thing for multi-agent based robots. When robots move, they make a 2d map that can help us. Map merger gets all the maps that were collected by robots from their laser sensor and merges them and makes a main map that all the robots can use it. So the robots never go to the place that another robot is already there. This can speed up the process of finding victims, so, robots focus on places that they haven't been to already and it increases the chance of finding a victim.

The merge algorithm plays a main role in the merge sort algorithm. It's crucial that robots send their map as it is and of course, it should be fast. In fig.2 you can see an example of merging two maps by two different robots.

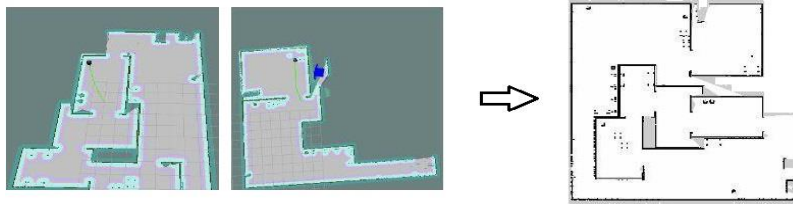


Fig.2.Map Merging example

4-Victim detection

The most challenging part for us was making the best algorithm for the victim detection. Because it has the great role for reaching the result that takes us to another level. For this part we took Histograms of Oriented Gradient (HOG) algorithm fig.3.This algorithm was used by our team therefore we can enable our RGB camera to dedicate the things between humans and other things we could have only use thermal sensor but in that way, we couldn't recognize dead humans. This matter can reduce our score because the other thing for getting scores was finding the dead humans. This algorithm will make our robot autonomously in detecting victims.

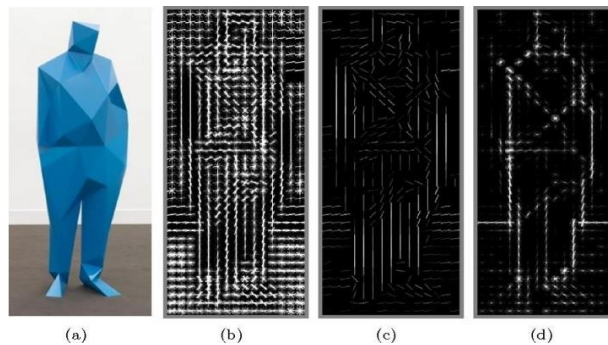


Fig. 3. HOG algorithm results

5-Navigation

For any robot that is in an unknown environment it's crucial to find a way to get to the goal. The goal is to search the map for humans, dead or alive bodies, by using ROS navigation packages we can get to our goals faster. ROS can be used by all teams so the navigation packages are necessary to run our code. In fig.4 the flowchart of the navigation and localization has been shown.

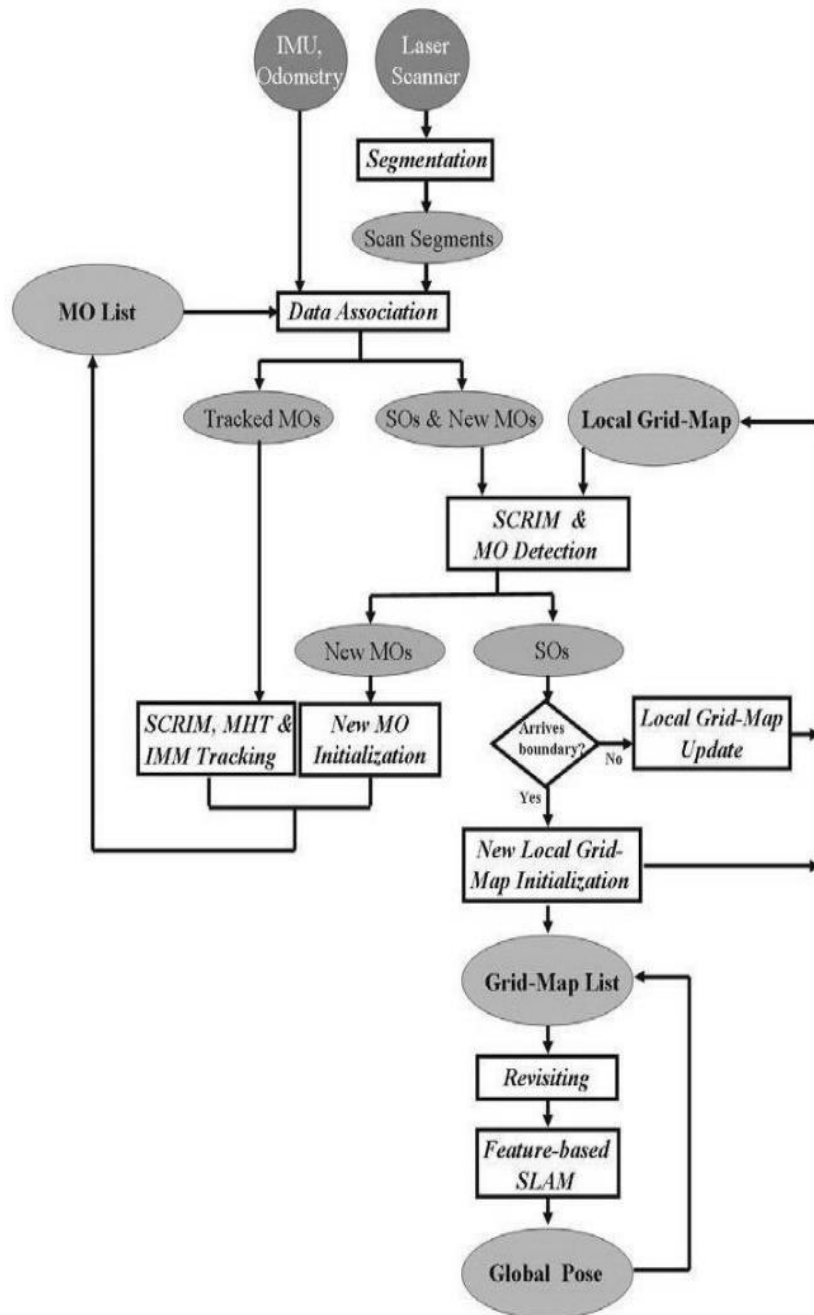


Fig. 4. Flowchart for localization and mapping

6-Sensors

In this part, we are talking about one of the valuable things that is used in many robots, mean sensors. A robot without sensors can't do many things but by adding them to the robot, we achieve our goals easier.

6.1-Laser scanner

Laser scanner has a high accuracy in scanning the map. This sensor can also give us some information about map in 240 angles wide. It is same as ultrasonic sensors but one of the important difference is that this sensor can detect unknown places because it can check in high length radius.

6.2-Thermal sensor

We use thermal sensor to detect the victim's body heat, but there is an important problem with detecting dead humans. The problem is that dead human's body doesn't have enough heat to be detected by thermal sensor.

6.3-Odometer sensor

Imagine a robot going forward in an environment. By using odometer sensor, we can recognize how much it has been going forward. It measures how many times the wheels have been rotated and if it knows it's wheels diameter, it can calculate its wheel scircumference and also calculate how much distance it has traveled.

6.4-RGB camera

This camera has been used because thermal sensor can't detect dead humans as it is said in 6.2. It detects victims face in range of it. It might see the victims face but in far places, it can't detect if it's a face or not. So it's better to be used in close range.

6.5-Ultrasonics

We use ultrasonic sensor to recognize the distance between robot and wall or any obstacles in order to avoid accidently hitting them. We use ultrasonic more than laser scanner because laser would get through some materials such as glass so we can't find out our distance from obstacles which are made by those materials but ultrasonic uses sound waves that wouldn't pass through anything and we can find the distance.

6.6-Statesensor

The State sensor reports the robot's state. Basically, it just checks the robot's state in the Unreal engine and then sends it out

7-Our goals

Nowadays the usage of robots is going to be increased and they're getting smarter and better. Our goal for next years is to improve our robots to be faster and more accurate. For this purpose, we should make our own base code and try to code there. Also, we had some difficulties, like we can't recognize moving and shouting victims but we're going to develop our robot to find and rescue them for the next year. The other problem was to use SLAM and Gmapping to build a map for every robot and merge them into one universal map.

8-Conclusion

This year was our first time of participating in this league. We are not competing for getting a great rank, our purpose of competing is to get experience for future. Also this competition is best for learning team work. Sometimes it might be stressful to manage the matters, but we can overcome the difficulties with help of others and their hope on us.

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3-HOG

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