A.T.R.T Team Description Paper

Robocup 2018 Rescue Virtual Robot League

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Abstract. In this article we are trying to introduce the preparations of Andishe Mehr ATRT tea to compete in Robocup 2018 Rescue Simulation League Virtual Robot Competition. We have concentrated on the victims and tried to familiarize our virtual robot with maps with pre-designing different moods using gazebo as virtual environment hence we can have the foremost idea because we have focused on victim detection accuracy. Our top challenge is to decrease the robot time consumption for finding victims that we have set it by our sensors.

Keywords: Robocup, Virtual Robot, Gazebo Simulation, ROS Kinetic, Navigation, SLAM, victim detection

1-Introduction

This league shows a simulated natural disaster that always has a totality which the teams with their special virtual coded robots are expected to avoid it, don't let it to be extended and salvage the simulated lives using many things such as sound, sight, temperature, etc. Nowadays the usage of robots is getting more important and every day it is getting more dependency due to the robots abilities. The messaging system between our robots is one of our ideas which the robots are able to communicate with each other. In the rest of this essay we'll introduce our specific methods and algorithms to get a great consequence. By using the sensors we have tried to simplify robot's work on victims finding that we'll speak well about them in the following.

2-System Architecture

Our system architecture includes Linux (Ubuntu 16.04 LTS) as an OS, for simulation we used Gazebo version 8, for running the code we used ROS kinetic to create better modules for navigation because the Robot Operating System (ROS) is the most popular framework this years. Writing the code and having another view from the robot has been done by QT. We needed a reliable discernment sensor that we use as SLAM. We also used P3AT model for our robot. RGBD camera, laser scanner and odometer sensor, thermal sensor are our used sensors. All of these stuff help us finding the victims.

2.1-Robot Model

Pioneer 3-AT is the best intelligent mobile robot for education and research. P3AT is a four-wheel robot and because of having great ability, easy to use, ability to navigate its environment and being reliable, it is very suitable for multipurpose tasks.

3-SLAM[1]

SLAM can be very suitable in many ways. First of all there is a huge amount of different hardware that can be used. Secondly SLAM is not something like an algorithm. We use it to update the robots location. There are many steps involved in SLAM and these different steps can be implemented using a number of different algorithms. SLAM is applicable for both 2D and 3D motion. We will only be considering 2D motion. It is useful to build and update maps within unknown environments, while the robot keeps the information about its location. Fig1 is an example of SLAM and data processing in Fig2.

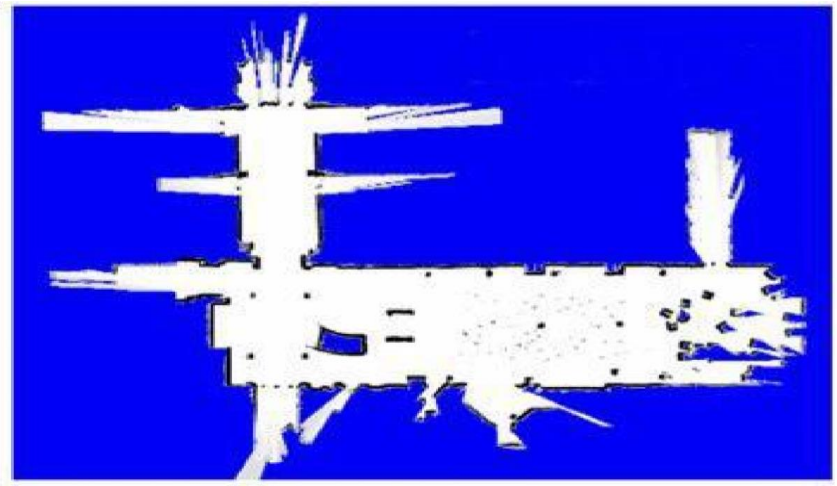

Fig1.Example of SLAM

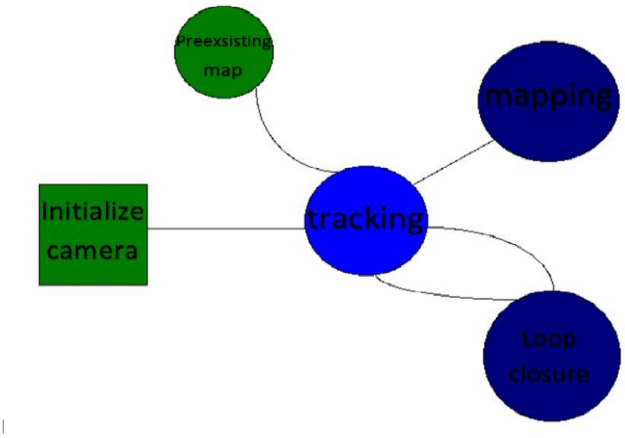

Fig2.Initialize camera

1-SLAM: Simultaneous Localization and Mapping (learning a map and locating the robot simultaneously)

4-Victim Detection

The main purpose of this league is to detect the victims. Handling the crisis conditions like disasters can be done very well by the robots if we introduce the map details flawlessly and according to this ability it can be used in our real life widely and this league isn't other than this. We tried to familiarize the robot with the victims as possible and to define the initial temperature to our robots. We have also increased our speed as far as it goes to cover maximum space. Our robot can save its position. Human motion sensor helps us understanding the victims with using the Histograms of Oriented Gradient (HOG) as the best completer algorithm for RGB camera that have a good coordination with each other.

4.1-Sensors used for Victim Detection

There are many sensors used for detecting the victims and all of them have useful advantages. We needed a good solution to make the discrimination between human and environment so we decided to use Infrared camera that is very useful in detection of heat in a principal case. We also wanted to make sure of our information of our robot's sight therefore we used Stereo vision to untie this issue this subject. Stereo vision uses two color cameras to have supplementary information and the variation between two pictures gives us unique info.

4.1.1-Laser scanner

It is mostly used for 2D mapping; it is a small and accurate sensor that is perfect for robots. The lasers are able to scan 240 degrees arc and they are accurate. We used them for SLAM and Navigation operations.

4.1.2-Camera

A camera is mounted on all robots that can help detecting all humans and victims. We used some image processing algorithms to detect moving victims, dead victims and fixed victims.

4.1.3-Ultrasonic range finder

This sensor has been placed all over the robot to detect obstacles and avoid them if there are no tasks to do.

4.2-Robots view

Classifying the view is what our robot does that its sight is divided into two parts that are views with human and without humans that it often looks for the views with victims. Forasmuch as the robots have common brain, they appraise each other from the places that they have been or have already searched.

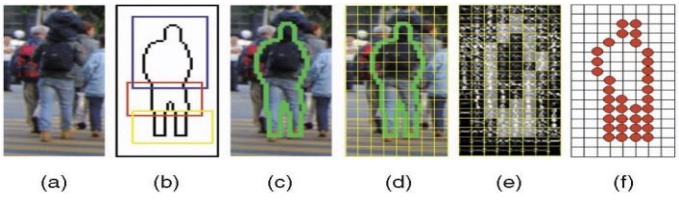

Fig3.Sight of the robot

4.3-Algorithms

The sensors located on the robot may make a lot of mistakes so we use Self Localization algorithm to let the robot know where it is located. This algorithm updates location of robot to make the robot not to be wandered. We used to talk about communication algorithm between our robots in **Robots view 5.2**. Map generating algorithm is used to make at least a 2D map and always having it. We also used victim localization algorithm to have their exact location.

5-Map-Merging

Map merging is an essential task for multi-agent robots so we used map-merger package from ROS to merge maps to a global one. Anywhere that the robots go, they each make an assumption map using the GPS, and then they merge this maps with finding out the parts that have the most similarities to make a general map that is available for all of them and it can make their task very simple. But there are some difficulties with it. One of them is to put up the right maps with correct places that we made an algorithm that finds the overlapping areas to make it easy to merge them convenient like a puzzle. The other one is to make sure that the provided data isn't wrong. For this situation we make our robot to check their location for several times and submit it when all data were equal. So our robot always has a 2D map as a minor map and a 3D map as a general map while researching for the victims.

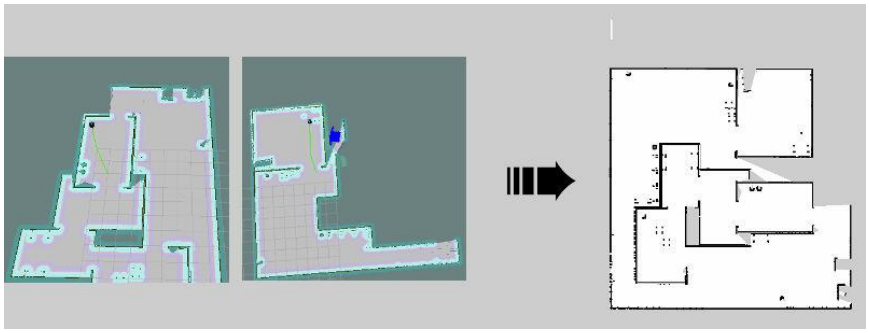

Fig4.Map merging

6-Path Planning

The other necessary task for the rescue robots is path planning that is essential when the robot has to reach a destination such as getting to a specific place. It is noteworthy thing for the autonomous mobile robots that lets the robot find the shortest or otherwise desirable route between two points. First option is to use a path finding algorithm in order to find some valid trajectory connecting start and goal. We have to do this works (how to localize a robot, and how to deal with

uncertain position information will be major). Sidewalks can help us with Path Planning that our robots use them a lot get to the location required.

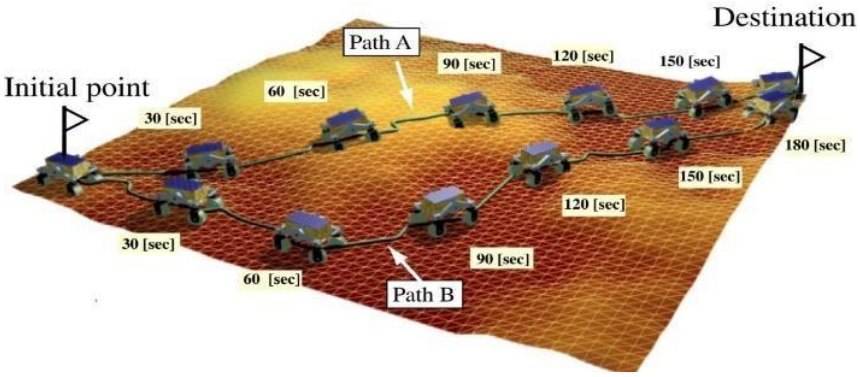

Fig5.Path Planning

7-Base code

We decided to use the last year release of SOSVR base code that is well documented and programmed. The base code helps us to focus on more important issues in the code with providing some packages and it contains standard robot definition, SOSVR controller, Teleop, SLAM, SOSVR Exploration, Victim Detection, SOSVR Panel and etc... The base code has been released after RoboCup 2017 competition. SOSVR is based on Ubuntu OS, C++ programming, python programming language and QT.

8-Practicing

We used a P3AT to practice the simulated disaster condition, searching for ways to improve our robot's operation and optimize it for high-density maps. Also we practiced map-merging using four robots in a huge and full of environment map to increase the communicate ability of our code.

9-Simulation

Simulators play an important role in the robotic world, to bring the whole real life and environment into computers. Gazebo is a 3D simulator which used to communicate to the Robot Operating System (ROS). There are plenty of packages in ROS that can be used for several purposes. One of them is SMACH. According to ROS wiki, SMACH is useful when you want a robot to execute some complex plan, where all possible states and state transitions can be described explicitly. This basically takes the hacking out of hacking together different modules to make systems like mobile robotic manipulators do interesting things.

10.Conclusion

Although this is a competition and the teams compete together, the main purpose is to develop robot rescuing, so we would be happy to be a part of this development path. Every year in this league there is an improvement in robots and they will be more accurate and smarter. So we attempted to program a better robot in comparison to last year. Generally robots are better than humans in rescuing, because they can operate in most of difficult situations.

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