Hinomiyagura Team Description Paper for Robocup 2013 Virtual Robot League

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Abstract. This paper describe our team's work recently and agenda by the competition. Our Goal is mapping by multi-robot. We try mapping by mono-robot or multi-robot with ROS, as a result we find the problem which multi-robot's mapping is inaccurate. We are challenging to solve the problem by developing method of integrating maps.

1 Introduction

We are challenging to develop a method for integrating maps from robots to work separately. On rescue, It is important to get the map disaster site. Then, to get the map in a short time, we should work multi-robot to do mapping. At this time it is easy if there is a program to integrate maps, but present SLAM[3],[4] don't integrate. In this paper, we show that the integrated map can be build, and the integration method has some problem. We show our ability and having problem now since next chapter.

2 Our goal

We have two challenges. One is way to integrate data of among robots. The other is way to get and describe 3D map. Now, we can 2D Mapping by mono-robot. On the next step, we want to get the map available as real time and 3-Dimension from some or many robots. The former is the problem to occur when robots try SLAM. The latter is problem in the case is coordinates have equal x and y, but unequal z, for example in building. In building, z of coordinate is different by floor, and moreover on floor or desk in case of same floor. We are challenging integration of map from robots with considering z of coordination. To achieve, we need a SLAM to output 3D map or way to generate a map similar to 3D by use of 2D SLAM. At first we tried mapping by use of two robots with gmapping or Hector_slam (these are ROS default packages). The results was depending on the situation. We plan to achieve the method of mapping and high accurately integration by the time the competition start.

3 System overview

Our system is consist from USARSim, including WSS, and ROS as Fig:1. We use ROS for robot's controller, SLAM and so on. Human Operator get information of camera view and whole map, and command robots ROS is ran on ubuntu, receive information of rangesensor and so on from a robot in USARSim, and output a map data published by SLAM algorithm. Also ROS directs a robot by human operator's command. One Ubuntu and ROS system is allocated to one robot. Each map data outputted by ROS are integrated, and the result, as a whole map, is shown a operator. Similarly the image of the camera attached to each robot is shown to a human operator. Basing on information of the Whole map data and these image, operator command robots through the command_translation program hatched rectangle. Ubuntu version is 12.04, and ROS version is FUERTE. Following figure is our system architecture. Hatching rectangles are developing now.

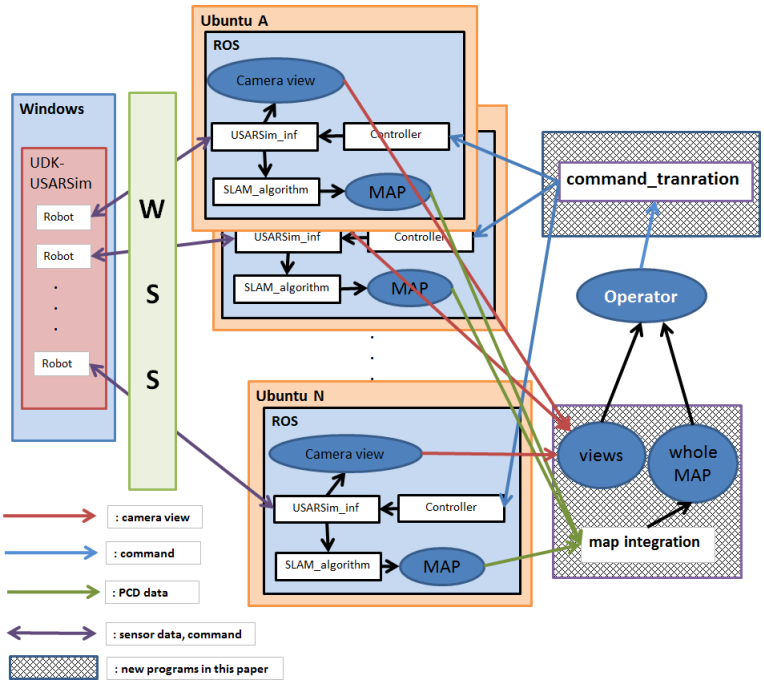

Fig. 1. System overview

4 SLAM

In this competition, we plan to try to integrate several maps from robots with SLAM into a map. Each robot is getting a map and merged PCD (Point Cloud Data) from SLAM with distance data of range sensor. We are going to construct a whole map of integration of maps and PCDs from robots, with holding the altitude. We saw whether gmapping or hector_slam which are ROS's stack can create a map by use of range information from two robots. Some examples which are simulation maps of USARSim and mapping from our experiment are shown below.

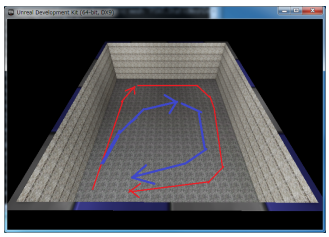

Fig. 2. simulation map1

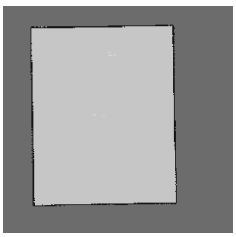

Fig. 3. 2D map1, use one robot

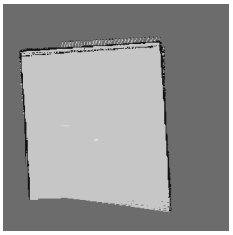

Fig. 4. 2D map1, use two robots at first

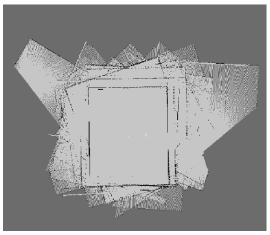

Fig. 5. 2D map1, use two robots at last

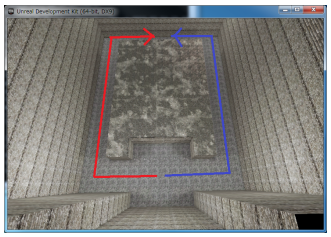

Fig. 6. simulation map2

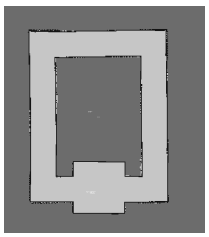

Fig. 7. 2D map2, use one robot

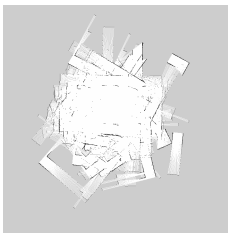

Fig. 8. 2D map2, use two robots

Fig.2 and Fig.6 are maps of USARSim. Fig.2 is a simple rectangle room. Fig.6 is a rectangle room with a large obstacle in the center of the room. This course's purpose is making a situation which each robots shut out other robot of eyesight. We draw these maps routes of robot. Fig.3 and Fig.7 are 2D map of gmapping by use of one robot. Fig.4, Fig.5 and Fig.8 are 2D map of gmapping by use of two robots. Fig.4 and Fig.5 show that the mapping get success at first but failure at last. Through these experiment we realized that depending on the situation, the simple SLAM mapping is possible.

- Hector_slam have a limitation on the speed of robot.
- Hector_slam is inaccurate when rangesensor's data get continued almost same value without the odometry.
- PCD which one robot get include a part of other robot's PCD.

In actuality, there is a case of sharing each PCD because each robot work separately. Thus we have a problem to be solved, is to develop a method to integrate maps without the sharing each PCD by changing the SLAM algorithm or use situation.

5 MAP Integration

Current our policy is that each map is created by each robot continuously and the whole map is created when an operator needs. Recording each map, we think that it is easy to fix when make a mistake map integration. We have two available parameters now.

- Relative angle among maps from robot's sensor.
- Distance of congruent points between a map and other map from each 2D map image.

By using these, we think that integrate 2D map images or PCD without SLAM. Thus next targets are below.

- Judge error of each map.
- Fix the whole map when Error of integrated maps increase.

We plan to achieve latter by recording each PCD. An example of integration which our goal is shown in the following.

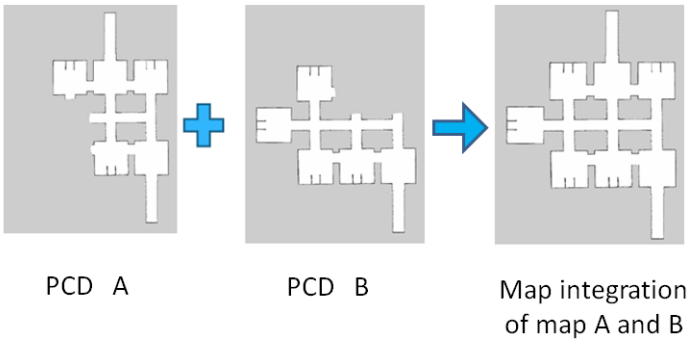

Fig. 9. Integration of maps

Fig.9 show a capability which we get the whole map by integrating two PCDs.

6 Future works

When we integrate maps which have some level, stairs or grade separated crossing, we should consider both plane and vertical direction. The reason is that robots and members of rescue team need the cubic map, accurately records the result of search in building, as common information source. In the future, we extend the study area, approach SLAM algorithm and develop the system which records a cubic map with 3D information.

References

1. S.B. Balakirsky and Z. Kootbally, "USARSim/ROS: A Combined Framework for Robotic Control and Simulation", Proceedings of the ASME 2012 International Symposium on Flexible Automation (ISFA 2012), St. Louis, June 18-20, 2012
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