LiDAR Based Method for Task1 in RobotX competition

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***Abstract*— This paper is both an instruction document and template to be used in preparation of RobotX journal papers. The goals of the RobotX journal paper are to assist teams in becoming more familiar with the preparation of scientific publications, to articulate the linkage between vehicle design tradeoffs and overall competition strategy, and to document successful approaches and lessons learned for future team members.**

I. Introduction

This paper presents method achiving task1 in RobotX competition. This method depends only on LiDAR since the detecting range of our rgb camera in gazebo is restricted to 5 meters. For task1, the starting point of the boat is highly posible away from the entry gate more than 5 meters. Therefore, the rgb camera has limited usage. As a result, I decide to focus only on LiDAR and develop a method that depends on LiDAR only.

A. Challenges

The method here solely depends on LiDAR. Without rgb camera, we lose information of colors. Therefore, the main challenge is to achieve this task without color information and camera.

B. Assumptions

Assumptions summarized as follows:

1) The starting point should be close to the entry gate, if the starting point is near to the exit gate, the method may fail.
2) LiDAR could detect four totems at the first time, this is because we should decide which state the boat is, which we will discuss in section 2.

II. Design Strategy

First, I will preprocess input pointcloud and perform clustering. For each cluster, extract center point and send the topic to the node that processes driving command.

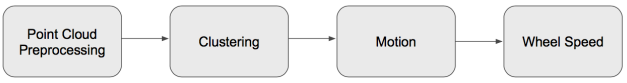

Fig. 1: The overall design strategy.

The main problem is that how to distinguish different states when four points are detected, we develop a method as shown in Fig. 3. We use different phi to distinguish the relative position of the boat. If the boat is in front of the entry gate, then the boat can drive to exit gate directly. However, if the boat is in other states, then we design an extra transition point which will discuss next.

Fig. 2: The simulation environment is in gazebo with four totems and WAM-V.

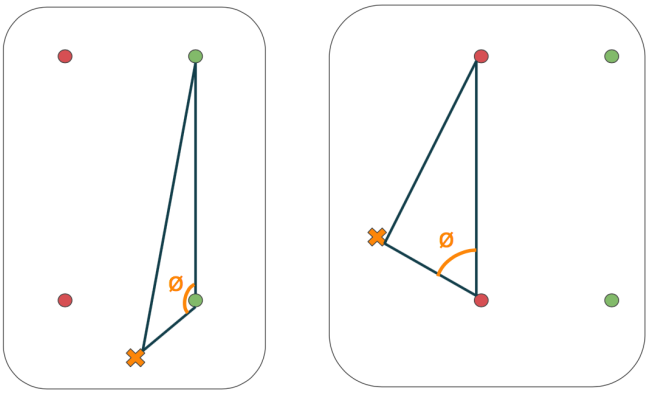

Fig. 3: In the left scenario, phi is greater than 90 degree. In the right scenario, phi will be less than 90 degree for sure.

Here we have three function in total: entrance, transition, and exit function. Entrance function lets the boat drive to entrance point, transition function lets the boat drive to transition point, and so on. Additionally, we design two triggers, entrance and exit. As a result, we develop our FSM (Finite State Machine) in Fig. 4.

III. Experimental Results

ROS unittest is used here to test the system. In this test, four user defined totem points are given to see how the driving command will respond to those points.

IV. CONCLUSIONS

Usually this task is solved by using both LiDAR and camera, which will be easier since we have additional color information. However, if the camera is not good enough or due to other environment restrains, LiDAR based method will be crucial. Moreover, LiDAR is used in almost all tasks in RobotX competition. Therefore, I hope this method will help my team to develop other methods or come up with new ideas.

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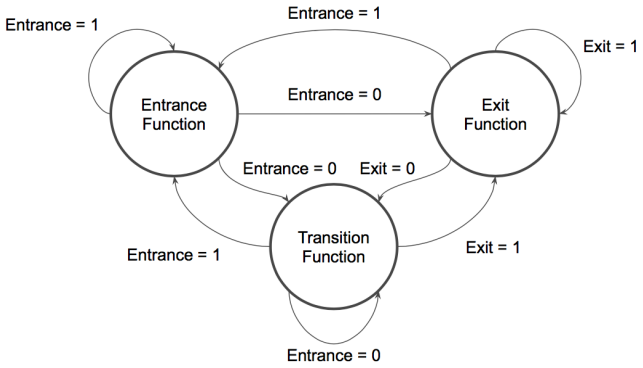

Fig. 4: The FSM of our design.

REFERENCES