Research on a Panoramic Mobile Robot for Autonomous Navigation

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Abstract. The panoramic autonomous navigation mobile robot is a kind of intelligent mobile device which simulates the human brain route planning and uses the technology of laser radar and SLAM technology. The premise of intelligent mobile is to model the environment. Environmental modeling needs positioning, which relies on the environment map. The idea of autonomous navigation for panoramic map building is to specify the end point on the visual virtual map interface. The system automatically searches and generates the most precise and fast route, which enables the robot to realize autonomous path planning path and so reaches the destination with the shortest route around obstacles. this paper introduces the key technology, research methods, function realization and auxiliary functions of panoramic autonomous navigation robot concretely.

Keywords: Autonomous navigation; Panoramic scan; SLAM building; ROS system.

1. Introduction

SLAM technology in real-time location and map building is a very active research direction in the application of mobile robot. Traditional mobile robots positioning movement need control their moving path by artificial induction trajectories or manual remote control. The relative intelligent mobile device can establish the system coordinate by manually inputting the position coordinate of the obstacle in advance in the system, but the workload is too large to fully understand the ground information and accurately identify the position of the obstacle,so it is difficult to apply complex environment.

The application of SLAM technology not only cooperates with mobile robots to acquire map model accurately, but also realizes autonomous navigation and location on virtual map. It has shown great application prospects in unknown environment exploration, disaster rescue, product delivery, military investigation and other fields. Based on the research of laser radar and SLAM technology, we independently developed a panoramic autonomous navigation mobile robot.

2. Research Means

2.1 Introduction of Laser Radar

Because of the long distance,strong anti jamming ability, good concealment and low cost,laser radar sensor has been widely applied in national life field,scientific research field and military field.For example,the use of laser ranging instead of microwave ranging,the ranging accuracy and direction have been greatly improved; By scanning the real-time ground, the laser radar can accurately obtain the three-dimensional coordinate parameters of the ground obstacle.

2.2 The Introduction of ROS System

The ROS(Robot Operating System) operating system is not the real operating system,usually it needs to be installed on the Ubuntu system.Ubuntu has a open source repository of software that eliminates the need to compile and install code on Linux.The operation of ROS is based on the ROS kernel,which has a parameter server and everything on ROS depends on it.The basic of a unit of ROS is the node,and the communication between node relies on message and service.ROS also has many

packages,which contains the resources needed for ROS to run,such as the type definition of programs,messages and services.The main characteristics of ROS system can be summarized as below:

Firstly,the point to point design improvement the accuracy;Secondly,variety of language supporting,improving universal property;Thirdly,integration improvement;Finally,toolkit rich and open source.

2.3 Basic Ideas

The basic minds of panoramic autonomous navigation mobile robot are:the measured data and odometer data are extracted from the laser radar, at the same time,it outputs to the Navigation navigation stack.then the COSTMAP possession grid map is constructed by using the main algorithm in Slam. At last, the autonomous navigation is completed in the constructed map.

Define the size of the unit raster,which will determine discrete degree of freedom. Discrete degree of freedom:starting from the origin of the robot,the distance from unit raster begins to diffuse to the surroundings area,which makes the virtual interfaces full of virtual grids.Then the laser radar is dropped into the corresponding grid,and the occupancy ratio of the grid represents all the ranging data falling into the grid. The algorithm is realized by bilinear filtering. After the laser radar data are dispersed, a partial occupancy grid map is obtained. The pose of the robot is evaluated and the collected map is fused into a panoramic map. The effect after collection is as follows figure 1.

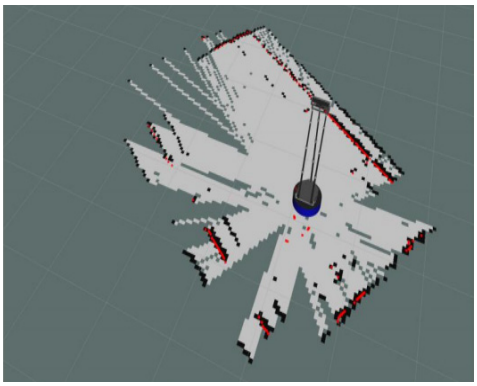

Figure 1. SLAM building results

Data flow is used in the system, and the transmission process can be understood as shown in Figure 2 below.

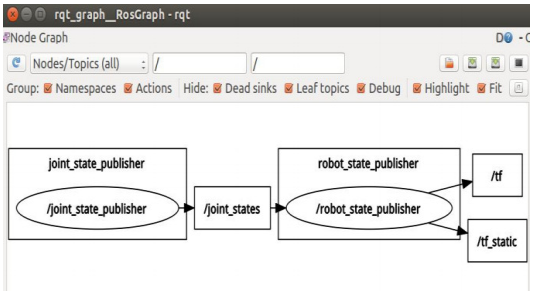

Figure 2. transmission relations of nodes

After the completion of the map construction, the starting point and the end point of the robot can be drawn up in the system interface, and it can realize the autonomous planing of the most accurate and fastest path, and the result is shown in Figure 3.

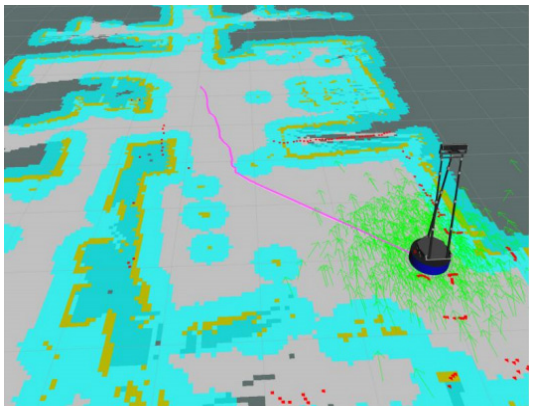

Figure 3. the path of autonomous navigation Function realization

3. Function Realization

Panoramic autonomous navigation mobile robot consists of three parts:visual acquisition,upper computer and scanning mobile.The visual acquisition is done with KINECT which has high-definition.The upper computer is the robot(UBUNTU)brain.The scanning is carried out by a 360 degree laser radar.The three wheels directional wheel control robot moves at multiple angles.KINECT equipment and laser radar are used as the eyes of robots to measure the distribution of 360 degree obstacles around them,forming a three-dimensional point set input system.The point clusters scanned by KINECT vision are connected through the UBUNTU brain to establish the corresponding relationship between nodes,forming virtual 3D maps. Panoramic autonomous navigation mobile robot simulates the brain's perception of the environment,autonomously plan the route,and intelligently execute the mobile operation.It breaks the disadvantage that the original mobile device needs auxiliary equipment and low intelligence,and builds Panoramic Map independently,simulate the principle of "the shortest straight line between two points", and plan the shortest route between starting point and terminal point.It is easy to operate and can be applied to the complex external environment.It can update maps in real time to achieve autonomous navigation and tracking,expanding the scope of utilization and improving utilization ratio.

This autonomous navigation mobile robot uses the most popular HECTERMOPPING and GMPPING algorithms in the cutting-edge SLAM technology to construct and process the collected data. It can realize 360-degree panoramic scanning map, autonomous navigation, intelligent planning the best route, as well as the system interface operation real-time feedback function. According to the environment, the map is constructed in real time, and the SLAM technology is used to intelligently plan the running track of mobile device.The two algorithms involved in Hector Mopping and GMAPPING are advanced technology algorithms in SLAM technology under a dynamic environment.Using Hector Mopping and GMAPPING algorithm can be directly constructed the radar scanning point set into a 3D visual map in UBUNTU operating system.By using the Dijkstra algorithm,the device can be positioned and moved autonomously on the ground by specifying the starting point and the terminal point at the system interface.In this way,SLAM map can be constructed in a dynamic environment and achieved autonomous navigation by specifying the end point at operation interface. After realizing the main functions of panoramic autonomous navigation mobile robot,its auxiliary function has been constantly improved,for example, the handle controls the omnidirectional movement of the robot,achieving guide by several continuous navigation points,autonomic operation after simple speech commands are an issued, using KINECT vision to recognize human face and objects,etc.

4. Concluding Remarks

Panoramic autonomous navigation mobile robot simulates the process of the human brain's perception of the environment, autonomously planning, and intelligent execution of mobile operations. For example, when we walk into an unfamiliar space, firstly, we need to have a whole

understanding of the external environment space, judging the scope we can go out and location of obstacles needed to keep distance, and then clear the starting point and terminal point, choosing the nearest route to achieve the goal of intelligent planning and the fastest arrival. Moreover, the relevant system of panoramic autonomous navigation mobile robot can also be used in automated forklift trucks, AGV handing robots and unmanned research. In the future, semantic information extraction and deep learning admission will accelerate the development of mobile robots, in order to the changing new development situation.

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