Research on Map Construction and Location of Laboratory Service Robot based on Iterative Closest Point

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***Abstract*—**The development of mobile robots has led to their wide application in a variety of fields. This study focuses on the intelligent application of mobile robots in laboratory management, especially the environmental awareness and self-positioning of a robot in the laboratory. In this study, a wheeled mobile robot is selected and equipped with a 2D laser scanner. Based on this, a Robot Operating System (ROS) environment is built. The nearest neighbor iterative closest point (ICP) matching algorithm is utilized to perceive the laboratory service environment, construct the indoor map in real time, and locate the robot precisely. Subsequently, data collected in the corridors and indoor environment of the experimental building are used to test the accuracy of the ICP matching algorithm. The results showed that the minimum translation error is as low as 0.0003 m and that the minimum rotation angle error is less than 0.5°. In addition, the positioning and mapping of the robot were analyzed. The experimental results show that the ICP matching algorithm is well suited to map construction and positioning of the laboratory service robot. This is of great significance for further research on laboratory service robots.

***Keywords*—**ICP algorithm；SLAM；Service robot

I. INTRODUCTION

With the rapid development of the robotics industry, service robots have become widely used in all walks of life. As an important location for experimental teaching and technology research, the laboratory requires a large amount of manpower to complete monotonous and repetitive work such as teaching, equipment sorting, information recording and so on. A service robot, which is a type of high-efficiency automation equipment, can effectively solve those problems in laboratory applications. This paper describes a laboratory service robot based on a Robot Operating System (ROS) as the control platform that obtains indoor environmental information through a 2D laser scanner, and establishes a task of simultaneous localization and mapping. 2D codes were pasted on the experiment cabinet and equipment to access the equipment information, and a monocular camera was used to obtain the information stored by the 2D code.

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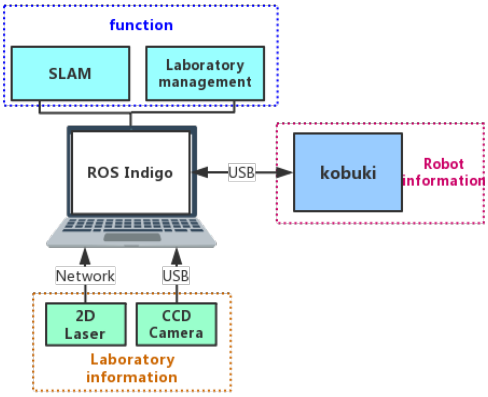

Fig. 1. Architecture of laboratory Service Robot

As an indoor service robot, the laboratory service robot needs some key technologies to realize autonomous work in complex environments, including positioning, navigation, identification and interaction. Among them, the laboratory service robot's judgment of the laboratory environment and its estimation of its own location are the primary foci of this research [1][2]. Because it provides a prerequisite for the robot to achieve other functions, such as avoiding obstacles, moving to target points, planning paths, and automatic charging. It is also the core technology of autonomous mobile robots and the key to achieving intelligence. Thus, we introduce simultaneous localization and mapping based on laser data (Laser SLAM). The core part of Laser SLAM is the head match. The data is matched according to the data measured by the external sensor. The main function of the head match is pose prediction, which refers to the estimation of the robot's current posture by using the relationship between the known previous posture and the current observed value, and the pose of robot are obtained [3]. The detection information of the current position of the robot is matched with the known map to accurately obtain the position of the robot [4]. The iterative closest point (ICP) algorithm is the most widely used point cloud registration algorithm, which can meet the precision requirements of point cloud registration. Therefore, the ICP algorithm is a good choice for data matching in Laser SLAM for the head match.

The ICP algorithm was proposed by Bsel and Mckey to solve the registration problem of 3D point clouds [5]. Since then it has been continuously improved by researchers and widely used in robot research. Holz and