Explanation of the introduction of the security system for Takasen robots

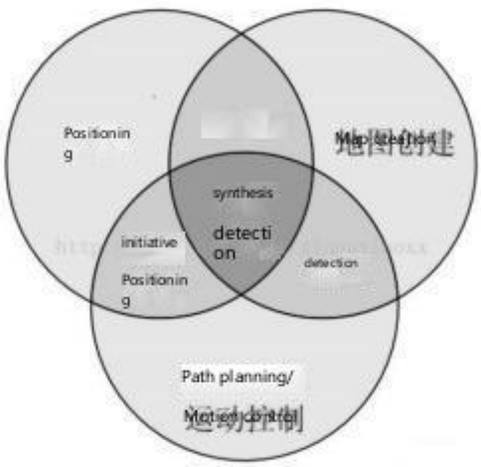
The purpose of this manual is to introduce the entire safety system of the Takasen Robot, including the functional description of sensors, the cooperation mechanism of software, and the safety mechanism in specific scenarios of customer's concern. For further information on the safety components on the robot, such as structural arrangement, quantity, etc., please refer to the product manual.

1. Introduction

Equipped with a variety of sensor devices, such as LIDAR, depth camera, ultrasonic sensors, etc., combined with the autonomous positioning and navigation technology of Goshen Robotics, Goshen Robotics is able to flexibly cope with static and dynamic obstacles in the environment and react in real time in order to maximize the safety of the robots themselves, the personnel and the facilities. There are some differences between different models, such as.

Sensor type	Phantas S1Pro	Vacuum40	Scrubber 50	Scrubber 75
3D laser radar (3D-LiDAR sensor)	×	×	×	√
2D laser radar (2D Laser)	√	√	√	√
depth camera (Depth camera)	√	√	√	√
RGB camera (RGB camera)	√	√	√	√
millimeter-wave sensor (Millimeter wave radar)	×	×	×	√ (75P)
Crash Sensor (Bumper)	√	√	√	√

2、Autonomous robot localization and navigation technology function introduction



As shown in the above figure, robot autonomous positioning navigation technology includes: positioning and map creation (SLAM

) with both path planning and motion control components.

SLAM technology is to solve the problem of mapping and positioning. Mapping is to build a map of the surrounding environment perceived by the robot. The basic geometric element of the map is the point. The point has no direction and only has a position of 3 degrees of freedom. Positioning is to locate the position and pose of the body in the world coordinate system. The Gaoxian robot uses the laser SLAM, visual vSLAM and semantic

The effective integration of SLAM and other technologies has been upgraded to SLAM2.0 technology, and many technical indicators are far above the industry average, ensuring that robots can achieve large-scale mapping capabilities through the indoor+outdoor full scene, centimeter level precise positioning capabilities, deep understanding of the environment, and the ability to dynamically update maps.

3、Sensor function introduction

Basically, the sensors listed above play different roles in the overall safety system because they have different functions.

3.1 3D LiDAR sensor

3D lidar is almost the most important part of Scrubber75 and Sweeper 111. It is mainly used for map function scanning, positioning and navigation, and provides auxiliary obstacle avoidance function. As an independent component, the maximum detection range of 3D lidar is 150m, and the measurement accuracy is+/- 2cm. It plays a key role in map scanning and building maps of open spaces such as warehouses and outdoors.

3.2 2D Laser

2D laser is used for map scanning, positioning and obstacle avoidance. As an independent component, the maximum detection distance of two-dimensional laser is 25m, and the measurement accuracy is 0.05m~8m.

3.3 Camera

At present, there are two main types of cameras, depth camera and RGB camera. The depth camera is used to measure the height and distance of obstacles around the robot. RGB camera is used to collect image data and video data around the robot. However, in the DPP version software developed, the RGB relative function is not available. Then, the height and distance data collected by the depth camera are transmitted to the host as the robot "brain" to make obstacle avoidance decisions.

3.4 Millimeter wave radar

The Scrubber75P is equipped with a millimeter wave radar to detect and avoid dynamic obstacles, such as moving cars in the garage.

3.5 Bumper

Usually, crash sensors are used to realize the crash cushioning function. It is usually mounted at the bumper. When manual mode is enabled, only the crash sensor is active when the automatic system is disabled. In this case, the robot is completely controlled manually by the operator, so it is important to be aware of the surroundings in order to respond in time in case of an emergency. If the robot hits another obstacle, the collision sensor will transmit a signal to stop the machine.

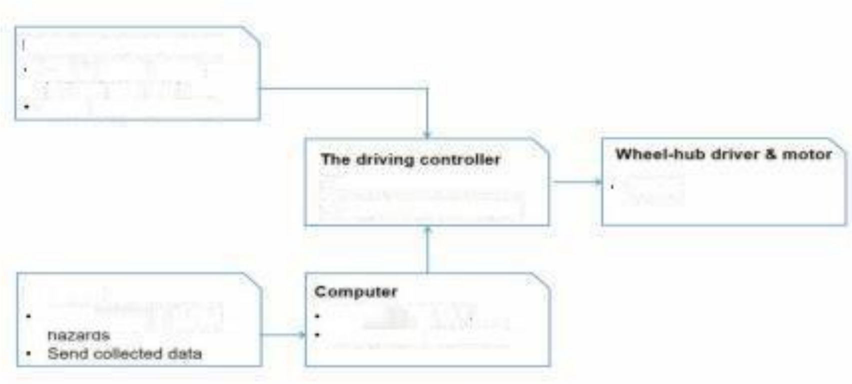
4. Introduction to security mechanisms

The entire safety mechanism is realized through the coordination of hardware and software. Overall, sensors are deployed to collect data such as depth, height, distance, images, etc. Then, all these data are simultaneously transmitted to the computer inside the robot. The computer acts as the brain of the robot, making decisions and transmitting commands to the power system.

, so that they make movements such as stopping and avoiding.

4.1 Collision protection mechanisms

The robot recognizes potential hazards through a variety of sensors (including LIDAR, cameras, etc.) and then triggers an emergency command to stop the robot. If there is an operator in the vicinity of the robot, he/she can also press the emergency stop button to stop the robot. This mechanism has the highest priority in the software, which ensures that the robot cannot perform its task until the threat is eliminated. When the robot finds a safe path, it will continue to perform the task. If the operator presses the Emergency Stop button, he/she can release the Emergency Stop button if it is safe to do so.



4.2 Anti-fall protection mechanism

The robot recognizes the height difference within a distance of 1.5 meters by means of different sensors, and if the host computer determines that it is at risk of falling, the robot triggers the fall protection mechanism. In this case, the host computer sends a command to the servo drive to decelerate the robot. At the same time, the host computer will calculate a new path to avoid falling.

4.3 Overshooting protection mechanisms

In general, the robot slows down its movement when it turns. All turns are marked by the host computer based on path data. When the robot is in a turning position, the computer sends a command to the servo drive to slow down the robot.

4.4 Virtual labeling protection mechanism

In general, when the machine is running, often encountered the following situation: some areas may have potential danger or plan to avoid in advance planning, such as: floor lamp area, temporary booth area, mobile display area, glass doors or steps, some important areas or objects, etc., the operator can through the robot control software by drawing a virtual wall, highlighting the area, the display area, the temporary booth area, the floor lamp area and so on. Virtual labeling, the above areas will become prohibited. When the robot is actually running, it will recognize and avoid.

5、Security certification

Scrubber 75, currently in compliance with the relevant certification of third-party certification bodies, is as follows (relevant certification certificates can be provided):

□ The product meets the safety requirements of GB 4706.1 and has CNAS test report.

- ▭ The product meets the requirements of EU CE certification for safety MD, EMC and RED
- ▭ The product meets the requirements for RF and EMI in FCC/IC certification in the United States and Canada
- ▭ The product meets the US and Canada FE/SI testing requirements

Scrubber 50, currently in compliance with the relevant certification of third-party certification bodies, is as follows (relevant certification certificates can be provided):

- ▭ The product meets the requirements of EU CE certification for safety MD, EMC and RED
- ▭ The product meets the requirements for RF and EMI in FCC/IC certification in the United States and Canada
- ▭ The product meets the US and Canada FE/SI testing requirements
- ▭ The product meets the RCM certification requirements of Australia and New Zealand
- ▭ The product meets Singapore IMDA certification requirements
- ▭ The product meets Taiwan NCC certification requirements

At present, Phantas meets the relevant certification of third-party certification bodies as follows (relevant certification certificates can be provided):

- ▭ The product meets the requirements of EU CE certification for safety MD, EMC and RED
- ▭ The product meets the requirements for RF and EMI in FCC/IC certification in the United States and Canada
- ▭ The product meets the US and Canada FE/SI testing requirements
- ▭ The product meets the RCM certification requirements of Australia and New Zealand
- ▭ The product meets Singapore IMDA certification requirements
- ▭ The product meets Taiwan NCC certification requirements
- ▭ The product meets the KC certification requirements of South Korea

Vacuum 40, currently in compliance with the relevant certification of the third-party certification authority, is as follows (relevant certification certificates can be provided):

- ▭ The product meets the requirements of EU CE certification for safety MD, EMC and RED
- ▭ The product meets the requirements for RF and EMI in FCC/IC certification in the United States and Canada
- ▭ The product meets the US and Canada FE/SI testing requirements
- ▭ The product meets Taiwan NCC certification requirements