Ground object indentification and obstacle avoidance of sweeping robot

Present Name 1: Long Jiajun| Present Name 2: Zhang Ximan
Present Name 3: Luo Jie| Present Name 4: Zheng Yikai
Present Name 5: Sinrithy Vong

2023.03.06

Background

(1) Sweeping robot– widely used in daily life, achieved great success in service robot

(2) Autonomous movement and decision-making– depend on environment sensing ability, using SLAM technologies

(3) Achieve better environment perception and intelligent decision making– introduce visual SLAM– make full use of visual information to achieve a high level of perception

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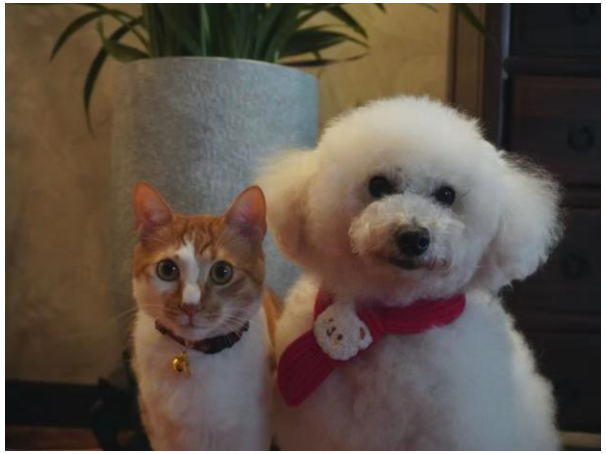
Investigating Problem

The problem of investigation:

the ground object recognition and obstacle avoidance of the sweeping robot



Why?

(1) great interest– most successful commercial robot products

(2) important technologies– object identification and obstacle avoidance

Ex: robot dogs, intelligent car driving…

The home environment corresponding to the sweeping robot is relatively basic, and the indoor environmental elements are also relatively stable, which is very suitable for our introductory study.

(3) present robot– not accurate enough and having defects in use

Ex: not shy away from pet poop, difficult to recognize moving objects…

By adding depth camera, object recognition can effectively solve various situations that the actual sweeping robot may face in life, so as to reduce the error of the sweeping robot and improve the safety.

(4) combined with SLAM learned in ROS– further expanded

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The dataset

Object identification:

Using VOC2012 data set of computer vision:

(1) Use to train the model well

(2) To verify object recognition accuracy of the model

SLAM mapping:

Using OpenLORIS dataset / Record video with depth camera:

(1) Test the mapping effect

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Methods and algorithms

YOLO Algorithm:

YOLO is an object detection algorithm, its task is to find all areas of interest in an image and determine the location and category probability of these areas.

To train the model of ground objects identification

Semantic mapping:

Identify the 2D and 3D objects on the map.

To complete the mapping through depth camera

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Reference

- **Process:**

  Semantic Mapping Based on Visual SLAM with Object Model-Replacement Visualization for Cleaning Robot

- **Visual SLAM:**

  (1) ORB-SLAM: a Versatile and Accurate Monocular SLAM System

  (2) ORB-SLAM2: An Open-Source SLAM System for Monocular, Stereo, and RGB-D Cameras

  (3) ORB-SLAM3: An Accurate Open-Source Library for Visual, Visual–Inertial, and Multimap SLAM

- **Review of SLAM:**

  Past, Present, and Future of Simultaneous Localization And Mapping: Towards the Robust-Perception Age

- **Semantic mapping:**

  (1) CubeSLAM: Monocular 3-D Object SLAM

  (2) Meaningful Maps With Object-Oriented Semantic Mapping

- (3) SemanticFusion: Dense 3D Semantic Mapping with Convolutional Neural Networks

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Project promotion process

Build the test platform of the sweeping robot and adjust the chassis control

Have a robot chassis
Needed to be built further

Run visual SLAM smoothly on the platform with depth camera

Depth Camera (azure kinect)

Complete object recognition and classification

YOLO Algorithm

The semantic mapping method is adopted to complete the mapping

Bonus

Navigation and obstacle avoidance based on identification and mapping results

If have more time

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Result Evaluation

Ground object identification:

Identification accuracy of 90% or above

Mapping effect:

(1) Observe the mapping effect by naked eye
(2) Compare with other algorithms to find out the optimal pattern

Obstacle avoidance effect:(bonus)

(1) Observe the effect by naked eye
(2) Compare with other algorithms to find out the optimal pattern

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