Movement Recognition Program for Mobile Robot (MRP)

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Introduction

The artificial intelligence robot is one of the most popular areas in the modern world because it could replace people in some job positions. Also, people are noticing the safety problem of artificial intelligence robots is as important as developing the robot itself. The robot might make a wrong decision, because there are various reasons which could mislead the robot, such as noise data generated from the sensor hardware. To interrupt the current command with a proper response action, this project is using computer vision technique on a mobile robot to make it be able to recognize the movement of a human. Based on the result of MRP, the robot will process different response actions for different situations.

Background

Robot Operating System (ROS)

Connecting hardware device to computer program for data transferring.

Controlling robot movements through programs.

Processing multiple tasks at the same time.

Filtering

Enhancing image feature by multiplicate normalized matrix (for example, edge filter in Figure 1).

Removing noise sensor data (white and black spots to complete the binary image)

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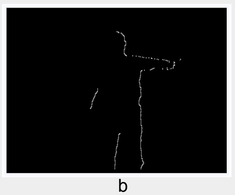
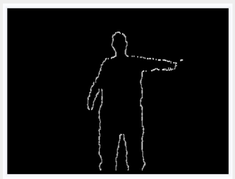
[[1, 0, -1],
 [2, 0, -2],
 [1, 0, -1]]/8
```

a



b



c

Figure 1
Image a and b is the filtered images of left edges and right edges. Image c is the combined binary image of image a and image b.

MRP Processing

Filter model

The goal of this project is try to recognized three movements. The only difference between those three movements is the right arm. Thus, the filter models are binary images which only contains arms part. (See Figure 2, 3, and 4)

Containing most important feature and reference objects.

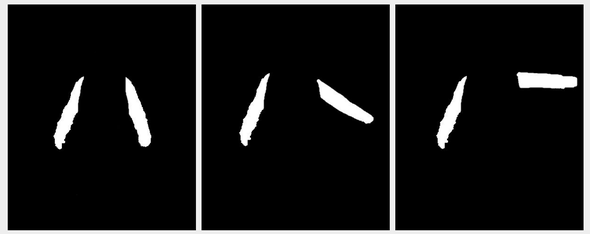


Figure 2, 3, and 4

Response Action Program

Following action (Figure 2 is keeping moving forward until the human is doing the movement of stopping and parking.

Stopping action (Figure 3 is stopping movement) is making the robot change all velocity to 0 and stop where it is. This command cannot be overwritten by “following”.

Parking action (Figure 4 is parking movement) is will do stopping action if previous command is “following” and do following action if the previous command is “stopping”.

MRP Description

This project is expected running in a wide and dynamic environment. The test environment is happened in the hallway of Golisano College of Computing and Information Science building. The human in the sensor area will start moving and lead the robot until doing the stopping movement or parking movement.

MRP did four main tasks:

- MRP read in the depth image and convert it to float matrix.
- Removing noise data, including “nan” value (sensor data out of range) and obstacle objects (wall, floor, and body area).
- Converting image from grayscale to binary image then filter it with filter models.
- Analysing the center area of the filtered images and processing response action program.

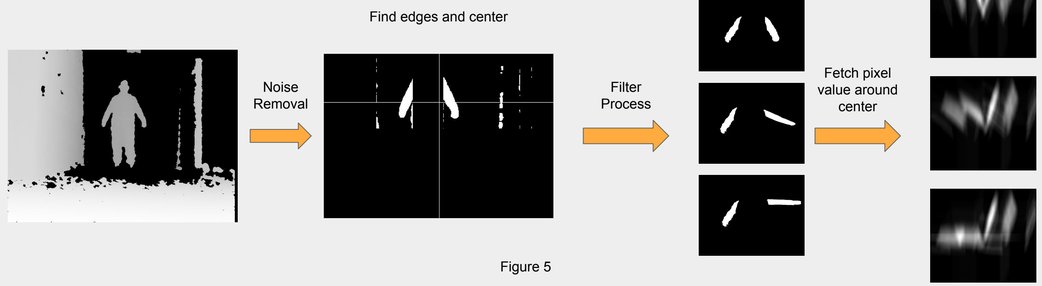


Figure 5

Result Analysis

MRP processed 18 depth images in 5.7 seconds, which is fast enough for most of cases.

MRP recognized image 0 as following movement, image 9 as stopping movement. There is no location restriction for human in the sensor area.

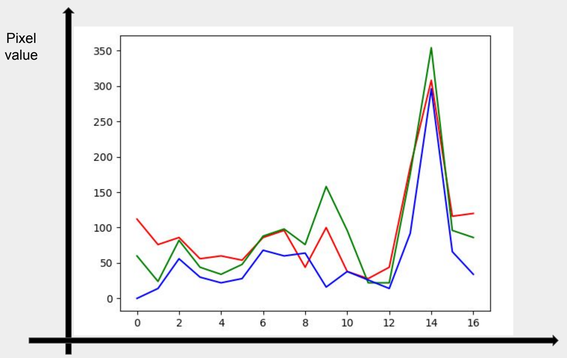


Figure 6
Red line represent maximum pixel value of following movement filter
Green line represent maximum pixel value of stopping movement filter
Blue line represent maximum pixel value of parking movement filter

Conclusion

MRP is designed for making robot recognize certain movements. Future improvement for this MRP would be designing filter models and analysing better threshold for noise removal of the depth image.