Three-dimensional object recognition using laser range sensor

Abstract Image information provided by cameras is strongly affected by environmental influence of an object’s circumjacent and circumference. In order to reduce environmental influence, a system which was integrated distance information provided from a laser range sensor (LRS) and image information provided by a camera was developed, and consisted of an object extraction section and a recognition processing section. In this paper the effectiveness of the system was inspected by performing an object extraction experiment using the combined integrated distance information and image information. From these results, this system could remove a background and a floor surface by using the distance information, and simpler object extraction was enabled.

Key words Robotics · LRS · Object recognition

1 Introduction

The robot market is increasing yearly now. In particular, the demand for robots useful in daily life is increasing. However, in a human living space, the environment is complicated by many factors. A background and an object in an image provided by a camera cannot be separated easily, and then it is difficult for a robot to recognize and interpreting an object in an image. The environmental influence including light and object’s pattern affects an object’s circumjacent and circumference.1–4

Therefore, a laser range sensor (LRS) is used to avoid the environmental influence as possible and we have attempted to extract desired object from an image. The object extraction section performs region splitting of an image information provided by a camera.5–7 The distance information that was provided from the LRS is converted into a set of three-dimensional coordinates that matched the camera image. The integrated processing matches distance information with the image which did the region splitting. And it calculates the distance to each area. It integrates all of the converted information and extracts the object from the integrated information.

In this paper is described about the development of an object recognition system using a camera and a LRS that is not influenced by these factors.

2 System architecture

2.1 Outline

Figure 1 shows a schematic of the system architecture. This system consists of an object extraction section and a recognition processing section.

In the object extraction section, the system performs region splitting of image information provided by a camera. The distance information that is provided from the LRS is converted into a set of three-dimensional coordinates that match the camera image. The integrated processing matches the distance information and the image as divided into regions and calculates the distance to each area.

The system integrates the converted information. The object extraction section then uses the integrated information.

2.2 Outline of the LRS

Figure 2 shows the overview of the LRS. This is a non-contact laser measuring system that irradiates an object...
with an infrared laser [wavelength: 785 (mm)]. The distance from the object to the LRS is measured according to the time it takes for light to travel from the object to the LRS. The LRS scans the horizontal space at certain intervals, 0.36[°] (360[°]/1024) to 240[°], and detects the distance and the direction to the object. The detectable distance is 20–4000 (mm), and the detectable resolution is 1 (mm). The measuring error is a few millimeters for a reflective white object but is larger for a black object because of light absorption.

3 Region splitting

The system performs region splitting to extract an object based on image information provided by a camera. In this study it divided a histogram into three domains of R, G, and B elements and then put them together.

Figure 3 shows an experimental environment in which we photographed an object with a camera and experimented with region splitting. We fixed the camera on a tripod and photographed the object, which was a can sitting on a box. The camera was inclined at a 30-degree angle.

Figure 4 shows an original image. Figure 5 shows an image processed after region splitting. Generally the image was easy to obtain, although there was a part that had been mixed in with the floor aspect depending on circumstances.

4 LRS

A measurement experiment performed using the LRS to inspect the effectiveness of the distance information to be provided by the LRS. The distance information that was provided by the LRS was converted into a set of three-dimensional coordinates that matched the camera image.