2006년도 대한전자공학회 하계종합학술대회 제29권 제1호

VRML 과 영상오버레이를 이용한 로봇의 경로추적

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A Path tracking algorithm and a VRML image overlay method

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Abstract

Abstract - We describe a method for localizing a mobile robot in its working environment using a vision system and Virtual Reality Modeling Language (VRML). The robot identifies landmarks in the environment, using image processing and neural network pattern matching techniques, and then its performs self-positioning with a vision system based on a well-known localization algorithm. After the self-positioning procedure, the 2-D scene of the vision is overlaid with the VRML scene. This paper describes how to realize the self-positioning, and shows the overlap between the 2-D and VRML scenes. The method successfully defines a robot's path.

Keywords: landmark navigation, path finding, robot localization, robotics, triangulation, VRML

I. Introduction

To determine the path of a mobile robot it is necessary to know the robot's position, which can be determined using landmark-localization techniques. Landmarks are any detectable structure in the physical environment [1]. In this paper, we used specially designed marks as landmarks. Given a specific focal length and a single image of three landmarks, it is possible to compute the angular separation between the lines of sight of the landmarks. Then, if the global positions of the landmarks are known, the angular separations can be used to compute the robot's position and heading relative to a 2-D floor map. The simplicity of this approach, and the fact that it does not involve any 3-D reconstruction, has made it popular [1].

We applied several image-processing techniques to extract landmarks from the visual scene, and used neural network pattern recognition techniques to recognize landmarks. Then, a combination 3-D/visual scene was modeled using Virtual Reality Modeling Language (VRML), a type of Web3D technology that supports 3-D information on the web. By overlapping the visual and 3-D scenes in wire-frame mode, the accuracy of self-positioning can be verified. Moreover, the invisible sides of obstacles (e.g., backside or inside) are predicted, thereby extending the field-of-vision. Invisible sides can be predicted from the 3-D model. Furthermore, VRML can serve as a reference data source with original environment information. Any displaced objects can be detected easily by comparing both images, so both the position and path of a robot can be detected in the 2-D scene. The proposed path-finding approach can identify an optimal path, and avoid obstacles.

II. Pathtracking

Landmarks are any detectable structures in the physical environment, such as vertical lines or specially designed

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markers, including crosses or patterns of concentric circles. We used simple patterns against a uniform background color.

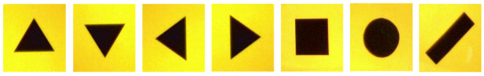

Figure 1. Landmarks used in this paper

To recognize landmarks, the following image-processing procedure was performed: acquire image data from the visual scene (320 X 240, 24bit); apply a color histogram spanning the image to improve it; perform binary image processing; remove salt and pepper noise from the threshold; detect objects using a tracking algorithm; separate the landmarks detected from the original image; and extract and resize the central marker for pattern recognition.

The tracking algorithm for image processing is described in [3]. This algorithm is used to locate the peripheral boundary of the region. First, a raster scan searches the image until a specific color is found. If a scanned point has already been visited once, the next point is scanned. If the value of the point is a specific color, a peripheral boundary-tracking process is initiated in a clockwise direction. In this way, the entire region of a landmark in the image is determined. For pattern recognition, a central mark is extracted from the original image in accordance with the tracked region.

To recognize patterns using neural networks, features of the mark extracted during image processing need to be defined. We defined 17 features as inputs of the neural network. The first eight features are the number of pixels in eight directions (→ ↘ ↓ ↙ ← ↖ ↑ ↗). We used the tracking algorithm introduced in this part to count the number of pixels.

Ⅲ. Simulation

We divided the search area into a grid to simplify the search area and reduce it to a simple 2-D array. Each item in the array represented one square on the grid, and its status was recorded as “walkable” or “unwalkable.” The path was defined by determining which squares should be taken to get from A to B. Once the path was found, the robot moved from the center of one square to the center of the next until the target was reached. These center points are called “nodes.”

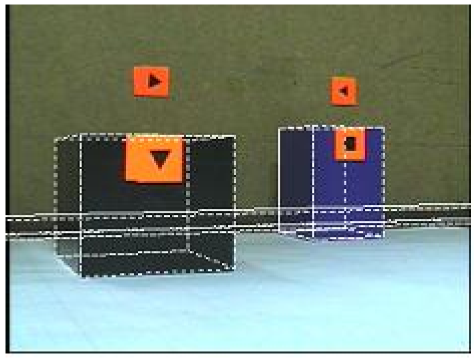

Figure 2 VRML and vision overlay

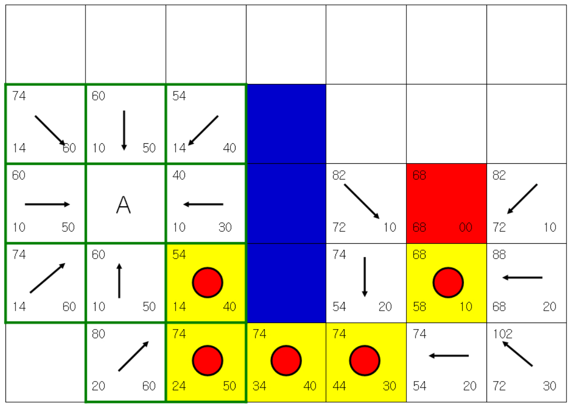

Figure 3 The robot’s path search

IV . Conclusion

We defined a robot’s path using VRML and image overlay. Our results show that VRML can be used as a tool for extending the field-of-vision. Overlaying the images helps predict the invisible sides (e.g., backside) of objects, and any possible dangers (e.g., obstacles). Furthermore, VRML can serve as a reference data source with original environment information.

References

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