

Fuzzy Control of a Mobile Robot with Camera

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Abstract

This paper describes the path planning method in an unknown environment for an autonomous mobile robot equipped with CCD(Charge-Coupled Device) camera. The mobile robot moves along the guideline. The CCD camera is useful to detect the existence of a guideline. The wavelet transform is used to find the edge of guideline. Using wavelet transform, we can make an image processing more easily and rapidly. We make a fuzzy control rule using image data then make a decision the position and the navigation of the mobile robot. The center value that indicates the center of guideline is the input of fuzzy logic controller and the steering angle of the mobile robot is the fuzzy output. Some actual experiments for the mobile robot applied fuzzy control show that the mobile robot effectively moves to target position.

1. Introduction

Generally, the robots have been used in fixed position but with the development of technology and economy, its application is extended to various environments [1]. The mobile robots are used to help the human activity in home, office, science field, manufacturing industry and exploration of the unknown world [2]. These mobile robots use ultrasonic sensor, infrared sensor, vision system and speech recognition to accomplish its task in various circumstances. The robot industry is developing in humanoid robot. The field of research that makes machine with intelligence like human is an artificial intelligence. Fuzzy and neural networks are being studied to implement artificial intelligence. Fuzzy logic approach has an advantage that it deals with various situations without analytical model of environments. Recently, many researchers proposed the navigation algorithms using the fuzzy logic [3][6]. Fuzzy systems are knowledge-based or rule-based systems. The heart of a fuzzy system is a knowledge

base consisting of the so-called fuzzy IF-THEN rules. A fuzzy IF-THEN rule is an IF-THEN statement in which some words are characterized by continuous membership functions [7]. The fuzzy algorithm is based on intuition and experience, and can be regarded as a set of heuristic decision rules or rules of thumb. Such nonmathematical control algorithms can be implemented easily in a computer [5]. The logic development method of fuzzy theory is approximate logic that is to get out of the logic method of computer such as true or false. It can have obscure values between true and false. That is, fuzzy logic converts ambiguous word such as a little, a few, more, less, etc. that are included in humans thought and decision into numerical value. Robot is required to work in variable situation. Therefore, mobile robots need the elementary skills of recognition of surroundings, path planning, collision avoidance, mapping, etc. The vision system and ultrasonic sensors are used for implementation of intelligence for the robot. The vision system is an effective sensor that can distinguish landmark or guideline from the environment [4]. In this paper, we used the Nomad Super Scout II robot made by Nomadic Technologies, Inc. for the experiment. The scanned image value of camera becomes the input of a fuzzy logic controller and the steering angle of the mobile robot becomes the output of the controller. This paper describes a method that a mobile robot equipped with camera can effectively follow a guideline using fuzzy logic controller.

2. Configuration of Mobile Robot

The Nomad Super Scout II is a mobile robot that has 16 ultrasonic sensors, bumper sensors, and odometer and the camera system on industrial PC. Wireless LAN connects the mobile robot with a remote PC. So we can control and monitor the mobile robot from the remote computer through exporting the window display