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AUTONOMOUS WHEELED MOBILE ROBOT CONTROL

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ABSTRACT

The autonomous wheeled mobile robots are very interesting subject both in scientific research and practical applications. The article deals with the fuzzy control of autonomous wheeled mobile robotic platform motion in an unstructured environment with obstacles. The simulation results show the effectiveness and the validity of the obstacle avoidance behaviour in unstructured environments and the velocity control of a wheeled mobile robotic platform motion of the proposed fuzzy control strategy.

KEY WORDS

autonomous wheeled mobile robots, fuzzy control strategy, unstructured environments, obstacles, simulation results

CLASSIFICATION

ACM: D.1.1.
JEL: L64

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INTRODUCTION

A wheeled mobile robot is a vehicle which is capable of an autonomous motion. The autonomous wheeled mobile robots are very interesting subject both in scientific research and practical applications [1-3].

Figure 1. show the recent situation and the future of the market size of the personal and service robots (source: Japan Robotics Association).

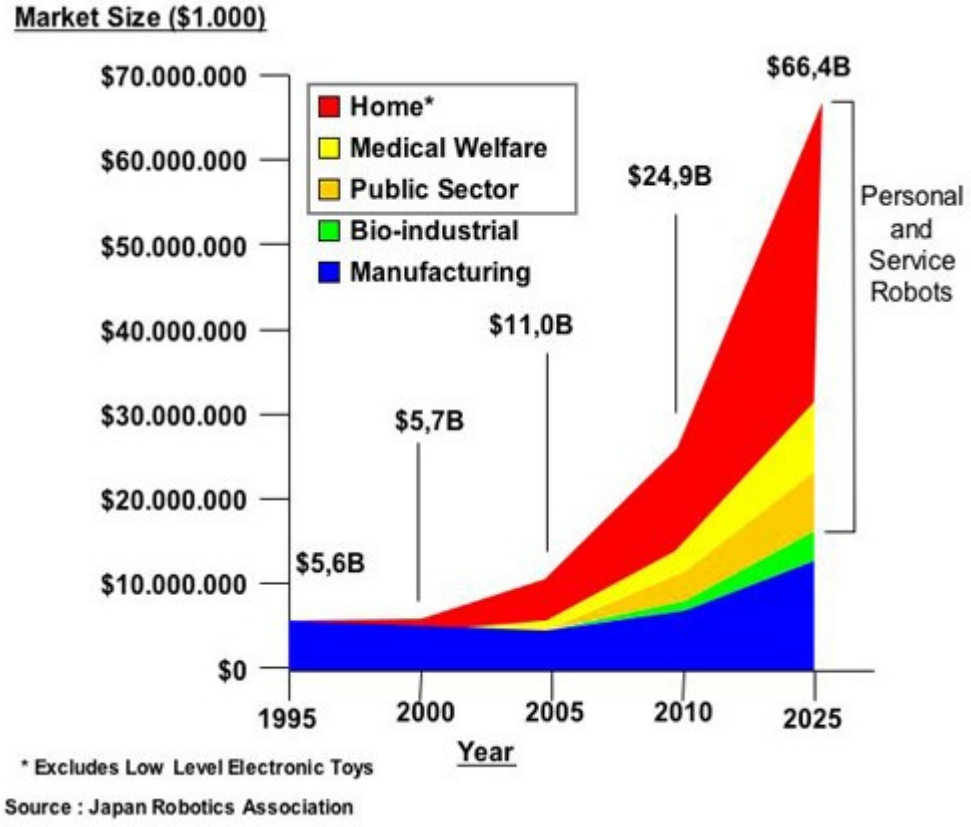

Figure 1. Market size of the personal and service robots.

The article deals with the fuzzy velocity control of an autonomous wheeled mobile robots motion in an unstructured environment with obstacles [4-9]. This article presents how to control of motion and velocity of wheeled mobile robots in an unstructured environment that contains obstacles with using ultrasonic sensors and a stereovision system.

The simulation results show the effectiveness and the validity of the obstacle avoidance behaviour in unstructured environment and velocity control of a wheeled mobile robot motion of the proposed fuzzy control strategy.

The article is organized as follows:

Section 1: Introduction.

Section 2: The structure of the general indoor/outdoor applications of mobile robots.

Section 3: Control strategy for wheeled mobile robots.

Section 4: Simulation results.

Section 5: Conclusions.

THE STRUCTURE OF THE GENERAL INDOOR/OUTDOOR APPLICATIONS OF MOBILE ROBOTS

The structure of the general indoor/outdoor applications of autonomous mobile robots are presented in Table 1 and Table 2.

Table 1. Indoor applications of mobile robots.

Indoor/Structured Environments
Cleaning large buildings
Transportation industry and service
Research entertainment
Surveillance buildings
Customer support museums, shops

Table 2. Outdoor applications of mobile robots.

Outdoor/Unstructured Environments
Agriculture
Forest
Space
Underwater
Military
Fire fighting
Sewage tubes
Mining

CONTROL STRATEGY FOR WHEELED MOBILE ROBOTS

In this section fuzzy control is applied to the navigation of the autonomous wheeled mobile robotic platform in unstructured environments with obstacles and slopes [10-15].

It is supposed that: the autonomous wheeled mobile robotic platform has two wheels driven independently and groups of ultrasonic sensors to detect obstacles in the front, to the right and to the left of the autonomous wheeled mobile robotic platform.

When the autonomous wheeled mobile robotic platform is moving towards the target and the sensors detect an obstacle, an avoiding strategy is necessary.

While the autonomous wheeled mobile robotic platform is moving it is important to compromise between:

- avoiding the obstacles and
- moving towards the target position.

With obstacles present in the unknown environment, the autonomous wheeled mobile robotic platform reacts based on both the sensed information of the obstacles and the relative position of the target [16-23].

In moving towards the target and avoiding obstacles, the autonomous wheeled mobile robotic platform changes its orientation and velocity.

When an obstacle in an unknown environment is very close, the mobile robot slows down and rapidly changes its orientation. The navigation strategy has to come as near to the target position as possible while avoiding collision with the obstacles in an unknown environment.

The block diagram of the fuzzy inference system is presented in Figure 2.

In the present implementation of the fuzzy controller the Center of Area method of defuzzification is used.

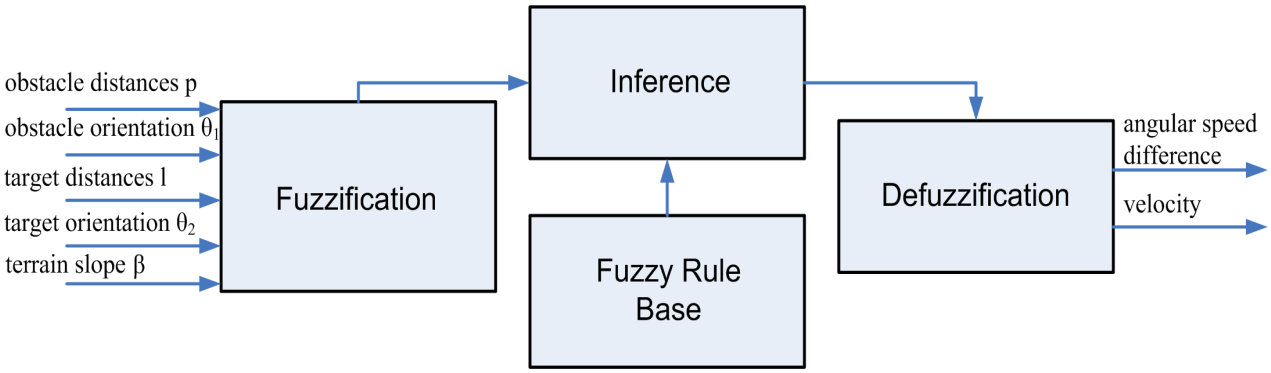

Figure 2. The block diagram of the fuzzy inference system.

SIMULATION RESULTS

The author applied the proposed fuzzy controller to the autonomous wheeled mobile robotic platform moving in an unstructured environment with obstacles. The control strategy was tested through simulations of wheeled mobile robot motion [24-27]. A simulation example of a wheeled autonomous mobile robotic platform is presented in Figure 3. The corresponding fuzzy control is implemented to perform tasks of obstacle and collision avoidance. In particular, the navigation strategy proved to be extremely sensitive to the balance between avoid obstacle and reach the target behaviors. Simulation results are shown in Figure 3.

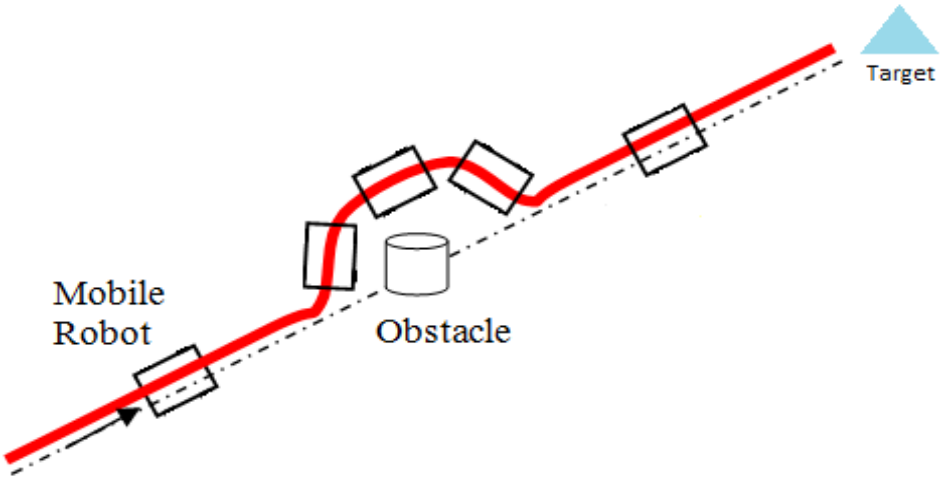

Figure 3. Obstacle avoidance trajectory of wheeled mobile robot platform.

CONCLUSIONS

The article deals with the fuzzy control of autonomous wheeled mobile robotic platform motion in an unstructured environment with obstacles. The simulation results show the effectiveness and the validity of the obstacle avoidance behaviour in unstructured environments and the velocity control of a wheeled mobile robotic platform motion of the proposed fuzzy control strategy.

Wheeled mobile robot navigation strategies using fuzzy logic have major advantages over analytical methods also simulation results recommends fuzzy logic controller for the wheeled mobile robot motion in unstructured environments.

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