Chapter 4
Integration of Advanced Obstacle Avoidance in Automated Robots to Enhance Autonomous Firefighting Capabilities

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ABSTRACT

The integration of obstacle avoidance and fire extinguishing in robots is essential for large-scale projects. This paper presents the design, development, and performance evaluation of autonomous robots with fire detection and extinguishing capabilities.

DOI: 10.4018/979-8-3693-6150-4.ch004

Using fire and temperature sensors for accurate detection and ultrasonic sensors for obstacle avoidance, the robot navigates dynamic environments while adhering to safety requirements. The paper details the selection and integration of hardware components, including sensors, actuators, and microcontrollers, and evaluates the robot's performance under varying environmental conditions. Experimental results highlight the robot's adaptability to complex scenarios and weight changes. The study also explores future improvements, such as advanced decision-making algorithms, aiming to enhance autonomous robotics for emergency situations and effective communication in critical scenarios.

1. INTRODUCTION

Robotics has undergone a remarkable evolution in recent years, permeating various sectors of our society and revolutionizing the way we approach complex tasks. From manufacturing plants to healthcare facilities, research laboratories to entertainment venues, robots have become indispensable tools, augmenting human capabilities and pushing the boundaries of what's possible. Among the most fascinating developments in this field is the emergence of self-reliant robots capable of navigating harsh environments and performing a multitude of tasks with minimal human intervention. This article delves into the intricacies of these advanced machines, focusing particularly on their line-based navigation and anti-defense capabilities, while exploring the methods and techniques essential for creating intelligent, self-managing robots. At the heart of these technological marvels lies the critical functionality of obstacle avoidance, a pivotal feature for robots operating in dynamic and unpredictable surroundings. This capability, coupled with fire detection and extinguishing abilities, forms the cornerstone of robotic systems designed to function effectively in diverse scenarios. From warehouse automation and surveillance to planetary exploration and smart home devices, the applications of such robots are vast and continually expanding.

The ability of a robot to follow a predefined path or navigate autonomously while avoiding obstacles is a testament to the seamless integration of sophisticated sensors, algorithms, and control systems. This remarkable feat is further enhanced by the incorporation of fire and flame sensors, enabling robots to detect and respond to potential fire hazards. Such advancements represent the culmination of years of research and development in robotics, computer vision, and artificial intelligence. To fully appreciate the scope and significance of these technologies, it is essential to examine the underlying principles that govern their operation. Sensor technologies play a crucial role in enabling robots to perceive and interpret their environment. Various types of sensors, including ultrasonic, infrared, and laser-based systems,