

A novel method of unmanned surface vehicle autonomous cruise

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Abstract

Purpose – This paper aims to propose a new method for combining global path planning with local path planning, to provide an efficient solution for unmanned surface vehicle (USV) path planning despite the changeable environment. Path planning is the key issue of USV navigation. A lot of research works were done on the global and local path planning. However, little attention was given to combining global path planning with local path planning.

Design/methodology/approach – A search of shortcut Dijkstra algorithm was used to control the USV in the global path planning. When the USV encounters unknown obstacles, it switches to our modified artificial potential field (APF) algorithm for local path planning. The combinatorial method improves the approach of USV path planning in complex environment.

Findings – The method in this paper offers a solution to the issue of path planning in changeable or unchangeable environment, and was confirmed by simulations and experiments. The USV follows the global path based on the search of shortcut Dijkstra algorithm. Both USV achieves obstacle avoidances in the local region based on the modified APF algorithm after obstacle detection. Both the simulation and experimental results demonstrate that the combinatorial path planning method is more efficient in the complex environment.

Originality/value – This paper proposes a new path planning method for USV in changeable environment. The proposed method is capable of efficient navigation in changeable and unchangeable environment.

Keywords Navigation, Path planning, Autonomous robots, USV, Dijkstra

Paper type Research paper

1. Introduction

Over the past several decades, unmanned surface vehicle technology has been greatly improved with the advance of computer capabilities (Ham *et al.*, 2015). It attracted much attention for their ability to perform dangerous and time-consuming missions for military and civilian purposes such as environmental monitoring, survey and inspection of marine structures after natural disasters or large-scale accidents (Murphy *et al.*, 2011).

To perform these missions using unmanned surface vehicle (USV), autonomous navigation is a central capability, as USV can move between a starting point and a target point without human intervention (Tann and Bucknall, 2013). Robot navigation involves solving the path planning or obstacle avoidance problem to generate a feasible path and to optimize this path with respect to certain criteria (Gu and Cao, 2011; Kim *et al.*, 2014). Obstacle avoidance is consisted of global

obstacle avoidance and local obstacle avoidance, and the problem of autonomous obstacle avoidance has been studied intensively in the past (Markus *et al.*, 2014; Chen *et al.*, 2013).

For local path planning, different algorithms bring different effect of obstacle avoidance in unknown environment. Artificial potential field (APF) is a typical path-planning algorithm for robots (Khatib, 1986). Although it is very suitable for low-level real-time control of robot due to its explicit physical implication and simple mathematical description (Zhang *et al.*, 2010; Shu *et al.*, 2014), there are still some problems in the original algorithm, and some substantial improvements were made. Bacterial potential field, which improves the APF with Bacterial evolutionary algorithm (Moensiel *et al.*, 2015; Byrne *et al.*, 2014; Pétrès *et al.*, 2012), ensures a feasible, optimal and safe path. For dynamic obstacles, Liu and Bucknall (2015) presented the novel

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Unmanned A Novel

Jiyuan Zhang



Unmanned A Novel:

Reviewing **Unmanned A Novel**: Unlocking the Spellbinding Force of Linguistics

In a fast-paced world fueled by information and interconnectivity, the spellbinding force of linguistics has acquired newfound prominence. Its capacity to evoke emotions, stimulate contemplation, and stimulate metamorphosis is really astonishing. Within the pages of "**Unmanned A Novel**," an enthralling opus penned by a highly acclaimed wordsmith, readers attempt an immersive expedition to unravel the intricate significance of language and its indelible imprint on our lives. Throughout this assessment, we shall delve to the book is central motifs, appraise its distinctive narrative style, and gauge its overarching influence on the minds of its readers.

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Table of Contents Unmanned A Novel

1. Understanding the eBook Unmanned A Novel
 - The Rise of Digital Reading Unmanned A Novel
 - Advantages of eBooks Over Traditional Books
2. Identifying Unmanned A Novel
 - Exploring Different Genres
 - Considering Fiction vs. Non-Fiction
 - Determining Your Reading Goals
3. Choosing the Right eBook Platform
 - Popular eBook Platforms
 - Features to Look for in an Unmanned A Novel
 - User-Friendly Interface
4. Exploring eBook Recommendations from Unmanned A Novel
 - Personalized Recommendations
 - Unmanned A Novel User Reviews and Ratings
 - Unmanned A Novel and Bestseller Lists

5. Accessing Unmanned A Novel Free and Paid eBooks
 - Unmanned A Novel Public Domain eBooks
 - Unmanned A Novel eBook Subscription Services
 - Unmanned A Novel Budget-Friendly Options
6. Navigating Unmanned A Novel eBook Formats
 - ePub, PDF, MOBI, and More
 - Unmanned A Novel Compatibility with Devices
 - Unmanned A Novel Enhanced eBook Features
7. Enhancing Your Reading Experience
 - Adjustable Fonts and Text Sizes of Unmanned A Novel
 - Highlighting and Note-Taking Unmanned A Novel
 - Interactive Elements Unmanned A Novel
8. Staying Engaged with Unmanned A Novel
 - Joining Online Reading Communities
 - Participating in Virtual Book Clubs
 - Following Authors and Publishers Unmanned A Novel
9. Balancing eBooks and Physical Books Unmanned A Novel
 - Benefits of a Digital Library
 - Creating a Diverse Reading Collection Unmanned A Novel
10. Overcoming Reading Challenges
 - Dealing with Digital Eye Strain
 - Minimizing Distractions
 - Managing Screen Time
11. Cultivating a Reading Routine Unmanned A Novel
 - Setting Reading Goals Unmanned A Novel
 - Carving Out Dedicated Reading Time
12. Sourcing Reliable Information of Unmanned A Novel
 - Fact-Checking eBook Content of Unmanned A Novel
 - Distinguishing Credible Sources
13. Promoting Lifelong Learning

- Utilizing eBooks for Skill Development
- Exploring Educational eBooks

14. Embracing eBook Trends

- Integration of Multimedia Elements
- Interactive and Gamified eBooks

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