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IMPLEMENTATION OF LASER SIMULATOR IN ROBOT PATH DETERMINATION

ZENAS CHUNG HAN YUAN

Report submitted in partial fulfillment of the requirements

for the award of the degree of

Bachelor of Engineering (Hons.) in Mechatronic Engineering

Faculty of Manufacturing Engineering

UNIVERSITI MALAYSIA PAHANG

June 2016

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Position : SENIOR SLECTURER

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ID Number : 920906-01-6319

Date : 16 JUNE 2016

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ABSTACT

The most important aspect for autonomous mobile robot to achieve its tasks is path planning. The path planning of autonomous robot is used to search a collision free path that a robot must take in order to pass over each point in an environment. The path is a plan of geometric locus points in a given space and the robot has to pass through it. In this research, the laser simulator search graph is a novel path planning approach which is proposed by Mohhammed A.H.Ali and the working principle of this approach is that the laser simulator is model as principle of real laser range finder. The environment of the robot is assume to be captured by camera and the laser range finder is used to measure the distance between robot and border. By using the measurement of distances, point in front of robot can be generated and this process repeat until the robot reach goal position. The developed laser simulator is then implemented by testing its performance in few different environments. In addition, one of the classical path planning approach which is A* algorithm will be used to compare the result generated by laser simulator. From this research, the laser simulator has advantages in computational time and low collision possibility compare with A* algorithm while the path cost of laser simulator is always greater than path cost of A* algorithm. Dari kajian ini, simulator laser mempunyai kelebihan dalam masa pengiraan dan kemungkinan perlanggaran rendah berbanding dengan A* algorithm manakala kos jalan laser simulator sentiasa lebih besar daripada kos jalan A* algorithm.

ABSTRAK

Aspek yang paling penting untuk robot mudah alih autonomi untuk mencapai tugas-tugas adalah perancangan laluan. Perancangan jalan robot autonomi digunakan untuk mencari jalan yang menghindari daripada perlanggaran dan robot mesti melalui atas setiap titik oleh perancangan jalan dalam persekitaran. Jalan dirancang adala pelan mata locus geometri dalam ruang yang diberikan dan robot perlu melaluinya. Dalam kajian ini, laser carian graf simulator adalah satu pendekatan perancangan laluan novel yang dicadangkan oleh Mohhammed A.H.Ali dan prinsip kerja pendekatan ini adalah bahawa simulator laser adalah model sebagai prinsip laser sebenar pencari julat. Persekitaran robot diandaikan akan ditangkap oleh kamera dan laser pelbagai pencari yang digunakan untuk mengukur jarak antara robot dan sempadan. Dengan menggunakan ukuran jarak, titik di hadapan robot boleh dihasilkan dan proses ini berulang sehingga kedudukan matlamat robot jangkauan. The laser simulator dibangunkan kemudiannya dilaksanakan dengan menguji prestasinya dalam beberapa persekitaran yang berbeza. Di samping itu, salah satu daripada pendekatan perancangan laluan klasik yang A* Algoritm akan digunakan untuk membandingkan keputusan yang dihasilkan oleh laser simulator.

CHAPTER 1

INTRODUCTION

1.1 Introduction

The most important elements for autonomous mobile robot to achieve its tasks is path planning. The path planning of autonomous robot is used to search a collision free path that a robot must follows in order to pass over each point in an environment. The path is a plan of geometric locus points in a given space where the robot has to pass through. There are two methods of path planning of a mobile robot which are global planning and local planning. For global planning, the surrounding terrain of a mobile robot is known totally and the collision free paths is determined off-line. The surrounding of mobile robot is partially or totally unknown and sensor with feedback need to be implemented for real-time plan of path through environment step by step in local planning.

In general, the problems of path planning for mobile robots are modeling the robot's environment in the useful way, foundation of collision-free path from start to the goal of robot's motion [4], and seeking of goal. Most of the path planning approaches have been used to search for shortest path or optimal path to reach goal, avoiding static and dynamic obstacles and navigate in a complex environments. However, most of the existed approaches of path planning have drawbacks such as each of these approaches are only suitable to specific environment and condition. This study innovate a novel path planning algorithm to determine the most optimum travelling path in a complex environment with applying multiple constrains for the motion.

1.2 PROBLEM STATEMENT

Classical path planning approaches have been used to search for shortest and optimal path to reach goal while avoiding static and dynamic obstacles and navigate in a complex environment. However, the classical path planning approaches have several disadvantages such as computational complexity and disability to solve the problem in static /dynamic environments. Therefore, a novel path planning algorithm needs to be developed to determine the most optimum traveling path in complex environments with applying multiple constraints for the motion.

1.3 RESEARCH OBJECTIVES

1. Model the laser simulator as a principle of real laser range finder.
2. Develop laser simulator search graph approach algorithm using MATLAB.
3. Simulate the laser simulator method in different environments.
4. Compare the outcome of laser simulator with a classical path planning.

1.4 SCOPES OF RESEARCH

1. The environments of mobile robot should be represented in two dimension grid map gm = f(x, y).
2. The borders of environments and obstacles are represented as polygonal (straight, tangent and circular lines) in the map.
3. Start and goal locations are totally known.
4. The Laser Simulator is working as laser range finder behavior.

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

2.1.1 ENVIRONMENT REPRESENTATION

Before a robot can plan a collision-free path, the robot needs a completed model of the objects in its environment. There are different ways for object representation in robotic environments [Choset 97, Warren 89], such as the grid, the cell tree, and the polyhedral. Figure 2.1 reflects a simple environment representation using these approaches. In the grid representation shown in Figure 2.1b an array of identical cells is setup, and the cells are marked according to the occupancy (usually 1 (dark), if occupied; 0 (white) otherwise). This type of representation simplifies the computation, but requires a large amount of memory [Warren 89]. The cell tree method overcomes this disadvantage by using a smaller number of cells. Cells that are completely inside or outside an objects have a fixed size, while the cells which are partially occupied by object(s) are further divided into smaller cells. The process is repeated until all cells are completely inside or outside the objects or the maximum resolution is reached. The 2D quadtree (Figure 2.1c) is the most widely used representation of the Cell tree class. This class representation is particularly efficient in environments that contain large objects; however, when the environment is occupied by small objects, this representation is wasteful due to the overhead of computing the adjacency of the cells.

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