PATH PLANNING FOR AUTOMATIC ROBOT

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"I hereby declared that this report is a result of my own work except for the excerpts that have been cited clearly in the references."

Signature :
Name : Nor Azura Binti Jaimin
Date : May, 07, 2008

"I hereby declared that this report is a result of my own work except for the excerpts that have been cited clearly in the references."

Signature : ....
Supervisor's Name : ....MAZREE BIN IBRAHIM....
Date : ....7/5/08....

To my beloved parent

ACKNOWLEDGEMENT

I would like to thank Allah s.w.t, the most gracious and most merciful, wisdom and peaceful for giving her a time in completing this task.

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Thanks.

ABSTRAK

Dalam Projek ini, pendekatan secara automatik digunakan di mana penglibatan interaksi di antara manusia tidak diperlukan. Sistem motor untuk robot ini dibina agar ia boleh bergerak mengikut arah yang telah ditetapkan. Dalam kes ini, langkah-langkah dalam membuat formula dan penyelesaian masalah robotik dalam pelbagai model akan ditekankan. Asas yang diperlukan dalam menyelesaikan masalah robotik adalah penggunaan algoritma yang mengubah spesifikasi peringkat tertinggi tugas manusia kepada peringkat terendah penerangan untuk bagaimana ianya akan bergerak. Perancangan jalan diperlukan dalam kaedah ini. Ia biasanya merujuk kepada permasalahan pergerakan robot dengan mengambil penyelesaian algoritma dan menentukan bagaimana pergerakannya dengan mengambil kira had mekanikal pada robot tersebut. Aplikasi penggunaan perancangan jalan untuk robot ini boleh digunakan di bangunan-bangunan seperti vakum. Maka, untuk menganalisa perancangan jalan yang telah dicipta, projek ini perlu dilaksanakan bagi menganalisa kemungkinan dan kebolehan pergerakan robot ini.

ABSTRACT

From this project, an automatic approach is used to assure that no human interaction is necessary. The motor system for the robot is build in order to make it mobile. In this case, the methods of formulating and solving the robotic problems in various models are stressed. A fundamental need in robotics is to have algorithms that convert high-level specifications of tasks from humans into low-level descriptions of how to move. The terms path planning is often used for these kinds of problems. It is usually refers to the problem of taking the solution from a robot motion planning algorithm and determining how to move along the solution in a way that respects the mechanical limitations of the robot. The application of this mobile robot can be used at any building such as vacuum robot. It can move to the path that has been planning to do their tasks. So, to analyze the path that has been created, these project need to be implemented to analyze its possibilities and abilities movement.

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LIST OF ABBREVIATION

PIC	- Palaralell interface Circuit
ROM	- Read-only memory
EPROM	- Erasable programmable read-only memory
PROM	- Programmable read-only memory
RAM	- Random access memory
WDT	- Watchdog-Timer

LIST OF APPENDICES

CHAPTER 1

INTRODUCTION

This chapter explained about the importance of this project in the future and the problem that always occurred nowadays.

1.1 Identification of Project

The main idea is to use a communicating and possibly sensing devices to plan paths for mobile agents. In this project, the path has been plan for a mobile robot. It will used to analyze the possibilities and abilities of the robot to follow the path from start to goal. The outcome is to find the solution of the cost of the path that reflects how easy it was to follow that path. The cost will then reflect the average characteristics of that path. By choosing the path with the lowest cost, the robot can reduce collision risk and minimize travel distance.

The use of this path planning will help UTeM's student to learn and how to create the path for mobile robot. It also gives them the example of the path planning that are less risky to follow because in our faculties does not have this planning yet.

This project is the combination between hardware and software in order to implement the paths that have been creating. The component will be testing such as microcontroller circuit (PIC) and motor controller circuit. The microcontroller (PIC) and motor controller will used to control motors left, right, and move forward and backward.

1.2 Objective

To achieve the target in this project, the objectives below have been fixing as a guide in how to implement this project to improve its ability. First, is trying to simulate a path-planning algorithm for automatic robot by using microprocessor-based system. Second is to integrate the mobile robot with a path planning software and third is to learn to choose paths that are less risky to follow.

1.3 Scope of Project

Generally, the scopes of this project are:

(i) Creates the path that are less risky to follow
(ii) Produce a mobile robot that can find a path that have been planned
(iii)Produce a motor system for the robot in order to make it mobile
(iv)Build up a program to control the motor
(v) Build a microcontroller circuit and controller circuit

If there is any indirection in this movement of the mobile robot, the modifying is needed to adapt the mobile robot with the path.

1.4 Problem Statement

From the previous application that I have observed, Sometimes the robot was trapped to the local minima and some paths that would have been easy to follow where never generated. In a real life, a robot is never able to follow precisely the path that it has planned. Therefore, it will be useful to analyze the abilities of the path that I have created and try to find a solution for the mobile robot.

In addition, the research on this path planning never has been resolved so that I would take this opportunity to recognize its ability and possibility. In our life, this path planning is important to thrifty people in time, cost and space in order to accomplish human necessity. The better the robot was able to follow the path that it has planned the better the path is. The application of the path will help inventor to reduce any collision, wasting their time, budget, and help them to make the robot follow the path that have been planned.

CHAPTER II

LITERATURE REVIEW

These literature reviews were about the research and the previous project that related with this project. This research helps me a lot to achieve the goals of my project. The sample of the project will show their research before.

2.1 Research on path planning

The journal's title covering the path space: A Case base Analysis for mobile Robot path planning [1] describes path planning as below:

> *They replace a heuristic path-planning algorithm of the mobile robot with a seed casebase and prove the upper and lower bounds for the cardinality of the casebase. The proofs indicate that it is realistic to seed the casebase with some solutions to a path-finding problem so that no possible solution differs too much from some path in the casebase. This guarantees that the robot would theoretically find all paths from start to goal. The proof of the upper bound of the casebase cardinality shows that the casebase would in a long run grow too large and all possible solutions cannot be stored. In order to keep only the most efficient solutions the casebase has to be revised at run-time or some other measure of path difference has to be considered.*

2.1.1 System Description

Their approach to mobile robot path selection consists of a general world model and of a memory, which stores the path traveling experiences for later use. The memory is a casebase. The casebase stores the paths traversed in the past in a form of cases.

The world model is a map that permits path planning. Since in a dynamic environment the robot is not able to model all the aspects of its surrounding, the map is always more or less imprecise.

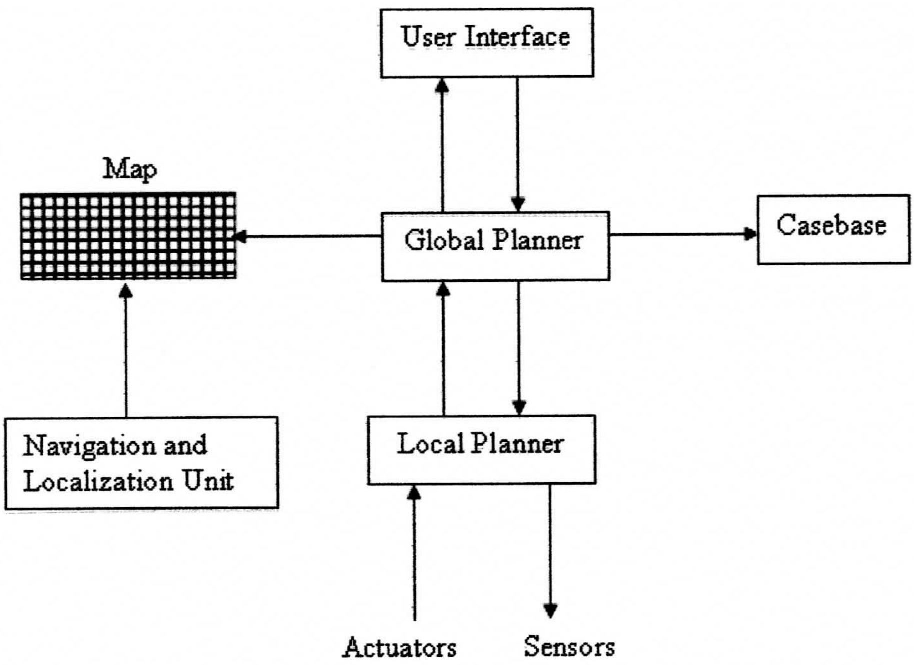

Figure 2.1: General overview of path planning

Figure 2.1 captures the bottom line of this approach. The global planner receives tasks from the user. The tasks are requests to move to a specific point from its present location. The global planner has a map of the environment that represents only the very general geometry of the environment and the locations of the target points. The presence and location of dynamic obstacles in the environment are unknown. Given a new task, the global planner can either find a new solution by using a map-based path planner or re-use one of the earlier found paths from the casebase. The path planned by the global planner is presenting the low-level planning and execution unit that is responsible for task decomposition (if necessary), re-planning, localization, sensor data processing and actuator control.

The objective of the global planner is to choose the best travel path according to some criterion (e.g. time, distance, safety). Case-based reasoning permits the robot to remember and learn from its experiences. The robot will adapt to the changes in the dynamic environment and learn to use paths that are better.

2.1.2 Path Planning

In the context of mobile robotics, path planning means finding a collision-free path from start to goal. The method of path planning depends on the world model of the robot. In this work, a grid map represents the world as a grid of small cells. Some cells that are known to contain static obstacles can be marked as occupied.

In journal's title Planning in Robotics written by Dana S. Nau[8] state the definitions of path planning are:

- *q = the configuration of the robot = an n-tuple of reals*
- *CS = the configuration space of the robot*
  = {all possible values for q}
- *CSfree = the free configuration space*
  {Configurations in CS that do not collide with the obstacles}

- Explicit definition of *CSfree* is computationally difficult
  - Exponential in the dimension of *CS*

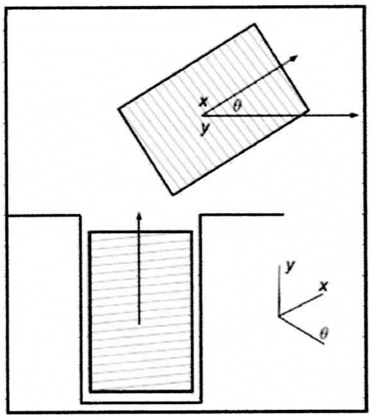

Figure 2.2: Car-like robot and environment

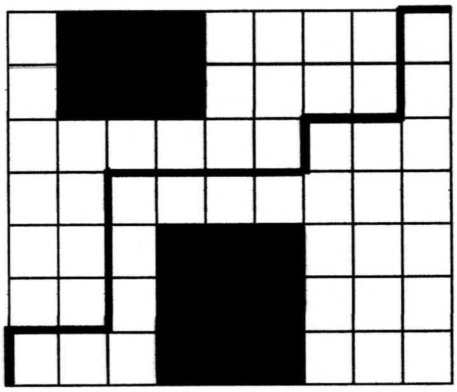

Figure 2.3: A grid map

Figure 2.2 shows a grid map. Black cells on the map represent static obstacles. The paths form start to goal is generate it heuristic algorithm that has been create.

There are two problems associated with our method of path generation. First, it cannot be guarantee that it would theoretically find all the possible paths from the given start to the given goal. Second, even on a relatively small grid the amount of different paths between specified target points is overwhelming. At the same time most of the paths differ form each other only by a very small amount.

The paths that the robot has followed are stored in the casebase. This remarkably reduces the size of the casebase. If a necessary solution is not in the casebase or its quality is not good enough, a new solution can be generated using map-based path planning.

2.1.3. Path building rules

a) The move is legal according the path rules above

b) You have not visited the grid location already

c) You have reached the max depth for this iteration

If b) is true, this means that the node is already in the tree, but it may not be on best path to reach that node. We resolve this conflict by associating with each node a cost of the path to reach that node from the starting point. In this case, the cost is the number of steps in the path and this corresponds to the depth of the three at the node location. So if we have already visited a node, we will move the node to the new path only if it is at a deeper level in the tree. Next step is to Plan and Execute a Path between known locations then write a behavior that reads in the map of the pen and computes the path between a goal location and a known starting grid cell location in the pen.

2.2 Mobile robot

Robot can classify into two categories; fixed robot and mobile robot. Fixed robot is a robot that placed in one static place and its work limited by area while mobile robot can move from one place to another. A robot that can moves from one place to another place to complete their tasks and it is very important to help human in many cases. Mobile robot has many kinds like wheeled, tracked and legged robot. It also has 3 main parts known as processor, motor controller and sensor. The Features of Mobile Robot is a Low Speed because Speed is a considerable disadvantage.

Where v is the velocity forward of the centre of the robot and Ǿ is the angular velocity around the centre of the robot.

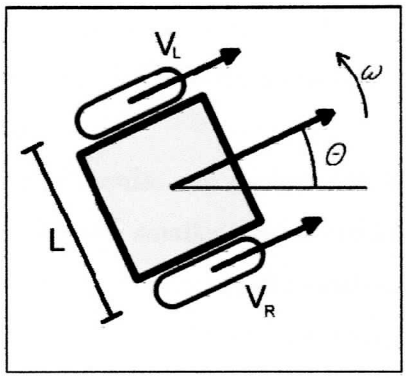

Figure 2.4: Differential driven robot

Figure 2.4 shows the Differential driven Robot indicates the instant heading angle of the robot. Assuming no slip, the direction the vehicle is facing towards, is the same as the direction of the velocity vector (at and instant in time). An advantage of this fact, it simplifies calculations. A disadvantage however is that it cannot move side wards.

2.2.1 Chassis

A chassis made from sheet metal or machined metal is generally very strong. In fact, it is usually much stronger than necessary. Steel and aluminum are both very popular. A metallic chassis often require quite specialized tools. If the chassis is not milled from a solid block or metal, methods to assemble the various pieces also required.

Plastic (acrylic) is not strong enough for a slower robot. The key to strength in a chassis made from sheet plastic is how the pieces are assembled. Plastic is easy to work with. Most stores selling sheet plastics (such as taps plastic) also optionally cut sheets into specified dimensions. Plastic is easy to cut, easy to put pieces of a plastic chassis together with glue (epoxy or hot glue). The robot need to add an extra weight just to make sure that the robot does not topple (to the front).

Wood chassis has a natural self-dampening property. This is quite useful for designs with long sensor arms because bouncing and consequent vibration can interfere with reflective sensor readings. Wood is also easy to work with.