Collision Free Autonomous Robot Path Planning

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Abstract

Robots play an important role in many typical and hazardous works. This paper consists of finding an optimum path without colliding with the obstacle or obstacles for a mobile robot to reach a predefined goal in an environment containing stationary or dynamic obstacles. Artificial potential field method has been employed for the purpose in this paper. However, there are certain critical situations in which this method may fail. These situations have been analyzed and a simple but robust algorithm has been suggested to overcome these situations. In this paper an algorithm for path planning is used to get optimum path without colliding with obstacle. The proposed path planning must make the robot to avoid obstacle to get optimum path towards its goal.

Introduction

A robot is programmable, human like structure & multifunction manipulator designed to perform different tasks through variable program.

Robotics is the art, science and technology of robots, and their design, manufacture, application, and structural character.

Autonomous robots which work without human operators and are required in robotic fields, in order to achieve diffrent tasks (Hachour, 2008).

Autonomous robots have to be intelligent and should decide their own action. When the autonomous robot decides its action, it is necessary to plan optimally depending on their tasks. More, it is necessary to plan a collision free path minimizing a cost such as time, energy and distance. When an autonomous robot moves from a point to a target point in its given environment, it is necessary to plan an optimal or feasible path avoiding obstacle in its way and answer to some criterion of autonomy requirements for example thermal, energy, time, and safety. Therefore, the major work for path planning for autonomous mobile robot is to search a collision free path.

Robot Path-Planning

Robot Path planning is generating a collision-free path in an environment with obstacles and optimizing it with respect to some criterion i.e. minimum distance traverse & minimum time taken

Planning process for development of robot

The artificial potential field methods provide simple and effective motion planning for practical purpose. The avoidance of local minimum has been an active research topic in path planning by potential field. As one of the powerful techniques for escaping local minimum, simulated annealing has been applied to local and global path planning.

The basic idea behind all potential field approach is that the robot is attracted towards the target, while being repulse by the obstacles that are known in advance. If new obstacles appear during robot motion, one could update the potential field in order to integrate this new information.

Artificial Potential Field Approach

The artificial potential field (APF) method provides simple and effective motion plan for practical purpose (Sharifi and Vinke 1993; Lee and Park 1991; Khatib, 1986).

The application of artificial potential fields for obstacle avoidance was first developed by Khatib. This approach uses repulsive potential fields around the obstacles to force the robot away and an attractive potential field around goal to attract the robot. Consequently, the robot experiences a generalized force which equals to the negative of the total potential gradient. This force drives the robot downhill towards its goal configuration until it reaches a minimum distance and then it stops. The artificial potential field approach can be applied to both global and local methods (Sharifi and Vinke 1993).

Algorithm

(1) Identify the work space of robot.
(2) Start to move from initial (start point) position towards target (end point).
(3) If target is reached then stop movement & display the path generated ,other wise go to step 4.
(4) If there is an obstacle then search the new shortest path.
(5) Move left or right to the obstacle.
(6) If the new path is near to target then follow it, otherwise follow left path.
(7) Repeat steps 4 to 6 until target is not reached.
(8) Stop the movement after reaching the goal by covering optimum path.

Flow Chart

General flowchart is presented in the figure 1, where the main work is described in order to get the target.

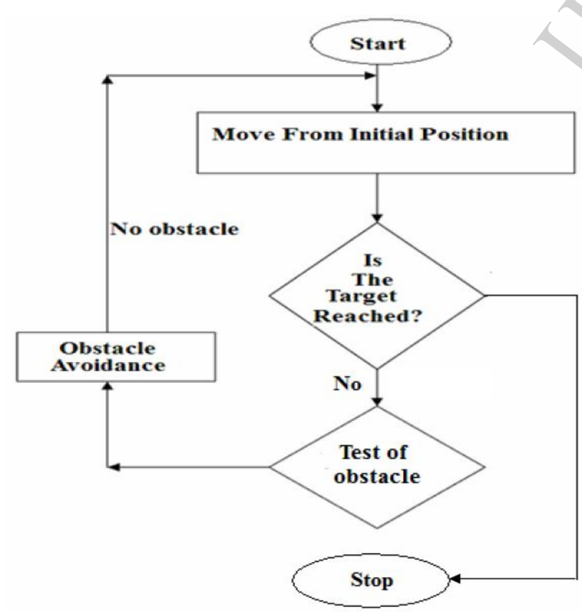

Fig. 1: General flowchart

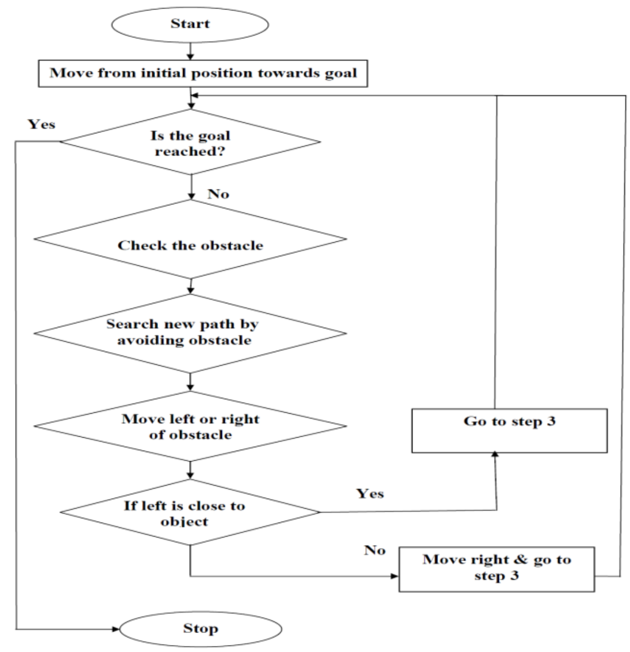

Fig. 2: Flow chart used in programming

Result

The following simulation paths are found by assuming that the robot moves at a constant speed and the environment is completely known. The following result shows that the robot reach to the end (goal) point without colliding with the obstacle in its path and get optimum path required.

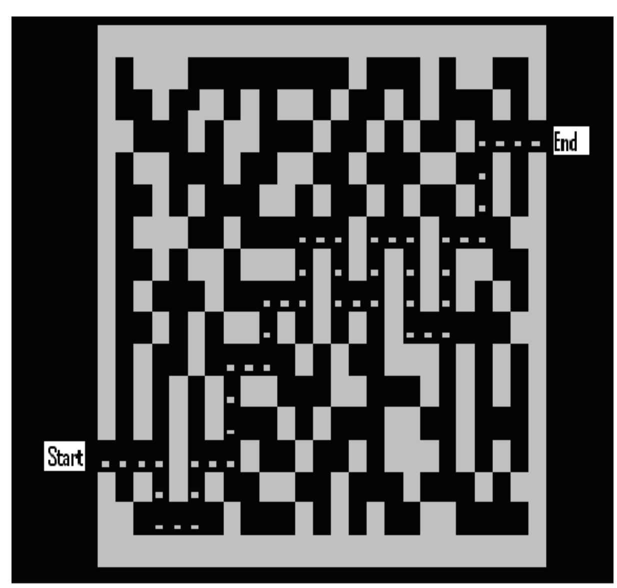

Fig. 3 : Simulation result for start to end point

Conclusion

In this paper, artificial potential field method has been used to find the optimum path for navigation of mobile robot. The critical cases where this method fails are analyzed and a new algorithm has been proposed to overcome these limitations.

Following are the conclusion of this project:-

(1) An algorithm for path planning is developed to navigate the robot from source to target.
(2) The algorithm is implemented in C++.
(3) The algorithm implemented in this paper can navigate the mobile robot from start to the end point by avoiding the obstacle and obtaining the optimum path.

Autonomous Robotics gives an outline of the following areas of significance as concerned with this paper.

(1) Path Traversal
(2) Map Generation
(3) Path planning for hazardous environment.
(4) It is suggested that in future some sensors should be used, like Range Detection Sensor to find the position of the obstacle(s) and the goal.

In future service robots will be required to run autonomously over long periods of time. These robots will have to share their workspace with people and interact with humans as well as manually and autonomously operated vehicles. Typically, these environments change over time and cannot be assumed as static.

References

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