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Research Paper

# AUTONOMOUS ROBOTS IN CHANGING SURROUNDINGS

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Autonomous robots are the robots that can perform desired tasks in unstructured environments without continuous human guidance. Many kinds of robots have some degree of autonomy. Different robots can be autonomous in different ways. A high degree of autonomy is particularly desirable in fields such as space exploration, where communication delays and interruptions are unavoidable.

**Keywords:** Autonomous, Human guidance, Interruptions

## INTRODUCTION

Some modern factory robots are “autonomous” within the strict confines of their direct environment. Every degree of freedom may not exist in their surrounding environment, but the work place of the factory robot is challenging and can often be unpredictable or even chaotic. The exact orientation and position of the next object of work and (in the more advanced factories) even the type of object and the required task must be determined. The important area of robotics research is to enable the robot to cope with its environment whether this be on land, underwater, in the air, underground or in space.

A fully autonomous robot has the ability to

- Gain information about the environment.
- Work for an extended period without human intervention.

- Move either all or part of itself throughout its operating environment without human assistance.
- Avoid situations that are harmful to people, property, or itself unless those are part of its design specifications.

An autonomous robot can learn or gain new capabilities like adjusting strategies for accomplishing its task(s) or adapting to changing surroundings. One of the ultimate goals in robotics is to create autonomous robots. Developing the technologies necessary for autonomous robots is a formidable undertaking with deep interweaved ramification in automated reasoning, perception and control. The minimum one would expect from an autonomous robot is the ability to plan its own motions.

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## METHODOLOGY

The theoretical and practical understanding of some of the issues has increased rapidly in the combined work of researchers in Artificial Intelligence, theoretical Computer Science, Mathematics and Mechanical Engineering. In addition to producing effective planning methods, this work has contributed in advancing the knowledge of the mathematical structure of the problems and to pinpointing their inherent computational complexity.

These methods definitely require the ability to plan motions to be developed automatically. Except in limited and carefully engineered environments, it is not realistic to anticipate and explicitly describe to the robot, all the possible motions that it may have to execute in order to accomplish requested tasks. Even in those cases where such a description is feasible, it would certainly be useful to incorporate automatic motion planning tools in off-line robot programming systems. As robots become more dexterous, the need for motion planning tools will become more critical. The kind of operative intelligence that people use unconsciously to interact with their environment, which is needed for perception and motion planning, turns out to be extremely difficult to duplicate in a computer program.

The mathematical and analytical analysis gives a comprehensive account of recent results in motion planning and to organize them in unified framework. Motion planning involves diverse aspects like, coordinating the motions of several robots, planning sliding and pushing motions to achieve precise relations among objects, reasoning about uncertainty and to build reliable sensory based motion strategies, dealing with

models of physical properties such as mass, gravity and friction and planning stable grasps of objects. Therefore, motion planning requires the robot to consider geometrical constraints, as well as physical and temporal constraints. In addition, uncertainty may require that it plans not only motion commands, but also their interaction with sensing. When knowledge at planning time is too incomplete, it may become necessary to interweave planning and execution in order to collect appropriate information through sensing.

## ROBOT PATH

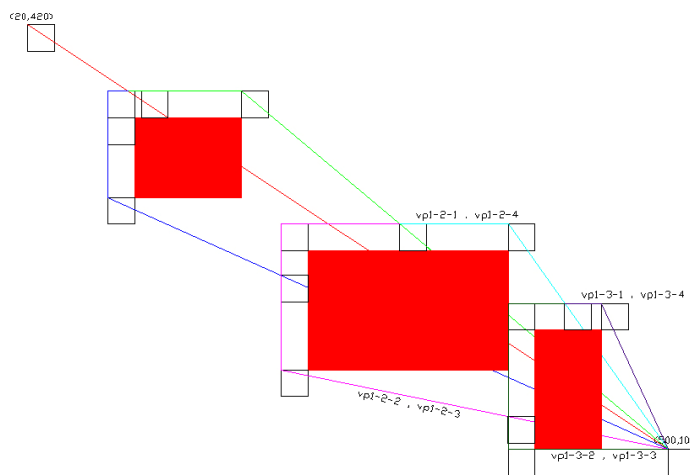
Robot path control is to program the robot to move on the designed path without any deviation so as to reach the target position. Thus the motion planning system has to be able to cope with the dynamic or static situations. To take advantage of high performance robots and respond quickly to external changes in the domain, the system has to run at real time rates during the motion with high speed. It means the respecting dynamics constraints in the robot motion to avoid collisions while staying within the operational bounds of the robot, in multiple robots working environment. Thus in such situation, the system must find solutions such that the robots do not collide to reach their respective destinations. Otherwise, the robot path control becomes more complex and unpredictable in the multiple working environment. The main goal of any designer is to develop a simple strategy for modifying the individual robot path by the shortest distance possible, to reach the target positions. In many situations multiple mobile robots operate in the same environment. When the robots stay far enough apart they can plan their motions more or less independently, but when they get within close range of each other, their motions must be

co-ordinated in order to avoid mutual collisions leading to deadlock situations.

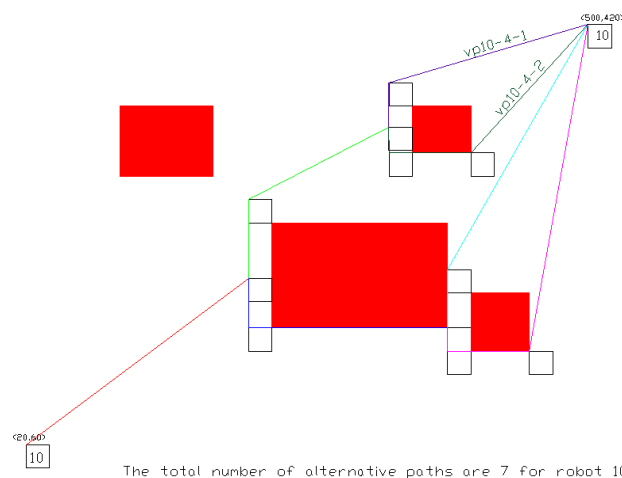
Any approach proposed by a designer has to suggest a suitable feasible motions for a robot and network in multiple robots systems. Once a path is available, path planning queries are solved easily by finding alternative path or paths, in case of the possibility of the robots facing obstacles.. First, a simple path is designed for just one robot. Then number of such paths can be combined to

identify number of shortest paths and alternate paths. Such approach is a flexible one, in the sense that it is easily applicable to various robots, provided that one is able to design simple path for one such robot. Proper design of the simple paths guarantees probabilistic completeness and then find the solution for planning problem and their time complexity, for which a solution exists and their time complexity. Therefore, a model is necessary to overcome such issues.

**Figure 1: All the Alteranate Paths for Robot 1 with the Three Obstacles**



**Figure 2 : All the Alteranate Paths for Robot 10 with the Four Obstacles**



## PATH COORDINATION

Path coordination approach has been proposed based on the scheduling technique, David and Canny, 1990 , Lozano Perez, et al., 1979 [118], Chaimowicz Luiz, et al., 2004 based on a scheduling technique for concurrent database. It is assumed that the path plan problem involves just two robots. First, paths P1 and P2 for the two robots are planned independently. Then a 2 – D coordination diagram is constructed, where the x axis corresponds to path p1 and the Y axis corresponds to path P2. a Point (x, y) in the co-ordination diagram corresponds to the placement of the first robot at the configuration P1(x) and the second robot at the configuration p2(y). If the two robots intersect at the configurations P1(x) and P2(y), then (x, y) is a forbidden point in the coordination diagram. The path co-ordination is not considered for more than two or multiple robots.

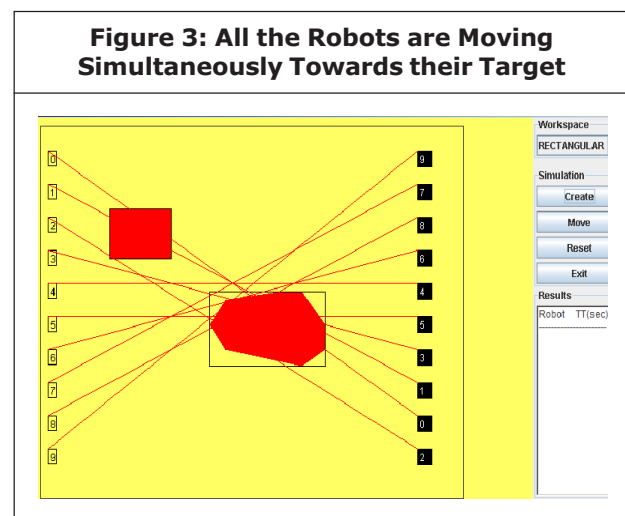
For the movement of the robot, a workspace is considered, in which the simulation is started by taking around 10 robots, and keeping the regular or irregular obstacles in the workspace. The motion planning is idealized in such a way that the robots start moving in the confined workspace and is able to reach the target to accomplish some task. While moving in the workspace, the robot comes across the boundary of the workspace, the other moving robots and the stationary obstacles. All these three parameters are treated as obstacles and therefore while the robots are moving to its destination, it has to come across these parameters and deviate from its initial path in order to avoid the collision with them. Based on the area of the workspace, the robots can be added to the existing scenario of the workspace, giving the added robots an initial position and target position. The obstacles too can be added

and accordingly, the existing robots have to change their path dynamically so as to avoid the newly added obstacles, and reach its goal by minimum possible distance.

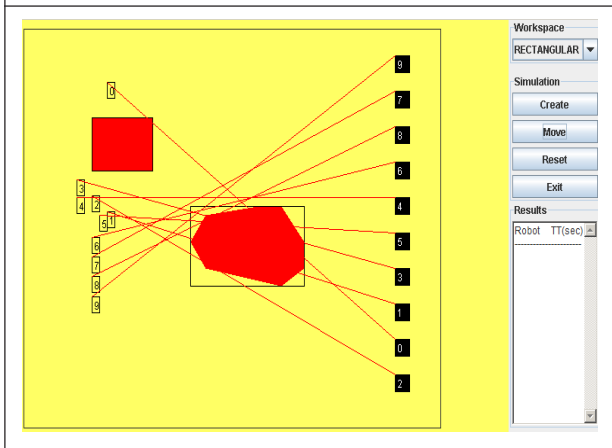
The position of the robot and the position of the obstacles are recognized by clustering incorporated to the geometrical aspects of the robot and its environment. Every movement of the robot with respect to the other robots at every instant is to be monitored continuously, so that the robot can take a decision instantaneously about its path planning and can trace on the newly planned path which is free from collisions.

## RESULTS AND DISCUSSION

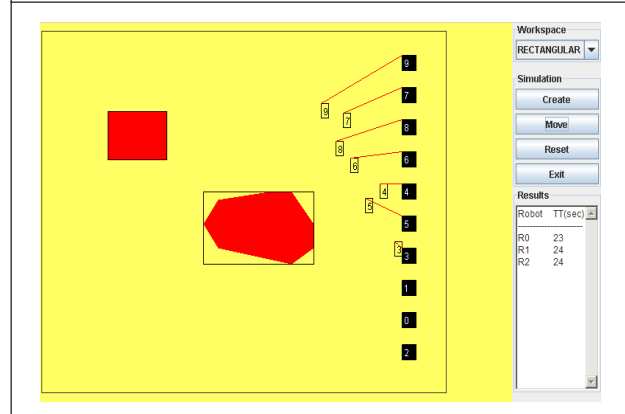
All the robots are moving on its path and selecting the alternate path which is the shortest among all considering the shape of the obstacles and also the boundaries. The motion of the robot is progressing in single one way direction and is constrained to move only in the forward direction. Figures 3-8 shows the instantaneous motion of the robot with respect to obstacles and the time that each robot is taking. The last figure shows that all the robots when starts simultaneously, each of them moving in a path which is obstacle free path and reaches its target.



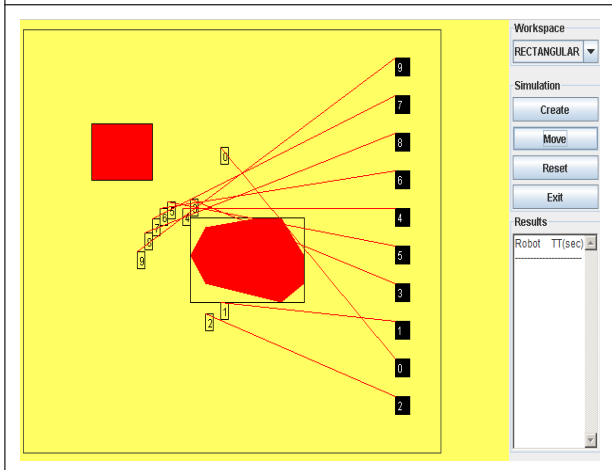
**Figure 4: All the Robots are Moving and Deviating Their Paths due to 1<sup>st</sup> Obstacle**



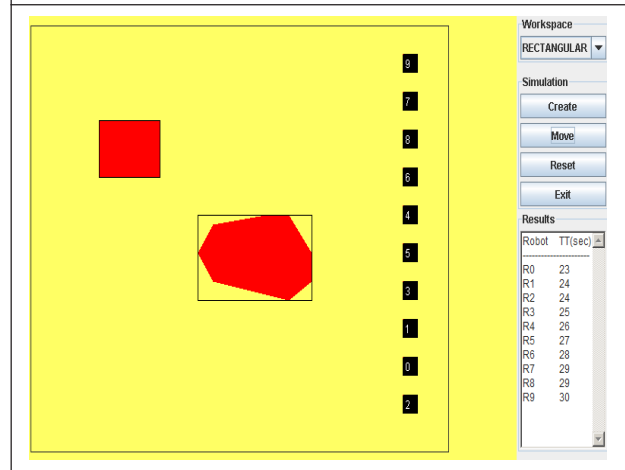
**Figure 7 : All The Robots are Moving and Approaching Their Target, Three Robots Reached**



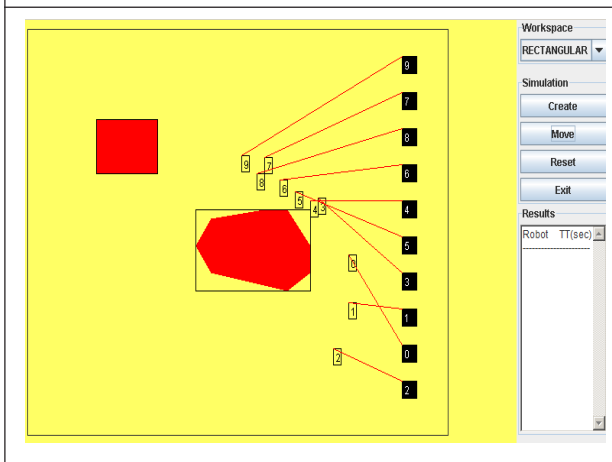
**Figure 5: All the Robots are Moving and Deviating Their Paths due to 2<sup>nd</sup> Obstacle**



**Figure 8: All the Robots are Moving and Approaching Their Target, all Robots Reached**



**Figure 6 : All the Robots are Moving and Approaching Their Target, Keeping Priority**



## CONCLUSION

The robots considered are allowed to move only in the forward direction, i.e., from left to rightward motion. The future scope may be concentrated on the motion in the backward direction too. The boundary of the robot is a rectangular workspace. The boundary may be altered to any of the curve or any combination of a closed line with varying dimensions.

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