Robotic Path Planning Using the Intelligent Control
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Abstract—This paper discusses using graphical user interface, a strategy based on model of evolution, to solve the path of robotic path planning. This method provides an alternative to conventional path planning. Aside from being efficient and robust, the parameters for the path can be changed without changing the complete algorithm. This strategy can be used in the military applications for the navigation purpose, by adding a metal detector and a spy cam on the robot. This paper discusses the mobile robot which can be extended to higher dimensional configurational space. These generations of military robots generally operate under direct human control. One factor is that as robotic systems perform a larger and more central role in military operations, there is a need to have them to continue to function just as a human soldier would, if communication channels are disrupted. We outline the tools and techniques necessary for an operator to specify, execute, and monitor such military applications.

Keywords—Robot, autonomous, path planning

I. INTRODUCTION

ROBOTICS are advancing today to the point where many tasks that used to be for humans only have been supplemented by machines that can do the same tasks faster and safer than the humans. Factories are using automated robots that do repetitive tasks all the daylong leaving the more skill oriented tasks for the qualified personnel. Nowadays, some modern households have small autonomous vacuum cleaners that patrol the house cleaning while no one is actually controlling them. Of course these products have their limitations. A human is always needed to verify that the robot is doing its job appropriately. We don't really want to leave people out of checkpoints and quality control, but the robots can do the majority of the grunt work for society to provide a safer, cleaner, and potentially better place to live for all humanity. With the advancement and ever shrinking foot print of microcontrollers and central processing units more power and features can be fit on to smaller devices. This paper intended to take advantage of the advancements in the electronics fields to create a wireless PC controlled robot.

These systems’ potentially decentralized processing, innocuous size, distributed sensing capabilities, and low cost will afford tomorrow’s soldier a powerful tool for situational awareness. The Robot is going to be controlled from a computer with a wide range of functions with a robot control systems. The presented robot control system can be used for different sophisticated robot applications. The control system consists of a PC, a microcontroller that collects data from the PC and control the robot. The intelligent control software, which has been developed using MATLAB. A complete solution of a robot control solution is presented in this paper.

Arkin et al. [1] has proposed a method by the use of Genetic Algorithm, as an unsupervised learning method for a complete reactive control architecture which greatly reduces the effort required to configure a navigation system. The system can be fully implemented and has been evaluated through extensive computer simulations of robot navigation through various types of environment.

Kavraki et al. [2] proposed a method for automated inspection or surveillance of indoor environments it is important to find a short path that covers the entire environment. This problem, also known as the watchman route problem. Their approach is general in that different visibility constraints can be imposed on the sensor model and it is also applicable for three-dimensional regions. In a variation of the watchman route problem, there is one or more intruders present that has to be detected. This problem is harder because intruders are assumed to move arbitrarily fast and can play “hide-and-seek” by sneaking back into areas already covered by the surveillance agent. A solution, if it exists, will cover the environment and detect all intruders, independent of their number and maximum speed. LaValle et al. [3] dealt with this problem in the case of one or more robots with omnidirectional vision and a polygonal environment. LaValle and Hinrichsen [4] later extended this work to include curved environments.

II. PATH PLANNING

While the scenario described is geared towards micro autonomous systems, initial research has focused on larger surrogate platforms until the first micro autonomous vehicles
become available. In the scenarios that serve as the focus of this paper, an unmanned aerial vehicle is used first to scout the exterior of a target building, discover an entrance point, and then utilize that ingress to locate a target of interest [Fig1]. Once the target has been identified, the aerial vehicle then guides the team of ground vehicles into the building and into the proximity of the target of interest using a controlled formation. Finally, when contact has been made, the ground vehicles form a mobile, distributed sensor network suitable for intelligence gathering, including visual Simultaneous Localization and Mapping (SLAM) for reconnaissance.

A. Collision-free Path

One of the main problems in robotics, called robot path planning, is to find a collision-free path amidst obstacles for a robot from its starting position to its destination[5][6].

Several military robotic-automation systems already operate at the level where the human is still in charge and responsible for the deployment of lethal force, but not in a directly supervisory manner [8]. Examples include: (i) the Phalanx system for Aegis-class cruisers in the Navy “capable of autonomously performing its own search, detect, evaluation, track, engage and kill assessment functions”[9] (Fig. 1); (ii) the MK-60 encapsulated torpedo (CAPTOR) sea mine system – one of the Navy’s primary anti-submarine weapons capable of autonomously firing a torpedo and cruise missiles; (iii) the Patriot anti-aircraft missile batteries; (iv) “fire and forget” missile systems generally; and (v) anti-personnel mines or alternatively other, more discriminating classes of mines (e.g., anti-tank). These devices can each be considered to be robotic by some definitions, as they all are capable of sensing their environment and acting, in these cases through the application of lethal force.

B. Exploring an unknown polygon

Discrete visibility: Many on-line computational geometry algorithms for exploring unknown polygons assume that the visibility region can be determined in a continuous fashion from each point on a path of a robot. Is this assumption reasonable?

1) Autonomous robots can only carry a limited amount of on-board computing capability. At the current state of the art, computer vision algorithms that could compute visibility polygons are time consuming. The computing limitations suggest that it may not be practically feasible to continuously compute the visibility polygon along the robot’s trajectory.

2) For good visibility, the robot’s camera will typically be mounted on a mast. Such devices vibrate during the robot’s movement, and hence for good precision the camera must be stationary while computing visibility polygon.

It seems feasible to compute visibility polygons only at a discrete number of points [7]. The cost is associated with a robot’s physical movement dominate all other associated costs. The criterion for minimizing the cost for robotic exploration is to reduce the number of visibility polygons.

III. Scenario Implementation

In the scenario described in the paper, an unmanned spying vehicle is used to survey the exterior of an unknown area, discover a point of ingress, and then utilize that ingress to locate a target of interest. Potential ingress points for the ground vehicles are also located by the aerial vehicle. If and when the target has been identified, the aerial vehicle then informs the ground vehicles in proximity of the target’s location. A subset of the ground vehicle then proceeds to advance towards that position until contact with the target is made. Once visual contact has been made of the target, the ground vehicles spread out across the environment so as to generate a map of the area[Fig3]. The robots used in this scenario consist of a team of four platforms, each equipped with a color camera, wireless communication, a single forward-facing IR sensor and a Metal Detector [Fig2]. As such, these surrogate platforms are sensor limited as the real microautomous robots will also be.

IV. Scenario Simulation

In order to evaluate the scenario outlined above, a simulation-based verification was conducted. MATLAB was used to specify the mission as shown above and to run the robot executables (a compiled software program which
realizes the mission specified for each robot). We used to simulate the motor and sensory capabilities [Fig. 3]. In this talk, we have reviewed a few algorithms for robot path planning in the plane which are based on visibility computations and have suggested a few open problems.

In this paper a method is presented for robot motion planning with respect to two objectives, the shortest and smoothest path criteria.

![Fig. 3 Control panel for directing the robot using MATLAB](image)

**V. CONCLUSION**

The use of micro autonomous vehicles in surveillance scenarios is one of the most promising application domains for the military platforms. Significant research must be done in order to measure the effectiveness of those platforms in such coordinated teaming scenarios, however. We have presented one such indoor/outdoor surveillance scenario utilizing both autonomous unmanned ground and unmanned aerial vehicles (spying robot). We described how such a mission can be specified in the multi-robot specification environment. This scenario was first demonstrated in simulation to verify operator intent. Once the target scenario was operating appropriately in simulation, a hardware-based verification was successfully demonstrated. This particular mission is only an example of the large potential space of missions that can be created and tested using the software tools described herein (more or less robots, different building layouts, etc.) Future work will involve the complete implementation of the scenario, including ingress detection, utilization of additional ground robots that will flock towards the target, and integration with distributed visuals. Beyond the current scenario, future work will also look at additional domains in which the promise of micro autonomous vehicles will be most beneficial.

**REFERENCES**


