Effective Path Planning of a Multi Robot System using a Hovering Eye

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***Abstract*— One of the main problems in the path planning of multi robot system is when several robots try to reach the same target at the same time, causing congestion situations that may compromise performance. The aim of our project is deadlock avoidance, i.e. if a moving or stationary obstacle appears in its path, than it should re-route new path and complete task assigned to it. A five robot system, which consists of a leader hovering eye robot will be creating maps and guiding the four ground robots. A distributed planning and control approach is presented that reduces the per-robot cost by centralizing the intelligence and sensing while keeping communication bandwidth low by distributing local control.**

***Index Terms*— Path planning, deadlock, hovering eye.**

I. INTRODUCTION

Swarm robotics is an approach where a large number of simple autonomous robots work collectively to achieve a relatively complex objective. The objective could be something like collective terrain mapping. On a larger scale they could play a part in military/search and rescue operations, acting together in areas where it could be dangerous or impractical for humans to go. These Multi Robot Swarm System (MRSS) are inspired from animals/insects which work in groups [1]. The multi robot system approach renders itself very tough to program and coordinate. This has limited its use in industries and for other applications. Collective decisions make the system extremely slow. We aim to solve this problem by making path planning faster and task oriented using a hovering eye (camera) above the Multi robot system [2]. The hovering eye works as a captain robot and coordinates the sharing of information and collective decision making. The hovering eye has a clear view of the terrain so collective decisions are faster and precise [3]. This will make the system more tasks oriented and useful in the view of applications like earthquake rescue operation, distributed sensing, to name a few.

II. INTERDISCIPLINARY RELEVANCE:

Multi Robot systems find application in varying fields. Micro bots are being used to penetrate human body and cure tumors [4]. While swarm robots are being made for planetary explorations. Multi robot systems have use in military too. As they can do reach places where it is not suitable for humans to go.

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III. REVIEW OF RESEARCH AND DEVELOPMENT IN THE SUBJECT:

Last decade has been stellar with respect you progress of swarm robotics research. Massive strides in implementing group behavior in these systems have been made. Various different swarm systems like kilo-bots, swarmanoid [2] etc. have been developed by various institutions across the world.

International Status: A lot of work is done in developing an artificial intelligence system to control swarms, enabling them to replicate the 'swarming' behavior seen in insects such as bees or ants, or even in birds or fish. I-swarm is one of the projects who have done this [5] [6].
Another aspect where work has been done is how a swarm moves or maintains its formation. This includes cluster formation, dispersing, cluster on source, cluster into groups etc. James Mclurkin has done ground breaking research in this [7].
National Status: The research in India for Multi Robot System is still in its infancy. Nothing significant has been achieved in this field.

IV. SIGNIFICANCE OF THE STUDY:

Path planning is an interesting problem in robotics. It is about finding the shortest, collision free and smooth path by the robot form predefined starting position to fixed goal position in an environment with obstacles either moving or stationary. This problem is difficult to solve particularly in the case of dynamic environment where the optimal path needs to be rerouted in real time when a new obstacle come out. If path planning is perfected it would open up robotics to various new applications.

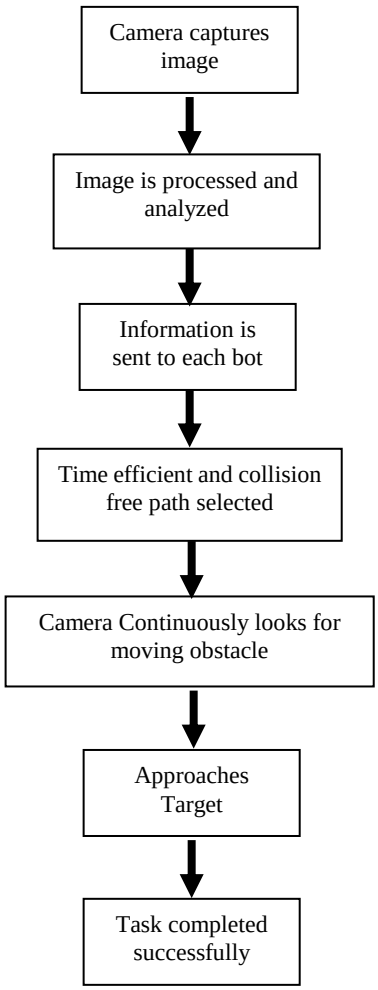
V. OBJECTIVE:

Wireless ad hoc sensor networks are being developed to collect data across the area of deployment. These technologies enable multiple robots to form a temporary multi-robot team and cooperate with each other to launch a complex mission. A path planning algorithm and well-organized communication protocol are needed when the multi-robot systems have to search for or reach a designated target. It is very complex to design a collaborative path planning algorithm and communication protocol for multi-robot systems since we have to consider avoiding intra-team collisions, energy efficiency, information sharing and cooperation problems, etc. Moreover, unlike single robot path planning problem, a multi-robot system is usually constructed by several simple, cheap, function-restricted, and energy-limited robots to plan a path towards the target by cooperative fashion.

Our objective is to develop and implement effective path planning strategies using a hovering eye.

VI. Methodology and Plan of Work:

Sample Algorithm:



We will be developing four robots and a static hovering robot. The ground bots will be equipped with IR sensors for communication and object detection. These robots will also have their own ad-hoc wireless RF network. A decision regarding path will be made by these bots after communicating over the network. After developing, these robots will be put through various path planning tasks. These tasks will be both static and dynamic in nature. Development of a wireless network will also be needed. We also aim to develop a background monitoring system on a computer which is informed of all the data inputs received to the bots. This will be helpful in further analyzing the system and develop it further. We are going to use the libraries provided by OpenCv for Image processing [8].

VII. Conclusion:

The completion of this project will enable us to understand the behavior of swarms in a much better way and how to implement them in a task oriented environment. The developed robots will be put into real life path planning problems and new strategies will be developed to tackle the difficulties faced. Strategies will be developed to make the system faster and more efficient. The increased efficiency in path planning and faster response will help us to incorporate these robots into the Real world. It will open doors of industries to these robots due to its closed space nature. These robots could also be used at home.

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