A NOVEL TASK ALLOCATION METHOD AMONG MULTI ROBOTS

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Abstract: Automation plays vital role in every sphere of human life. The advancements in Information Technology creates abundant ways to carry out the works automatically, amongst Robots plays crucial role to carry out most of the tasks with minimum error rate with accuracy. Multi Robot task allocation in industry automation is another revolutionary area of research. But due to unavoidable mechanical or software issues the task allocation itself is a challenge. Hence, in our paper we propose a novel method for task allocation for multi robot industry automation.

Keywords: Path Planning, Area Exploration, Fault Detection, Mobile Robots, Mutual Coordination.

I. INTRODUCTION

Task allocation in multi robot area exploration is very vast topic of research. Nowadays, the communication between mobile robots is very essential to perform the task with proper coordination among them. However, the communication between mobile robots is still in infant stage and a big challenge. Since technology is changing very rapidly, so it is difficult to know the function of each individual device on robot functions every time, or if a new robot is connecting or disconnecting, etc.

The advancements in information technology leads to carry out the research work in task allocation in multi robot coordination system. The Control and coordination of these mobile robots is a crucial issue. Our research proposes a novel method for the task allocation in an efficient way among the robots the tasks will be completed by those robots with accuracy and reliable. From this perspective, the design of the system works accurately, stably and cost-effective way. The targets must be allocated to all the robots in such a way that all the work will be completed in least time.

1.1 Synchronization & Mutual Coordination:

The idea of global database is applied in our work in which the database consists the location of the robots with their coordinate values. The robots will coordinate with each other with the help of global database table in which the coordinate information of robots as well as targets is stored and whichever robot having the less distance with any of the target it will do that task.

1.2 Area Exploration:

Area exploration in multi robot system is very crucial in which the area exploration means the arena which is allotted to the group of robots must be explored fully in significant manner and in less time. The task which is allotted to the robots should be completed at any cost. The idea of multi robot system is introduced because of failure rate in robots. Since if there is a single robot for a task and it fails then our task will be incomplete. So, to achieve the task completion and efficient working multi robot system becomes popular.

II. LITERATURE REVIEW:

Currently many methods are used for multi robot task allocation. Xuefeng Dai et. al. [1] uses an auction procedure for task allocation. In this, each robot bids for a task and after that by using Genetic Algorithm task is assigned to the robots based on their bids. For this purpose, they are using Back Propagation Neural Network Algorithm known as BP Neural Network Algorithm.

Similarly, Emrah Dönmez et. al. [2] uses task sharing system based on matrix form in which task balancing is done based on passive or active states. In this system, their goal is to avoid overloading a robot. After assignment of tasks to the working robots, the cluster nodes are equal to the number of robots. For each set, the robot position and the available targets are considered as one of the graph nodes. The distance matrix is formed by making these nodes as fully connected to each other.

Everyone is using its own technique for task allocation and path planning. Like Wei Sun et. al. [3] uses self-organizing map(SOM) neural network and the artificial potential filed algorithm for task allocation in which they are converging competitive layer neurons with input

layer neurons along the direction of resultant force in the artificial potential field. They are using this method for the environment which is having obstacles in it.

In[5], Anders Lyhne Christensen et. al. they are inspired by the flashing behaviour of some species of fireflies. They are using this technique for checking the failed robots. Every robot flashes its light in on-board light-emitting diodes (Leds), and neighbouring robots are additionally flashing synchronously. If any robot experiencing any failure, it won't be able to flash it's LED which can be observed by functional robots.

In[6], Kakkar et al proposes the use of low cost infrared sensors for simultaneous area exploration, path planning, obstacle avoidance, and object detection by an autonomous multi-robot system.

III. METHODOLOGY:

In this chapter, we are discussing the path planning of all the robots that how they will be assigning the task. Figure 1.1 shows our arena which we have created on Player/Stage Simulator showing four robots R1, R2, R3, and R4 with green colour dot and four tasks T1, T2, T3 andT4 with black colour squares and stars which they have to perform but right now it's not decided which robot will perform which task. Our arena is designed on coordinate-based system which makes the movement of robots and calculation of distance easy.

Refer table 3.1which shows the location of all the robots and the tasks which are present in that arena:

Table 3.1 Showing robot's and task's locations in (x,y) coordinates

Robot	Location	Task	Location
R1	(-12,-12)	T1	(-3.5, -2.5)
R2	(-12,12)	T2	(-6.5, 8)
R3	(12,12)	T3	(6, 11)
R4	(12,-12)	T4	(12, -4)

Now from the above table all the robots fetch the tasks and their locations and calculates the distances to all the tasks from its locations and whichever the task in nearer to its location he will move forward for completing that task. In this way, at the end all the robots will complete the assigned tasks.

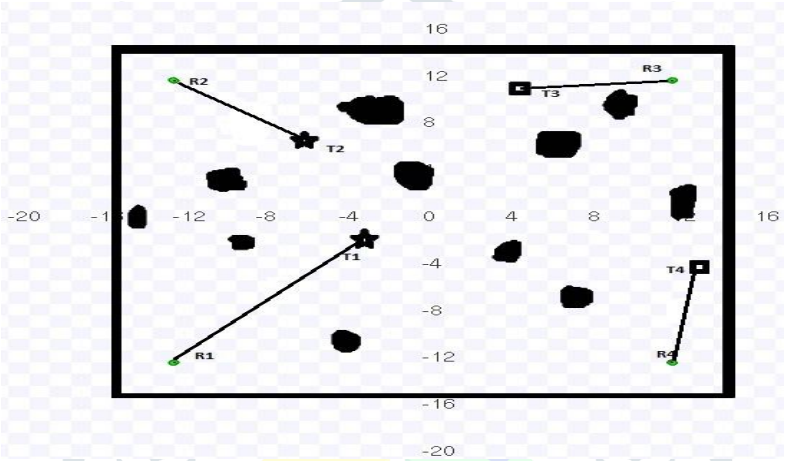

Figure 3.1 Experimental Arena on Player/Stage Simulator

Now the completion of tasks is depending on 3 variables like speed of the robot, distance between the robot and its task and last is obstacles present in the environment. But for this work we are not considering the obstacles present in the environment. So, we can assume that value will be null. So, to calculate the total time our formula should be like:

T=D/S +obs_delay (in secs)

where obs_delay is null in this case

Here, speed of our robot in player/Stage simulator is 0.4 m/sec.

And distance is calculated between robot and tasks by distance formula:

$$D = \sqrt{[(x2 - x1)^2 + (y2 - y1)^2]}$$

IV. CONCLUSIONS:

Robot synchronizes through the idea of global database table. Each time robot assigned by a task, the global database entry will take place in Global database. The multi robot system in our proposal shares these coordinate values among other robots. The process of task allocation creates an effective impact on Robots task allocation. Also, our proposal applies the calculation of distances using Euler's formula makes it easier to identify the total time for task completion since speed of robot is constant in our case. Further to this work the author will propose a novel algorithm for multi robot task allocation in a real time environment.

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