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Cumulative Working of Machines (Robots) by Observing Situation

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Abstract - In the field of electronics machines are very useful to implement the task. It can be manually or automatic, but we cannot surveillance them for long time task. So, we need a communication system which can automatically monitor the task and take the decision to complete the task. Hence, Author presenting an incremental method for working of machines in cumulative manner. The approach uses a fast implementation of decision making, observing, tasking and resulting. The goal of this paper is to study the cumulative behaviour of machines and improving their response for better results. To achieve this goal we are going to implement the algorithms for cumulative tasking by the machines.

Keywords: Cumulative working, robots, deliberative action, tasks in open environment.

I. INTRODUCTION

This paper is about Cumulative Working of Machines by Observing Situation. Automatic machines are used in several areas, ranging from mechanical and electrical/electronics to control theory and computer science, with recent extensions toward material physics, bioengineering or cognitive sciences. The automatic machines connection is very rich. It covers issues such as:

- Deliberate action, planning, monitoring and goal reasoning,
- Perceiving, modelling and understanding open environments,
- Interacting with humans and other machines,
- Learning models required by the above functions,
- Integrating these functions in an adaptable and resilient architecture,
- And the most importantly cumulative working by observation.

If you search for "Cumulative Working of Machines" or "Cumulative Working" on the internet using your favourite search engine, you will find a radically smaller number of entries. Trying to answer this question of why this might be the case, reveals a lot about the structure of this research field and uncovering it is one of the goals of this paper. The cumulative working of machines can help to the development of inexpensive platform with more advanced sensing and control capabilities, to a number of popular competition, and to a better understanding of the scientific challenges of machine intelligence, to which we would like to contribute here.

II. DELIBERATION FUNCTION IN MACHINE WORKING

Deliberation Refers to purposeful, chosen or planned actions, carried out in order to achieve some objectives. Many machines applications do not require deliberation capabilities, e.g. fixed machines in manufacturing and other well-modelled environments; vacuum cleaning and other devices limited to a single task; surgical and other tele-operated machines. Deliberation is a critical functionality for an autonomous robot facing a variety of environments and a diversity of tasks.

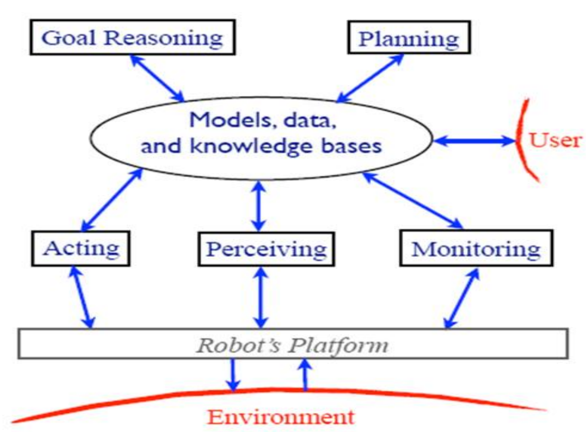

Fig. 2.1 Schematic view of deliberation functions.

Several functions can be required for acting deliberately. The frontiers between these functions may depend on specific implementations and architectures, but it is clarifying to dis- -tinguish the following five deliberation functions, schemati- cally depicted in figure 1:

- *Planning:* combines prediction and search to synthesize a trajectory in an abstract action space, using predictive models of feasible actions and of the environment.
- *Acting:* implements on-line close-loop feedback functions that process streams of sensors stimulus to actuators commands in order to refine and control the achievement of planned actions.
- *Perceiving:* extracts environment features to identify states, events, and situations relevant for the task. It combines bottom-up sensing, from sensors to meaningful data, with top-down focus mechanisms, sensing actions and planning for information gathering.
- *Monitoring:* extracts compares and detects discrepancies between predictions and observations, performs diagnosis and triggers recovery actions.
- *Goal reasoning:* keeps current commitments and goals into perspective, assessing their relevance given observed evolutions, opportunities, constraints or failures, deciding about commitments to be abandoned, and goals to be updated.

These deliberation functions interact within a complex architecture that will be discussed later. They are interfaced with the environment through the robot's platform functions, i.e. devices offering sensing and actuating capabilities, including signal processing and low-level control functions. The frontier between sensory-motor functions and deliberation function depends on how variable are the environments and the tasks. For example, motion control along a predefined path is usually a platform function, but navigation to some destination requires one or several deliberation skills, integrating path planning, localization, collision avoidance, etc.

Learning capabilities change this frontier, e.g. in a familiar environment a navigation skill is compiled down into a low level control with pre-cached parameters. A meta-reasoning function is also needed for trading off deliberation time for action time; critical tasks require careful deliberation, while less important or more urgent ones may not need, or allow for, more than fast approximate solutions, at least for a first reaction.

III. CUMULATIVE WORKING OF ROBOTS

The communication system plays a vital role in working of machines together. To achieve a good working platform the communication system should be strong between the robots. The figure 1 below shows the navigation system among the robots to communicate with each other to perform a task on a construction site..

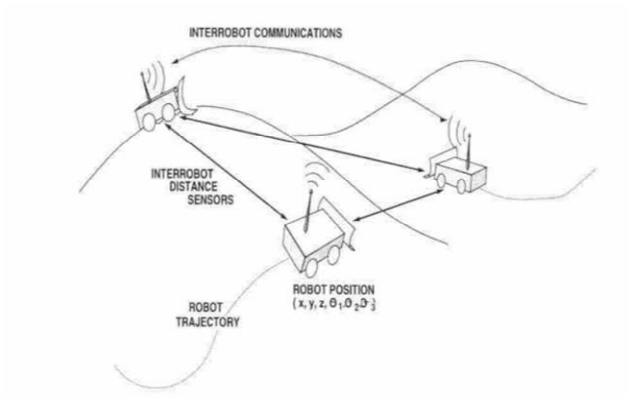

Figure 1. Multiple robot navigation of machines on a construction site.

Here we can see that each robot follows its predefined paths and gives information to one another about their current position and work progress. Each robot perform its task and also check the other's progress and position. Now there are two possibilities which can happened during the task:

- Any robot can distract from its path,
- Or can stuck during the operation of its task.

Distraction from path

When a robot get distracted from its path, firstly it tries to recapture its path itself otherwise it sends the signal to the other robots that it is not able to find its path. After receiving the signal the main monitoring robot send another robot to help him. Now this robot follows the location of that robot and take it on the right path

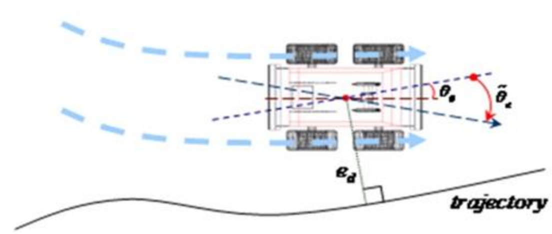

Fig1.2:The algorithm for finding path by avoiding obstacles

The algorithm deals with every obstacle as a point source of repulsive potential affect on the robot with an inverse proportional of the distance square between them. This force can be computed by:

W/(J-y)^2+(I-x)^2

Where I and J represent all points in the map
X and Y represent the center of the obstacle
W represent the weight of the charge

This generate a matrix map and every element of this matrix carry the amount of potential found on (I,J) coordinates. This map will have large values at the obstacles centers and boundaries.The other forces are generated by the target and it can be represented as a source of attractive potential and it is directly proportional with the distance with the robot. This force can be computed by:

W*sqrt((J-GoalY)^2+(I-GoalX)^2)

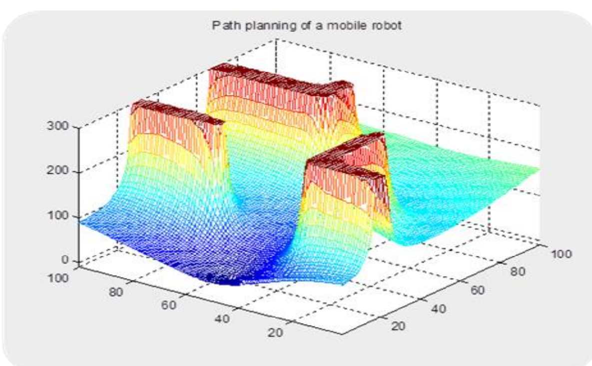

Fig1.3: Path planning simulation

Where GoalY, GoalX is the target coordinates

This will generate a matrix map that has a minimum value at the target and a maximum at the robot position.

Then by summing the two forces map we will get a map with repulsive and attractive forces. These forces with each other will draw the path of the robot.

The above Fig shows the path planning simulation, when robot tries to find any path then this simulation is running.

IV. CUMULATIVE BEHAVIOUR BY ROBOTS

Now consider the second condition which is arises in the previous section (strucking of robot during the operation of the task) to understand the cumulative behavior on observing the situation.

Suppose one robot is send to perform any task after some time the observing machine (can be a centralized mechanism for observing the operation of more than two robots) observes that the robot cannot complete the task in specified time, so an another robot will be send to help the previous one.

The simulation can be seen in picture below.

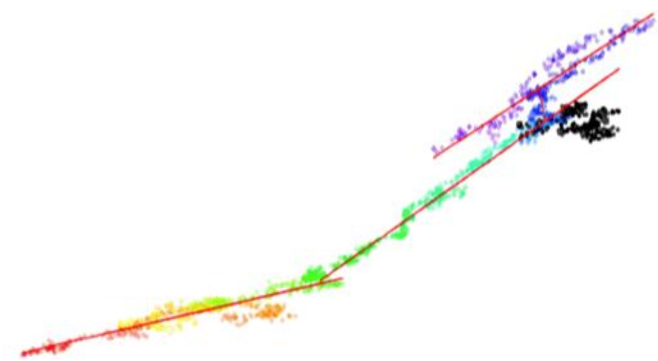

Fig1.4: Cumulative behavior simulation

Here we can see that the first robot is working on its task (shown by the violet color on the upper right side in picture)

But after a long time another robot is moving towards the first one (shown by the red color in lower left corner).

After some time it reaches near the first robot and tries to help the robot by sharing the information (shown by the blue color).

V. ALGORITHMS FOR CUMULATIVE WORKING DURING A TASK

Algorithms for cumulative working between two robots are to given separately for both the robots.

Here the major noticeable point is that the robot which came for the help of first robot must work with synchronization to the first one.

Now we can understand the cumulative working with a simple example.

Assume that there are two robots in which one is master and other one is slave. When any task is to be done then master instruct slave to do the task. Then on the basis of algorithm it performs task. Suppose that the task is to lift the cylindrical rod which is shown in figure below.

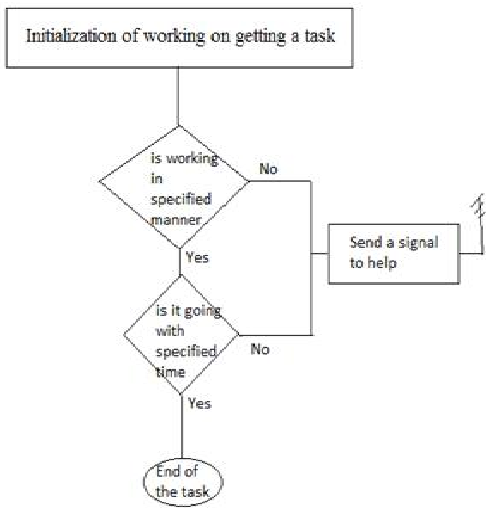

Fig1.5: Algorithm for first robot

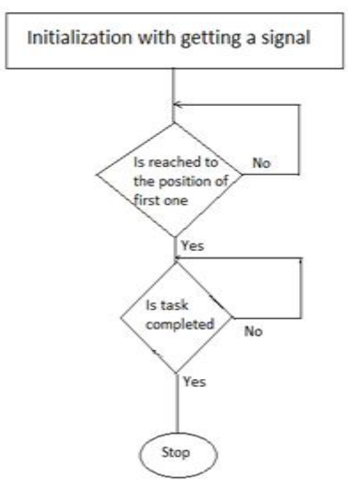

Fig1.3: Algorithm for second robot

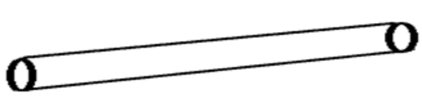

Fig1.6: Object for operation

Now robot will come near to the rod and observes its position by angle and edge detection. The simulation is given below;

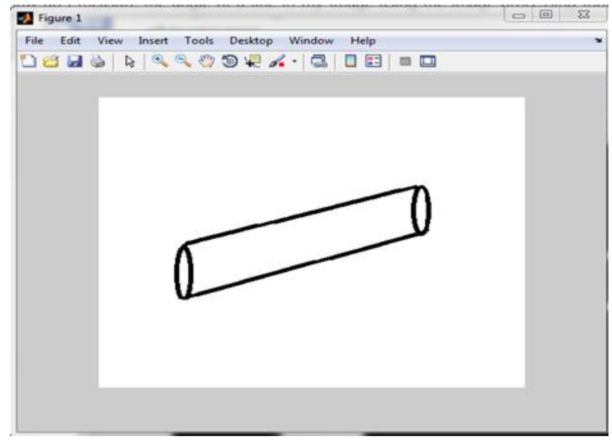

Fig1.7: Object in Matlab

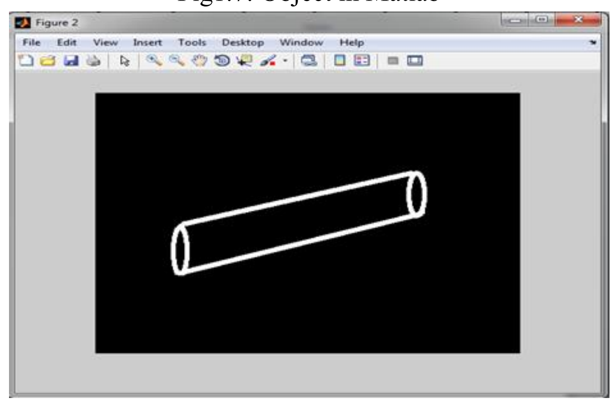

Fig1.8: Edge detection on Object

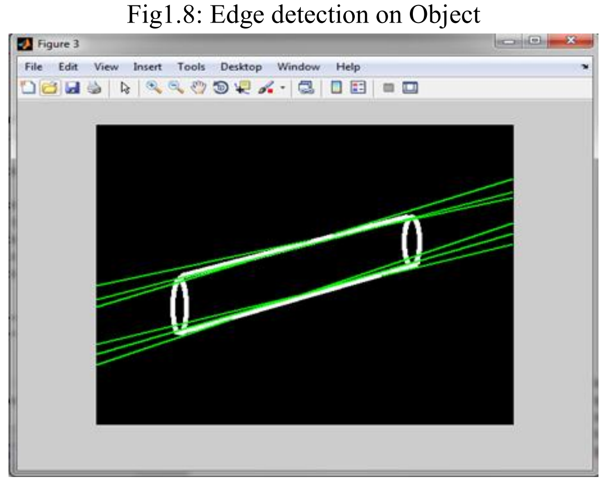

Fig1.9: Angle detection on edge detected object

The above simulation shows the position to the robot to hold the rod for lifting up.

And the robot can easily pick up the rod and can complete the task. But in any circumstances if the slave robot is not able to pick up then it will send the signal to the master robot, then the master robot will come to help it.

Then the two previous simulation are the same but third one will change.

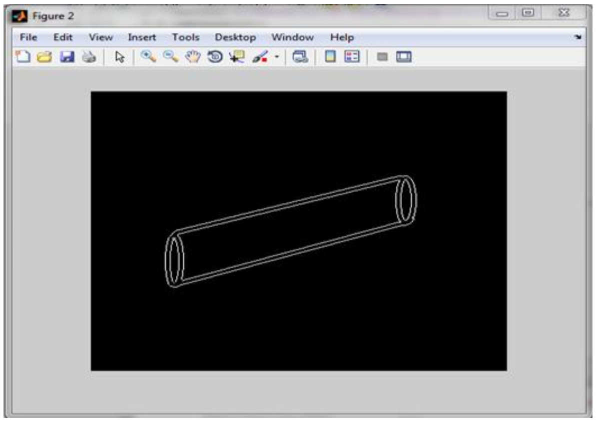

Fig1.10: Plane extraction

Now the master and slave combinedly perform the task by holding the rod from both the sides(one side will be hold by master and the other side will be hold by slave) and then they can pick up the rod can move it from one position to the other position to perform the task.

Author believes that the Cumulative Working of Robots is becoming richer and more complex, and it remains today as fruitful for both fields as it used to be in their early beginning. And do hope that this overview will attract more practitioners to the challenging problems of their intersection.

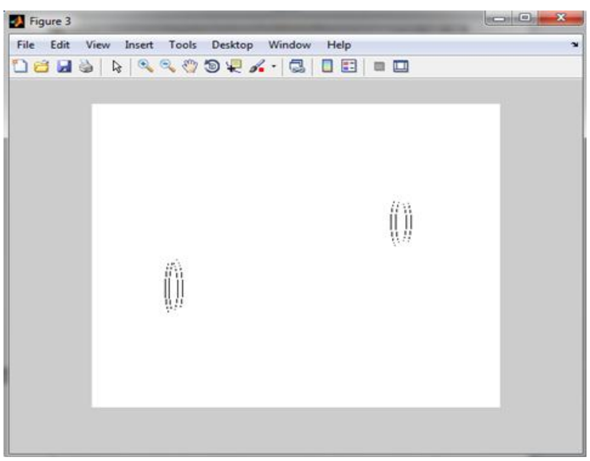

Fig1.11: Corner Detection

VI. ACKNOWLEDGMENT

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Vikrant Tomar pursuing his Engineering degree from Meerut Institute of Engineering and Technology, Meerut ,Uttar Pradesh,India, during 2012-2016. The author's major field of study is electronics. He has worked on microprocessor, microcontroller & software based instruments. He also worked on the Spice, LabVIEW and Matlab for understanding the working of software based instruments. He has the knowledge of basic & embedded c language, HTML, functional programming, basic of java, PLC & Scada and many IDE tool for programming of microcontroller or development boards. Mr. Tomar got many prices in the various competition in the his field of study. He is also awarded with the title "Innovative mind" in his batch by his faculty.