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Design Approach of a Shortest Path for Robot Navigation Using Fuzzy Logic & PSO

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Abstract - *An autonomous robot is important device in digital electronic. Basically most of the man-made work can be reduced by using robot. An autonomous robot is functioning normally with any condition. The work is very simple we can apply simple programming language. But finding the shortest path is very difficult. Shortest path may reduce the time required to complete the task. The reduction of time through moving obstacles is hard in actual case. Simple way to reduce time as well as distance to move from one point to another point is explained here. A fuzzy based technique is used here to find the path for moving obstacles by using the sensor. This will avoid them by searching the changing direction of obstacle. For finding the shortest path using a special optimization technique is used, PSO (Particle Swarm Optimization) is used to find the shortest path which will also consume the time required to move from initial point to final point. Implementing the shortest path for autonomous robot by using fuzzy logic and PSO. This will help people to operate the robot efficiently and effectively.*

In the field of electronic engineering the work of automation is growing very fast. The fundamental concept of autonomous operation depends on technique and logic that we are using. The navigation consists of providing the specific path to follow minimum distance. If any obstacle is hitting to that robot, the robot should understand how to find a path by avoiding that obstacles. We can direct that robot with some logic. The way of navigation is decided by that robot itself by using fuzzy logic. It will direct the robot how to avoid any obstacle which is having various characteristics depends on nature i.e. obstacles is moving or static, height etc. The fuzzy logic criterion gives brief explanation about this concept.

While comparing with the time consumption in the navigation of autonomous robot, we are calculating the time required to move the robot with using PSO and without using PSO optimization technique.

Key Words: **PSO, autonomous robot, fuzzy logic, navigation, image processing, static, dynamic.**

1. INTRODUCTION

The autonomous robot simply is used in many engineering fields such as industrial, medical, institutional, agriculture etc. The work of robot simply depends on the control or programming of particular robot. The fundamental functioning is to be done very carefully. Hence the autonomous robot works efficiently.

In autonomous robot, various parameter to be taken for the smooth working of robot without any error. The working consists of driving the wheels of robot, navigation of that robot, reaching to its destination point etc. Here the main parameters we are considering as a point of view is navigation of that robot. The navigation consists of driving autonomous robot in a specified direction without any disturbance. Disturbance is like few obstacles are running in between the robot while moving from any specific point to its destination point. That obstacle may be static or dynamic in nature depending on the current condition. We have to move that robot simply avoiding those obstacles.
For the perfect navigation point of view we can use various sensors specially camera sensor. Here we are using fuzzy controller for controlling the moving direction of autonomous robot. The concept of fuzzy logic controller is useful for perfect navigation purpose. Fuzzy means not exact condition while comparing with real sets. The number of condition given in the sets is non-exact type in nature considering non real case. So for the navigation purpose it is required to control the exact movement of robot. This will show how we can turn the wheel of robot with some constant range through fuzzy controller. The condition which we are putting in controller depends on the movement of robot.

In the real world collision of robot can be controlled by a camera sensor attach with the robot. That sensor will sense the edges of moving or static obstacle. After sensing, sensor will decide the position of movement. It needs to move right, left or straight depending on way of obstacles. The fuzzy controller will give the control to the camera sensor. This process decides how to navigate the robot in required direction. The direction will be depending on the movement of obstacles and nature of obstacles. Here in this concept we are dealt with the time consumption. Time required to reach its destination point is another parameter. For reduction of

time we are using PSO based optimization technique. Basically there are various nature inspired optimization techniques like BFO, ACA etc. We are using PSO. This technique will reduce time required to complete path movement.

2. RELATED WORK

In most of the methods researchers have used manual method for rotating the wheels and changing the direction of robot. The process is very slow and requires large time for navigation process. The navigation process is also very complex and cheaper. The solution is explained here. We are simply using two basic criteria fuzzy based method for controlling the wheel of robot and PSO optimization technique for time reduction. By using this two simple process we are easy to navigate the robot also time required is very less. The programming based on controlling the direction of robot and reducing the time consumption is done where we are using various methods for resolving this issue.

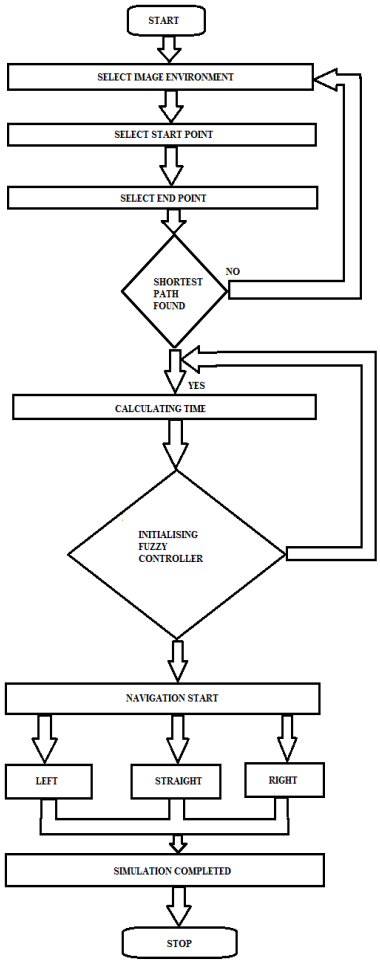
3. METHODOLOGY USED

The navigation is a process of locating position from where the robot will search the moving path. If we are considering the movement of robot in the given environment say for industry, institution, agriculture etc. According to the environment given we have to set up the image representation. So that we can draw to access the given environment using image processing tool. Let select the image where you need to move that robot.

After selecting the environment in the let select the start point by double clicking on that specified point. Also select the end point by double clicking on that specified point. Now the program will find the shortest path and it will show the model image containing the path direction. Now by entering program will calculate the time required to complete navigation process. Here we are using PSO. So we can compared the time consumption with two parameter say time required with PSO and time required without PSO. After calculation of time it will show actual time required in both the cases.

Calculating the time gives the difference between two cases. Now the work comes on navigation process. For the navigation process we need programming on fuzzy controller. The process is explained in [17]. Controlling the direction is basic task. It will initialize the fuzzy controller for operating the direction of robot. After initializing the fuzzy controller navigation process will start. It will show the exact moving path of the robot. The visualization will also show the direction one by one. Say, if the robot is moving to the left direction it will show left. Also same for straight and right direction. After completion it will show the simulation process will end.

4. FLOW CHART



5. RESULTS

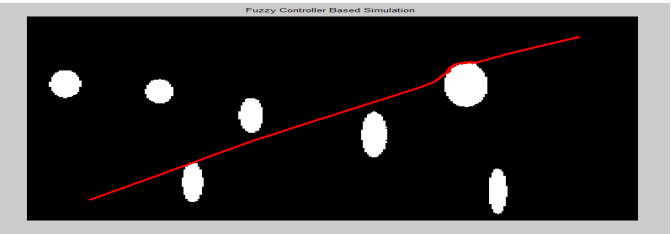


Fig 1: Image 1

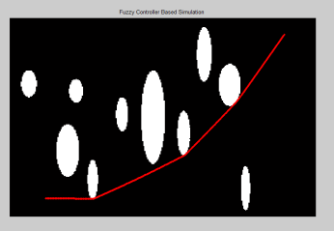


Fig 2: Image 2

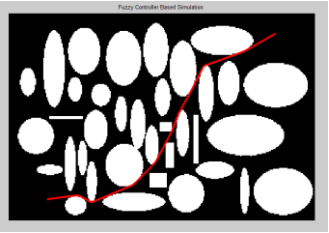


Fig 3: Image 3

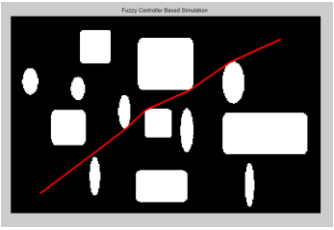


Fig 4: Image 4

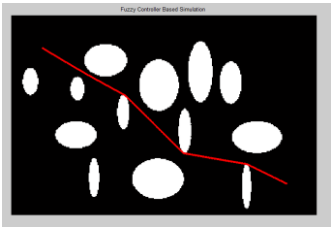


Fig 5: Image 5

Fig 6: Image 6

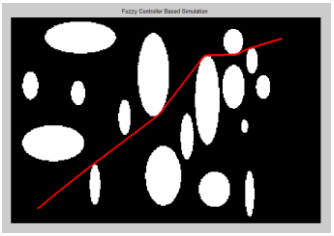


Fig 7: Image 7

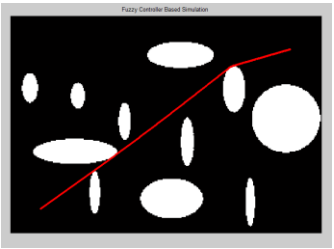


Fig 8: Image 8

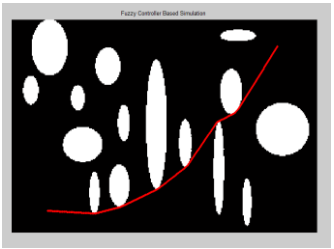


Fig 9: Image 9

6. COMPARISION OF RESULTS

The number of different image environment is developed using image processing. We can calculate the complete time period with PSO and without PSO. Clearly seen that time is reduced for optimization point of view.

Table -1: Result for various images

Sr. No.	Name of Images	Time required without PSO (Sec)	Time required with PSO(Sec)
1	1	12.67	2.73
2	2	17.53	2.21
3	3	10.38	2.33
4	4	12.30	2.34
5	5	9.39	2.29
6	6	17.67	2.14
7	7	17.34	2.24
8	8	19.43	2.16
9	9	9.94	2.40

7. CONCLUSION

We have designed various path using different images with number of obstacles inside the image environment. We also use this method for any other obstacle avoiding path for smooth operation of autonomous robot. Hence the time required to reach destination is reduced and calculated the minimum time required to reach the destination point. Also we have compared the time required to reach the destination using PSO optimization technique and Comparing the time period by using PSO.
Finally we can conclude that PSO technique can easily be used for navigation process with the fuzzy based logic also we can reduce time consumption.

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