Cooperative Control of Multiple Mobile Robot Using Particle Swarm Optimization For Tracking Two Passive Target

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Cooperative Control of Multiple Mobile Robot Using Particle Swarm Optimization For Tracking Two Passive Target

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Abstract: This paper proposes a cooperative control method for multiple mobile robots to track two passive targets in unknown environment on the basis of a particle swarm optimization (PSO). By adjusting the left and right wheels speed of the mobile robot using the proposed control method, each mobile robot can move towards the target on the basis of information about the previous best location of each particle and its neighbors. The simulation results demonstrate the validity of the proposed cooperative control method of multiple mobile robots for tracking two passive targets.

Keywords: Multiple mobile robots, Target tracking, Particle swarm optimization (PSO).

1. INTRODUCTION

Particle swarm optimization (PSO) is a population based heuristic minimization technique based on social behavior, and had been proposed by Kennedy and Eberhart in 1995 [1]. PSO achieves optimization using three primary principles: evaluation where a quantitative fitness can be determined for some particle location; comparison where the best performing location for some particle can be selected out of multiple possibilities; and an imitation where the qualities of better particles are mimicked by others. And also PSO is a self-adaptive population based method in which behavior of the swarm is iteratively generated from the combination of social and cognitive behaviors. Each particle then determines its movement through the search space by combining some aspect of the history of its own current and best (best-fitness) locations with those of one or more members of the swarm with some random perturbations. The next iteration takes place after all particles have been moved. Eventually the swarm as a whole, like a flock of birds collectively foraging for food, is likely to move close to an optimum of the fitness function [2].

This paper treats of the cooperative control of multiple mobile robots. The mobile robot has limited mobility range and energy availability; there for it should be have an effective motion to reach the two different position of passive target [3].PSO for the moving actions of each mobiles robot is preferable to be used in multiple mobile robots (swarms) that can explore in the unknown environment with the goal of reaching two passive targets [4].

A decentralized PSO is used in this project for each mobile robot to determine the velocities of the left and right wheels for reaching known two targets in unknown environment. Some issues in design and implementation of an unsupervised distributed PSO for target locations include robot dispersion and deployment, localization, obstacle avoidance, overshooting targets, effect of particle neighborhood sizes on performance and scalability [5]. Generally, PSO is more than just a collection of particles. A particle by itself has almost no power to solve any problem; progress occurs only when the particles interact and can be used to evolve parameters for robotic controllers.

In this paper, the PSO-based target tracking control method for multiple mobile robots, to determine the velocities of the left and right wheels to two different targets, is proposed. That is, PSO is not used as an optimization algorithm. Each mobile robot as a particle has responsibility for another robot and themself, which evaluates the nearest position into the target at each iteration. After each evaluation, the robots communicate to share the fitness information needed to progress to the next iteration. Each mobile robot can decide by themself, which the target position will be selected. The simulation results demonstrate the validity of the proposed cooperative control method.

2. PROBLEM STATEMENT

The focus of this research is creating algorithm for moving action to reach two different passive targets position in unknown environment. And the robots have the information of the target position and the mobile robots use a fitness function, during the simulation. We adopt PSO algorithm to solve this problem. During simulation, the mobile robot we make full use of the real-time information attained by updating the coordinate position of each mobile robot, in this case the Euclidean distance of the individual robots relative to the target, to analyze the status of their current position. The basic PSO algorithm is slightly modified to accommodate for the obstacle (i.e. Walls or other robots) avoidance and collective robotic search applications.

In the Simulation, the size of working space is 640x480 pixels with random style a wall surrounded. Each mobile robot is programmed in order to find the moving action without crashing the wall and other robots using PSO method. Here,it is assume that each robot have information about two different target position, itself position and another robot position close to the robot.

3. PARTICLE SWARM OPTIMIZATION FOR TRACKING TWO PASSIVE TARGET

3.1 Definition of Particle Swarm Optimization

The problem space is initialized with random solutions in which the particles search for the optimum. Each particle randomly searches in the problem space by updating itself with the best solution it ever found and the social information gathered from other particles. Within the defined problem space, the system has a population of particles. Each particle is randomized with a velocity and flies in the search space. The velocities and positions of the particles are constantly updated until they have all reached the target.each mobile robots as particles communicate with each other while learning their own experience in the population begins with a randomized position $\vec{P}_i(t)$ and randomized velocity $\vec{P}_i(t)$ in the 2 dimensional search space.

The problem in unknown environment is initialized with random solutions in which the robots search for the optimum. Each robot randomly searches in the problem space by updating itself with the best solution it ever found and the social information gathered from other robots. Global-best position ($gBest$) is the best overall position of the neighbors. The velocity equation of the basic PSO contains three components: last velocity, cognitive and social components (with consideration to neighborhood topology).The velocities and positions of the robots are constantly updated until all robot reached the target position.

Velocity update equations based on the PSO are given by (1) and (2).

$$\begin{aligned}\vec{V}_i(t+1) &= \omega\vec{V}_i(t) + c_1 rand(*)(pBest_i - \vec{P}_i(t)) \\ &+ c_2 rand(*)(gBest_i - \vec{P}_i(t)) \qquad (1)\end{aligned}$$

$$\vec{P}_i(t+1) = \vec{P}_i(t) + \vec{V}_i(t+1)H \qquad (2)$$

where, H: sampling time in the simulation with 0.1s. c_1 and c_2: the balance factors between the effect of self-knowledge and social knowledge in moving the particle towards the target. $rand(*)$: a random number between 0 and 1,and different at each iteration. ω: inertia weight. $pBest_i$: the best position of a particle (mobile robot).$gBest_i$: the best position within the swarm. $\vec{P}_i(t+1)$: the new position of mobile robot for next iteration. $\vec{P}_i(t)$:the current position of mobile robot. $\vec{V}_i(t+1)$: the velocity of mobile robot. Since, in the above algorithm, there is the possibility of particles movement to out of the problem space, an upper velocity bound for particle movement is specified.

3.2 The mobile robot model

Kinematic equations of the two-wheeled mobile robot are:

$$\begin{bmatrix} \frac{dx}{dt} \\ \frac{dy}{dt} \\ \theta \end{bmatrix} = \begin{bmatrix} \frac{\cos(\theta)}{2} & \frac{\cos(\theta)}{2} \\ \frac{\sin(\theta)}{2} & \frac{\sin(\theta)}{2} \\ \frac{1}{2l} & \frac{1}{2l} \end{bmatrix} \begin{bmatrix} V_L \\ V_R \end{bmatrix} \qquad (3)$$

where $\frac{dx}{dt}$ and $\frac{dy}{dt}$ are coordinates of the center of mobile robot gear, θ is the angle that represents the orientation of the vehicle, V_L and V_R are velocities of right and left wheels and $2l$ is the mobile robot base length.

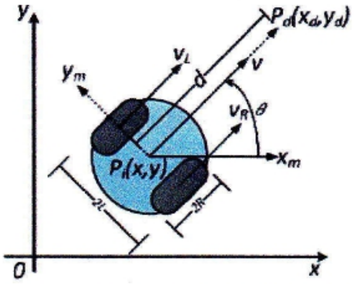


Fig. 1 Model of two wheeled mobile robot.

Each particle remembers the position that achieved its highest performance also a member of some neighborhood of particles, and remembers which particle achieved the best overall position in that neighborhood. Fig. 6 shows the description of a two-wheeled mobile robot model. Where, $P_i(x, y)$ is coordinates of the mobile robot position, θ is a heading angle and v is a linier velocity of the mobile robot.

Evaluation function of distance between each mobile robot and the goal,means the distance d between the current position $P_i(x, y)$ and the desired position $P_d(x_d, y_d)$ of the robot at next sampling,and is defined by

$$d = \sqrt{(x_d - x)^2 + (y_d - y)^2} \qquad (4)$$

And the angle to the goal as follows:

$$\theta_g = \tan^{-1}\left(\frac{y_d - y}{x_d - x}\right) \qquad (5)$$

$$\theta_e = \theta_e - \theta \qquad (6)$$

where the error angle to the goal is defined as equation (5), and in the next sampling program will minimize the error angle. From the equation (3) we can know where is the nearest target position with the robot position and the mobile robot will decided and choosed the final target. The nearest position of the mobile robot with the target will become $gBest$. The equation (4) for determining direction toward of mobile robots into the goal.

3.3 Moving action of mobile robot

The moving action algorithm of each mobile is shown in Fig. 2. In initialization $t = 0$,first each mobile robot has some information such as own position in the unknown environment position of another mobile robot surrounding near position of two target. These information will be used for PSO, each mobile robot will check the distance between his own position with targets position and mobile robot will decides the target. Next, performed tracking the shortest path to reach the target using PSO method.

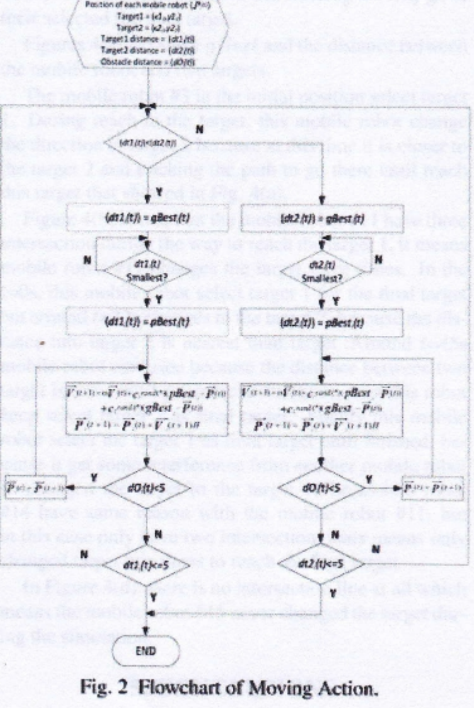


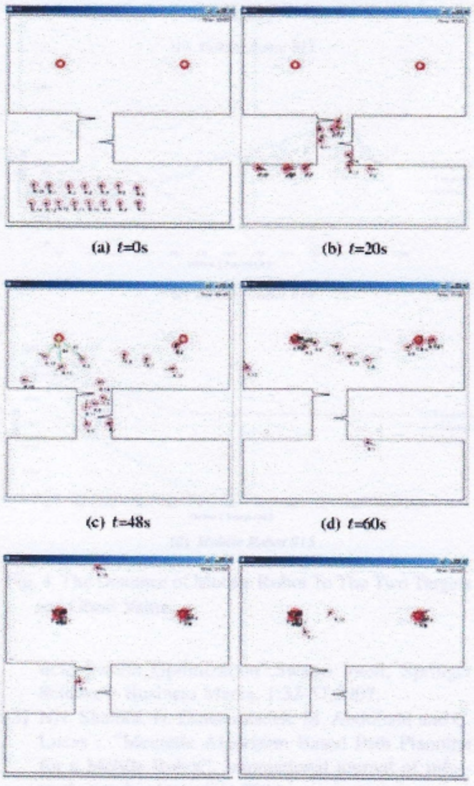
Fig. 2 Flowchart of Moving Action.

In iteration, the mobile robot updates the nearest target position by. The target will be determined by $gBest$, and the distance of the nearest mobile robot to the nearest target position will be determined by $pBest$. After we have information about the current position of each mobile robot, $gBest$, $pBest$ and $\vec{V}_i(t+1)$ for the velocity of mobile robot will be calculate by PSO algorithm to obtain a new position of each mobile robot. During moving action to reach the target, mobile robot also check availability of the obstacle (i.e.walls or other robots) using avoidance algorithm. If have a obstacle during moving action to reach the target, mobile robot will use his last position closest to the obstacle as an input to the PSO algorithm to get the next new position to avoid the obstacle.

4. SIMULATION RESULTS

In this research, we have proposed the use of PSO method in order to cooperative control multiple mobile robot to reach two different position of target in unknown environment. Fifteen mobile robots are used in this simulation. The conditions that accompany the goal were fixed position during robot reached the target and moving condition after the mobile robot closed it. The parameters of PSO in the simulation are set as follows: c_1=c_2=1.5, ω = 0.5, $rand(*)$ = [0, 1], and maximum velocities of mobile robot is 9.4 cm/s.

Figures 3(a)-3(f) show snap shots during the moving of 15 mobile robots to the two different positions of the target in unknown environment. Each mobile robot can move towards the two target quickly and cooperatively during avoid wall and another mobile robot.



(a) t=0s (b) t=20s

(c) t=48s (d) t=60s

(e) t=110s (f) t=120s

Fig. 3 Tracking actions of the 15 mobile robots using PSO method.

At the beginning of simulation, position of each mobile robot and the targets position in unknown environment is shown as Fig. 3(a). In Fig. 3(a), the mobile robot will moves from the current position to the one of target with its velocity. At thats time each mobile robot have three important information; current position of the mobile robot; another mobile robot position; distance between each mobile robot and distance between each mobile to the target.

Figure 3(b) shows the moving actions of each mobile robot to reach their selected final target by avoidance the obstacles and through the narrow path. At the t=48s in Fig. 3(c), some of mobile robot can pass through the narrow path with obstacle, while others mobile robot still find the way to reach the target.

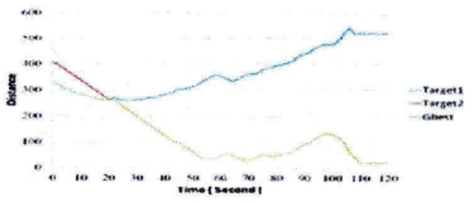
In the t=60s shown in Fig. 3(d), each mobile robot moves to the nearest selected target and some mobile robot already arrived in the final target position shown in Fig. 3(d). Figures 3(e) and 3(f) show that almost all of mobile robot already reach their selected target at t=110s, until t=120s two mobile robot still tracking the way go to their selected the final target.

Figures 4(a)-(d) show $gBest$ and the distance between the mobile robot and two targets.

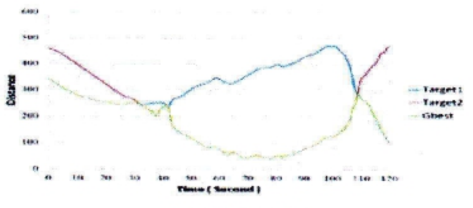
The mobile robot #3 in the initial position select target 1. During reach to the target, this mobile robot change the direction to target 2 because at this time it is closer to the target 2 and tracking the path to go there until reach this target that showed in Fig. 4(a).

Figure 4(b) shows that the mobile robot #11 have three intersection during the way to reach the target 1, it means mobile robot #11 changes the target three times. In the t=0s, this mobile robot select target 1 for the final target but around t=32s changes to the target 2, because the distance into target 2 is nearest than target .Around t=45s mobile robot confused because the distance between two target is same until get some disturbance, then this robot keep select target 2 as final target. Finally this mobile robot select the target 1 as final target until finished, because it get some interference from another mobile robot so changed the target to the target 1.The mobile robot #14 have same reason with the mobile robot #11, but in this case only have two intersection, thats means only changed target two times to reach the final target.

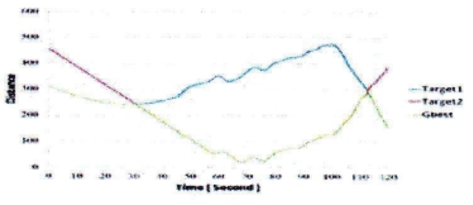
In Figure 4(d), there is no intersection line at all which means the mobile robot #15 never changed the target during the simulation.



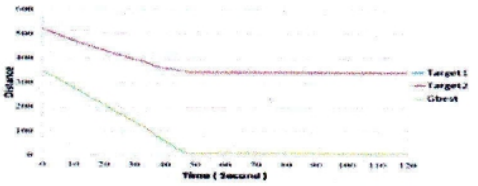
(a) *Mobile Robot #3*



(b) *Mobile Robot #11*



(c) *Mobile Robot #14*



(d) *Mobile Robot #15*

Fig. 4 The Distance of Mobile Robot To The Two Targets and Gbest Value.

5. CONCLUSIONS

In this paper, we proposed cooperative control multiple mobile robot using particle swarm optimization (PSO) for tracking two passive target. The simulation results show that the PSO-based method succesfully generates moving actions to the two passive target while avoid the wall and collision other robot in unknown environment.

REFERENCES

[1] Lisa L. Smith : "Obstacle Avoidance in Collective Robotic Search Using Particle Swarm Optimization", IEEE Congress on Evolutionary Computations, pp.1390-1395, 2004.

[2] Riccardo Poli, James Kennedy, Tim Blackwell :"Particle Swarm Optimization",Swarm Intell, Springer Science + Business Media, 1:33-57,2007.

[3] NN. Shahidi, H. Esmaeilzadeh, M. Abdollahi and C. Lucas : "Memetic Algorithm Based Path Planning for a Mobile Robot", International journal of information technology, 4(1),2004.

[4] Kurt Derr and Milos Manic : "Multi-Robot, Multi-Target Particle Swarm Optimization Search in Noisy Wireless Environments", IEEE 978-1-4244-3960-7/09,Catania ,Italy,pp.81-86, 2009.

[5] E. P. Dadios and O. A. Maravillas Jr.: "Cooperative mobile robots with obstacle and collision avoidance using fuzzy logic", Proceedings of the 2002 IEEE International Symposium on Intelligent Control,27-30 Oct, pp.75 - 80. 2002.

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Ditetapkan di : Surabaya
Pada tanggal : 22 Maret 2001

a.n. Menteri Pendidikan Nasional.
Koordinator Kopertis Wilayah VII,

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Tembusan : *disampaikan kepada Yth.* :
1. Dirjen DIKTI Depdiknas.
2. Kepala Biro Kepegawaian Setjen Depdiknas.
3. Kepala BKN di Jakarta.
4. Bendaharawan Kopertis Wilayah VII.
5. Pimpinan Perguruan Tinggi Swasta Ybs.