Providing Security for the Building Using Ant Colony Optimization Technique

Anita*, Dr. S. S. Tyagi**

* Department of Computer Science & Engineering , MRIU , Faridabad
** Professor and Head, Department of computer science and Engineering, MRIU, Faridabad

Abstract- To describe the approach of real-world activities we have proposed an idea by using ACO technique for providing security to the building and building can be bank, parliament house, prime minister's house, ambani's house etc. In this paper we are providing the security to the building and if any security-guard feels weakness than he can be replaced by other. And if there is the need of increase in the number of security-guards, they can do so on their own without interrupting the simulation and changing the input parameters.

Index Terms- Swarm Intelligence (SI), Ant Colony Optimization (ACO), Particle Swarm Optimization (PSO)

I. INTRODUCTION

Swarm Intelligence focuses on the collective behaviors that result from the local interactions of the individuals with each other and with their environment. SI is an innovative computational and behavioral metaphor for solving distributed problems that takes its inspiration from the behavior of social insects and the swarming, flocking, herding, and shoaling phenomena of vertebrates[1]. Examples: colonies of ants, flocks of birds, herds of animals and schools of fish.

Ants perform cooperative transport which has inspired the scientists to design the controllers of robots so that they can do coordinated work. Sorting behavior of ants like clustering of dead bodies and eggs have motivated the sorting and clustering algorithms. The path-finding and orientation skills of Cataglyphis ant one of the desert ant were used for building a robot orientation unit. Models that ants queen used for the division of labor between the members of an ant colony to perform various tasks were used to carry out the joint work of robots. Among many successful bio-inspired swarm intelligence computational paradigms, two well-known approaches are Ant Colony Optimization (ACO) [2] and Particle Swarm Optimization (PSO) [3].

Based on these ideas, in this paper we have proposed the method for providing the security to the building of any important person. We will have some security guards and building of any vip person. The paper is organized as follows. Section II gives the introduction about ACO techniques and PSO technique of Swarm Intelligence. Method for providing the security is introduced in section III. Finally conclusion is given in the section IV.

II. ACO AND PSO TECHNIQUES

ACO is a technique for solving combinatorial optimization problems that can be viewed in the form of path finding problem. ACO technique is inspired by the way how real ants find shortest paths from their nest to food i.e. from source to the food destination. An essential part from which we get the idea is the indirect communication of the ants with the help of pheromone. Pheromone is a chemical substance that is released by an ant on the pathway while moving from nest to the food source and that shows the behavior of other individuals of the same species. So, Ants lay the pheromone on the way to mark the paths to their food sources. The pheromone traces are then smelled by other ants and which lead them to the food source.

A biological experiment called the double bridge experiment was the inspiring source for the first ACO algorithm[2]. In the experiment a double bridge with two branches of different lengths are connected to the nest of the ant and to the food source[2]. The Long Branch is twice in length than the shorter branch. When the experiment was run, after watching for few minutes it was noticed that after a few minutes almost all ants move to the shorter branch. This behavior was interesting because this experiment was carried out on the Argentine ants and these ants cannot see very well.

The behavior of ants shows that the ants lay pheromone along their path.

In figure 1.1, we have taken three branches of different lengths. The ant moves out of the nest and initially they randomly choose the path in search of the food.

Initially, there was no pheromone on the paths means white colored path according to the figure. Ants release pheromone on each path they visit. In figure we can see that darker the color on the path means more the intensity level of pheromone on that path. This increases the probability of choosing that path by the ants. So, the probability of the ants which chooses the shortest path arrives earlier at the food source than other ants.

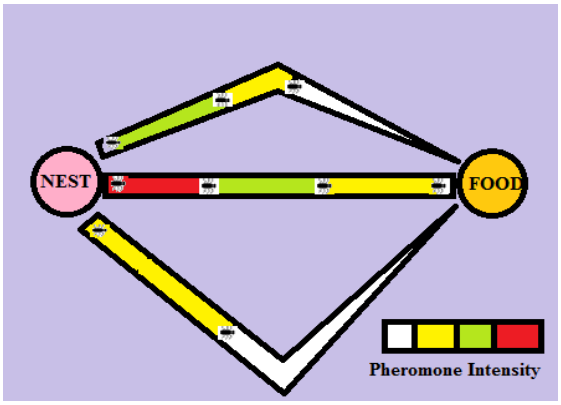

Figure 1.1: ant searching for the food, laying pheromone on the path. Pheromone intensity shows them which path to choose.

They follow same thing when they go back to their nest. When they go back, they smell pheromone on the path. The pheromone deposit on the shortest path will accumulate faster than the other branches which are longer branches. So, the concentration of pheromone on the shortest branch is much higher and nearly all ants move to the shorter branch. The color of the shortest path can be seen in figure 1.2, it is red in color means the high intensity of pheromone. And the pheromone deposit on the other paths evaporates.

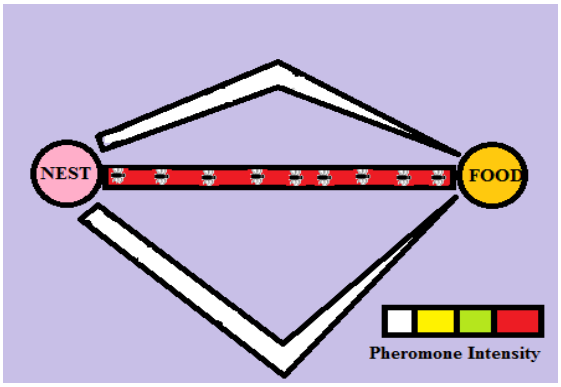

Figure 1.1: all ants will move to the shortest path ,red color shows the high intensity of pheromone deposit. The pheromone on other paths evaporates.

PSO is a technique that is used for finding maximum or minimum values of a function[3]. PSO is also inspired by the behavior of insects like swarms of fishes or flocks of birds to find the food source. They coordinate their movements with their neighbors. This coordination of movements of the individuals in the swarm is the essential aspect that inspires PSO.

III. PROVIDING SECURITY FOR THE BUILDING USING ACO TECHNIQUE

Using ACO technique, we have proposed the method to provide the security for the building. We have implemented this scenario in the NetLogo. NetLogo is used to simulate this scenario. NetLogo is a programmable modeling environment to simulate complex multi-agent systems. Instructions are given to hundreds and thousands of independent agents can be given concurrently.

First step is to find the building to which we have to provide the security. So, we security-guards will sense the building first like ants does with the help of pheromone. Here we can sense it by smell, light etc. For this scenario we have used the light. With the help of light security-guards can visualize the building and climb-up the light gradient. The light of a building will diffuse evenly over the neighbor environment. It is assumed that the security-guards will only react to a light intensity greater than a threshold value. If the light intensity is less than the Threshold value, security-guards can't visualize anything, and therefore they are unable to find where a building could be. Hence they keep on searching means that they keep on moving randomly until they sense the light of a building. If they sense the light of a building, they climb up the light gradient, which leads them directly to the building.

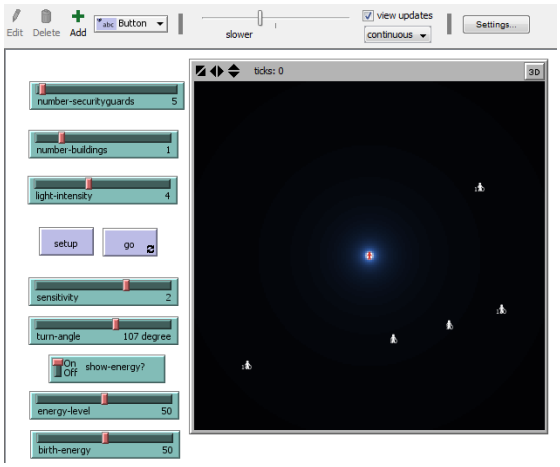

Figure 1.3: Screenshot of providing a security to the building in NetLogo Simulation. Initially security-guards will randomly take their positions.

Second step is to provide security. Security-guards will scatter around the building randomly which is shown in figure 1.3. They will sense the building through light and move towards that. This will be same like as ant smell the pheromone and move towards that. They will use the intensity of light. This is how we are using the ACO technique. We can increase or decrease the number of security-guards and buildings.

All agents will use their local information and no global information is there. Same as the ant does, they use their local information to search the food. In this scenario we have assumed that there is no obstacle and no collision. There is no direct communication between the agents. Each security-guard has some energy associated with them. In this figure we have assumed that there are 5 security-guards and 1 building.

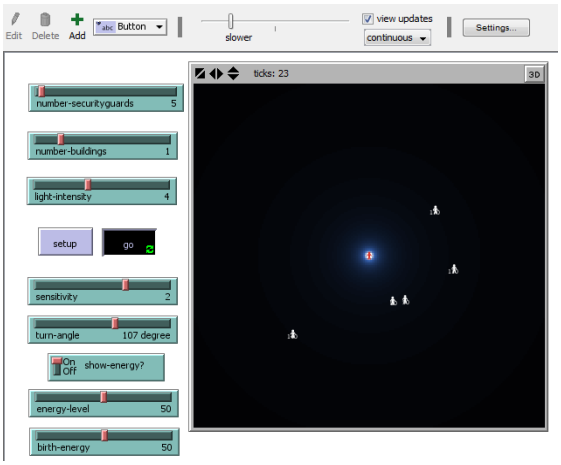

Figure 1.4: Screenshot showing the movements of security-guards towards the building.

This figure clearly shows that security-guards have start approaching towards the building. They will sense the light and according to the intensity they will take their positions. If the intensity of light is greater than the threshold value then the security guard will step back. Else, he will keep on moving towards the building. The result is shown in the figure 1.4.

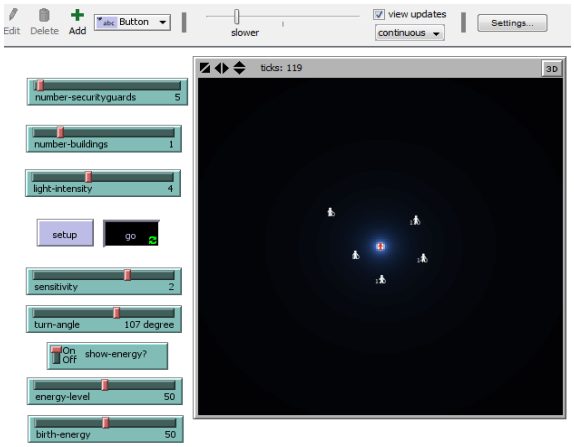

Figure 1.5: Screenshot showing that how security-guards providing the security to the building.

Now, what happens if any security guard fell ill or feels some weakness and wants to rest? So, in this case he will disappear from the scenario. We can see that in figure 1.6 we are left with four security-guards after one dies due to decrease in the energy level.

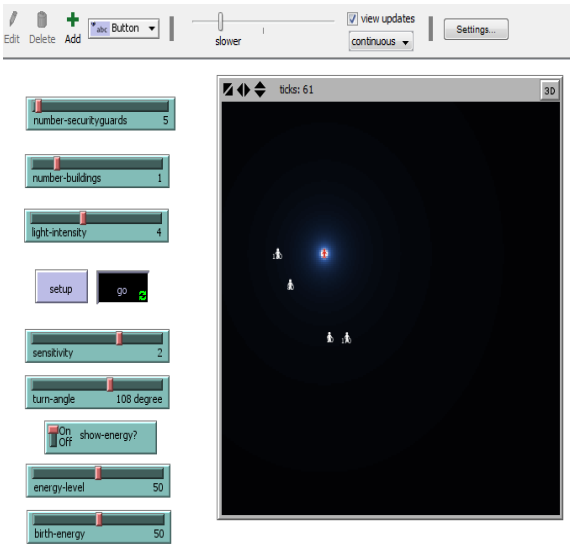

Figure 1.6: Screenshot when one security-guards dies after getting their energy down.

When any security-guard will, he then is replaced by the new security-guard. In figure 1.7 we can see that the entry of new security-guards without changing the input, in input we have 5 security-guards but in simulation we have six.

Figure 1.7: Screenshot of scenario when other security guard will enter the scenario on their own without changing the input parameters.

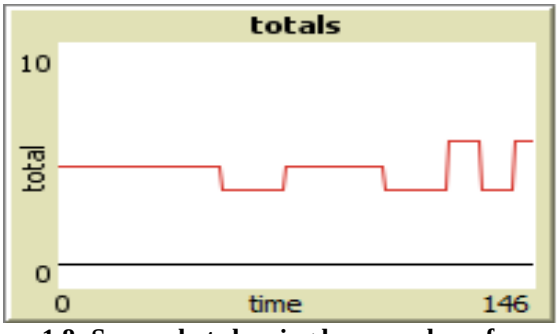

Figure 1.8: Screenshot showing how number of security-guards is changing.

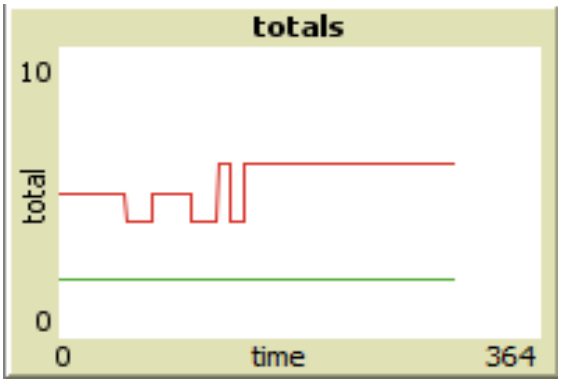

Figure 1.9: In this we have increased the number of building to two.

In figure 1.8, we can easily see that how number of security-guards are increasing or decreasing. Decreasing means security-guard has died due to decrease in the energy and increasing means there is the need for increase in the number of security-guards. So, this figure shows the fluctuations in the number of security-guards around the building while building is taken single for this example. We can increase the number of buildings also as in figure 1.9.

.

IV. CONCLUSION

In this paper, we have proposed an idea to provide the security to the building and buildings can be the banks, parliament house, prime ministers house, ambani's house or etc. We have implemented this scenario in the NetLogo to describe how we can provide the security to any building. By utilizing the ACO algorithm in contexts for which they are well-suited, this scenario provides an efficient method for providing the security.

REFERENCES

[1] Matthew Conforth and Yan Meng, "Reinforcement Learning for Neural Networks using Swarm Intelligence", 2008 IEEE Swarm Intelligence Symposium St. Louis MO USA, September 21-23, 2008, 978-1-4244-2705-5/08/ ©2008 IEEE.

[2] M. Dorigo, V. Maniezzo and A. Colorni. "Ant System: optimization by a colony of cooperating agents", IEEE Transactions on Systems, Man and Cybernetics - Part B, vol. 26, no. 1, pp. 29-41, 1996.

[3] J. Kennedy and R. Eberhart, "Particle Swarm Optimization", in: Proc. IEEE Intl. Conf. on Neural Networks (Perth, Australia), IEEE Service Center, Piscataway, NJ, IV:1942-1948, 1995.

[4] Marco Dorigo and Mauro Birattari, "Swarm intelligence, (2007) Ant colony optimization. Scholarpedia, 2(3):1461.

[5] Julia Handl & Bernd Meyer: "Ant-Based And Swarm-Based Clustering"; Springer Science +Business Media,LLC 2007/Swarm Intell 1:95-113/Doi: 10.1007/s11721-007-0008-7/13 nov 2007.

[6] Dervis Karaboga · Bahriye Akay : "A survey: algorithms simulating bee swarm intelligence" ; Springer Science +Business Media B.V. 2009/ Artif Intell Rev (2009) 31:61–85/ Doi 10.1007/s10462-009-9127-4 /28 October 2009.

[7] Fatemeh R. Yazdi: "Ant colony with coloured pheromones routing for multi objectives quality of services in WSNs ";International journal of research in computer science; eISSN 2249-8265 volume 3 issue/(2013) pp.1-9; doi: 10.7815/ijorcs.31.2013.055.

[8] Ahlam Towfeeq N. Al-S Arraf:" Ants creativity and different approaches to achieve better pathing construct"; International journal of scientific and engineering research; Volume 4, Issue 2,February-2013; ISSN 2229-5518/ IJSER 2013.

[9] Ying Tan, Nikola Kasabov: " Special issue on Swarm Intelligence algorithms and applications "; International journal of artificial intelligence; ISSN 0974-0635, Volume 7, Number A11, October 2011.

[10] Ms. T.Hashni and Ms .T.Amudha " Relative Study of CGS with ACO and BCO Swarm Intelligence Techniques" ; T Hashni et al ,Int.Journal of Computer Technology & Applications,Vol 3 (5), 1775-1781; IJCTA | Sept-Oct 2012.

[11] Lalit Kumar Behera and Aparna Sasidharan," Ant Colony Optimization for Co-operation in Robotic Swarms", Pelagia Research Library; Advances in Applied Science Research, (3): 476-482,2011.

[12] Pan Junjie1 and Wang Dingwei2," An Ant Colony Optimization Algorithm for Multiple Travelling Salesman Problem"; Proceedings of the First International Conference on Innovative Computing, Information and Control (ICICIC'06),0-7695-2616-0/06© 2006;IEEE.

[13] Zar Chi Su Su Hlaing and May Aye Khine," Solving Traveling Salesman Problem by Using Improved Ant Colony Optimization Algorithm"; International Journal of Information and Education Technology, Vol. 1, No. 5, December 2011.

[14] Michael Brand, Michael Masuda, Nicole Wehner, Xiao-Hua Yu,"Ant Colony Optimization Algorithm for Robot Path Planning";2010 International Conference On Computer Design And Appliations (ICCDA 2010); 978-1-4244-7164-51© 2010 IEEE.

AUTHORS

First Author – **Anita** has done M.Tech. in Computer Engineering from Manav Rachna International University and B.TECH degree in Computer Science and Engineering with Hons. from Maharshi Dayanand University. Her areas of interests are Artificial Neural Network, Soft Computing and Pattern Recognition., Email:anidagar@gmail.com

Second Author – **Dr. S. S. Tyagi** is a Proferssor and Head at the Department of Computer Science and Engineering in Manav Rachna International University, Faridabad. He did his Ph.D from Kurukshetra University and has published many Papers in National and International journals and guiding Ph.D Scholars in the fields of Computer science and Engg., Email: shyamtyagi@hotmail.com