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Ant Colony Optimization: A Technique Used For Finding Shortest Path

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Abstract*-Ant colony optimization technique is used to find the shortest path finding algorithm in spite of GPS or any other method. Our motive is to compare the time and accuracy with the old algorithms with our proposed algorithm using ant colony optimization. It is used for searching and scanning the shortest path in between two points selected randomly by the user. This algorithm is basically designed for edge detection but here is implemented to find the path through hurdles. Ant colony optimization (ACO) is a class of optimization algorithms modeled on the actions of an ant colony. ACO methods are useful in problems that need to find paths to goals. It Forms a zig zag track which will be randomly generated by the algorithm every time we implement our algorithm. Our arena which is randomly created has white pixels showing clear area and black one for restricted entry. This paper presents the average time taken by our algorithm and the accuracy for the same to build a chat. The main aim is to pass through environment in secure form and to avoid obstacles. Examples of this are autonomous robots on distant planets without the possibility to be controlled in real time because of latencies in signal sending, or automatic vehicles control. Another example of path-finding is strategic computer games, mostly with computer opponent. Path-finding is also widely used in finding best routers interconnection for data transmission in many kinds of computer networks, some user-friendly visualization of results of path-finding, which is realized by application of computer graphic techniques have also seen. A geographical information system (GIS) is software and geographical data designed for effective gathering, retaining, editing another, is called routing.

Keywords: **ACO (Ant Colony Optimization), GIS (Geographical Information System), Image Compression.**

I. INTRODUCTION

Ant Colony Optimization (ACO) studies artificial systems that take inspiration from the behavior of real ant colonies and which are used to solve discrete optimization problems.In 1999, the Ant Colony Optimization metaheuristic was defined by Dorigo, Di Caro and Gambardella. The first ACO system was introduced by Marco Dorigo in his Ph.D. thesis (1992), and was called Ant System (AS). AS is the result of a research on computational intelligence approaches to combinatorial optimization that Dorigo conducted at Politecnico di Milano in collaboration with Alberto Colorni and Vittorio Maniezzo. AS was initially applied to the edge detection [1], and to the quadratic assignment problem. Dorigo, Gambardella and Stützle have been working on various extended versions of the AS paradigm. Dorigo and Gambardella have proposed Ant Colony System (ACS), while Stützle and Hoos have proposed MAX-MIN Ant System (MMAS). They both have been applied to the Graph Theory for Route-Searching in Geographical Information Systems [2], Finding Shortest Path in Car Navigation System [3], and Intelligent Path Finding for Avatars in Massively Multiplayer Online Games [4] with excellent results. Dorigo, Gambardella and Stützle have also proposed new hybrid versions of ant colony optimization with local search. For a nice introduction to the field see the issue of Scientific American or the paper titled "Inspiration for Optimization from Social Insect Behavior" appeared on July 6, 2000, in Nature. The book "Ant Colony Optimization" (Dorigo and Stützle,) gives a full overview of the many successful applications of Ant Colony Optimization. Marco Dorigo received the "CajAstur International Prize for Soft Computing" for his outstanding contributions to the development of soft computing, by developing the Ant Colony Optimization (ACO) methodology. The King of Belgium presented the "FNRS - Dr A. De Leeuw-Damry-Bourlart award in Applied Sciences" to Marco Dorigo for his fundamental contributions to the foundation of the swarm intelligence research field. In 2003, Marco Dorigo received the European Commission's Marie Curie Excellence Award for his research on Ant Colony Optimization and Ant Algorithms.Currently three special issues are published on Swarm Robotics (guest editors are Erol Sahin and Alan FT Winfield), Ant Colony Optimization (guest editors are Thomas Stützle, Karl Doerner and Daniel Merkle), and Particle Swarm Optimization (guest editors are Riccardo Poli, Jim Kennedy, and Andries Engelbrecht). Marco Dorigo received the "CajAstur International Prize for Soft Computing" for his outstanding contributions to the development of soft computing, by developing the Ant Colony Optimization (ACO) methodology. The King of Belgium presented the "FNRS - Dr A. De Leeuw-Damry-Bourlart award in Applied Sciences" to Marco Dorigo for his fundamental contributions to the foundation of the swarm intelligence research field. In 2003, Marco Dorigo received the European Commission's Marie Curie Excellence Award for his research on Ant Colony Optimization and Ant Algorithms.

II. IMPLEMENTATION

Ant Colony System Algorithm Different steps of a simple ant colony system algorithm are as follows.

***A. Initialization*-**To create a arena by creating image of certain pixels and introducing noise randomly acting as hurdles for the path. This noise is known as salt and pepper noise, it will be introduced in R, G, and B format of image separately. Then imdilate is used to make the hurdles visible as balls shown in fig.1.

Se =strel ('disk', 25);

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```
Image (: 3) = imdilate (image (: 3), se);
```

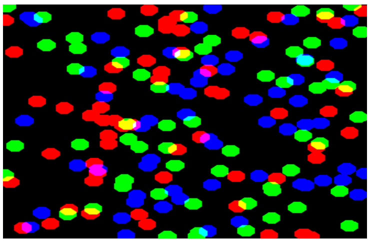

Fig1: Dilated hurdles in R, G, and B format of the image

B. Random points- Taking two random points in image to define the path and making straight line between them using loop. Straight line defines the possible hurdles coming in way. Following fig.2 shows the two random points as the startup and end point.

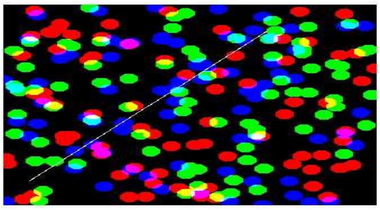

Fig2: Two Random Points to Show Straight Path

C. Routing- Defines the possible routes to reach the destination. In fig.3 First the image is converted from RGB to gray scale then to black and white and lines defining the routes are thinned .now problem is to fill the holes in routes?? image4=~image3;

```
image4 = bwmorph (image4,'thin', INF);
Se = strel ('disk', 2);
image4=imdilate (image4, se);
image4=~image4;
image4=imfill (image4,'holes');
Figure (3)
Imshow (image4)
```

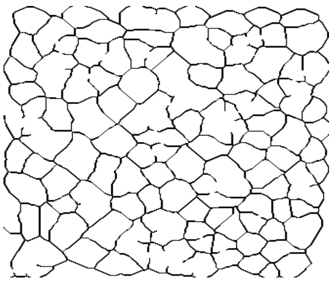

Fig3: Possible Thinned Routes To Reach The End Point

D. Imfilling- Filling is done by kanan kan method ,which classifies the objects separately .Each object will be taken separately in a dummy image and will be dilated and eroded to fill the holes .It will be repeated for every object. Fig.4 shows the dummy image that is ORed with original image.

```
Se = strel ('disk', 4);
For i=1: num
dummy1=labeled==i;
dummy1=imdilate (dummy1, se);
dummy1=imerode (dummy1, se);
dummy_image4=dummy1 | dummy_image4;
Figure (5) Imshow (dummy_image4) Draw now end
dummy_image4=bwmorph
(~dummy_image4,'thin', INF);
image4=dummy_image4 image3;
```

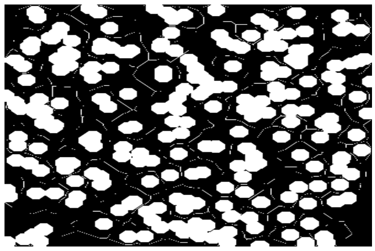

Fig.4: Imfilling to complete the holes

E .Finding nearest points- Two nearest points are taken i.e. one near the startup point and one near the end point. Nearest points are taken by forming the matrices defining rows and column. Then loop starts as shown in fig.5 for finding the shortest path through the hurdles and finally nearest points are attached to their startup and end point.

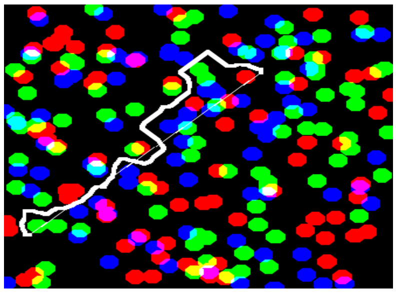

Fig.5: Algorithm Following the Shortest Path to Reach End Point in Less Time

IV GRAHPS

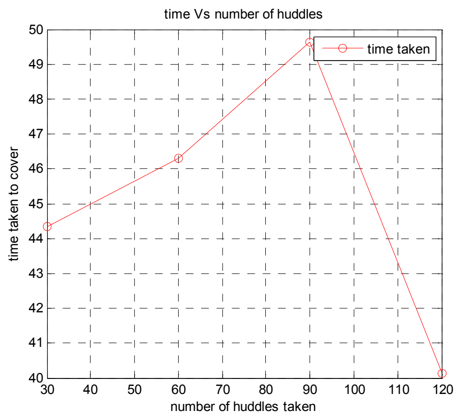

Fig.6: Time variations with hurdle density.

This fig. shows that as hurdle density goes on varying time taken by the algorithm to reach the end point also varies depending on the hurdles coming on the way. Distance is the total distance pixel covered by the

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algorithm. It varies according to the hurdles and with random selection of startup stop point and.

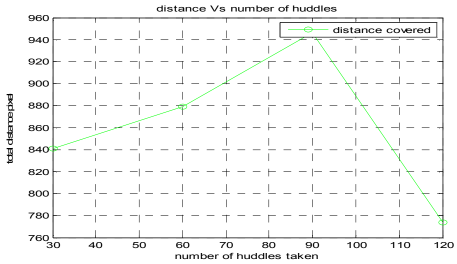

Fig.7: Distance covered with varying hurdle density.

V. RESULTS

S.NO	HURDLE DENSITY	NEAREST ROUTE TRACK TIME	ROUTE TRACK TIME	NEAREST END ROUTE TRACK TIME	TOTAL TIME	TOTAL DISTANCE PIXEL
1.	30	1.4460	127.4406	4.1284	44.33	841
2.	60	1.7922	131.7390	5.4036	46.31	879
3.	90	0.4360	142.6364	5.7949	49.62	946
4.	120	2.4272	100.7793	17.1741	40.12	774

Nearest Route Track Time is time taken to attach nearest startup point to actual startup point, Route Track Time is time taken to find the shortest path i.e. loop execution time and Nearest End Route Track Time is time taken to attach nearest end point to destination point.

VI .CONCLUSION

Ant colony optimization is a new paradigm for solving problems that can be reduced to finding short paths, based on how real ants find the shortest path to a food source. It finds good paths using distributed decisions, local information and indirect communication. Hence, ACO has found numerous applications for example: Traveling Salesman Problem, routing etc. But it doesn't always find the optimal solution. Why? How can this be reverted? Ant colony optimization algorithms are a meta-heuristic approach initially inspired by the observation that ants can find the shortest path between food sources and their nest. The basic algorithm of Ant Colony Optimization is the Ant System. Many other algorithms, such as the Max-Min Ant System, have been introduced to improve the performance of the Ant System.

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