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Travelling Salesman Problem (TSP) for Vehicle Route Optimization in MANETs using ABC Algorithm

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***Abstract*- Path selection process is one of the basic requirements for any Vehicle and when we talk about the MANETs (Mobile Ad Hoc Networks), it is critical task. This paper mainly explains about the performance of variants of Artificial Bee Colony (ABC) algorithms in solving the Travelling Salesman Problem (TSP). The main goal of TSP is that a number of cities should be visited by a salesman and return to the starting city along with a number of possible shortest routes. The results of the Routing Algorithm are compared with the results of the ABC algorithm and perform well in finding the shortest distance.**

Keywords- Mobile Ad Hoc Networks (MANETs), Travelling Salesman Problem (TSP), and Artificial Bee Colony (ABC).

I.INTRODUCTION

A. MOBILE AD HOC NETWORKS

A mobile Ad Hoc Network is a set of mobile nodes which communicate each other via radio waves. MANETs do not need any infrastructure so it's call an infrastructure less network. So these types of networks are very flexible and suitable for several applications. All nodes are changes in arbitrarily; so no any central authority for control them. Then the network is decentralized. Every node in MANETs is free to move independently in any direction. Eachnode can directly communicate with those nodes whose are in its communication range.

In recent years, a large number of MANET routing algorithms have been proposed. These algorithms all deal with dynamic aspects of MANETs in their own way, using reactive or proactive behavior or a combination of both. The demand for real time and quality of services (QoS) in the network has been increased as the internet expands. However, the service level is sensitive to the characteristics of network transmission, such as delay, bandwidth, packet loss rate and cost.

The role of a QoS routing strategy is to compute paths that are suitable for different type of traffic generated by various applications while maximizing the utilizations of network resources. But the problem of finding multi constrained paths has high computational complexity, and thus there is a need to use algorithms that address this difficulty. The major objectives of QoS routing are i) to find a path from source to destination satisfying user's requirements ii) To optimize network resource usage and iii) To degrade the network performance when unwanted things like congestion, path breaks appear in the network [5].

The main advantages of an Ad Hoc network are:-

- Independence from central network administration
- Self-configuring, nodes are also routers

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- Self-healing through continuous re-configuration
- Scalable-accommodates the addition of more nodes
- Flexible-similar to being able to access the Internet from much different location [3].

B. TYPES OF MANETS [3]

(1) Vehicular Ad-Hoc Networks (VANET's)

VANET is a type of Mobile Ad-Hoc network where vehicles are equipped with wireless and form a network without help of any infrastructure. The equipment is placed inside vehicles as well as on the road for providing access to other vehicles in order to form a network and communicate.

(2) Intelligent Vehicular Ad-Hoc Networks (InVANET's)

The main aim of designing InVANET's is to avoid vehicle collision so as to keep passengers as safe as possible. This also help drivers to keep secure distance between the vehicles as well as assist them at how much speed other vehicles are approaching. InVANET's applications are also employed for military purposes to communicate with each other.

(3) Internet Based Mobile Ad-Hoc Networks (iMANET's)

These are used for linking up the mobile nodes and fixed internet gateways. In these networks the normal routing algorithms does not apply.

C. TRAVELLING SALESMAN PROBLEM

One of the best vehicle routing problems is the Traveling Salesman Problem (TSP). In TSP a number of cities have to be visited by a salesman who must return to the same city with the solution of shorter routes. A Salesman travels around a given set of cities, and return to the beginning of the path (from where he started), covering the smallest total distance. The traveling sequence has to comply with a constraint, that is the salesman will start at a city, visit each city exactly once, and back to the start city. The resulting route should incur a minimum cost. Finding an optimized route in various fields is the main application of TSP [9].

In solving the problem one tries to construct the route in such a way that the total distance traveled by the salesman is minimized. To solve the TSP, nearest neighbor method is used. The nearest neighbor algorithm was one of the first algorithms used to determine a solution to the travelling salesman problem. In this, the salesman starts at a random city (or node) and repeatedly visits the nearest city (or node) until all have been visited once. Thus it obtains a shorter tour, but usually not the optimal one. The nearest neighbor method is based on comparing the distribution of the distances that occur from data point to its nearest neighbor in a given data set with the randomly distributed data set [9].

II. ROUTING ALGORITHM

Routing is the path selection process from source to destination node. For routing between source and destination point will be possible using of different types of routing algorithms. An ideal routing algorithm is one which is able to send the packet data to its destination with minimum amount of delay. It must be adaptive and intelligent enough to make the decisions. The routing tables are every time updated by exchanging routing information between the routers.

A. NEAREST NEIGHBOUR ALGORITHM

The Nearest Neighbor method was initially introduced by J. G. Skellam where the ratio of expected and observed mean value of the nearest neighbor distances is used to determine if a data set is clustered. Further work was done by P. J. Clark and F. C. Evans to introduce a statistical test of significance of the nearest neighbour statistic in order to quantify the departure of the pattern from random This type of test is great importance because even randomly data generated could be labeled as clustered, but the significance test would reveal if the evidence for this Classification is lacking [2].

For find the near neighbour using Euclidean distance method. When measuring the distance in the plane, we use the

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formula for the Euclidean distance. According to the Euclidean distance formula, the distance between two points in the plane with coordinates (x_1,y_1) and (x_2,y_2) is given by

$$\text{dist}((x_1, y_1), (x_2, y_2)) = \sqrt{(x_1 - x_2)^2 + (y_1 - y_2)^2}$$

The nearest neighbor algorithm is easy to implement and quickly executes, but sometimes it can miss shorter routes which are easily noticed with human insight, due to its "greedy" nature. Thus there is a disadvantage of greedy strategy in this method, due to which some errors occur such as the optimal path obtained is not exactly the shortest path, time required to find the optimal path is more, etc [9].

The important steps of the algorithm are [9] :
Step 1. Start from a random node at the beginning of the path.
Step 2. Move to the nearest unvisited node
Step 3. Repeat Step 2 until all nodes are visited by the vehicle. Then, join the first and last nodes. Based on it, the procedure for nearest neighbor method to compute an efficient path for TSP problem is as given below,

- Input-M: A city map, which is a matrix of 2D city coordinates.
- Enter the number of cities.
- Compute the distance matrix.
- Initialize the path.
- Perform nearest neighbor path finding loop
- Find each path, and then evaluate the minimum of the paths.
- Compute the path length.

III. ARTIFICIAL BEE COLONY (ABC)

Bee swarms exhibit many intelligent behaviors in their tasks such as nest site building, marriage, foraging, navigation and task selection. There is an efficient task selection mechanism in a bee swarm that can be adaptively changed by the state of the hive and the environment. Foraging is another critical task for bees. Forage selection depends on recruitment for and abandonment of food sources.

Teodorovic suggested use the bee swarm intelligence in the development of artificial system aimed at solving complex problems in traffic and transportation. For optimizing multivariable functions, Karaboga has described an Artificial Bee Colony (ABC) algorithm which is different from the virtual bee algorithm [6].

Artificial Bee Colony (ABC) algorithm, proposed by Karaboga for real parameter optimization, is recently introduced optimization algorithm and simulates the foraging behavior of bee colony for solving optimization problems.

A. STRUCTURE OF ABC

In the ABC algorithm, the colony of artificial bee contains three groups of bees.

- Employed bees
- Onlooker bees
- Scout bees

In any colony number of EB is equal to number of OB and number of EB is equal to number of food source. In ABC algorithm, each cycle of search consist of three steps.
(1) Sending a employed bee on the food source and measure the nectar amount.
(2) Selecting food source by onlookers after sharing the information of employed bee and determine nectar amount of food.
(3) Determine the scout bees and sending them possible food source.

B. WORKING MECHANISM OF ABC ALGORITHM [6]

Phase-1 Employed bee initialization phase

A set of food source position randomly select by EBs and their nectar amount are determined. After determining food source they come back on hive and share nectar information through dance. Dances are divided in main two parts.
1) Round dance: The round dance when food is very close. This dance indicates only the direction.

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2) Waggle dance: It indicates distance and direction of the food source. The distance between the food source and the hive is transmitted depending on the speed of the dance. If dance is faster then, the food distance is smaller.

Phase-2 Employed Bee Neighbourhood selection

After sharing information, every EBs go to the food source area visited by herself in previous cycle since that food source exist in her memory and choose food source by mean value of visual information in the neighbourhood of the present one. Visual information based on comparison of food source position.

Phase-3 Onlookers process

An onlooker bee prefers a area for nectar is distributed area by dancing area of Employed bees. Nectar amount of food source increases, the probability with which that food source chosen by an Onlooker increases too.

After arriving a selected area Onlooker chooses a new food source in the neighbour same as a Employed bee.

Phase-4 Scout bee

When a nectar food source left by bees, a new food source is randomly determined by a Scout bee and replace with left one. In our model, at each cycle at most one Scout goes outside for searching a new food source and the number of EB=OB.

Scout goes outside for searching a new food source and the number of EB=OB.

A food source by an onlooker bee depends on the nectar amount F (θ) of that food source. As the nectar amount of food source increases; the probability with the preferred source by an onlooker bee increases proportionally.

Therefore, the probability with the food source located at θi will be chosen by a bee can be expressed as

$$Pi = \frac{F(\theta i)}{\sum_{k=1}^{s} F(\theta k)}$$

Where; F (θi) = The fitness value, θi = position of the i^{th} employed bee, pi = probability of selecting i^{th} employed bee, s = numbers of employed bees.

Where F (θi) fitness function can be expressed by

$$F(\theta i) = \begin{cases} \frac{1}{1+fi} & \text{if } fi \geq 0; \\ 1+abs(fi) & \text{if } fi < 0 \end{cases}$$

Where i evaluated by its employed bees which is proportional to the nector amount of food source in the position i and SN is number of food sources which is equal to the number of employed bees (BN).

For repeat cycle, in employed bee phase to produce a candidate food source position from the old one. The ABC uses the expression for calculating new position;

$$Vij = Xij + \phi ij\ (Xij - Xkj)$$

Where k € {1,2,….BN} and j € {1,2,….D} are randomly chosen indexes. Although k is determine randomly, it has be differ from i. ϕij is random number between [-1, 1]. It controls the production of neighbour food positions. If the new food source equal or better nectar amount than the old source, it is replaced with the old one in the memory otherwise, the old one is retained.

IV SIMULATION RESULTS

IV.1 TSP SOLUTION PATH FOR ROUTING ALGORITHM

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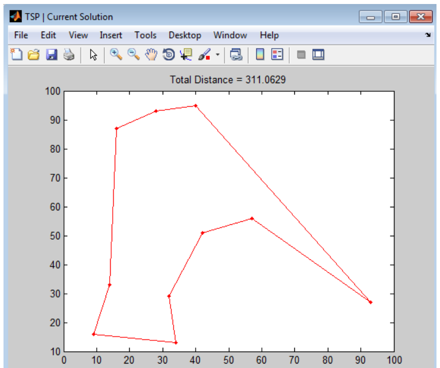
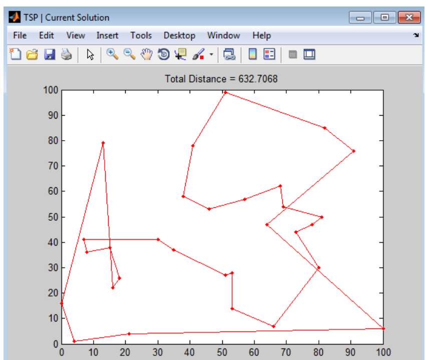
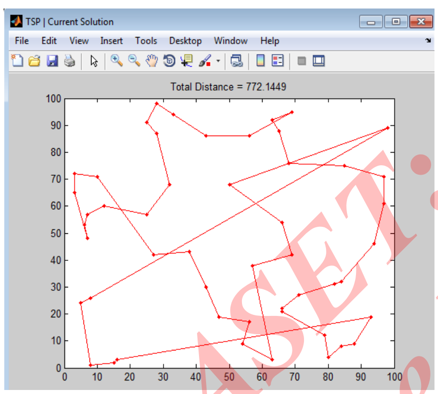


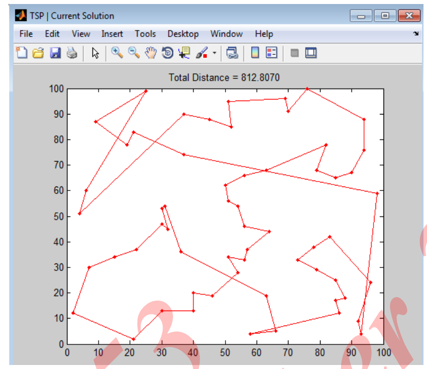
1) TSP solution path for no of 10 nodes



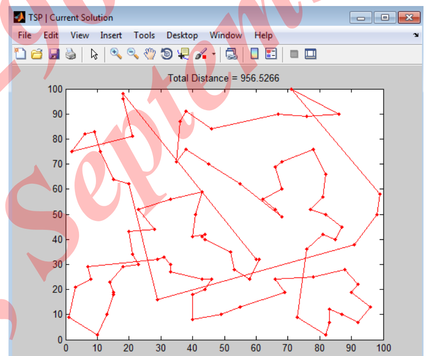
2) TSP Solution path for no of 30 nodes



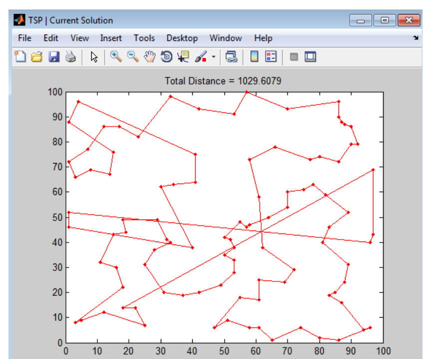
3) TSP Solution path for no of 50 nodes



4) TSP solution path for no of 60 nodes



1) TSP solution path for no of 10 nodes



6) TSP Solution path for no of 100 nodes

IV.2 TSP SOLUTION PATH FOR ABC ALGORITHM

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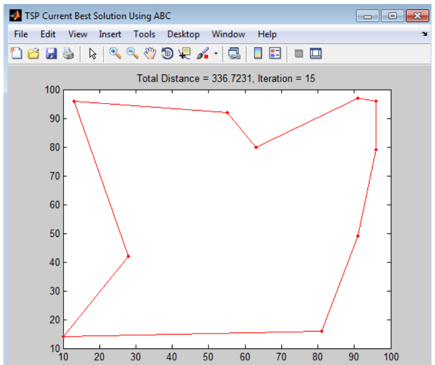
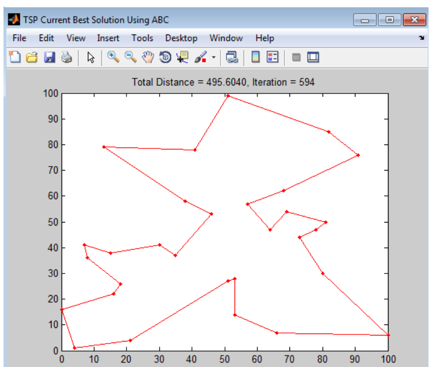
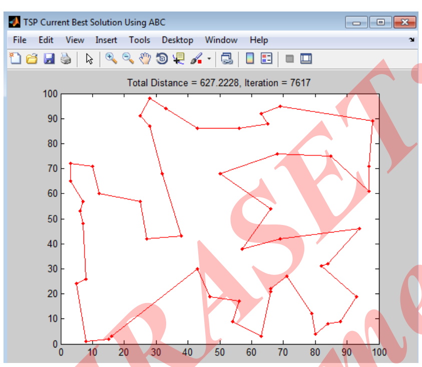


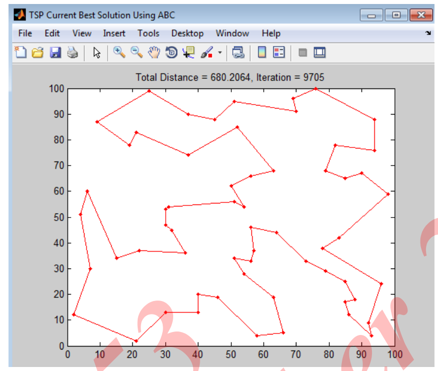
TSP solution path with ABC for 10 nodes



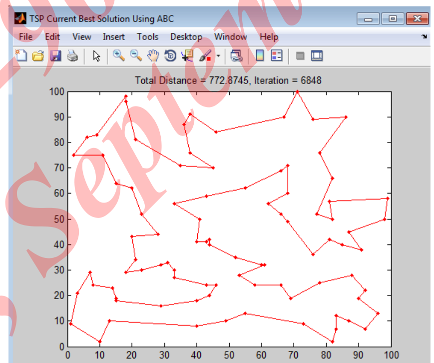
TSP solution path with ABC for 30 nodes



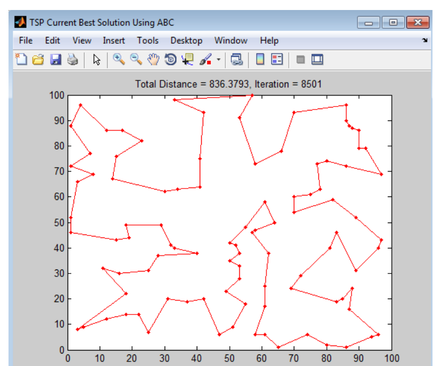
TSP solution path with ABC for 50 nodes



TSP solution path with ABC for 60 nodes



TSP solution path with ABC for 90 nodes



TSP solution path with ABC for 100 nodes

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V. TABLE SHOWING ANALYSIS:

Table V.1: Different paths and their shortest distance at different Algorithm

Algorithm	No of Nodes	Path Allocated	Shortest distance (in units)
Routing	10	8-2-10-4-3-1-6-7-5-9-8	311.6229
ABC	10	2-7-6-4-3-1-5-9-8-10-2	304.9038
Routing	30	25-17-30-2-1-28-4-5-29-10-24-22-18-7-3-19-27-15-14-26-12-20-13-11-9-8-16-23-6-21-25	632.7068
ABC	30	28-1-4-2-30-17-25-21-16-6-23-29-5-24-10-15-27-26-14-13-20-12-11-8-9-19-3-7-18-22-28	495.6040
Routing	50	50-46-41-36-38-5-33-13-19-40-4-44-49-26-9-20-25-37-7-24-39-17-45-48-43-27-18-29-6-41-47-10-1-32-15-3-12-30-35-8-38-22-23-42-16-34-14-11-21-2-50	772.1449
ABC	50	19-44-49-4-40-36-31-46-28-50-21-11-5-33-13-34-14-16-42-6-27-43-39-24-7-17-45-48-41-47-10-1-32-15-3-12-30-23-22-8-38-2-35-29-18-37-25-20-9-26-19	627.2228

Table V.2:

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Comparison result at different time run

No of Nodes	Vehicle routing distance (in units)								
	1st time run			2nd time run			3rd time run		
	Using routing algorithm	With ABC algorithm		Using routing algorithm	With ABC algorithm		Using routing algorithm	With ABC algorithm	
		Dist	Iteration		Dist	Iteration		Dist	Iteration
10	356.3381	336.7231	15	362.9534	334.4751	7	311.0629	304.9038	161
30	632.7068	495.6040	594	577.2409	500.7750	331	577.5359	475.2759	6876
50	772.1449	627.2228	7617	760.7212	624.8971	8306	593.9342	496.2312	3603
60	812.8070	680.2064	9705	822.2199	655.7783	1947	807.9584	641.0441	6379
90	956.5266	772.8745	6848	923.8335	792.1143	10000	884.1583	783.7643	9464
100	962.7560	801.8120	8911	908.5412	813.4387	9076	1029.6079	836.3793	8501

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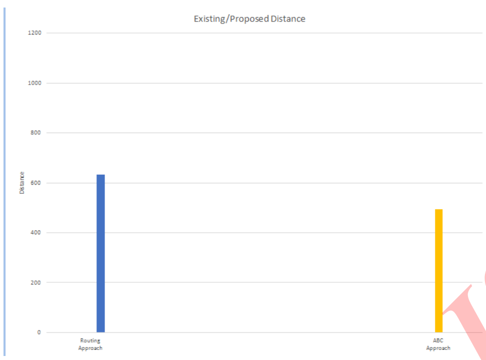
VI.GRAPHICALLY REPRESENTATION OF SIMULATION RESULT ANALYSIS

VI.1 ROUTING/ABC DISTANCE

For nodes = 10

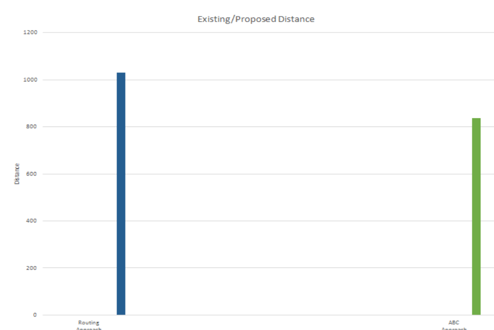


For nodes = 30

For nodes = 50

For nodes = 60

For nodes = 90



For nodes = 100

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VII. CONCLUSION

Routing in Ad Hoc Networks is a hard work and actually it is an interesting research area that has been growing in recent years. In this proposed work, Solve Travelling Salesman Problem using Nearest neighbour routing algorithm for vehicle routing optimization problem. Then after getting result compare with ABC Algorithm. The Artificial Bee Colony Algorithm can be used to solve several optimal problems. It is aimed to minimize the length of the tour and find the optimal path.

IX. REFERENCES

[1] Gary Breed, "Wireless Ad Hoc Networks: Basic Concepts", High Frequency Electronics. March 2007.

[2] Amit Kamboj, R. S. Chauhan, "Implementation of Shortest path For Networks Topology Using Matlab", International Journal of Information Technology and Knowledge Management, June 2009,Vol-2.

[3] Jaspal jindal, Vishal Gupta, "Fuzzy Improved Genetic Approach for Route Optimization in MANET", International Journal of Advanced Research in Computer Science and Software Engineering. Vol-3, Issue 6, June 2013.

[4] B.Nancharaiah, B.Chndra Mohan, "Routing in Mobile Adhoc Networks (MANETS) Using Fuzzy Aided Ant Colony Optimization (ACO) Technique", Journal of Theoretical and Applied Information Technology. 20th June 2013. Vol-52 No.2.

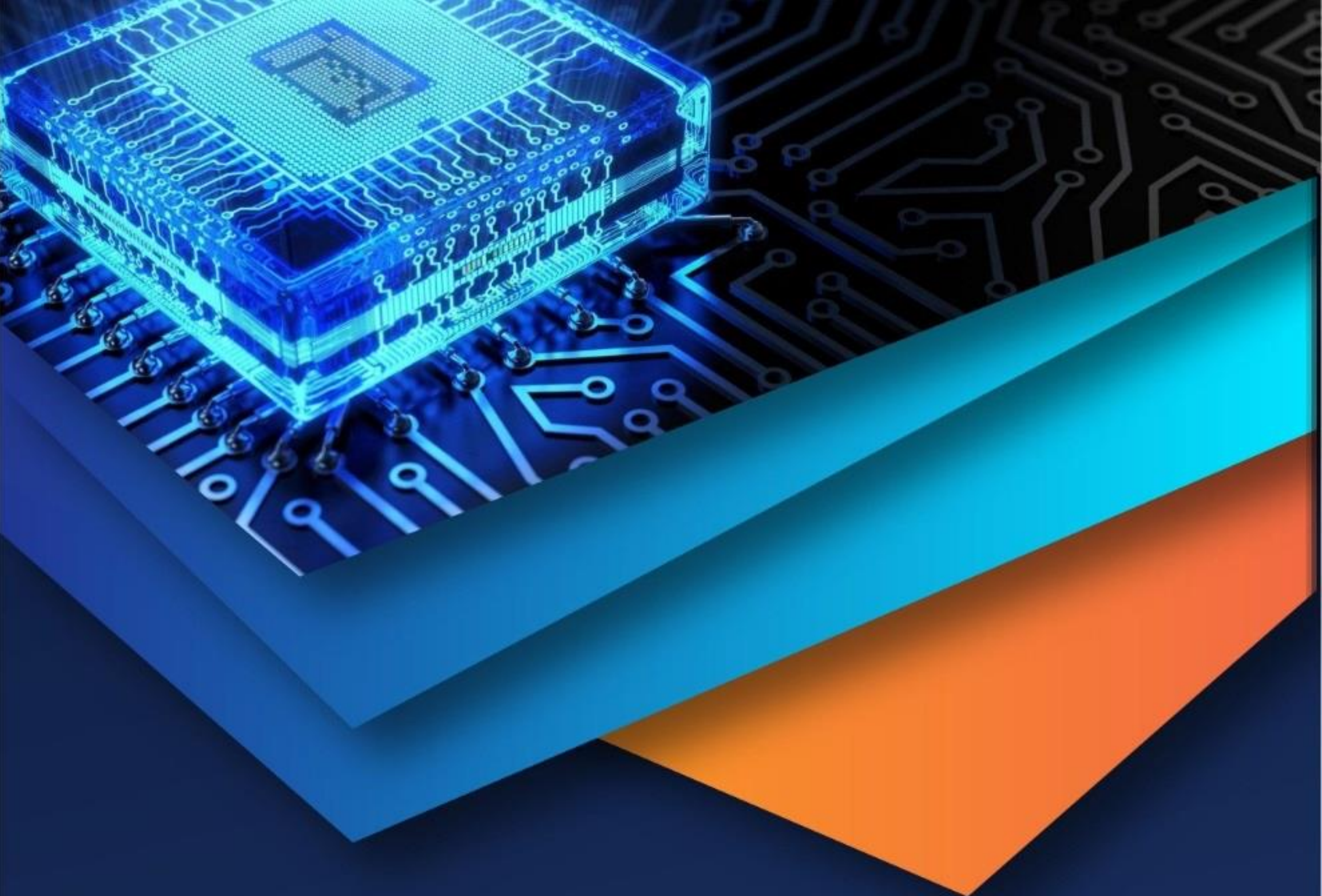
[5] P.Deepalakshmi, Dr.S.Radhakrishnan, "Ant Colony Based QOS Routing Algorithm Mobile Ahoc Network", International Journal of Recent Trends in Engineering, Vol-1, No. 1, May 2009.

[6] Dervis Karaboga, Bahriye Basturk, "A powerful and efficient algorithm for numerical function optimization: artificial bee colony (ABC) algorithm", Springer science-business Media B.V. 2007.

[7] Asaju la'aro bolaji, Ahamad Tajudin Khader, Mohammed Azmi al-betar, Mohammed a. Awadallah, "Artificial Bee Colony Algorithm, Its Variants and Applications: A survey", Journal of Theoretical and Applied Information Technology 20th January 2013. Vol-47 No.2.

[8] D. Karaboga , Bahriye Akay, "A comparative study of Artificial Bee Colony algorithm", Applied Mathematics and Computation, 2009.

[9] Ashita S. Bhagade, Parag. V. Puranik, "Artificial Bee Colony (ABC) Algorithm for Vehicle Routing Optimization Problem", International Journal of Soft Computing and Engineering, Vol-2, Issue-2, May 2012



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