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Neural Network and Ant Colony Optimization for Vehicle Traffic Analysis and Routing

Er.Manpreet Kaur[1]Er.Gurpreet Singh[2]
[1]*M.Tech Scholar, Deptt of CSEBaba Sant Bhag Singh UniversityJalandhar,India*[1]
[2]*Assistant Professor, Deptt of CSESant Baba Bhag Singh University Jalandhar, india*[2]

***Abstract:** In current timing of real world the traffic congestion and control is the major issue in the different cities. Real time traffic control is a main criterion of the urban traffic signal control system, and giving viable ongoing traffic signal control for a substantial complex traffic system is a testing issue. The main objective of the research work is to find and adjust the timing of signals based on the traffic density to overcome the congestion. Such a situation arises in a city where outbound vehicles during morning time and inbound vehicles during evening time is more while the vehicular movement in the opposite direction is less. To do this, the paper proposed the hybrid technique of neural network and ant colony optimization to overcome the error ratio and improve the accuracy of traffic congestion. And further, the paper proposed to find out the shortest path for the vehicles that are struck into the traffic.*

***Keyword:** Artificial Neural Network, Ant Colony Optimization, Traffic Congestion, Training Performance, Regression.*

I. INTRODUCTION

The traffic lights are utilized fundamentally for people on foot to be secured when they cross the streets. The typical capacity of traffic framework is to control the coordination to guarantee that traffic moves as easily and securely as could reasonably be expected. It was decreasing crashes, both vehicular and people on foot. It was energize travel within the speed limit to meet the green lights. The crisis will happen anyway, any time and on any area. All things considered the expediently reaction is required. The number of vehicles using the limited road networks infrastructure which was slowly increased. I feel that the real result of this expansion is the traffic administration issue. A standout amongst the most basic outcomes of activity issue is the postponement of crisis vehicles, for example, ambulance during mishaps to reach healing facilities on time, Fire unit vehicles, police van to get the thief, and VIP vehicles. There are congested roads happen on primary path in exceptional seasons and rush hours. That was prompt a long holding up time of people groups and high cost of fuel utilization on the street. What's more, in that postpone the Emergency vehicles are trapped in roads turned parking lots. Some of the time regardless of the possibility that there is no activity at that point likewise individuals need to hold up on the grounds that there is a sure time utmost of activity flag. So street clients need to hold up till the movement flag swung to green light. Subsequently we need to find new techniques which tackle this issue. Traffic light streamlining is a complex issue. Not with standing for single intersections there may be no ideal arrangements. With multiple intersections, the issue gets to be considerably more unpredictable, as the condition of one light impacts the stream of traffic towards numerous different lights. Confusion is the way that stream of traffic continually changes, contingent upon the time, the day of the week and the time. In traffic management Ant Colony Optimization is increasing in popularity, with its ability to find optimized solution in situation where traditional methods fail to produce any good solution. The One of large benefits is using ant colonies to assist the planning of transport systems is their ability adapts to changes within the environment. The de-centralized control of an ant colony allows it to easily work around problems in a network. Given a model to working system, changes of restrictions can be applied to help simulate different styles of problems. For example, in the road network system is lane closure could be simulated through decreasing the maximum capacity of that path or by increasing the estimated time taken to traverse down it. In the case of a major road traffic collision it could be represented in a similar way or by completely removing a connection in network depending on the severity of the accident.

II. PROPOSED WORK IN NEURAL NETWORK ALGORITHM AND ANT COLONY OPTIMIZATION

Let a dataset D, consist of training samples and their target values, L be the rate of learning by the network to generate a trained network:

A. Initialize the weights and the biases of the layers using small random values.
B. Compute the weighted sum of the inputs, where

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$$O_j = I_j$$

The output of the inputs is the true input values.

C. Compute the activation functions of hidden layers, where

$$I_j = \sum_j W_{ij} O_j + \theta_j$$

Compute the net input of j with respect to i (previous layer).

D. Compute the output of the layers, where

$$O_j = \frac{1}{1 + e_j^{-1}}$$

*E.*Compute the error rate by Back-Propagation, Error for output layer:

$Error_j = O_j(1 - O_j)(T_j - O_j)$Error calculation of next hidden layer, h:

$$Error_j = O_j(1 - O_j) \sum_h Error_h w_{jh}$$

Weight update:

$w_{ij}=w_{ij} + \Delta w_{ij}$

Bias update:

$\theta_j = \theta_j + \Delta\theta_j$Eq. No. 11

Where Δw_{ij} and $\Delta\theta_j$are the change in weight and bias

F. {Initialization}

Initialize t?? And???, ?(??).

G. {Construction}

For each ant k (currently in which state) do Repeat Choose in probability the state to move into.

H. append the chosen move to the k-th ant's set tabuk.

Until ant k has completed its solution End for

I. Trail updat

For each ant move (??) do

Compute??

Update the trail matrix. End for

J. Terminating condition

If not (end test) go to step 7

III. RESULTS AND DISCUSSION

Data set has been created by taking different scenarios of vehicles in various directions and on the basis of this traffic signal is defined.(fig:1) Showing dataset rows and columns In this figure minimum maximum is calculated from the dataset rows and columns(fig:2) Training of neural network In this figure Training of neural network is taking place showing the no of iterations performed in order to predict the results (fig:3) Graph between mean square error vs. no. of iterations In this figure, the graph is representing the variation between mean square error and number of iterations. The best training performance is 0.32446 at 18 epochs(fig:4) Neural Network Training State showing at maximum epochs i.e. 18 the various plots for the neural network performance including gradient, validation checks(fig:5) Regression plot for designed Artificial Neural Network with respect to target the deviation is shown. The best fit value is plotted with respect to target value(fig:6) Showing the distance between ants in ACO Algorithm(fig:7)The Figure showing deployment of vehicles(fig:8) Distance covered is 4.2599 in 80 number of iterations. Showing the shortest path covered by the vehicles at 80 iterations and the distance covered is 4.2599(fig:9).

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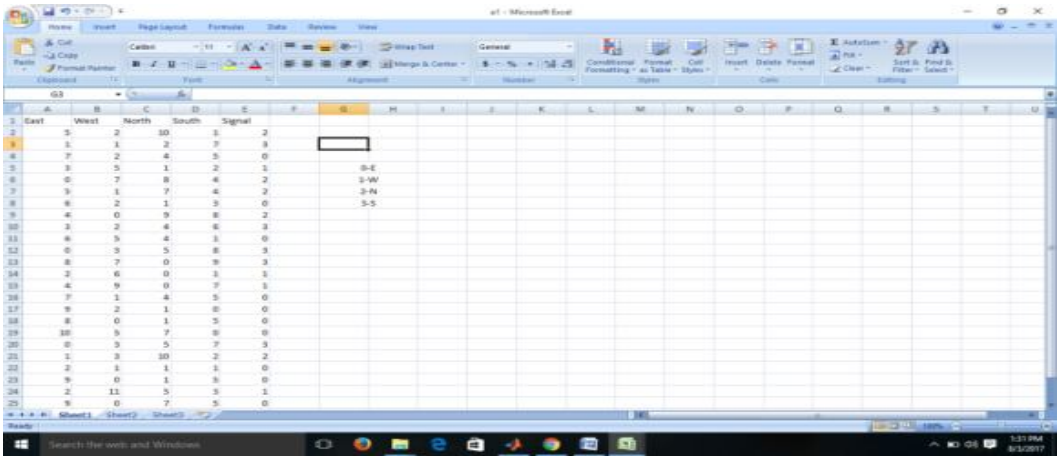

Fig 1: Dataset representing vehicle direction

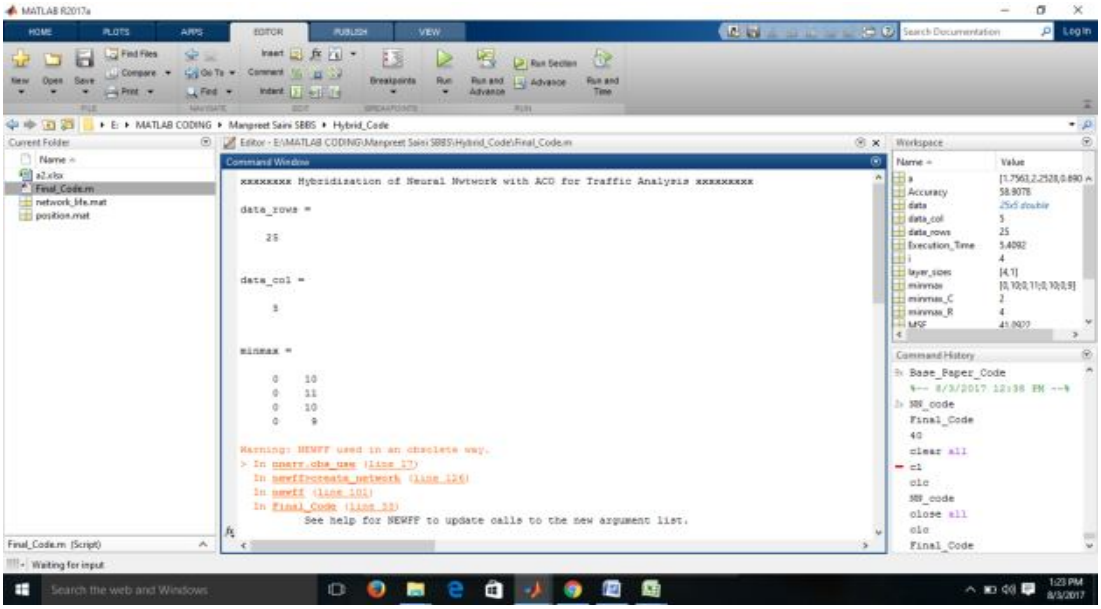

Fig 2: Showing dataset rows and columns

Fig 3: Training of neural network

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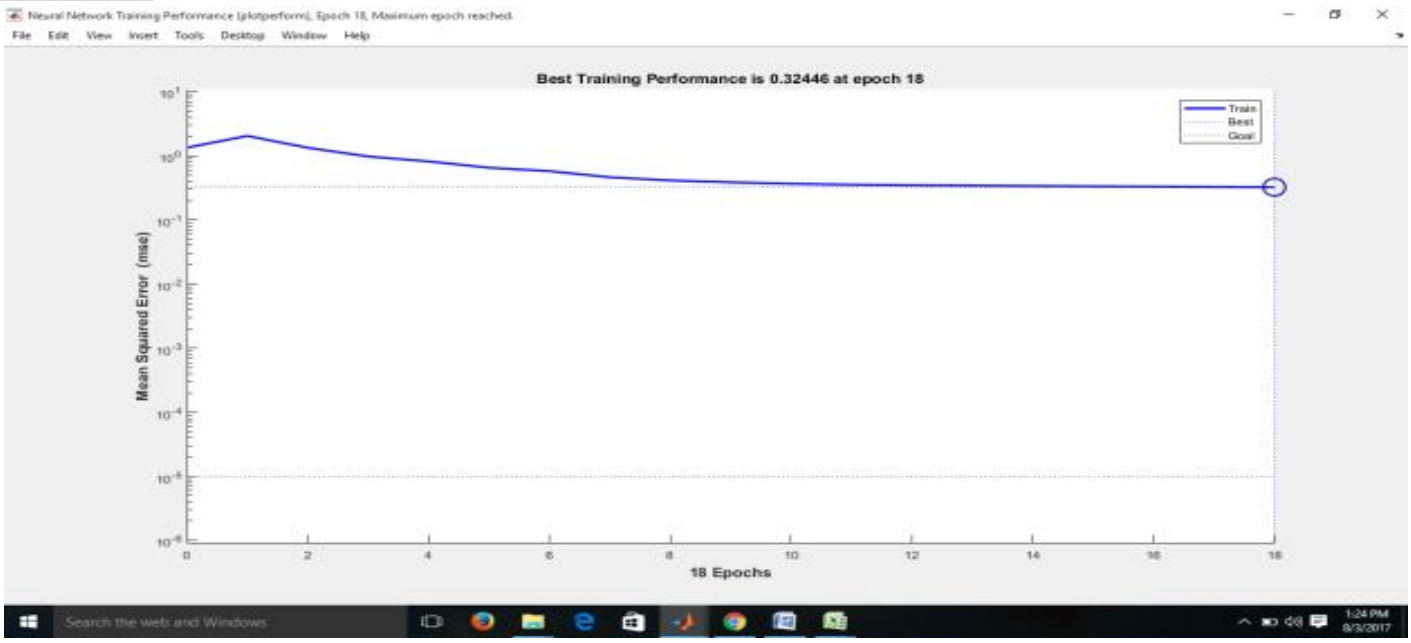

Fig 4: Graph between mean square error vs no. of iterations

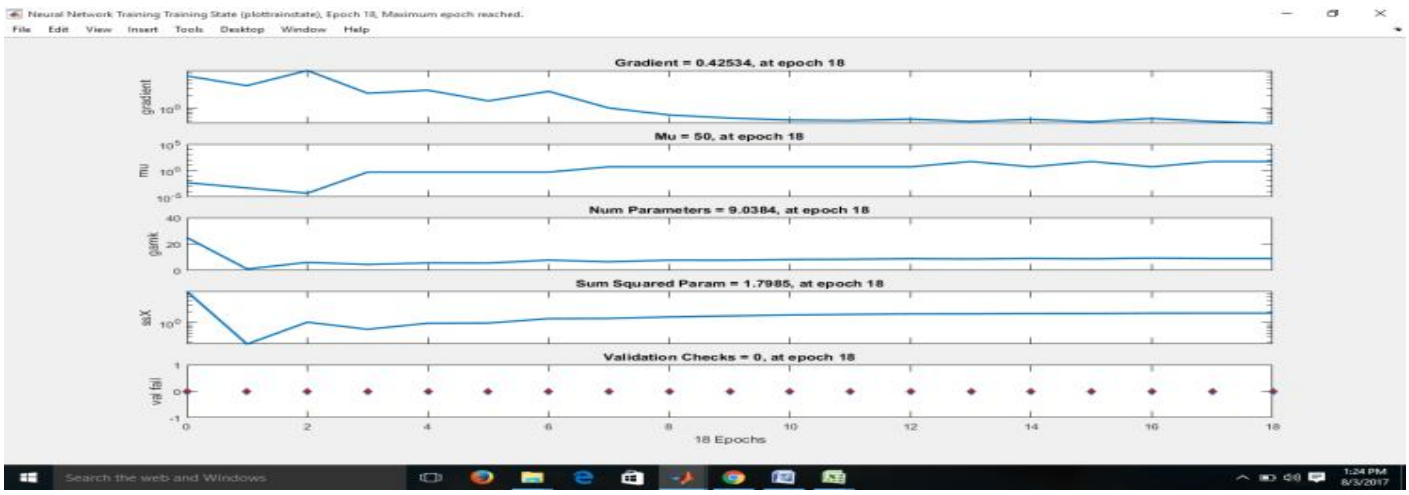

Fig 5: Training State of Neural Network at 18 epochs the various plots for the neural network

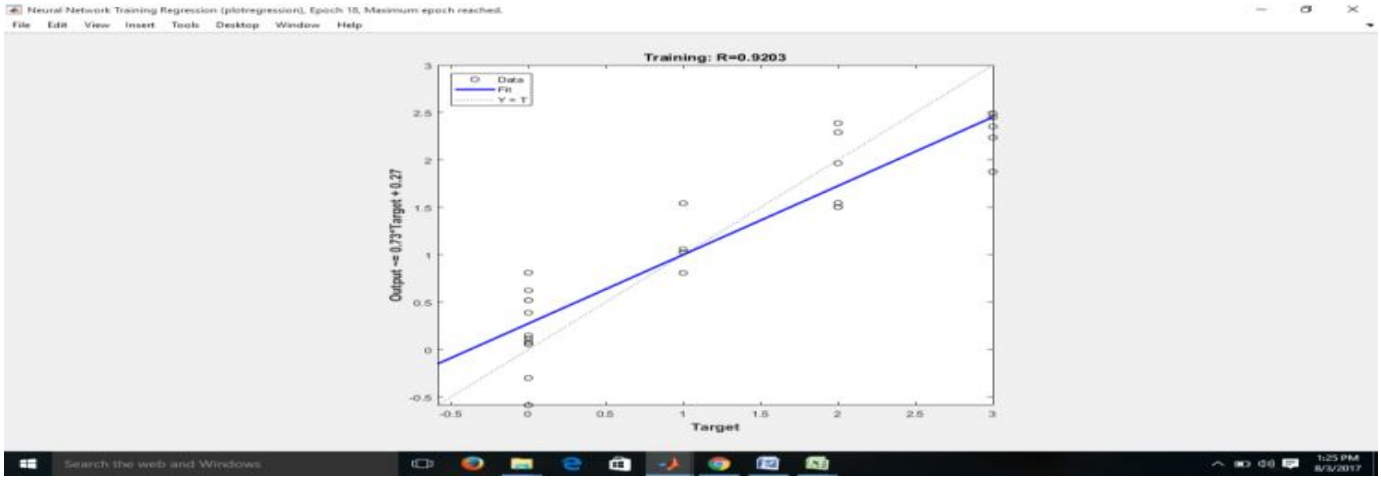

Fig 6: Regression plot for designed Artificial Neural Network.

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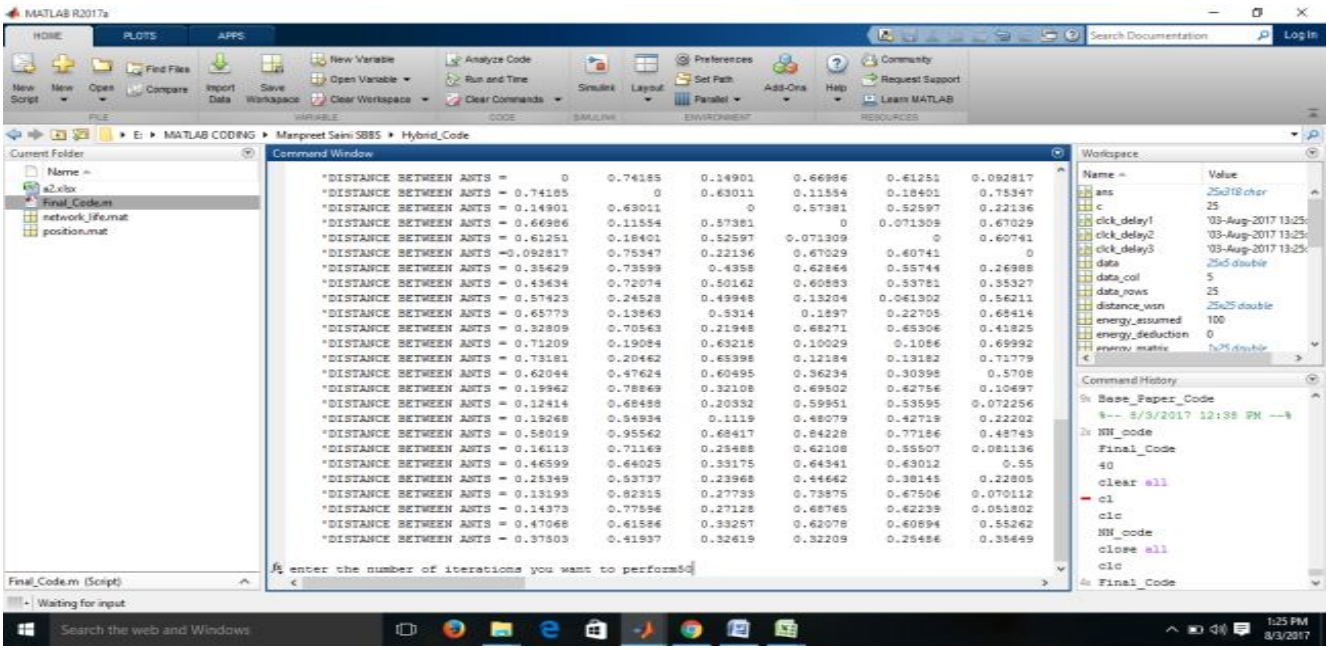

Fig 7: Showing the distance between ants in ACO Algorithm

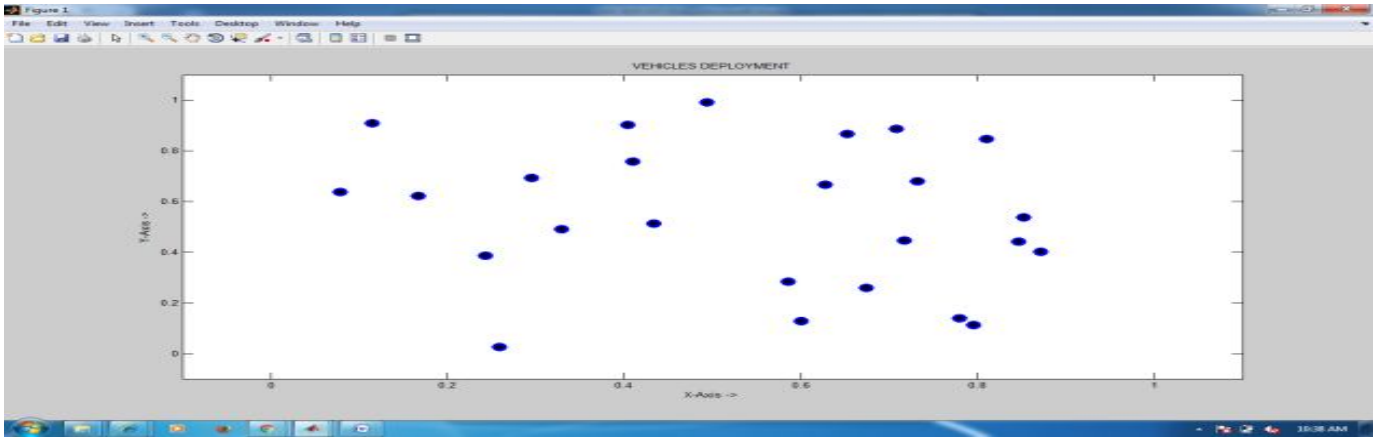

Fig 8: Figure showing deployment of vehicles

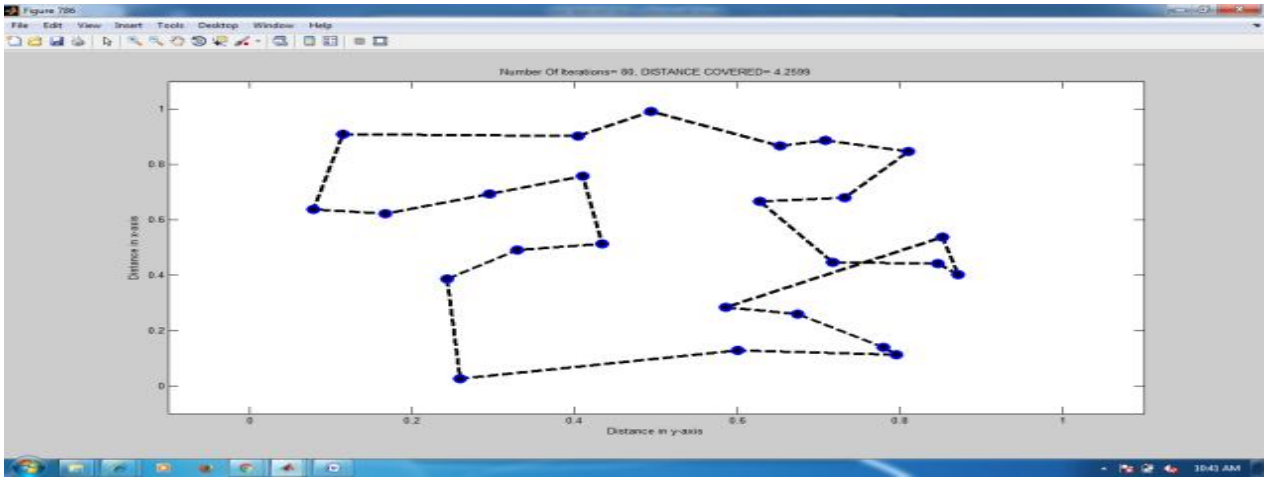

Fig 9: Distance covered is 4.2599 in 80 number of iterations. Showing the shortest path covered by the vehicles at 80 iterations and the distance covered is 4.2599.

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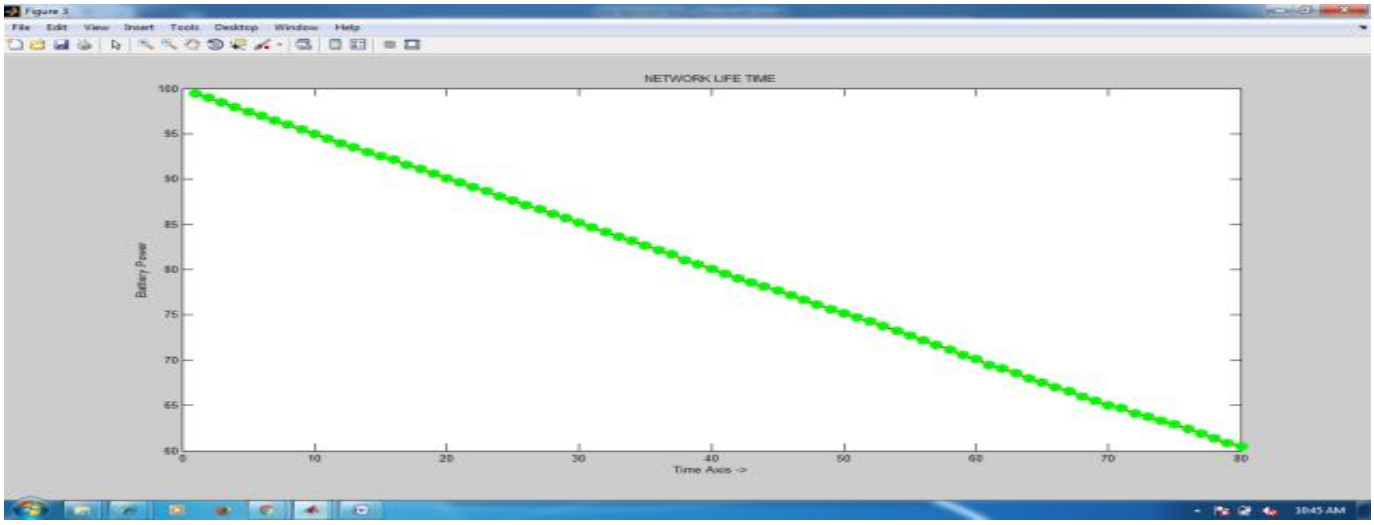

Fig 10: Plot representing Network Life Time

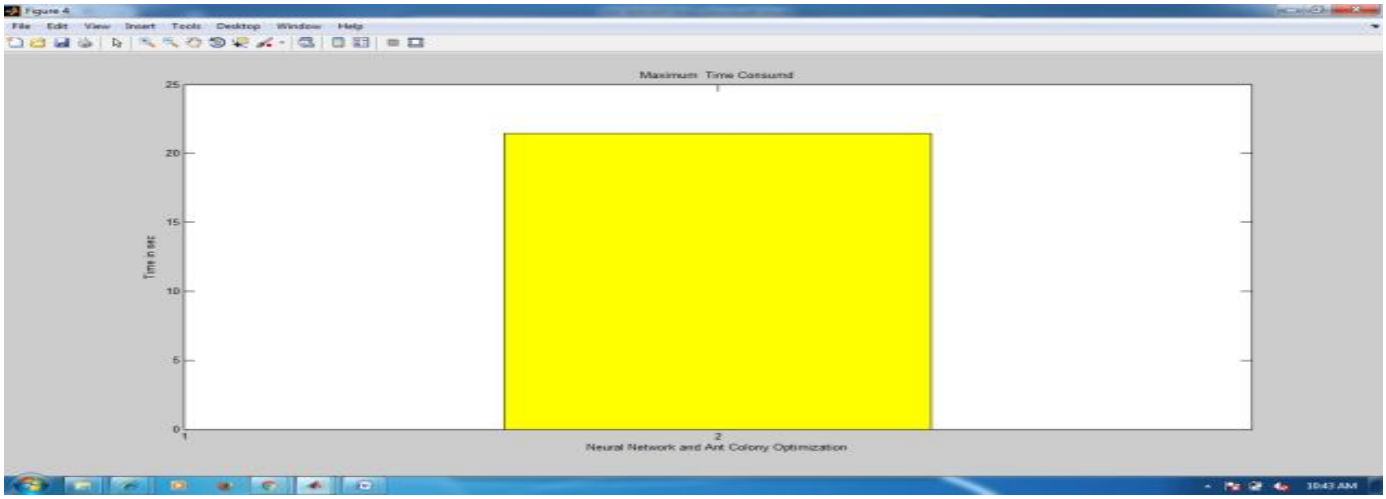

Fig 23: Bar graph representing Maximum Time Consumed

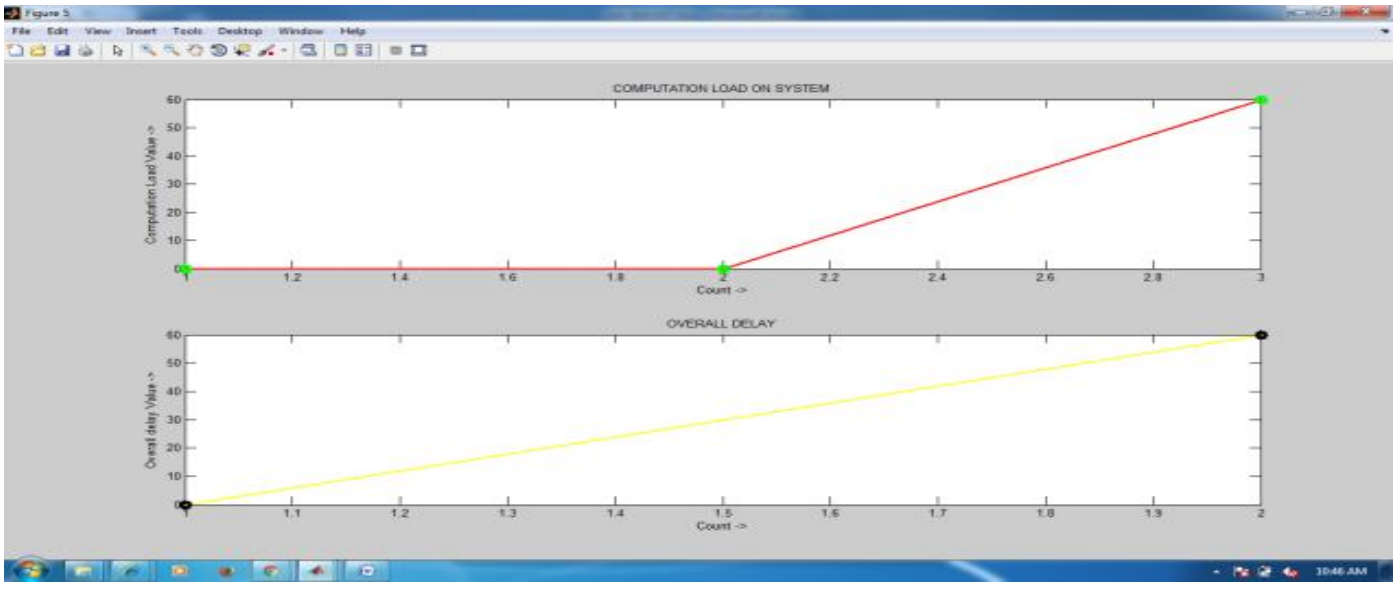

Fig 24: Line graph showing computation load on system and overall delay

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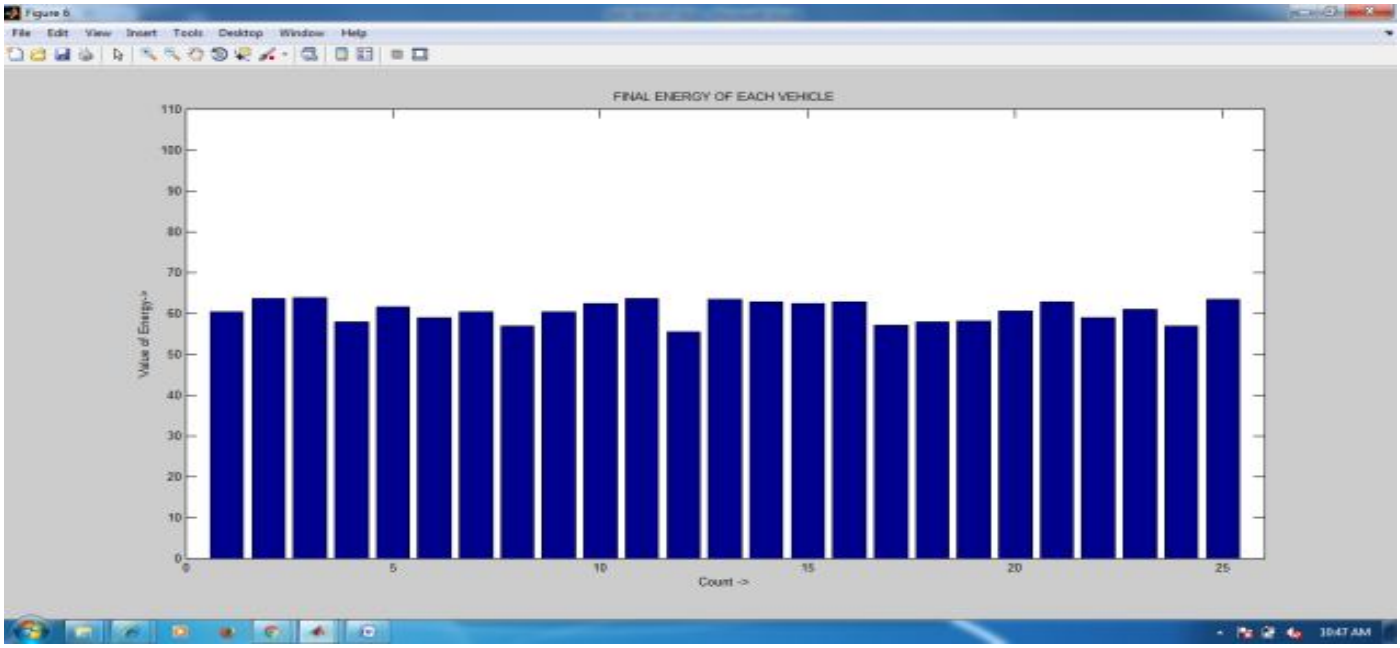

Fig 25: Graph representing Final energy of each vehicle

Table 1: Performance measures comparison

Performance Measures	Existing	Proposed
Training Performance	23.46	32.46
Regression	90.76	92.03
RMSE	46.2808	38.5638
MSE	39.5546	30.8756
Accuracy	60.4454	69.1244
Execution time (in milliseconds)	0.5023	8.5778

The existing system is build with only neural network and the proposed system is build with the help of neural network and ant colony optimization. Hence it shows better results.

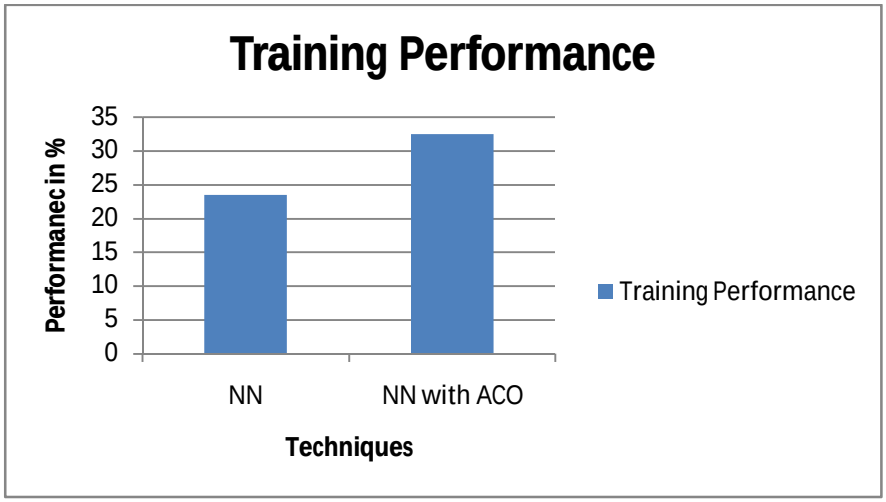

Fig 26: Bar graph representing training performance of techniques

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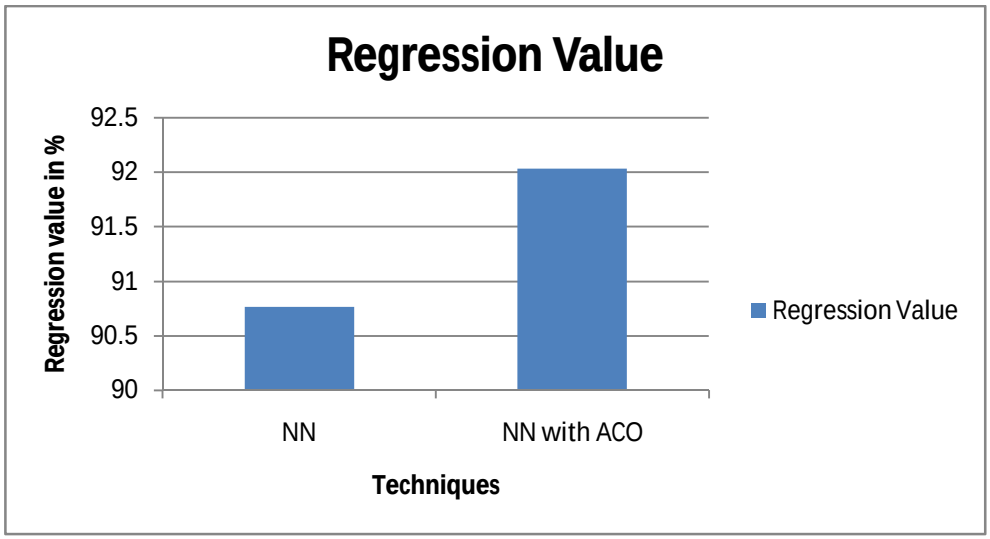

Fig 27: Bar graph representing regression value of techniques

These graphs shows that the proposed methodology showing better training performance and regression value as compare to the existing methodology. The improved training performance value is 32.46 % and improved regression value is 92.03%.

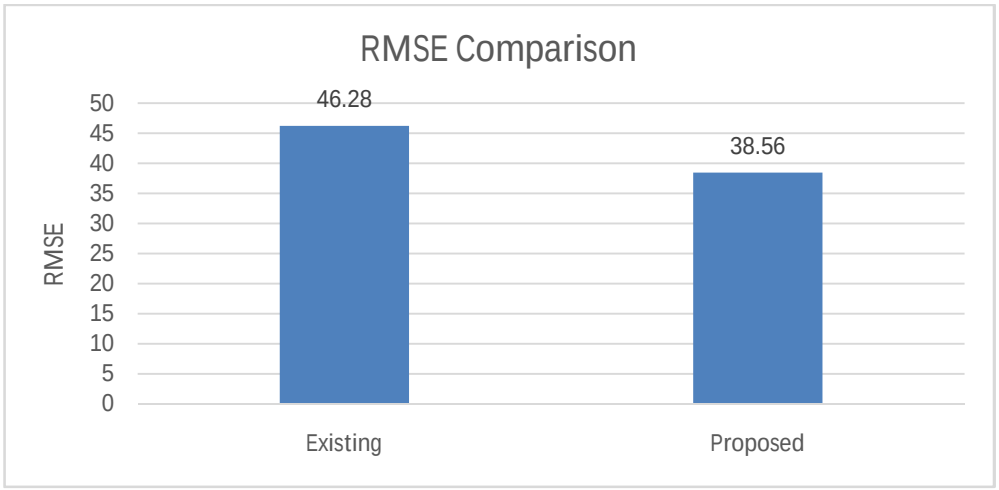

Fig 28: RMSE Comparison

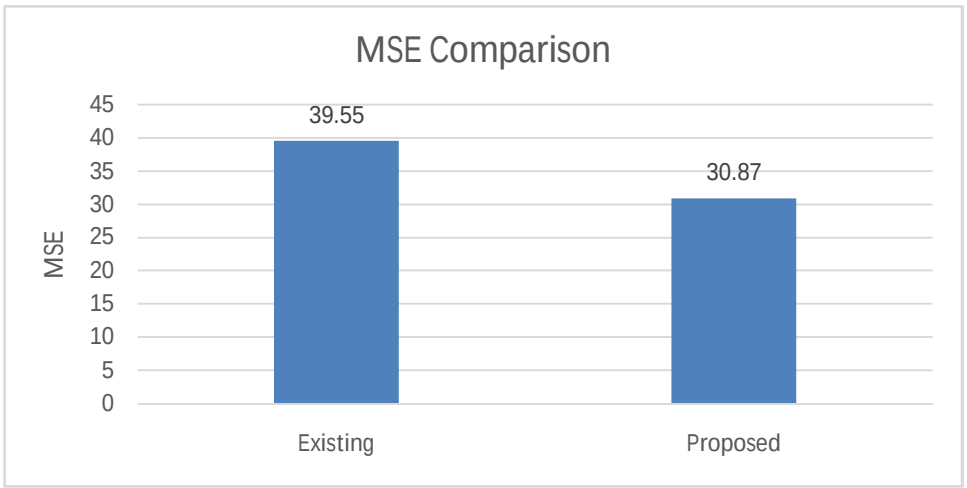

Fig 29: MSE Comparison

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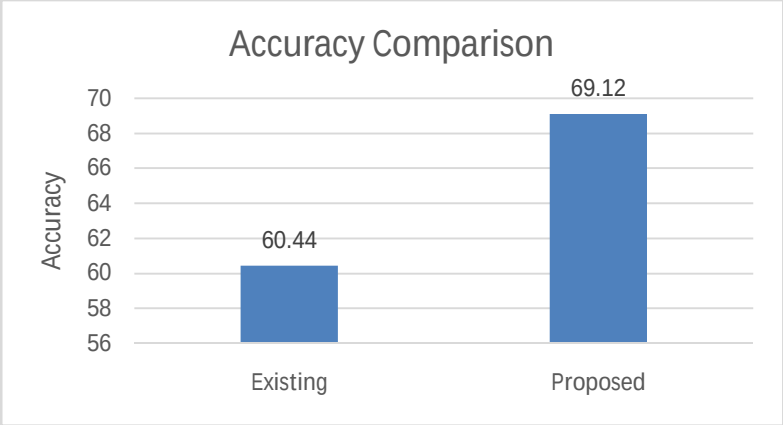

Fig 30: Accuracy comparison

IV. CONCLUSION

In the previous work experience, fixed turns of allowing the traffic either in clockwise or in anti-clockwise direction irrespective of the traffic density. Also fixed time allocation is followed. The fixed time is allocated for the particular direction based on survey taken by some traffic experts for different time period. In existing system, traffic congestion problem occurs. The Earlier system only analyzes the traffic and did not provide alternate route. In this research, we have used the ant colony optimization with the artificial neural network to find the shortest path or route to reach the vehicle to its own destination and improve the error ratio and accuracy of traffic congestion. Also, the training performance has been improved as compare to existing technique. Previous work showing training performance is23.46% and the proposed work is giving the result of 32.46%. Moreover, the regression value of the existing technique is 90.76 and current technique showing improved regression value is 92.03%.In future, we can improve our results by using advanced intelligent techniques and to control the traffic congestion and timing of signals as per numbering of vehicles on the spot by real life smart devices without the interface of human.

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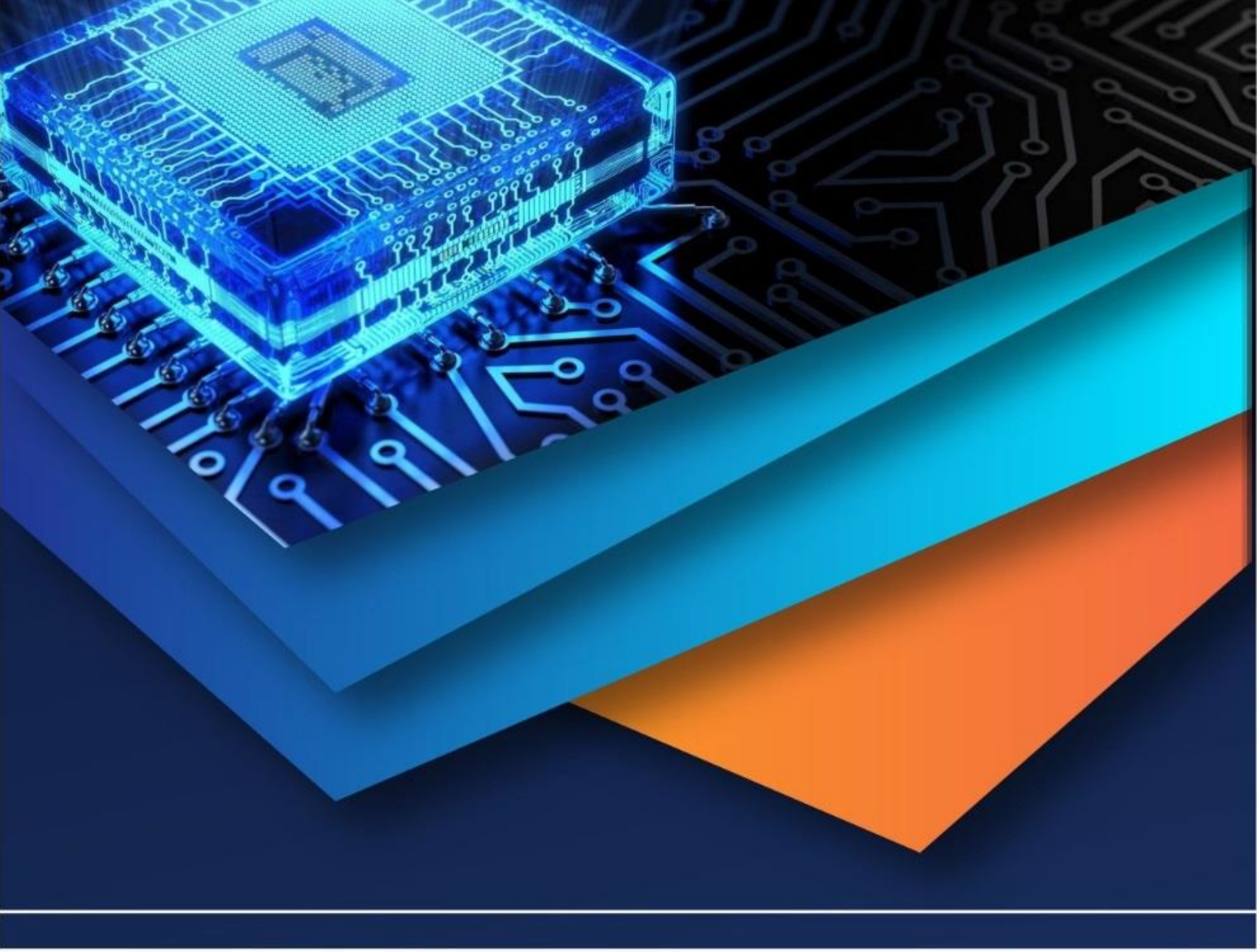

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