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Microscopic Simulation-Based Model analysis at Jaipur

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Abstract: ***Socio-Economic development of a country includes sustainable transportation system. As simulation is safer, less expensive and faster than field implementation and testing, Microscopic simulation models have been widely used in transportation operations and management analysis. The accuracy and reliability decide the usefulness of these models in making design and traffic control. Now in India, VISSIM which is microscopic traffic simulation software is used. However, modifications to the default behavioral parameters are essential to effectively simulate Indian heterogeneous traffic conditions. In this study, the queue length and travel time of link connected to Narayan Singh Circle and Trimurti Circle intersection is analyzed before and after transfer the bus stop at Narayan Singh Circle to the periphery of city. For this, intersections are designed in VISSIM software and traffic flow performance is validated via VISSIM. Then average vehicular delay under different traffic volumes was analyzed. The results are finally compared before and after transfer the bus stop at Narayan Singh Circle to the peripheryof city.***

Keywords: Non-destructive Testing, Concrete, Structural Health Monitoring, Ultrasonic Pulse Velocity,Rebound Hammer.

I. INTRODUCTION

In major developing Asian nations, the nature of traffic is heterogeneous. Heterogeneous traffic is defined as mix of vehicles having different type of characteristics which may be static and dynamic. Mix of vehicles consists of motorized and non-motorized vehicles with different composition. There are no lane marking and lane discipline in heterogeneous traffic. And also widths of lane are not constant. In most of cities in India, almost all the intersections are controlled by traffic signal lights, no matter what the flow volume of traffic. There is also low flow volume intersection which has no signal and management, safety and efficiency of this type of intersection depends on drivers themselves. Obviously signalized intersection increases the safety but on the other hand it also increase the travel time, delay time and also decrease the efficiency of intersection. So improve traffic safety and decrease travel delay, it is appropriate to take some control measures for those intersections.

Jaipur city nowadays has a big problem with their transportation; congestion, delay, and air pollution are several conditions to describe it. This problem caused by the unequal number of vehicles with road capacity, road user behavior, and transportation support facilities such as road marking, traffic lights, crossing bridge, pedestrian facilities etc. The problem also leads to queue lengths at intersection, resulting in the high delays and congestion at the intersection.

The increasing number of vehicles from year to year, especially motorcycles and cars are the essential factors causing congestion. In the Jaipur city, number of registered vehicles growing at the rate of 8.9 %.(Times of India)

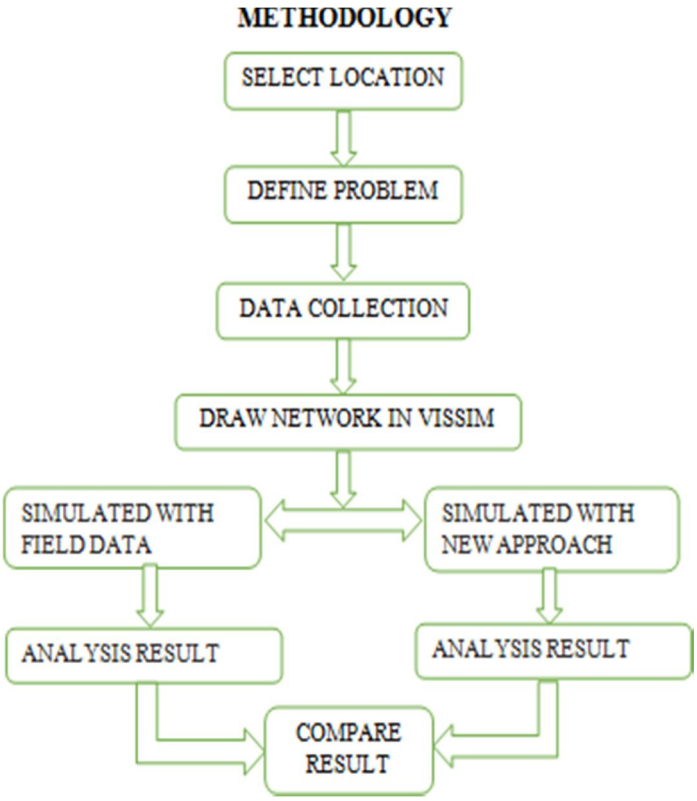
Narayan Singh circle is the bus stop in Jaipur where a large number of buses pass in a day. Dueto this frequent traffic jam occurs. And also delay time, travel time, queue length, increases.

Rapid increase in traffic volume, mixed nature of traffic and poor lane discipline prevailing on roads in developing nations need a good understanding of traffic flow analysis and data interpretation. The roadway system and operational analysis greatly depends on availability of reliable, relevant and recent traffic flow data from field. The period of time over which a traffic count data is recorded is an important consideration in assessing the load borne by the facility in terms of traffic flow rate. Estimation of roadway capacity poses different levels of difficulties under mixed traffic and poor lane discipline of drivers. Vehicles of different types are allowed to mix and they share the same road space along the length of a roadway. Unrestricted mixing of various classes of vehicles makes the capacity analysis more complex as compared to homogeneous traffic condition. Field data in such situation are generally not suitable to study the effect of individual vehicle type on stream speed and capacity. Simulation of traffic flow has been a very effective tool for such problems. Various traffic simulation programmers have been developed in different countries based on homogeneous traffic conditions. One such microscopic traffic simulation model is VISSIM which was developed in Germany based on the continuous work of Wiedemann (1999) on car following behavior.

It has default values of certain parameters evaluated for the type of traffic prevailing in the Europe and other developed countries. Although traffic conditions are heterogeneous in the Europe and the US also, but the degree of heterogeneity is different in developing and developed nations. The roads in developed countries have dominating traffic of cars with very low (5-10 percent) proportions of light/heavy commercial vehicles. The traffic stream in developing countries like India has variety of vehicles like cars, light commercial -vehicles, heavy commercial vehicles, motorized two-wheelers, three wheelers, non-motorized vehicles etc. The applicability of VISSIM in mixed traffic conditions of the type prevailing on Indian roads has been examined in the present study andcalibrated to truly reflect these traffic conditions.

Microscopic simulations are widely used in transportation operations and management analysis because "simulation is safer, less expensive and faster the field implementation and testing" (park & schneeberger, 2002). It is a useful tool to effectively analyze and evaluate proposed improvements and alternatives. For example an intersection can be simulated for different signal timing plans and its effect found before implementing it.

II. MATERIALS AND METHODS



A. Site Location

Narayan Singh Circle intersection and Trimurti Circle intersection.

B. Data Collection

As discussed in previous section, literature review has been done to show the latest work done to calibrate the traffic micro-simulation software in different conditions. The second important step was to collect data. Mode-wise volumetric traffic data at 10-minute interval was extracted from videorecorded at Narayan Singh circle and Trimurti Circle on typical week day for 2 hours in the morning(i.e. 9:00 A.M – 11:00 A.M) and 2 hours in the evening(i.e. 5:00 P.M – 7:00 P.M) . The nature of traffic was heterogeneous therefore, traffic data was classified into different categories, which includes Motorcycles/Scooters, Rickshaws, Cars, and Busses vehicles. The peak hour data as given below in table:-

Table 3.1 Traffic Data in Peak Hour at Narayan Singh Circle

Direction / Types Of vehicle	Rambag To SMS	Rambag To Trimurti	SMS To Rambag	SMS To Trimurti	TrimurtiTo SMS	TrimurtiTo Rambag
2- Wheeler	570	275	533	320	520	162
3-Wheeler	592	491	375	303	353	216
Car	323	191	297	260	492	220
Bus	180	55	170	200	58	65

Table 3.2 Traffic data in peak hour at trimurti circle

Direction / Types Of vehicle	NSC ToRP	Nsc To MNIT	MNIT To Ramniwas Garden	MNIT To RP	Ramniwas Garden To MNIT	Ramniwas Garden To NSC	RP To NSC	RP to Ramniwas Garden
2- Wheeler	352	110	1312	250	758	210	372	100
3-Wheeler	310	330	244	360	320	470	205	370
Car	215	240	446	470	354	380	325	170
Bus	255	20	10	25	25	15	130	30

C. Network in VISSIM

The following links are prepared in vissim:-

1) Link between Rambag to SMS and Rambag to Raja Park.
2) Link between SMS to Rambag and SMS to Raja Park.
3) Link between MNIT to Ramniwas Garden, MNIT to Narayan Singh Circle and MNIT to Rajapark
4) Link between Ramniwas Garden to MNIT, Ramniwas Garden to Narayan Singh Circle andRamniwas Garden to Raja Park.
5) Link between Raja Park to Ramniwas Garden, Raja Park to MNIT, Raja Park to Narayan SinghCircle.

Snapshots of the network prepared are shown below:-

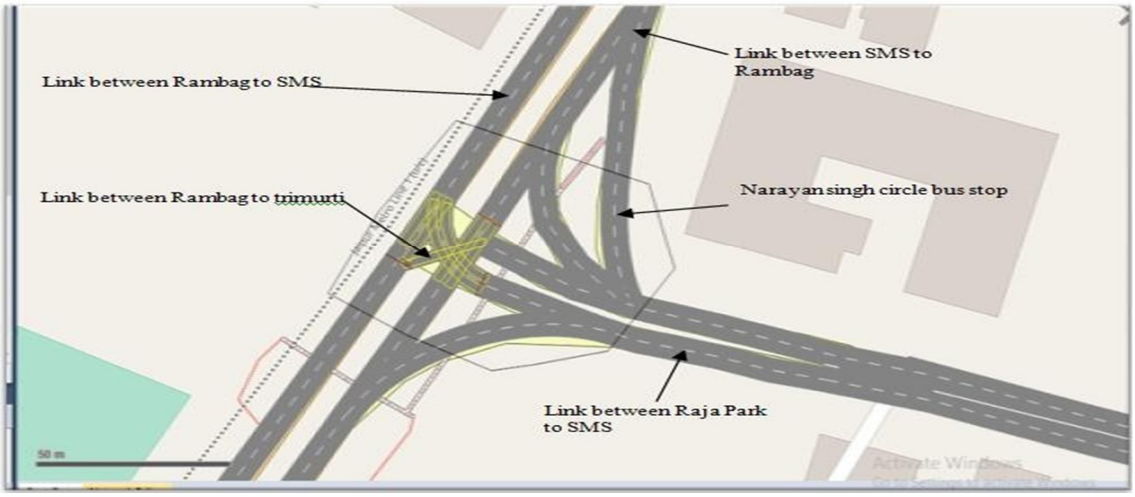


Figure-1 link at Narayan Singh circle

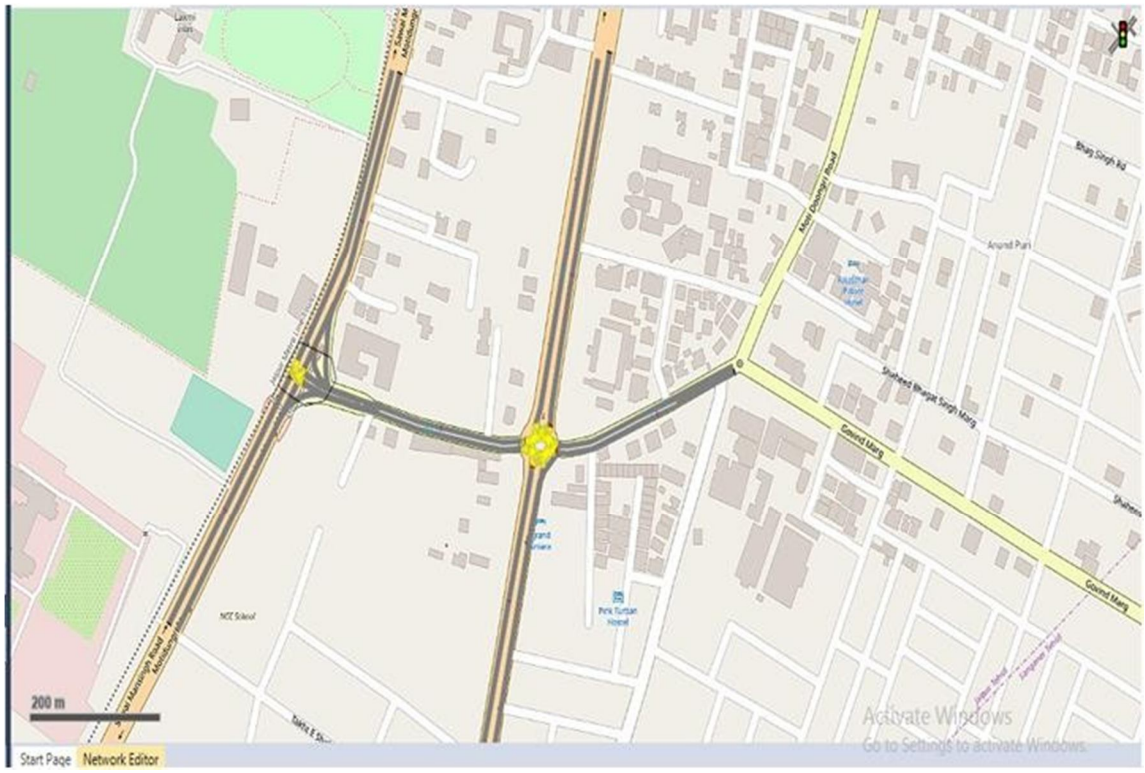


Figure-2 Total network prepared

D. Simulation

The first step for preparation of model was to locate the intersection and lay out the geometry as on site. VISSIM is equipped with Open Street maps, which were used for location identification and laying out the geometry. As a signalized intersection, signal heads governed by a signalprogram was defined in the model. Signal timing for each movement was determined in the model as of obtained from the site. After the model was completed in terms of physical features, traffic data was added. Traffic routing decision option in VISSIM was used to determine the share of each movement.

Like in real life every intersection has conflict areas where two or more than 2 traffic paths overlap, so inorder to make the model precise conflicts areas were defined.

Simulation runs for 600 seconds at an interval of 100 seconds.Some snapshot of simulation run are shown below figures.

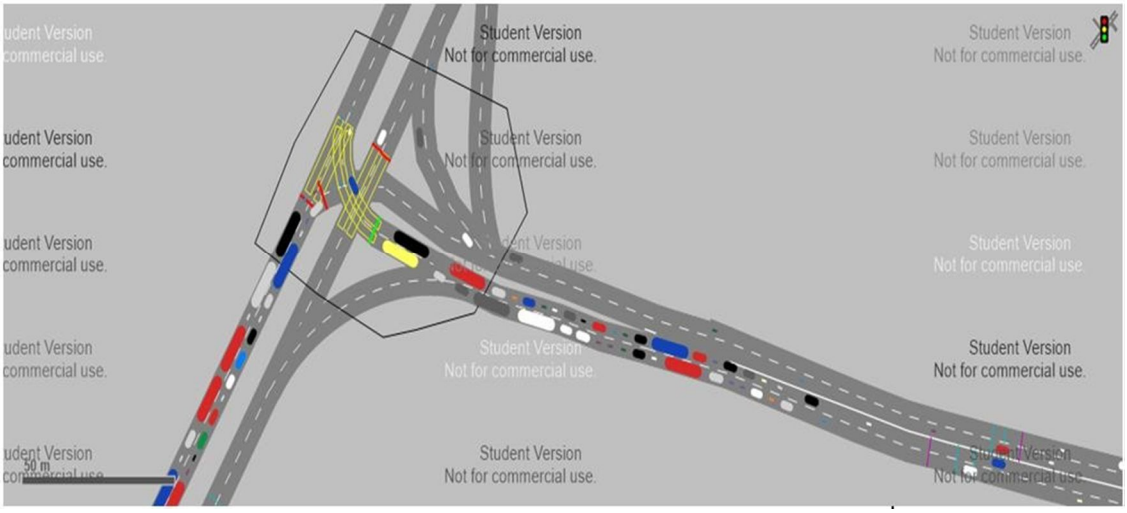


Figure-3 simulation run at Narayan sing circle

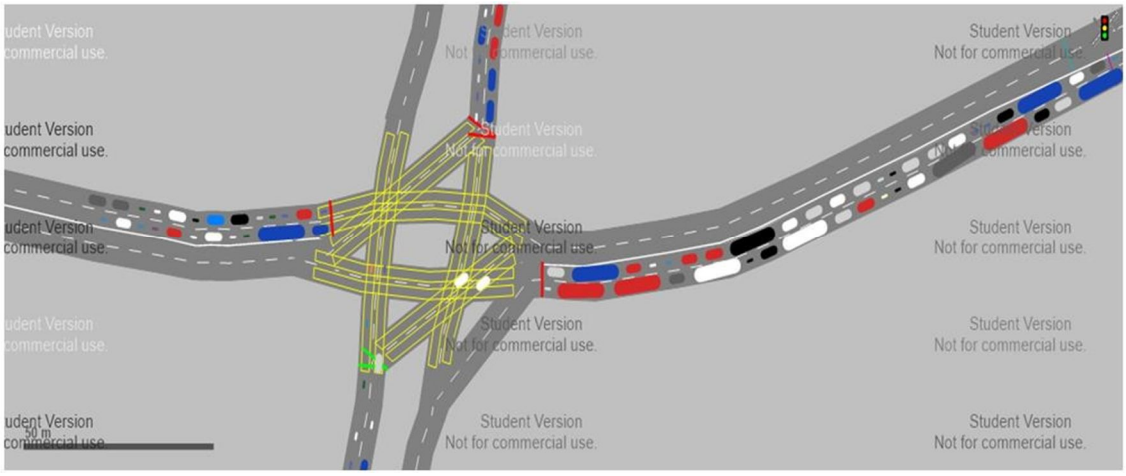


Figure-3 simulation run at Trimurti circle

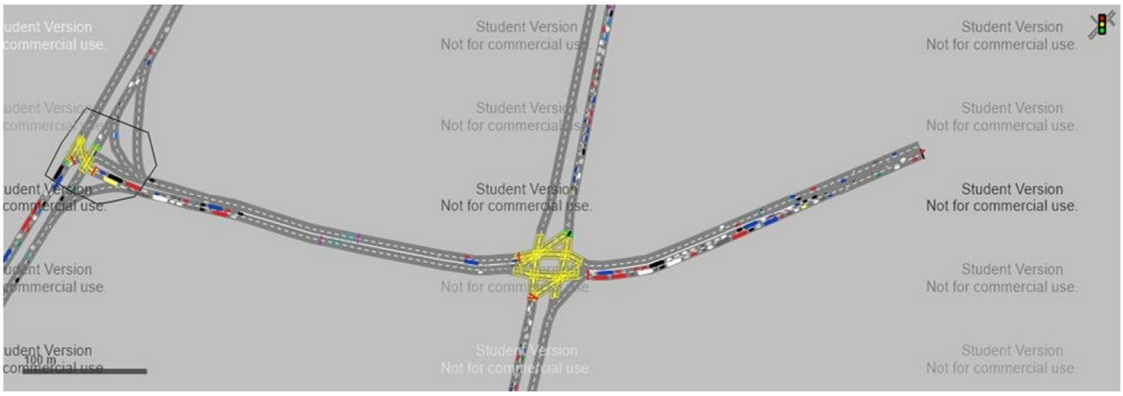
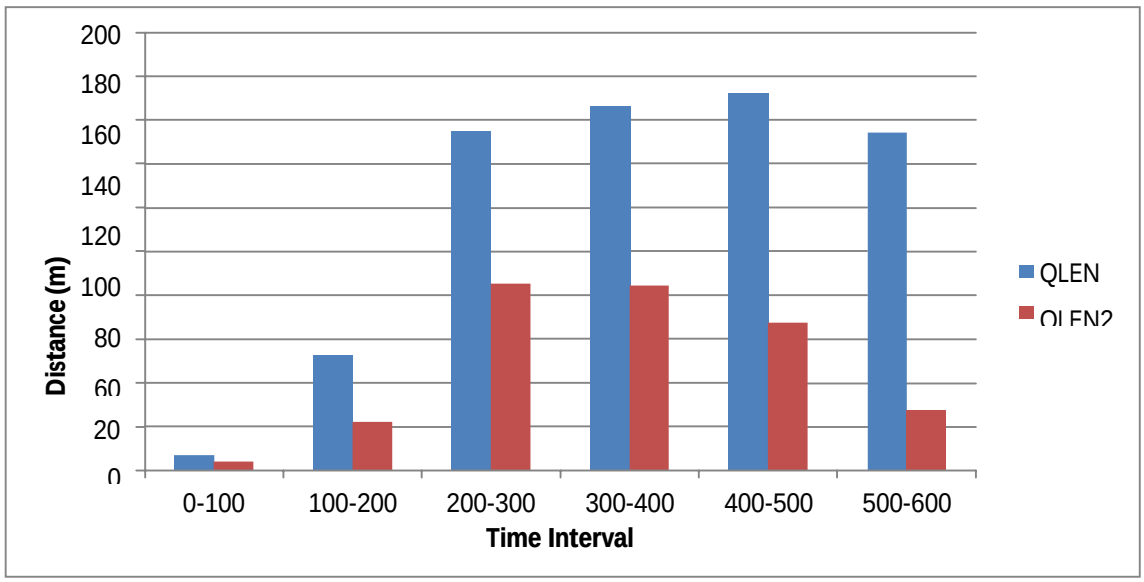


Figure-5 Simulation run at Narayan sing circle and Trimurti circle

III. RESULTS

The graph between the queue length after and before bus stop transfer shown below:



Graph - 1 the graph between normal Queue length before and after bus stop transfer (at queue counter1)

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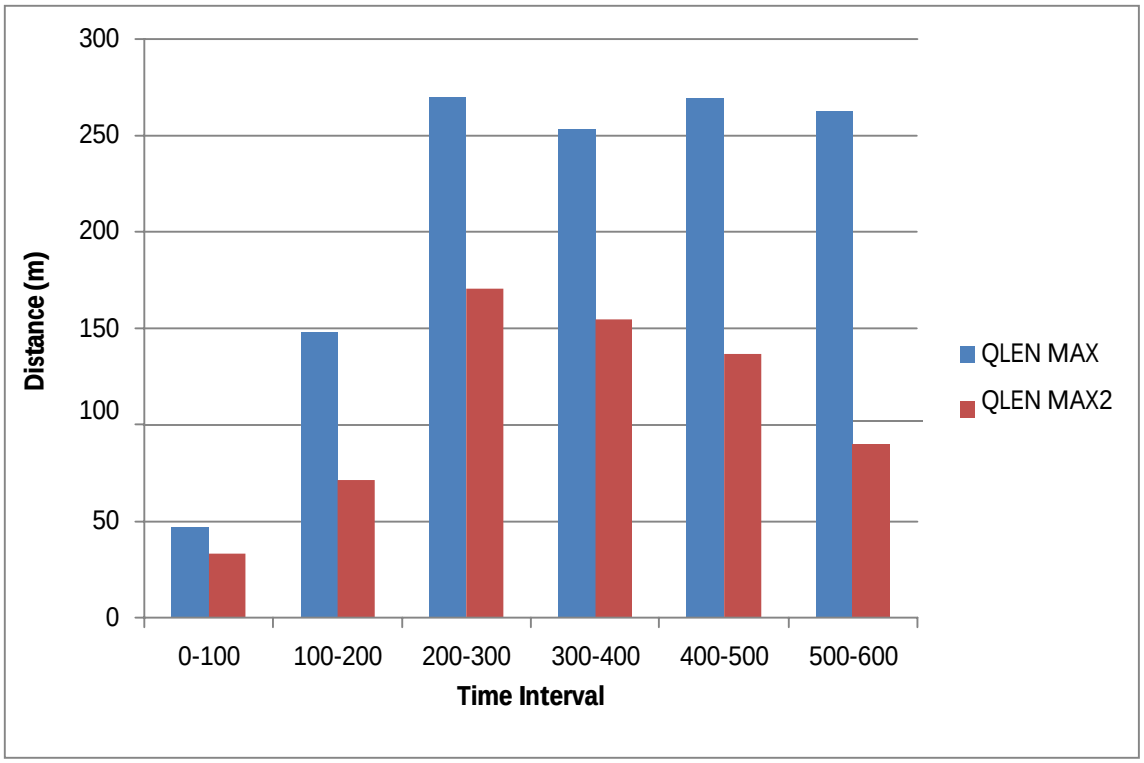
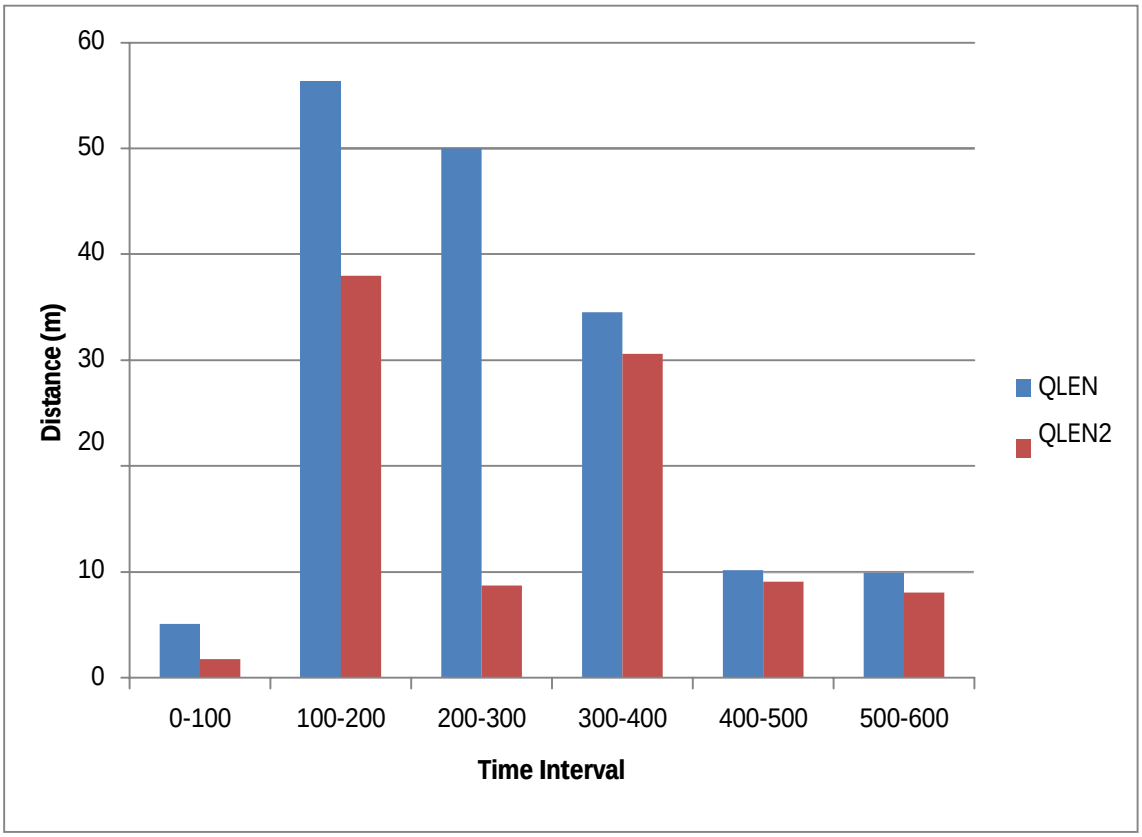
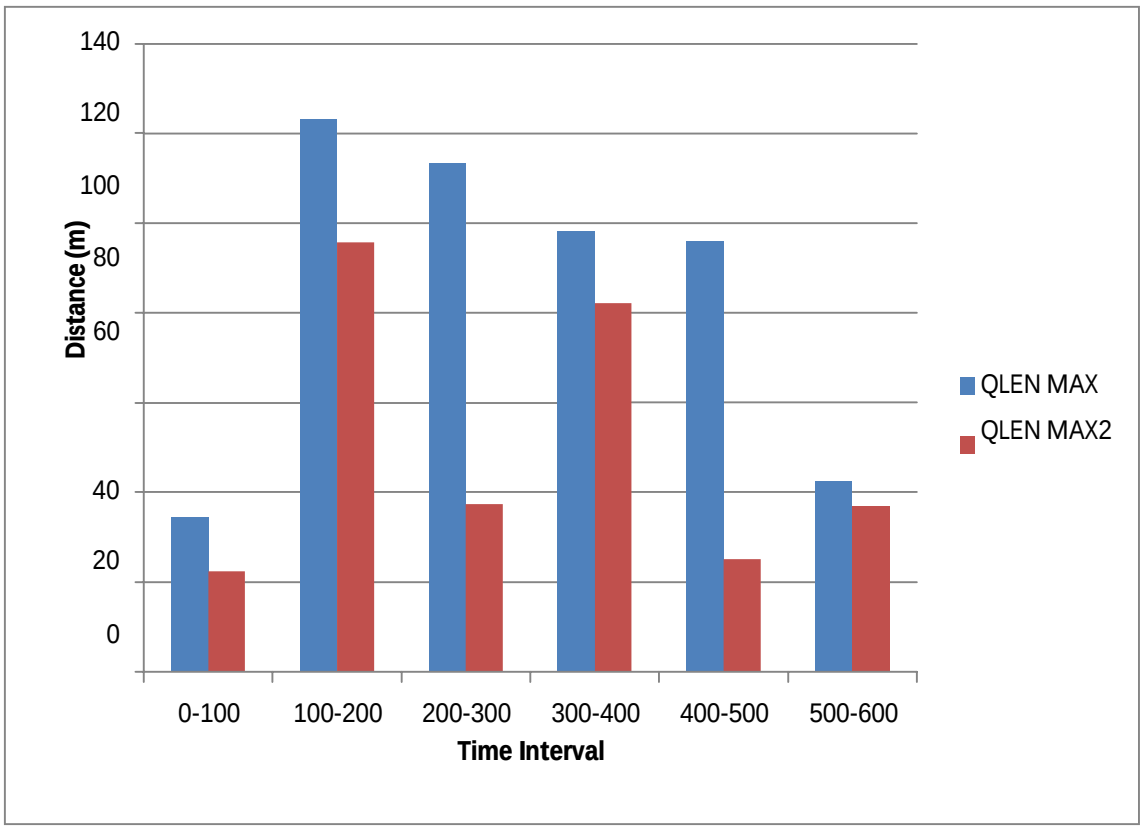


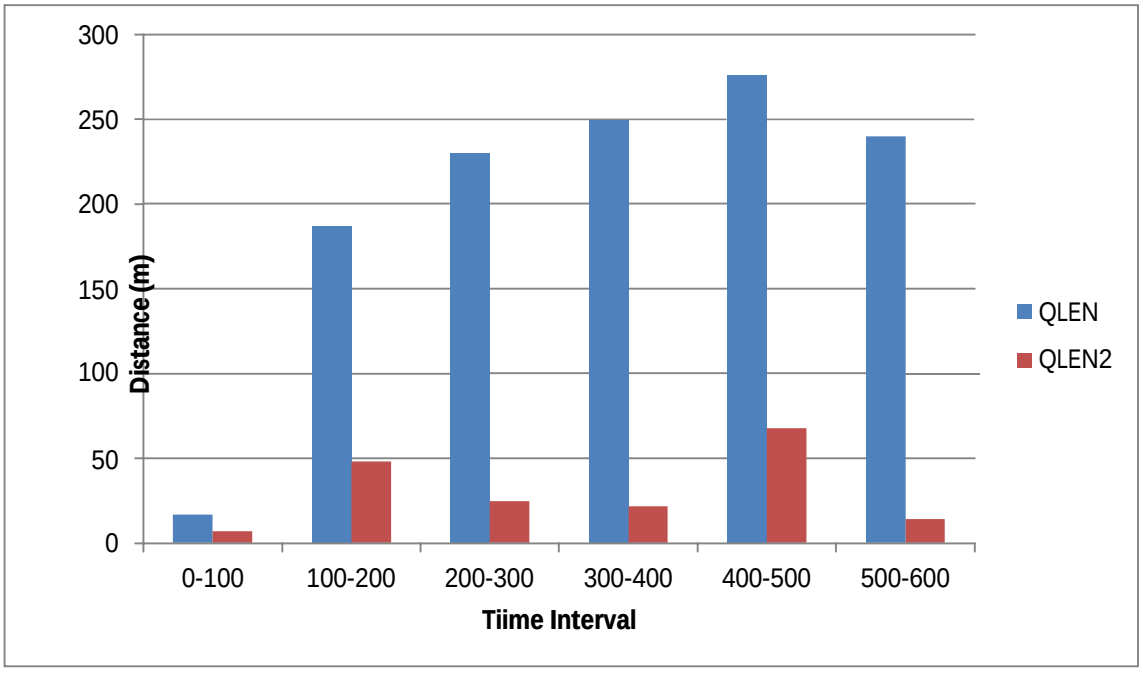
Graph - 2 the graph between maximum Queue lengthbefore and after bus stop transfer (at queue counter1



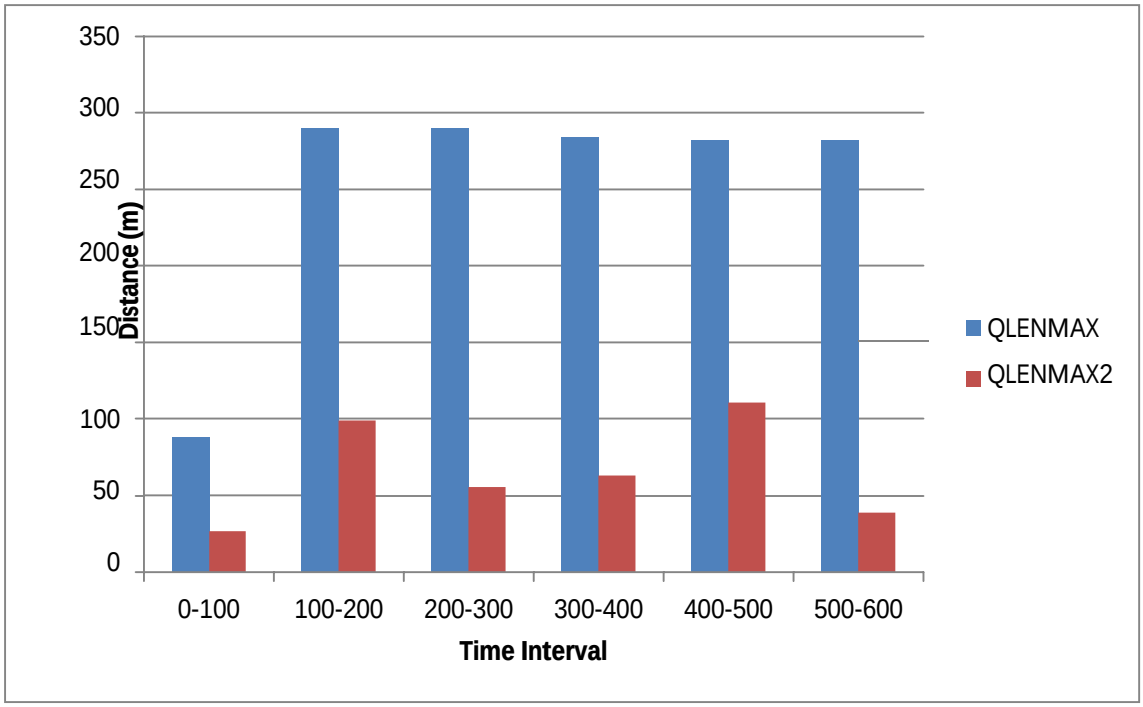
Graph - 3 the graph between normal Queue length beforeand after bus stop transfer (at queue counter2)



Graph - 4 the graph between maximum Queue lengthbefore and after bus stop transfer at queue counter2

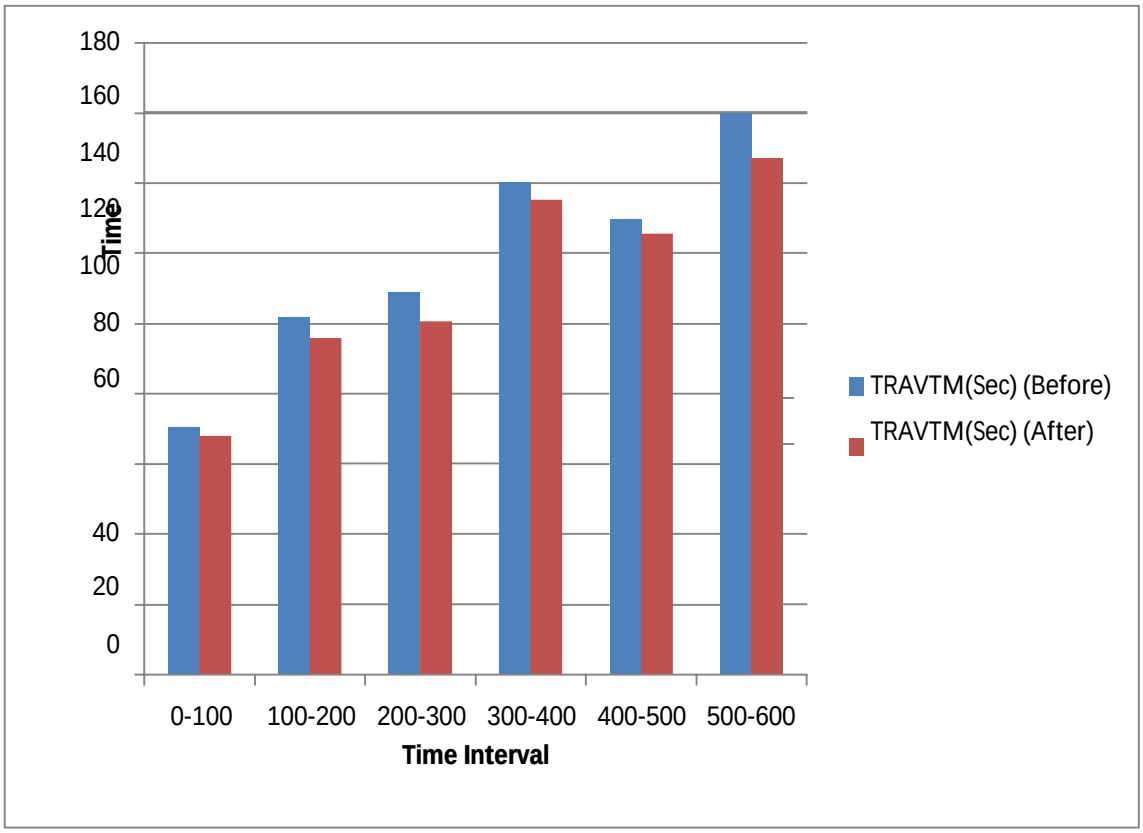


Graph - 5 the graph between normal Queue length beforeand after bus stop transfer at queue counter3

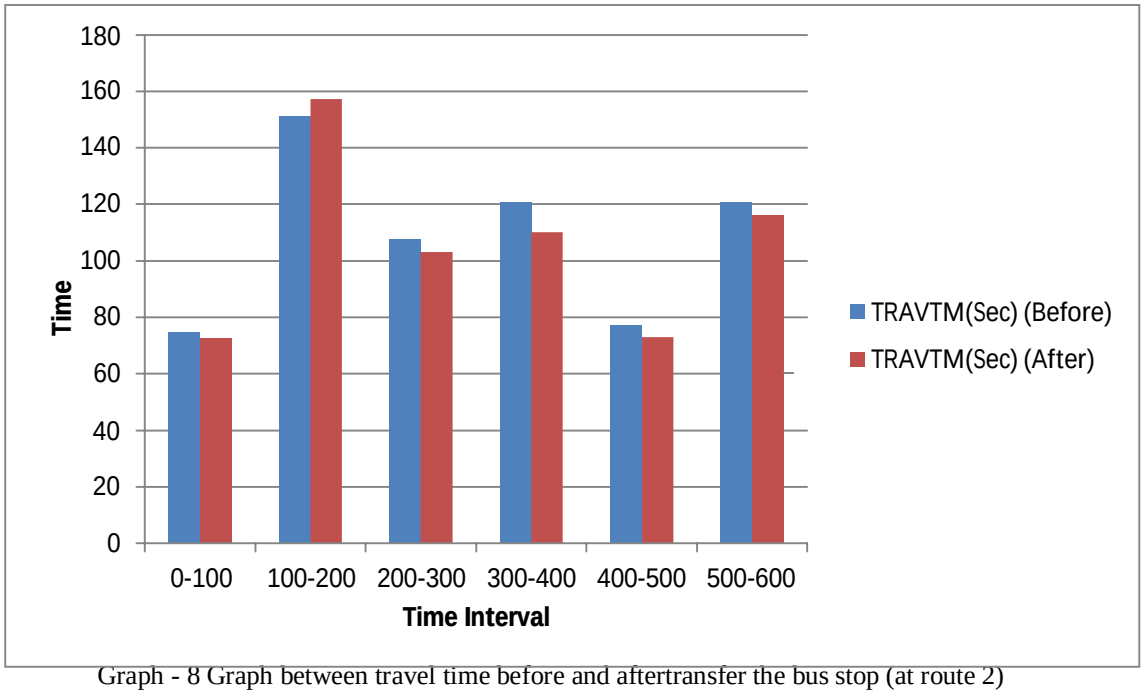


Graph - 6 the graph between maximum Queue lengthbefore and after bus stop transfer at queue counter3

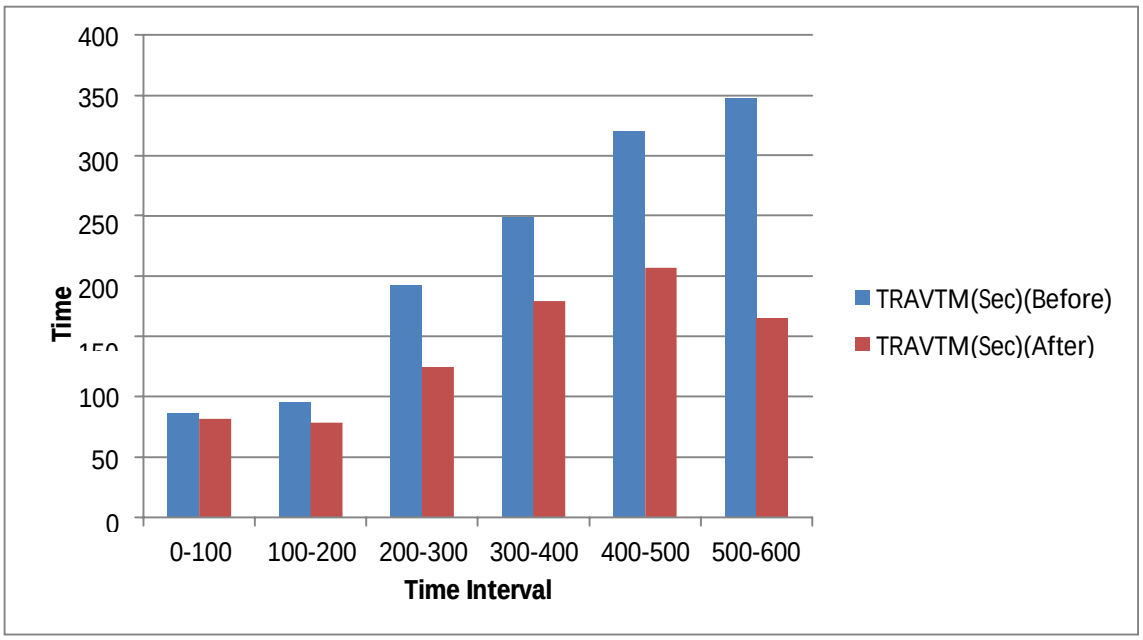
Following graph are shows the comparison of travel time before and after transfer the bus stop:



Graph - 7 Graph between travel time before and aftertransfer the bus stop (at route 1)



Graph - 8 Graph between travel time before and aftertransfer the bus stop (at route 2)



Graph - 9 Graph between travel time before and aftertransfer the bus stop (at route 3)

IV. CONCLUSIONS

1) The average queue length decrease by 70 meter and average maximum queue length decrease by99 meter at the link Rambag to Narayan Singh Circle.

2) The average queue length decrease by 12 meter and average maximum queue length decrease by35 meter at the link SMS to Rambag.

3) The average queue length decrease by 164 meter and average maximum queue length decreaseby 171 meter at the link Raja Park to Trimurti.

4) The average travel time of all vehicles moving from Rambag to Raja park (950 meter) decreaseby 10 seconds.
5) The average travel time of all vehicles moving from Raja Park to SMS (988 meter) decrease by 7seconds.
6) The average travel time of all vehicles moving from SMS to Raja Park (1050 meter) decrease by75 seconds.

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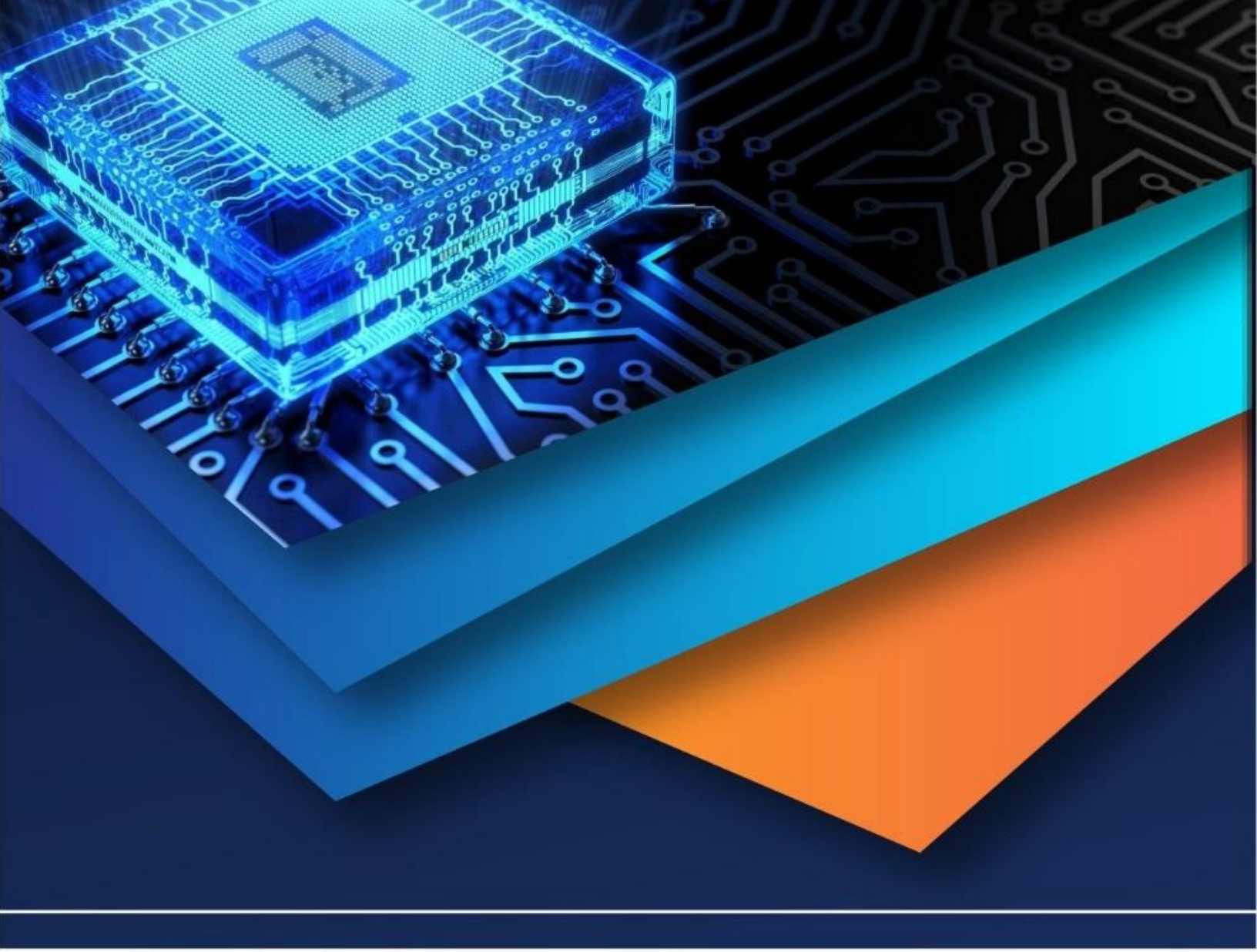

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