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Lessening of Delay by Optimization and Coordination of Several Signals on a Busy Route

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Abstract: ***Traffic congestion in inner-city areas has become a severe problem now-a-days due to rapid urbanization and industrialization. The traffic congestion in India is more critical problem as compare to other nations because of high population and vehicle ownership in India is quite high. As the traffic congestion problems rises day by day in inner-city areas it leads to various difficulties such as increase in delay, increase in travel time and elongated queue formation hence the aim of the study is to coordinate closely spaced intersections to reduce delay and as the delay decreases the queue length and travel time will also decreased. The signals are synchronized such that the vehicle moving at particular speed gets continuous green time while travelling over a particular section. In this study four intersection are considered which is located along the selected strip and the traffic volume count during morning peak hours are recorded and the signals are designed by Webster method. The optimized signal phases are coordinated by considering pre assigned average speed of vehicles, time and distance required to reach each intersections, offsets and green splits of each intersections. A model of study area is simulated using PTV VISSIM. The results of uncoordinated and coordinated signals are analysed considering basic aspecs of traffic i.e. Delay.***
Keywords: Delay, Travel time, Queue length, Green time splitting, Coordination of signal

I. INTRODUCTION

Traffic signals play a vital role in maintaining the traffic flow in organized manner. Traffic signals are one of the most effective control systems. In India traffic is a heterogeneous one and to control such type of traffic is a tough challenge. During climax hours many signalized intersection are operated beyond their maximum capacity due to which long queues are formed at intersection which results in problems like development of shockwaves and sometimes causes intersection deadlock etc. Implementation of Signal coordination can reduce such problems during peak hours at busy routes.

Signal coordination kind of a traffic management in which the signals which are intimately spaced to each other are coordinated so that the vehicle can move in an well-organized manner through the set of signals Signal timing plays an important role in coordination so that the vehicles moving on a road proceeds through various intersection without stopping. Effectiveness of signal coordination depends on spacing between intersections, traffic flow characteristics and cycle length. The aim of signal coordination is to pass the highest number of vehicles through the corridor with least amount of stops in an appropriate manner.

Thus an effort has been made in this study to employ signal coordination by considering the actuated signal system for most crowded stretch of Nagpur city to reduce the journey time through it and boost the capacity of intersections within that stretch. The measures obtained as a output of study; if implemented may help to solve the same problems for different stretches of Nagpur city based on spatial characteristics of the areas in the vicinity.

There are various studies done theoretically and software based in recent years, the research paper have been considered to evaluate best way of signal optimization and coordination H. K. Dave et al (2014)carried out a research on application of signal coordination. In this paper a road stretch with three signalised intersection situated in Ahmedabad city has selected for signal coordination purpose for signal coordination three intersections of four legs are selected. The length of study corridor is 1.8km and spacing between intersections is 900m each. The data is collected by counting volumes of vehicle during peak hours by videography and manual counting; stopped delay at signals is counted out manually. After data collection signals are design by Webster method. Time space diagram are used to show the outcome of signal coordination the diagram shows movement of vehicle in study area. Time space diagram shows that vehicle travel at speed of 32kmph will take advantage of signal coordination and stopped delays are reduced upto 62%.G karthik et al.(2015)carried out study on optimization of signal timings at signalized intersection on Indian condition in which they proposed an in deterministic way of signal optimization which is appropriate for Indian road condition. The road link of study area was arranged in Micro simulation software known as VISSIM. In these paper five road intersections is selected as a study area which is situated in Nagpur city. The data is collected by various sources such as vehicle volume count by videography and speed count by screen line method are carried out signal control data is collected from field after data collection. The current signal timings and delays in arena are calculated and after estimation they are compared with the simulated results for software validation.

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Sensitivity analysis was approved out by varying the parameters in the software. This paper suggested cycle time which will give less delays and increase capacity of intersection. This paper shows that delays are decreased up to 29%.Auxiang wuet al. (2013)suggested mechanism analysis and coordination of signal which are operated under oversaturated conditions. In this paper they defined various types of queue spillback and shockwave profile of traffic flow the main objective in this these paper was to reduce the risk of intersection deadlock when the intersection runs beyond their capacity. In this experiment two intersections are considered which 400m apart was. The data was collected was collected by various techniques and various parameter such as average speed, signal control data were estimated, signal was design by Webster method and queue analysis is done to identify the type of queue formation. After that simulation model is made in order find out best cycle offset under various saturated condition they carried out four experiments. Xing zheng et al(2008) They suggests a actual time adaptive signal control model whichimplementideal signal control parameters. This control parameters are adjusted cycle by cycle to fulfil real time traffic demand The main advantages of these parameters are they also offer signal timing information for future estimation. Highway capacity manual are used to evaluate effective green time for each phase. After evaluation of all the parameters. The projected adaptive signal control model is verified using microscopic simulation model on paramics. Simulation result displays that optimized parameters which are used in actuated signal control are capable to advance the performance of road network mainly in off peak traffic conditions.

II. METHODOLOGY

A. Study Area

Nagpur is centraly located in india one of the largest city of maharashtra in terms of area, revenue etc. also widely known as orange city as the black cotton soil is quite favaroable for the oranges. It is been many time awarded as the greenest city of india. For the study of signal optiimization and co-ordination purpose the route is selected which is situated in the centre of the nagpur city, the route is located on centeral avenue road nagpur which is one of the most crowded route of the city. the population of the area is quite large and the market area are also situated around this region hecnce the traffic congestion is one of the major problem. The selected intersection has four signals conrtol which placed close to each other but because of high heavy traffic volume and non co-ordination of signals, the signals usually runs beyond their saturation capacity and queue formation is a common problem on junctions hence this route is selected as a study corridor for green splitting and signal co-ordination.the name of road junction are Dosar bhavan Square, Gitanajli square, Seva sadan square and agrasen square. The spacing between Dosar bhavan sqaure to Gitanjali sqyare is 250m, Gitanjali square to seva sadan square is 350m and seva sadan square to Agrasen square is 260m.The total length of study corridor is 850m.

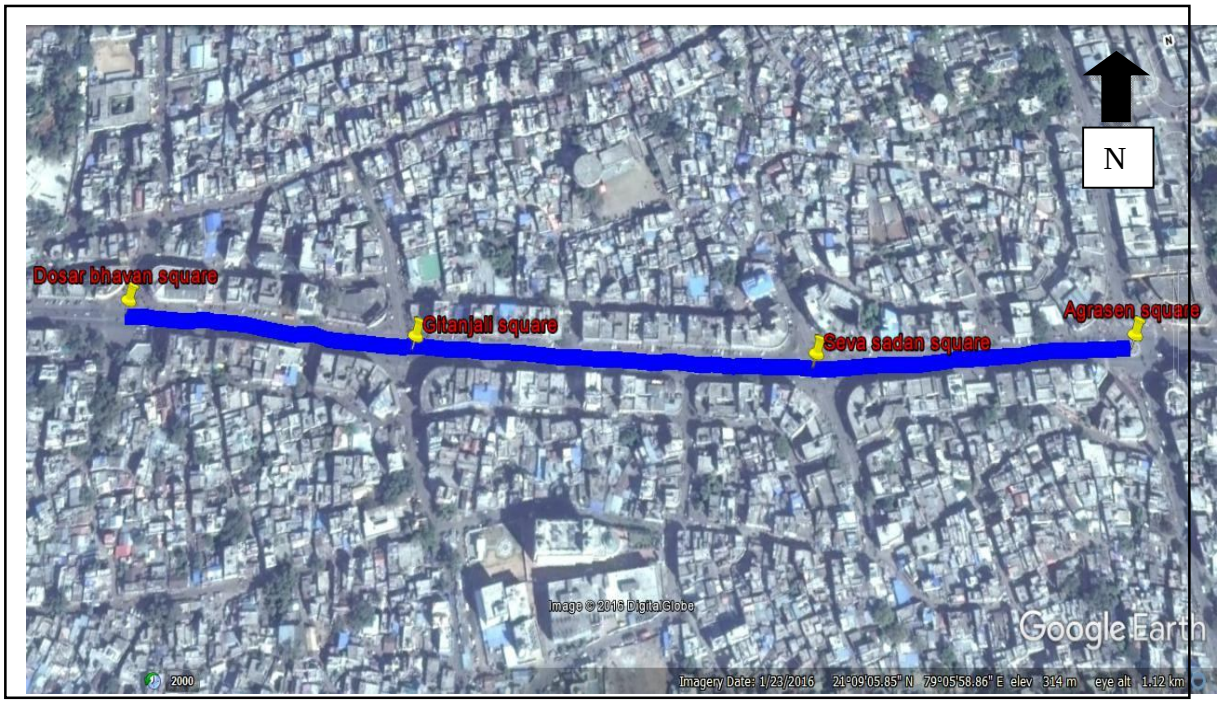


Fig. 1 Study corridor from Dosar Bhavan square to Agrasen square

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B. Data Collection

In this study the volume count is done by videography technique in which data during morning peak hour is collected. Volume count is carried out is collected at all four intersection the data is extracted by tally sheet method. Geometric data of road network is measured manually from field. Spot speed data is collected by using manually by using stop watch method in which 50m road section is selected and from time and distance formula speed is evaluated.

C. Signal Design

All the four signals are designed by using Webster method of signal designed. Following are the design details of signal at Dosar Bhavan square.



Fig.2 Image of Dosar Bhavan square

TABLE 1.SIGNAL DESIGN DETAILS AT DOSAR BHAVAN SQUARE

Approach	N	S	E	W
Approach width(m)	8	8	12	12
Volume (veh/hr)	1015	913	2051	1976
Green time (sec)	15	11	30	25
Yellow time (sec)	3	3	3	3
Red time (sec)	75	79	60	65



Fig 3 Phase diagram at dosar bhavan square

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D. Signal Coordination

Signal coordination is one the important techniques in traffic management system in which signals which are closely spaced to each other are coordinated so that the maximum number of vehicle over a coordinated stretch will get continuous green light while travelling over coordinated corridor. In this study the corridor which is selected has four intersections which are very close to each other hence such road network required to be coordinated to decrease queue length, delay and travel time. In this study one way signal progression is done from Dosar Bhavan square to Agrasen square. Signal coordination is done by theoretical method by considering time required to reach each intersection, pre apportioned average speed of vehicle, offset and green phases of each intersections.

E. Development Of Simulation Model In Vissim

VISSIM is microscopic multimodal traffic flow simulation software which is used to make simulation model of real condition by considering various factors such as driver's behavior, lane changing operations and traffic characteristics. In this study simulation model of road network is prepared on PTV VISSIM. Parameters as model input is properly assigned while preparing simulation model this parameters are driver's behavior, lane changing operation, composition and characteristics of vehicle, desired speed and acceleration of vehicles.

In this study two simulation model is prepared on VISSIM one is existing condition model (uncoordinated system) and other network is coordinated system model. Signals timings plays vital role in coordination process hence signal controllers are used to set cycle length and signal timings. The two networks are compared to each other to identify the variation of delay, travel time and queue length.

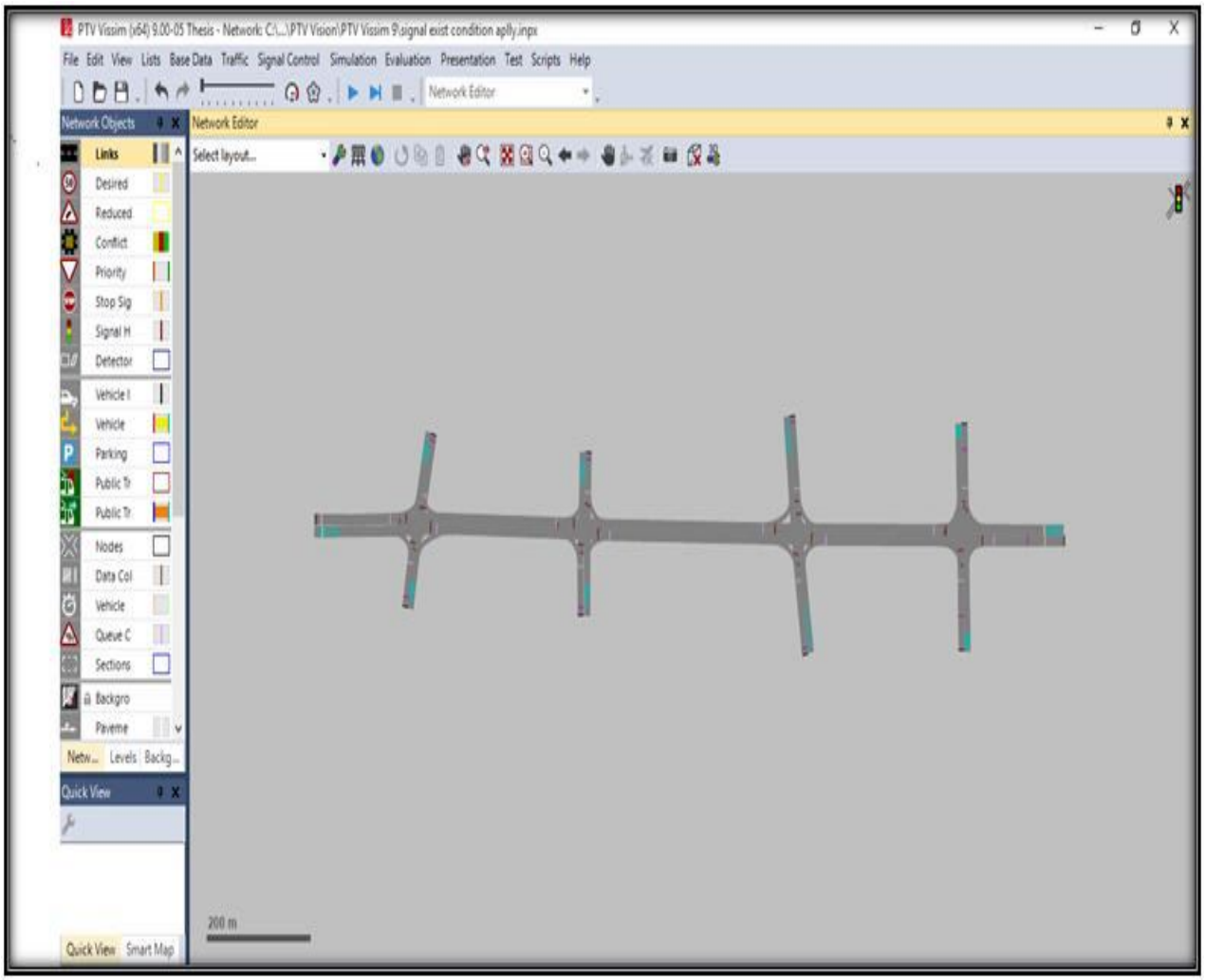


Fig.4.Network model in PTV VISSIM

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III RESULTS

Signal coordination mainly use to demote travel time ,queue length and delay on a busiest routes hence the results evaluated from simulation model is compared before and after coordination on the basis of delay the results are presented as follows.

Comparison of Uncoordinated and coordinated signal control on the basis of delay.

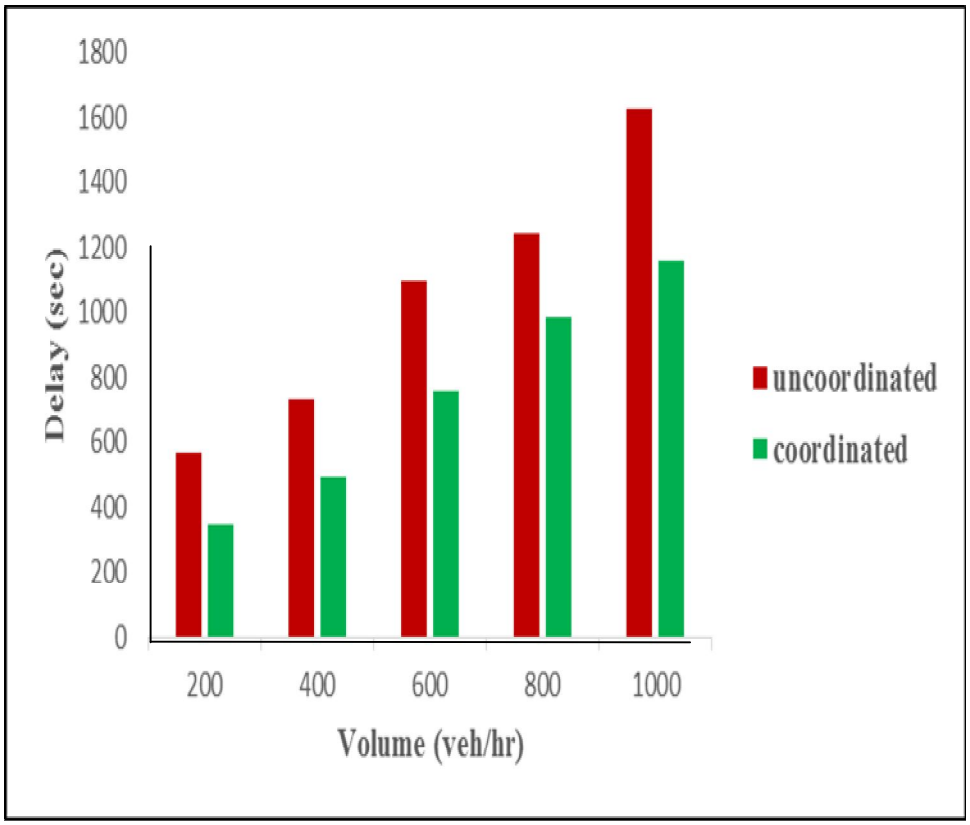


Fig 5 Delay variation at Dosar bhavan square

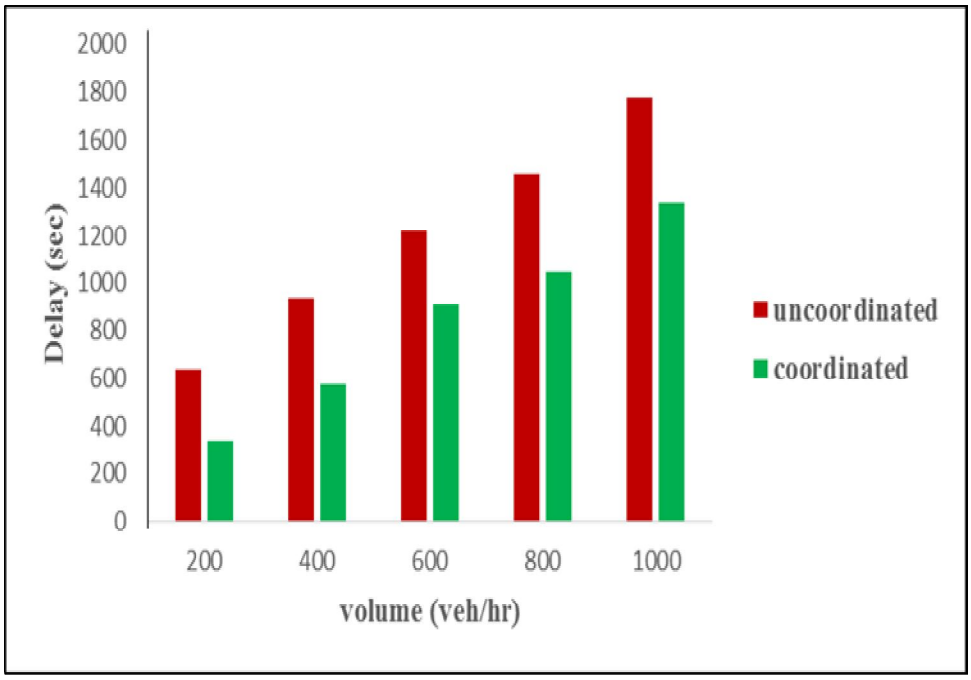


Fig 6 Delay variation at Gitanjali square

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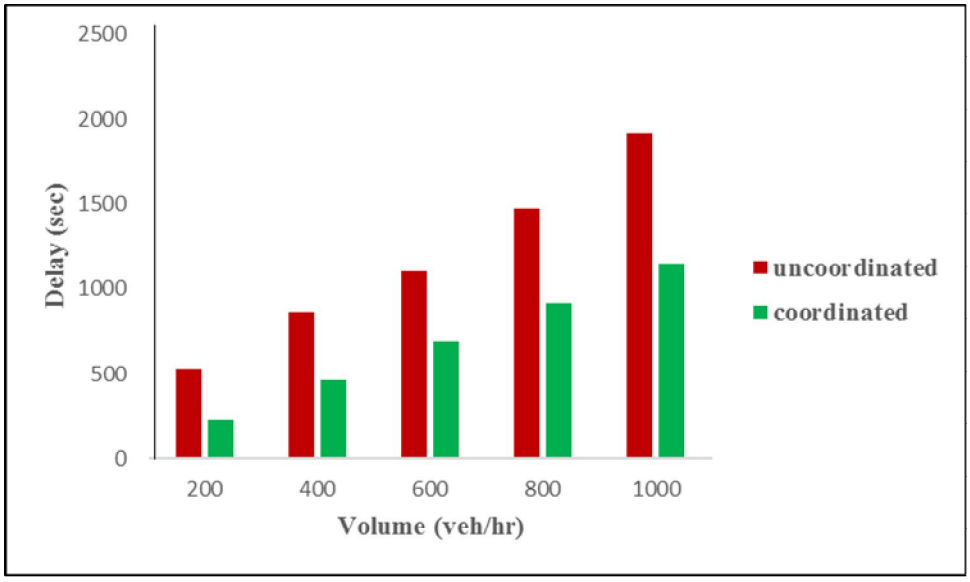


Fig.7 Delay variation at Seva sadan square

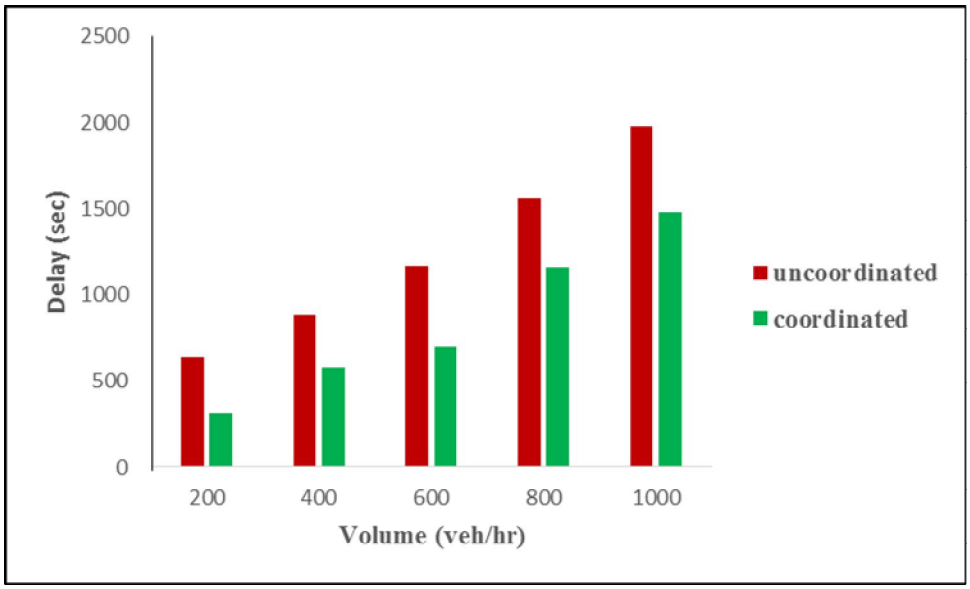


Fig.8 Delay variation at Agrasen square

IV. CONCLUSION

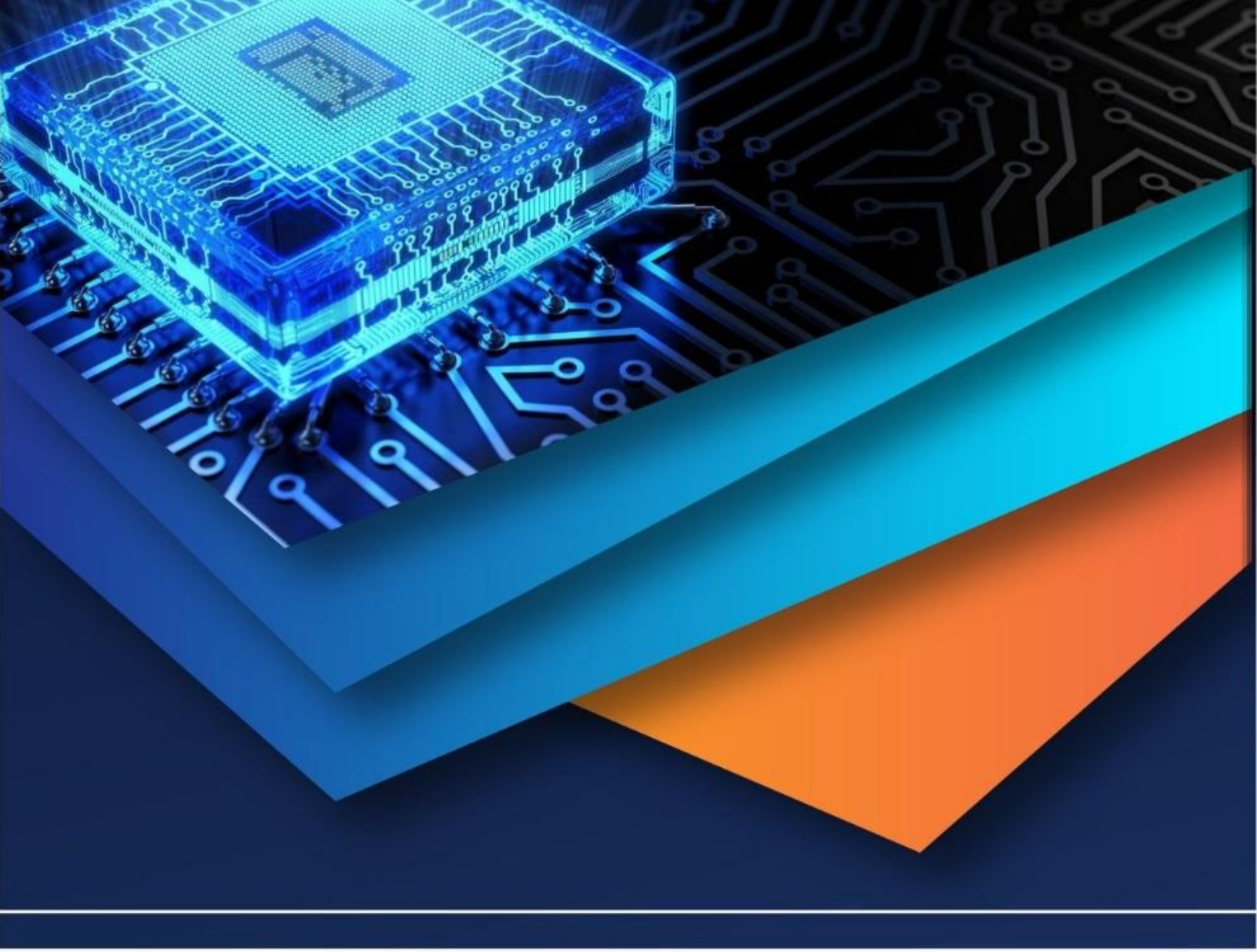
After implementing signal coordination at all four intersection of selected route from Dosar Bhavan square to Agrasen square it is found that signal coordination is helpful in lessening delay, travel time and queue length for busiest stretch. The comparative results show that the queue length and delay at all four intersection is reduced after coordination of signals.

After comparing the result of uncoordinated and coordinated signal control it is found that the vehicular delay is reduced up to 34%. After the reduction delay it is clear that the travel time of vehicle is also reduced.

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