"Traffic Signal Synchronization and Simulation using PTV VISSIM"

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Abstract

In today's scenario the volume of the vehicles is increasing day by day, queue lengths are increasing during peak hours and the journey time also increased. There are two options to tackle with this situation; the first one is by altering the geometry of road like widening of the roads and the second one is by optimizing the various facilities which are available on the roads. Now days in the modern world of computers the advancement is so much that we can stimulate the study area in the simulation tool and analyze the different options which are available with us to optimize the facilities which are available on the roads. One such simulation tool is VISSIM. Here in this tool the network of the study area is prepared. The signal timing is then simulated in the VISSIM.
The aim of the coordinating the traffic signals is to provide smooth flow of traffic along streets and highways in order to reduce travel time, stops and delay. This research was carried out to investigate the benefits of signal coordination by means of traffic microsimulation software, PTV Vissim. After calibrating vissim, signal coordination was performed by executing simulation runs of the prepared model in vissim. The output values of the performance measures, namely delay and travel time were compared to the corresponding values before coordination.

Keywords: *Spot speed studies, Journey time and delay studies, Volume count, Travel time, PTV VISSIM.*

Introduction

Traffic Signal a lot of automatically worked shaded lights, ordinarily red, golden, and green, for controlling traffic at street intersections, walker intersections, and roundabouts. The world first traffic light was truly worked sign presented in Landon on December 1868.traffic control executed in the late 1890s and 1910 true sirrine from Chicago outfitted with the essential electronic traffic control structure. It utilized the words "STOP" and "PROCEED", albeit neither one of the words was lit up. Traffic signals are accounted for to have been utilized in Westminster, London as ahead of schedule as 1868. The initial three shading light (physically worked) signals were introduced in 1918 in New York. Vehicle impelled signs were presented in the 1930's. Traffic lights substitute the option to proceed agreed to clients by enlightening lights or LEDs of standard hues (red, golden (yellow), and green) after an all-inclusive shading code. In the run of the mill grouping of shading stages. The green light permits traffic to continue toward the path signified, on the off chance that it is sheltered to do as such and there is room on the opposite side of the crossing point. The golden light cautions that the

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sign is going to change to red. Notwithstanding the way that for the walkers, there has only two lights, red light and green light that suggests continue to stop independently. The conflict conveyed by traffic improvement from different headings can be diminished by sharing the time between advancements. the traffic lights have given various focal points to all road customers other than diminishing the amount of accident, it made the traffic stream successfully and possible could save people time in any case, weights of the signalized crossing point are it might realize greater ended deferrals, and the arrangement requires complex examinations, notwithstanding the way that the general delay may be lesser than a rotatory for a high volume, a client is increasingly worried about the halted delay.

Objectives

1) To study the performance of existing signal design and calibration and evaluation of the model replicate field conditions
2) To find out the delay for heterogeneous traffic.
3) To study the performance of existing signal design and calibration and evaluation of the model replicate field conditions.
4) Optimization of the existing traffic signal.
5) To Synchronization of traffic signal.

LITERATURE REVIEW

Alvaro J.Calle-Laguna (2019) In this exploration paper upgrading cycle length and diminishing the deferral at crossing points utilizing Webster plan techniques. Lessening the air contamination and diminish the fuel utilization levels and equation got from reproduction programming and presume that investigative definition adjust the ideal cycle length that limit the vehicle delay at the crossing point, decreases the fuel utilization at all 3 significant convergences and furthermore decrease the blockages.

Ke Han Hongcheng Liu (2015) This examination utilizing the Lighthill-Whitham-Richards(LWR) model to decrease the sign control and issue and tackle issue utilizing blended interger scientific programming approach. they proposed a novel reformulation of the LWR-E issue as blended whole number straight program (MILP) to diminish the computational expense and dodging the traffic holding and limit the movement time deferral and emanation related concerns. Infer that proposed signal enhancement definition limit the normal postponement all through a system and fuel utilization. In the wake of building up a perceptible connection this give the scope of emission.

Christopher M.Day, Darcy M.Bullock (2018) In this paper detailed study on the signal operation and examine progression of cyclic flow profile and Predicted changes to the traffic stream under trail offset adjustments by utilizing the cyclic flow profile and also using the link pivot algorithm. And conclude that Link Pivot offset optimization and relies on prediction methodology that uses to predict the vehicle arrivals at coordinated signal and this method accomplishment into the open source software for automated traffic signal performance and this study gives the success of static analysis by changing the anticipated values.

Krishna Saw, Aathira K.Das,Bhimajo k.Katti,Gaurang J.Joshi (2018) In this research paper includes the Travel time is generally important for the transport planner and financial development in heterogeneous traffic and done the field surveys traffic volume and composition survey, Speed profile survey and road side friction survey(RSF) and conclude that travel time is the most significant factors for trip makers and traffic compositions of 2Ws,3Ws matters more in travel time for the heterogeneous traffic volume and noteworthy job has been observed by RSF on travel time.

Methodology

- Selection of Study area
- Traffic Studies
- Details of the Existing Signals
- Synchronize the signalized intersection

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- Simulation and Evaluation using PTV VISSIM

Study Area

According to the guidelines of IRC:93-1985 "Guidelines on Design and Installation of Road Traffic Signals" signals which are located in series with minimum distance (within 1000 meters) between each other are required to synchronize with each other to reduce delays and avoid traffic from a stop and go movement at every intersection. Bangalore is the capital city of Karnataka, is one of the fifth largest metropolitan cities in the country. Bangalore population is growing rapidly day by day. The intensity of the traffic has increased significantly and there is a requirement of increase of capacity for safe and efficient means to cross over roads especially at junctions in multiple directions. In Bangalore total 330 Signalized Intersections are present. The study area having 932 m length having 3 Intersection. And also this stretch we known as St John's Church road this road connecting to the Ulsoor Lake and Old Airport in main stretch. Other road in the 3 intersection connected to Shivajinagar, Frazer Town and Cox Town. Figure 1 Shows study area map.

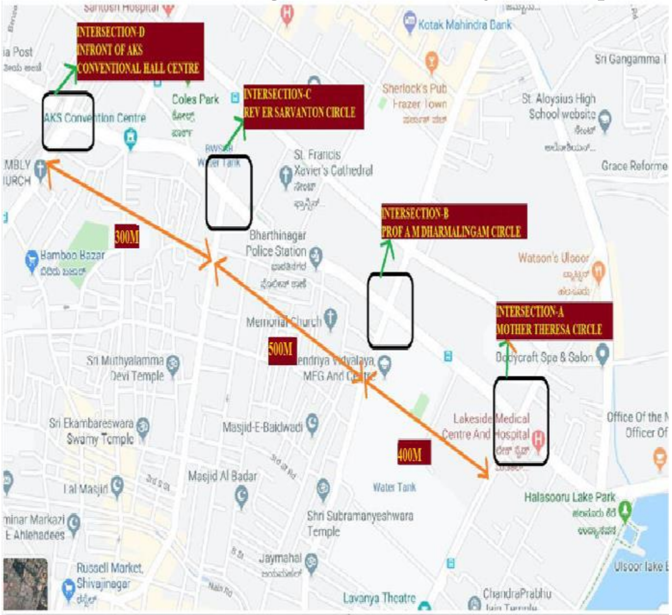

Figure 1: Study area map

Table 1: Approach width at intersection

Intersection Number	Intersection Name	Approach Road	Width of the carriageway (Meter)
A	Mother Theresa Road	RD1	14
		RD2	7
		RD3	7
		RD4	14
B	Prof A M Dharmalingam Circle	RD5	7
		RD6	14
		RD7	14
		RD8	7
		RD9	10.5
		RD10	14

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C	REV, ER Sarvanton circle	RD11	7
		RD12	7

Table 2: Distance between the Intersections

Intersection number	**Intersection Name**	**Distance (Meter)**
A	Mother Theresa Road	–
B	Prof A M Dharmalingam Circle	425
C	REV,ER Sarvanton circle	506

SPOT SPEED STUDIES

Spot speed studies are used to determine the speed distribution of a traffic stream at a specific location.
The data gathered in spot speed studies are used to determine vehicle speed percentile.

Spot speed = Distance/Time m/s

JOURNEY TIME AND DELAY STUDIES

Field Delay studies were conducted at all the intersection along by adopting the moving observer method. Total 4 Runs were made during the peak hours period for both the direction from Mother Theresa Circle (Intersection-A) to REV ER Sarvanton intersection (Intersection -C) and vice-versa and also Travel time measured from Junction-A to Junction-C to evaluate the effect of signal synchronization. Table 4.4Represent the travel time required to travel from Intersection-A to Intersection- C and vice-versa. Table 4.5 gives the average Journey time from Mother Theresa Intersection to REV ER Sarvanton Intersection (Intersection-C) and 4.6 gives the average journey time from REV ER Sarvanton intersection to Mother Theresa intersection.

Delay Studies

Stopped (Fixed) Time Delay

Stopped-time delay is defined as the time a vehicle is stopped in queue while waiting to pass through the intersection. It begins when the vehicle is fully stopped and ends when the vehicle begins to accelerate. Average stopped-time delay is the average for all vehicles during a specified time period.

Control Delay

Control delay is the delay caused by a control device, either a traffic signal or a STOP-sign. It is approximately equal to time-in-queue delay plus the acceleration-deceleration delay component. Delay measures can be stated for a single vehicle, as an average for all vehicles over a specified time period, or as an aggregate total value for all vehicles over a specified time period. Aggregate delay is measured in total vehicle-seconds, vehicle-minutes, or vehicle-hours for all vehicles in the specified time interval. Average individual delay is generally stated in terms of seconds per vehicle for a specified time interval.

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Table 3: Speed of different classes of vehicle at all the intersection.

Intersection	Distance (M)	Rounds	Stopped Delay (sec)	Controlled Delay (sec)	Average Delay (sec)
A-B	460	1	0	33	29.51
		2	0	33.05	
		3	0	42	
		4	0	10	
			0	118.05	
B-C	603	1	0	10	43.75
		2	0	15	
		3	0	90	
		4	0	60	
			0	175	

Table 4: Delay time from REV ER Sarvanton Circle to Mother Theresa Intersection

Intersection	Distance (M)	Rounds	Stopped Delay (sec)	Controlled Delay(sec)	Average Delay (sec)
C-B	603	1	15	60	56
		2	0	30	
		3	0	44	
		4	0	30	
			15	164	
B-A	460	1	75	126	443
		2	130	92	
		3	65	126	
		4	54	132	
			324	476	

Cycle time: It is the time required by a signal to complete one full cycle. i.e. one finishes turn of every single signal sign. It is denoted by C. As the signal started, the time period between two vehicles, indicated as headway, passing the cross line is recorded. The time interval between the start of the green and the moving vehicle crossing the control line is the first headway. The time interval between the first and the second vehicle crossing the control line is the second headway. The first

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headway will be relatively longer since it incorporates the response time of the driver and the time fundamental to the acceleration of the vehicle.

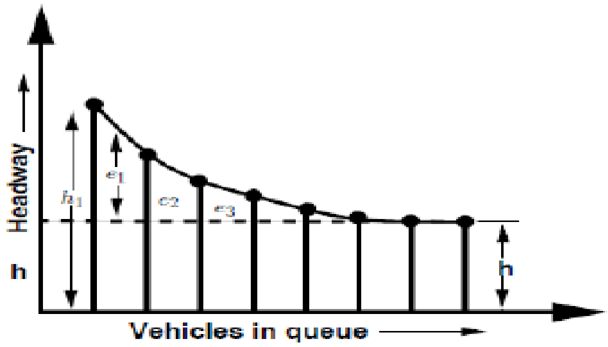

Figure 2: Headways Departing Signal

The difference between the actual headway and h for the height of the vehicle and is denoted as is shown in Figure 5.5. These differences for the first few vehicles can be added to get start-up lost time, l1 which is given by,
($l_1=\sum_{i=1}^{n} e_i$).

The green time required to clear N vehicles can be found out as, **T = l1 + n.h**

Cycle Length: Highway capacity manual (HCM) has given an equation for determining the cycle length. Accordingly, cycle time C is given by
$C=N.L.Xc/(Xc - \Sigma\ (v/s)$
Effective green time: This is the definite time available for the vehicles to pass the intersection. It is the addition of actual green time (Gi) plus the yellow minus the applicable lost times. This lost time is the sum of start-up lost time (l1) and clearance lost time (l2) denoted it. Thus effective green time can be written as,

(Total effective green available in a cycle) Tg = C – (L*N)

Green splitting (gi) = (Lane volume per link/Total volume) * tg
(Actual green time) Gi = gi - A + L (Sec)

Vehicular movement

Figure 3: 3d view of vehicular movement
Queue Results

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Queue Results / Queue Counters

Cou	SimRun	TimeInt	QueueCounter	QLen	QLenMax	QStops
1	3	0-3600	1	6.21	20.01	48
2	3	0-3600	2	2.55	9.74	9
3	3	0-3600	3	0.00	0.00	0
4	3	0-3600	4	10.20	40.39	63

TRAVEL TIME RESULTS

Vehicle Travel Time Measurements / Links

Cou	No	Name	StartLink	StartPos	EndLink	EndPos	Dist
1	1	ULSOOR TO CONTONMENT	1: ULSOOR TO CONTONMENT	11.800	2: ULSOOR TO CONTONMENT	61.058	162.31
2	2	CONTONMENT TO ULSOOR	4: CONTONMENT TO ULSOOR	17.476	3: CONTONMENT TO ULSOOR	53.488	160.48
3	3	SHIVAJINAGAR TO COX TOWN	5: SHIVAJINAGAR TO COX TOW	26.800	8: SHIVAJINAGAR TO COX TOW	43.738	139.08
4	4	COX TOWN TO SHIVAJINAGAR	7: COX TOWN TO SHIVAJINAGA	18.596	6: COX TOWN TO SHIVAJINAGA	50.512	128.49

Vehicle Travel Time Results / Time Intervals

Cou	SimRun	TimeInt	VehicleTravelTimeMeasurement	Vehs(All)	TravTm(All)
1	3	0-3600	1: ULSOOR TO CONTONMENT	80	84.21
2	3	0-3600	2: CONTONMENT TO ULSOOR	83	69.52
3	3	0-3600	3: SHIVAJINAGAR TO COX TOW	13	114.05
4	3	0-3600	4: COX TOWN TO SHIVAJINAGA	16	50.87

Conclusion

After Signal synchronization travel time reduced by 102.4 sec and delay by 110.32sec from mother Theresa intersection to Sarvanton Intersection. From Sarvanton Intersection to Mother Theresa Intersection travel time reduced by 39.69sec and delay 46.18 sec. Queue length also been reduced. Adoption of Synchronization will reduce the unnecerry waiting in the signal and fuel consumption also.

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