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ANALYTIC RESEARCH ON TRAFFIC SIGNAL TIMING SYNCHRONIZATION USING MATLAB

Adarsh Panuriya [1]*, Dr. Umank Mishra [2]

[1]M. Tech Scholar, Department of Civil Engineering, SSTC - FET, Junwani Bhilai, India.
[2]Asso. Prof., SSTC - FET, Junwani Bhilai, India.

Abstract

Now a days especially large cities experienced haphazard and country – wide urbanization. As a result, the urban population must travel longer distances in the shortest amount of time. To manage travel demand, the intersection should provide the least amount of barrier to traffic flow in order to reduce travel time. In this research, an attempt is made to investigate numerous crossings in order to reduce delays at these intersections and, as a result, enhance the level of service. Traffic signals can be synced such that a vehicle leaving from one end of the street and proceeding at a predetermined speed can reach the opposite end without stopping at a red light. Existing traffic has been estimated at each intersection, and then signal designs have been created. Optimized signal has been synchronized and assessed the benefits to improve the level of service at junctions and to minimize delay.

Keywords: *Signal timing, Synchronization, Delay.*

** Corresponding author*

1. INTRODUCTION

Traffic Signal Synchronization is a traffic engineering technique of matching the green light times for a series of intersections to enable the maximum number of vehicles to pass through, thereby reducing stops and delays experienced by motorists. Synchronizing signals ensures a better flow of traffic and minimizes gas consumption and pollutant emissions.

The study stretch selected along the major intersection (SHARDA CHOWK TO TELIBANDHA- 3.13KM) serves the huge traffic community in Raipur city making the need for proper signal design a mandatory need. The synchronization of these major intersections of the city will be benefited not only by time and money but also in terms of safety and violation against traffic rules. Thus, synchronization of traffic signal timing at the selected study stretch will allow the smooth functioning of traffic flow. Webster method is used for the optimization of traffic timings thus more efficient signal timings can be achieved. The journey time is then calculated by floating car method to calculate the required journey speed through which synchronization can be done.

2. LITERATURE REVIEW

Extensive research has been carried out over the years to examine traffic flow patterns and offer practical strategies that might potentially increase the efficiency of junction capacity use (Robert 1998; Garber and Hoel 2001).

Many similar researches have used the kinematic wave theory, also known as the Lighthill-Whitham-Richards (LWR) theory, to describe traffic dynamics on a highway segment or intersection approach using kinematic waves, such as queue formation or shock-wave discharge.

The shockwave hypothesis was used to model moving events involving overtaking in a study headed by Chandana (Wirasinghe 1978). Michalopoulos and Stephanopoulos (1981) proposed a real-time signal control technique for reducing overall intersection delays given a maximum queue length limit.

Hisai and Sasaki (1993) developed a shockwave model to study the behaviour of queues in coordinated signal systems as well as traffic wave motion along successive route segments.

Dion et al. (2004) conducted research comparing vehicle delays predicted by INTEGRATION microscopic traffic simulation software and a number of analytical delay models on a one lane approach to a pre-timed signalised intersection approach for traffic conditions ranging from undersaturation to oversaturation.

Wu et al. (2010) presented a measurable measure of oversaturation by concentrating on its negative impacts in both temporal and spatial dimensions in another investigation. Ban et al. (2011) has suggested a novel shockwave approach for estimating real-time queue lengths at signalized crossings utilising mobile traffic sensor sample journey time.

On the other hand, some researchers investigated pedestrian walking behaviours using kinematic wave theory, agent-based methods, and discrete choice modelling techniques (Okazaki and Matsushita 1993; Curio et al. 2000; Qin and Ivan 2001; Kukla et al. 2001; Dijkstra and Timmermans 2002; Hughes et al. 2002; Desyllas et al. 2003; Osaragi 2004; Kitazawa and Batty 2004 Few scholars investigated the interplay between automobile and pedestrian movements.

For example, Airault et al. (2004) created ARCHISIM, a microscopic simulation tool that could simulate pedestrian movements on virtual lanes and, in the case of barriers, allow pedestrians to negotiate around them.

Vehicle-to-Vehicle (V2V) and Vehicle-to-Infrastructure (V2I) communications (Wang et al., 2015), and so cars may be managed in a CAV environment in an efficient, safe, and sustainable manner, taking real-time traffic signals into consideration (Feng et al., 2018). As a result, various research have been conducted to study the cooperative design of traffic lights and/or CAV trajectories at signalised junctions using CAV technology.

There are three main research areas for improving traffic operations at urban intersections using CAV technology: classical control (e.g., signal control algorithms), guiding or controlling vehicular speeds and paths (e.g., cooperative intersection methods, speed guidance systems, and CAV trajectory planning), and joint control approaches of both traffic signals and vehicle trajectories.

In terms of classical control, signal control algorithms with connected vehicles (not necessarily automated vehicles) aim to generate the optimal signal parameters at an isolated intersection) (Feng et al., 2015; Chen and Sun, 2016), along a corridor (Beak et al., 2017; Li and Ban, 2018), or at the network level (Le et al., 2015; Al

Islam and Hajbabaie, 2017). (Guo et al., 2019a). These signal control methods do not optimise CAV paths, but instead use connected vehicle data to estimate and predict state.

They are typically tough to solve integer nonlinear programming problems and/or bi-level optimization models. To define and approximate control issues, dynamic programming (DP) (Feng et al., 2015; Chen and Sun, 2016; Beak et al., 2017; Li and Ban, 2018) and distributed control (Le et al., 2015; Al Islam and Hajbabaie, 2017) are often used.

Individual speed guidance systems, such as GLOSA (Green Light Optimized Speed Advice) (Stevanovic et al., 2013; Li et al., 2014a; Stebbins et al., 2017) and Eco-Approach and Departure systems (Altan et al., 2017; Hao et al., 2018; Wang et al., 2019), provide advisory speeds to individual vehicles for fewer vehicle stops, travel delay, and/or The produced speed recommendations can also be employed in autonomous cars, reducing uncertainty caused by human drivers and therefore improving control performance.

However, because these speed guiding systems are dedicated to a single vehicle rather than a vehicle platoon(s), the consequences on the whole platoon or traffic flow are neglected.

Actuated traffic signal control is commonly used at signalised junctions across the world (Toledo et al., 2020; Moghimi et al., 2018; Shirvani Shiri and Maleki, 2017).

The ability to promptly update the signal timing parameters in response to actual arrivals at junction approaches is critical to ensuring the actuated operation is effective. This is traditionally accomplished by modifying actuated control parameters like as MinGT, MaxGT, and cycle duration.

Wu et al. (2019) calculated the maximum green duration for a left turn movement based on the maximum number of left turning cars, using ten vehicles per lane as the maximum number of left turning vehicles. The control parameters identified in the preceding operations are bound by a set of predetermined static parameters recommended by qualified experts or engineers based on statistical analysis of previous patterns in vehicle data.

However, in practical operation, it is always difficult to precisely estimate the traffic state or circumstances on the basis of which the ideal control parameters to match the traffic fluctuation may be identified.

Shirvani Shiri and Maleki (2017) proposed a fuzzy control strategy that may dynamically estimate the MaxGT based on the usual range of maximum green time as indicated by Highway Capacity Manual (Highway Capacity Manual, 2010) and queue length data from fixed traffic sensors on the route.

In the preceding experiments, the control parameters are dynamically altered in response to real traffic demand, whereas the control parameters are typically set using data acquired from stationary detectors. The stationary detector's nature describes its difficulties in correctly detecting traffic arrivals on an approach in a dynamic manner (Yang and Zuo, 2017).

Cycle duration is another important aspect in determining phase timing. Webster (1958) created the TRRL model, with the operational goal of minimising the overall control latency of the intersection. The TRRL model served as the foundation for the ARRB model.

The control goals are to reduce the control latency and the number of stops throughout the whole junction (Akcelik, 1980). The Highway Capacity Manual, 2010, proposes the cycle length model, which is based on intersection critical demand (or arrival) and capacity utilisation, as evaluated by the Peak hour factor (PHF) and flow over saturation ratio (i.e. v/c ratio). The cycle length model is based on predicted saturation and may be used in a variety of traffic situations.

Nishantkushwah, Raman Natariy, and "ujJaiswal" did research on "Traffic A Review in Bhopal." They used various types of coordination, such as time-based coordination, in which a constant synchronised time is set for current traffic flow by offsetting the signal times of study junctions, whereas Actuated signal controllers, which are interconnected with other signals, work on current traffic flow demands and signal timings are set. During the research, certain proposals such as road widening and commercial vehicle division are made.

LOA corporation, 1120W La Veta Avenue, Suite 660 of California, completed the "Traffic signal management and Synchronization project at Salt Lake City," in which existing conditions such as delays, pollutant levels, queuing length, and vehicle operation cost are assessed, and signals are redesigned by minimising the delay using the HCM method, and then optimised signals are synchronized, and the effectiveness of proposed improvements is tabulated.

"Synchronization of traffic light system for optimal efficiency along Jalan Bukit Gambier, Penag, Malaysia" was carried out by M.A Ahmed Rafidi and A.H Abdul Hamid. The research looked at the number of vehicles on Jalan Bukit Gambier, as well as the traffic time, in order to plan adequate retiming of traffic signals along the analyzed road. This demonstrated significant improvements in traffic flow, with shorter trip times than previously.

"Synchronisation of A Case Study on Eastern Ring Road Indore" was carried out by "H.S Goliya and Nitin Kumar Jain." This included an analysis of data collected from the Eastern Ring Road, signal design using the Webster method, and synchronization for 9 intersections on the Eastern Ring Road to minimize delays.

The effectiveness of coordination was calculated, and 24 Kl petrol and 340 Kl diesel per year were saved, and Co2 emissions are estimated to be 1.5 million Kg/year, with a loss of 30.15 million Kg/year for low running speed.

Karthick et al. (2012) proposed a system to analyse live video camera recordings to automatically handle traffic by allocating green time to the traffic by calculating the number of vehicles, which gives the traffic density, which acted as an input for the algorithm that was in place for allocating optimal time for the vehicles to pass through the intersection.

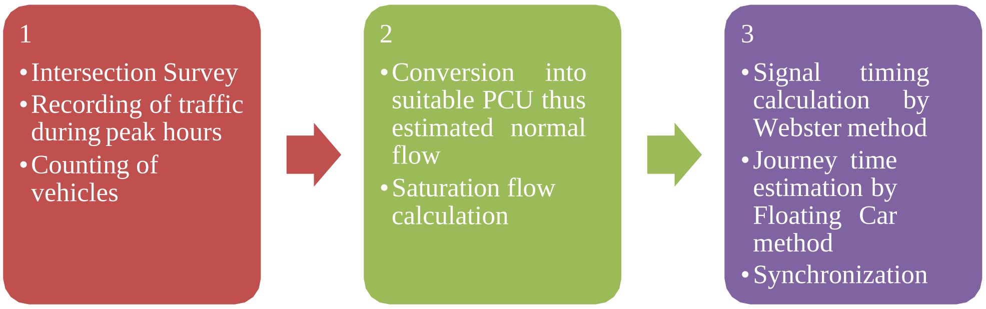
3. STUDY SPECIFICATIONS & APPROACH FOR SYNCHRONIZATION

3.1 Traffic survey procedure and approach for data collection and designing

The study consists of the collection of preliminary data and traffic survey analysis. Traffic volume has been recorded during their peak hours (10:00 AM to 12:00 AM and 6:00 PM to 8:00 PM) for 4 days which consists of 2 weekdays and 2 weekends at each intersection. The type of traffic i.e., whether the vehicles are light or heavy commercial, decides the type of PCU values to be adopted as per the IRC. After computing the normal flow rate, these values were converted to PCU per hour.

Saturation flow rates are estimated for each flow direction from 20 minutes of recording during a green time and average data is calculated by averaging morning and evening data. Cycle lengths are then estimated for each intersection by Webster’s method and green time is also then calculated for each phase.

Journey time is then estimated by conducting the floating car method. 6 trips were made throughout the study stretch with 3-3 trips in each direction (Sharda chowk to Telibandha chowk - Telibandha chowk to Sharda chowk). The synchronization was then done for each intersection signal after the calculation of journey speed and time needed for travelling within the intersections.



The study area consists of major intersections of Raipur city accommodating in the total length of 3.13 km. The study area comprises of 6 intersections namely Sharda Chowk, Jaistambh Chowk, Kutchery Chowk, Ghadi Chowk, Bhagat Singh Chowkand Telibandha Chowk. Each intersection have a four phase signalized traffic system. The reason behind selecting these intersections is as these intersections possess a large traffic volume of Raipur city.

Table 3.1: Description of the study area

Name of the Intersection	**Next Intersection**	**Distance between the intersections**	**Co-ordinates**	**Type of Intersection**
Sharda Chowk	Jaistambh Chowk	130m	21° 14' 31.2" North, 81° 37' 38.4" East	4 - Phase Intersection
Jaistambh Chowk	Kutchery Chowk	700m	21° 14' 37" North, 81° 38' 8" East	4 - Phase Intersection
Kutchery Chowk	Ghadi Chowk	250m	21°14'45.7"North 81°38'30.7"East	4 - Phase Intersection
Ghadi Chowk	Bhagat Singh Chowk	1700m	21° 14' 41" North, 81° 38' 34" East	4 - Phase Intersection
Bhagat Singh Chowk	Telibandha Chowk	350m	21°14'31"North 81°39'18"East	4 - Phase Intersection
Telibandha Chowk	-	-	21°14'23"North 81°39'18"East	4 - Phase Intersection

Fig.2 Study route

3.2 Design Calculation Utilized for Traffic Signal

The optimum signal cycle is given by relation:

$$C_o = \frac{1.5L + 5}{1 - Y}$$

Where, L= total lost time per cycle, sec = 2n+R

n= number of phases

R= all-red time or red-amber time

$$Y = y_1 + y_2$$

Here,

y1 = q1/s1 and y2 = q2/s2

Then,

$$G1 = \frac{y1}{Y}(C_o - L) \text{ and } \quad G2 = \frac{y2}{Y}(C_o - L)$$

4. DATA CALCULATION

following are the data of traffic signal timing from each intersection

Table 4.1 Traffic design data of Sharda Chowk

SHARDA CHOWK								
Intersection	Green (sec.)	Amber (sec.)	Red (sec.)	Current Cycle Length		Road Width		Type of signal system
Sharda Chowk to Tatyapara Chowk	43	3	104	150 seconds		3.75m		Fixed Time
Sharda Chowk to Jaistambh Chowk	43	3	104					
Sharda Chowk to Banjari Chowk	36	3	111					
Sharda Chowk to Gurunanak Chowk	19	3	128					
Normal flow(PCU/hr)	Saturation flow (PCU/hr)	Flow ratio	L=2*n+all red time	Cycle length	g	Amber	Green	Red
			2*4+(2*4)				A=3,l=2	
1307	5651.21	0.23	16	120	32	3	31	86
1737.2	6362.8	0.27	16	120	38	3	37	80
500.2	3850	0.13	16	120	19	3	18	99
261.2	2173.81	0.12	16	120	17	3	16	101

Table 4.2 Traffic design data of Jaistambh Chowk

JAISTAMBH CHOWK								
Intersection	Green (sec.)	Amber (sec.)	Red (sec.)	Current Cycle Length		Road Width		Type of signal system
Jaistambh to sharda	37	5	108	150 seconds		3.75m		Fixed Time
Jaistambh Chowk to Kutchery Chowk	37	5	108					
Jaistambh Chowk to Gol Bazar	25	5	120					
Jaistambh Chowk to Moudhapara	22	5	123					
Normal flow(PCU/hr)	Saturation flow (PCU/hr)	Flow ratio	L=2*n+all red time	Cycle length	g	Amber	Green	Red
1764.9	8042.7	0.22	16	100	27	3	26	71
1346.8	7145.85	0.19	16	100	23	3	22	75
979.9	5463.8	0.18	16	100	22	3	21	76
1000.5	8678.72	0.12	16	100	15	3	14	83

Table 4.3 Traffic design data of Kutchery Chowk

<table>
<tr><th colspan="9">KUTCHERY CHOWK</th></tr>
<tr><td>Intersection</td><td>Green (sec.)</td><td>Amber (sec.)</td><td>Red (sec.)</td><td colspan="2">Current Cycle Length</td><td colspan="2">Road Width</td><td>Type of signal system</td></tr>
<tr><td>Kutchery Chowk to Jaistambh Chowk</td><td>22</td><td>8</td><td>90</td><td colspan="2" rowspan="4">120 seconds</td><td colspan="2" rowspan="4">6m</td><td rowspan="4">Vehicle Actuated Controls (VAC)</td></tr>
<tr><td>Kutchery Chowk to Ghadi Chowk</td><td>19</td><td>8</td><td>93</td></tr>
<tr><td>Kutchery Chowk to Moti Bagh</td><td>27</td><td>8</td><td>85</td></tr>
<tr><td>Kutchery Chowk to Mekahara</td><td>17</td><td>8</td><td>95</td></tr>
<tr><td>Normal flow</td><td>Saturation flow (PCU/hr)</td><td>Flow ratio</td><td>L=2*n+all red time</td><td>Cycle length</td><td>g</td><td>Amber</td><td>Green</td><td>Red</td></tr>
<tr><td>1068.15</td><td>5086.43</td><td>0.21</td><td>16</td><td>110</td><td>27</td><td>3</td><td>26</td><td>81</td></tr>
<tr><td>966.5</td><td>5685.29</td><td>0.17</td><td>16</td><td>110</td><td>22</td><td>3</td><td>21</td><td>86</td></tr>
<tr><td>814.5</td><td>4072.5</td><td>0.2</td><td>16</td><td>110</td><td>26</td><td>3</td><td>25</td><td>82</td></tr>
<tr><td>860.35</td><td>5735.67</td><td>0.15</td><td>16</td><td>110</td><td>20</td><td>3</td><td>19</td><td>88</td></tr>
</table>

Table 4.4 Traffic design data of Ghadi Chowk

<table>
<tr><th colspan="9">GHADI CHOWK</th></tr>
<tr><td>Intersection</td><td>Green (sec.)</td><td>Amber (sec.)</td><td>Red (sec.)</td><td colspan="2">Current Cycle Length</td><td colspan="2">Road Width</td><td>Type of signal system</td></tr>
<tr><td>Ghadi Chowk to Kutchery Chowk</td><td>27</td><td>5</td><td>78</td><td colspan="2" rowspan="4">110 seconds</td><td colspan="2" rowspan="4">6m</td><td rowspan="4">Vehicle Actuated Controls (VAC)</td></tr>
<tr><td>Ghadi Chowk to Bhagat Singh Chowk</td><td>30</td><td>5</td><td>75</td></tr>
<tr><td>Ghadi Chowk to Raj Bhavan</td><td>7</td><td>5</td><td>98</td></tr>
<tr><td>Ghadi Chowk to Civil Court</td><td>12</td><td>5</td><td>93</td></tr>
<tr><td>Normal flow(PCU/hr)</td><td>Saturation flow (PCU/hr)</td><td>Flow ratio</td><td>L=2*n+all red time</td><td>Cycle length</td><td>g</td><td>Amber</td><td>Green</td><td>Red</td></tr>
<tr><td>615.4</td><td>2930.48</td><td>0.21</td><td>16</td><td>100</td><td>25</td><td>3</td><td>24</td><td>73</td></tr>
<tr><td>746</td><td>3390.91</td><td>0.22</td><td>16</td><td>100</td><td>27</td><td>3</td><td>26</td><td>71</td></tr>
<tr><td>237.2</td><td>1976.67</td><td>0.12</td><td>16</td><td>100</td><td>15</td><td>3</td><td>14</td><td>83</td></tr>
<tr><td>314.9</td><td>2099.33</td><td>0.15</td><td>16</td><td>100</td><td>18</td><td>3</td><td>17</td><td>80</td></tr>
</table>

Table 4.5 Traffic design data of Bhagat Singh Chowk

BHAGAT SINGH CHOWK						
Intersection	Green (sec.)	Amber (sec.)	Red (sec.)	Current Cycle Length	Road Width	Type of signal system
Bhagat Singh Chowk to Ghadi Chowk	19	3	98	120 seconds	6m	Vehicle Actuated Controls (VAC)
Bhagat Singh Chowk to Telibandha Chowk	35	3	82			
Bhagat Singh Chowk to C M House	23	3	94			
Bhagat Singh Chowk to BTI Ground	22	3	95			

Normal flow(PCU/hr)	Saturation flow (PCU/hr)	Flow ratio	L=2*n+all red time	Cycle length	g	Amber	Green	Red
918.7	3674.8	0.25	16	120	35	3	34	83
897.45	5609.06	0.16	16	120	22	3	21	96
1073.35	8256.54	0.13	16	120	18	3	17	100
812.6	3869.52	0.21	16	120	29	3	28	89

Table 4.6 Traffic design data of Telibandha Chowk

TELIBANDHA CHOWK						
Intersection	Green (sec.)	Amber (sec.)	Red (sec.)	Current Cycle Length	Road Width	Type of signal system
Telibandha Chowk to Bhagat Singh Chowk	44	5	88	137 seconds	6m	Fixed Time
Telibandha Chowk to Gurudwara	28	5	104			
Telibandha Chowk to Canal Linking Road	28	5	104			
Telibandha Chowk to Katora Talab	20	5	112			

Normal flow(PCU/hr)	Saturation flow (PCU/hr)	Flow ratio	L=2*n+all red time	Cycle length	g	Amber	Green	Red
1335.8	4947.41	0.27	16	120	38	3	37	80
624.85	4463.21	0.14	16	120	20	3	19	98
1071.3	8927.5	0.12	16	120	17	3	16	101
1092.55	4966.14	0.22	16	120	31	3	30	87

Flow data converted into Passenger Car Unit (PCU)

Pedestrian timings:

Since pedestrian movement has been majorly obtained at Sharda Chowk and Jaistambh Chowk thus pedestrian green times has to be designed for these two intersections. The widths of these junctions are 7.5m.

Pedestrian green = 7.5/1.2 + 7 = 13.25 sec say 14 sec.

Therefore, pedestrian green time for pedestrian movement of 14 seconds is provided.

5. GRAPHICAL REPRESENTATION OF TRAFFIC SURVEY DATA

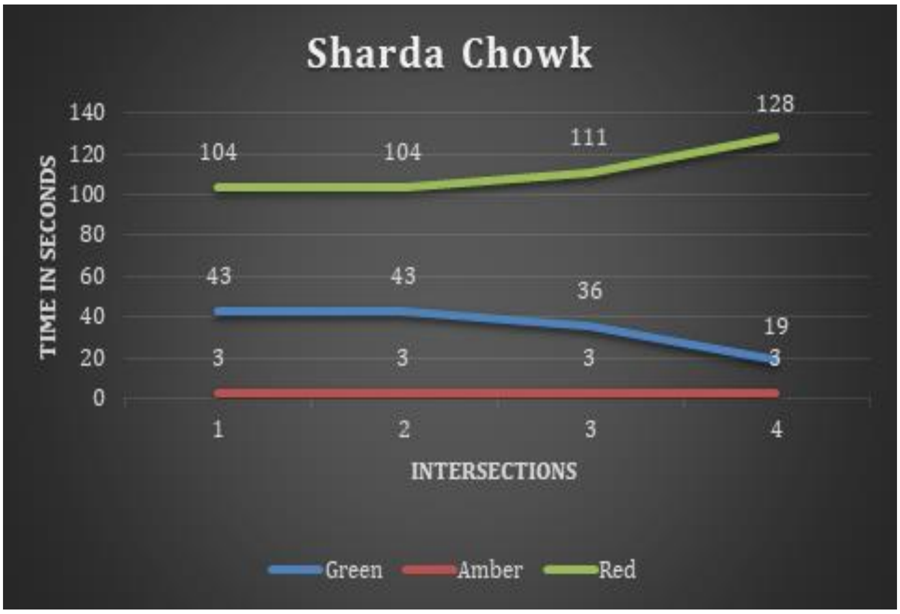


Fig. 5.1 Sharda Chowk

Fig. 5.2 Jaistambh Chowk

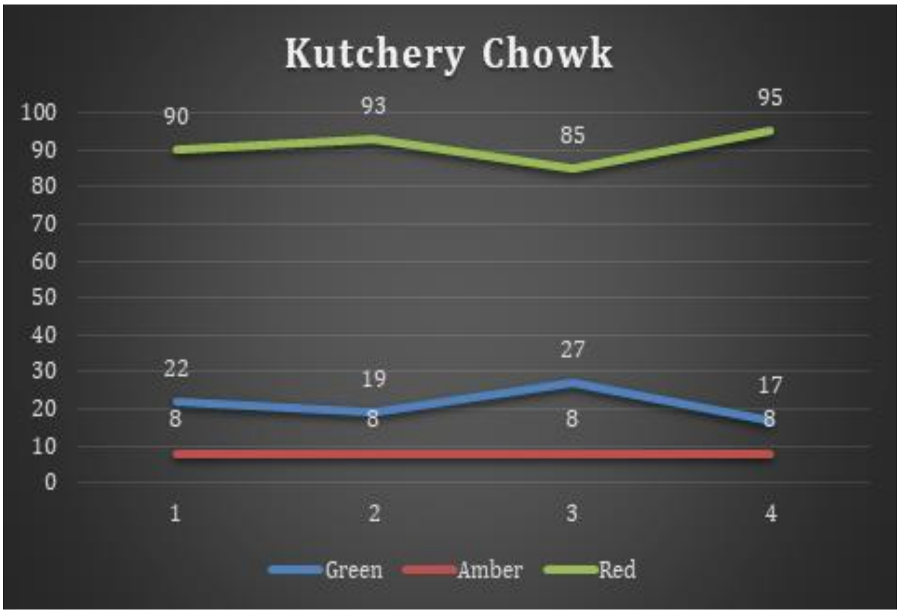


Fig. 5.3 Kutchery Chowk

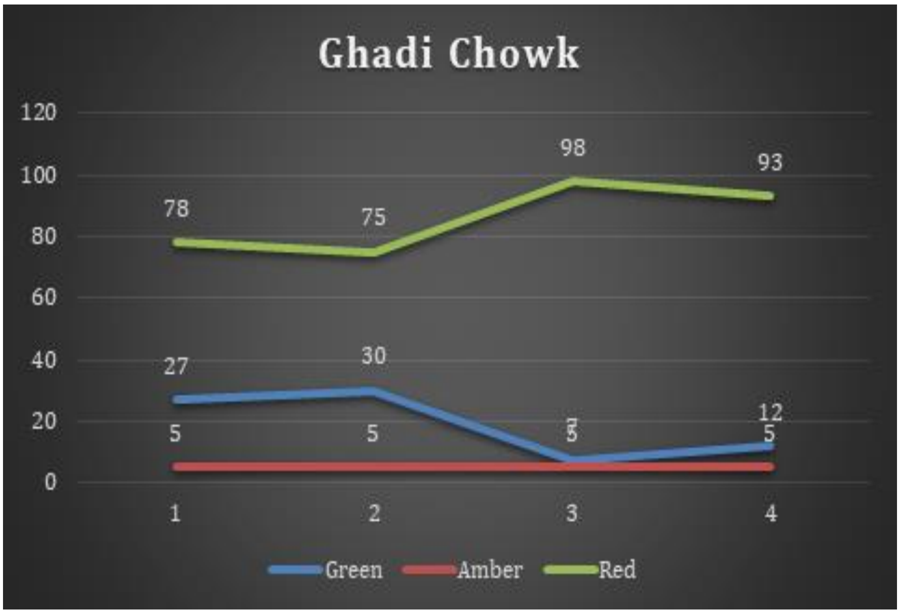


Fig. 5.4 Ghadi Chowk

Fig. 5.5 Bhagat Singh Chowk

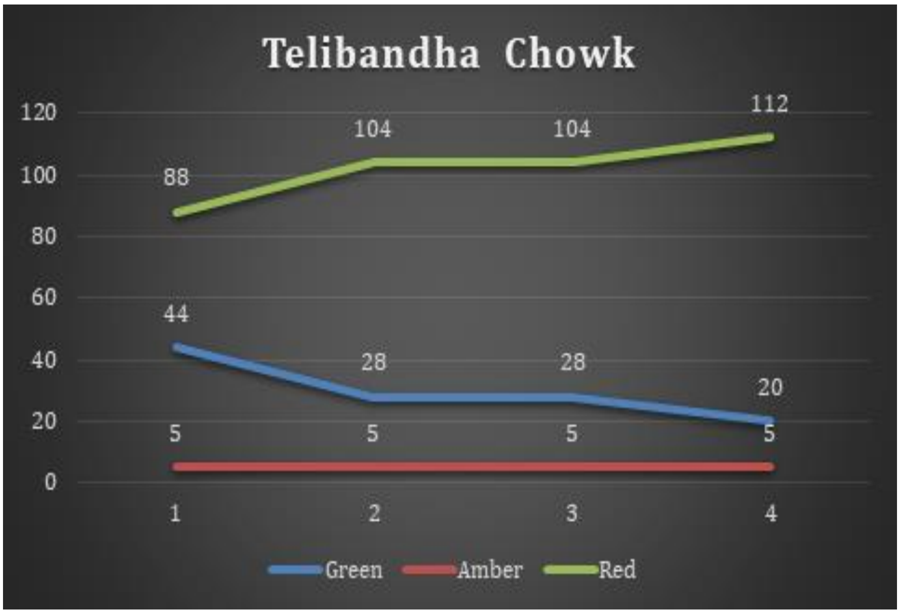


Fig. 5.6 Telibandha Chowk

6. SYNCHRONIZATION OF TRAFFIC SIGNAL TIMINGS

After designing appropriate signal timings for each junction under consideration, they must be synchronized to achieve maximum trip efficiency by eliminating delay. Because it is almost difficult to synchronize traffic from all approaches to the junctions, synchronization is performed primarily on all main routes of the junctions to achieve optimum efficiency on synchronization. The synchronization allows traffic on main routes to flow without stopping at study intersections owing to Red signal encounters. All cars travelling along key roads are instructed to travel at a certain pace, and junction signal timings are changed such that none of the vehicles on main roads of the research stretch experience the Red signal, allowing seamless transit of vehicles along the study stretch

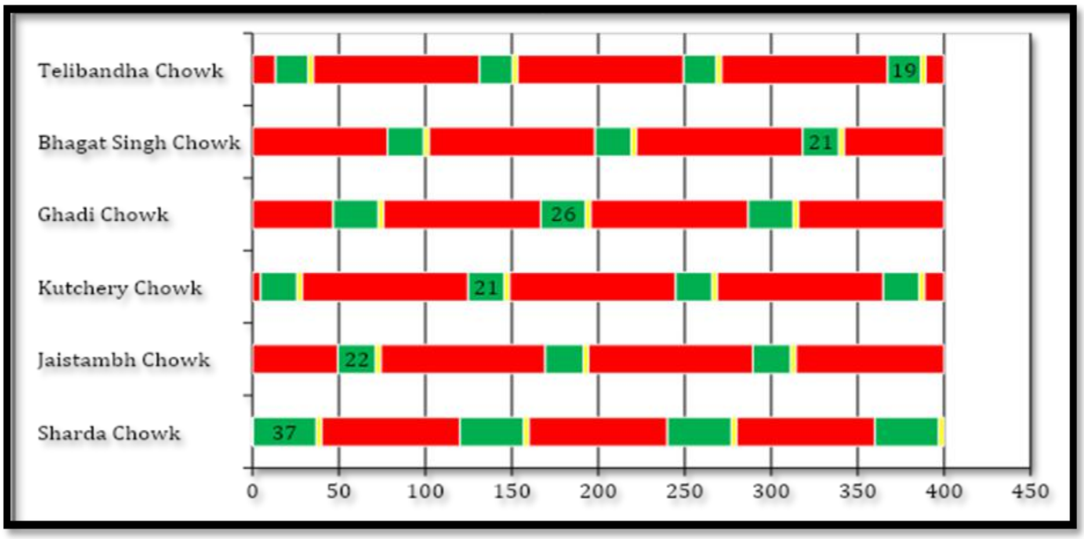


Fig. 4.8 Synchronization chart of the signal timings

7. EVALUATION BY FLOATING CAR METHOD

In order to the evaluate the effectiveness of the project existing Journey speed, Running speed and Delays at the study stretch is examined by floating car method during the peak hour of traffic flow were journey time, number of vehicle met with opposite direction and number of vehicles overtaking and overtaken by the test vehicle are noted and analyzed as below.

ny = Average no of vehicles overtaking the test vehicle minus the no of vehicles overtaken when the test is in the direction of q na = Average no of vehicles counted in the direction of the stream when the test vehicle travels in the opposite direction

tw = Average journey time, in minute when the test vehicle is travelling with the stream q ta = Average journey time, in minute when test vehicle is running against the stream q

q = Average volume= (na + ny)/(ta + tw) t = Average journey time= tw - (ny/q)

Journey speed = Journey length/Journey time

Table 4.7 Along Sharda to Telibandha

Average no of vehicles overtaking the test vehicle	14
Average no of vehicles overtaken by the test vehicle	15.33
n_y	-1.33
n_a	161.67
t_w	5.13 min
t_a	6.37 min
Average volume q	13.94 veh/min
Journey length	3.13 km
Average journey time, t	5.22 min
Average journey speed	36 kmph
Average delay	1.4 min
Average running time = Average journey time - Average delay	3.82 min
Average running speed	50 kmph

Table 4.8 Along Telibandha to Sharda

Average no of vehicles overtaking the test vehicle	23
Average no of vehicles overtaken by the test vehicle	23
n_y	0
n_a	186
t_w	6.37 min
t_a	5.13 min
Average volume q	16.17 veh/min
Journey length	3.13 km
Average journey time, t	6.37 min
Average journey speed	29.5 kmph
Average delay	1.74 min
Average running time = Average journey time - Average delay	4.63 min
Average running speed	41 kmph

As a result, the trip speed from Sharda to Telibandha and Telibandha to Sharda is 36 kmph and 29.5 kmph, respectively, with an acceptable delay of 1.4 minutes and 1.74 minutes. After synchronization, the travel speed rises by about 39% from Sharda to Telibandha and 39% from Telibandha to Sharda, with no vehicle stops at any point throughout the study length. Since the synchronization has been completed, the static delay caused by encountering the Red time signal is ideally zero. The synchronization is done at 50 kmph for more efficient flow and a shorter trip duration. The table below displays the time necessary to go between each junction when traffic flows at the design speed of 50 mph.

Table 4.10.3 Time required between two Intersection

Intersection	Distance, km	Time, sec
Sharda Chowk		
	0.13	9.36
Jaistambh Chowk		
	0.7	50.4
Kutchery Chowk		
	0.25	18
Ghadi Chowk		
	1.7	122.4
Bhagat Singh Chowk		
	0.35	25.2
Telibandha Chowk		

8. MATLAB SIMULATION

MATLAB is a programming environment designed primarily for engineers and scientists to research and develop systems and products that will alter the world. At the core of MATLAB is the MATLAB language, a matrix-based language that provides for the most natural description of computer mathematics.Simulink is a block diagram environment for creating multidomain models, simulating them before deploying them, and deploying them without writing code.

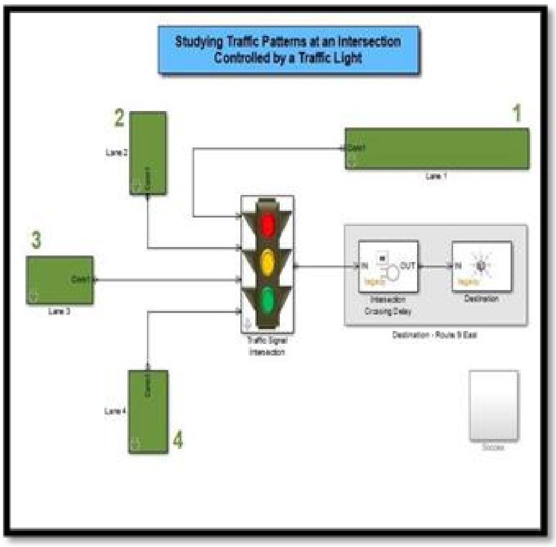


Fig. 8.1 Traffic patterns at an intersection

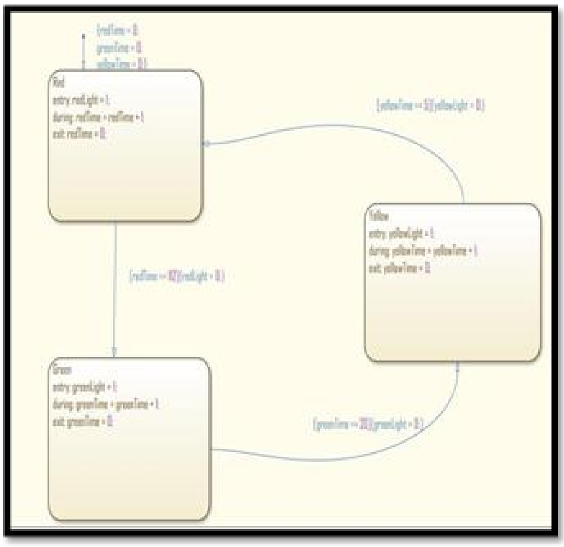


Fig. 8.2 Date input block

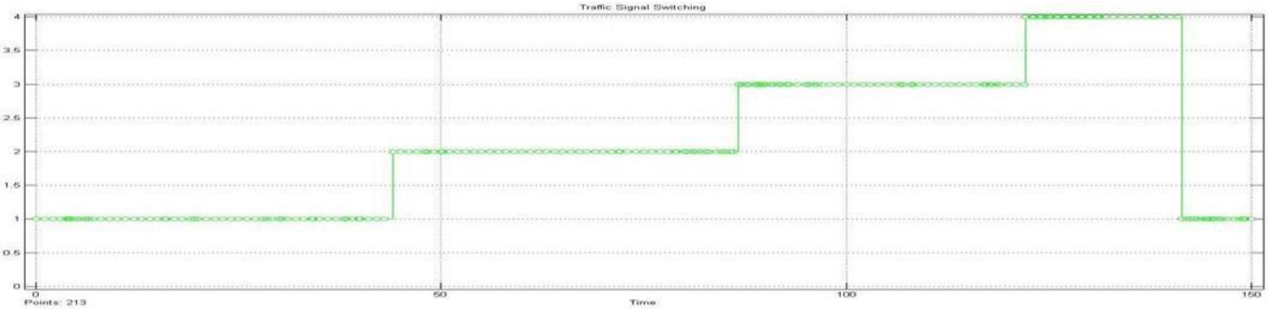


Fig 8.3 Traffic signal switching between the phases of Sharda chowk

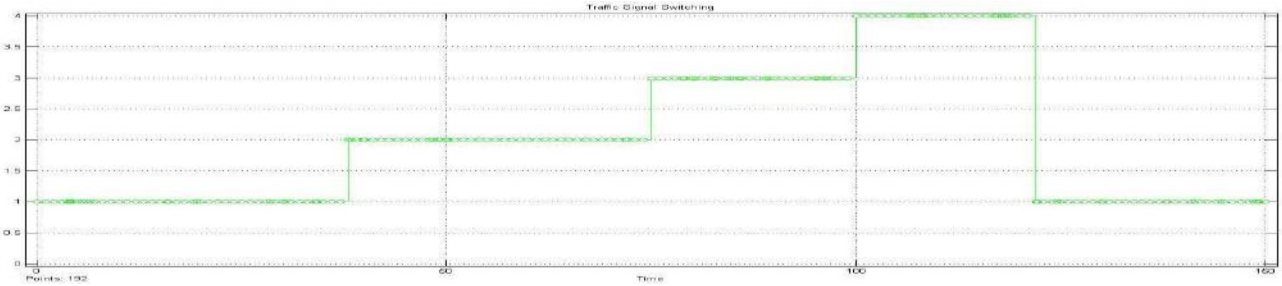


Fig 8.4 Traffic signal switching between the phases of jaistambh chowk

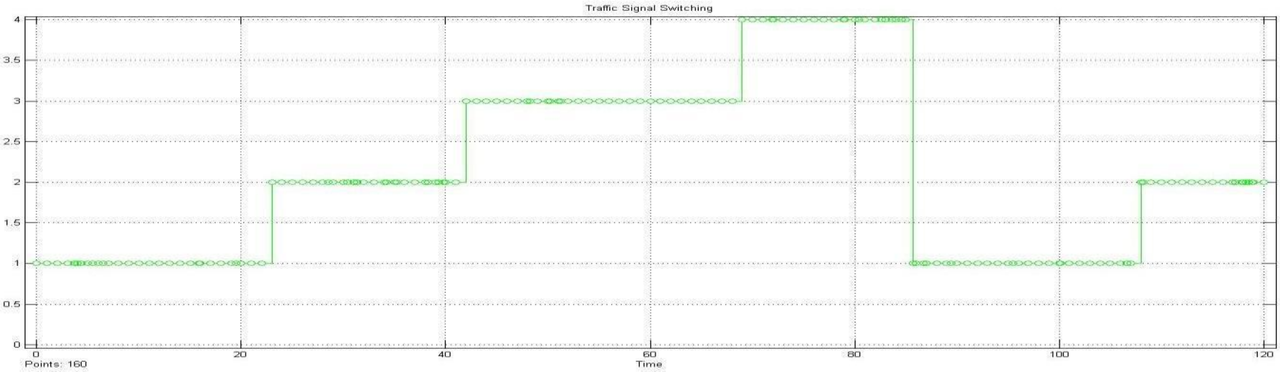


Fig 8.5 Traffic signal switching between the phases of Kutchery Chowk

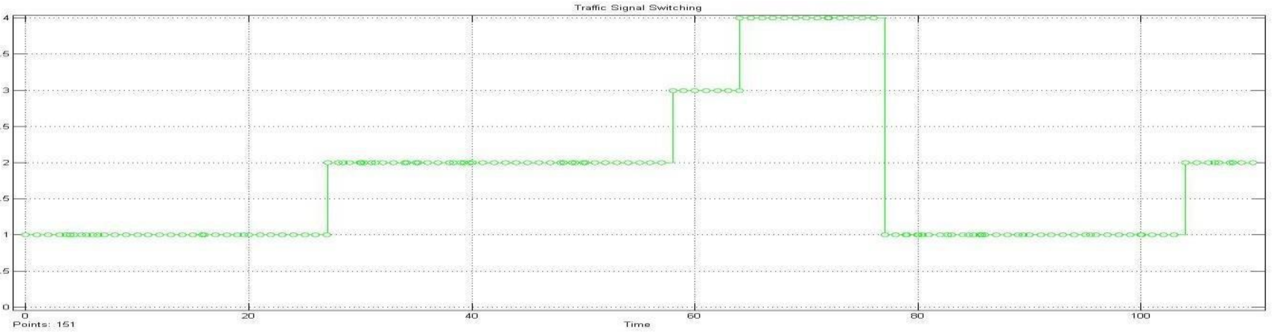


Fig 8.6 Traffic signal switching between the phases of Ghadi Chowk

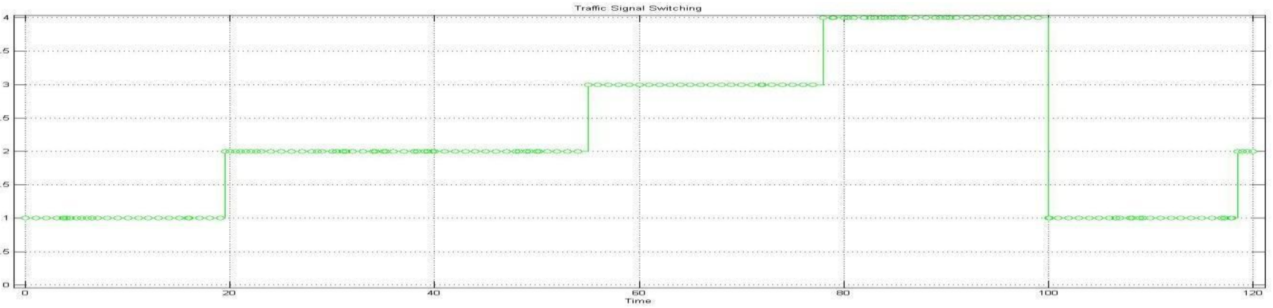


Fig 8.7 Traffic signal switching between the phases of Bhagat Singh Chowk

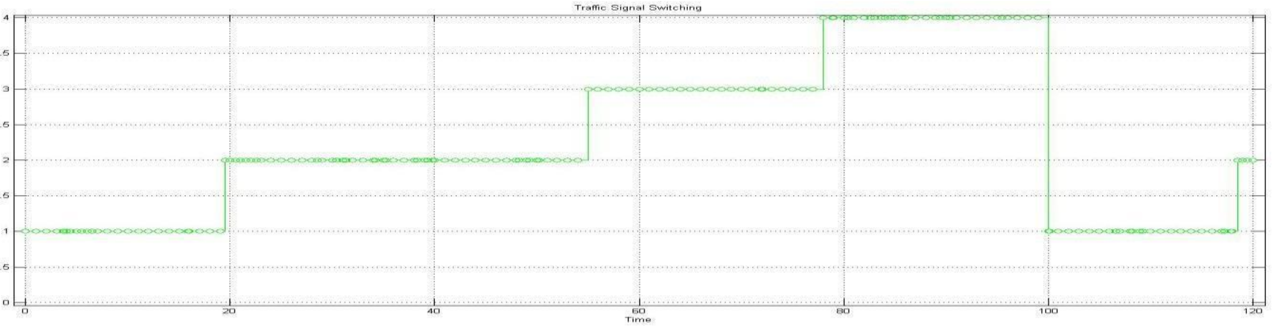


Fig 8.8 Traffic signal switching between the phases of Telibandha Chowk

9. CONCLUSION

- Webster's technique optimizes signal timings, resulting in shorter cycle durations and fewer stoppages.
- Why Low red time stoppages result in less mental irritation and a lower probability of red light running.
- By synchronizing the route signal timings, travel time is decreased.
- When travelling at the design speed of 50 kmph, the timings at each of the six junctions are synchronized.
- A 39% improvement in travel speed is recorded once synchronization eliminates waits at crossings.
- There will be no idling of automobiles since there will be no delay. As a result, the idle fuel consumption of traffic flow is minimized, resulting in cost savings for transportation users.
- Because there is no idling, there are fewer gas emissions, demonstrating synchronisation to be an ecologically friendly strategy.
- There would be no traffic congestion even at the narrow junctions of Sharda Chowk and Jaistambh Chowk.

- The necessity for pedestrian timings was identified at Sharda Chowk and Jaistambh Chowk, for which a 14-second green pedestrian time was given.

10. FUTURE SCOPE

- The study length chosen provides transportation for a vast community in Raipur, making effective signal design a must.
- The synchronisation of these significant crossroads will benefit road users not only in terms of time and money, but also in terms of safety and avoidance of traffic rule infractions.
- The designation of signals leads in reduced congestion at junctions and a lower accident rate since the smooth flow of traffic is maintained.
- Drivers will be less annoyed as a consequence of fewer stops, resulting in fewer red light infractions.
- Changing the stopping and accelerating of cars repeatedly leads in a large amount of fuel consumption and therefore increased pollution; this problem will also be mitigated to a larger extent if fewer stops are made.

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