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Green Time Optimization In Gulshan 2 Intersection By PTV Vissim Software

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Abstract:
The rapid urbanization process in Bangladesh possesses enormous challenges to meet the growing demand for safe and sustainable mobility in the major cities, Dhaka megacity in particular. Dhaka, the capital city of Bangladesh is one of the fastest growing megacities has approximately 20 million population which generates nearly 40 million trips daily. The greatest challenge thus for transportation professionals is to develop a system for urban transport that meets the basic mobility need for all urban dwellers at desirable safety and avoiding the unacceptable level of congestion and its consequent overwhelming adverse environmental effects. The research paper presents a comprehensive analysis of the green time optimization in the Gulshan 2 intersection in Dhaka city by PTV Vissim software. Traffic congestion in Gulshan 2 is a pervasive issue affecting the efficiency of transportation networks in Gulshan Zone. This research work explores the implementation of a green time optimization strategy at the Gulshan 2 intersection, utilizing PTV Vissim software. The focus is on improving traffic flow and reducing congestion through the adjustment of signal timing. The proposed signal timing configuration allocates 60 seconds to the green phase, 5 seconds to amber, and 25 seconds to red-amber. From traffic survey data in 40 seconds of green time, a total of 3,450 vehicles passed in the Gulshan 2 intersection. On the other hand, another data point from PTV Vissim shows that a total of 3,447 vehicles passed in 40 seconds, 7,494 in 60 seconds, and 75 seconds of green time; it is 6,956 and 5,754 in 90 seconds. This configuration aims to enhance the overall intersection efficiency while considering the safety and convenience of all road users.
Background*: Bangladesh faces challenges in managing highway traffic flow due to its growing population and rapid urbanization. The country's road networks, which support the movement of goods, services, and people, are characterized by highways, urban roads, and rural routes. Dhaka, the capital and largest city, is notorious for traffic jams, contributing to air pollution and economic losses. The efficient traffic flow on highways connecting major cities and ports is vital for trade and commerce.*
PTV Vissim, a technological breakthrough for traffic management, has the potential to alleviate congestion in Dhaka and improve traffic flow on critical highways. By providing real-time traffic data and intelligent traffic management, PTV Vissim could help reduce travel time and fuel consumption, benefiting commuters and the environment.
Methods*: This is Our Software base Research, we are using PTV Vissim also our research have 4 steps (40s,60s,75s & 90s).*
Results: *From traffic survey data, against Green time (40s) total vehicle passed Gulshan 2 intersection is 3450. On the other hand, PTV Vissim provides vehicle count 3447. Different Green Time (40s,60s,75s & 90s) analysis is done for the signal design of Gulshan 2 intersection in PTV Vissim. After simulation in PTV Vissim for existing Green time (40s) it is found that 3447 Additionally for 60s Green time it is 7494 and 75s Green time it is 6956 further more for 90s Green time it is 5754 In traffic signal for the 60s, vehicle flow is much higher than the 90s because if we pass the traffic flow for 90s then additional green period causes traffic congestion in the simulation of PTV Vissim. But passing in 60s signal not create much traffic congestion like as 90s signal. So 60s will be preferable than 90s for Gulshan 2 Intersection.*
Conclusion: *The Existing Traffic Operation at the Gulshan 2 Intersection is four leg intersection. The optimum Red, Green, and amber time period (25s, 90s & 5s) in Gulshan 2 intersection by PTV Vissim. Actual Traffic Flow Data in 40s green time is **3450** and Signal Design Data in PTV Vissim output is **3447** for 40s , **7494** for 60s, **6956** for 75s and **5754** for 90s Traffic signal Green time is **preferable 60s** in Cycle length 90s & PTV Vissim Traffic Signal **Fixed Controller** (Green time, Amber time & Red time).*

Key Word: *PTV Vissim; Traffic flow; Traffic Congestion; Road Safety; Traffic Management; Intersection; Microsimulation and Road Infrastructure.*

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I. Introduction

Green time optimization at signalized intersections is a critical aspect of traffic management aimed at reducing delays, minimizing congestion, and improving overall traffic flow efficiency. Several studies have explored the effectiveness of simulation-based tools like PTV VISSIM in optimizing traffic signal timings. PTV VISSIM, a microscopic traffic simulation software, allows for detailed modeling of traffic behavior, making it a popular choice for evaluating and enhancing signal performance under various traffic conditions. According to research by *Kumar et al. (2018)*, VISSIM's capability to simulate real-world traffic scenarios helps in accurately assessing the impacts of different signal timing strategies on vehicle delays and queue lengths.

Moreover, *Ahmed and Rahman (2020)* highlighted the importance of integrating traffic volume data, intersection geometry, and signal control parameters to develop realistic simulation models. Their study demonstrated significant improvements in intersection performance after green time optimization, with reductions in average delays and stop frequencies. Additionally, adaptive signal control strategies, as discussed by *Chen et al. (2019)*, have been shown to further enhance traffic flow by dynamically adjusting green times based on real-time conditions, which can be effectively tested using VISSIM.

In the context of urban intersections like Gulshan-2, characterized by mixed traffic conditions and high congestion levels, simulation-based optimization provides a cost-effective and efficient approach compared to traditional trial-and-error methods. The literature consistently emphasizes that combining PTV VISSIM with optimization algorithms, such as genetic algorithms or traffic-responsive models, can lead to more sustainable traffic management solutions.

The software is designed to assist in realistically simulating and balancing roadway capacity as well as traffic and transport demand. The traffic control model generates the indications (i.e. Green, Red, amber) which is exported to the traffic flow model.

II. Methodology

The methodology for green time optimization at the Gulshan-2 intersection using PTV VISSIM involves several key steps. First, traffic volume data, signal timing details, and geometric layouts are collected through field surveys. This data is then used to develop a detailed simulation model of the intersection in PTV VISSIM, incorporating accurate traffic flow patterns and existing signal controls. The model is calibrated and validated by comparing simulated outputs with real-world observations to ensure accuracy. Various signal timing scenarios are created by adjusting green times while keeping the cycle length constant. These scenarios are simulated to evaluate performance metrics such as vehicle delays, queue lengths, and level of service. The optimal green time allocation is identified based on the scenario that shows the most efficient traffic flow, with recommendations provided for implementation and potential future improvements.

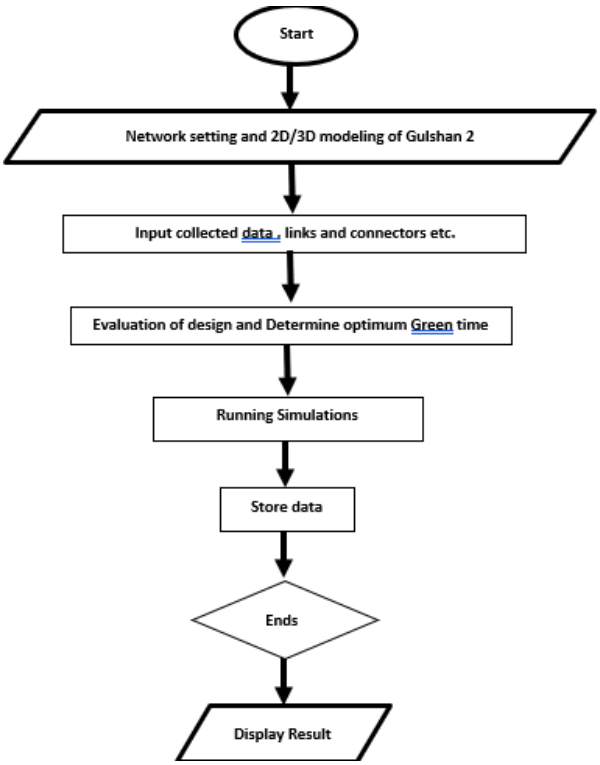

Fig.1. Methodology adopted for the study

III. Study Area And Data Collection

Study Area

Gulshan 2 is an upscale enclave with leafy streets of modern apartment buildings, embassies, and a high-end international dining scene focused on Gulshan Avenue.Gulshan-2 Circle intersection is located at northern side of mid-east block (Gulshan Island) in DCC, and it was initially a well designed roundabout and converted as conventional intersection during last decade[17].

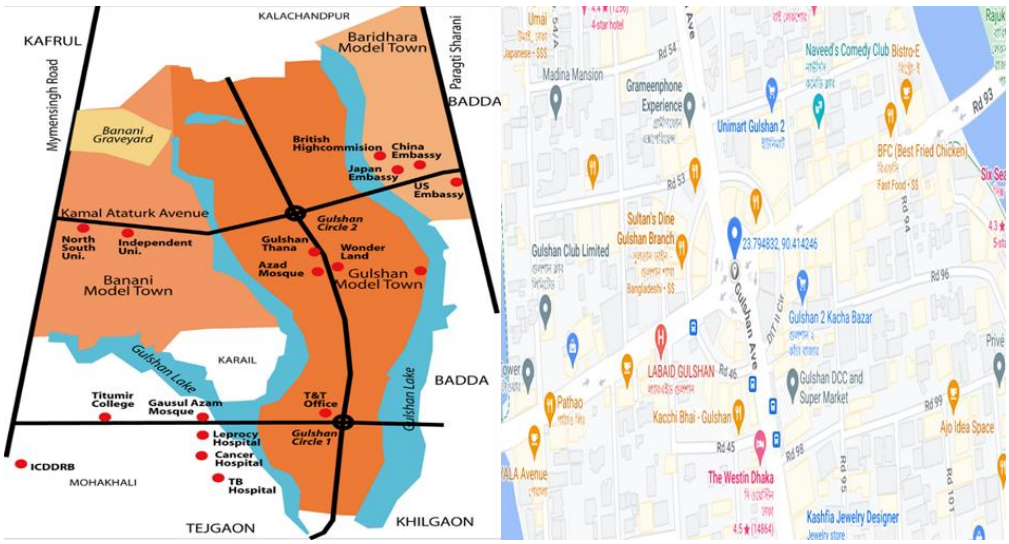

Fig.2. Study Area.

Data Collection

We have collected Gulshan 2 intersection vehicle data over three weeks at different times, sometimes during peak hours, sometimes during normal times, and the whole day after that average data.

Signal Control Data:

1. Cycle Length Green,
2. Amber and Red times for each signal group.

Classified vehicles count: In each leg, classified vehicles such as Motor/Bi Cycle vehicle/Jeep/Micro-bus/Taxi, CNG, Large Bus, Medium Bus, Small Bus, Utility Truck, Rickshaw/Van are counted in 5-minute intervals coming from that leg to, another four legs. This counting is continued to an hour. From this classified vehicle, counting the vehicle flow per hour in every 5-minute interval can be found.

Traffic survey sample data:

Green Time Optimization In Gulshan 2 Intersection											
Traffic Flow Count Survey Data Sheet											
Date:	18/12/2023	Intersection/Road:Gulshan 2									
Day:	9	Approach Name:4/B Madani Ave, Dhaka 1212									
Count Hours	4 pm to 4:30 pm	Surveyor Name: Mehedi ,Aminul ,Himel, Tusar									
Location Name	Gulshan 2										
Location ID	23.795766, 90.417465	Supervisor:Mr.Md.Tarikul Islam									
Direction from	Baridhara	Direction to	Gulshan 2	Signal time: 60 second							
Traffic Flow Direction		Traffic Flow									
		MOTORISED								Non-MOTORISED	
Time		1	2	3	4	5	6	7	8	9	11	13
Start	End	Bus	private Car	CNG	Hiace	Bike	covered van	Pick UP	van	Ambulance	Cycle	Rickshaw
0:00	0:05	0	68	16	0	25	1	3	0	4	5	0
0:05	0:10	0	64	13	2	21	0	2	2	2	7	0
0:10	0:15	0	70	12	1	19	0	0	1	3	9	0
0:15	0:20	0	67	1	0	17	2	2	1	2	8	0
0:20	0:25	0	73	16	2	20	0	3	2	1	6	0
0:25	0:30	0	65	14	1	19	2	2	1	1	5	0
Total Vehicle		0	407	89	6	121	5	12	7	13	40	0

Fig.3. Traffic sample data in Gulshan 2 intersection.

IV. Modeling In PTV Vissim

In Gulshan 2 Intersection, we see a four-leg or cross intersection, which we created in PTV Vissim.This is initial position when we start in PTV Vissim Input this Intersection. However this is 4 leg intersection, That's whey we input 4 traffic direction

Fig .5. Channelized intersection and Initial position intersection in PTV Vissim

Here we collected 4 traffic data input in
PTV Vissim for analyze Green time,

1. Gulshan 2 to Banani
2. Gulshan 2 to Notun Bazar
3. Gulshan 2 to Gulshan1
4. Gulshan 2 to Baridhara

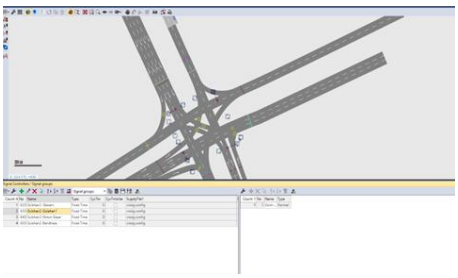

Fig .6. Initial traffic data in PTV Vissim

V. Data Analysis

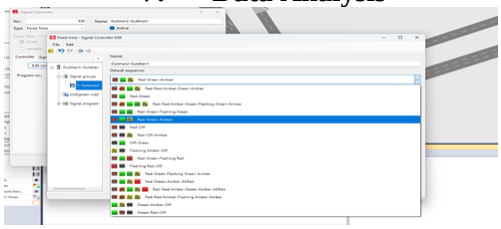

Fig .7. Assigning Red, Green & Amber time in signal controller.

Above figure demonstrates several kinds of signal controllers that are available. As Bangladesh perspective we use only **Red, Green & AMBER time.**

In 60s cycle length:

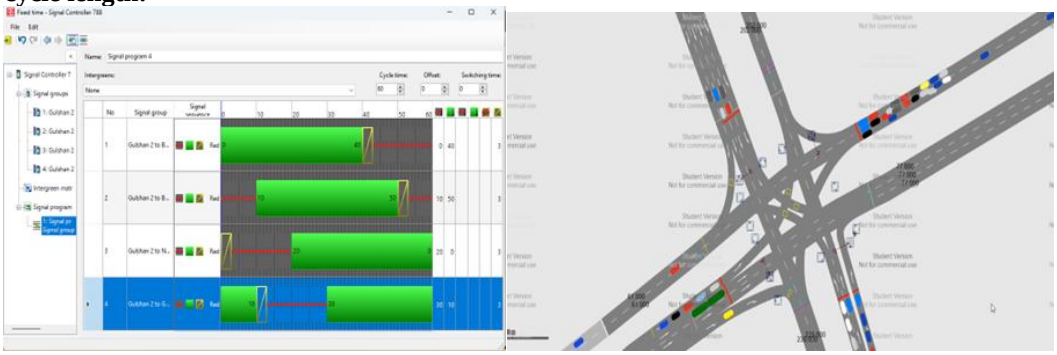

Fig .8. Analyze the output of Green time (40s) in PTV Vissim.

Traffic Direction	Number of Vehicle (30 minutes)
Gulshan 2 to Gulshan 1	1212
Gulshan 2 to Banani	1410
Gulshan 2 to Baridhara	366
Gulshan 2 to Notun Bazar	462

In PTV Vissim, Green time input is 40s when the cycle length input is 60s.After that, fixed Amber time (3s) is assigned for the whole project. Afterwards, Red time assigned is 17s; (Fig 8).

In 90s cycle length:

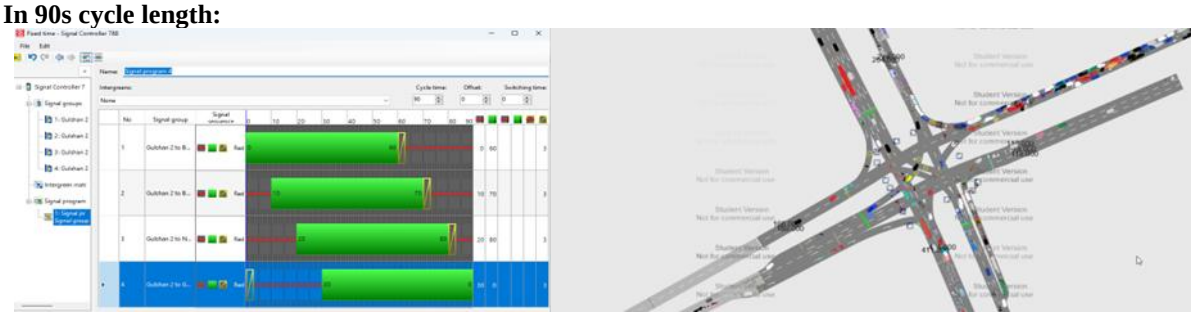

Fig .9. Analyze the output of Green time (60s) in PTV Vissim.

Traffic Direction	Number of Vehicle (30 minutes)
Gulshan 2 to Gulshan 1	1584
Gulshan 2 to Banani	2466
Gulshan 2 to Baridhara	708
Gulshan 2 to Notun Bazar	996

In PTV Vissim, Green time input is 60s when the cycle length input is 90s.After that, fixed Amber time (3s) is assigned for the whole project. Afterwards, Red time assigned is 27s; (Fig 9)

In 105s cycle length:

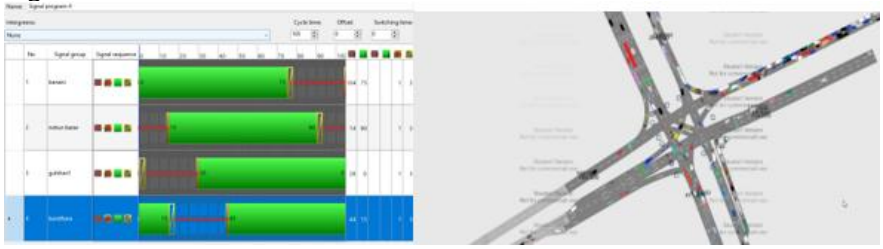

Fig .10. Analyze the output of Green time (75s) in PTV Vissim.

Traffic Direction	Number of Vehicle (30 minutes)
Gulshan 2 to Gulshan 1	1784
Gulshan 2 to Banani	2261
Gulshan 2 to Baridhara	1408
Gulshan 2 to Notun Bazar	1503

In PTV Vissim, Green time input is 75s when the cycle length input is 105s. After that, fixed Amber time (3s) is assigned for the whole project. Afterwards, Red time assigned is 30s; (Fig 10)

In 120s cycle length:

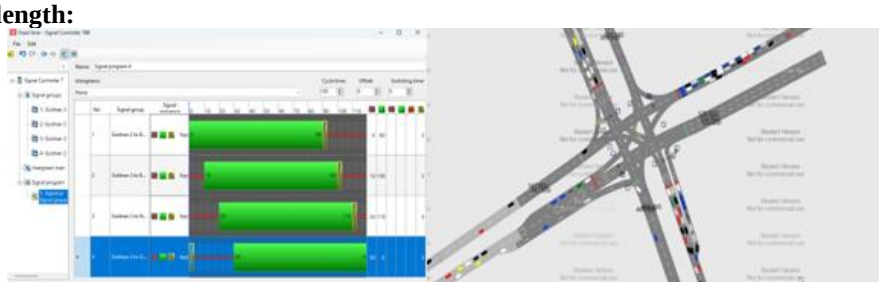

Fig .11. Analyze the output of Green time (90s) in PTV Vissim.

Traffic Direction	Number of Vehicle (30 minutes)
Gulshan 2 to Gulshan 1	2790
Gulshan 2 to Banani	1848
Gulshan 2 to Baridhara	774
Gulshan 2 to Notun Bazar	2082

In PTV Vissim, Green time input is 90s when the cycle length input is 120s. After that, fixed Amber time (3s) is assigned for the whole project. Then, Red time assigned is 27s; (Fig 11)

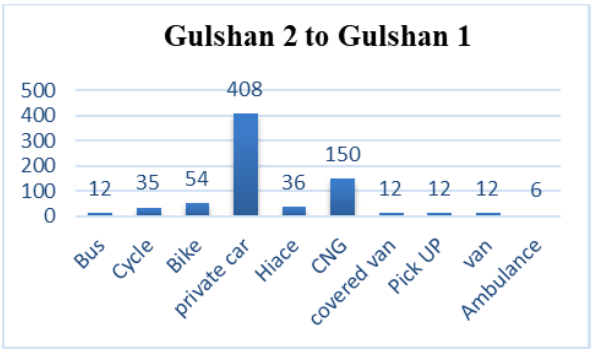

Fig .12. Gulshan 2 to Gulshan 1 Vehicle Count

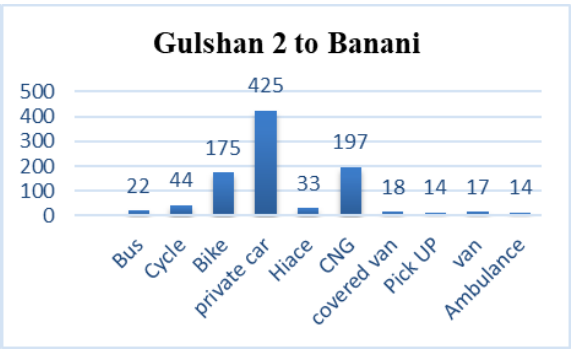

Fig .13. Gulshan 2 to Banani Vehicle Count

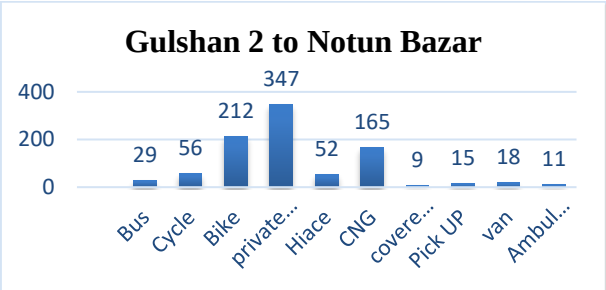

Fig .14. Gulshan 2 to Notun Vehicle Count

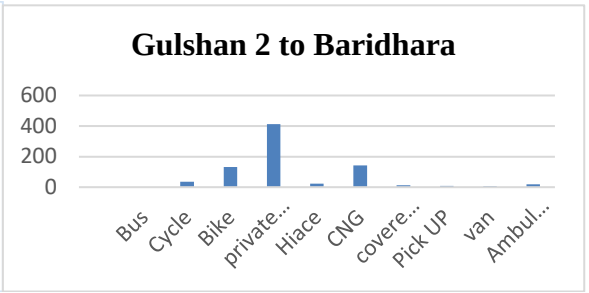

Fig .15. Gulshan 2 to Baridhara Vehicle Count

Real Survey Data Vs PTV Vissim:

Table 1: Data collection in Intersection and PTV Vissim Green time(40 s)

Traffic Direction	Number of Vehicle (30 minutes) Collected Data	Number of vehicle(per 30 min) in PTV Vissim
Gulshan 2 to Gulshan 1	737	1212
Gulshan 2 to Banani	959	1410
Gulshan 2 to Baridhara	792	366
Gulshan 2 to Notun Bazar	959	462

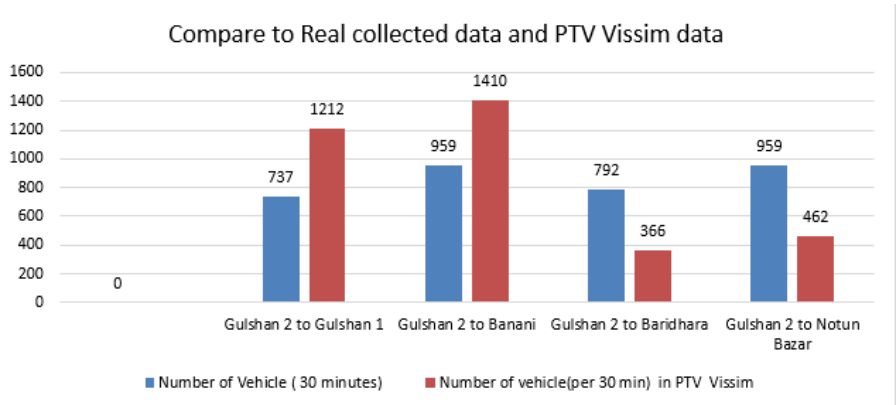

Fig.16. Compare to the real collected data with PTV Vissim data in 40s Green time

Fig.16. shows that, Total vehicle into Gulshan 2 Intersection real time data (40 s) and PTV Vissim output data (40 s) the maximum vehicle in Banani 1 and Minimum Vehicle in Baridhara

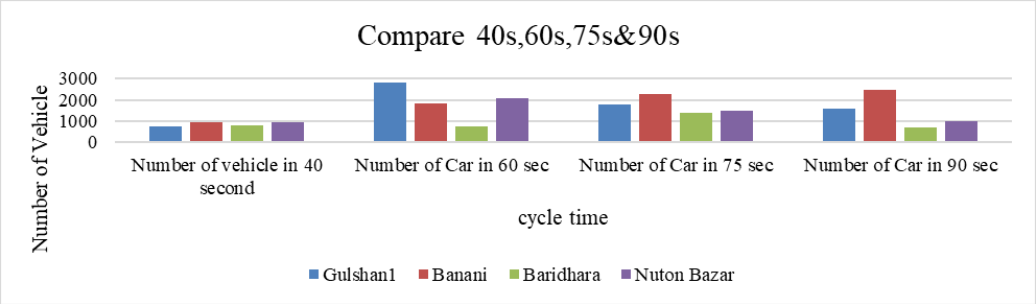

Fig .17. Compare to (40,60,75 & 90) s PTV Vissim Data

Here Total Vehicle into Gulshan 2 Intersection PTV Vissim output data (40s,60s,75s &90s) the maximum vehicle in Gulshan 1 and Minimum Vehicle in Baridhara.

VI. Result And Discussion

From traffic survey data, against Green time (40s) total vehicle passed Gulshan 2 intersection is 3450. On the other hand, PTV Vissim provides vehicle count 3447. Different Green Time (40s,60s,75s & 90s) analysis is done for the signal design of Gulshan 2 intersection in PTV Vissim. After simulation in PTV Vissim for existing Green time (40s) it is found that 3447.Additionally for 60s Green time it is 7494 and 75s Green time it is 6956 further more for 90sGreen time it is 5754.

Signal Time(s)	Number of Vehicle (30 minutes) Collected Data	Number of vehicle(per 30 min) in PTV Vissim
60	3450	3447
90	-	7494
105	-	6956
120	-	5754

- In traffic signal for the 60s, vehicle flow is much higher than the 90s because if we pass the traffic flow for 90s then additional green period causes traffic congestion in the simulation of PTV Vissim.
- But passing in 60s signal not create much traffic congestion like as 90s signal.
- So 60s will be preferable than 90s for Gulshan 2 Intersection.

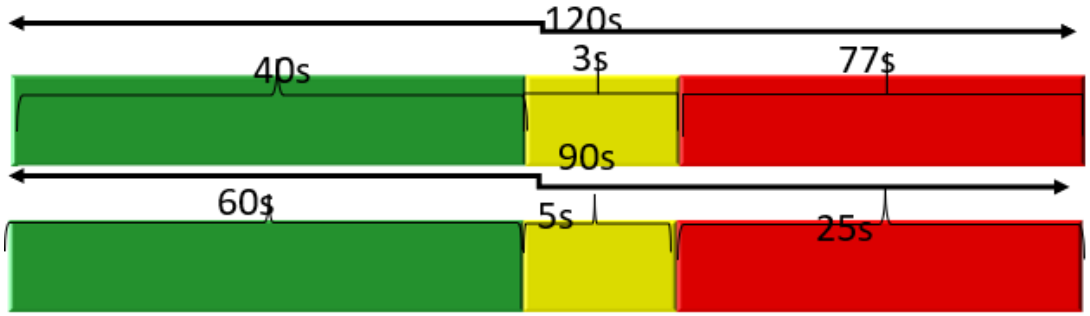

Fig .18. Green time, Amber time & Red time in signal by PTV Vissim

VII. Conclusion

- The Existing Traffic Operation at the Gulshan 2 Intersection is four leg intersection.
- The optimum Red, Green, and amber time period (25s, 90s & 5s) in Gulshan 2 intersection by PTV Vissim.
- Actual Traffic Flow Data in 40s green time is 3450 and Signal Design Data in PTV Vissim output is 3447 for 40s , 7494 for 60s, 6956 for 75s and 5754 for 90s
- Traffic signal Green time is preferable 60s in Cycle length 90s & PTV Vissim Traffic Signal Fixed Controller (Green time, Amber time & Red time)

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