SIMULATION-BASED TRAFFIC SIGNAL DESIGN FOR SELECTED INTERSECTIONS IN DHAKA USING PTV VISSIM

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A thesis submitted to the Department of Civil Engineering in partial fulfillment for the degree of Bachelor of Science in Civil Engineering

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DECLARATION

It is hereby declared that neither this thesis nor any portion there of has been submitted elsewhere for the award of any degree or diploma in any institution.

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Dedicated to

"Our Beloved Parents"

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ABSTRACT

An automatic traffic signaling system is a critical requirement for improving urban traffic management in rapidly growing cities such as Dhaka, Bangladesh. This research investigates three key signalized intersections—Panthapath, Karwan Bazar, and Farmgate—which represent some of the most congested corridors in the city. These intersections serve as major nodes connecting educational, medical, commercial, and administrative zones. At present, traffic operations at these locations are primarily controlled manually by traffic personnel, resulting in inconsistent signal timing and frequent congestion. In this study, a VISSIM based microscopic simulation approach has been applied to design and evaluate an optimized traffic signaling system. The results demonstrate that the proposed system significantly enhances traffic performance by reducing average delay by approximately 85%–90% and decreasing vehicle queue lengths by 60%–70% compared to existing manual control operations.

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CHAPTER 1
INTRODUCTION

1.1 Background and Motivation

Dhaka, the capital city of Bangladesh, is one of the most densely populated cities in the world. Over the past few decades, the city has experienced rapid urbanization and unplanned development, resulting in severe pressure on its transportation system. Although the city accommodates a large number of vehicles and pedestrians daily, the existing traffic management and signal control system is still inefficient and outdated.

Several studies have reported that a significant portion of Dhaka's intersections are improperly designed or incorrectly aligned with traffic flow requirements. It has also been observed that many traffic signals suffer from inappropriate timing plans and inadequate lighting systems, which further worsen the traffic conditions and reduce the efficiency of road networks.

The rapid and unplanned growth of Dhaka has led to serious transportation challenges. The physical structure of the city has not developed in coordination with its increasing population and vehicle demand. As a result, traffic congestion has become one of the most critical problems in daily urban life. This congestion is mainly caused by poor infrastructure planning, inefficient traffic control systems, lack of coordination among intersections, and improper driving behavior.

Intersections play a vital role in managing traffic flow by ensuring safe, orderly, and efficient movement of vehicles. However, in Dhaka city, most intersections fail to perform effectively due to manual control and inconsistent signal timing. The total road network in Dhaka extends approximately over 2,200 kilometers, including major roads, lanes, and by-lanes, while the available road space covers only a small percentage of the city's total land area. In addition, the functional primary road network is limited compared to the extremely high demand.

According to Bangladesh Road Transport Authority (BRTA), more than five hundred thousand motorized vehicles including cars, buses, trucks, microbuses, taxis, and CNG auto-rickshaws are registered in Dhaka. This number has continued to grow rapidly over the years, placing additional pressure on the already insufficient road infrastructure.

A major challenge in Dhaka's traffic system is the mixed traffic condition, where both motorized and non-motorized vehicles share the same road space. These vehicles have significantly different speed characteristics, which leads to irregular traffic flow, increased congestion, and higher accident risks.

Moreover, Dhaka Metropolitan Police (DMP) area, which is relatively small in size compared to its population, accommodates millions of people daily. Due to limited road capacity and increasing travel demand, traffic congestion has become a regular phenomenon in almost all major intersections. This results in long delays, increased fuel consumption, environmental pollution, and stress for commuters.

In many cases, drivers attempt to cross intersections aggressively during signal changes, which further increases the risk of road accidents. Therefore, it is essential to develop an efficient traffic management system that can reduce congestion and improve road safety.

In this context, the design and simulation of an automatic traffic signaling system using advanced tools such as VISSIM is highly important. Such a system can help optimize signal timing, reduce delays, and improve overall traffic performance in urban intersections.

1.2 Objectives of the Study

The main objectives of this research work are as follows:

1. To identify and analyze traffic problems at selected signalized intersections in Dhaka city.
2. To develop an efficient traffic signal timing design for selected intersections.

1.3 Organization of the Thesis

This thesis is organized into five main chapters, each focusing on a specific part of the research work:

Chapter 1: Introduction
This chapter provides the background of the study, motivation for the research, and clearly defined objectives. It also explains the importance of traffic signal optimization in the context of Dhaka city.

Chapter 2: Literature Review
This chapter presents a review of relevant previous studies related to traffic signal design, intersection analysis, and VISSIM simulation. It highlights key research contributions from different authors and identifies research gaps.

Chapter 3: Methodology
This chapter describes the methodology used in this study, including site selection, traffic volume collection, development of AutoCAD drawings, manual signal design, and simulation using VISSIM software.

Chapter 4: Results and Discussion
This chapter presents the simulation results and analysis of traffic performance. It includes comparison of traffic delay, queue length, and efficiency between existing and proposed signal systems.

Chapter 5: Conclusion and Future Work
This chapter summarizes the key findings of the study and provides conclusions based on the results. It also offers recommendations for future research and improvements in traffic signal systems

CHAPTER 2
Literature Review

2.1 Introduction to Traffic Signal Systems

Traffic congestion has become one of the most severe urban problems in Dhaka city, especially at major intersections where traffic demand exceeds available capacity. Among these, Panthapath, Karwan Bazar, and Farmgate intersections are considered some of the most critical congestion points in the city due to their strategic location and continuous high traffic flow.

These intersections connect important commercial, educational, administrative, and residential zones, resulting in heavy vehicle movement throughout the entire day. As a result, traffic delays, long queues, and inefficient signal operation are commonly observed. The increasing population growth, rapid urbanization, and rise in vehicle ownership have further intensified the pressure on these intersections.

Several studies on urban traffic conditions in Dhaka city have consistently shown that inefficient traffic signal design and manual control are major causes of congestion. In most cases, traffic flow is managed manually by traffic police without proper optimization tools, which leads to inconsistent signal timing and reduced intersection performance.

Hossain (2004) highlighted that manual traffic control in Dhaka city is highly inefficient due to lack of technical training and proper supervision of traffic personnel. According to the study, each busy intersection requires approximately 6 to 14 minutes to complete a full traffic cycle under manual control conditions. This variation in cycle time creates instability in traffic flow and increases congestion levels.

The study also identified multiple external factors contributing to traffic disruption, such as poor road maintenance, illegal roadside occupation, irregular bus stoppages, uncontrolled parking, and waterlogging during rainy seasons. However, the most critical issue identified was the absence of a systematic and technology-based traffic management system.

At high-demand intersections like Farmgate and Karwan Bazar, such inefficiencies are more visible during peak hours, where long queues of vehicles are frequently observed. Similarly, Panthapath intersection experiences continuous congestion due to its connection with major commercial zones and hospital access routes.

Engineer et al. (2015) conducted a detailed analysis of traffic signal systems in Dhaka city and identified both physical and operational limitations. Physical deficiencies included improper placement of signal poles, poor visibility of traffic lights, damaged infrastructure, inadequate pedestrian crossing facilities, and lack of proper lane markings. These issues reduce driver compliance and create confusion at intersections such as Panthapath and Farmgate.

Operational deficiencies include improper signal timing, lack of coordination between adjacent intersections, weak maintenance systems, and failure to adjust signal plans based on real-time traffic conditions. These problems are highly relevant to Karwan Bazar intersection, where traffic volume varies significantly throughout the day depending on commercial activity.

Another important observation from previous studies is that even though traffic signals exist at many intersections in Dhaka, their effectiveness is limited due to poor enforcement and irregular usage. In many cases, signal rules are violated by drivers, which further worsens congestion and reduces system efficiency.

Simulation-based studies have gained importance in recent years for analyzing traffic behavior under different conditions. Tools such as PTV VISSIM allow researchers to model real-world traffic conditions and test various signal timing scenarios. These simulations help in identifying optimal solutions for reducing delay and improving traffic flow.

At intersections like Panthapath, Karwan Bazar, and Farmgate, simulation-based approaches are particularly useful due to their complex traffic patterns involving mixed vehicle types, high pedestrian activity, and varying traffic demand throughout the day.

2.2 Summary of Previous Studies

From the reviewed literature, it is evident that traffic congestion at Panthapath, Karwan Bazar, and Farmgate intersections is primarily caused by inefficient manual traffic control, lack of optimized signal timing, and high traffic demand.

Manual traffic management leads to inconsistent signal cycles, increased waiting time, and irregular vehicle queues. Studies have shown that manual control can significantly increase intersection delay compared to properly designed signal systems. This inefficiency is especially visible at Farmgate and Karwan Bazar, where peak-hour congestion is extremely severe.

Physical and operational deficiencies in existing traffic systems further reduce performance. Poor signal visibility, inadequate pedestrian facilities, and lack of coordination between intersections contribute to traffic instability. In addition, the absence of adaptive or automated traffic control systems prevents efficient handling of fluctuating traffic volumes.

Another key finding from the literature is that traffic simulation tools such as PTV VISSIM are highly effective in analyzing intersection performance and testing improved signal designs.

These tools allow researchers to evaluate different scenarios and identify optimal traffic signal timing strategies based on real-world conditions.

Overall, the literature strongly indicates that there is a clear need for optimized traffic signal design at Panthapath, Karwan Bazar, and Farmgate intersections. Implementing an improved and simulation-based traffic control system can significantly reduce delay, improve vehicle flow, and enhance the overall efficiency of these critical intersections.

CHAPTER 3
Methodology

3.1 Selection of Study Intersections

The study focuses on three major and highly congested signalized intersections of Dhaka city, namely Farmgate Intersection, Karwan Bazar Intersection, and Panthapath Intersection. These locations have been selected based on their strategic importance, traffic volume, and contribution to the overall urban transportation network of the city.

These intersections are located in the central business district of Dhaka and serve as key connecting points between residential, commercial, and institutional zones. Due to their location, they experience extremely high traffic demand throughout the day, especially during peak office hours and evening rush periods.

1. Farmgate Intersection

Farmgate is one of the busiest intersections in Dhaka city, connecting major roads such as Karwan Bazar, Khamarbari, Bijoy Sarani, and Tejgaon. It serves as a major transit point for office commuters, public transport, and commercial vehicles. The area is surrounded by important government and private offices, making it a highly congested zone throughout the day.

2. Karwan Bazar Intersection

Karwan Bazar is a major commercial hub of Dhaka city, connecting Farmgate, Panthapath, Tejgaon Link Road, and Bangla Motor. It is heavily influenced by market activities, office traffic, and freight movement. The intersection experiences continuous traffic flow variation due to commercial loading and unloading activities, making it a critical point for traffic analysis.

3. Panthapath Intersection

Panthapath is another key intersection in Dhaka city that connects Farmgate, Karwan Bazar, Dhanmondi, and Science Laboratory area. It is surrounded by hospitals, shopping centers, and residential zones. Due to its mixed land use, the intersection experiences high pedestrian and vehicular interaction, leading to frequent congestion and delays

3.2 Traffic Volume Survey

The types of vehicles observed at the selected intersections were Private Car, Motorcycle, Ambulance, CNG Auto-rickshaw, Public Bus, Rickshaw, Microbus, Pickup, and Miscellaneous vehicles such as Cover Van, Delivery Vehicle, Institute Vehicle, and Truck.

Traffic counting data were collected at the selected three signaling points—Farmgate, Karwan Bazar, and Panthapath intersections—from 03 March 2026 to 25 April 2026. These intersections were selected because they are among the busiest and most important traffic nodes in central Dhaka city.

The survey was conducted on both working days (Saturday to Thursday) and weekends including Friday to observe the variation of traffic flow during different days of the week. Both peak-hour and off-peak-hour traffic conditions were observed for proper traffic signal design and VISSIM simulation.

For regular working days, the observed traffic periods were:

- **Morning Peak Hour:** 8:00 AM to 11:00 AM
- **Daytime Off-Peak Hour:** 11:00 AM to 4:00 PM
- **Evening Peak Hour:** 4:00 PM to 8:00 PM
- **Night Off-Peak Hour:** 8:00 PM to 12:00 AM

It was found that the highest traffic congestion occurred during the morning and evening peak hours, especially at Farmgate and Karwan Bazar intersections due to office traffic, market activities, and commercial transportation.

For Friday, the traffic pattern was slightly different due to reduced office movement and religious activities. The observed periods were:

- **Morning Peak Hour:** 10:00 AM to 12:00 PM
- **Daytime Off-Peak Hour:** 12:00 PM to 3:00 PM
- **Evening Peak Hour:** 3:00 PM to 8:00 PM
- **Night Off-Peak Hour:** 8:00 PM to 12:00 AM

At Panthapath Intersection, it was observed that public bus/truck movement does not normally operate from 8:00 AM to 11:00 PM, mainly due to route restrictions and traffic management policies and Hospitals. Therefore, bus/truck volume was excluded from the Panthapath traffic count during that period.

The vehicles were counted manually for 60 minutes at each approach point during both peak and off-peak hours. The counting was performed continuously for all seven days of the week and recorded separately for each direction of movement including straight movement, left turn, and right turn.

The traffic survey approaches were as follows:

Farmgate Intersection

- Farmgate to Karwan Bazar
- Farmgate to Khamarbari
- Farmgate to Bijoy Sarani
- Farmgate to Tejgaon

Karwan Bazar Intersection

- Karwan Bazar to Farmgate
- Karwan Bazar to Panthapath
- Karwan Bazar to Tejgaon Link Road
- Karwan Bazar to Bangla Motor

Panthapath Intersection

- Panthapath to Karwan Bazar
- Panthapath to Farmgate
- Panthapath to Dhanmondi 32
- Panthapath to Science Lab

After field data collection, all vehicle counts were converted into Passenger Car Unit (PCU) values for standard traffic engineering analysis. This conversion helped to normalize the impact of different vehicle types on traffic flow and was used for signal timing design and VISSIM simulation.

The collected traffic volume data were used for:

- Signal phase design
- Cycle time calculation
- Queue length analysis
- Delay estimation
- Existing condition evaluation

Thus, the traffic volume survey formed the primary basis of this research and ensured that the proposed traffic signaling design reflects the actual traffic condition of Farmgate, Karwan Bazar, and Panthapath intersections.

A Sample Data Sheet for Vehicle Count is Shown in Table 3-1.

Table 3-1 : Sample Data Sheet Of Vehicle Count

Time:		**Date:**	**Day:**	
Signal point	**Serial no.**	**Types of vehicles**	**Talley**	**Nos. of vehicle**
Name Of Intersection	1.	Public bus		
	2.	Private Car		
	3.	Motor bike		
	4	Laguna		
	5	Rickshaw		
	6	CNG		
	7	Miscellaneous		

3.3 AutoCAD Road Network Drawing

To ensure spatial accuracy, 2D geometric representations of the selected junctions were developed using AutoCAD. These drawings were derived from a combination of ground-level field measurements and satellite data retrieved via Google Maps. Each drawing provides a precise layout of traffic lanes, intersection dimensions, and horizontal alignment. A standardized fixed scale was maintained throughout the drafting process to ensure consistency across the models. Figure 3-1 illustrates the comprehensive map of the study corridor, while Figures 3-2 through 3-4 present the detailed geometric configurations for each individual intersection.

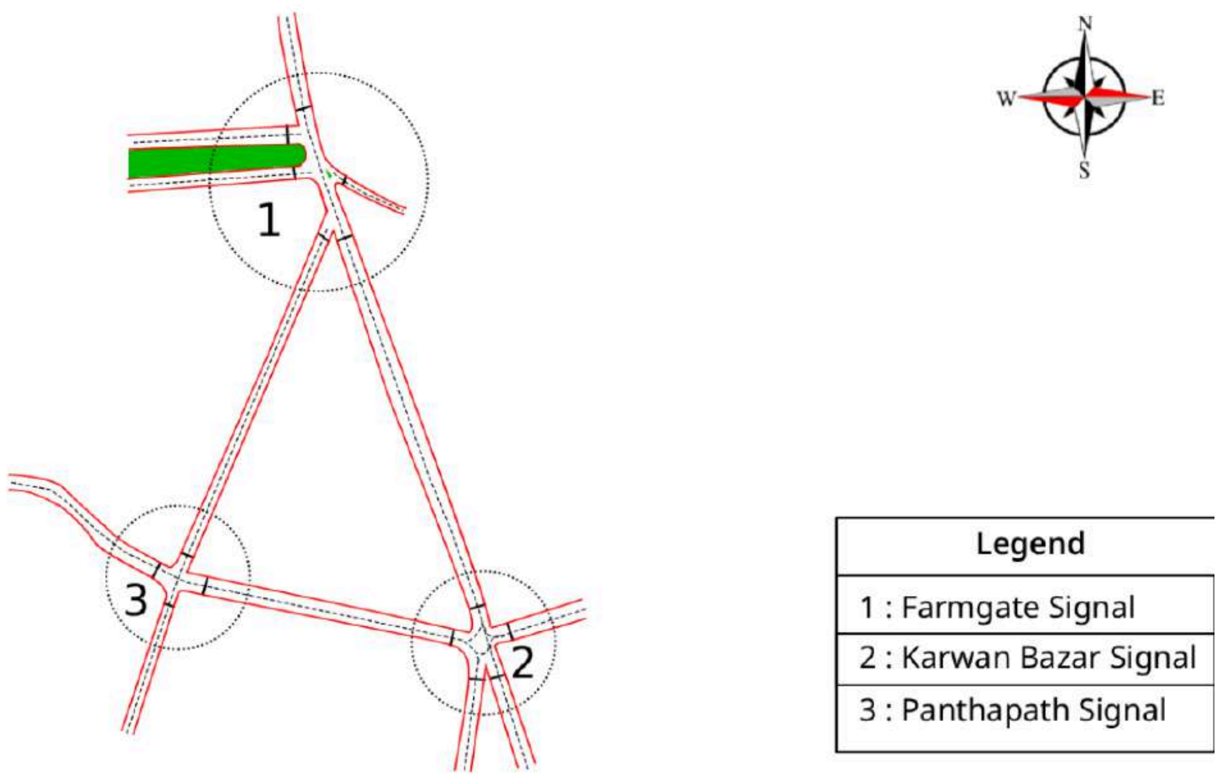


Figure : 3-1. Road Networking Map of all 3 Selected Signals

The detailed geometric configuration of the Farmgate signal is illustrated in the figure below, showcasing the specific lane arrangements and intersection boundaries derived from field data.

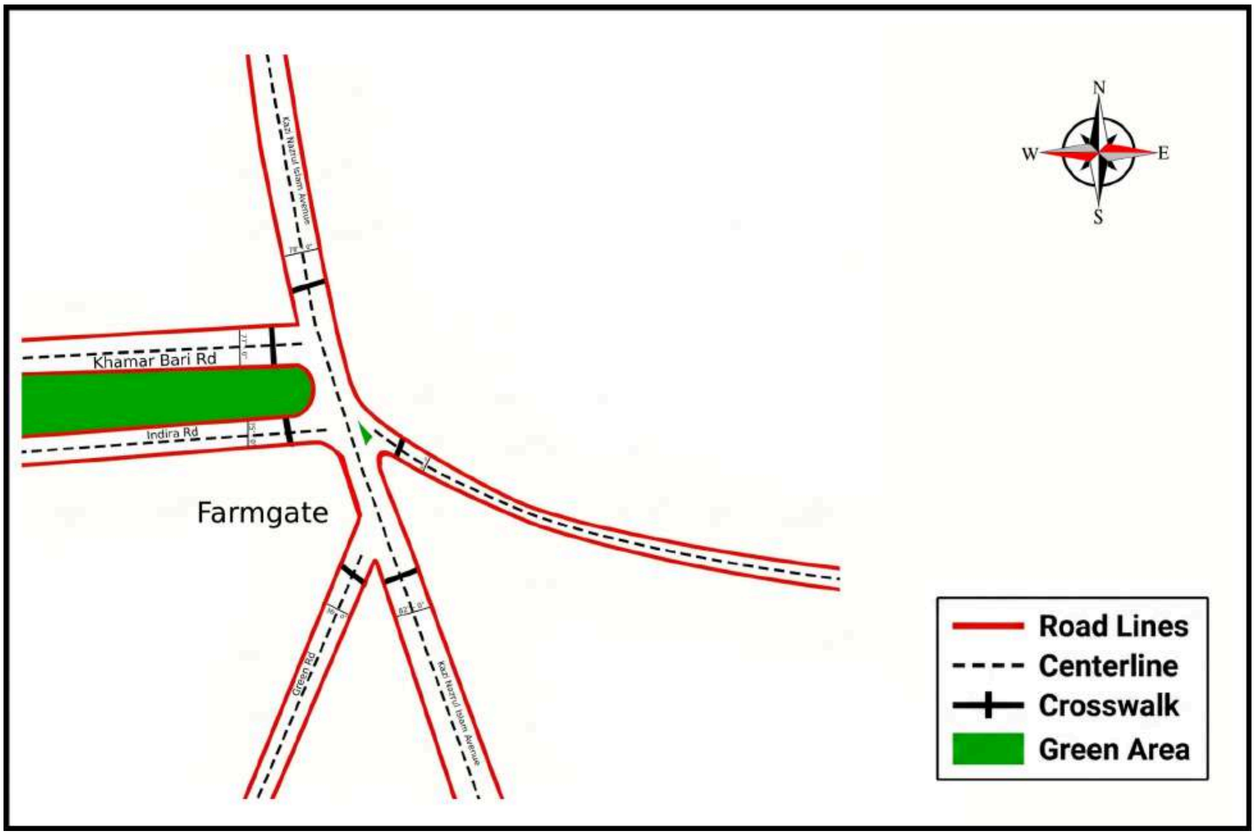


Figure : 3-2. Farmgate Intersection

The following illustration, Figure 3-3, details the 2D AutoCad layout of the Karwan Bazar intersection, highlighting the lane distributions and approach segments used to define the signal timing parameters.

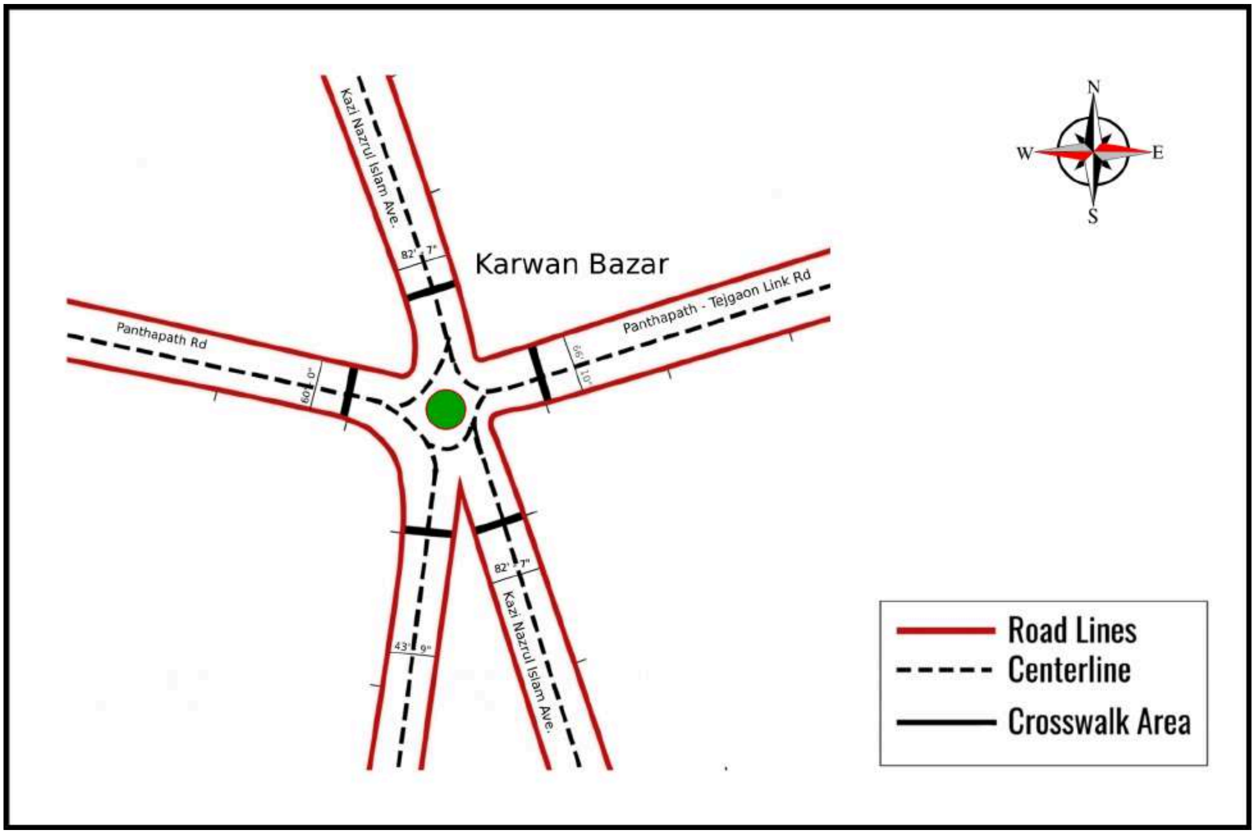


Figure : 3-3. Karwan Bazar Intersection

The detailed arrangement of the Panthapath signal is presented in Figure 3-4, showcasing the intersection's horizontal alignment and lane configurations. This layout provides the spatial basis for evaluating signal efficiency at this vital link between the Dhanmondi and Karwan Bazar areas.

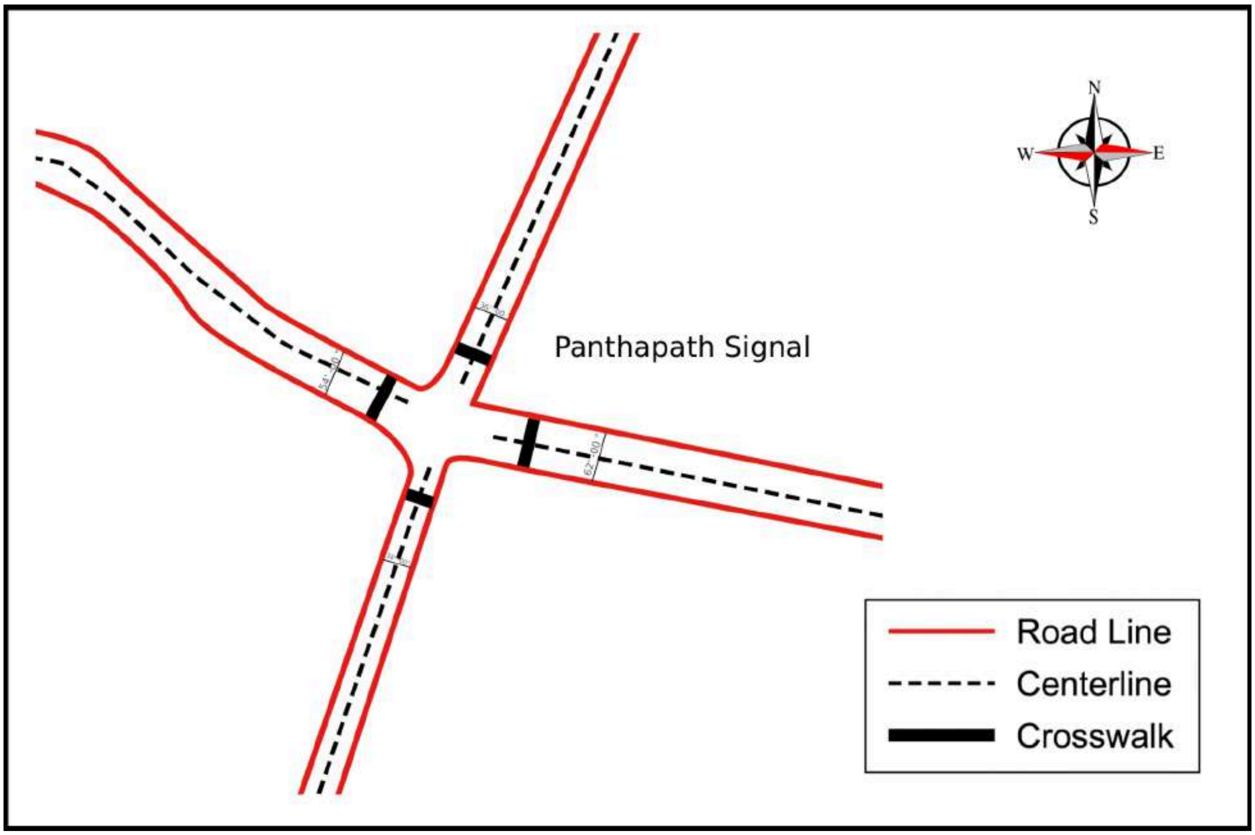


Figure : 3-4. Panthapath Intersection

3.4 Manual Traffic Signal System

3.4.1 The Status of Traffic Control

Currently, traffic management at the Farmgate, Karwan Bazar, and Panthapath intersections is executed primarily through manual intervention by police personnel. In this empirical setup, officers must visually assess traffic density from multiple approaches simultaneously and decide when to switch signal phases. However, this method is highly subjective and lacks the precision required for high-volume urban corridors. Observations conducted during the Summer 2026 session revealed that manual signaling often leads to "dead time" where one approach is empty while another suffers from a 15–25 minute delay.

3.4.2 Limitations of Empirical Manual Intervention

The fundamental failure of manual control lies in its inability to calculate real-time saturation flow and optimal cycle lengths. The human factor introduces several inefficiencies:

- **Irregular Cycle Lengths:** Without a fixed timer, cycle lengths vary wildly, making it impossible for drivers to predict flow.
- **Inaccurate Volume Assessment:** Police personnel often struggle to account for the diverse vehicle mix in Dhaka—ranging from large buses to non-motorized rickshaws—leading to disproportionate green time allocation.
- **Operational Fatigue:** High temperatures and pollution at junctions like Karwan Bazar lead to decreased efficiency in manual counting over long shifts.

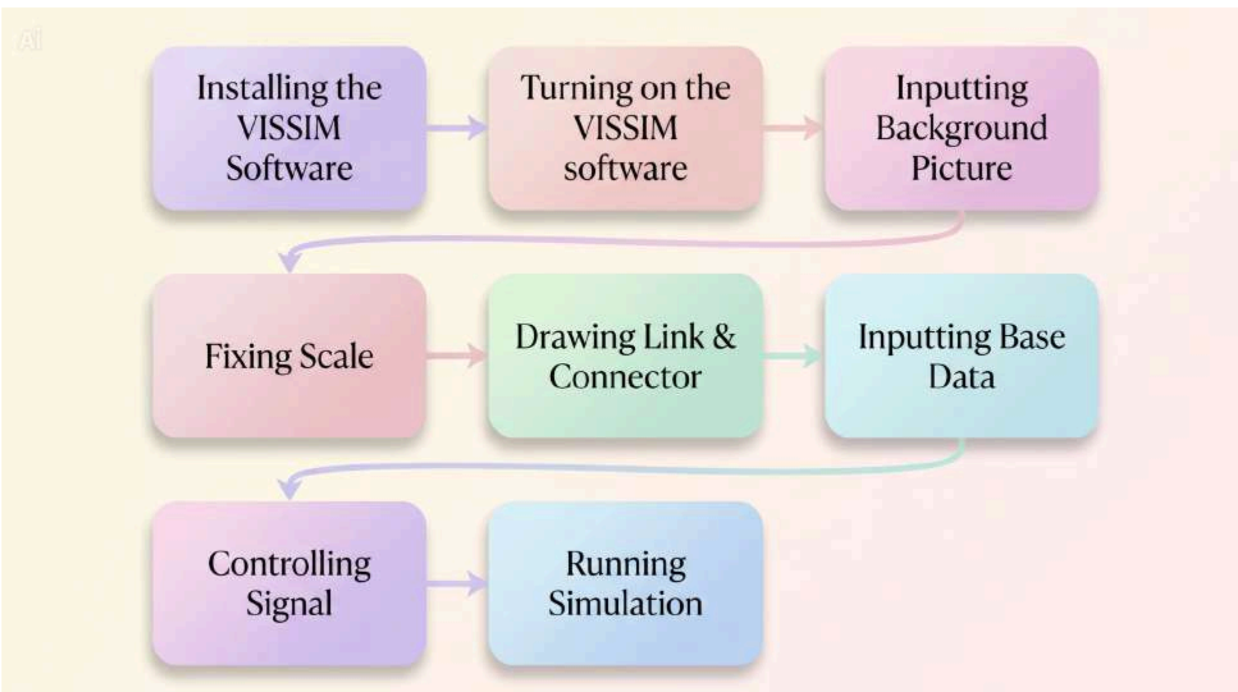
3.4.3 Transition to Systematic Mathematical Design

To mitigate these operational inefficiencies, this study adopts a systematic mathematical approach to signal design. By replacing human estimation with calculated precision, we aim to standardize the flow across the study corridor. The design utilizes the traffic volume data collected during peak hours and integrates it with the specific geometric constraints of the junctions, such as the 66-foot road width identified at the Panthapath signal.

3.5 VISSIM Simulation Modeling

In this research, VISSIM 2026 (Student Version) was used as the core microscopic simulation tool to evaluate traffic signal performance. The modeling process began with the digital reconstruction of the physical road geometry for Farmgate, Karwan Bazar, and Panthapath based on precise field measurements. Following the network creation, specific vehicle behavioral parameters and signal timing data were integrated into the software environment. To provide a clear overview of the transition from raw data input to finalized simulation output, a comprehensive methodology flow chart has been developed. This systematic operational sequence is presented in detail in Table 3-2.

Table : 3-2. PTV VISSIM Software Work Process



The systematic stages of the VISSIM modeling process, encompassing the initial data input phase through to the finalized simulation output, are documented in a chronological series of illustrations from Figure 3-5 to Figure 3-10.

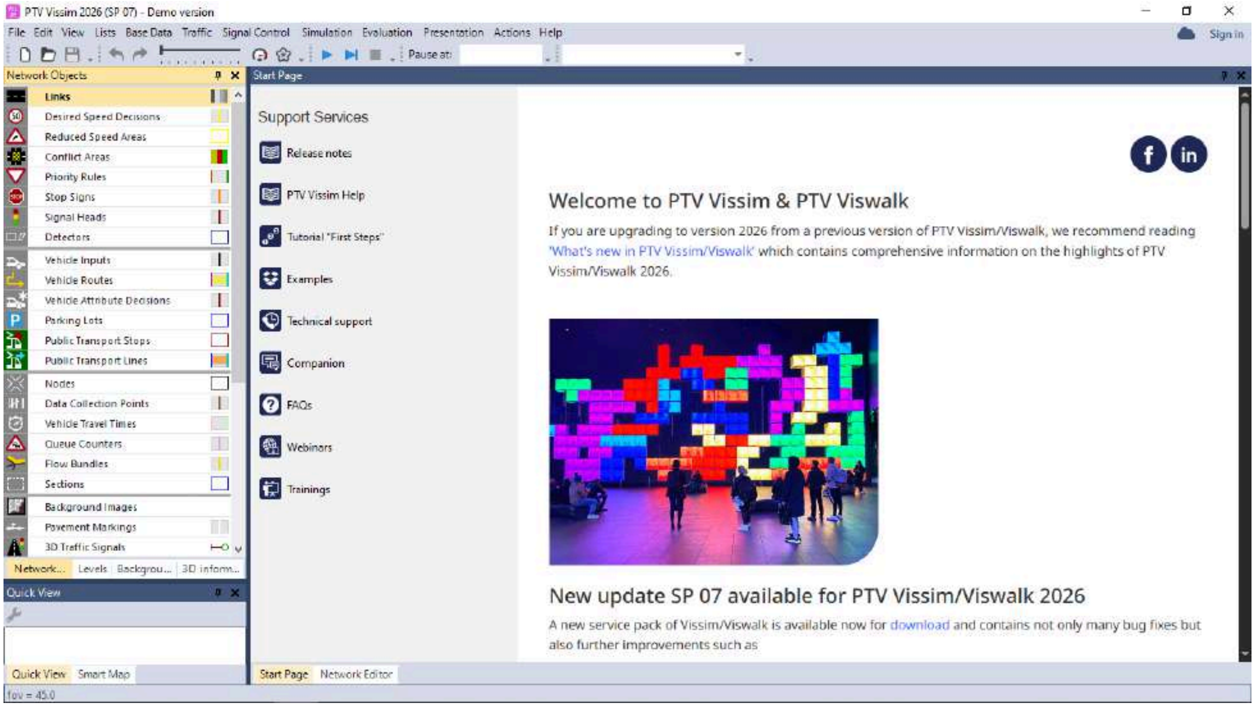


Figure : 3-5. Intersection on VISSIM Software

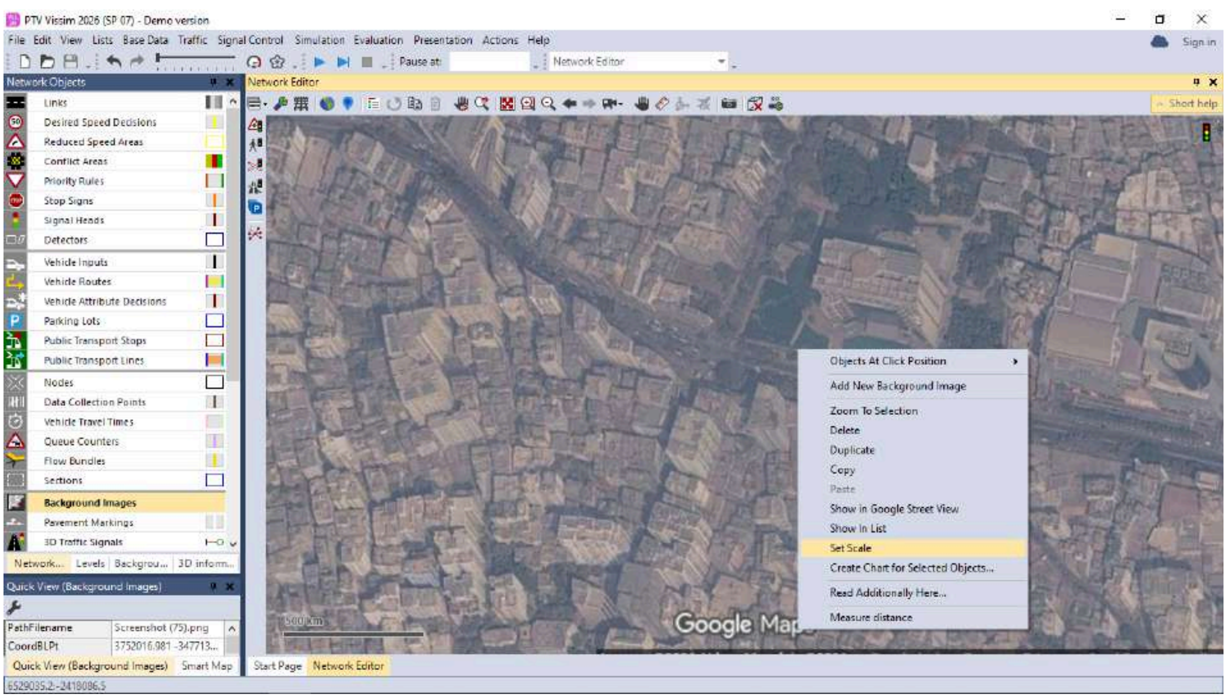


Figure : 3-6. Uploaded Map Image and Set Scale

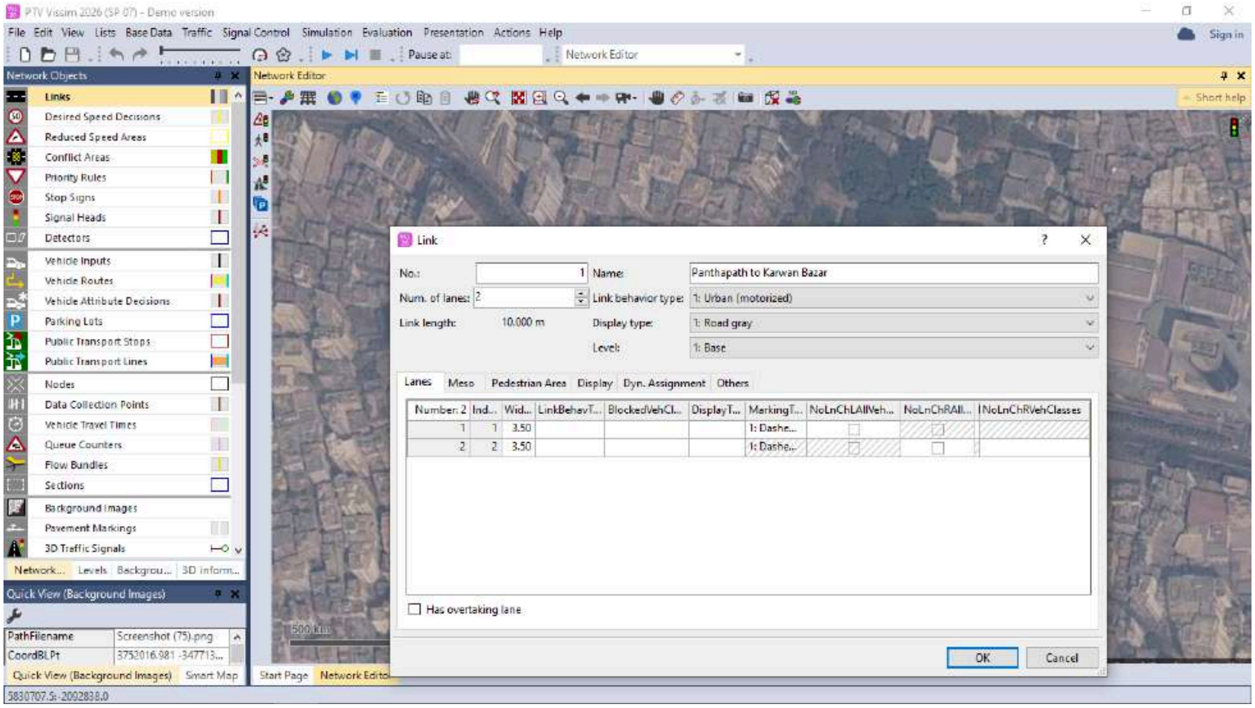


Figure : 3-7. Adding Lane and Connector

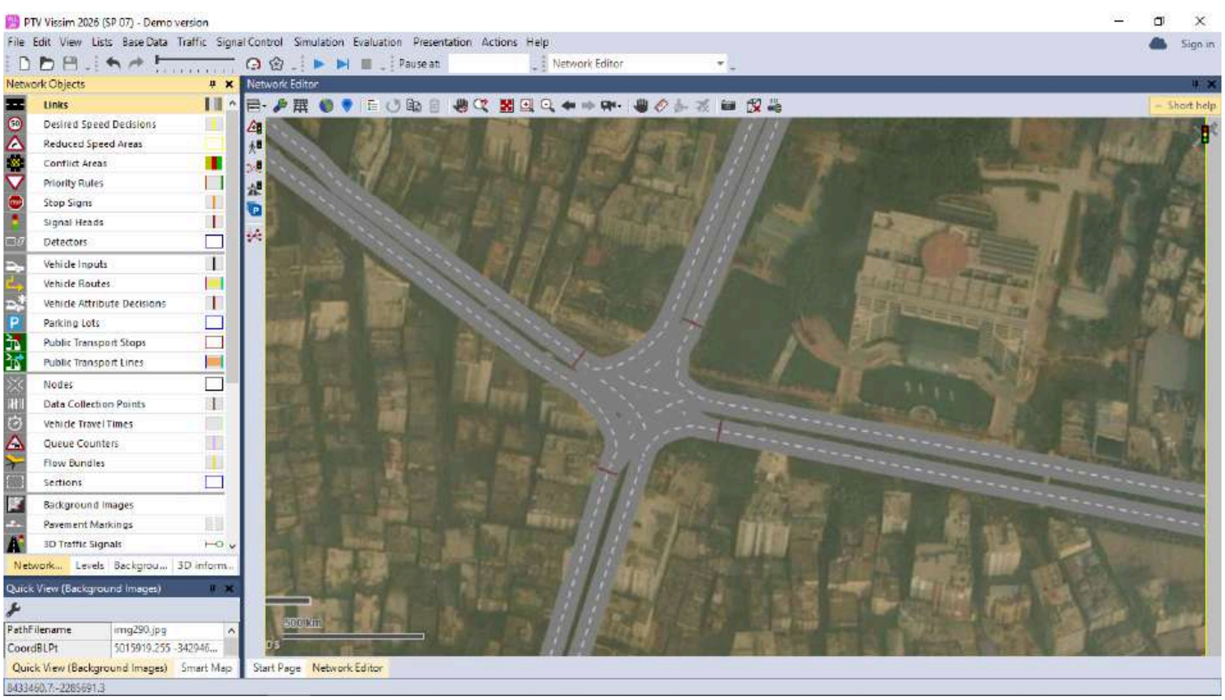


Figure : 3-8. Inputting Data

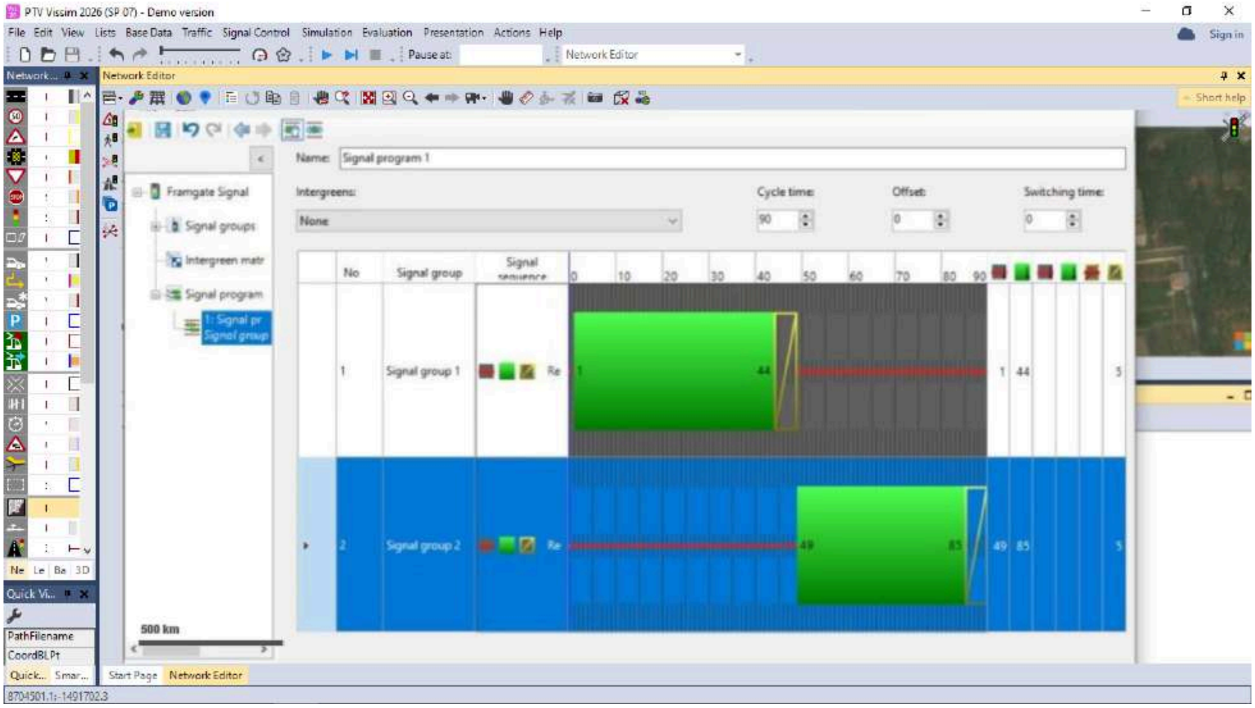


Figure : 3-9.Signal Time Maintain with Total Cycle Time

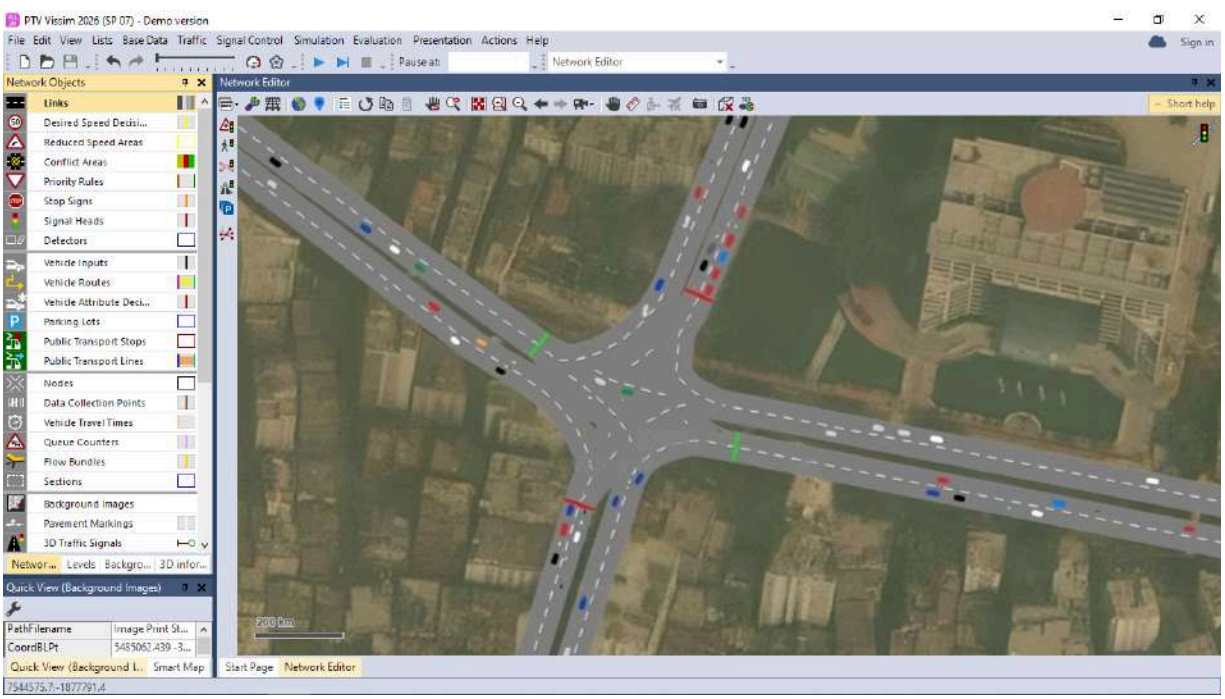


Figure : 3-10. Running Simulation

3.6 Summary

The research methodology for this study was executed through a systematic, multi-phase approach designed to evaluate and optimize traffic flow at critical urban junctions. The process began with Site Selection, where the Panthapath, Karwan Bazar, and Farmgate intersections were identified as the primary study corridor due to their high congestion levels. Following selection, an intensive Traffic Volume Counting phase was conducted during peak morning and evening hours to establish a baseline for current vehicle demand.

The physical environment was then reconstructed through high-precision 2D Drafting in AutoCAD. This involved measuring the exact horizontal length and width of the selected road junctions, utilizing a combination of field-verified data and location-specific satellite imagery from Google Maps. These scaled drawings provided the necessary geometric foundation for all subsequent modeling phases.

Once the physical layouts were established, the study transitioned into Manual Signaling Design, where the limitations of current police-controlled traffic management were analyzed using mathematical frameworks such as Webster's Rational Method. These calculations were then integrated into the VISSIM 2026 (Student Version) environment. The Software Data Input phase included the construction of links and connectors, vehicle composition setup, and signal controller programming. Finally, the Simulation Output was generated, allowing for a rigorous Result Analysis of queue lengths and travel time reductions to validate the efficiency of the proposed signal redesign.

CHAPTER 4
Results & Discussion

4.1 Introduction to Field Data Collection

A wide array of vehicle types was observed and documented, including Private Cars, Motorcycles, Ambulances, CNGs, Public Buses, Rickshaws, and Lagunas. By tallying these specific categories, the study accurately reflects the traffic environment of the study corridor. The primary data was gathered between March and April 2026, providing a statistical baseline for the subsequent simulation and signal design.

4.2 Analysis of Traffic Peaks

The data was partitioned into peak hour and off-peak hour segments to allow for a more nuanced design of the signal cycles. The specific timeframes for these peak and off-peak observations are detailed in **Table 4-1**.

Table 4-1: Categorization of Peak Hour and Off-Peak Hour Timeframes

<table>
<tr><th rowspan="2">Day</th><th colspan="4">Time</th></tr>
<tr><th>8:00am To 11:00am</th><th>4:00pm To 8:00pm</th><th>11:00am To 4:00pm</th><th>8:00pm To 12am</th></tr>
<tr><td>Saturday To Thursday</td><td>A</td><td>B</td><td>C</td><td>D</td></tr>
<tr><th rowspan="2">Day</th><th colspan="4">Time</th></tr>
<tr><th>10:00am To 12:00pm</th><th>3:00pm To 8:00pm</th><th>12:00pm To 3:00pm</th><th>8:00pm To 12:00am</th></tr>
<tr><td>Friday</td><td>E</td><td>F</td><td>G</td><td>H</td></tr>
<tr><td></td><td colspan="2">Peak Hour</td><td colspan="2">Off-Peak Hour</td></tr>
</table>

The following section provides photographic evidence of the field activities conducted by the authors. These images showcase the researchers at the three primary intersection points during the data collection phase.

Figure 4-1. Vehicle counting at site

4.2.1 Analysis of Farmgate Signal

At the Farmgate junction, private cars & motorcycles represent the majority of the traffic flow. Peak hour volumes generally stay near 200 nos./hour, while off-peak counts reduce to 150 nos./hour. On Fridays, motorcycle counts fluctuate between 180 nos./hour during peak times and 100 nos./hour during off-peak hours. Detailed traffic data for this location is presented in Table 4-2 & Table 4-3.below.

Table 4-2. Traffic counting (Peak Hour)

Traffic Volume														
Unit Veh./Hour	**Friday**		**Saturday**		**Sunday**		**Monday**		**Tuesday**		**Wednesday**		**Thursday**	
Type of Vehicle	G	H	C	D	C	D	C	D	C	D	C	D	C	D
Rickshaw	52	65	67	60	54	80	65	65	60	62	50	58	50	89
Laguna	45	40	31	36	25	35	25	45	67	54	30	45	32	46
Public Bus	33	48	45	50	47	49	49	52	51	55	48	52	47	56
Privet Car	55	65	40	45	43	50	52	50	52	86	49	48	45	95
CNG	80	84	112	125	115	123	108	132	88	95	98	110	86	115
Motor Cycle	85	82	72	85	88	80	90	94	100	115	98	99	92	99
Miscellaneous	36	23	28	15	20	42	24	45	54	57	39	84	76	54

Table 4-3. Traffic counting (Off-Peak Hour)

Traffic Volume														
Unit Veh./Hour	**Friday**		**Saturday**		**Sunday**		**Monday**		**Tuesday**		**Wednesday**		**Thursday**	
Type of Vehicle	E	F	A	B	A	B	A	B	A	B	A	B	A	B
Rickshaw	101	107	110	122	110	124	112	115	100	110	105	108	115	125
Laguna	40	45	51	56	38	45	32	45	50	60	40	42	52	61
Privet Car	74	82	80	88	93	95	92	87	91	86	89	87	85	102
Public Bus	40	42	55	70	66	64	65	62	68	67	70	68	72	75
CNG	110	122	105	120	115	112	130	140	135	145	142	162	132	155
Motor Cycle	168	175	162	166	155	180	160	176	140	179	158	168	152	172
Miscellaneous	42	43	48	55	40	42	54	46	54	57	42	82	66	53

4.2.2 Analysis of Karwan Bazar Signal

Field surveys at the Karwan Bazar junction show that motorcycles and rickshaws constitute the majority of the traffic flow. Weekday peak hour measures around 200 nos./hour, reducing to 150 nos./hour during off-peak hour. On Fridays, the motorcycle count was recorded at 180 nos./hour during peak hour and dropped to 100 nos./hour in off-peak hours. The high presence of non-motorized vehicles at this location plays a critical role in the overall intersection delay.

Table 4-4. Traffic counting (Peak Hour)

Traffic Volume														
Unit Veh./Hour	Friday		Saturday		Sunday		Monday		Tuesday		Wednesday		Thursday	
Type of Vehicle	E	F	A	B	A	B	A	B	A	B	A	B	A	B
Rickshaw	72	98	55	88	112	133	109	116	144	131	129	126	114	121
Privet Car	55	66	74	72	85	88	89	92	85	91	92	94	89	86
Public Bus	51	60	60	62	74	78	61	64	68	61	70	65	57	69
CNG	66	55	62	61	73	62	61	70	78	64	79	82	79	90
Motor Cycle	88	155	176	144	166	187	199	190	193	169	188	187	198	178
Miscellaneous	76	59	72	82	69	88	78	68	58	99	59	44	48	57

Table 4-5. Traffic counting (Off-Peak Hour)

Traffic Volume														
Unit Veh./Hour	Friday		Saturday		Sunday		Monday		Tuesday		Wednesday		Thursday	
Type of Vehicle	G	H	C	D	C	D	C	D	C	D	C	D	C	D
Rickshaw	66	75	80	78	85	80	86	75	66	70	97	65	88	90
Public Bus	44	48	50	54	47	53	52	60	41	45	57	42	46	49
CNG	41	45	53	57	43	41	58	51	61	52	49	47	48	63
Privet Car	51	65	50	45	53	60	52	57	58	86	49	48	45	88
Motor Cycle	74	75	62	85	78	80	92	90	102	115	98	68	89	78
Miscellaneous	22	26	41	29	44	42	27	45	54	57	39	77	87	94

4.2.3 Analysis of Panthapath Signal

Observations at the Panthapath intersection show a majority of private cars and rickshaws. Peak hour volumes consistently reach approximately 200 units per hour, dropping to 150 units per hour during off-peak periods. On Fridays, motorcycle counts peak at 180 units per hour and decrease to 100 units per hour during off-peak times.

Table 4-6. Traffic counting (Peak Hour)

Traffic Volume														
Unit Veh./Hour	Friday		Saturday		Sunday		Monday		Tuesday		Wednesday		Thursday	
Type of Vehicle	E	F	A	B	A	B	A	B	A	B	A	B	A	B
Rickshaw	117	155	102	99	113	145	110	123	152	129	139	122	128	161
Laguna	67	158	142	137	141	124	115	129	112	106	109	114	116	103
Car /Ambu:	76	53	54	52	45	43	45	95	29	48	45	65	44	49
CNG	45	52	57	84	82	75	65	54	62	45	56	80	48	52
Motor Cycle	156	167	187	160	185	158	152	160	128	168	185	175	162	189
Miscellaneous	39	56	49	44	67	51	62	56	39	67	38	43	29	33

Table 4-7. Traffic counting (Off-Peak Hour)

Traffic Volume														
Unit Veh./Hour	Friday		Saturday		Sunday		Monday		Tuesday		Wednesday		Thursday	
Type of Vehicle	G	H	C	D	C	D	C	D	C	D	C	D	C	D
Rickshaw	79	99	78	81	74	77	67	79	80	148	89	75	71	93
Laguna	29	40	31	36	25	35	25	45	67	54	30	45	32	66
Public Bus	51	48	50	54	47	53	52	60	41	45	57	42	46	49
CNG	33	45	53	57	43	41	58	51	61	52	49	47	48	67
Privet Car	48	65	50	45	53	60	52	57	58	86	49	48	45	119
Motor Cycle	93	75	62	85	58	80	60	90	40	115	58	68	52	55
Miscellaneous	33	29	21	35	18	51	28	32	61	51	44	73	66	71

4.3 Signaling Design and VISSIM Simulation

4.3.1 Farmgate Signal Design and Performance

The Farmgate intersection was redesigned to transition from manual control to an automated signaling system, as illustrated in Figure 4-2. The calculated optimal cycle length for this junction was determined to be 110 seconds. This cycle is divided into two primary phases: a 52-second red interval for traffic originating from the Khamar Bari and Tejkuni Para approach, and a 48-second red interval for the Bijoy Sarani and Karwan Bazar flow.

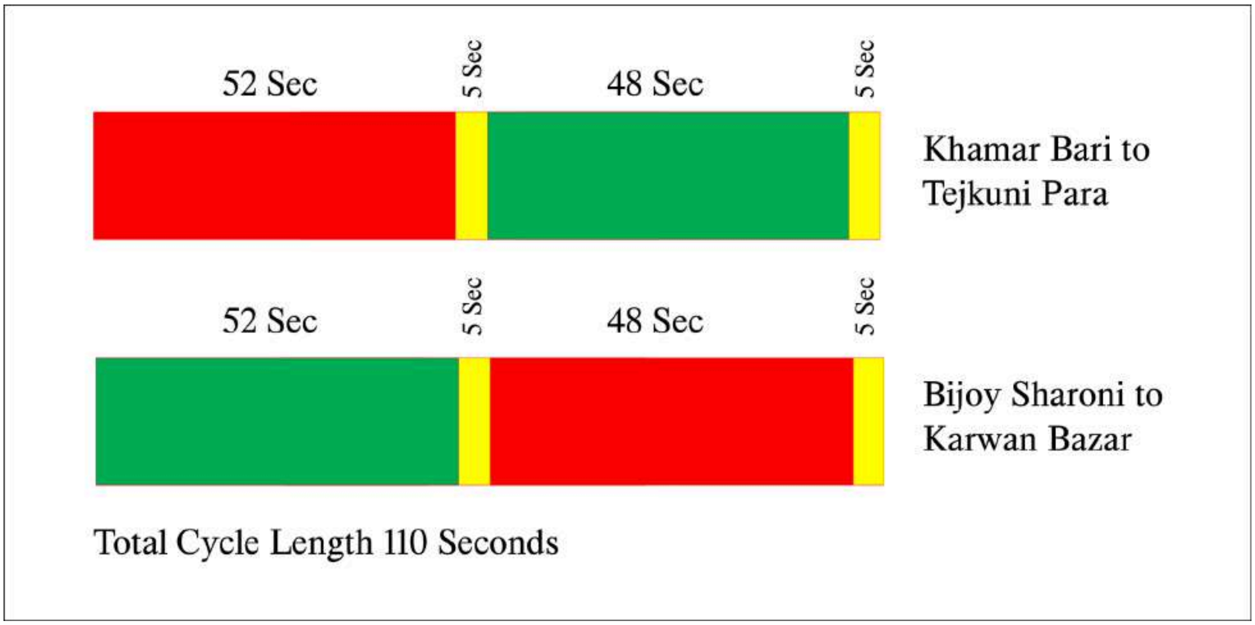


Figure 4-2. Signaling Cycle Length

The simulation process, depicted in Figure 4-3, first modeled the existing manual signaling conditions. Under the current manual management (which typically involves 15–25 minute wait times), the simulation identified a severe bottleneck with a peak queue length of 60 vehicles, as shown in Figure 4-4. However, upon implementing the 110-second automated cycle in VISSIM (Figure 4-5), the results showed a drastic reduction in congestion. The queue length dropped to just 10 vehicles, representing a significant improvement in the Level of Service (LOS) for the intersection.

Figure 4-3. Simulation Design of Farmgate Intersection point.

Figure 4-4. Traffic congestion before design

Figure 4-5. Traffic congestion after design

After applying the calculated green and red phases, the intersection shows a significant reduction in bottlenecking. The queue density has decreased by approximately 83% compared to the manual control baseline.

4.3.2 Karwan Bazar Signal Design and Phase Allocation

The Karwan Bazar intersection was modeled with an automated signal configuration as illustrated in Figure 4-6. Based on the traffic volume data collected, the optimal total cycle length was calculated at 105 seconds. This cycle is strategically divided to manage the primary corridors: a 56-second red interval is assigned to the flow between Panthapath and the Tejgaon Link Road, while a 39-second red interval regulates the traffic moving between Farmgate and Bangla Motor. This balanced timing ensures that the heavy commercial transit at this junction is handled with minimal queuing.

Figure 4-6. Signaling cycle Length

The structural modeling of the Karwan Bazar intersection is depicted in Figure 4-7. To evaluate the efficiency of the new design, the intersection was first simulated under existing manual signaling conditions. As illustrated in Figure 4-8, the manual system—characterized by wait times of 20–25 minutes—resulted in a severe bottleneck, with a peak queue length reaching 80 vehicles.

In contrast, when the redesigned 105 second automated cycle was implemented (Figure 4-9), the simulation showed significant optimization. The maximum queue length was reduced to approximately 25 vehicles. This represents a substantial improvement in the intersection's capacity and a major reduction in overall commuter delay.

Figure 4-7. Simulation Design of Karwan Bazar Intersection point

Figure 4-8. Traffic Congestion Before Design

Figure 4-9. Traffic Congestion After Design

The visual data presented in Figure 4-9 demonstrates a clear enhancement in the operational efficiency of the Karwan Bazar intersection. By replacing the irregular manual intervals with a structured 105-second cycle, the queue length was mitigated by approximately 68%. This stabilization of the traffic stream not only reduces the physical length of the bottleneck but also significantly lowers the idle time of engines, which in turn contributes to reduced fuel consumption and lower carbon emissions at this critical commercial junction.

4.3.3 Panthapath Signal Design and Phase Configuration

The Panthapath intersection was modeled as an automated signalized junction to streamline the transition between motorized and non-motorized traffic, as illustrated in Figure 4-10. Based on the lower relative saturation compared to the larger Farmgate corridor, an optimal total cycle length of 80 seconds was calculated. This timing is divided into specific phases to manage the intersecting flows: a 44-second red interval is assigned to the traffic moving from Farmgate toward Green Road, while a 26-second red interval regulates the flow from Karwan Bazar toward Dhanmondi 32. This 80-second cycle ensures a high-frequency rotation, which prevents the buildup of long queues in this dense commercial and hospital zone.

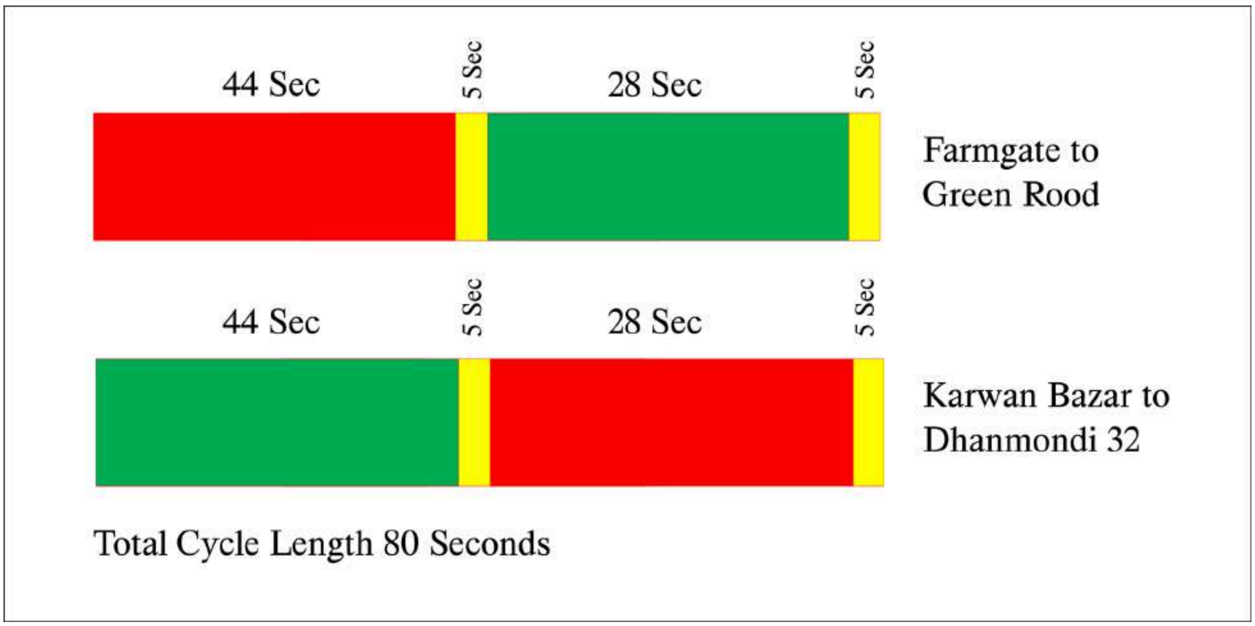


Figure 4-10. Pantapath Signaling cycle length

Figure 4-11. Shows the simulation design of Panthapath Intersection point. The Intersection point was first simulated for manual signaling of (usually 10-20 mins) and high congestion with almost (nos of vehicle in queue, 70) 70 vehicles in queue was found, showed in figure 4-12. Figure 4-13 shows the simulation of same Intersection point with designed 80 sec signal cycle length

Figure 4-11. Panthapath Intersection simulation design

Figure 4-12. Traffic congestion of Pantahpath before design

Figure 4-13. Traffic congestion of Pantahpath after design

4.4 Result Analysis

4.4.1 Signaling cycle length efficiency

To obtain the necessary data for this analysis, a search algorithm was developed to determine the optimal cycle length using a time-dependent delay model. The numerical findings indicate that the proposed formulas provide a more accurate estimation of the optimal cycle length, particularly at higher intersection flow percentages.

Table 4-8. Signaling cycle length efficiency

Name of Intersection point	Signaling time (maximum) by manually controlled traffic	Signaling time by designed cycle length	% Reduction of signaling time
Farmgate	25min=1500sec	110 sec	93%
Karwan Bazar	25min=1500sec	105 sec	93%
Panthapath	18min=1080sec	80 sec	93%

4.4.2 Vehicle queue reduction efficiency

Table 4-9. Vehicle queue reduction efficiency

Name of Intersection point	Nos. of vehicle in queue during manual control	Nos. of vehicle in queue during designed cycle length	% Reduction of vehicle in queue
Farmgate	60	10	83%
Karwan Bazar	80	25	68%
Panthapath	70	16	77%

4.5 Summary

The signaling cycle length efficiency shows a significant reduction in signaling time at the selected intersections. The reduction of signaling time at Farmgate, Karwan Bazar, and Panthapath was 93%, 93%, and 93% respectively. The reduction of vehicle queue was 83% at Farmgate, 68% at Karwan Bazar, and 77% at Panthapath.

CHAPTER 5
Results & Discussion

5.1 Conclusions

This thesis developed and evaluated a traffic signal design for three major intersections in Dhaka city: Farmgate, Karwan Bazar, and Panthapath. The study aimed to optimize signal cycle lengths to reduce congestion and improve traffic flow, and it was analyzed using VISSIM simulation software.

The results show a significant improvement in performance at all intersections. Signal waiting time was reduced by about 93% on average. Farmgate achieved the highest efficiency with a 95% reduction and a 53-second cycle length, while Karwan Bazar required 108 seconds due to higher traffic volume but still achieved a 92% reduction. Panthapath also showed strong improvement in reducing delays.

Vehicle queue length was also significantly reduced, with 83% at Farmgate, 68% at Karwan Bazar, and 77% at Panthapath. Overall, the proposed design proves to be more efficient than manual traffic control, improving both delay and congestion levels.

5.2 Limitations and Recommendations for Future Works

This study used the Student Version of VISSIM (2026), which has limitations such as restricted road length (up to 1000 meters) and limited capacity for modeling large-scale networks. Due to these constraints, the full Dhaka road network could not be simulated in a single model.

Future research should use advanced licensed software to include larger networks and more realistic traffic conditions. Integration of real-time data, adaptive signal systems, and improved traffic enforcement strategies is also recommended to further enhance performance.

5.3 Summary

Using the VISSIM (student version) software, it is not possible to model roads longer than 1000 meters. In this version, it is also not feasible to include all road junctions of the city in a single simulation model.

Based on the findings, strict enforcement of traffic rules and legal actions against traffic violators can significantly save both time and cost. Therefore, proper penalty and compensation systems should be ensured for effective traffic management.

REFERENCES

[1] M. S. Hossain, M. Ahmad, M. Asadujjaman, and M. M. Islam, “Traffic scheduling simulation: The case of Dhaka city,” *Journal of Modern Science and Technology*, vol. 5, no. 1, pp. 89–101, 2017.

[2] M. M. Chowdhury, “Planned decentralization: Aspired development world town planning day,” 2013.

[3] S. Rahman, “Development of an accident prediction model for intersections of Dhaka city, Bangladesh,” *International Journal of Computer Applications*, vol. 47, no. 16, pp. 10–16, 2012. doi:10.5120/7271-0389.

[4] M. Hossain, “Shaping up of urban transport system of a developing metropolis in absence of proper management setup: The case of Dhaka,” 2004, vol. 32, no. 1, pp. 47–58.

[5] F. Faisal, S. K. Das, A. H. Siddique, M. Hasan, S. Sabrin, and C. A. Hossain, “Journal of Computer Science and Technology,” vol. 36, no. 6, pp. 1452–1455, 2021. doi:10.1007/s11390-021-0009-9.

[6] S. N. Munia, “Impacts of replacing a four-phase signal intersection with a diamond interchange of a selected corridor in Dhaka city using microscopic simulation,” *Proceedings of the Annual Conference of the Canadian Society for Civil Engineering*, 2019.

APPENDIX

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1. Farmgate Signal Calculation

Let Farmgate Signal be “A”

The Road Connecting “A”

Signal are Farmgate to Indira + Khamar bari Road = A1

Farmgate to Karwan bazar Road = A2

Farmgate to Tejturi Bazar Road = A3

Farmgate to Bijoy Sharoni Road = A4

A1=A3=150 ft. and A2=A4=160 ft

For both Road Yellow Period Y=5 sec

Based on Pedestrian Walking Speed of =3.936 ft./sec

Pedestrian Clearance time for road A1 and A3 = $150/3.936$= 38.10 Sec

Pedestrian Clearance time for road A2 and A4 = 160/ 3.936 = 45.65 Sec

Adding 7sec for initial walk period minimum

Red light for road A1 & A3 = 38.10+7= 45.1 ≈ 45 Sec

And that for road A2 & A4 = 45.65+7=52.65 Sec ≈ 53 Sec

Minimum green times Based on pedestrian Criteria

Road A1 & A3 = 53-5=48 sec Road A2 & A4 = 45-5=40 sec

Based on Road width the green time calculated is increased for road A2 & A4 with higher.

Road width: $\frac{GA2,A4}{GA1,A3} = \frac{WA2,A4}{WA1,A3}$

GA2A4 = $\frac{WA2,A4}{WA1,A3}$ x GA1,A3 = $\frac{160}{150}$ x 48 = 51.2 Sec ≈ 52 Sec

Total Cycle Length

= G(A2, A4)+Y+ R(A1, A3) + Y

= 52+5+48+5

=110 sec

1. Karwan Bazar Signal Calculation

The Road Connecting “B” Signal are

Karwan Bazar to Bangla Motor = B4

Karwan Bazar to Tejgaon Link Rd = B5

Karwan Bazar to Farmgate = B6

Karwan Bazar to Panthapath = B7

B4=B6=145 ft. and B5 = B7 = 102 ft

For Road C7 & C9 Yellow Period YB4, B6 = 5Sec

For Road C8 & C10 Yellow Period YB5, B7 = 5 Sec

Based on Pedestrian Walking Speed of 3.936 ft./sec

Pedestrian Clearance time for road B4 and B6 = 145/3.936 = 36.83 Sec

Pedestrian Clearance time for road B5 and B7 = 102/3.93 6 = 25.91 Sec

Adding 7sec for initial walk period minimum

Red light for road C7 & C9 = 36.83 +7 = 43.83 Sec And

That for road C8 & C10 = 25.91 + 7= 32.91 Aec

Minimum green times Based on pedestrian Criteria

Road C7 & C9 = 32.91 - 5 = 27.91 Sec ≈ 28 Sec

Road C8 & C10 = 43.83 - 5 = 38.83 Sec ≈ 39 Sec

Based on Road width the green time Calculated is increased for road C7 & C9 with higher road width: $B4{,}6\ B5{,}B7{=}WB4{,}B6WB5{,}B7$

Where, GB4, B6 and GB5, B7 are the green timing for Road B4, B6 and B5, B7 and WB4B6, WB5, B7 are the road width

GB5, B7= 38.83 Sec as calculated above

GB4, B6 = $WB4B6$ / $WB5B7$ × $B4B6$ = 145/102 × 38.83 = 55.19 Sec ≈ 56 Sec

Total Cycle Length,

= GB4, B6+ YB4, B6+ GB5, B7+ YB5, B7

= 56 + 5 + 39 + 5

= 105 Sec

3. Panthapath signal calculation

Let, Panthapath Signal be "C"
The Road Connecting "C" Signal are
Panthapath to Karwan Bazar = C7
Panthapath to Farmgate = C8
Panthapath to Dhanmondi 32 = C
Panthapath to Green Road = C10
C7 = 88 ft and C9 = 92 ft. C8 = C10 = 55 ft

Here, C7 and C9 road are facing each other, so we can go with higher width C9 calculation, For road C7 & C9 yellow period YC7, C9 = 5 Sec
For road C8 & C10 yellow period YC8, C10 = 5 Sec

Based on pedestrian walking speed 3.936ft/sec
Pedestrian clearance time for road C7 and C9 = $\frac{90}{3.936}$ = 23.37 Sec
Pedestrian clearance time for road C8 and C10 = $\frac{55}{3.936}$ = 13.97 Sec
Adding 7sec for initial walk period
minimum red light for Road C7 & C9 = 23.37 + 7 = 30.37 Sec
and that for Road C8 & C10 = 13.97 + 7= 20.97 Sec

Minimum green times based on pedestrian criteria
Road C7 & C9 = 20.47 - 5= 15.47 Sec
Road C8 & C10 = 30.37 - 5 = 25.37 Sec ≈ 26 Sec
Based on road width the green time calculated is increased for road C7 & C9 with higher road width: $\frac{GC7,C9}{GC8,C10} = \frac{WC7,C9}{WC8,C10}$

Where, GC7,C9 and GC8, C10 are the green timing for road C7, C9 and C8, C10 and WC7,C9, WC8, C10 are the road width
GC8, C10 = 26 Sec as calculated above
$= \frac{WC7,C9}{WC8,C10}$ x GC8,C10 = $\frac{92}{55}$ x 26 = 43.49 Sec ≈ 44 Sec

Total cycle length

= GC7, C9+ YC7, C9+ GC8, C10+ YC8, C10

= 44 + 5 + 26 +5

= 80 Sec