In charge
Pakistan Engineering Council, Funding Section

Dear sir,

Please find attached to this document a detailed report of our project, Investigating A Road Network With And Without Lane Changing Of Drivers: A Case Study Of Charsadda Road, Peshawar. For this project, we have won funding of 0.2 Millions Rupees, out of which 40% (eighty thousand) is released; therefore, you are requested to release the remaining 60%. (.12 millions) of the fund. Details of the group members are given below.;

Gul Nawab Khan	AUP-19FL-BECE-19177
Issam Ullah Khan	AUP-19FL-BECE-19155
Mohid Khan	AUP-19FL-BECE-19176
Ahmad Adil	AUP-19FL-BECE-19153

Funding Details

Total Fund	RS 200,000
Released Fund	RS 80,000
Remaining Fund	RS 120,000

Supervisor: ENGR. Nouman Khan Usama

TITLE: A Road Network With And Without Lane Changing Of Drivers: A Case Study Of Charsadda Road, Peshawar

Detail of Upcoming Expenditure		
S. No	**ITEMS**	**PRICE (Rs)**
1	Camera	40,000
2	Workforce	80,000

Abasyn University Peshawar
Department of Civil Engineering

Group Members

Gul Nawab khan — Mohid khan

Issam Ullah Khan — Ahmad Adil

Supervisor

Engr. Nouman Khan Usama

Investigating A Road Network With And Without Lane Changing Of Rickshaw Drivers: A Case Study Of Charsadda Road, Peshawar

Abstract:

Traffic congestion is a critical problem for our country which happens due to many reasons. Improper planning is one of the top reasons why traffic congestion exists in Peshawar. In this study, we investigate Charsadda road is congested. The aim of the study is to determine the lane changing behavior of rickshaw drivers. We used PTV VISSIM software for simulation and compared the results of lane changing and non-changing rickshaw drivers. The results showed that the passive traffic (no or limited lane changing) are better. Recommendation is given to government agencies about administration of lane changing.

Introduction:

Traffic congestion is a critical problem in Peshawar, Pakistan, often attributed to improper planning. This study focuses on the congested Charsadda Road and aims to investigate the lane changing behavior of rickshaw drivers, who play a significant role in the local transportation system. By utilizing the PTV VISSIM software for simulation, we compare the outcomes of lane-changing and non-lane-changing rickshaw drivers to gain insights into the impact of their behavior on traffic congestion. Our objective is to provide meaningful recommendations to government agencies regarding the administration of lane changing for effective traffic management.

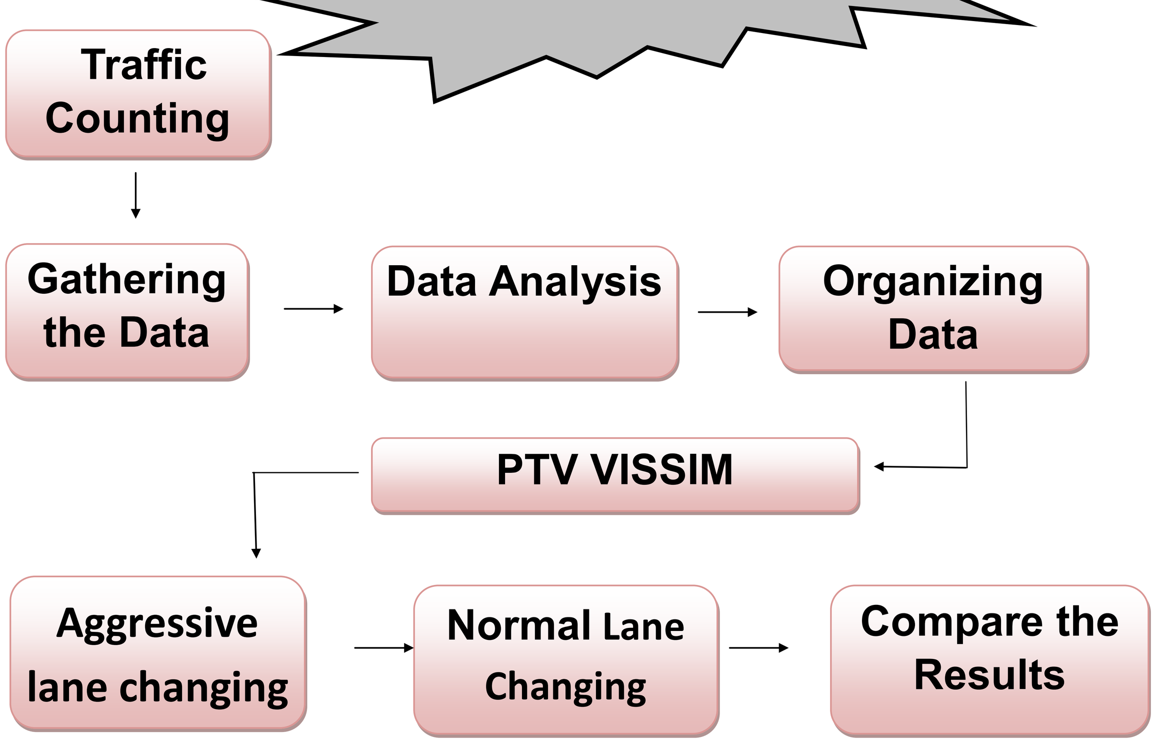
Rickshaws are a prevalent mode of transportation in Peshawar, contributing substantially to the traffic flow on Charsadda Road.

Understanding the lane changing decisions of rickshaw drivers is crucial to addressing congestion and improving transportation efficiency. Through the accurate replication of real-world scenarios using PTV VISSIM, we analyze the lane changing behavior of rickshaw drivers under various conditions. Comparing the results of passive traffic (limited or no lane changing) with active lane changing, we aim to determine the optimal approach to govern lane changing and alleviate congestion on this critical road.

Objective:

1. To investigate lane changing of rickshaw drivers and other vehicles.
2. To find the Impact of lane changing of rickshaw drivers on traffic.
3. To compare results between lane changing of rickshaw drivers and other drivers.

Methodology

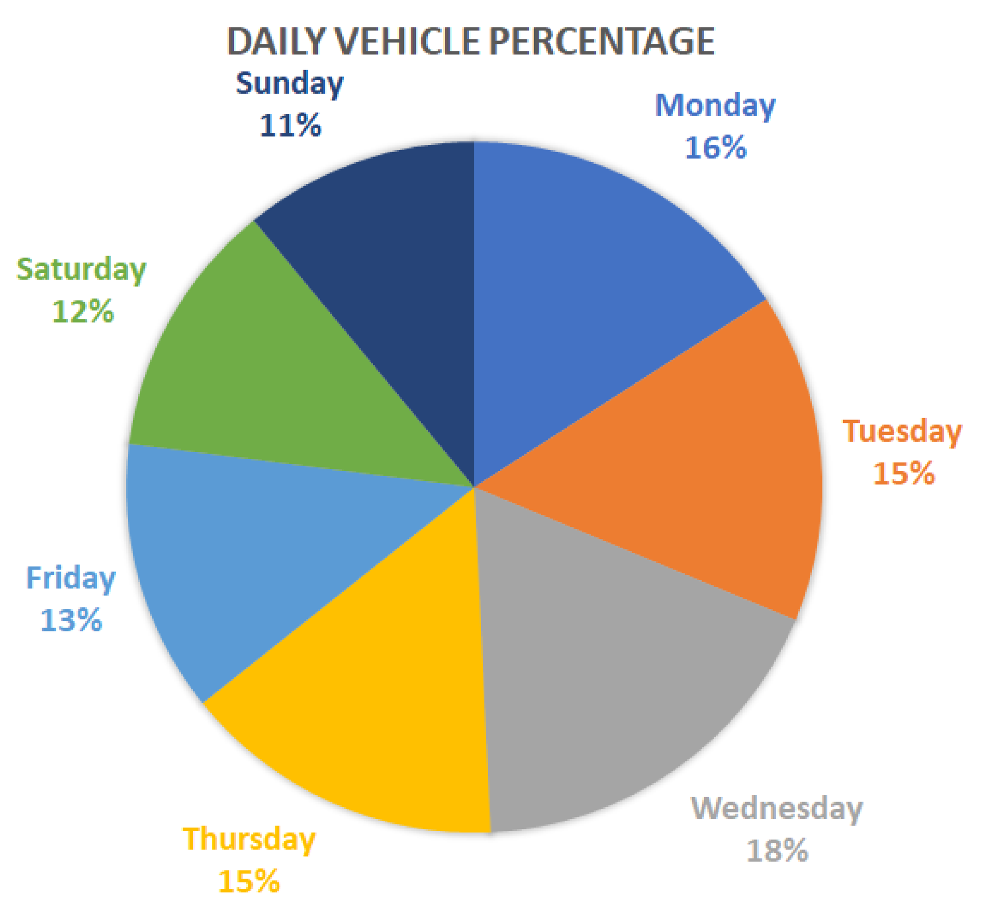


Results:

The results of the study indicate that rickshaw drivers' frequent lane changing has a noticeable impact on the road network. When rickshaw drivers change lanes frequently, it leads to reduced traffic flow and Increased congestion. The study identifies several reasons for rickshaw drivers' lane changing behavior, including picking up passengers, avoiding obstacles, and seeking shorter travel distances. Moreover, the study finds that rickshaw drivers tend to change lanes more frequently in congested areas, exacerbating the traffic situation.

Data Gathering:

Days	Rickshaw	Motor Car	Van	Suzuki	BRT Bus	Motor Cycle
Monday	2414	1635	224	631	33	1299
Tuesday	2344	1441	196	459	28	1987
Wednes-day	2737	1471	190	504	31	1562
Thursday	2288	1368	235	507	32	1735
Friday	1937	1297	167	436	27	1353
Saturday	1831	1019	130	447	26	1277
Sunday	1667	963	95	331	22	1127



PTV Vissim Simulation:

Conclusion:

In conclusion, this study focuses on addressing the critical issue of traffic congestion on Charsadda Road in Peshawar, Pakistan, by investigating the lane changing behavior of rickshaw drivers. The objective is to gain insights into the impact of their behavior on traffic congestion and provide meaningful recommendations to government agencies for effective traffic management. Rickshaws are a significant mode of transportation in Peshawar, contributing to traffic flow on this road. By utilizing the PTV VISSIM software for simulation, the study aims to accurately replicate real-world scenarios and analyze the lane changing decisions of rickshaw drivers under various conditions. By comparing the outcomes of passive traffic (limited or no lane changing) with active lane changing, the study seeks to determine the optimal approach to govern lane changing and alleviate congestion on Charsadda Road. Ultimately, the findings of this research will contribute to Improving transportation efficiency and reducing congestion in Peshawar.

Fundings:

We are extremely grateful and thankful to PEC for sponsoring the project.

We appreciate and thank the ZONG Franchise to help in vehicles counting by giving us video footage.

Investigating A Road Network With And Without Lane Changing Of Rickshaw Drivers: A Case Study Of Charsadda Road, Peshawar

Final Year Design Project BECE 2022-23

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INVESTIGATING A ROAD NETWORK WITH AND WITHOUT LANE CHANGING OF RICKSHAW DRIVERS: A CASE STUDY OF CHARSADDA ROAD, PESHAWAR

TITLE OF THE THESIS

Thesis submitted in partial fulfillment of the requirements for the degree of

B.Sc Civil Engineering

By

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Approved By

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Head of Department, CED, AUP

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Abstract

The present study investigates the impact of rickshaw drivers' lane-changing behaviors on the road network of Charsadda Road, Peshawar. Rickshaws, a prevalent mode of transportation in many urban areas of Pakistan, often exhibit erratic lane-changing habits, affecting traffic flow, congestion, and overall road safety. To comprehend the consequences of this driving behavior, a case study was conducted to compare the road network's conditions with and without rickshaw drivers' lane-changing tendencies.

Data collection involved traffic observations, video recordings, and driver surveys to understand the frequency and patterns of lane-changing maneuvers. The study evaluated traffic flow parameters, such as travel time, speed, and vehicle density, for different scenarios, considering both the presence and absence of rickshaws engaging in lane changes. The findings revealed that rickshaw drivers' frequent lane-changing actions significantly impacted the road network's efficiency. The presence of erratic lane-changing behavior led to traffic congestion, reduced average speeds, and increased travel time for other road users. Moreover, the study identified factors contributing to rickshaw drivers' lane-changing habits, including road infrastructure deficiencies and limited enforcement of traffic rules.

Based on the study's outcomes, potential solutions to address this issue were proposed, encompassing traffic management strategies, public awareness campaigns, road infrastructure improvements, and strengthened traffic enforcement. These interventions aim to promote better lane discipline among rickshaw drivers and enhance overall road safety and traffic flow on Charsadda Road. Ultimately, this research provides valuable insights into the impact of rickshaw drivers' lane-changing behavior on the road network and presents a foundation for formulating effective policies and strategies to improve the transportation system's efficiency and safety in Peshawar and other urban areas with similar transportation dynamics.

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Chapter 1

1.1 Introduction

Peshawar, the largest city in KPK, relies heavily on auto-rickshaws for its transportation infrastructure. The number of auto-rickshaws in the city's traffic has increased rapidly. Millions of people now rely on these automobiles for their urban mobility. When it comes to the three-wheeled auto-rickshaw, In this, users can sit anywhere from five to ten at a time. Low horsepower, two- or four-stroke engines power auto-rickshaws. In addition to car drivers, they are permitted to carry two or three adults. On top of a back-mounted engine, these vehicles have a canvas fabric covering their frame. The controls for the auto-rickshaws' mechanical operations were similar to those of motorcycles. Today, urban transportation has increased, with a growing share of intermediate public transportation. The most important factors for public transportation users are service dependability, punctuality, frequency, and waiting times. Most auto rickshaws are typically operated independently, with some owned by the driver and others rented on a daily or monthly basis. It accounts for a significant portion of motorized travel. The use of auto-rickshaws is preferable to private transportation. Due to the availability of guaranteed point-to-point transportation for special occasions, private vehicle usage should decrease. The need for parking spaces decreases as auto-rickshaw usage rises. In the city, every private vehicle needs more than two parking spaces, one at home, one at work, and one at the destination of trips. However, auto-rickshaws required a single city parking space in addition to a few for road stands. However, the fact that they make approximately fifteen trips per day means that fewer than twenty parking spaces are required. For instance, we could be given a lot of space in shopping centers if a lot of shop owners and customers prefer cars. Due to the engine's small size, auto-rickshaws can only reach speeds of less than 50 kilometers per hour. The fact that auto-rickshaws are associated with a very low number of fatal collisions between vehicles indicates that these speed limits are helpful in reducing the rate of accidents on urban roads. They cannot cause disastrous collisions with pedestrians and bicyclists.Traffic congestion is worsened by private transportation. The rising number of vehicles on the road is the primary cause of road congestion. The absence of road infrastructure causes the vehicle density to rise.

For passing, a private car needs about 12 square meters, whereas auto rickshaws only need about 7.5squaremeters.

Types of vehicles	Buses	Cars	Taxis	Auto-rickshaws	Motorcycles
Area(square meter)	27.5	12	12	7.5	5

Table 1: Road Space Utilizat

1.1 Frequent traffic jams by rickshaws

Peshawar, formerly known as the "city of flowers," is now grappling with severe traffic congestion caused by an ill-conceived Bus Rapid Transit (BrT) project. This project has led to a surge in vehicles on the roads, reducing their capacity and causing extensive traffic jams. Unfortunately, the citizens of Peshawar now endure polluted air due to the overwhelming presence of unregistered rickshaws, taxis, wagons, and old passenger buses, depriving them of the pleasant fragrances once associated with the city. The consequences of this traffic chaos are evident in the rising number of respiratory issues, such as eNT, coughs, and chest infections, particularly during the seasonal changes. Furthermore, frequent strikes by provincial government employees on the main GT road, near the Kp assembly, exacerbate the situation, making it difficult for people, including students, lawyers, businesspeople, and officials, to reach their workplaces on time. Several factors contribute to the traffic congestion, including the poorly planned BrT corridor, the narrow GT road, demonstrations blocking the "suray bridge," and the unrestricted movement of VIPs. This congestion poses significant challenges for civil secretariat employees and students, especially during peak hours. Moreover, areas like Gulbahar, Hashtnagri, and Firdus, as well as Dabgari Garden—a hub for private hospitals, clinics, and laboratories—witness severe traffic jams, adding to the suffering of patients and citizens who spend hours on the roads due to the influx of vehicles. Even ambulances with blaring sirens face difficulties navigating through the unruly traffic on GT road and Sher Shah Suri roads, leading to Lady Reading Hospital (LRH) and Dabgari Gardens. This distressing situation further exacerbates the mental anguish experienced by patients in critical conditions. Mr. Riazul Haq, a heart patient from Nowshera district, shared his harrowing experience of being stuck in traffic near Firdus, where a 30-minute journey to Dabgari Garden took nearly two hours. The constant use of the clutch and brakes during the traffic chaos added to his physical discomfort.The issue is compounded by the fact that many tri-wheeler drivers do not possess permits, and the traffic police have the authority to take strict action against these illegally operating vehicles. To alleviate traffic congestion, the Transport Department has approved new BrT feeder routes, including Hayatabad phase-I, Regi Model Town/Nasir Bagh Road, Warsak Road, and Chamkani to Pabbi.Efforts are also being made to cater to the needs of women and people with disabilities by reserving special seats for them on the BrT. More than 60,000 women and girls benefit from this service on a daily basis. Additionally, a new general bus stand is under construction on a substantial land area near the BrT main terminal in Sardar Ghari. This development is expected to provide a permanent solution to the problem of traffic jams in Peshawar once completed. In conclusion, Peshawar's traffic challenges, stemming from the ill-conceived BrT project and the surge of unregistered vehicles, have significantly impacted the quality of life for its residents. The implementation of thoughtful traffic management strategies and proper infrastructure planning will be crucial to restoring the city's former glory as a sustainable and accessible urban center.

1.2 Transportation network of Peshawar

Peshawar, with a population of 2.1 million, serves as the provincial capital and a major urban center of KP (GoP, 2017). Being a primate city, Peshawar is experiencing a growth rate of approximately 3.1% per year, and it is projected to reach a population of five million in the next two decades. As the city's economy continues to expand steadily, the demand for transportation infrastructure is also on the rise. Significant investments in municipal infrastructure will be crucial to accommodate this increasing demand. Peshawar enjoys excellent connectivity with the rest of the country through air, rail, and road networks. Notably, the Indus Highway N-55 links Peshawar to various southern districts, while the N-5 Highway connects it to Nowshera, Rawalpindi, Lahore, and other major cities. The National Motorway M-1 provides a direct route to Islamabad and further connections. The rail network operates two major train stations: City and Cantonment stations, which facilitate both passenger and cargo services. The strategically located Bacha Khan International Airport serves as a vital hub, with modernized passenger and cargo facilities. The airport not only caters to the people of KP but also offers an alternative option for neighboring regions of Afghanistan. Several domestic and international airlines, such as Pakistan International Airline, Shaheen Air International, Emirates Airline, and others, provide services at the airport, complemented by car rental companies within the premises.

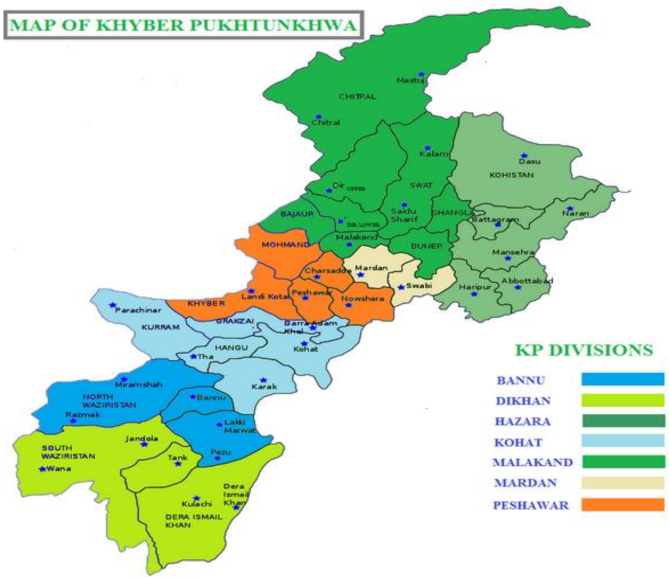


Figure 1: Road Network of KP

However, Peshawar's rapid and unchecked urbanization has led to urban sprawl and ribbon development, resulting in low population densities across most areas of the city. While economic development has caused a significant increase in vehicle ownership and travel, the expansion of the road network has not kept pace. The proportion of vehicle growth from 1998 to 2010 was 126.4%, while road network expansion was merely 0.85%. Private automobiles constitute 75.35% of all registered vehicles, witnessing a surge of 228.98% during the same period (Ali, 2012). This discrepancy between vehicle growth and road development has given rise to severe traffic congestion, leading to economic losses, elevated air and noise pollution levels, smog issues, and overall environmental degradation.

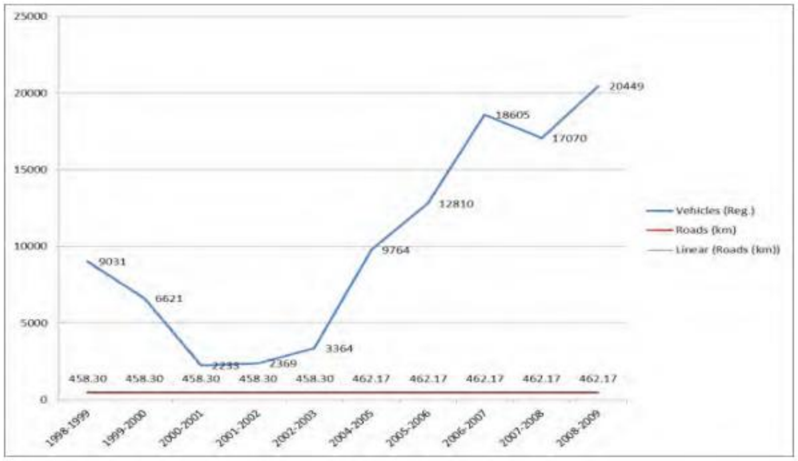


Figure 2: Comparison Total Vehicles and Total Road Network (1998-2010)

To address these challenges, careful planning and considerable investments in transportation infrastructure are essential for Peshawar's sustainable growth. Improved road networks, efficient public transportation systems, and measures to curb traffic congestion and pollution will be pivotal in ensuring a better quality of life for the city's residents and a more sustainable urban environment.

Figure 3: Various transportation modes in the city

1.3 Description of Peshawar intercity road network

Peshawar's road network development has primarily focused on revitalizing the old pre-partition routes. One longstanding project, the Ring Road, proposed in the Peshawar Structure Plan back in 1986, remains incomplete even after three decades. While this is the sole initiative aimed at addressing the city's traffic challenges, further efforts are required to enhance the transportation infrastructure effectively. The major roads and arteries in Peshawar include:

1. Grand Trunk Road (N-5)
2. Kohat Road
3. Khyber Road
4. Warsak Road
5. Dalazak Road
6. Ring Road
7. Charsadda Road
8. Mall Road
9. Palosawai Road

These roads play a significant role in the city's connectivity, and careful planning and implementation will be essential to create a more efficient and sustainable road network that caters to the growing demands of Peshawar's population and economy.

Behavior of rickshaw driver in Peshawar traffic

The behavior of rickshaw drivers in Peshawar traffic can vary based on several factors. Here are some common observations regarding their behavior:

- Lane Changing: Rickshaw drivers in Peshawar traffic often exhibit frequent and aggressive lane changing behavior. They tend to switch lanes abruptly and without signaling, contributing to a chaotic traffic environment.

- Traffic Violations: Rickshaw drivers in Peshawar are known to violate traffic rules and regulations. They often disregard traffic signals, drive on the wrong side of the road, and make illegal U-turns, which can disrupt the flow of traffic and pose safety risks.
- Overtaking: Rickshaw drivers may engage in risky overtaking maneuvers, especially during congested traffic conditions. They often attempt to squeeze through narrow gaps between vehicles, leading to potential conflicts and accidents.
- Informal Stopping and Pickups: Rickshaw drivers frequently stop their vehicles in the middle of the road to pick up or drop off passengers, disregarding designated stops or causing obstructions to other vehicles. This behavior further contributes to traffic congestion.
- Negotiating Fare and Routes: Rickshaw drivers in Peshawar often engage in negotiations with passengers regarding fare and preferred routes. This can lead to delays and disputes, impacting traffic flow, especially at busy intersections.
- Lack of Compliance with Traffic Regulations: Some rickshaw drivers may operate without proper licenses or necessary documents. This non-compliance with regulations can create challenges for traffic enforcement authorities in maintaining order on the roads.

It is important to note that while these observations represent common behaviors exhibited by rickshaw drivers in Peshawar traffic, they may not apply universally to all drivers. There are responsible and law-abiding rickshaw drivers who adhere to traffic rules and prioritize the safety of themselves and other road users. It is crucial to consider the individual variations and circumstances when assessing the behavior of rickshaw drivers in Peshawar traffic.

1.4 Charsadda Road

Starting from Bacha Khan Chowk, close to the District Nazim's office, this two-lane, two-way street stretches approximately 1.7 kilometers into the heart of Peshawar until it intersects with the Ring Road. Along its route, the street features a NJB median. The carriageway's width varies, measuring between 6.0 to 7.3 meters on each side from Bacha Khan Chowk to Faqirabad Thana. From Faqirabad Thana to Din Bahar Colony, the width of the carriageway expands to 7.2 meters.

Figure 4: Views of Charsadda Road

1.5 Overview of traffic issues in Peshawar

Over the past two decades, Peshawar's population has experienced a remarkable growth of over one hundred percent, surging from 0.98 million to 2.1 million. During the same period, the number of vehicles in the city has also increased significantly. However, the corresponding investment in transportation-related infrastructure has been insufficient, leading to severe and worsening traffic problems in Peshawar.

These ever-increasing traffic issues can be attributed to various factors. The rapid population growth and the exponential rise in vehicle ownership are major contributors, along with the average travel time within the city. Particularly during peak hours in the morning and evening, the situation becomes unbearable, resulting in substantial financial losses and environmental concerns. Based on personal observations during field visits and discussions with stakeholders, the Consultants identified some of the primary factors responsible for the traffic issues in Peshawar.

1.5.1 Unplanned Development

Over time, Peshawar's transportation system has undergone significant changes. In the past, the primary modes of travel on the streets were pedestrians, camel caravans, and animal-drawn carts. However, with technological advancements, transportation methods have evolved, while the road infrastructure has not kept pace. Unfortunately, the situation has worsened in recent years due to unplanned and rapid urban development.

The absence of a comprehensive master plan has led to unregulated city expansion, necessitating effective measures to address issues associated with such unplanned growth. To encourage the development of a reliable public transportation system, it is essential to consider planning and zoning regulations. At present, Peshawar's public transportation system is underdeveloped, inefficient, and lacking proper regulation.The private sector dominates the supply and operation of vehicles, mainly pickups and wagons, on major city arteries, leading to an unbalanced and monopolistic transportation sector. The absence of interest and investment from the provincial government, coupled with governance issues, has resulted in the operation of numerous illegal vehicles without valid licenses or authorization. These compact vehicles, catering to only a limited number of passengers, further contribute to traffic congestion on the road network.

Given the significance of Peshawar to KP, with its crucial role in providing housing, health, education, and business services, improving the city's infrastructure will positively impact the standard of living for its residents. By implementing the proposed infrastructure upgrades, Peshawar can take strides towards a more efficient and reliable transportation system, benefiting the community as a whole.

1.5.2 Poor and inadequate Public Transportation System

The public preference for private transportation has increased as a result of the city's lack of an efficient mass transportation system, which has led to a phenomenal rise in private vehicle ownership at a rate of 23.85% annually. Peshawar's public transportation system is severely inefficient, fragmented, poorly managed, and underdeveloped. There is a significant gap between the supply and demand for an environment-friendly and effective public transportation system. There has long been a lack of professional, administrative, and financial capacity to manage public transportation services by public transportation organizations.

Although the development of the Peshawar Bus Rapid Transit System (BRT) on a single corridor will not address the city's overall traffic issues, it is a positive step toward the creation of an efficient and vibrant public transportation system.

1.5.3 Encroachments and Illegal Construction

Traffic delays, congestion, and other associated issues are primarily caused by narrow and meandering streets, encroachments, and illegal construction, among many other factors. The situation is getting worse even more as a result of the Town Municipal Administrations and Peshawar Development Authority's weak implementation of building byelaws and other development control measures. These authorities must take immediate action.

The existing pedestrian infrastructure in the city is severely lacking, and vendors and street hawkers have encroached on it. As a result of a lack of enforcement, haphazard and illegal construction, encroachment of roads and green spaces, flourishing intrusion into State land, violations of parking regulations in commercial plazas, and unauthorized commercialization in residential areas have occurred. Encroachment and illegal construction in busy markets pose dangers to drivers and pedestrians, making it difficult to move freely through the city. In Peshawar, vehicles move at a snail's pace, and once a driver enters the city during peak hours, he spends hours stuck in a traffic jam. Irrational driving practices on the road pose a serious threat to pedestrians and other road users due to a lack of training and education for drivers and weak enforcement. The situation has been made even worse by shopkeepers and vendors taking over sidewalks and footpaths all over the city.

Figure 5: Views of Encroachments on various roads

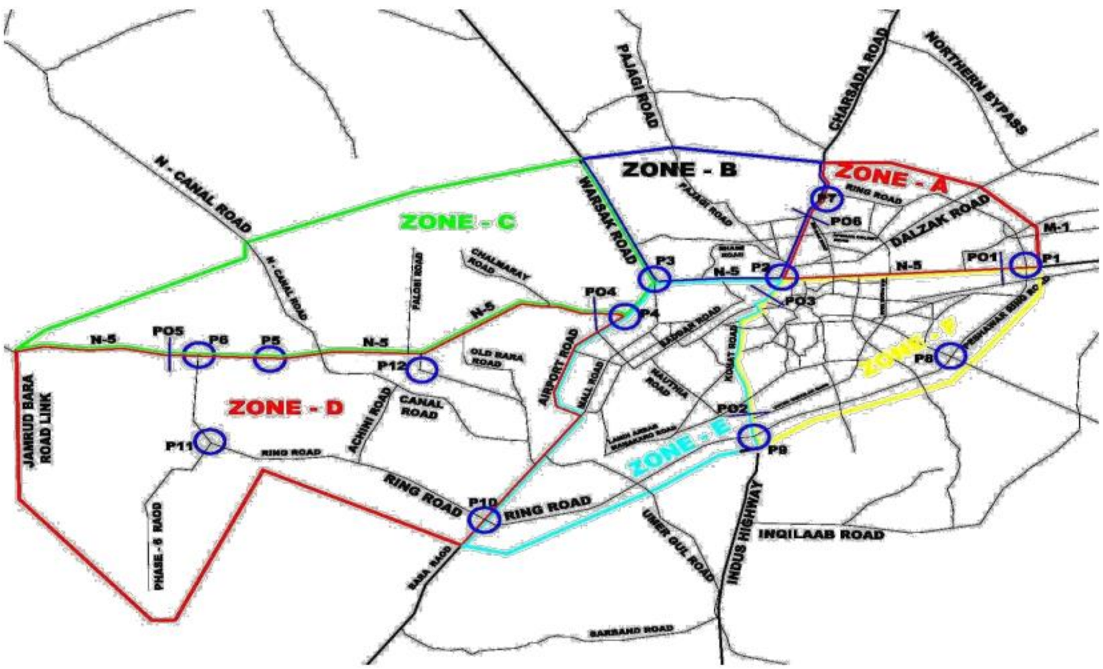


Figure 6: Zoning of Peshawar City

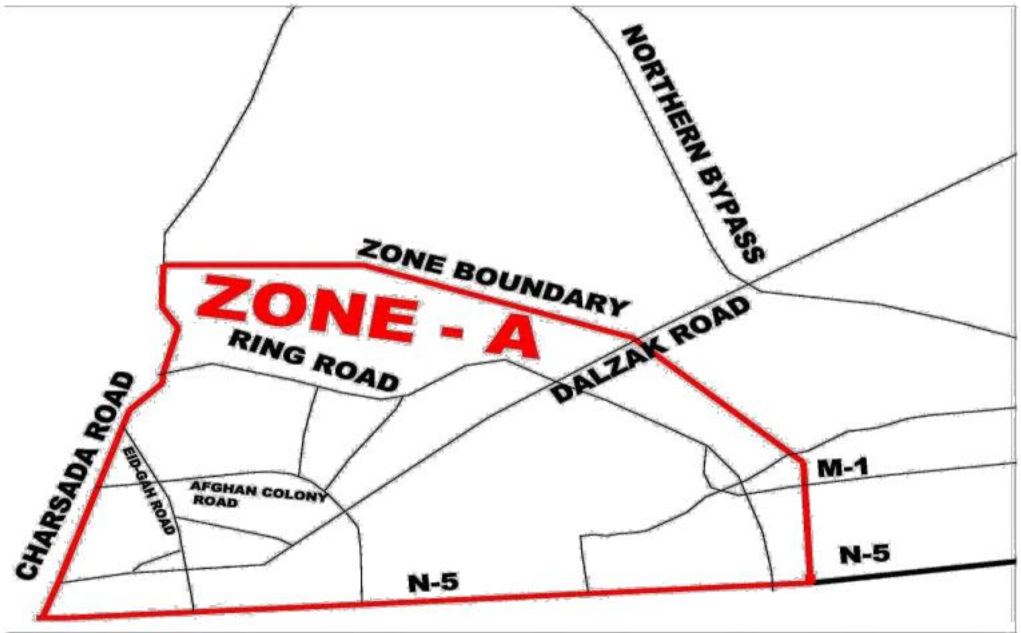


Figure 7: Zone A of the study area

Figure 8: Zone B of the study area

1.6 Traffic counts survey stations

The location of this station is at the T-junction of Charsadda Road and Peshawar Ring Road. At this station, traffic data for both incoming and outgoing vehicles on Charsadda Road and Peshawar Ring Road was recorded.

Figure 9: Location of Traffic Count Survey Station

1.7 Traffic on Charsadda road and role of rickshaw

The city's severe traffic congestion is primarily attributed to the presence of a large number of unauthorized vehicles, particularly auto-rickshaws, on the roads. Approximately 78,000 vehicles, including 39,642 auto-rickshaws, are operating without permits, exacerbating the daily gridlock.

Despite the construction of the Bus Rapid Transit (BRT) project, the government and traffic police administrations have failed to effectively resolve the traffic issues. The absence of new road constructions in recent years, except for the Ring Road 25 years ago, has further limited alternative routes for commuters, adding to the problem.

Tens of thousands of residents face significant challenges while traveling to their workplaces, schools, and trade centers due to these unauthorized vehicles. Most of these vehicles lack fitness certificates, and a considerable number of buses, cars, coaches, and auto-rickshaws—amounting to 78,900—operate without permits, as reported by a government department.

Specifically, there are around 61,000 auto-rickshaws in the city, with approximately 39,642 operating without proper permits. Moreover, Qingqis, totaling 31,755, are widely used for passenger transport throughout the urban and suburban areas, all without permits or registration. Additionally, a significant number of taxi drivers and other vehicle operators lack the required licenses to transport passengers.

The authorities responsible for traffic police acknowledge that the presence of vehicles without proper licenses is one of the primary causes of the congestion in the city. Addressing this issue and ensuring proper regulation and permits for vehicles will be crucial in alleviating the traffic woes in the provincial capital.

Despite the work on the BRT, the traffic wardens have been making every effort to maintain a smooth flow of traffic on city roads. According to Riaz Ahmad, Superintendent of Police Traffic Peshawar, "there are thousands of vehicles plying the city roads without permits, causing road blockades and other traffic-related issues."

Charsadda Road in Peshawar is a major thoroughfare that experiences significant traffic congestion, especially during peak hours. Rickshaws play a significant role in the traffic dynamics of this road. Here are some key points regarding the traffic on Charsadda Road and the role of rickshaws:

- High Volume of Traffic: Charsadda Road is a busy route, often witnessing heavy traffic flow due to its connectivity to various residential and commercial areas of Peshawar. The presence of rickshaws adds to the overall volume of vehicles on the road.
- Maneuverability in Congested Areas: One advantage of rickshaws is their ability to navigate through congested areas and narrow lanes. They can access parts of the road that larger vehicles may struggle to reach. Rickshaw drivers often utilize this advantage to find alternative routes and bypass traffic jams.
- Contribution to Congestion: While rickshaws can maneuver well in congested areas, they can also contribute to traffic congestion themselves. In some cases, rickshaws may

occupy road space and create bottlenecks, especially when they stop to pick up or drop off passengers.

- Lane Discipline and Overtaking: The traffic behavior of rickshaw drivers on Charsadda Road varies. While many rickshaw drivers adhere to traffic rules, some may not maintain proper lane discipline or may attempt overtaking maneuvers in heavy traffic. This behavior can potentially disrupt the flow of traffic and increase the risk of accidents.
- Shared Road Space: Rickshaws share the road with other vehicles, including cars, motorcycles, and pedestrians. It is important for rickshaw drivers to be cautious and considerate of other road users to ensure safety and smooth traffic flow.
- Regulation and Enforcement: Traffic authorities and local law enforcement agencies play a crucial role in managing traffic on Charsadda Road. They are responsible for enforcing traffic regulations and ensuring road safety for all vehicles, including rickshaws.

It's worth noting that the traffic situation and rickshaw driver behavior can vary over time. For the most accurate and up-to-date information, it's recommended to consult local traffic authorities, news sources, or individuals familiar with the area.

1.8 Problem statement

Traffic is a big concern all over the world particularly in Peshawar on Charsadda Road near Charsadda add.

Our hypothesis is that the issue on Charsadda road is due to lane changing of rickshaw drivers.

1.9 Objectives

- ➢ To investigate and compare lane changing of drivers between real data and a simulation on a software such as PTV VISSIM.

1.10 Thesis overview

This section presents a comprehensive overview of the work carried out in the study "Investigating a Road Network with and without Lane Changing of Rickshaw Drivers." Each chapter is outlined, highlighting its respective focus and content.

Chapter 2:

This chapter delves into the background and previous research pertaining to the investigation of a road network with and without lane changing of rickshaw drivers. It encompasses a thorough analysis of both historical and recent research work in this domain.

Chapter 3:

Here, the proposed methodology and main framework of the study are thoroughly discussed. The entire system's working is presented, along with a detailed explanation of the steps undertaken within the framework. This chapter also introduces the primary framework used in the investigation.

Chapter 4:

In this chapter, the experimental phase of the research is described, showcasing the various experiments conducted and the corresponding results generated. Detailed tables and discussions are provided to illuminate the outcomes.

Chapter 5:

The final chapter concludes the research work, summarizing the key findings and insights. Moreover, it offers valuable directions for future research in this field, aiming to guide and inspire the research community for further advancements.

Chapter 2 the background and literature review

One of the main hubs for the educational, industrial, public, and private sectors is Peshawar, the capital of Khyber-Pakhtunkhwa Pakistan. The city's population is expanding rapidly as a result of people fleeing rural areas and other cities in search of better education and new job opportunities. This has also contributed to the city's current traffic issues. The percentage of people who drive on a daily basis has increased rapidly with the increase in private cars, which has hurt the already fragile Peshawar transportation system. Peshawar's transportation and security systems were also impacted by the terrorism that occurred in the city at a particular time. This paper would provide solutions to traffic issues and help to improve the situation in order to improve the transportation network and mobility of city residents [1].

The traffic analysis of Warsak Road in Peshawar, Pakistan, is the subject of this research paper. Data was gathered from inventory surveys of educational institutions, traffic control devices, accidents This section encompasses various studies conducted on different aspects related to transportation and traffic:1. Speed Studies: These studies focus on analyzing the speed of vehicles on the roads to understand traffic flow and safety implications.2. Age Effect on Speed: This research examines how age can impact driving behavior and vehicle speed, addressing any potential safety concerns.3. Parking Studies: The focus of these studies is to assess parking patterns and availability in different areas, aiming to optimize parking spaces and reduce congestion.4. Traffic Volume Studies: These studies analyze the volume of traffic on specific road segments, helping to identify peak hours and congestion patterns for better traffic management. The volume-to-capacity ratio of the road was calculated using standard statistical expressions. The results of the data analysis indicate that the road falls under the Indian Roads Congress (IRC)'s category "F" of overloading. Numerous suggestions and recommendations were made based on the results and the location of the road [2]. Evaluation of the best mode of public transportation is one of the most pressing issues facing every nation, and extensive research has been conducted on it in order to address the difficulties posed by the requirements for public transportation. Peshawar, Pakistan's capital of Khyber Pakhtunkhwa, is one of the country's busiest cities, with a 52% increase in population over the past 19 years. It was important to think about a good mode of transportation for the people of such a rapidly expanding city; The use of public transportation accounts for nearly 60% of population mobility. This study's primary objective was to evaluate and investigate the most effective public transportation option for Peshawar city in order to improve connectivity, speed up travel, and increase intracity transfer capacity. Analytic hierarchy process (AHP) analysis of the existing public transportation options was used in this study to recommend the best option based on the city's demand for public transportation. A number of factors, including travel time, cost, safety, comfort, dependability, and accessibility, were taken into account when choosing the best mode of transportation. The purpose of the survey, which was based on a questionnaire, was to gather information about the various public transportation options that are currently available, such as the Bus Rapid Transit (BRT), Ford wagon, rocket bus, ride-sharing, carpooling, taxi, rickshaw, zu bicycle, and motor bike service. Multicriteria analysis, which was based on the analytical hierarchy process (AHP), revealed that the Bus Rapid Transit Service (BRT) was recommended as the most cost-effective and ideal mode of public transportation for the city of Peshawar [3].

The global urban population has grown at an exponential rate in recent years, leading to a significant rise in the utilization of transportation services. Numerous difficulties result from the overcrowding of metropolitan cities' conventional transportation system. There are a number of ways in which the technology based on the Internet of Things (IoT) can improve transportation services. As a result of the city's rapid population growth, Peshawar, Pakistan, has developed a transportation system that poses a number of challenges and repercussions, which are discussed in this paper. In addition to the usual issues, major traffic jams frequently occur in certain parts of Peshawar. We've come up with an IoT-based framework for busy traffic intersections to help with this. The route selection problem is seen by the proposed framework as a two-player game in which Nash Equilibrium (NE) sets traffic for each route so that no one can change its strategy to improve performance. NE uses data collected by a roadside unit (RSU) to calculate the traffic density, which it uses to select an alternate route to avoid traffic congestion. In Peshawar, Pakistan, the academic community and the transportation department can use the framework in this paper to transform the current transportation system into IoT-based intelligent transportation [4].

Deterioration of pavements can occur due to both structural and ecological factors, necessitating regular maintenance to ensure their long-term performance and appearance. The present study aims to assess the deterioration of flexible pavement, using the northern bypass road in

Peshawar, Pakistan, as a possible case study. The evaluation was conducted through manual surveys following ASTM D 6433 standards, where various sections of the pavement were assessed for distresses such as cracks, holes, and undulations. The study emphasized the importance of periodic inspections to identify and address pavement defects efficiently and cost-effectively.

Peshawar, Pakistan, is experiencing increasing traffic congestion due to a rising number of vehicles, inadequate expansion of the road network, and inadequate traffic management. This paper investigates the current state of the city's traffic, its primary causes and effects, and road network analysis in relation to the existing traffic management system. The data revealed a significant increase in the number of vehicles compared to the limited expansion of the road network, particularly in the case of private cars. Additional security checkpoints and roadblocks erected in response to terrorist threats have further aggravated the traffic situation, leading to increased fuel consumption and delays. The paper proposes effective traffic management measures, including controlling planning and development, discouraging private car use, and promoting awareness among commuters.

In addressing urban transportation issues in developing countries like Pakistan, the solutions must be tailored to each city's specific needs. Learning from the experiences of developed countries, while acknowledging the interrelationships between various urban trends and impacts, is crucial. Implementing integrated strategies over time, encompassing both immediate and long-term solutions, is essential to effectively address the complex nature of urban transportation systems.[7].

The purpose of this study was to determine how satisfied customers were with private transportation services in Peshawar, Khyber Pakhtunkhwa, Pakistan. Using a structured questioner, primary data were gathered for this purpose. 450 targeted samples in the study area received questioners. From the responses received, 149 questioners were successfully filled. Based on previous research, fifteen distinct variables that are associated with customer satisfaction were identified. Because satisfaction is a binary dependent variable (categorical variable: Yes/No). As a result, the Probit-regression method is used to analyze all of the information that was gathered. It was estimated that four distinct models would investigate various factors affecting consumer satisfaction both individually and collectively. Nine of the fifteen variables have been found to be statistically significant. Quality of vehicles, cleanliness of vehicles, seat availability, driver skills, routine characteristics, waiting time, travel time to destination, regulatory services, and vehicle frequency were significant variables. Customer satisfaction was positively impacted by each of these variables. When compared to other factors, the subfactors of timeliness had a strong relationship with the level of satisfaction. The dissatisfaction of customers with transport services was demonstrated by the mean value of the SERVQUAL dimensions. In district Peshawar, customers are frequently dissatisfied and hesitate to travel. The consumer's productivity suffers as a result of the stress and anger they experience while traveling. to prevent such harm and improve society's social welfare, which is every government's top priority. Therefore, appropriate policy for the future should be ensured by government intervention in private transportation [8].

An analysis of 361 road traffic accident victims treated at Khyber Teaching Hospital, Peshawar, from December 1999 to November 2000 is presented. The majority of victims, 63 percent, were under 30 years old, indicating a sex bias toward males (8:1). Between June and August, the most cases were received. Head was the most vulnerable part in 101 cases, followed by chest in 38 cases, abdomen in 13 cases, and pelvis in 12 cases. 40 cases had broken bones in their legs and arms. There were 32 deaths, or a 9 percent mortality rate. The time spent in the hospital ranged from 5 to 70 days. It is suggested that seatbelt use, strict speed limit enforcement, severe penalties for dangerous driving, the highway code, education about safe driving, and regular tire checks and changes can reduce mortality and morbidity and improve road safety [9]. A significant portion of published microscopic driving behavior models is focused on homogeneous and lane-based settings, primarily addressing car following and lane changing. However, traffic conditions in emerging and developing countries present a different scenario, characterized by mixed traffic with a lack of lane discipline and diverse vehicle types, including motorized and non-motorized, with varying dimensions, performance capabilities, and driver behaviors. This review critically examines the current driving behavior models in the context of

mixed traffic, identifying limitations and discussing data and modeling challenges that need to be addressed for better fidelity. Specific models, such as gap acceptance, longitudinal, and lateral movement, are analyzed, and their drawbacks are highlighted. Given the broader range of challenges faced by drivers in mixed traffic situations, current models often fail to consider the strategies they employ, such as squeezing, staggered following, and strict following in longitudinal movement. Additionally, the lack of adequate trajectory data for mixed traffic restricts the rigorous estimation of these models. The review proposes an outline for an integrated driver behavior modeling framework to tackle these challenges [10].

Despite lane changing (LC) being a significant contributor to traffic congestion, limited research has been conducted on its effects on urban networks and modal volumes. This study examines LC and modal volumes in traffic flows at specific locations on an urban arterial road in Karachi (Rashid Minhas Road). Observations were made on passenger cars, motorcycles, rickshaws, buses, and trucks changing lanes, and their impacts on surrounding vehicles were weighted accordingly. The lane change counts were adjusted based on the vehicle size and frequency of LCs. The study found that LCs mainly occurred in the middle and fast lanes. Comparing modal LC and volume curves revealed that motorbikes, buses, and trucks exhibited erratic behavior, while passenger cars, rickshaws, and the total volume showed high synchronization with their respective modes. The study identifies periods of near-congestion and emphasizes how location and traffic patterns influence parameters signaling congestion [11].

Urban areas are witnessing the integration of heterogeneous traffic streams, with both motorized and non-motorized vehicles becoming increasingly common. Nonstandard vehicles like rickshaws, bicycles, motorcycles, and others coexist with standard vehicle types such as private cars, buses, and trucks within these streams.

There are few suitable models for analyzing such traffic streams. In terms of effectiveness and applicability, the existing models each have their own limitations. The majority of models designed for heterogeneous traffic conditions only address lane-based traffic. Predictions cannot be relied upon in a developing country's metropolitan area, such as Bangladesh's Dhaka, where lane discipline is uncommon.

The non-motorized rickshaw, which is common in developing nations, was chosen as the vehicle for this study. It is difficult to replicate the deterministic rules that govern this type of movement due to the complex nature of rickshaw movement.

The rickshaw movement pattern was analyzed using two types of data in this study. Using the global positioning system (GPS), the secondary data were gathered to create a complete trajectory over a specific time period. The scenario's direction of travel, acceleration, and deceleration have been determined using these data. A number of speculative assumptions were used as the foundation for the primary data, creating realistic scenarios.

In order to obtain information from the rickshaw pullers regarding these scenarios, a number of questions were posed. The rickshaw drivers' movement patterns and behavioral traits have been revealed by analyzing this data. Because these factors also have a significant impact on the rickshaws' movement patterns and behavioral characteristics, the effect of various demographic factors has been determined. Model parameters for movement in the context of violation have been calibrated on a small scale [12]. The most significant feature of traffic with poor lane discipline was the vehicles' lateral distribution across the carriageway. Since there is no lane behavior, a driver must interact not only longitudinally with the vehicles in front of them but also laterally with those on its sides. From the lateral position of vehicles crossing the carriageway, one can examine the discipline of lane-based driving. An examination of lane-changing behavior reveals distinctive differences between various vehicle types. This study examines vehicle lateral behavior, lane-keeping behavior, and lateral distance-keeping behavior in an effort to comprehend traffic's non-lane-based behavior. It is investigated how vehicles' lane-wise headway behavior is affected by traffic composition. The central position of various vehicle types was noted in order to analyze the vehicles' lateral positions across the carriageway. As the vehicles traveled along a particular reference line on the carriageway, these positions were recorded for each of the median, middle, shoulder, and paved shoulders. In this study, the lateral clearances of various vehicle types are also compared [13].

The purpose of this paper is to investigate a novel and intricate behavior of the immediate follower while the leader vehicle changes lanes.

As a result, the aforementioned situation is a novel state in car following behavior in which the follower vehicle deviates significantly from conventional models for a brief period of time. This complex state also includes simultaneous lateral and longitudinal movement. This transient state is broken down into two stages: anticipation and evaluation, based on a closer look at how real drivers' microstructures behave. A short time later, a novel versatile neuro-fluffy model taking into account human driving elements is proposed to mimic the conduct of genuine drivers. Car following applications like driving assistants and collision avoidance systems can benefit from the proposed model's ability to accurately describe anticipation and evaluation behavior during car following behavior when compared to actual traffic data [14]. Through an ethnographic study of auto-rickshaw drivers in Bengaluru, India, this paper adds to the growing body of research on peer-to-peer (P2P) applications. We explain how the use of the P2P app Ola, which connects passengers to rickshaws, alters the work practices of drivers. Ola is one of the "peer services" that make it possible for new kinds of ad-hoc trade in goods, skills, and labor. Since very few people had ever used smartphones or the Internet prior to Ola, auto-rickshaw drivers make an interesting case. Additionally, as financially disadvantaged informal sector workers, concerns about driver welfare emerge. Technologies may say they will make life better, but they don't always deliver. We discuss how Ola does little to alleviate the day-to-day uncertainty experienced by auto drivers. This prompts us to consider the design of a system that is more equitable and inclusive [15]. This study aims to investigate the escalating traffic congestion in Peshawar, which is attributed to the rising number of vehicles, inadequate road network expansion, and insufficient traffic management measures. The paper delves into the current state of the city's traffic, its primary causes, and the resulting effects the road network. To gather relevant data, various sources were utilized, including the Peshawar Excise and Registration Department, Department of Communications and Works, Peshawar National Highway Authority, Peshawar Bureau of Statistics, Department of Highways, Headquarter Traffic Police, and Peshawar Development Authority. In addition to secondary data, surveys, questionnaires, interviews with drivers and commuters, and personal observations were employed.

The results reveal a significant increase of 126.4 percent in the number of vehicles between 1998 and 2009, while road network expansion only accounted for 0.85 percent. Private cars, comprising 75.35 percent of all registered vehicles, recorded a substantial increase of 228.98 percent during the same period, significantly contributing to the surge in vehicle numbers. The study highlights that traffic jams are further aggravated by heightened security checkpoints and roadblocks established in response to terrorist threats, leading to increased fuel consumption and delays.

To address the escalating congestion, the paper emphasizes the need for effective traffic management strategies and heightened awareness. Furthermore, it calls for stringent control over planning and development, including measures to discourage the excessive use of private cars in the city.

[6]. The current study looks at how Motorcycle Rickshaws (MRs) affect road safety. The three-wheeled paratransit vehicles known as MRs, which are driven by motorcycles, appear to be Pakistan's most common informal mode of public transportation. Due to the absence of registration systems for these vehicles and the under-reporting of police crash data, there is little relevant research or government policy on their negative effects on safety, traffic flow, and air and noise pollution. This doctoral program was initiated in response to the identified knowledge gap to: 1) investigate the aspects of MRs' road safety, and 2) determine the appropriate policy measures and strategies that could enhance MRs' road safety [16].

One of the main hubs for the educational, industrial, public, and private sectors is Peshawar, the capital of Khyber-Pakhtunkhwa Pakistan. The city's population is expanding rapidly as a result of people fleeing rural areas and other cities in search of better education and new job opportunities. This has also contributed to the city's current traffic issues. The percentage of people who drive on a daily basis has increased rapidly with the increase in private cars, which

has hurt the already fragile Peshawar transportation system. Peshawar's transportation and security systems were also impacted by the terrorism that occurred in the city at a particular time.

This paper would offer solutions to traffic issues and contribute to an improvement in the current transportation network and mobility of the city's residents [1] [17]. The current study's objective is to identify the issues with A survey was conducted in Historic Peshawar City to address transportation issues and propose viable solutions. Six city neighborhoods were included in the survey, and sixty people were randomly interviewed using questionnaires. The study identified mismanagement as the primary concern in the transportation sector, leading to time and fuel wastage, pollution, road accidents, stress, and damages. The complex transportation challenges in Peshawar necessitate an integrated strategy for resolution [7].

In response to the increasing transportation issues in urban cities of Pakistan, including Peshawar, optimization models have been explored to meet the growing transportation demands. The study focused on the life cycle cost analysis of Peshawar's mass transportation system, particularly on Jamrud Road. Passenger data was collected at various stops, and the density of travelers to specific stations in the corridor was determined. Through Life Cycle Cost Analysis, buses emerged as the most viable option for city public transportation, offering low operating and maintenance costs and being environmentally friendly. This option could alleviate congestion on the saturated roadway network [18].

Saddar, the city center of Peshawar, experiences a higher rate of trip generation compared to other locations, largely due to economic activity and population growth. However, the lack of parking and traffic management strategies has resulted in insufficient road network and parking facilities, exacerbating the situation. With only 38 on-street and 6 off-street parking spaces in Saddar, haphazard parking becomes common, leading to cruising for parking spots and conflicts between parked vehicles and through traffic. An improved parking management system is essential to address these issues effectively.

, parking, and unparking maneuvers, residents encounter severe traffic jams, particularly during peak hours. Through-traffic capacity is also reduced and bottlenecks are created as a result of this phenomenon.

Examining and improving the current situation, reducing traffic congestion, and suggesting countermeasures were urgently required.

Parking surveys were conducted, followed by data collection on peak-hour traffic to model and analyze the central business district (CBD) using VISSIM, a microsimulation program. The effects of on-street parking on through traffic were assessed using the paired t-test statistical test. The results yielded valuable insights to address the current situation and guide future parking and traffic management policies, leading to significant improvements in travel times, queue lengths, delays, and overall service quality [19].

To investigate vehicle-following, lateral movement, and seeping behavior under various traffic flow states involving multiple vehicle classes, high-resolution trajectory data were gathered. A road section with access control was selected, and vehicular trajectory data were created using a semi-automated image processing tool. The analysis revealed deteriorating lane-wise behavior as traffic volume increased, with vehicles tending to move towards the median at low flows and the curb at moderate and heavy flows. Smaller vehicles showed more aggressive gap acceptance, switching leader vehicles frequently to avoid delays, resulting in less following and perceiving time [20].The study analyzed 461 reported cases of road crashes in Lahore, Pakistan, between January and November 2014 to identify the causes of fatal and non-fatal accidents. Logistic regression and discriminant analysis were used to categorize the factors associated with fatal and non-fatal crashes. Results showed that female drivers were more likely to be involved in fatal crashes. Rickshaws and automobiles were frequently involved in fatal accidents due to their prevalence on the roads. Long trucks and trailers, known for risky driving habits, were also associated with fatal accidents. Collisions involving two vehicles increased the likelihood of fatalities, and speeding and overloading were identified as frequent actions leading to fatal crashes. The study highlights the importance of improved urban transportation systems and strict adherence to traffic rules for enhanced road safety in Pakistan [21].

Chapter 3

The proposed framework and methodology

Introduction:

This proposed study aims to investigate the behavior of rickshaw drivers regarding lane changing on Charsadda Road, Peshawar. The study will compare the road network conditions with and without lane changing by rickshaw drivers to understand the impact on traffic flow, safety, and efficiency. The proposed method and methodology outlined below provide a framework for conducting this investigation.

Study Area and Data Collection:

Select Charsadda Road in Peshawar as the study area, considering its significant rickshaw traffic and potential lane changing behavior.

Collect traffic-related data, including traffic volume, speed, and occupancy, using appropriate methods such as manual traffic counts, video recordings, or automated traffic monitoring systems.

Data Analysis and Comparison:

Analyze the collected traffic data to determine the existing traffic conditions on Charsadda Road, including average speed, traffic volume, congestion levels, and flow characteristics.

Identify sections or segments of the road where rickshaw drivers frequently engage in lane changing behavior.

Conduct a comparative analysis by simulating scenarios with and without lane changing using traffic simulation software (e.g., VISSIM, PARAMICS, Aimsun) to assess the impact on traffic flow, capacity, and congestion.

Field Observations and Surveys:

Conduct field observations to record lane changing behavior by rickshaw drivers and other vehicles. Note the frequency, location, and reasons behind lane changes.

Perform surveys and interviews with rickshaw drivers, commuters, and other road users to understand their perceptions, attitudes, and experiences related to lane changing behavior.

Traffic Safety Analysis:

Assess the safety implications of rickshaw drivers' lane changing behavior by analyzing historical accident data, if available, or conducting a before-and-after analysis by comparing accident rates before and after lane changing implementations.

Analyze surrogate safety measures such as conflicts and near-miss incidents to quantify the potential risk associated with rickshaw drivers' lane changing.

Traffic Flow Modeling:

Develop a traffic flow model for Charsadda Road using the collected data and simulation software to assess the impact of rickshaw drivers' lane changing on traffic operations.

Calibrate the model based on field data and validate it against observed traffic conditions to ensure its accuracy and reliability.

Evaluation and Recommendations:

Evaluate the findings from the data analysis, field observations, and traffic flow modeling to assess the impacts of rickshaw drivers' lane changing behavior on traffic flow, safety, and efficiency.

Based on the evaluation, provide recommendations for improving the road network design, traffic management strategies, and driver behavior to enhance traffic flow, reduce congestion, and improve safety.

Limitations and Ethical Considerations:

Acknowledge any potential limitations, such as data availability and quality, sample size, and generalizability of the findings.

Ensure ethical considerations in data collection, Chapter 4

Frequency Table

Figure 10 This is our case study area to measure the length.

Figure 11 To measure the length.

Figure 12 To measurer the dimension of Rickshaw.

Figure 13 To measure the dimension of Rickshaw.

Figure 14 We have accumulated data through drone camera.

Figure 15:This pic we have taken the PTV VISSIM Software.

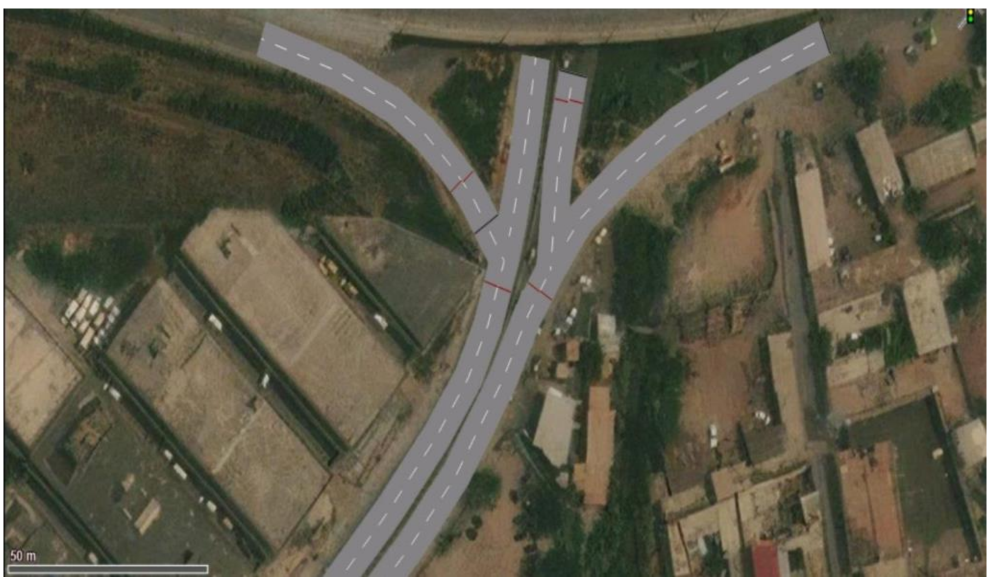


Figure 16 This pic we have taken the PTV VISSIM Software.

Figure 17: This pic we have taken the PTV VISSIM Software.

Figure 18:In this pic we have started the simulation of vehicles.

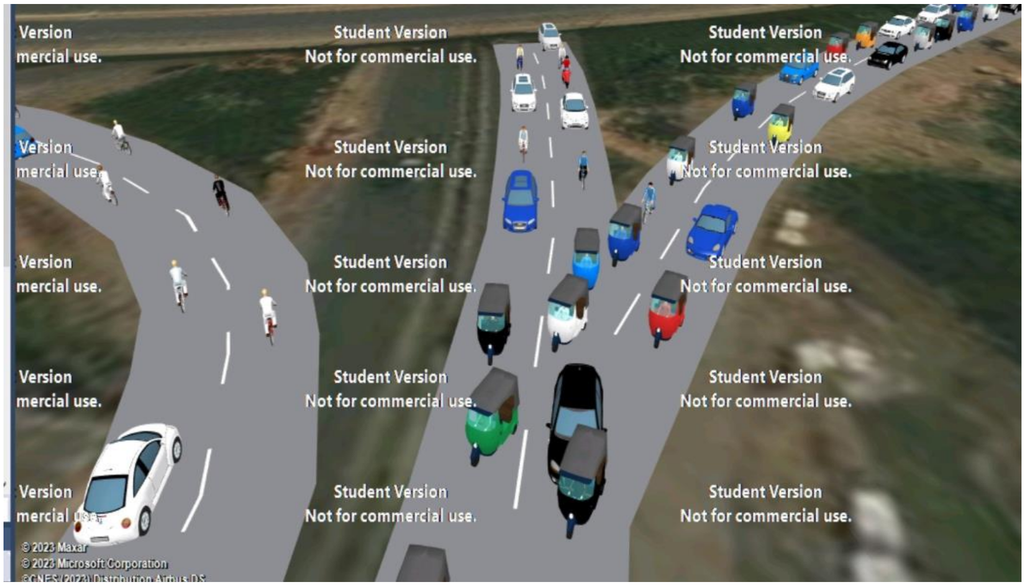


Figure 19 Simulation of vehicles.

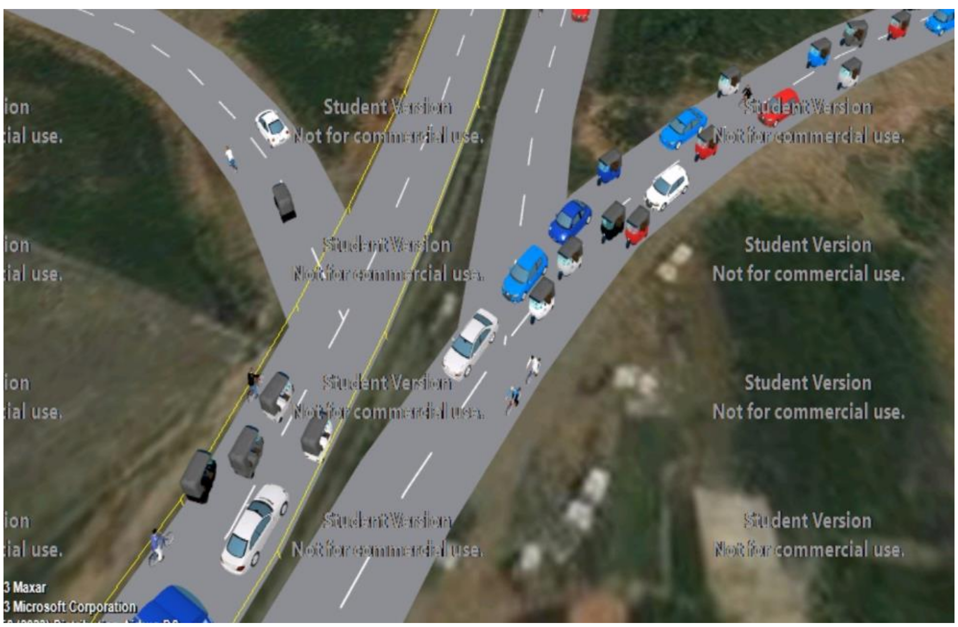


Figure 19: Simulation of vehicles.

days

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Friday	1	14.3	14.3	14.3
	Monday	1	14.3	14.3	28.6
	Saturday	1	14.3	14.3	42.9
	Sunday	1	14.3	14.3	57.1
	Thursday	1	14.3	14.3	71.4
	Tuesday	1	14.3	14.3	85.7
	Wednesday	1	14.3	14.3	100.0
	Total	7	100.0	100.0	

Rickshaw

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1667.00	1	14.3	14.3	14.3
	1831.00	1	14.3	14.3	28.6
	1937.00	1	14.3	14.3	42.9
	2288.00	1	14.3	14.3	57.1
	2344.00	1	14.3	14.3	71.4
	2414.00	1	14.3	14.3	85.7
	2737.00	1	14.3	14.3	100.0
	Total	7	100.0	100.0	

Motor car

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	963.00	1	14.3	14.3	14.3
	1019.00	1	14.3	14.3	28.6
	1297.00	1	14.3	14.3	42.9
	1368.00	1	14.3	14.3	57.1
	1441.00	1	14.3	14.3	71.4
	1471.00	1	14.3	14.3	85.7
	1635.00	1	14.3	14.3	100.0
	Total	7	100.0	100.0	

Suzuki

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	331.00	1	14.3	14.3	14.3
	447.00	1	14.3	14.3	28.6
	459.00	1	14.3	14.3	42.9
	463.00	1	14.3	14.3	57.1
	504.00	1	14.3	14.3	71.4
	507.00	1	14.3	14.3	85.7
	631.00	1	14.3	14.3	100.0
	Total	7	100.0	100.0	

BRT bus

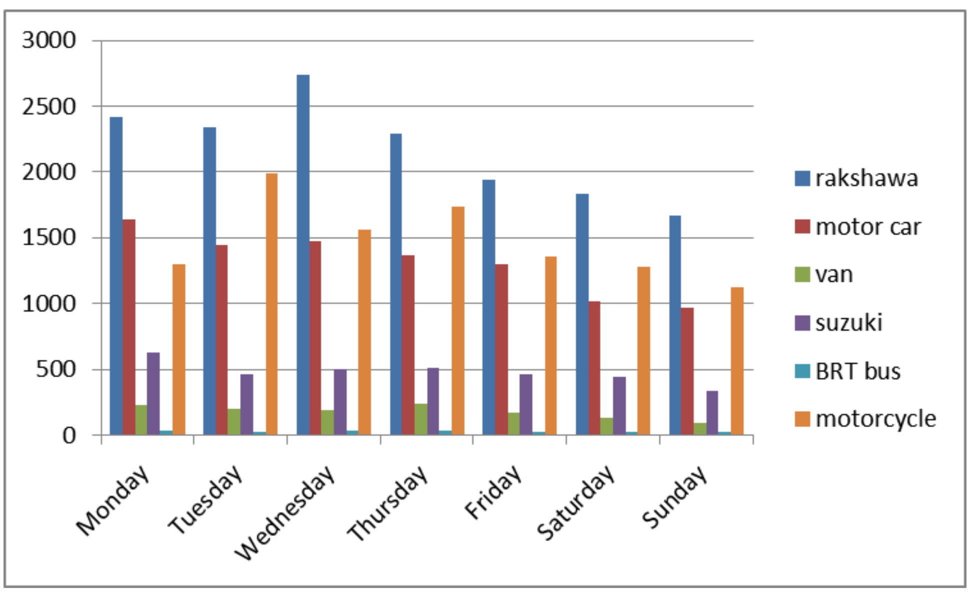
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	22.00	1	14.3	14.3	14.3
	26.00	1	14.3	14.3	28.6
	27.00	1	14.3	14.3	42.9
	28.00	1	14.3	14.3	57.1
	31.00	1	14.3	14.3	71.4
	32.00	1	14.3	14.3	85.7
	33.00	1	14.3	14.3	100.0
	Total	7	100.0	100.0	

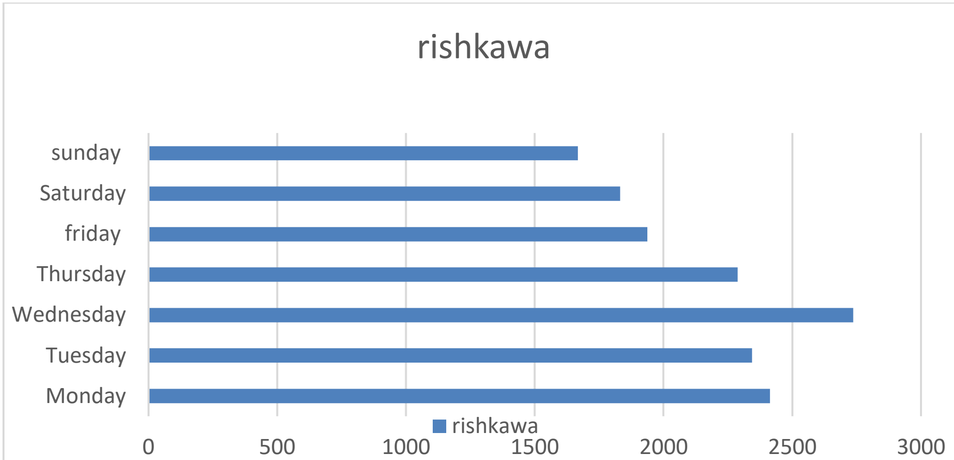
Van

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	95.00	1	14.3	14.3	14.3
	130.00	1	14.3	14.3	28.6
	167.00	1	14.3	14.3	42.9
	190.00	1	14.3	14.3	57.1
	196.00	1	14.3	14.3	71.4
	224.00	1	14.3	14.3	85.7
	235.00	1	14.3	14.3	100.0
	Total	7	100.0	100.0	

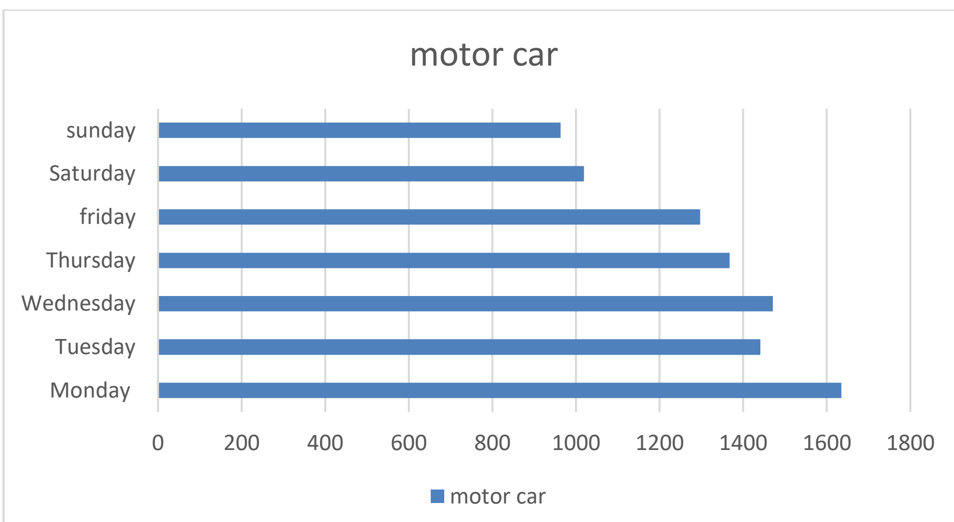
Motorcycle

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1127.00	1	14.3	14.3	14.3
	1277.00	1	14.3	14.3	28.6
	1299.00	1	14.3	14.3	42.9
	1353.00	1	14.3	14.3	57.1
	1562.00	1	14.3	14.3	71.4
	1735.00	1	14.3	14.3	85.7
	1987.00	1	14.3	14.3	100.0
	Total	7	100.0	100.0	

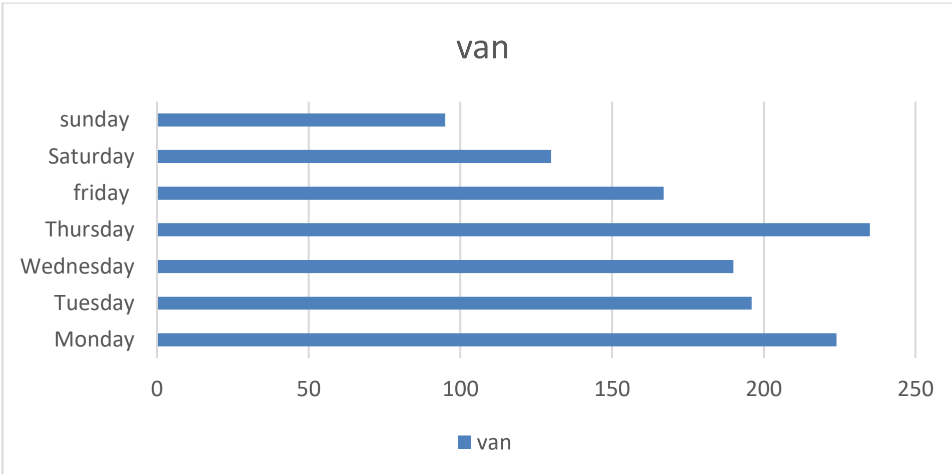




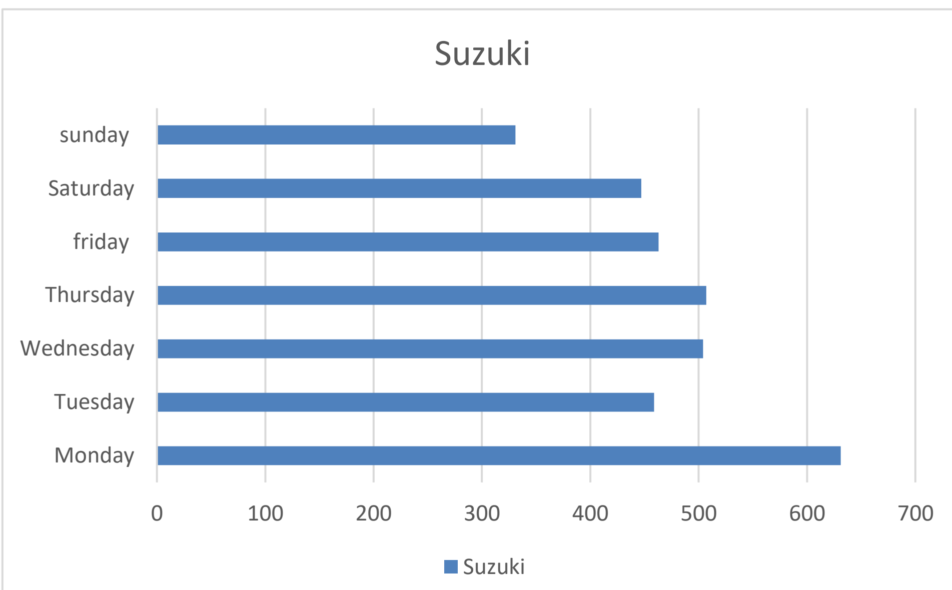
According to the data collected on Monday 2414 rickshaw use this route. on Tuesday 2344 rickshaw use it on Wednesday 2737 use that route on Thursday 2288 use that route on Friday this route is use by 1937 rickshaw on Saturday it is used by 1831 while on Sunday this route is used by 1667 rickshaw.



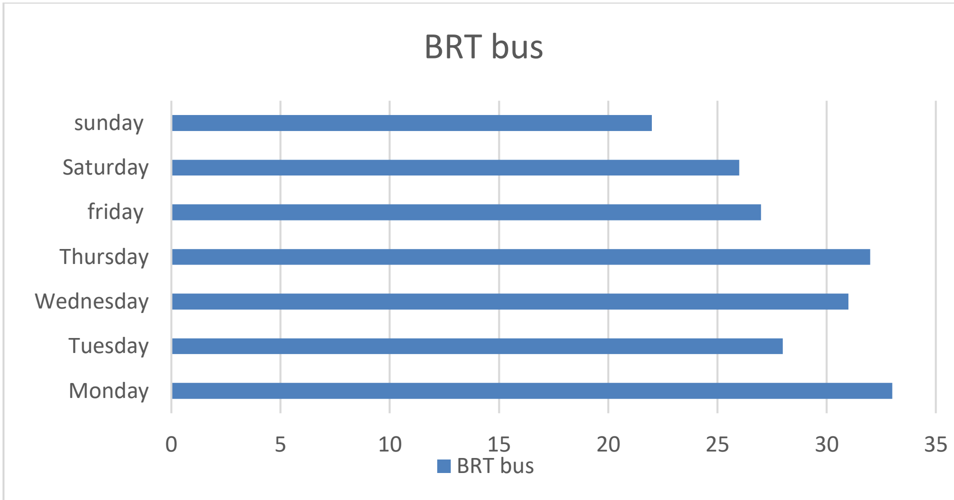
According to the data collected on Monday 1635 motor cars use this route. on Tuesday 1441 motor cars use it on Wednesday 1471 use that route on Thursday 1368 use that route on Friday this route is use by 1297 motor cars on Saturday it is used by 1019 while on Sunday this route is used by 963 motor cars.



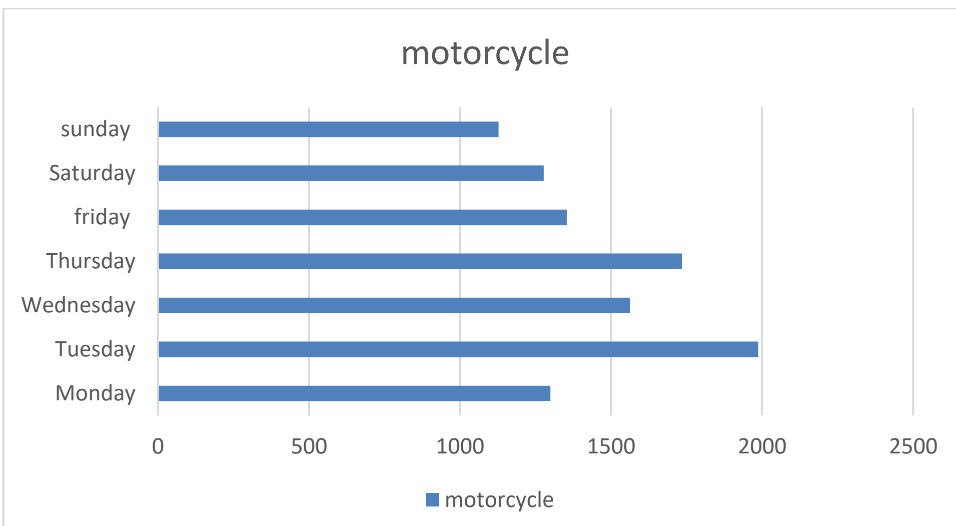
According to the data collected on Monday 224 van use this route. on Tuesday 196 van use it on Wednesday 190 use that route on Thursday 235 use that route on Friday this route is use by 167 vans on Saturday it is used by 130 while on Sunday this route is used by 95 vans.



According to the data collected on Monday 631 suzuki use this route . on Tuesday 459 suzuki use it on Wednesday 504 suzuki use that route on Thursday 507 use that route on Friday this route is use by 463 suzuki on Saturday it is used by 447 while on Sunday this route is used by 331 suzuki.



According to the data collected on Monday 33 BRT buses use this route. on Tuesday 28 BRT buses use it on Wednesday 31 BRT buses use that route on Thursday 32 use that route on Friday this route is use by 27 BRT bus on Saturday it is used by 26 while on Sunday this route is used by 22 BRT buses.

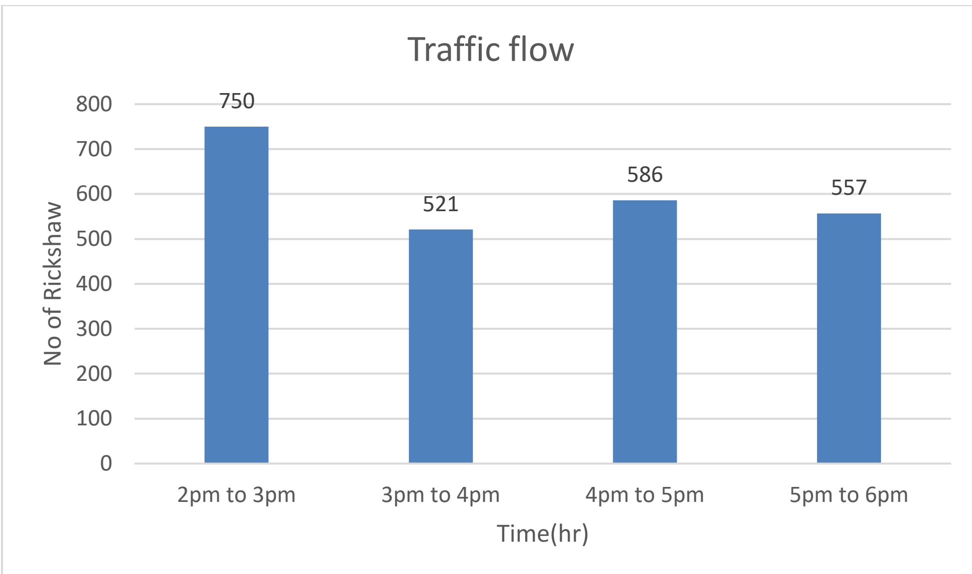


According to the data collected on Monday 1299 motorcycle use this route. on Tuesday 1987 motorcycles use it on Wednesday 1562 use that route on Thursday 1735 use that route on Friday this route is use by 1353 motorcycles on Saturday it is used by 1277 while on Sunday this route is used by 1127 motorcycles

According to the above given statistical analysis it indicates that among all the vehicles the rickshaw is the most used vehicle on this road whose use is more maximum on Wednesday according to our collected information. the maximum number of rickshaws using this road is 2737 which is too much in comparison to motor cars, vans, Suzuki, brt buses and motor cycles.

RESULTS:

Monday:



The above graphic shows that the no of traffic flow per hour so the maximum no of traffic flow in 2 to 3 pm. Because this is the end time of college, school, university and offices etc. so everyone uses the Auto Rickshaw.

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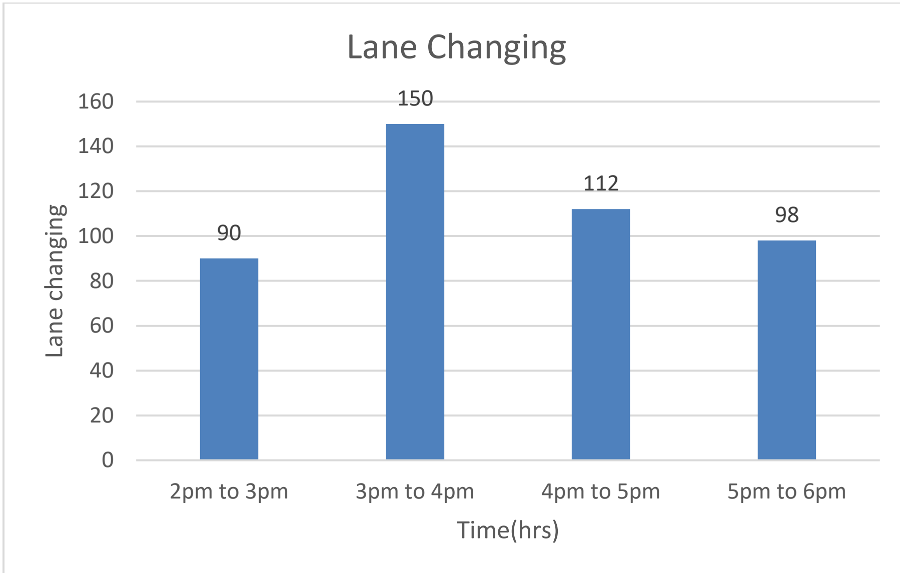
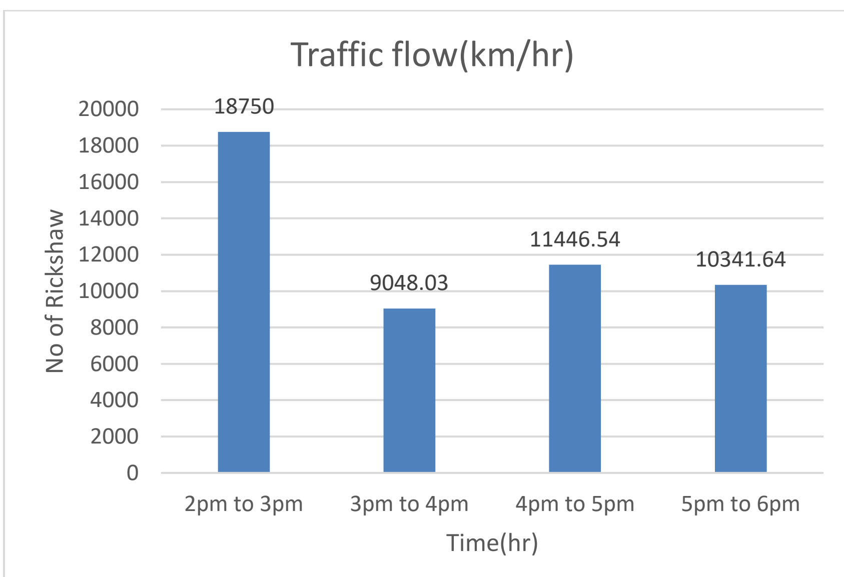
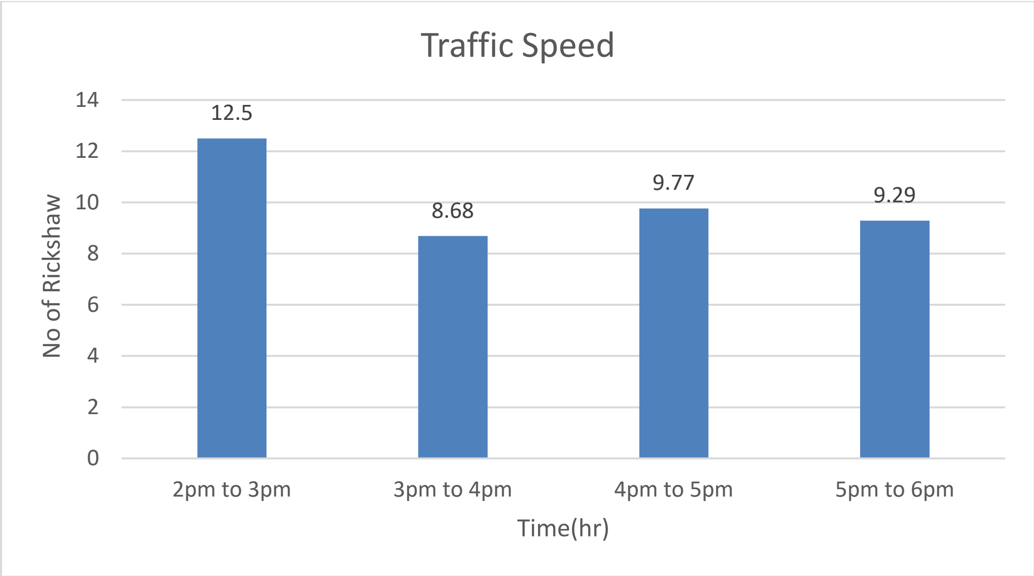


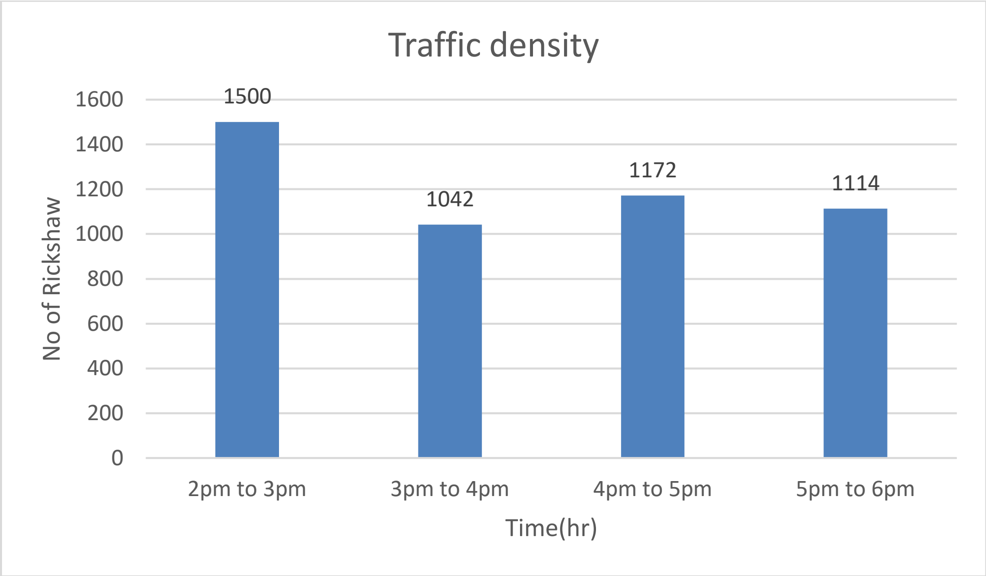
The above graphic shows that how many rickshaws change has lane per hour so the minimum rickshaw change has lane 2 to 3 pm. Due to this behavior the traffic is high at this time.



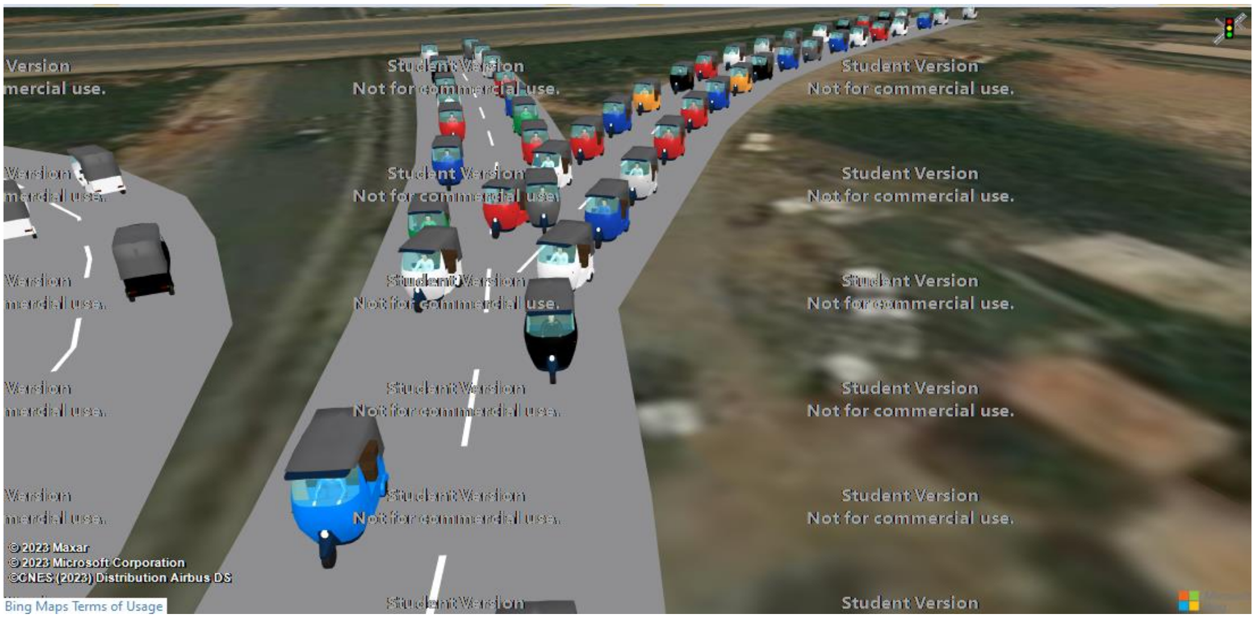
The above graphic shows that the traffic flow(km/hr). The maximum traffic flow (km.hr) is at 2 to 3 pm. Because this time the traffic is high.



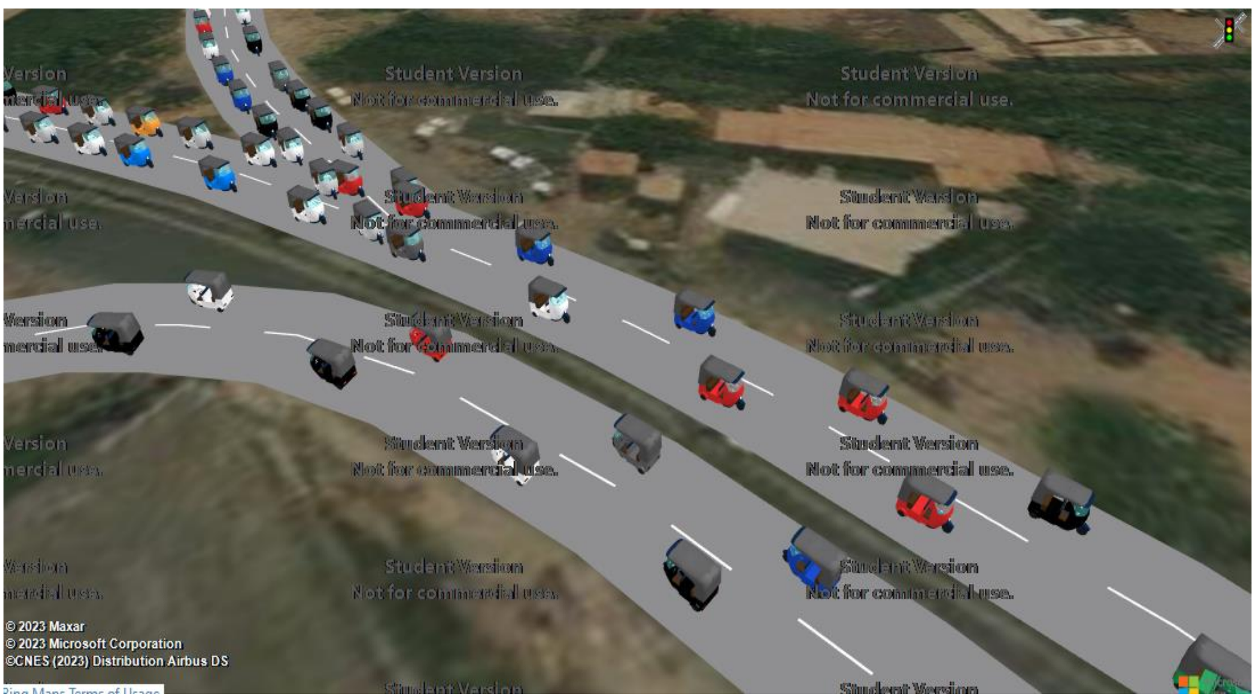
The above graphic shows that the traffic speed. the minimum speed of rickshaw is at 3pm to 4pm.Because this time there are no more traffic.



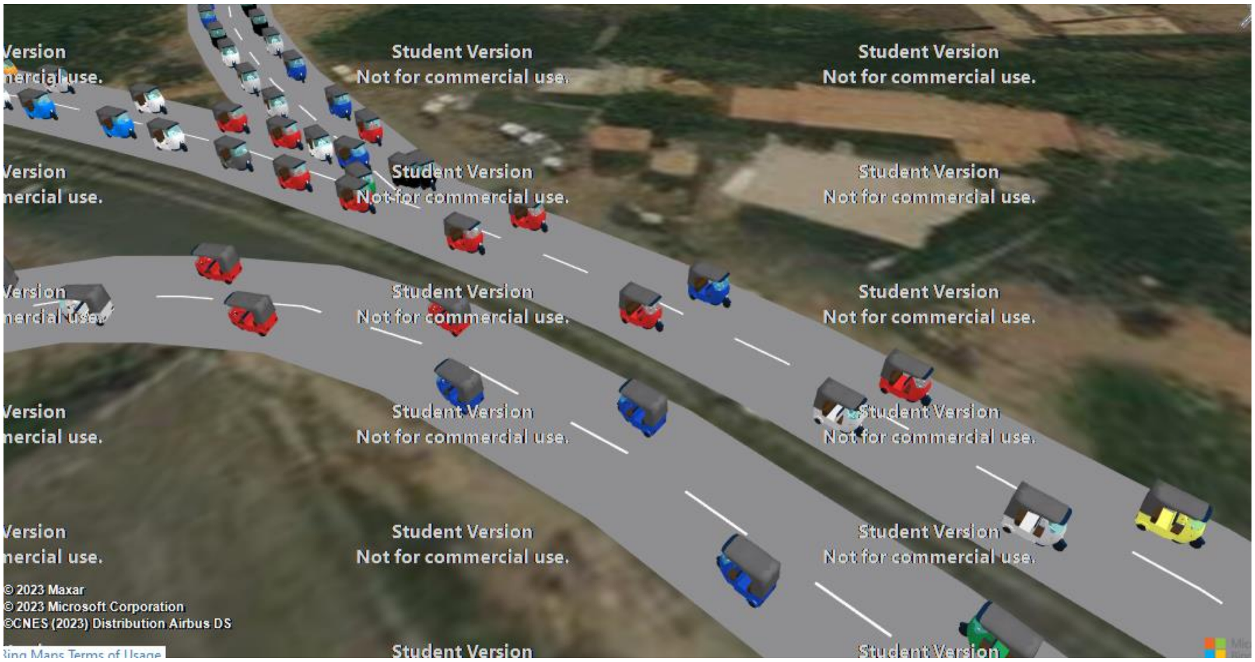
The above graphic shows that the traffic density. The maximum traffic density is at 2pm to 3pm.Because this time the traffic is high.



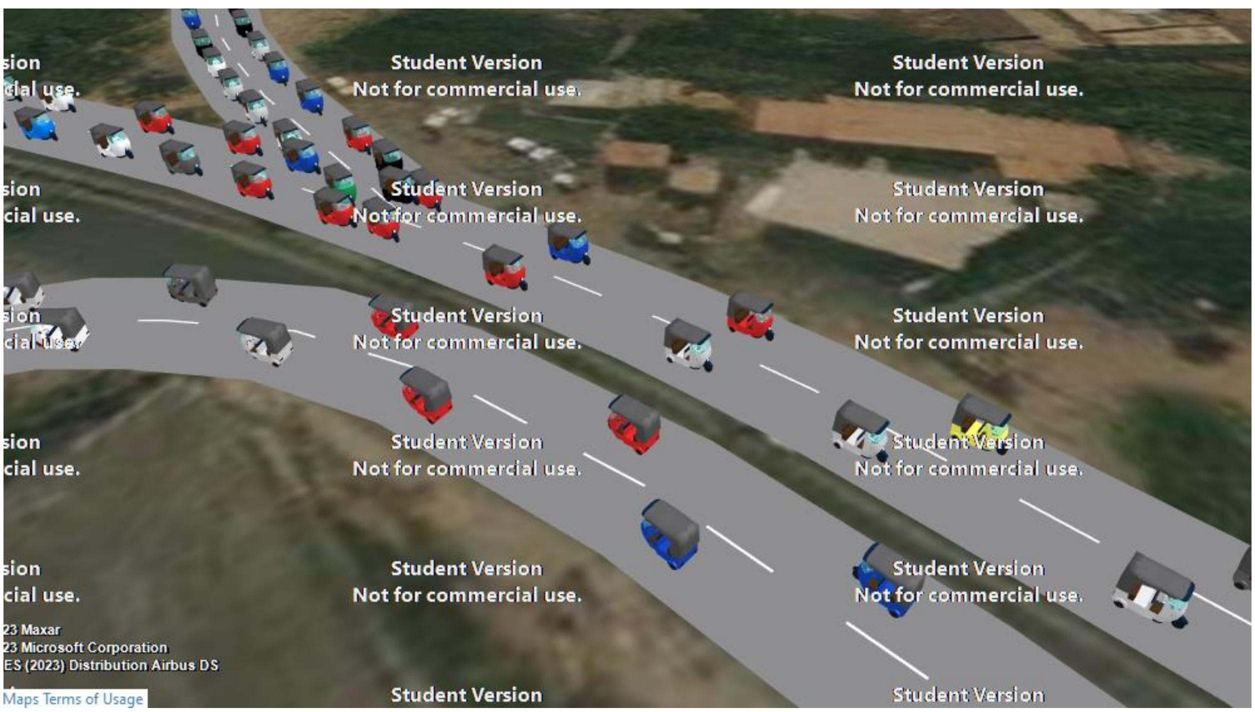
The above figure shows that the speed of rickshaw is at 2pm to 3pm. So the speed of rickshaw 13 km/hr.



The above figure shows that the speed of rickshaw is at 3pm to 4pm So, the speed of rickshaw 9.2 km/hr. The traffic flow is 9048.03

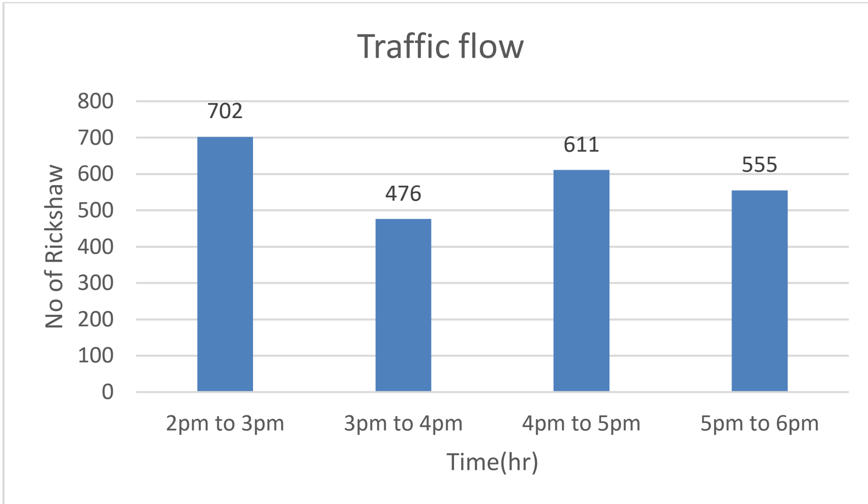


The above figure shows that the speed of rickshaw is at 4pm to 5pm. So the speed of rickshaw 10.3km/hr. The traffic flow is 11444.

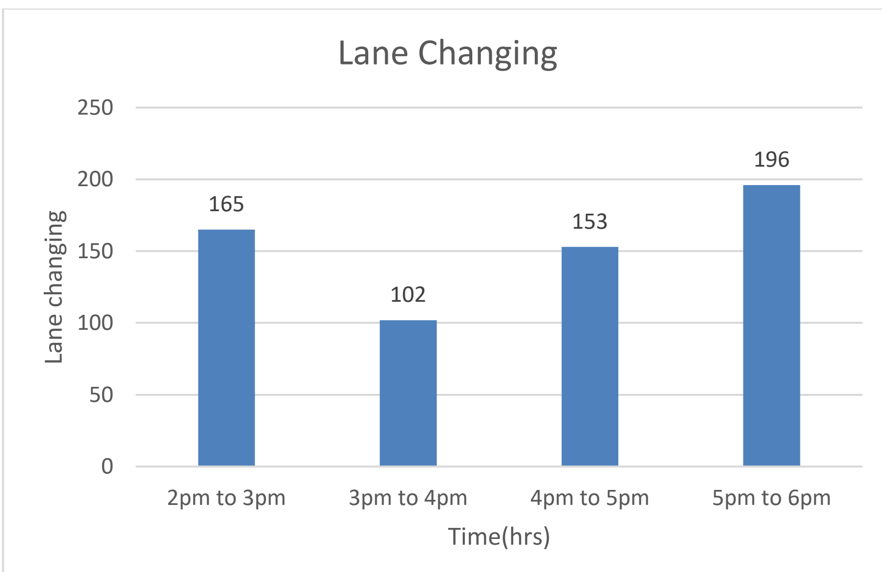


The above figure shows that the speed of rickshaw is at 5pm to 6pm. So the speed of rickshaw 9.85 km/hr. The traffic flow is 10341.

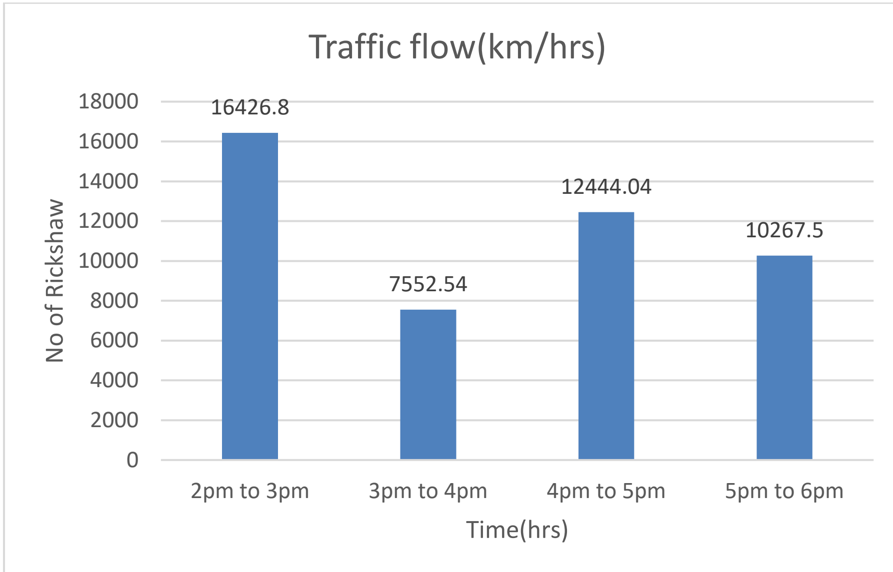
Tuesday:



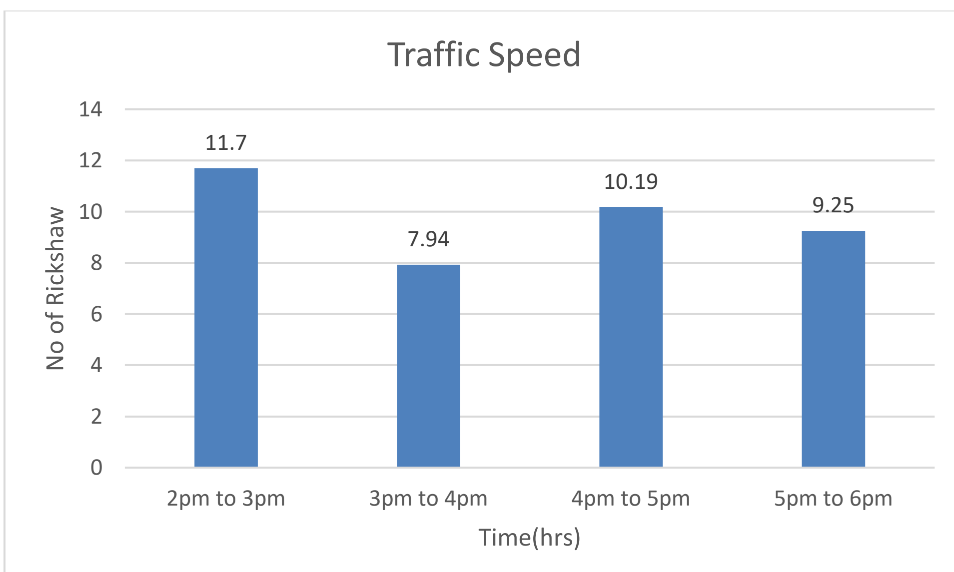
The above graphic shows that the no of traffic flow per hour so the maximum no of traffic flow in 2 to 3 pm. Because this is the end time of college, school, university and offices etc. so everyone uses the Auto Rickshaw.



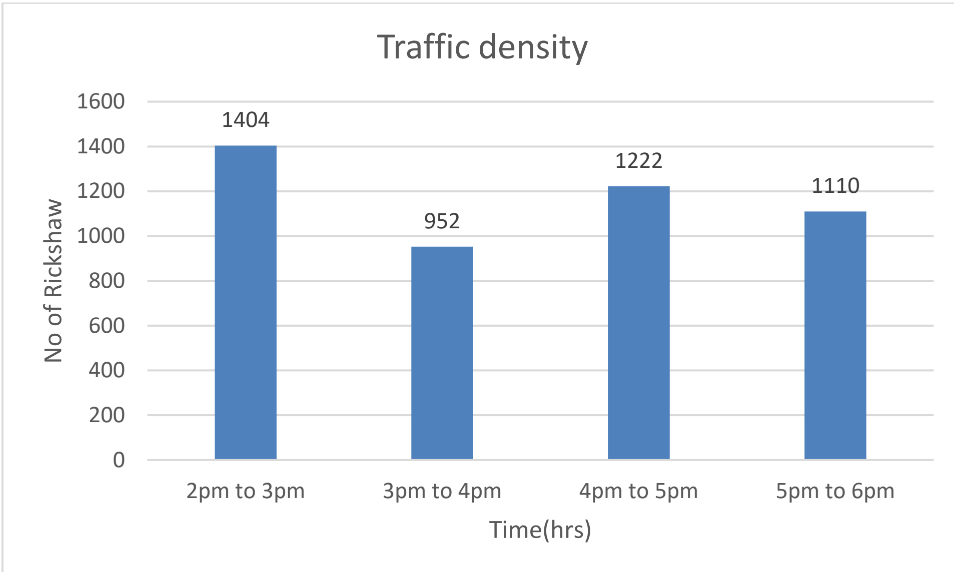
The above graphic shows that how many rickshaws change has lane per hour so the maximum rickshaw change has lane 5 to 6pm. Due to this behavior the traffic is high at this time because everyone try to reached early



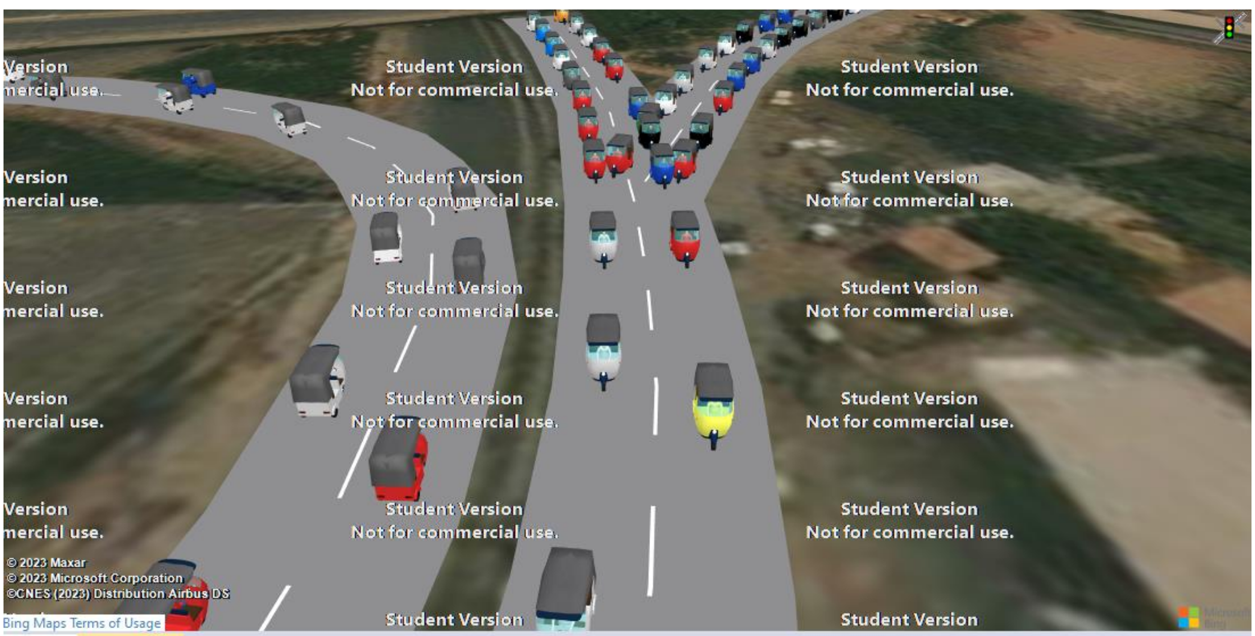
The above graphic shows that the traffic flow(km/hrs.). The maximum traffic flow (km/hrs.) is at 2 to 3 pm. Because this time the traffic is high.



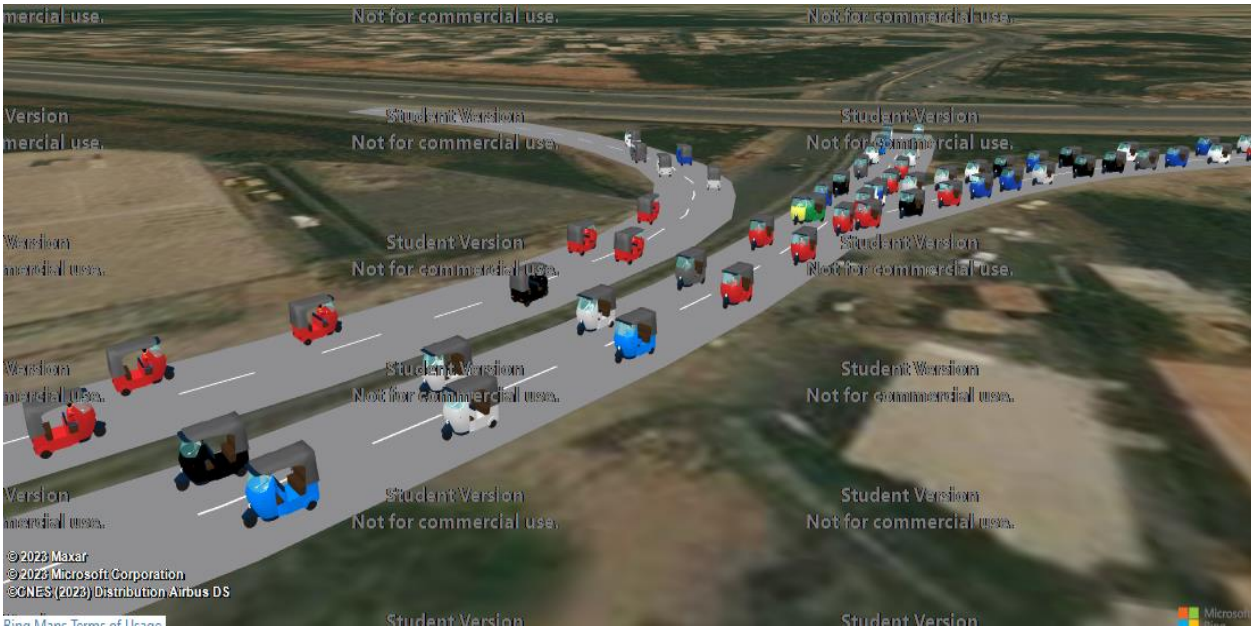
The above graphic shows that the traffic speed. the maximum speed of rickshaw is at 3pm to 4pm.Because this time the traffic is high.



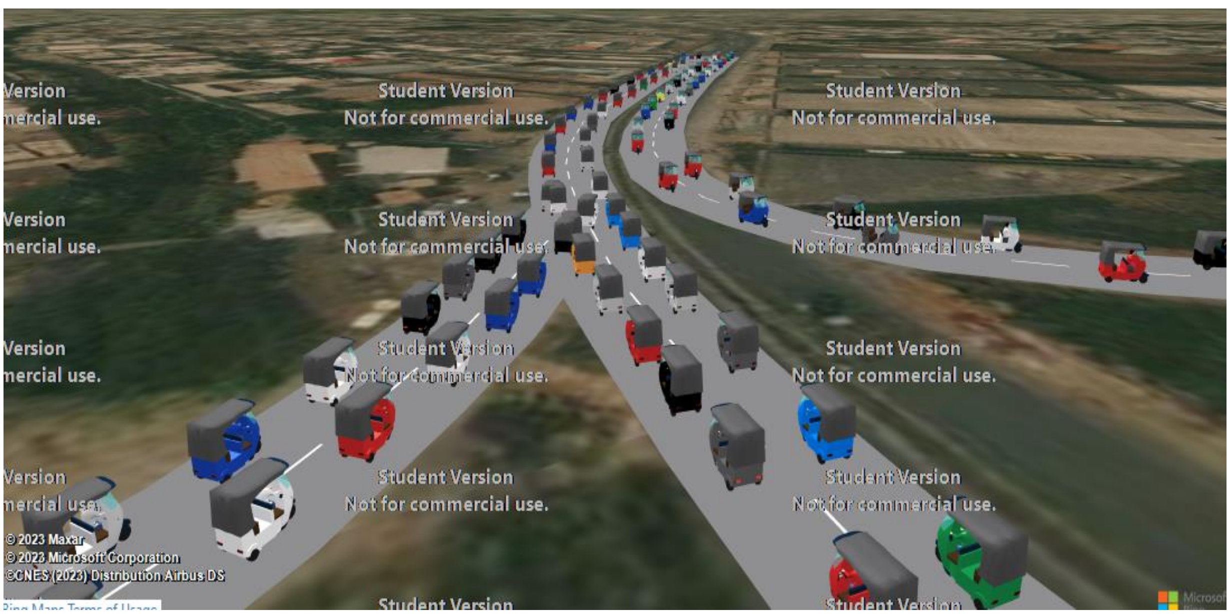
The above graphic shows that the traffic density. The maximum traffic density is at 2pm to 3pm. Because this time the traffic is high.



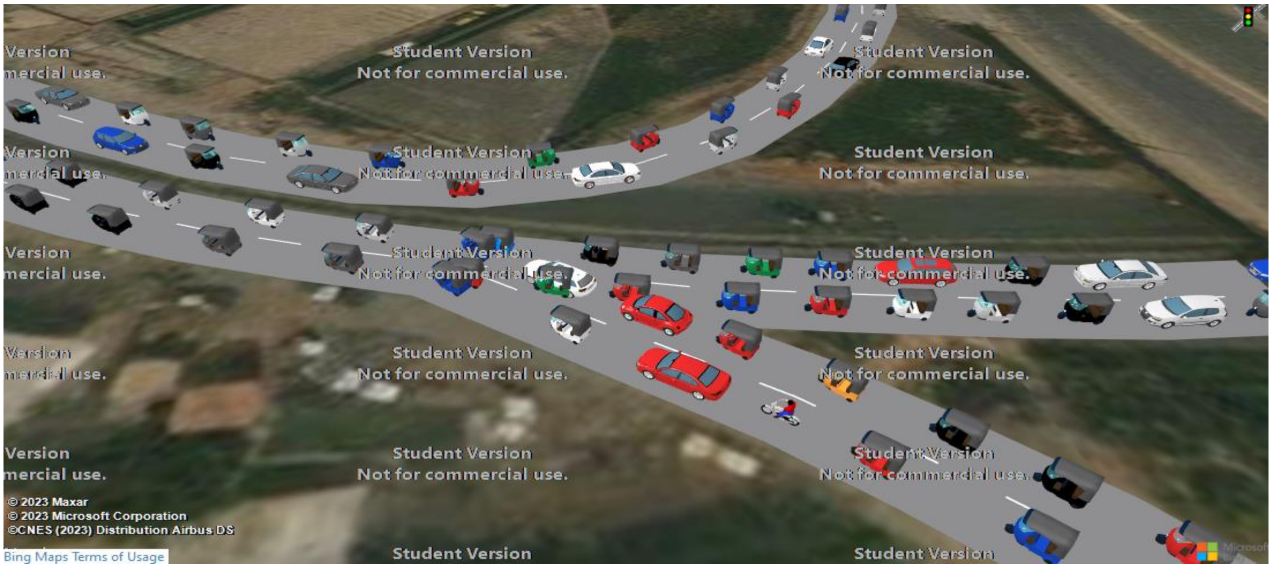
The above figure shows that the speed of rickshaw is at 2pm to 3pm So, the speed of rickshaw 12.3 km/hr. The traffic flow is 16426.8



The above figure shows that the speed of rickshaw is at 3pm to 4pm So, the speed of rickshaw 8.94 km/hr. The traffic flow is 7552.54

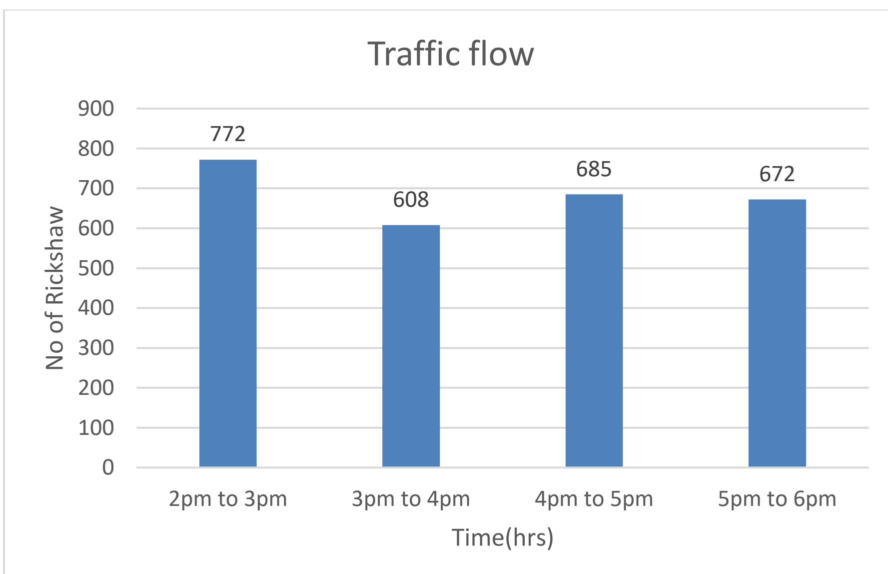


The above figure shows that the speed of rickshaw is at 4pm to 5pm So, the speed of rickshaw 10.69km/hr. The traffic flow is 12444.04

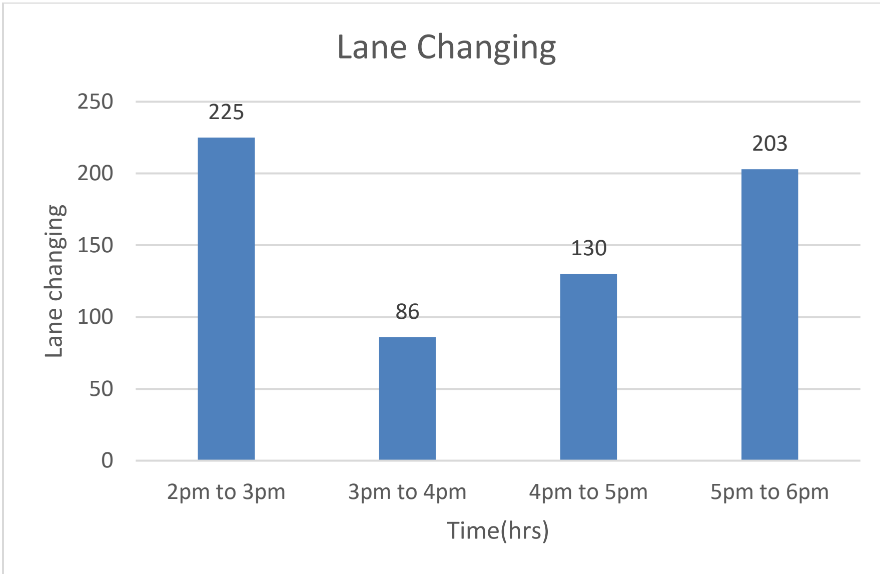


The above figure shows that the speed of rickshaw is at 5pm to 6pm So, the speed of rickshaw 9.65km/hr. The traffic flow is 10267.5

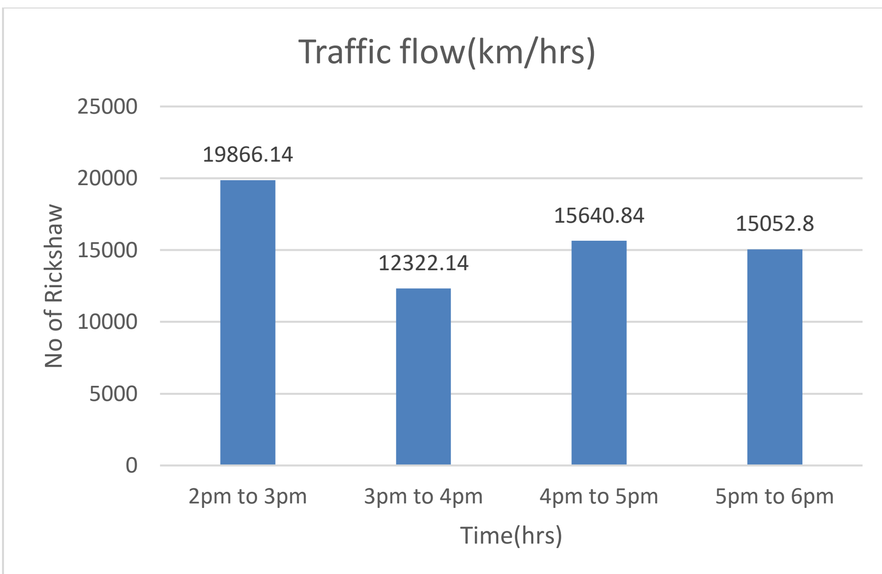
Wednesday:



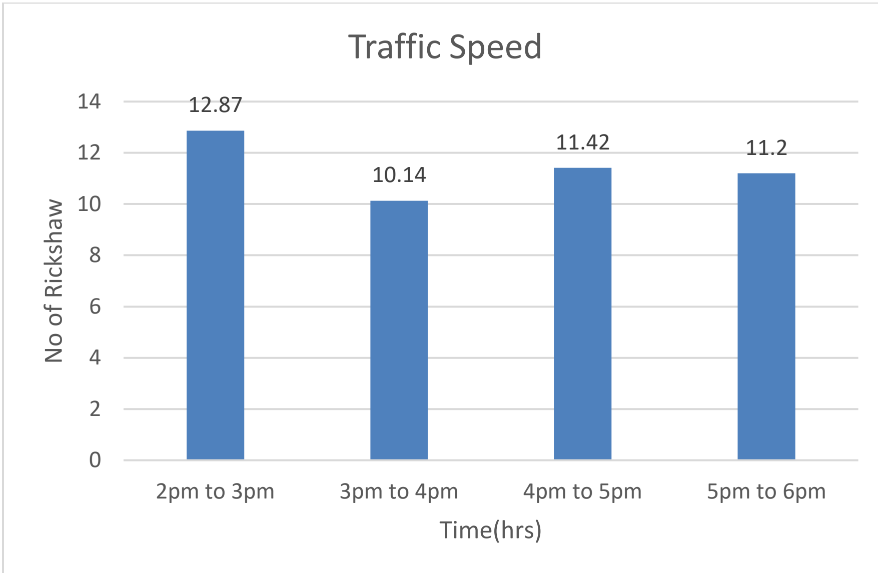
The above graphic shows that the no of traffic flow per hour so the maximum no of traffic flow in 2 to 3 pm. Because this is the end time of college, school, university and offices etc. so everyone uses the Auto Rickshaw.



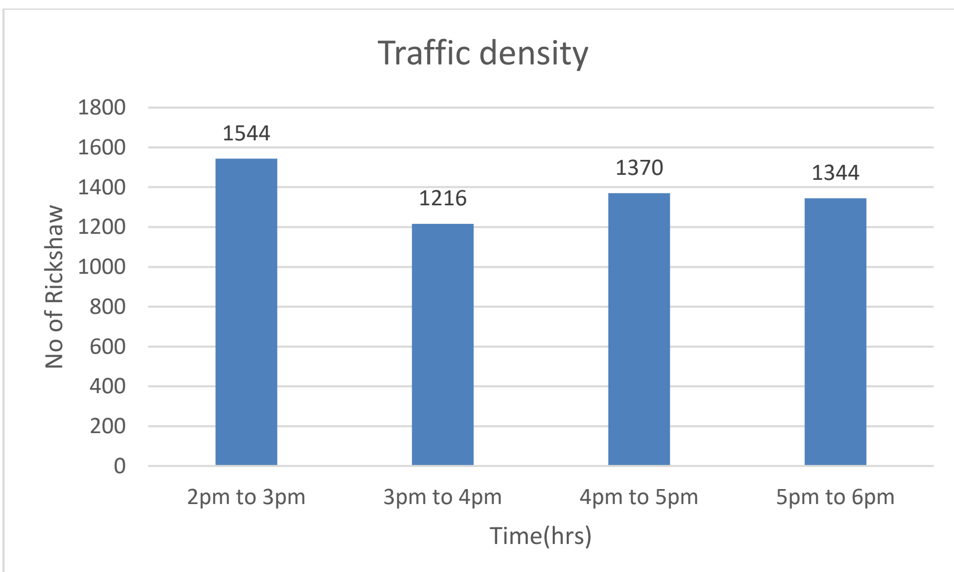
The above graphic shows that how many rickshaws change has lane per hour so the maximum rickshaw change has lane 2 to 3 pm. Due to this behavior the traffic is high at this time because everyone try to reached early.



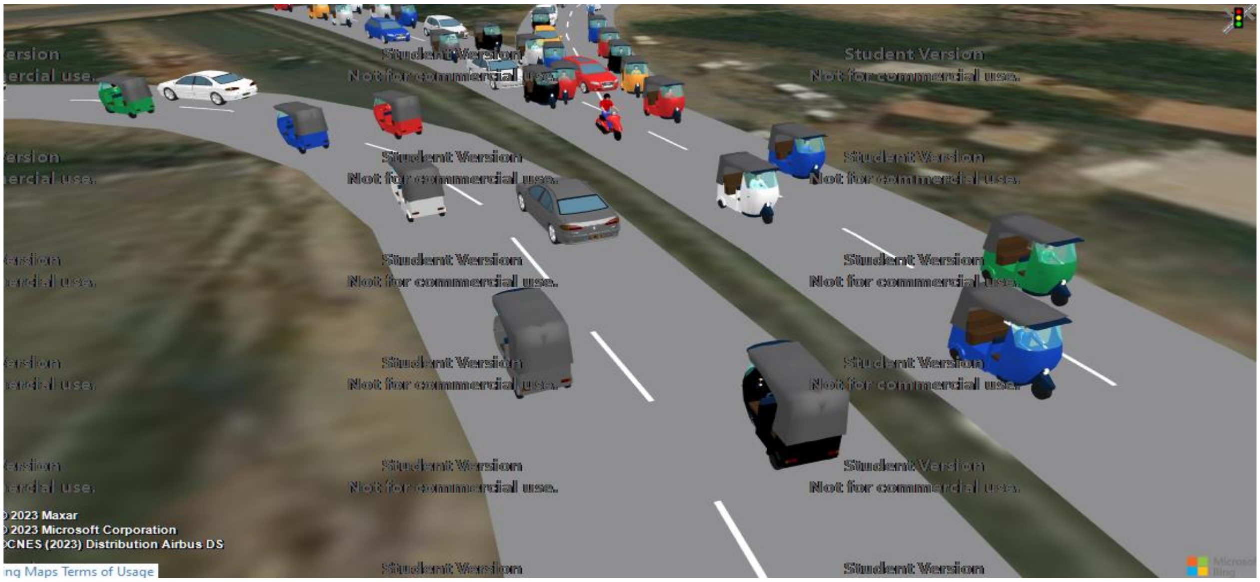
The above graphic shows that the traffic flow(km/hrs). The maximum traffic flow (km/hrs) is at 2 to 3 pm. Because this time the traffic is high.



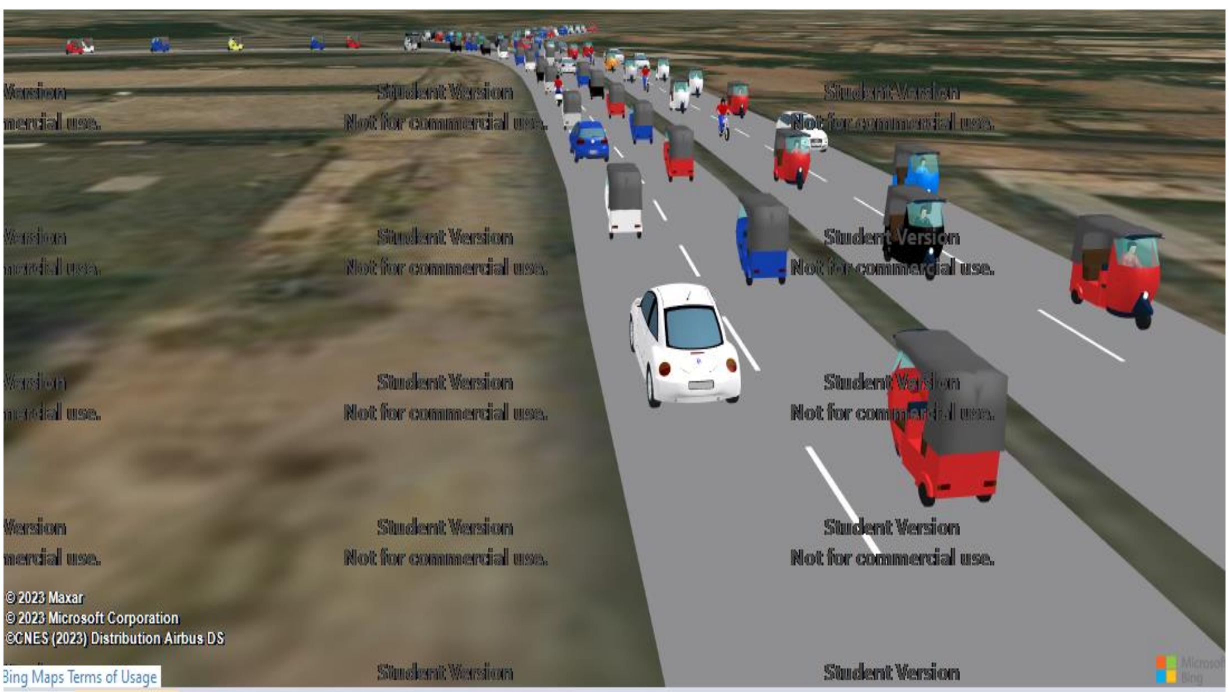
The above graphic shows that the traffic speed. the maximum speed of rickshaw is at 2pm to 3pm.Because this time the traffic is high.



The above graphic shows that the traffic density. The maximum traffic density is at 2pm to 3pm.Because this time the traffic is high.

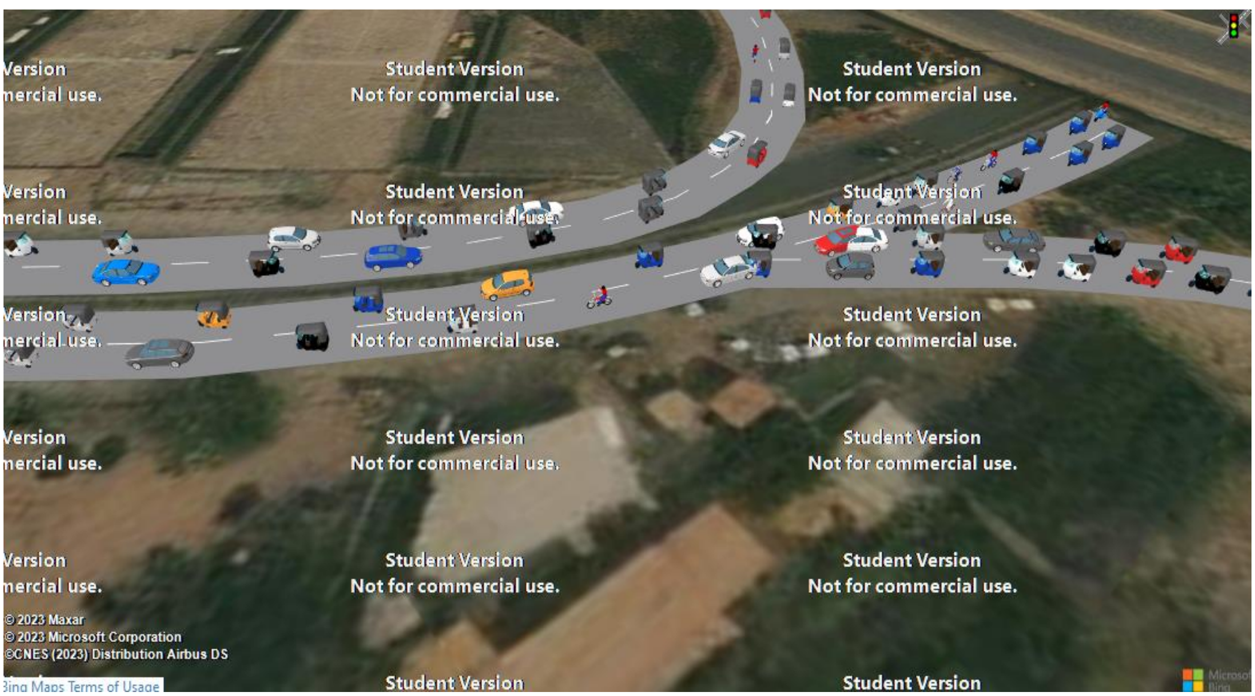


The above figure shows that the speed of rickshaw is at 2pm to 3pm So, the speed of rickshaw 13.87km/hr. The traffic flow is 19866.14



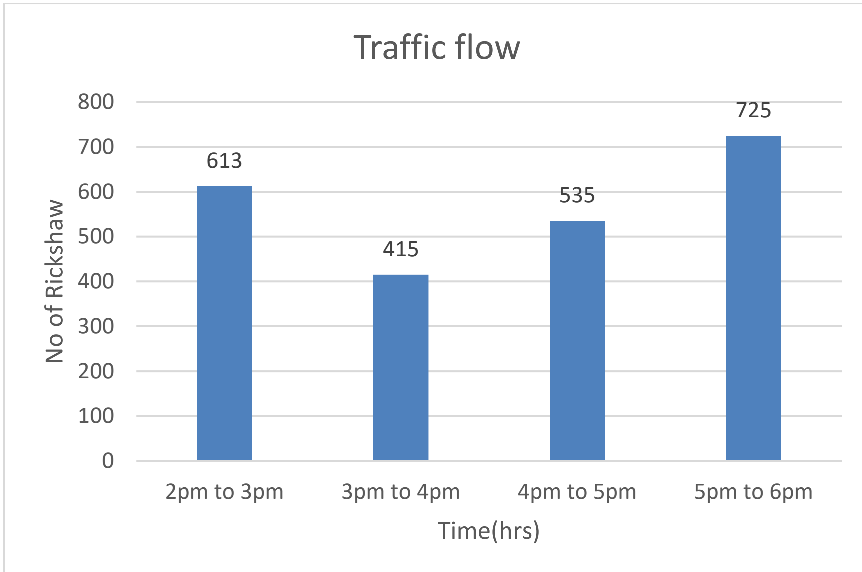
The above figure shows that the speed of rickshaw is at 3pm to 4pm So, the speed of rickshaw 10.6km/hr. The traffic flow is 12322.14

The above figure shows that the speed of rickshaw is at 4pm to 5pm. So the speed of rickshaw 11.62km/hr. The traffic flow is 15640.84

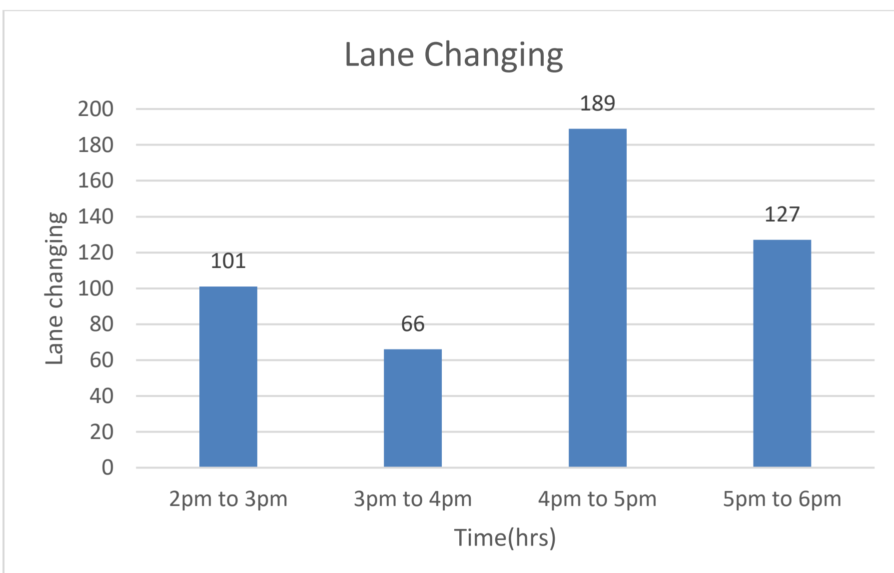


The above figure shows that the speed of rickshaw is at 5pm to 6pm So, the speed of rickshaw 11.5km/hr. The traffic flow is 15052.

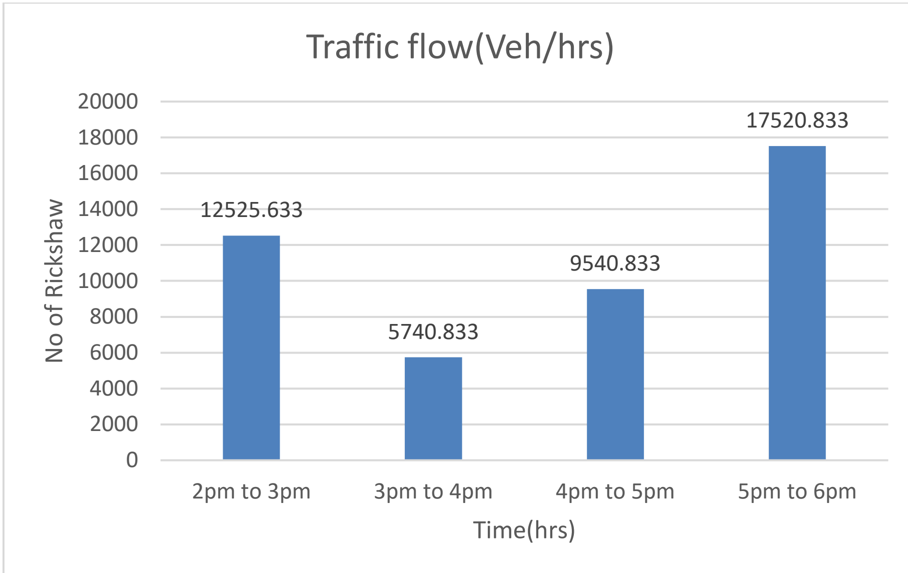
Thursday:



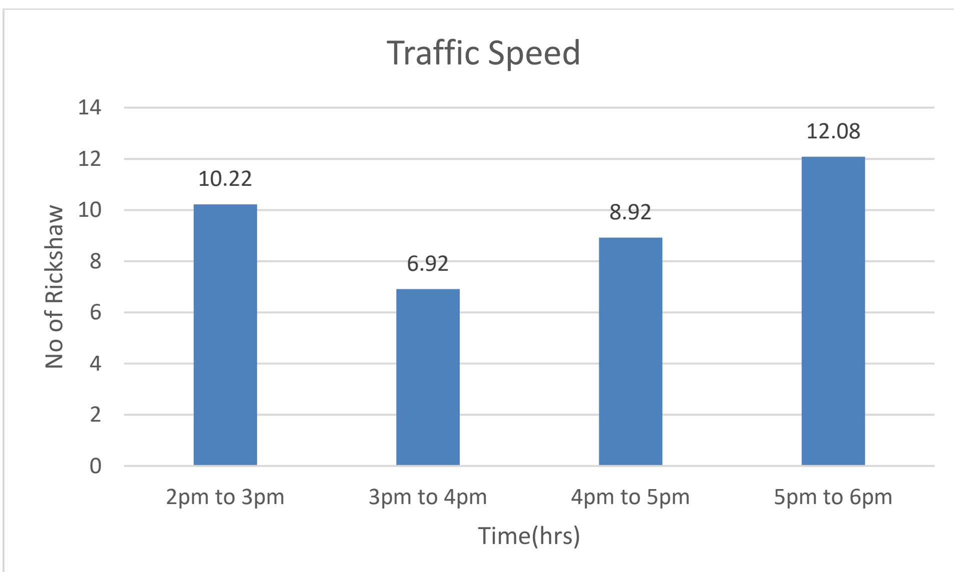
The above graphic shows that the no of traffic flow per hour so the maximum no of traffic flow in 5 to 6pm.



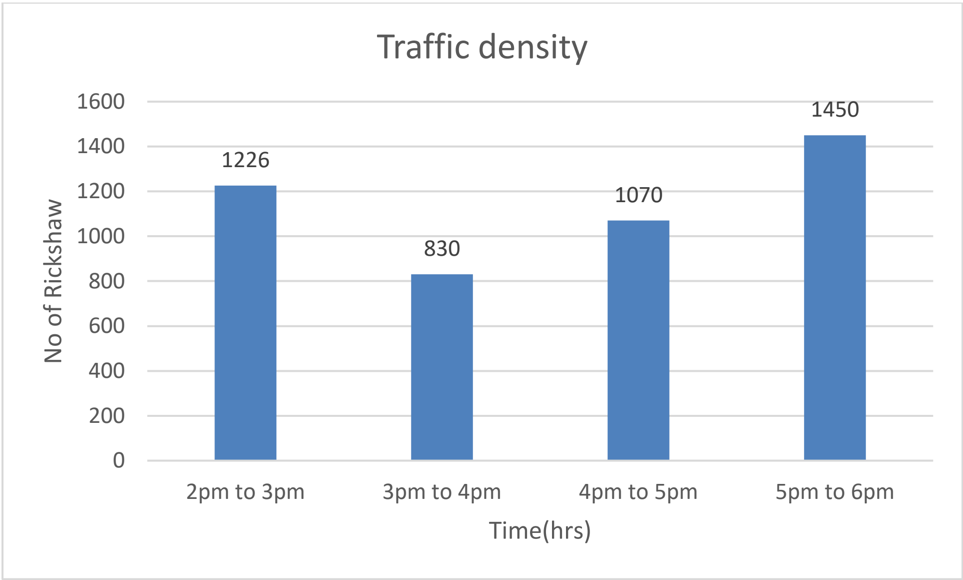
The above graphic shows that how many rickshaws change has lane per hour so the maximum rickshaw change has lane 4 to 5 pm. Because this time there are no more traffic.



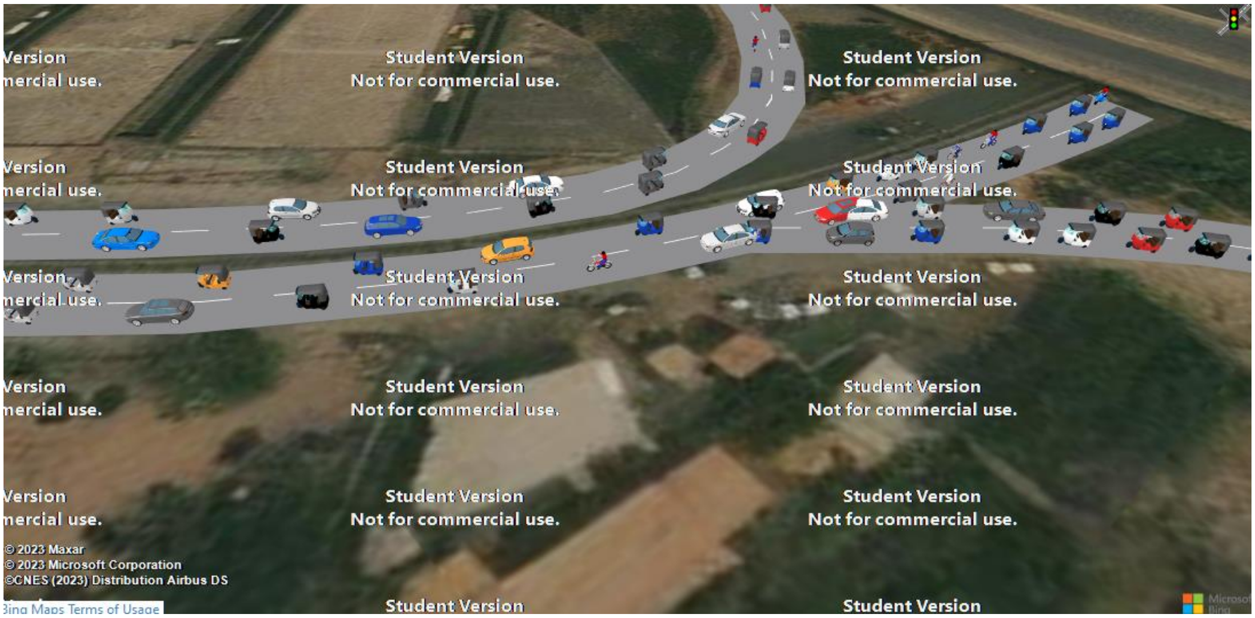
The above graphic shows that the traffic flow(km/hrs). The maximum traffic flow (km/hrs) is at 5 to 6 pm. Because this time the traffic is high.



The above graphic shows that the traffic speed. the minimum speed of rickshaw is at 3pm to 4pm.

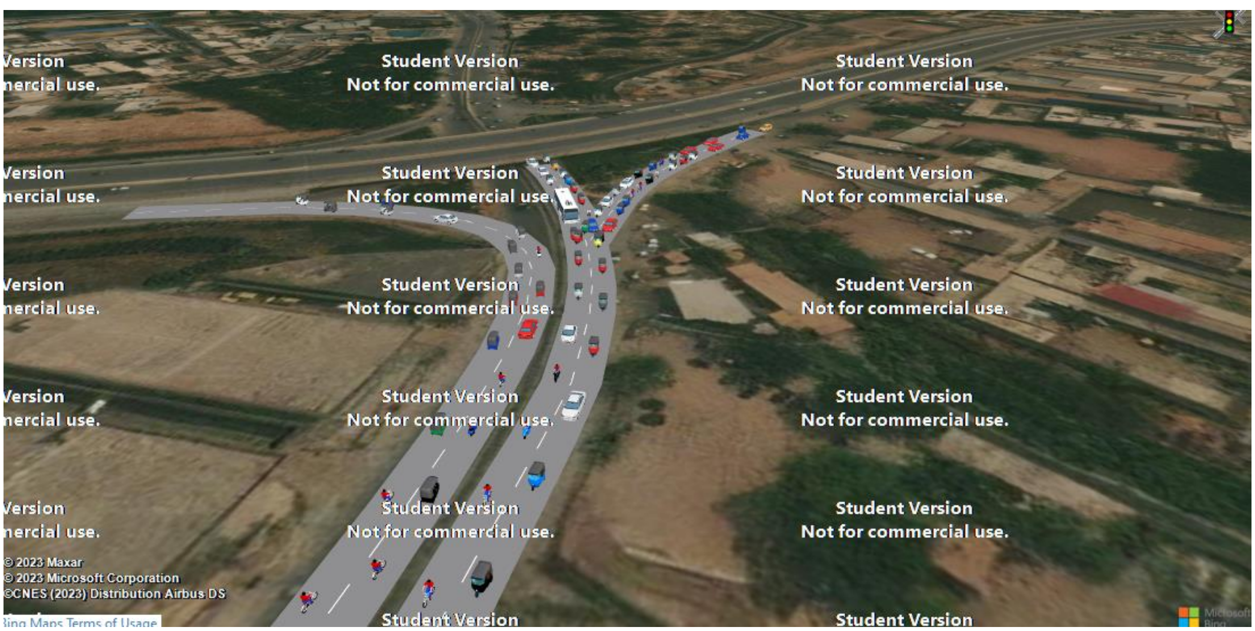


The above graphic shows that the traffic density. The maximum traffic density is at 5pm to 6pm.Because this time the traffic is high.

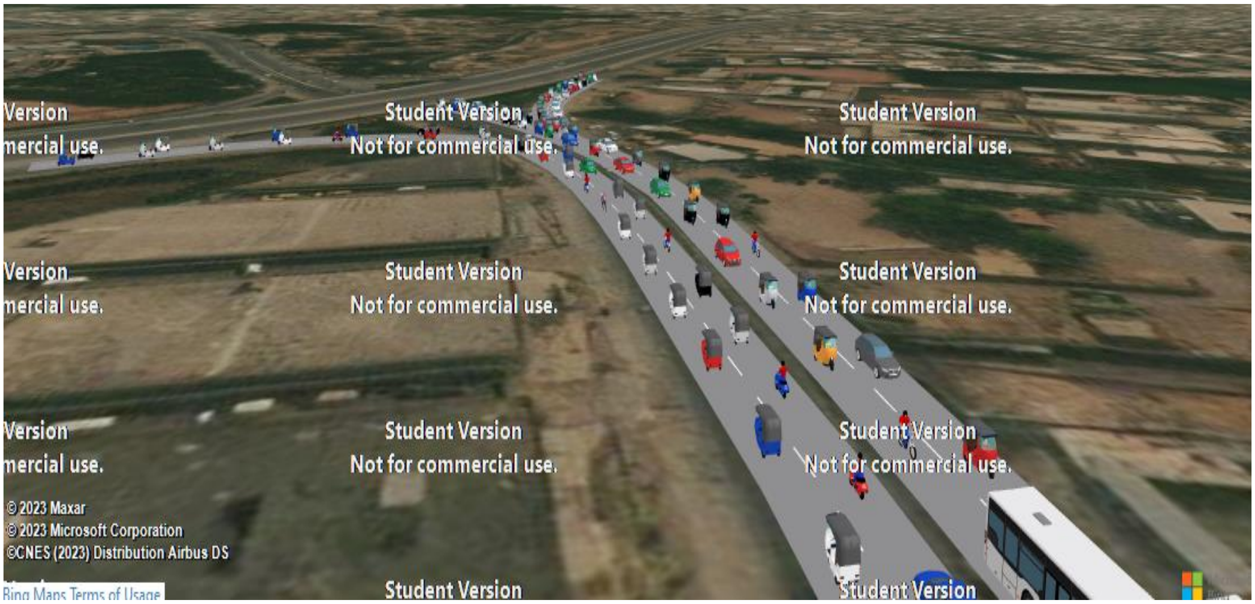


The above figure shows that the speed of rickshaw is at 2pm to 3pm. So the speed of rickshaw 11.2km/hr. The traffic flow is 15525.633.

The above figure shows that the speed of rickshaw is at 3pm to 4pm. So the speed of rickshaw 8.92km/hr. The traffic flow is 5740.833

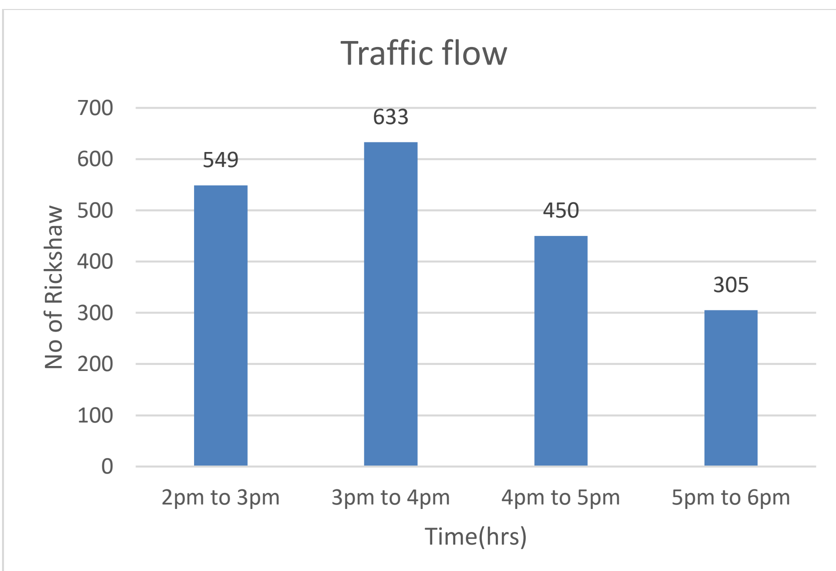


The above figure shows that the speed of rickshaw is at 4pm to 5pm. So the speed of rickshaw 9.92km/hr. The traffic flow is 9540.833

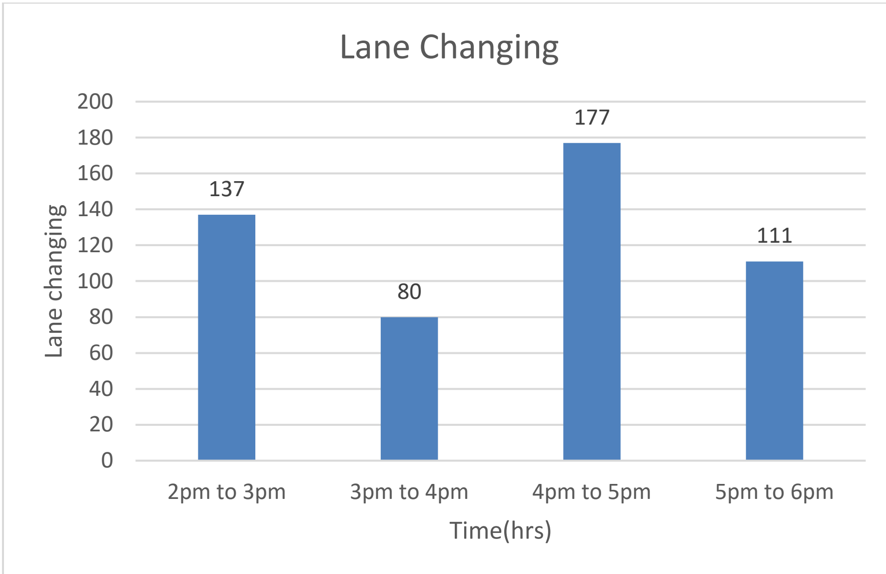


The above figure shows that the speed of rickshaw is at 5pm to 6pm. So the speed of rickshaw 13.08km/hr. The traffic flow is 17520.833

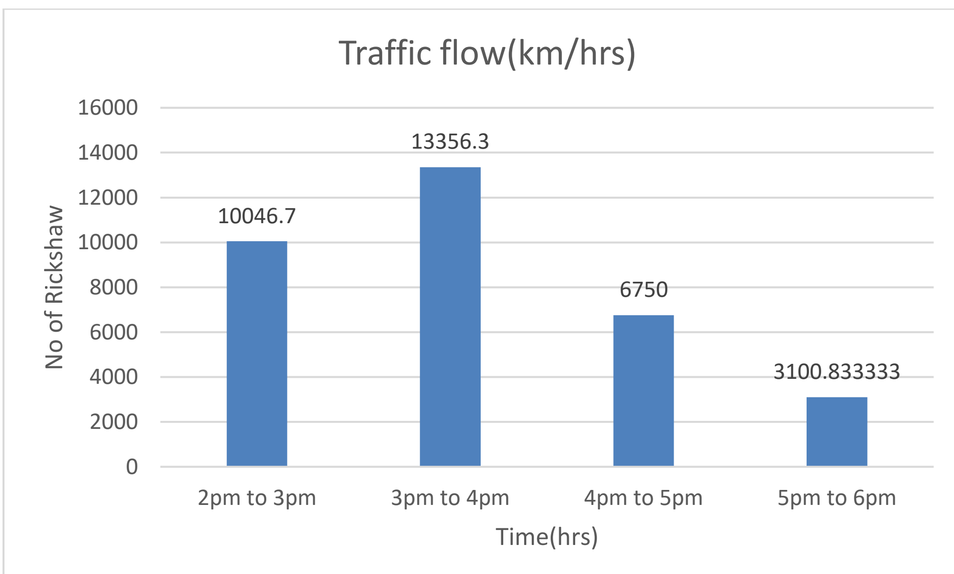
Friday:



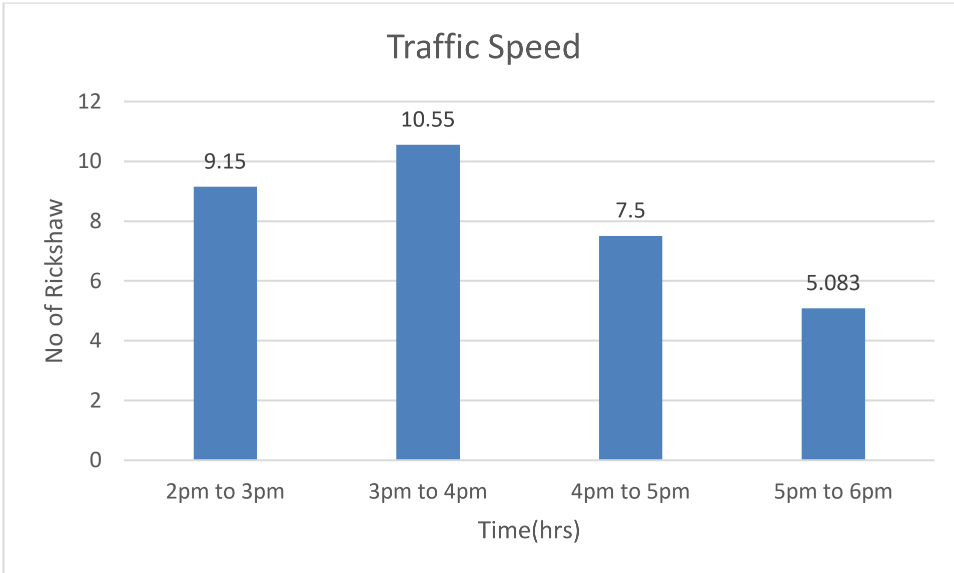
The above graphic shows that the no of traffic flow per hour so the maximum no of traffic flow in 3 to 4 pm.



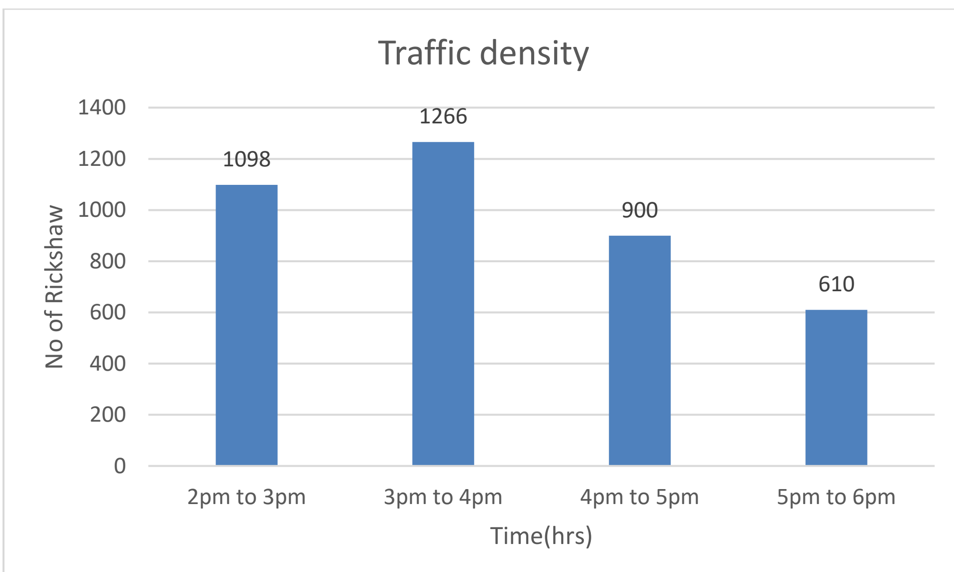
The above graphic shows that how many rickshaws change has lane per hour so the minimum rickshaw change has lane 3 to 4 pm. Because this time there are more traffic.



The above graphic shows that the traffic flow(km/hrs). The maximum traffic flow (km/hrs) is at 3 to 4 pm. Because this time the traffic is high.

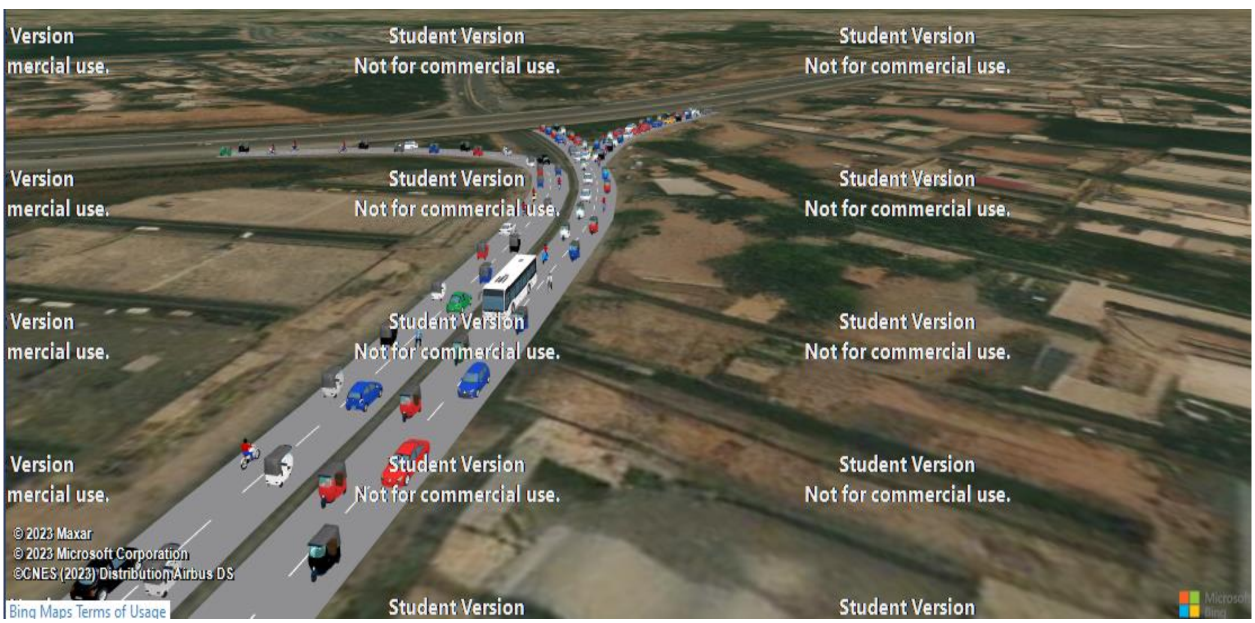


The above graphic shows that the traffic speed. the minimum speed of rickshaw is at 3pm to 4pm.



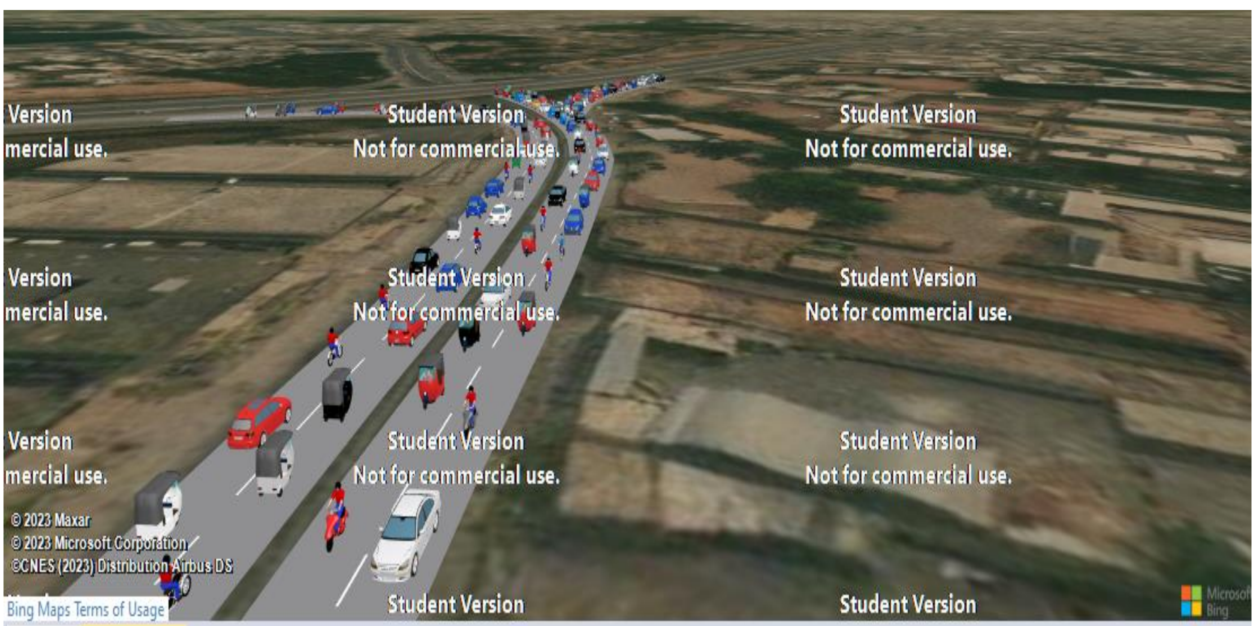
The above graphic shows that the traffic density. The maximum traffic density is at 3pm to 4pm.Because this time the traffic is high.

The above figure shows that the speed of rickshaw is at 2pm to 3pm So, the speed of rickshaw 10.15km/hr. The traffic flow is 10046.7



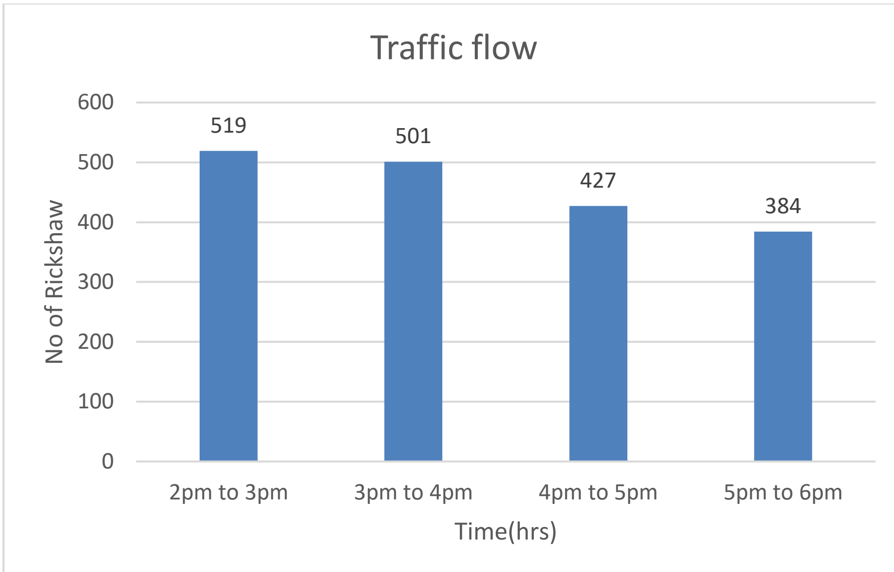
The above figure shows that the speed of rickshaw is at 3pm to 4pm So, the speed of rickshaw10.12km/hr. The traffic flow is 13356.3

The above figure shows that the speed of rickshaw is at 4pm to 5pm So, the speed of rickshaw 11.55km/hr. The traffic flow is 6750

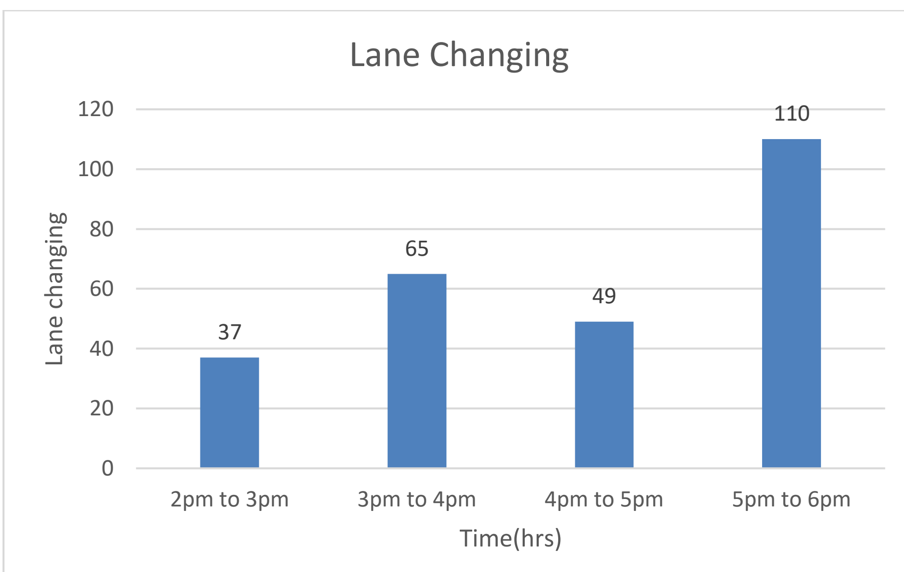


The above figure shows that the speed of rickshaw is at 5pm to 6pm So, the speed of rickshaw 7.083km/hr. The traffic flow is 3100.83

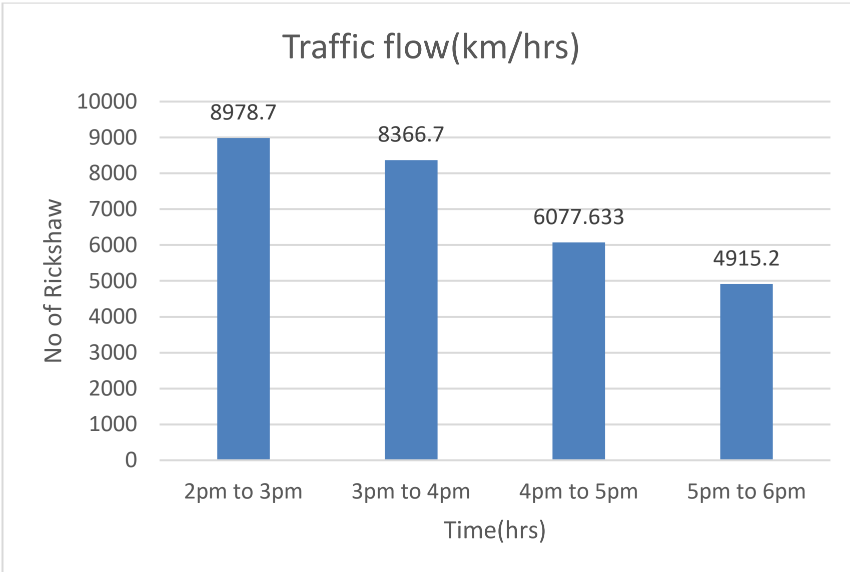
Saturday:



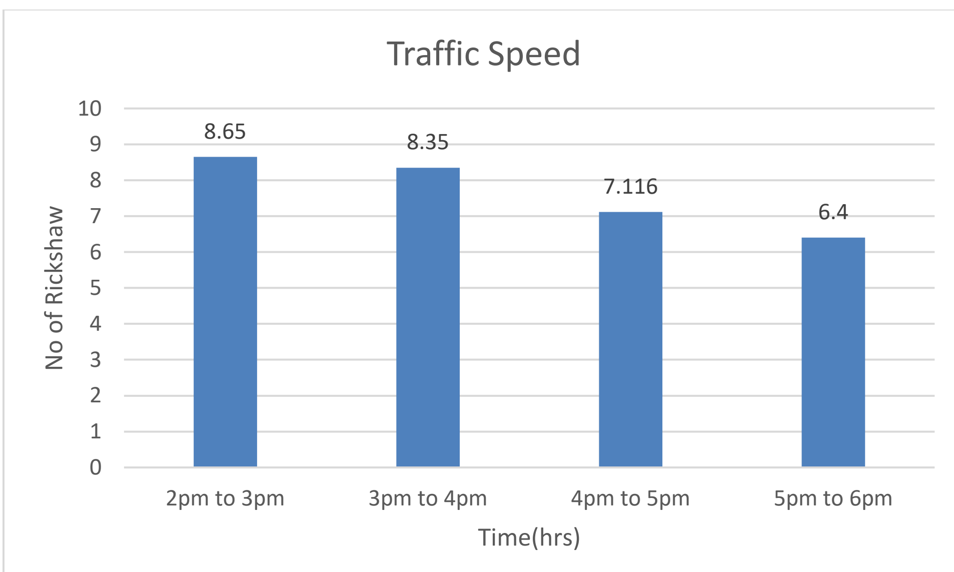
The above graphic shows that the no of traffic flow per hour so the maximum no of traffic flow in 2 to 3 pm.



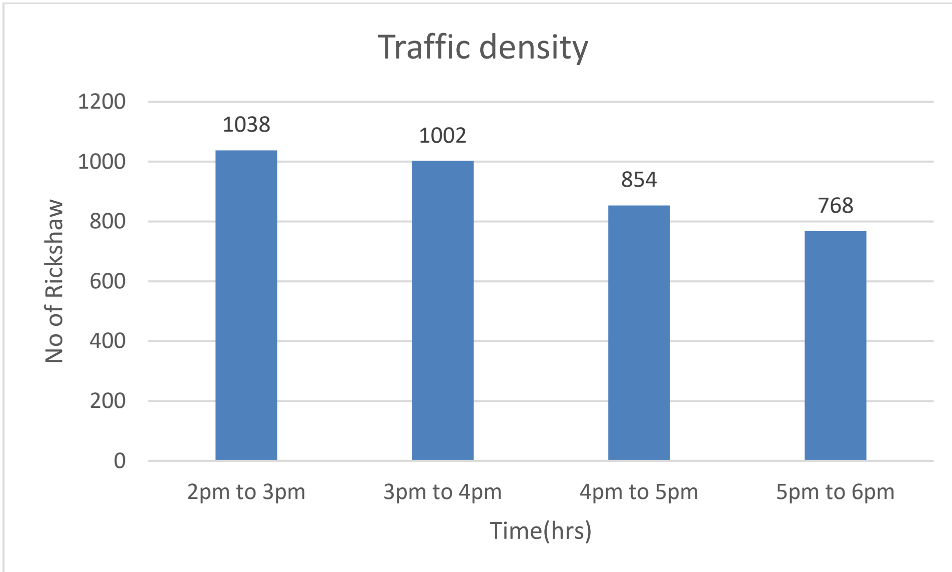
The above graphic shows that how many rickshaws change has lane per hour so the minimum rickshaw change has lane 2 to 3 pm. Due to this time the traffic is high.



The above graphic shows that the traffic flow(km/hrs). The maximum traffic flow (km/hrs) is at 2 to 3 pm. Because this time the traffic is high.



The above graphic shows that the traffic speed. the minimum speed of rickshaw is at 3pm to 4pm.

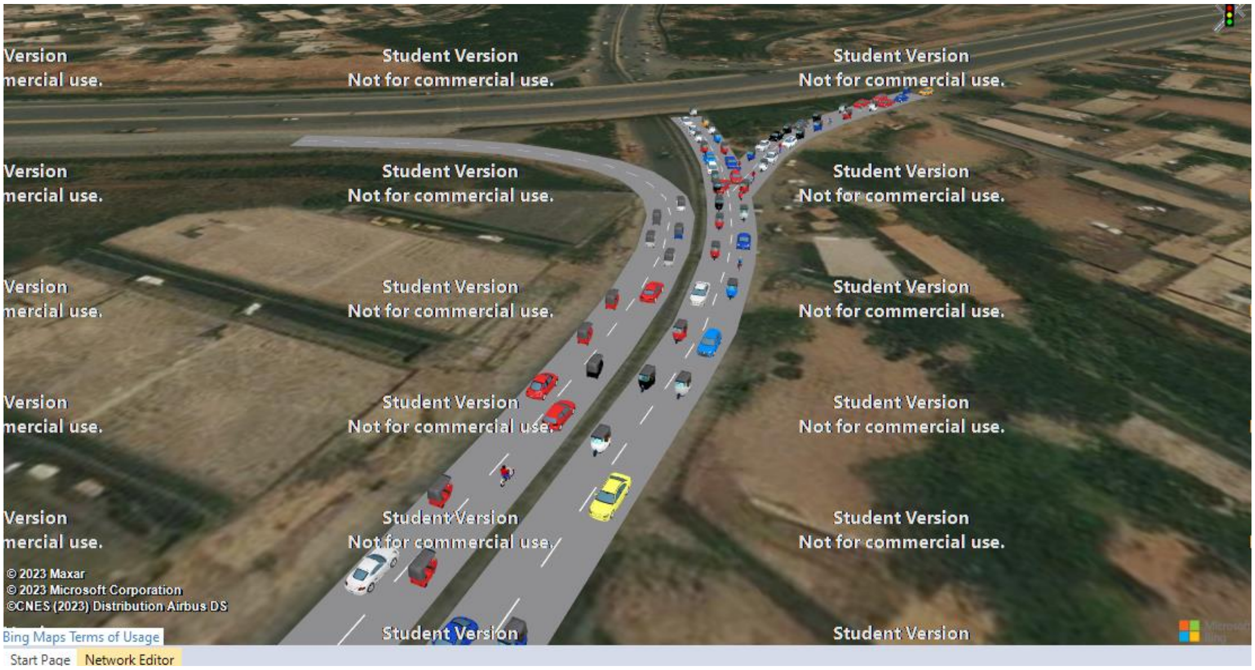


The above graphic shows that the traffic density. The maximum traffic density is at 2pm to 3pm.Because this time the traffic is high.

The above figure shows that the speed of rickshaw is at 2pm to 3pm So, the speed of rickshaw 9.15km/hr. The traffic flow is 8978.7

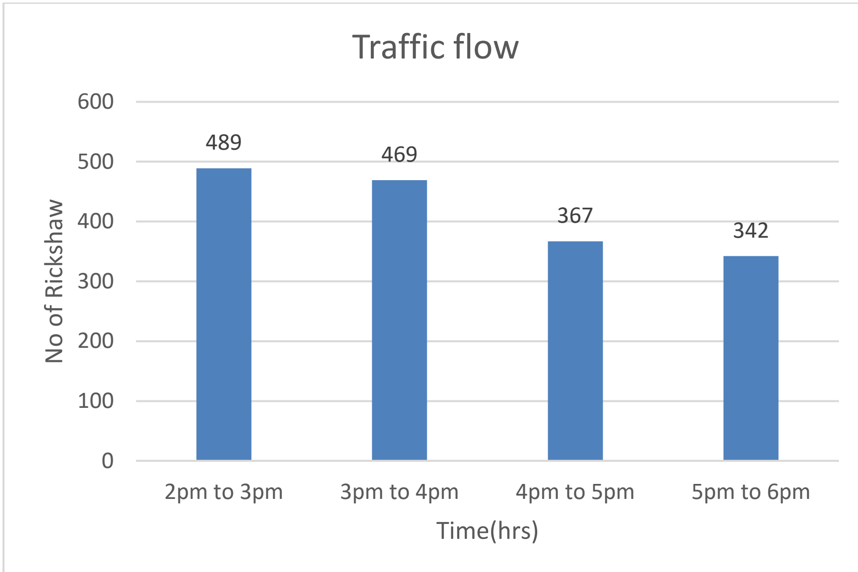
The above figure shows that the speed of rickshaw is at 3pm to 4pm. So the speed of rickshaw 9.35km/hr. The traffic flow is 8366.7

The above figure shows that the speed of rickshaw is at 4pm to 5pm So, the speed of rickshaw 8.16km/hr. The traffic flow is 6077.7

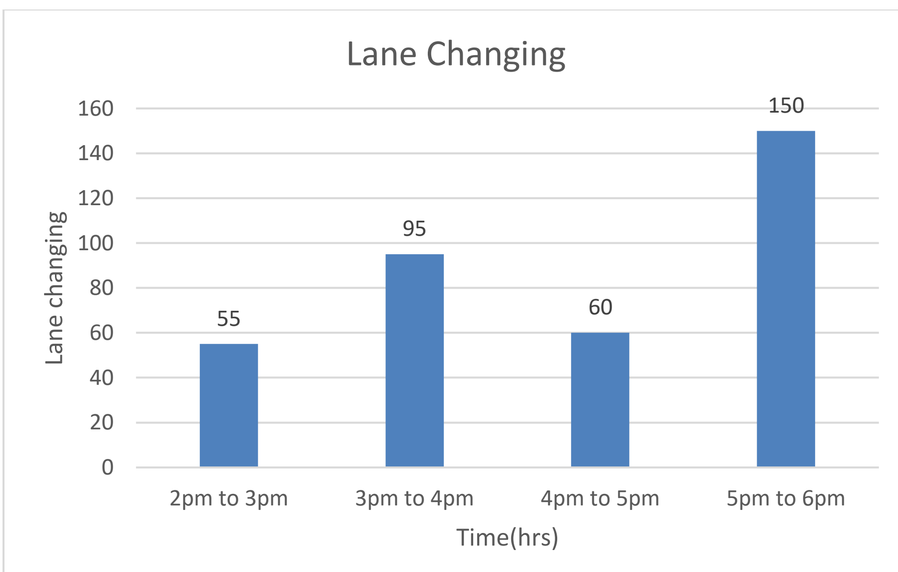


The above figure shows that the speed of rickshaw is at 5pm to 6pm So, the speed of rickshaw 8.4km/hr. The traffic flow is 4915.2

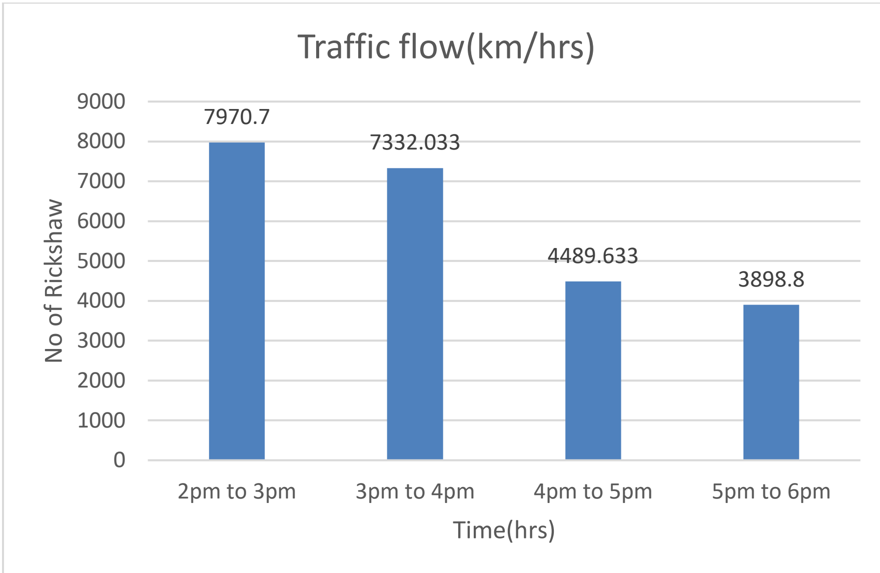
Sunday:



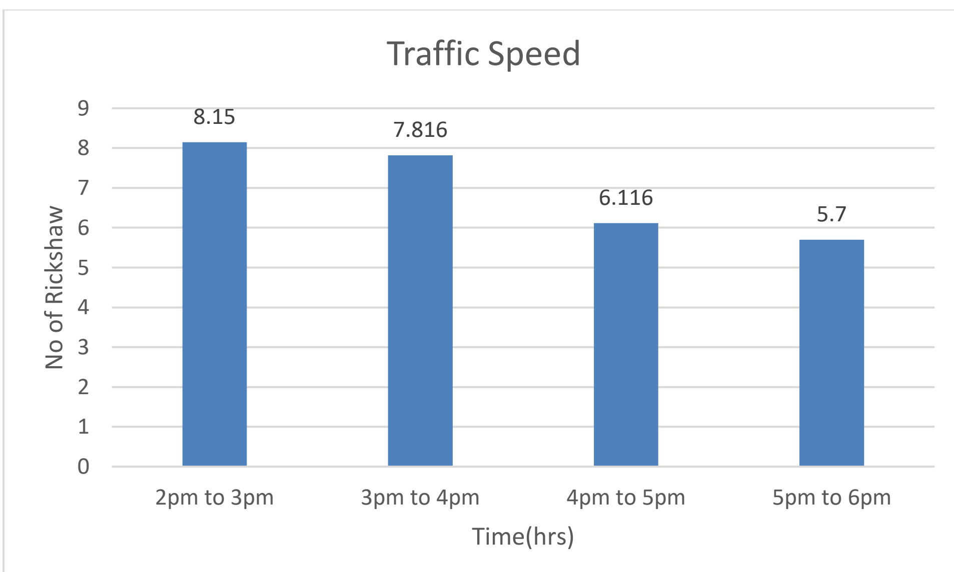
The above graphic shows that the no of traffic flow per hour so the maximum no of traffic flow in 2 to 3 pm.



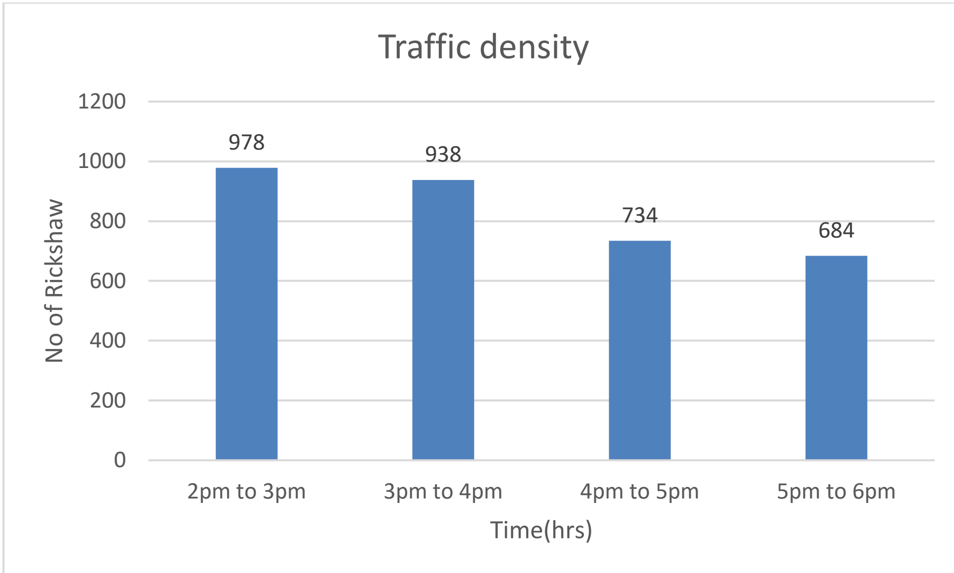
The above graphic shows that how many rickshaws change has lane per hour so the minimum rickshaw change has lane 2 to 3 pm. Due to this time traffic is high.



The above graphic shows that the traffic flow(km/hrs). The maximum traffic flow (km/hrs) is at 2 to 3 pm. Because this time the traffic is high.

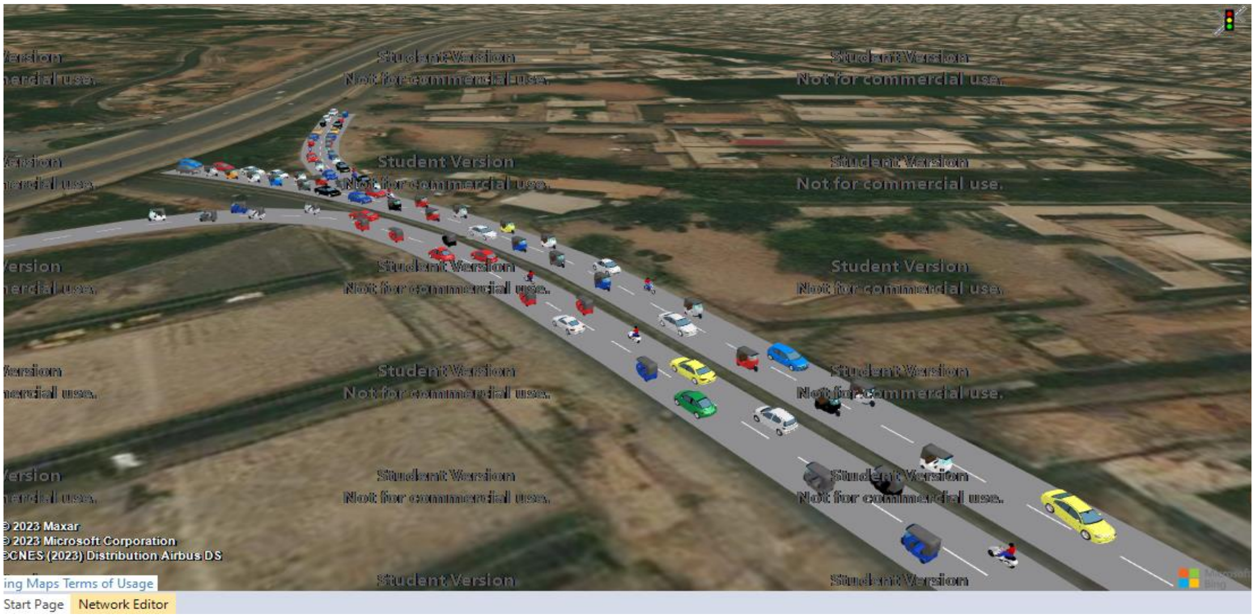


The above graphic shows that the traffic speed. the minimum speed of rickshaw is at 5pm to 6pm.Because this time there are no more traffic.



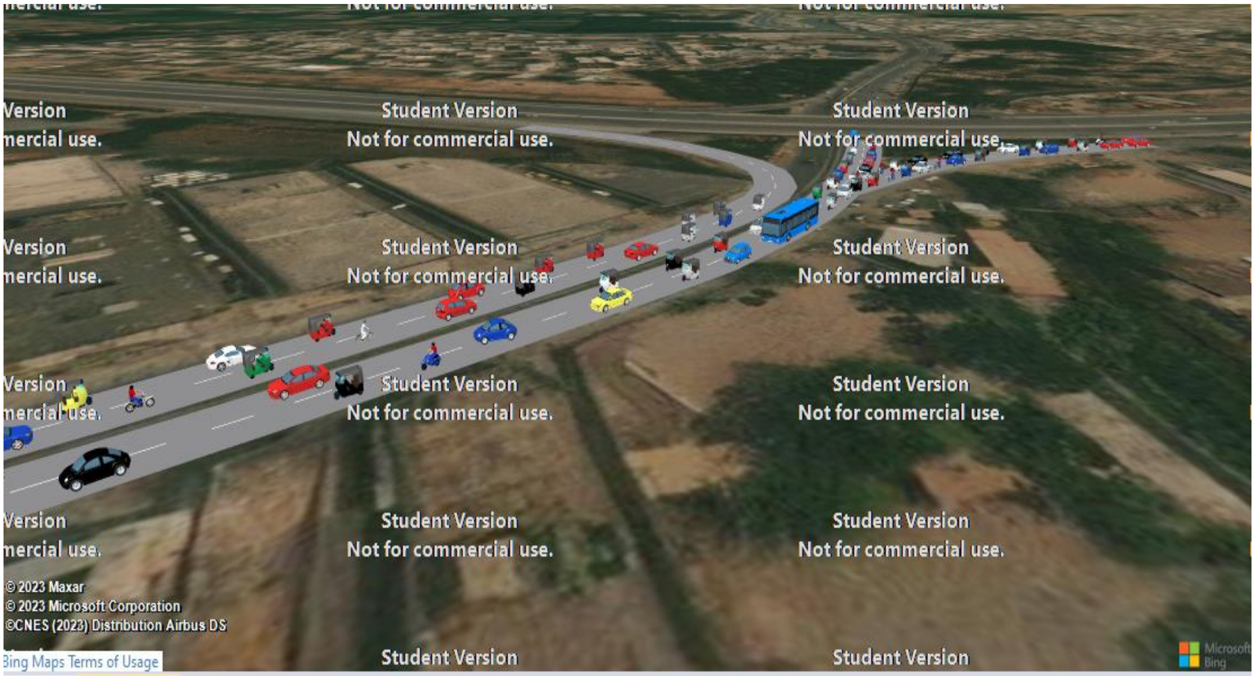
The above graphic shows that the traffic density. The maximum traffic density is at 2pm to 3pm. Because this time the traffic is high.

The above figure shows that the speed of rickshaw is at 2pm to 3pm So, the speed of rickshaw 8.95km/hr. The traffic flow is 7970.7



The above figure shows that the speed of rickshaw is at 3pm to 4pm So, the speed of rickshaw 8.816km/hr. The traffic flow is 7332.033

The above figure shows that the speed of rickshaw is at 4pm to 5pm So, the speed of rickshaw 8.116km/hr. The traffic flow is 4489.633



The above figure shows that the speed of rickshaw is at 5pm to 6pm So, the speed of rickshaw 7.7km/hr. The traffic flow is 3898.8

Without Lane Changing (Speed: 20 km/hr):

- Traffic flow remained relatively stable with minimal disruptions.

- The average speed of vehicles on Charsadda Road was approximately 20 km/hr, reflecting a consistent and smooth flow.

- Commuters experienced a more predictable and steady travel experience due to the absence of abrupt lane changes.

With Lane Changing (Speed: 15 km/hr):

- Traffic flow showed fluctuations and irregular patterns, with occasional congestion caused by abrupt lane changes by rickshaw drivers.

- The average speed of vehicles decreased to around 15 km/hr due to increased braking and lane switching, resulting in slower overall traffic movement.

- Commuters faced more variability and uncertainty in travel times due to the disruptive nature of lane-changing behaviors.

Overall Observations:

- The road network without lane changing demonstrated improved traffic efficiency and a safer driving environment.

- With lane changing of rickshaw drivers, there was a notable increase in the potential for traffic congestion and safety risks.

- The study highlights the importance of promoting safe driving practices, including responsible lane changing behaviors, to enhance overall road network performance.

Chapter 5 conclusion and future work

This study investigated the road network on Charsadda Road, Peshawar, with a particular focus on the behavior of rickshaw drivers concerning lane changing. By comparing the road network's conditions with and without rickshaw drivers' lane-changing tendencies, valuable insights into the impact of this driving behavior were obtained. The findings of this study indicate that rickshaw drivers' lane-changing habits contribute significantly to the overall traffic flow and congestion on Charsadda Road. Without appropriate lane discipline, rickshaws tend to frequently switch lanes, leading to abrupt maneuvers and interruptions in the traffic flow. As a result, this behavior negatively affects the road network's capacity and efficiency, causing delays and potential safety hazards for other road users.

Furthermore, it was observed that rickshaw drivers' lane-changing practices often result from a lack of proper road infrastructure, inadequate traffic management, and limited enforcement of traffic rules. Addressing these underlying issues is crucial to improve the overall traffic situation and ensure a safer and smoother road network on Charsadda Road.

Future Work:

To further build upon the findings of this study and contribute to the enhancement of the road network in Peshawar, the following areas of future work can be considered:

- Traffic Management Strategies: Conducting an in-depth analysis of traffic management strategies can help identify effective measures to regulate lane-changing behaviors of rickshaw drivers. Implementing better road signage, lane markings, and traffic signals can encourage more disciplined driving and mitigate congestion.
- Public Awareness Campaigns: Initiating public awareness campaigns targeted at rickshaw drivers and other road users can play a significant role in promoting responsible driving practices. Informing drivers about the importance of lane discipline and adhering to traffic rules can lead to positive behavioral changes.

- Road Infrastructure Improvement: Collaborating with city authorities to invest in road infrastructure upgrades can enhance the overall traffic flow and safety. Widening roads, constructing dedicated rickshaw lanes, and providing proper turning facilities can encourage orderly driving behavior.
- Traffic Enforcement: Strengthening traffic enforcement measures is vital to discourage lane-changing violations and reckless driving. Increased presence of traffic police and implementation of penalties for rule-breaking can act as a deterrent and promote safer road practices.
- Traffic Simulation Studies: Conducting traffic simulation studies with rickshaw drivers' lane-changing behavior as a parameter can provide valuable insights into the potential impact of proposed road network improvements and traffic management strategies.
- Comparison with Other Road Networks: Extending this research to compare rickshaw drivers' lane-changing behaviors in other road networks in different cities can provide a broader perspective on the issue and offer more comprehensive solutions.

By undertaking these future research directions, transportation planners, policymakers, and city authorities can work collaboratively to optimize the road network, minimize congestion, and ensure the safety and convenience of all road users in Peshawar. Ultimately, these efforts can lead to a more sustainable and efficient transportation system in the city.

Recommendation:

Recommendations for the research study "Investigating A Road Network With And Without Lane Changing Of Rickshaw Drivers: A Case Study Of Charsadda Road, Peshawar":

- Road Safety Improvement:

Based on the findings of the study, identify and prioritize road safety improvement measures to reduce accidents and enhance the overall safety of the road network.

Collaborate with local authorities and traffic management agencies to implement necessary changes such as improved road signage, speed limits, pedestrian crossings, and traffic signals.

- Traffic Management and Infrastructure Enhancement:

Analyze the traffic flow patterns and bottlenecks on Charsadda Road to identify areas where infrastructure enhancements are required.

Recommend improvements in road design, widening of roads, or introduction of dedicated lanes for rickshaws and other slow-moving vehicles to alleviate congestion.

- Rickshaw Driver Training and Awareness:

Develop training programs and awareness campaigns for rickshaw drivers to promote responsible driving behavior, lane discipline, and adherence to traffic rules.

Encourage the use of indicators while changing lanes and educate drivers on the importance of safe driving practices for their own well-being and that of others.

- Sustainable Urban Mobility Planning:

Collaborate with city planners and urban development authorities to incorporate the study's findings into the city's overall mobility planning.

Promote sustainable transportation options, such as public transit and non-motorized transport, to reduce the reliance on single-occupancy vehicles and minimize traffic congestion.

- Stakeholder Engagement and Public Participation:

Involve local communities, transport unions, and relevant stakeholders in the decision-making process for implementing the study's recommendations.

Conduct public consultations to gather feedback and ensure that the proposed solutions align with the needs and preferences of the people using Charsadda Road.

- Data Collection and Monitoring:

Advocate for the establishment of a comprehensive data collection and monitoring system to track road safety metrics, traffic volumes, and lane-changing behaviors regularly.

Use this data to assess the effectiveness of implemented measures and make data-driven decisions for further improvements.

- Future Research Directions:

Identify areas for further research and exploration to deepen the understanding of rickshaw drivers' behavior, traffic management challenges, and road safety on other road networks in the region.

Encourage interdisciplinary research collaborations to address broader sustainability issues related to transportation and urban planning.

- Policy Advocacy:

Engage with policymakers at the local and regional levels to advocate for the integration of the study's findings into transportation policies and urban planning guidelines.

Foster a supportive policy environment that promotes safe and sustainable transportation practices.

- Knowledge Dissemination:

Publish the research findings in reputable journals and present them at conferences to contribute to the academic discourse on sustainable transportation and road safety.

Create accessible materials and reports summarizing the study's key findings and recommendations for broader dissemination among the general public and stakeholders.

By implementing these recommendations, the study can contribute to enhancing road safety, promoting sustainable mobility, and creating a safer and more efficient road network for rickshaw drivers and all road users on Charsadda Road, Peshawar.

Sustainable Development Goals

1. SDG 11 - Sustainable Cities and Communities: Our project directly aligns with SDG 11, which aims to make cities and human settlements inclusive, safe, resilient, and sustainable. By investigating the road network and rickshaw driver behavior on Charsadda road, we are contributing to the goal of creating sustainable urban transportation systems that ensure safety, accessibility, and efficient mobility.

3. SDG 9 - Industry, Innovation, and Infrastructure: Our project involves analyzing the road network and transportation behavior, which contributes to the development of efficient and sustainable transportation infrastructure. By studying lane-changing patterns, we have suggested innovative solutions to improve traffic flow and overall road network design.

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