Travel time analysis using Google based real time data and actual surveyed data for a busy street segment (Ashok Rajpath) of Patna, India and evaluating travel mode choice.

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Abstract

Heterogeneous traffic consisting of motorised and non motorised transport (NMT) is the feature of India's street and roads. Roads of smaller town have no segregated traffic and vehicles compete to each other for moving ahead to reach destination. Very often basic traffic rules are violated and lanes are not followed. Two and three wheelers take advantage in this competitive race often creating a *jam* like situation. This paper examines the street segment of Patna and tries to find out the travel time with varied means of transportation system, both private and public. The survey was conducted on a working days. The hourly data was collected for different modes of transport for a particular stretch from morning 6 AM to evening 6 PM. Average speed is calculated based on travel time. Cost of travel in public transportation is examined and mode choice based on socio-economic condition is evaluated. It is then superimposed with Google real 'travel time model' to check the similarity of travel time.

Keywords: - Travel time, non-motorised transport (NMT), public transportation

1. Introduction

Developing Country like India with a very large population is seeing a phenomenal urban growth. With the growing urbanization and people migrating from rural to urban areas the cities are choking with traffic. Covering a long intra-city distance, through various short commuting modes on a narrow street with mixed mode traffic are challenges for the urban commuters. The objective of commuter is not only to reduce the travel time but also minimise the cost of travel. Travel time is most important for any Intelligent Transport System. (Cheol Oh, 2011). In a developing country like India where a large number of people belong to economically weaker section and a lower income group, every rupee saved, matters a lot. In a study conducted in Vadodara, Gujarat, India (2019-20) it was found that 89% of commuters utilised motorised and only 11% of commuters used non-motorised vehicle. The mode choices are affected by Travel time, travel cost, age, income and vehicle ownership. (Javeed, Juremelani, & Sanket, 2020). This study was conducted for the Metropolitan city of Patna to estimate the travel time by various modes of transportation for a busy and vibrant street section.

2. Literature review

Cities around the world are facing an urgent transportation dilemma due to the modern era's rapid expansion in urban population and the number of private cars. When traffic demand exceeds the capacity of the roadways, there is "congestion." Congestion is caused in part by the physical capacity limit. Road construction, bad weather, and special events are other key factors that have an impact on traffic flow and congestion. (Padiath Ameena, 2009). There are two ways to estimate the level of congestion: by using real-time data and historical traffic data (Suporn Pongnumkul, 2013). Road traffic congestion is a constant issue that causes delays, lost time, stress among people, energy consumption, environmental pollution, and other negative effects. Simulating and optimising traffic control and enhancing traffic management are required to lessen traffic congestion. There are various methods for monitoring and analysing traffic congestion, including the use of video monitoring and surveillance systems, static and dynamic sensors, and real-time traffic management. There are further techniques that use non-real-time research to draw conclusions about current traffic congestion from earlier data. Various methods are used to calculate traffic congestion using historical or real-time data. Sensing technologies such as RFID tags, cameras, laser scanners, GPS trackers, and mobile phones are a few examples

19404

Travel time analysis using Google based real time data and actual surveyed data for a busy street segment (Ashok Rajpath) of Patna, India and evaluating travel mode choice

Section A-Research paper
ISSN 2063-5346

that have been utilised to gather information and create intelligent transportation systems. (Stevanovic, 2015). For effectively managing urban traffic, real-time monitoring of traffic flow data is essential. Deep learning methods and UAV-based recordings were used to conduct a traffic analysis. A position-fixed UAV was used to record the video of the traffic on the roads. In order to recognise moving objects in films, the most modern deep learning techniques were used. In order to analyse traffic and determine how bad traffic is, important mobility measures were calculated. (Huaizhong Zhang, 2019). In a study, a webpage-based revealed preference (RP) and stated preference (SP) survey was carried out, where the options for the stated preference experiment were generated in real-time using the information gathered from the revealed preference questionnaire. Google Maps API was utilised to retrieve the precise origin-destination coordinates of a trip, as well as the travel time by all feasible modes. A mode choice model employing separate RP and SP data and a composite RP+SP model using a conventional approach were built, and the resulting data were compared. According to the developed models, this methodology can be applied to the collection of RP data. However, the methodology can be enhanced to better serve SP experiments and to aid in the collection of high-quality SP data. Google Maps API usage offers more benefits. When compared to zonal level skims produced from a travel demand model, use of the Google Maps API yields journey time and travel distance skims that are more accurate. (Kalyanpad N. G., 2020).

3. Methods

Patna, the capital city of Eastern state of Bihar is a metropolitan city with a population of 1.68 million people (Patna Municipal Corporation) as per census of India (2011) (Census Handbook, 2011). The city has grown linearly along the river Ganga on its Southern bank. City has a linear stretch of 25 km with major roads running along East- West direction.

The study area is from Kargil Chowk at Gandhi Maidan (an important landmark) to NIT *More* which is a stretch of 2.3 km. The name of road is Ashok Rajpath, which runs parallel to Ganga and has an existence since the ancient city of Patliputra from 3rd Century BC. Whole stretch identified for survey is a two lane road with high commercial zone at one side and other side flanked with institutional buildings.

Three types of public transportation vehicles were studied. City ride buses are mini buses with a seating capacity of 20 people. E-Rickshaw are battery powered four seater vehicle, but very often seven people sit including driver. Pedal rickshaw is human powered vehicle with a seating capacity of two passengers. For private vehicles, two wheeler and cars were used in our survey.

Survey was carried out on 12 Feb, 2021 (Friday) from 6 AM in the morning to 6 PM in the evening. A working day was chosen instead of weekends. Weekends have generally a lower traffic in the day time. Survey was conducted till 6 PM only, becauseEvery hour few random vehicles (City ride mini bus, two wheeler, E-Rickshaw, Pedal Rickshaw and Car) were selected at both the ends and their registration number were noted. The same vehicle was traced at the other end and time marked. Difference of time gave the travel time of the vehicle. This was done for every hour. A few vehicles took a different route and were removed from our survey.

Google data was recorded for travel time by car and two-wheeler.Google map estimates its travel time data based on two types of information based in its database. One is historical data based on average travel time and the other is real time data, based on real time speed of vehicles. (Dumbliauskas, 2017)

Table 1 - Google data showing estimated travel time

Mode	Source-Destination	NIT More to Kargil Chowk (Time shown in Minutes)												
	Time slot	6:00 AM	7:00 AM	8:00 AM	9:00 AM	10:00 AM	11:00 AM	12:00 AM	1:00 PM	2:00 PM	3:00 PM	4:00 PM	5:00 PM	6:00 PM
	Temperature in degree celcius													
		12	12	14	16	19	21	22	23	23	24	23	22	21
Two Wheeler	NIT More													
	Kargil Chowk	6	6	6	6	7	9	9	10	10	11	11	12	12
Car	NIT More													
	Kargil Chowk	5	6	7	7	7	9	9	10	11	12	12	13	14
Pedestrian	NIT More													
	Kargil Chowk	29	29	29	29	29	29	29	29	29	29	29	29	29
Mode	Source-Destination	Kargil Chowk to NIT More (Time shown in Minutes)												
Two Wheeler	Kargil Chowk													
	NIT More	6	6	6	6	8	9	10	9	10	11	9	11	11
Car	Kargil Chowk													
	NIT More	7	6	6	7	9	10	10	10	10	12	10	13	15
Pedestrian	NIT More													
	Kargil Chowk	29	29	29	29	29	29	29	29	29	29	29	29	29

19405

Travel time analysis using Google based real time data and actual surveyed data for a busy street segment (Ashok Rajpath) of Patna, India and evaluating travel mode choice

Section A-Research paper
ISSN 2063-5346

Table 2 Surveyed travel time of various modes of travel (Kargil Chowk to NIT More)

Time slot	City Ride(Mini Bus)			Two Wheeler (Motorcycle)			E- Rickshaw			Pedal Rickshaw			Car		
6 AM - 7 AM	6:43:00	6:50:00	0:07:00	6:53:00	7:00:00	0:07:00	6:50:00	6:58:00	0:08:00	6:17:00	6:30:00	0:13:00	6:19:00	6:26:00	0:07:00
7 AM - 8 AM	7:21:00	7:40:00	0:19:00	7:14:00	7:21:00	0:07:00	7:01:00	7:09:00	0:08:00	7:23:00	7:36:00	0:13:00	7:15:00	7:22:00	0:07:00
8 AM - 9 AM	8:20:00	8:42:00	0:22:00	8:09:00	8:15:00	0:06:00	8:09:00	8:15:00	0:06:00	8:13:00	8:30:00	0:17:00	8:13:00	8:19:00	0:06:00
9 AM - 10 AM	9:00:00	9:06:00	0:06:00	9:19:00	9:26:00	0:07:00	9:20:00	9:28:00	0:08:00	9:36:00	9:52:00	0:16:00	9:15:00	9:24:00	0:09:00
10 AM -11 AM	10:01:00	10:10:00	0:09:00	10:35:00	10:45:00	0:10:00	10:01:00	10:12:00	0:11:00	10:15:00	10:35:00	0:20:00	10:13:00	10:25:00	0:12:00
11 AM - 12 PM	11:00:00	11:12:00	0:12:00	11:51:00	11:59:00	0:08:00	11:04:00	11:15:00	0:11:00	11:20:00	11:37:00	0:17:00	11:51:00	12:02:00	0:11:00
12 PM - 13 PM	12:02:00	12:15:00	0:13:00	12:05:00	12:18:00	0:13:00	12:10:00	12:25:00	0:15:00	12:15:00	12:35:00	0:20:00	12:05:00	12:19:00	0:14:00
13 PM - 14 PM	13:43:00	13:49:00	0:06:00	13:08:00	13:18:00	0:10:00	13:52:00	14:01:00	0:09:00	13:35:00	13:50:00	0:15:00	13:07:00	13:20:00	0:13:00
14 PM - 15 PM	14:09:00	14:19:00	0:10:00	14:06:00	14:16:00	0:10:00	14:22:00	14:31:00	0:09:00	14:30:00	14:48:00	0:18:00	14:07:00	14:19:00	0:12:00
15 PM - 16 PM	15:00:00	15:12:00	0:12:00	15:06:00	15:17:00	0:11:00	15:30:00	15:41:00	0:11:00	15:35:00	15:53:00	0:18:00	15:12:00	15:24:00	0:12:00
16 PM - 17 PM	16:00:00	16:15:00	0:15:00	16:03:00	16:14:00	0:11:00	16:10:00	16:26:00	0:16:00	16:30:00	16:50:00	0:20:00	16:20:00	16:33:00	0:13:00
17 PM - 18 PM	17:00:00	17:18:00	0:18:00	17:08:00	17:19:00	0:11:00	17:05:00	17:22:00	0:17:00	17:18:00	17:40:00	0:22:00	17:02:00	17:19:00	0:17:00
18 PM - 19 PM	18:00:00	18:20:00	0:20:00	18:00:00	18:17:00	0:17:00	18:00:00	18:18:00	0:18:00	18:10:00	18:34:00	0:24:00	18:00:00	18:20:00	0:20:00

Table 3 - Surveyed travel time of various modes of travel (NIT More to Kargil Chowk)

Time slot	City Ride(Mini Bus)			Two Wheeler (Motorcycle)			E- Rickshaw			Pedal Rickshaw			Car		
6 AM - 7 AM	6:30:00	6:40:00	0:10:00	6:44:00	6:47:00	0:03:00	6:34:00	6:41:00	0:07:00	6:10:00	6:21:00	0:11:00	6:25:00	6:28:00	0:03:00
7 AM - 8 AM	7:12:00	7:24:00	0:12:00	7:15:00	7:20:00	0:05:00	7:24:00	7:37:00	0:13:00	7:11:00	7:22:00	0:11:00	7:20:00	7:24:00	0:04:00
8 AM - 9 AM	8:00:00	8:12:00	0:12:00	8:45:00	8:52:00	0:07:00	8:13:00	8:24:00	0:11:00	8:15:00	8:28:00	0:13:00	8:45:00	8:53:00	0:08:00
9 AM - 10 AM	9:00:00	9:12:00	0:12:00	9:20:00	9:25:00	0:05:00	9:03:00	9:12:00	0:09:00	9:21:00	9:36:00	0:15:00	9:08:00	9:15:00	0:07:00
10 AM -11 AM	10:00:00	10:13:00	0:13:00	10:21:00	10:30:00	0:09:00	10:03:00	10:21:00	0:18:00	10:22:00	10:48:00	0:26:00	10:22:00	10:34:00	0:12:00
11 AM - 12 PM	11:00:00	11:12:00	0:12:00	11:08:00	11:19:00	0:11:00	11:05:00	11:21:00	0:16:00	11:00:00	11:17:00	0:17:00	11:07:00	11:16:00	0:09:00
12 PM - 13 PM	12:00:00	12:16:00	0:16:00	12:02:00	12:15:00	0:13:00	12:16:00	12:30:00	0:14:00	12:35:00	12:52:00	0:17:00	12:25:00	12:39:00	0:14:00
13 PM - 14 PM	13:32:00	13:52:00	0:20:00	13:28:00	13:40:00	0:12:00	13:33:00	13:45:00	0:12:00	13:32:00	13:49:00	0:17:00	13:20:00	13:37:00	0:17:00
14 PM - 15 PM	14:11:00	14:20:00	0:09:00	14:16:00	14:24:00	0:08:00	14:12:00	14:18:00	0:06:00	14:32:00	14:51:00	0:19:00	14:46:00	15:02:00	0:16:00
15 PM - 16 PM	15:01:00	15:16:00	0:15:00	15:21:00	15:32:00	0:11:00	15:33:00	15:45:00	0:12:00	15:18:00	15:39:00	0:21:00	15:39:00	15:58:00	0:19:00
16 PM - 17 PM	16:02:00	16:17:00	0:15:00	16:05:00	16:15:00	0:10:00	16:14:00	16:29:00	0:15:00	16:04:00	16:17:00	0:13:00	16:19:00	16:32:00	0:13:00
17 PM - 18 PM	17:01:00	17:19:00	0:18:00	17:35:00	17:56:00	0:21:00	17:04:00	17:16:00	0:12:00	17:10:00	17:23:00	0:13:00	17:08:00	17:28:00	0:20:00
18 PM - 19 PM	18:00:00	18:23:00	0:23:00	18:00:00	18:13:00	0:13:00	18:05:00	18:23:00	0:18:00	18:01:00	18:16:00	0:15:00	18:02:00	18:24:00	0:22:00

Table 4 - Basic Statistics of travel from Kargil Chowk to NIT More.

City_R		Two_Wh		E_Rick		Pedal_R		Car	
Mean	12.69231	Mean	9.076923	Mean	10.92308	Mean	17.61538	Mean	11.61538
Standard Error	1.541663	Standard Error	0.512179	Standard E	1.046738	Standard E	0.90255	Standard E	1.089216
Median	12	Median	10	Median	10	Median	17	Median	12
Mode	6	Mode	11	Mode	8	Mode	13	Mode	12
Standard Deviation	5.558546	Standard Deviation	1.846688	Standard D	3.774068	Standard D	3.254189	Standard D	3.927223
Sample Variance	30.89744	Sample Variance	3.410256	Sample Var	14.24359	Sample Var	10.58974	Sample Var	15.42308
Kurtosis	-1.29167	Kurtosis	-1.51247	Kurtosis	-0.27715	Kurtosis	-0.15988	Kurtosis	0.558647
Skewness	0.404059	Skewness	-0.41363	Skewness	0.916855	Skewness	0.424012	Skewness	0.584195
Range	16	Range	5	Range	12	Range	11	Range	14
Minimum	6	Minimum	6	Minimum	6	Minimum	13	Minimum	6
Maximum	22	Maximum	11	Maximum	18	Maximum	24	Maximum	20
Sum	165	Sum	118	Sum	142	Sum	229	Sum	151
Count	13	Count	13	Count	13	Count	13	Count	13

19406

Eur. Chem. Bull. 2023, 12(Special Issue 4), 19404–19413

Travel time analysis using Google based real time data and actual surveyed data for a busy street segment (Ashok Rajpath) of Patna, India and evaluating travel mode choice

Section A-Research paper
ISSN 2063-5346

Table 5: Basic Statistics for various modes of travel from NIT More to Kargil Chowk

|	City_R		Two_Wh		E- Rick		Pedal_R		Car
Mean	14.38461538	Mean	9.692308	Mean	12.5384615	Mean	16	Mean	12.61538462
Standard Error	1.118254487	Standard Error	1.206141	Standard Error	1.04154339	Standard Error	1.176696811	Standard Error	1.696672692
Median	13	Median	9.846154	Median	12	Median	15	Median	13
Mode	12	Mode	5	Mode	12	Mode	13	Mode	#N/A
Standard Deviation	4.03192389	Standard Deviation	4.512966	Standard Deviation	3.75533808	Standard Deviation	4.242640687	Standard Deviation	6.11744039
Sample Variance	16.25641026	Sample Variance	20.36686	Sample Variance	14.1025641	Sample Variance	18	Sample Variance	37.42307692
Kurtosis	0.259552154	Kurtosis	1.974413	Kurtosis	-0.53330669	Kurtosis	1.266161616	Kurtosis	-1.114252509
Skewness	0.858220824	Skewness	0.961517	Skewness	-0.20902477	Skewness	1.060064964	Skewness	-0.101565538
Range	14	Range	18	Range	12	Range	15	Range	19
Minimum	9	Minimum	3	Minimum	6	Minimum	11	Minimum	3
Maximum	23	Maximum	21	Maximum	18	Maximum	26	Maximum	22
Sum	187	Sum	135.6923	Sum	163	Sum	208	Sum	164
Count	13	Count	14	Count	13	Count	13	Count	13
Largest(1)	23	Largest(1)	21	Largest(1)	18	Largest(1)	26	Largest(1)	22
Smallest(1)	9	Smallest(1)	3	Smallest(1)	6	Smallest(1)	11	Smallest(1)	3
Confidence Level(95.0%)	2.436467222	Confidence Level(9...)	2.605709	Confidence Level(95...)	2.26932809	Confidence Level(95.0...)	2.563802108	Confidence Level(95.0%)	3.69673223
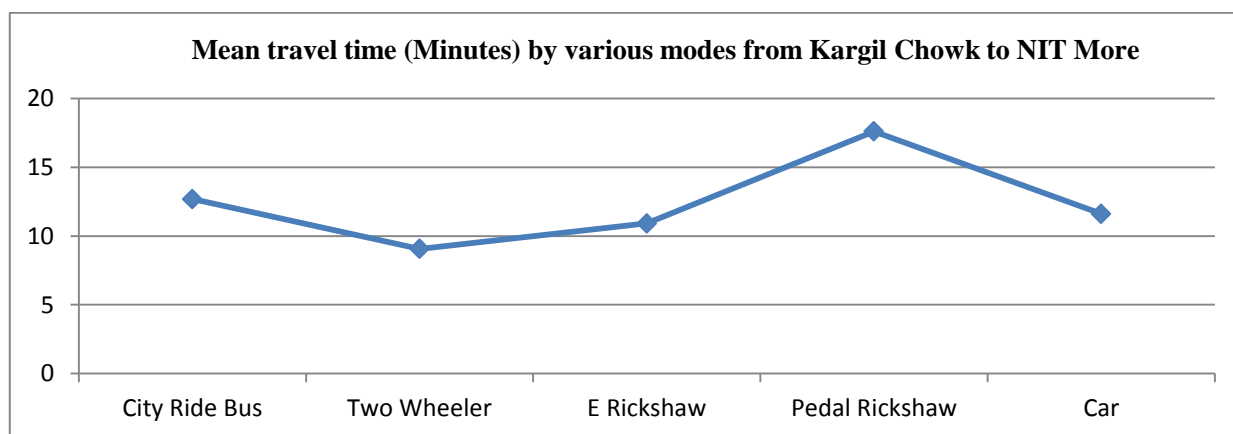
Figure 1 Travel time from Kargil Chowk to NIT More
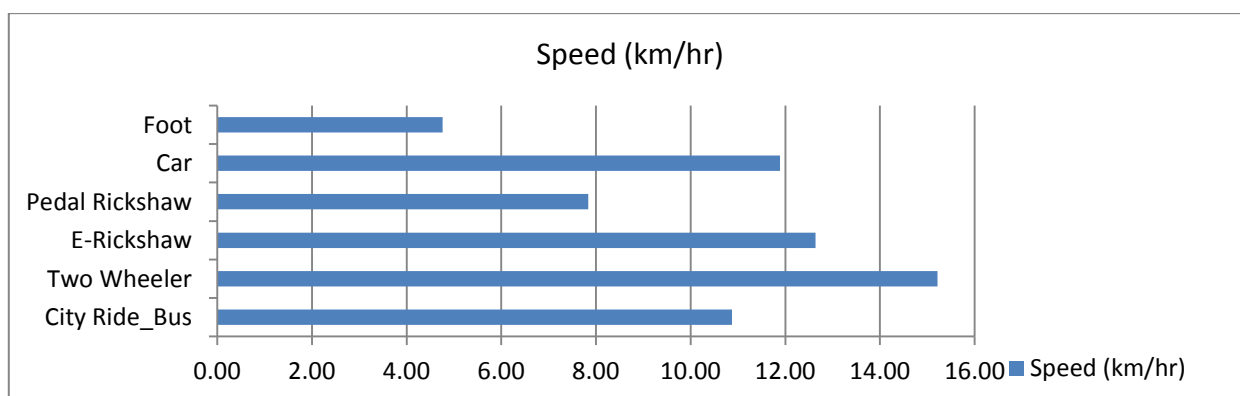
Figure 2 Speed of various travel means from Kargil Chowk to NIT More

19407

Travel time analysis using Google based real time data and actual surveyed data for a busy street segment (Ashok Rajpath) of Patna, India and evaluating travel mode choice

Section A-Research paper
ISSN 2063-5346

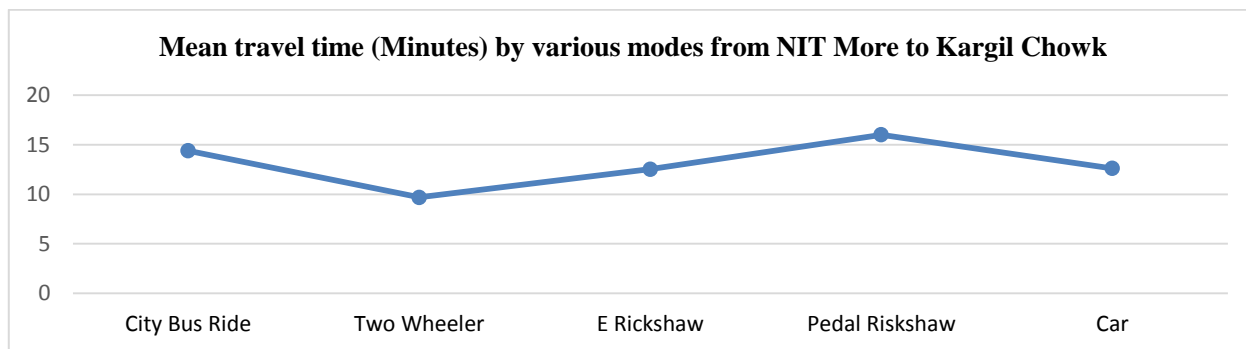**Mean travel time (Minutes) by various modes from NIT More to Kargil Chowk**

Figure 3 Mean travel time (min) from NIT More to Kargil Chowk
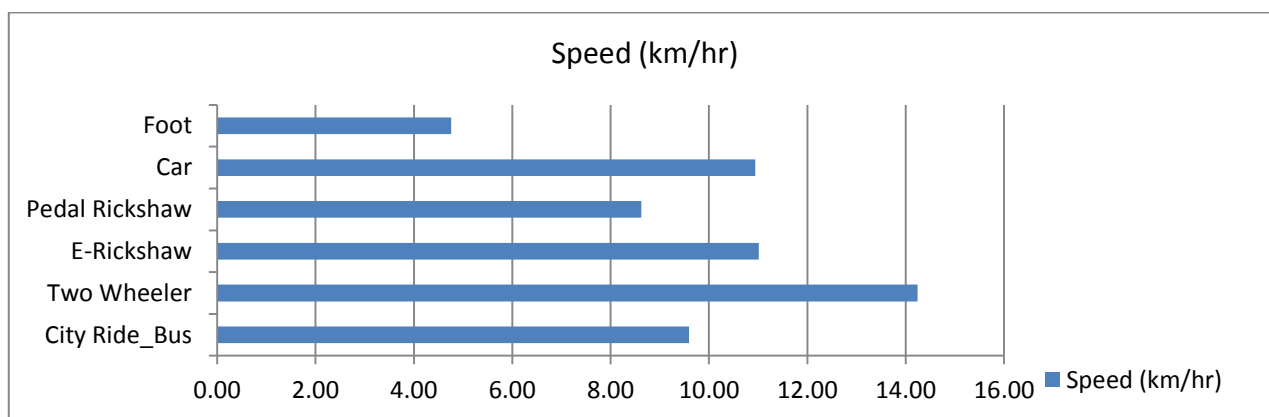
Figure 4 Speed of various travel means from NIT More to Kargil Chowk

Table 6 - Correlation among various modes of travel from Kargil Chowk to NIT More

	City_R	*Two_Wh*	*E_Rick*	*Pedal_R*	*Car*
City_R	1				
Two_Wh	0.002498	1			
E_Rick	0.352317	0.778113	1		
Pedal_R	0.42136	0.71255	0.845547	1	
Car	0.162094	0.854718	0.88618	0.835144	1

Table 7 - Correlation among various modes of travel from NIT More to Kargil Chowk

	City_R	*Two_ Wh*	*E- Rick*	*Pedal _R*	*Car*
City_R	1				
Two_ Wh	0.688786	1			
E- Rick	0.552067	0.340867869	1		
Pedal _R	0	0.05436041	0.308592575	1	
Car	0.732896	0.790152791	0.299961197	0.372452372	1

4. Results

The fastest among the five is two wheeler with a mean time of 9.35 minutes while travelling from Kargil Chowk to NIT *More* and almost same time when travelling from NIT *More* to Kargil Chowk (9:40 Minutes).

19408

Eur. Chem. Bull. 2023, 12(Special Issue 4), 19404–19413

Travel time analysis using Google based real time data and actual surveyed data for a busy street segment (Ashok Rajpath) of Patna, India and evaluating travel mode choice

Section A-Research paper
ISSN 2063-5346

Cycle Rickshaw which is a non motorised human powered vehicle took the maximum time (mean travel time of 17.45 minutes) when travelling from with a standard deviation of 3.22 minutes. Car and E-Rickshaw almost took the same average time of around 11 minutes and 30 seconds.The skewness is between -1 and +1, hence the data is roughly symmetrical and it follows a normal distribution.

The highest standard deviation is for City ride mini buses (5.5 Minutes) which is an indication of a wide fluctuating travel time. Two wheeler has a least std. deviation of (1.8 Minutes) which is an indicator of less variation in travel time. City ride bus has the weakest correlation with the other mode choice because of its frequent stopping at several places and a large waiting time. Bus stops do exist but it is not strictly followed either by passenger or the bus driver. Passengers can stop and take a ride at any point on road just by showing hand! All the following traffic comes to a halt with frequent brawl on road.
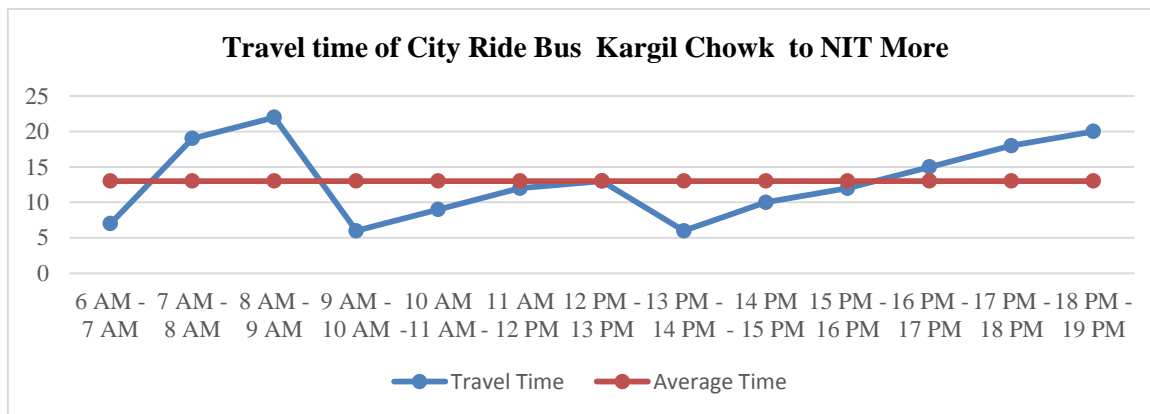
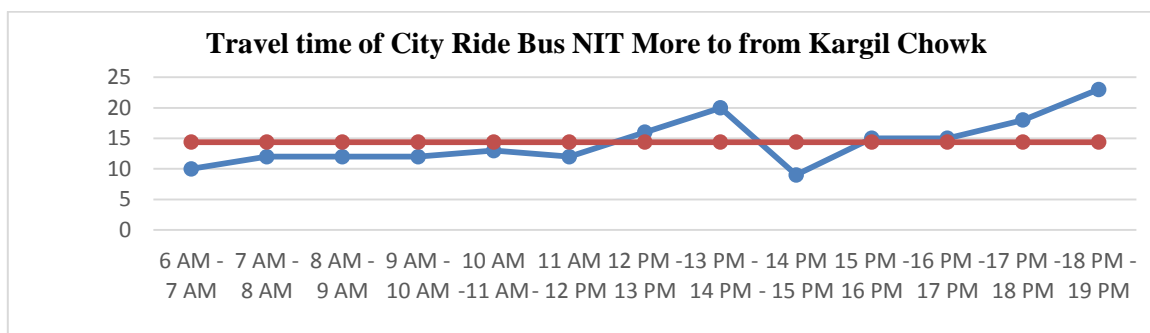**Figure 5: Travel time of City Ride Bus from Kargil Chowk to NIT More**

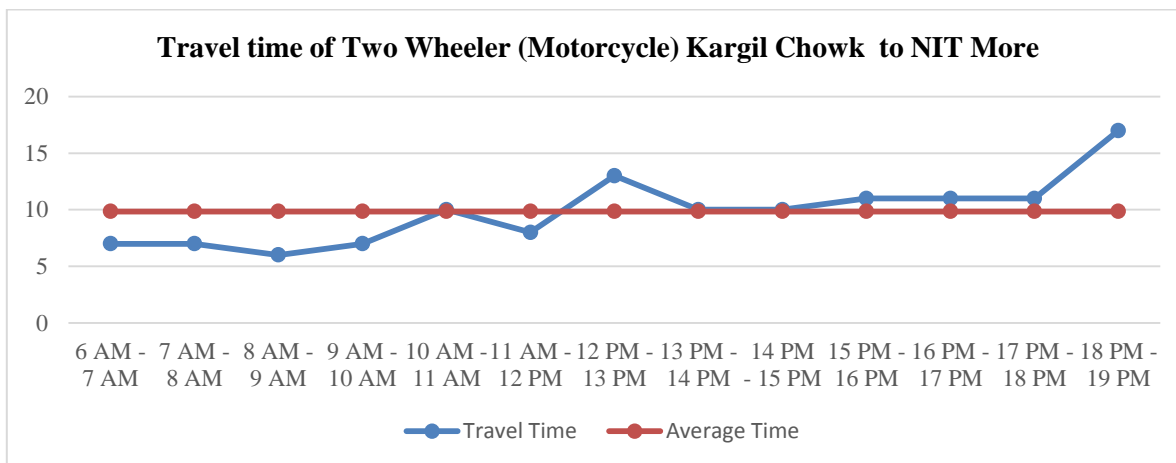**Figure 6: Travel time of City Ride Bus from NIT More to Kargil Chowk**

Figure 7: Travel time of two wheeler (Motor Cycle) from Kargil Chowk to NIT More

Travel time analysis using Google based real time data and actual surveyed data for a busy street segment (Ashok Rajpath) of Patna, India and evaluating travel mode choice
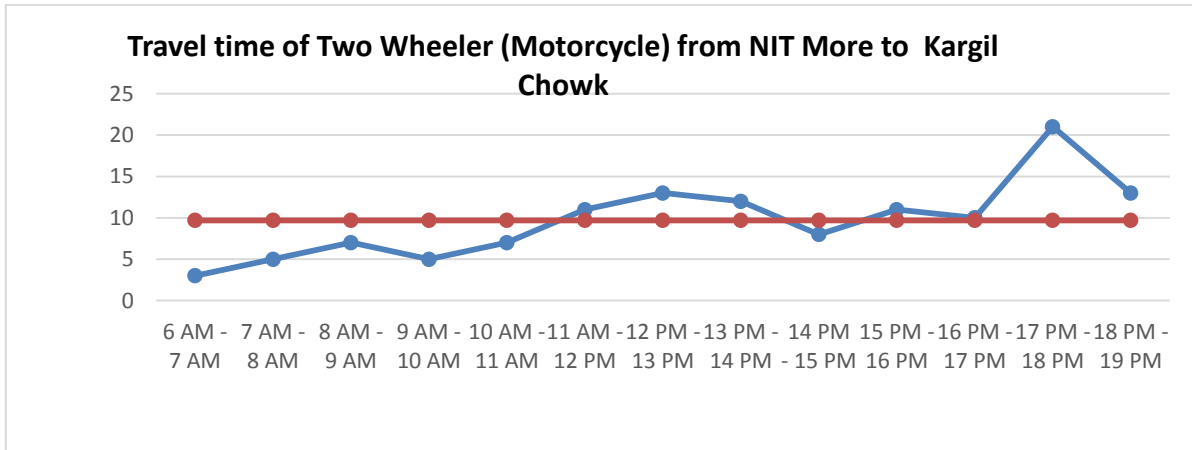
Section A-Research paper
ISSN 2063-5346

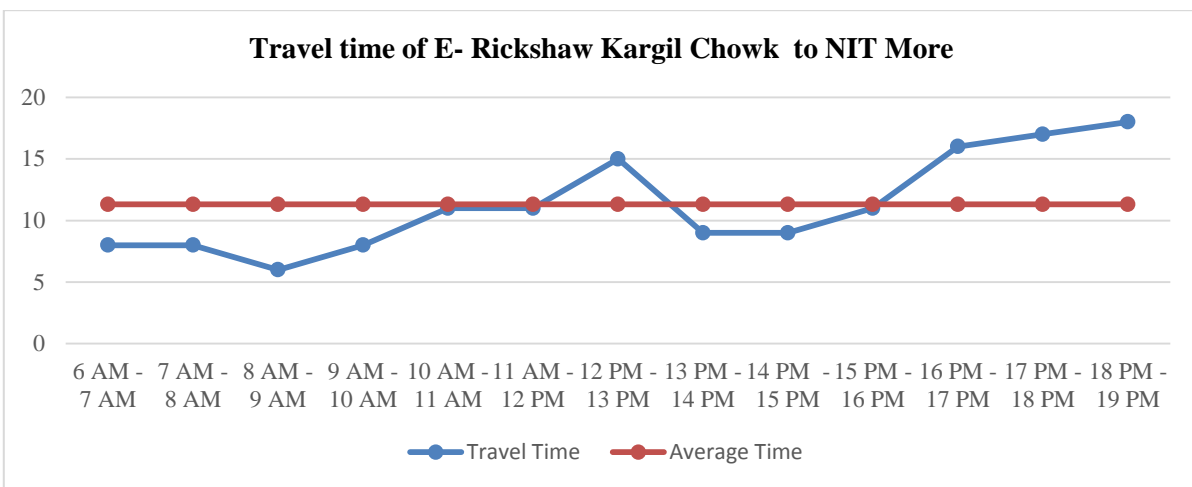Figure 8: Travel time of Two-wheeler (Motor Cycle) from NIT More to Kargil Chowk

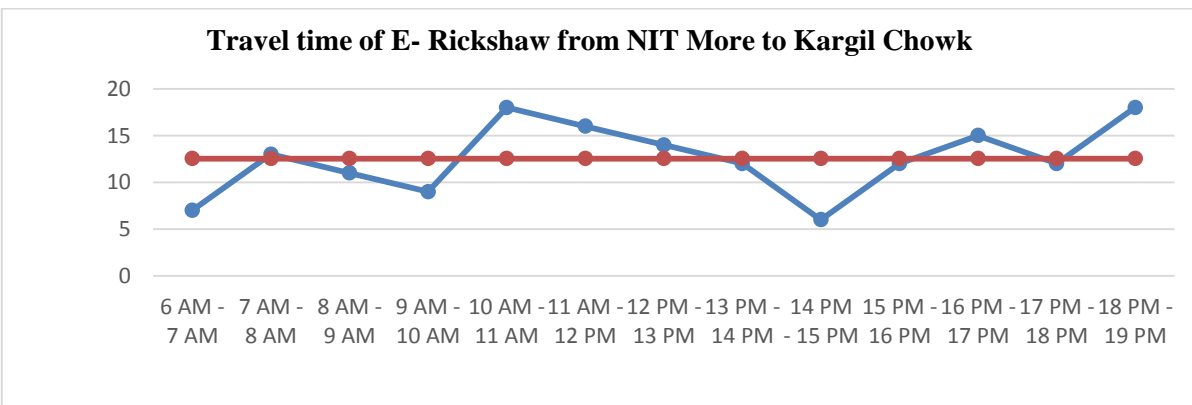Figure 9: Travel time of E-Rickshaw from Kargil Chowk to NIT More

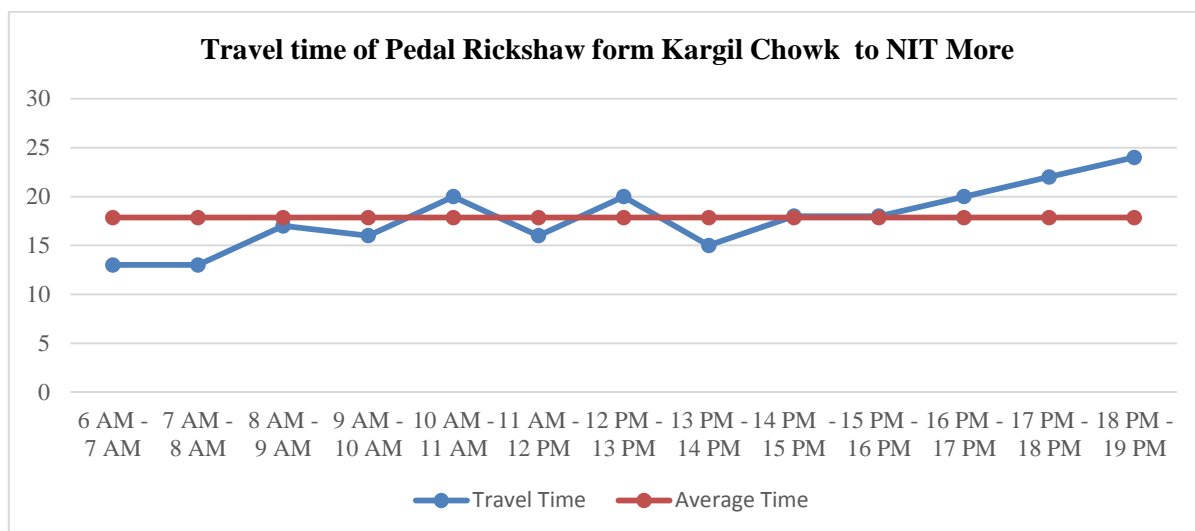Figure 10: Travel time of E- Rickshaw from NIT More to Kargil Chowk

19410

Travel time analysis using Google based real time data and actual surveyed data for a busy street segment (Ashok Rajpath) of Patna, India and evaluating travel mode choice

Section A-Research paper
ISSN 2063-5346

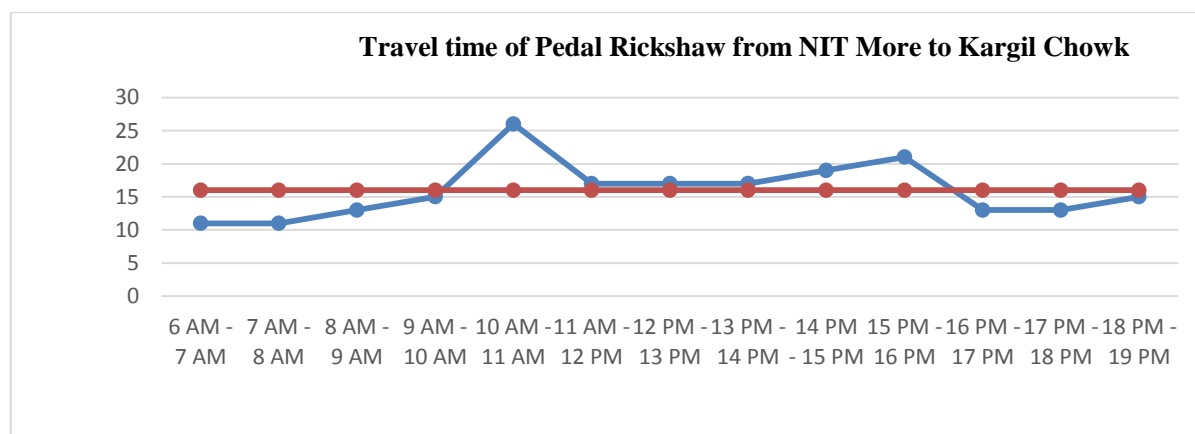Figure 11: Travel time of Pedal Rickshaw from Kargil Chowk to NIT More

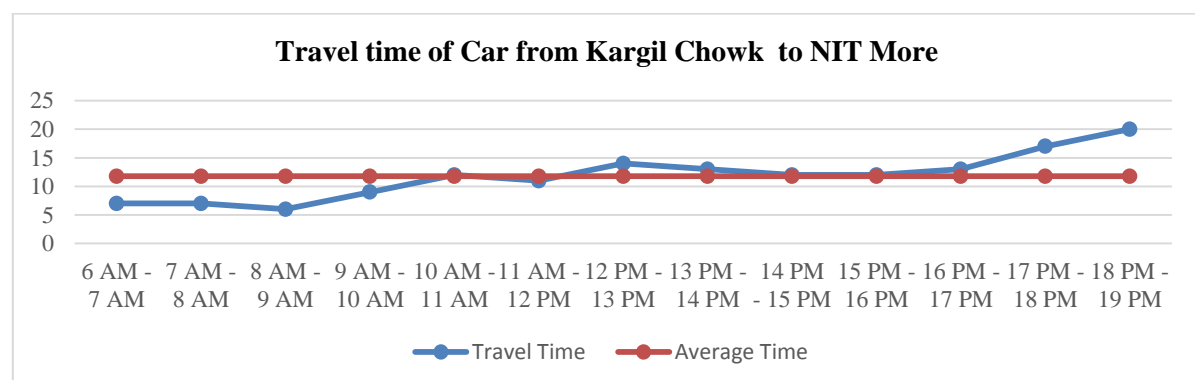Figure 12: Travel time of Pedal Rickshaw from NIT More to Kargil Chowk

Figure 13: Travel time of Car from Kargil Chowk to NIT More

19411

Travel time analysis using Google based real time data and actual surveyed data for a busy street segment (Ashok Rajpath) of Patna, India and evaluating travel mode choice

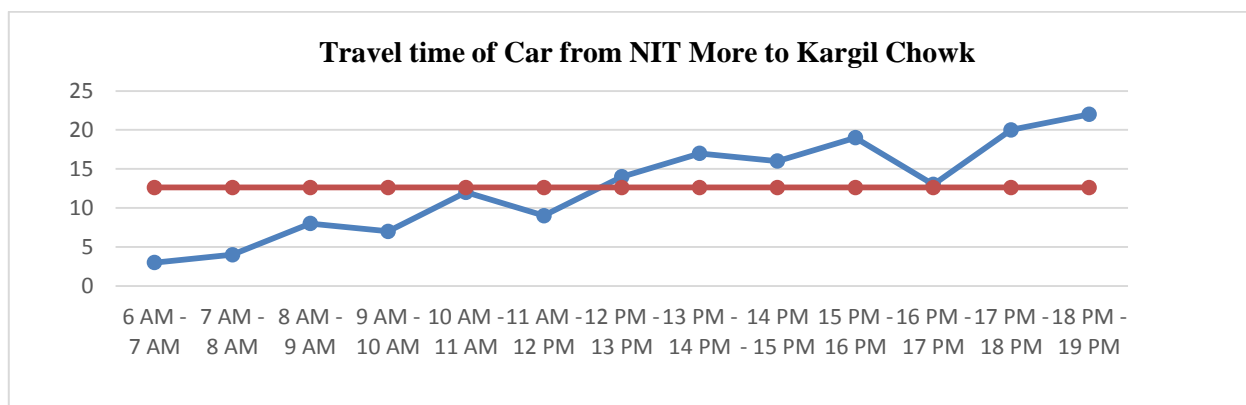*Section A-Research paper*
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Figure 14: Travel time of Car from NIT More to Kargil Chowk

Google data exactly matched with the actual travel time measured. Google data shows a pedestrian will take a travel time of 29 minutes to commute irrespective of time they travel.

5. Discussion

Two wheeler is the most preferred privately owned vehicle (those who can afford) for short distance commuting on a busy street. E-Rickshaw is the most preferred public transport for short distance commuting when the commuters are willing to pay double the cost of travel (Rs 10/- per trip) as compared to city ride mini bus (Rs 5/- per trip). Those who want to save money at the cost of travel time preferably use city ride mini bus. Travel time and travel cost are important parameters for selection of mode of travel.

Pedal Rickshaw is the costliest mode for commuting short distances with fare almost eight to ten times to that of city ride bus and four to five times to E-Rickshaw for single passenger. Pedal Rickshaw has the negotiable fare and depends on number of passenger travelling and luggage carried. Advantage with pedal rickshaw is that it gives the connectivity up to the commuters door step in most cases.

6. Conclusion

The paper examined the travel time by various modes of transport and there by average speed of different vehicle was calculated. People chose the mode of travel as per their economy, comfort and travel time. Such study will be record for future research who wants to know the average speed of different modes of transport in this period of time. In the future when a flyover is being constructed and metro will start on this route it will be a valuable document for the records of the survey period.

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19412

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