Modeling Travel Time for Heterogeneous Traffic Condition in Ahmedabad City

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Abstract: Transport condition in Ahmedabad city is rapidly deteriorating because of the increasing travel demand and inadequate transportation system. Due to exponential increase in the vehicle ownership in Ahmedabad results the issue of traffic control and management. The city is facing the problem of traffic congestion and people prefer more private transport than public transport in terms of comfort and convenience leads to the traffic issue. The study area covered for the above problem is New West Zone of Ahmedabad city. The main objective of the study is to develop a travel time prediction model under heterogeneous traffic condition. The study is to be done to access the impact of different travel mode on travel time. For primary data video graphic survey is to be carried out using hand held GPS in the vehicle. Traffic volume survey is performed for primary data. Travel time of different modes to be compared and the effect of vehicle composition on travel time is to be analyzed.

Index Terms **- travel time, heterogeneous traffic, GPS, ANN, regression, vehicle mode.**

I. INTRODUCTION

One of the most important parameters in traffic studies is travel time. Travel time is defined as the total time for a vehicle to travel from one point to another over a specified route taking into account the stops, queuing delay and intersection delay. Prediction has been a long topic of research. Travel time estimation is transforming the observed traffic variables such as flow and occupancy into expected travel time. Forecasting the future travel time values is termed as prediction.

Traffic in urban areas of India such as Surat, Vadodara, Ahmadabad, Rajkot is heterogeneous in nature. As the socioeconomic characteristics of the people in the society changes with time and also the development of transportation leads to change in the people's living results into increasing vehicle ownership at faster rate. People prefer more private transport then public transport because private transport provide safety, comfort, and convenience. In urban areas there are restricted chances of expansion of road network because of unavailability of road space. The use of intelligent transportation system is one of the solutions for traffic situation in India.

TRAVEL TIME PREDICTION MODELS

1. Regression Models
2. Artificial Neural Network model
3. Kalian Filtering Algorithm
4. Historical Data Based Model

II. OBJECTIVE OF THE STUDY

- To develop a travel time prediction model in the study area.
- To determine the effect of mode of transportation on travel time

III. LITERATURE REVIEW

Rajesh Bera (et. al.) conducted study to develop travel demand model. The main study of this paper is to develop travel time prediction model for mixed traffic conditions and to determine the effect of mode of transportation on travel time. GPS probe vehicle along with the video camera has been used for different mode of transportation such as 2 wheeler and 3 wheeler has been used as a test vehicles for data collection in the Warangal city of Chennai. Artificial Neural Network model and a multi linear regression model have been developed to compare the estimated travel time with the field data. MATLAB has been used for the comparison of two ANN models.

From this study it is concluded that average stopped time while making journey has been more for passenger car than that of 2 wheeler and 3 wheeler. Travel time of passenger car will be less compared to 3 wheeler if the section is increased and the travel time for passenger car will be more for shorter section. The section wise travel time of 2 wheeler is less compared to other modes and apart from off- peak period the journey time using passenger car fluctuates significantly from link to link.

Diu Guang (et. al.) conducted study to determine travel time based on SP survey. In this study estimation of travel time values for urban passengers is done base on SP survey.

Stated preference survey is used because of its capability to make good use of data to its high efficiency and low cost. Data of public transport values of travel time are used for analysis. The main aim is to develop a Logit based model. Then the developed model is used for calibration. SPSS software is used for performing SP survey and VOT model is identified. In this paper Travel time values for work purposes, business and for leisure are compared and chart is drawn.

In this paper it is concluded that time values for work purposes are generally higher than those for leisure purposes and time values increase with the increase of traveller incomes. Meanwhile, waiting time values are higher than in- vehicle time values and transferring time values because travellers are more anxious when waiting than when in vehicle or transferring.

Transferring time is valued less than in-vehicle time for work and business purpose for transferring because trips for work and business purpose occur during peak hours with heavy traffic. Transferring time values are nearly the same as in – vehicle time values for leisure purposes with transferring

IV. STUDY AREA

Ahmedabad is the commercial capital of the State and is also known as the textile capital of India. It lies in the cotton belt of Gujarat, 23 km south of Capital Gandhinagar, 552 km north of Mumbai and 96 km from the Gulf of Cambay. It has excellent connectivity through air, road and rail links with Mumbai and Delhi.

Historically Ahmedabad has been one of the most important centres of trade and commerce in western India. The city has a great architectural tradition reflected in many exquisite monuments, temples and modern buildings. The city is facing problems of traffic, parking, and pedestrian safety on certain stretches of road in the city.

The study area taken is corridor from Prahladnagar to Sola in the New West Zone of Ahmedabad city as shown in the figure. The study area is selected on the basis of composition of traffic, types of intersection control. It is approximately 8.5 km in length. The selected route should be of great importance both for public and private transport modes.

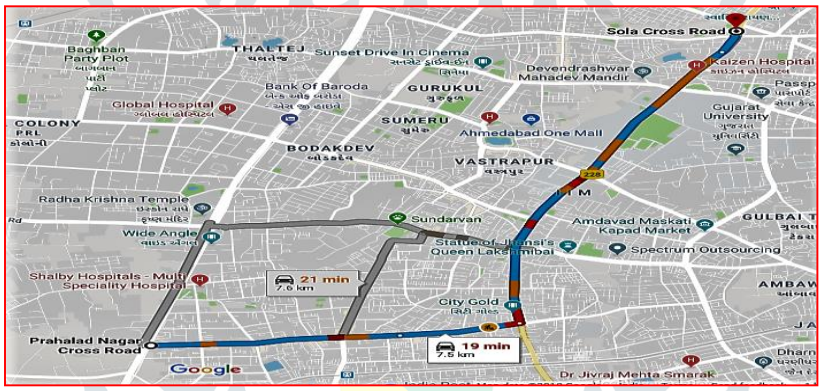

Figure: 1 Study Stretch (Source: Google INC.)

V. DATA COLLECTION AND ANALYSIS

❖ **Traffic volume count:-**

Traffic volume studies are conducted to determine the number, movements, and classifications of roadway vehicles at a given location. These data can help identify critical flow time periods, determine the influence of large vehicles or pedestrians on vehicular traffic flow, or document traffic volume trends. The length of the sampling period depends on the type of count being taken and the intended use of the data recorded. For example, an intersection count may be conducted during the peak flow period. If so, manual count with 15-minute intervals could be used to obtain the traffic volume data.

Study Method:

Two methods are available for conducting traffic volume counts:

(1) Manual counting method.

(2) Automatic counting method.

Table 1:- vehicle volume count

Vehicle volume count					
Direction:- Sarkhej circle – Vasna bus station			**Direction:- Vasna bus station - Sarkhej circle**		
Day-1	8 AM – 9 AM	2772	Day-1	8 AM – 9 AM	2178
	9 AM – 10 AM	3300		9 AM – 10 AM	2646
	10 AM-11 AM	4177		10 AM-11 AM	2968

❖ **Spot speed survey:-**

Speed is an important transportation consideration because it relates to safety, time, comfort, convenience, and economics. Spot speed studies are used to determine the speed distribution of a traffic stream at a specific location. The data gathered in spot speed studies are used to determine vehicle speed percentiles, which are useful in making many speed-related decisions.

Table 2:- Spot speed data

Sr. No.	Class limit	Mid point	Frequency	% Frequency	Cumulative frequency
1	15.00-19.99	17.495	5	3.3	3.3
2	20.00-24.99	22.495	46	30.7	34.0
3	25.00-29.99	27.495	71	47.3	81.3
4	30.00-34.99	32.495	26	17.3	98.7
5	35.00-39.99	37.495	2	1.3	100
6	40.00-44.99	42.495	0	0	100
7	45.00-49.99	47.495	0	0	100
Total			150		

❖ **Travel time & delay survey:-**

Travel time studies involve recording the time it takes vehicles to traverse a specified length of roadway. This stretch of roadway may include one or more intersections, or may be a relatively long stretch of freeway. In any case, a long "zone" is often broken into shorter, individually analyzed "links." Travel time data is often reported in terms of delay (travel time in excess of free-flow, unimpeded travel time) or of average speeds in links or zones.

Different data collection Method:

1. Test Vehicle Method
2. Observed Vehicle Method
3. Moving Vehicle Method
4.Licence Plate Method

Table 3:- Travel time & Delay survey

During Peak Hours		**During light traffic hours**	
Length	5.2 km	Length	5.2 km
Running time	13.20 min	Running time	09.38 min
Stopped time	7.14 min	Stopped time	03.29 min
Journey time	20.34 min	Journey time	12.67 min
Running speed	23.63 kmph	Running speed	34.66 kmph
Journey speed	15.33 kmph	Journey speed	24.76 kmph
Delay	**7.67 min**		

VI. MODEL CONSTRUCTION FOR TRAVEL TIME

Travel time in urban arterials is complex in nature and is influenced by many parameters. This sect ion presents mathematical relationship developed between the influencing parameters and travel time values. The influencing parameters that are considered for modeling are volume per lane, percentage of vehicle classes, distance covered, average speed, queue length, red time and stopping time. The parameters are analyzed first to understand the effect of each parameter on travel time and the relations of each parameter. The correlations between each independent variable have been found out. The MLR model has been adopted because of its simplicity and applicability in any conditions.

❖ **Regression model**

It is observed from the correlation table that total distance is the most influencing parameter out of the others. The other parameters are also showing medium to low correlation with the travel time. The development of the model has been done using 70% of the total data set whereas the testing has been done using the rest 30% data. The step wise regression analysis has been done in SPSS with intercept value.

The final model is as below

$$TT = 0.225*d - 6.309*v + 0.719*r + 0.019*q - 0.217*c + 0.147*l$$

Where,
TT = travel time,
d = total distance,
v = average speed,
r = red time,
q = volume,
c = % of class,
l = queue length

VII. CONCLUSION

The application of travel time prediction modeling is huge as it has been already implemented for bus travel time prediction. So, if private transportation also can be provided with such kind of facilities, the travel time cost will come down. This was the main motivation for this work. In this study along with the development of model, the impact of vehicle class is also explored. The comparison of the results and validation shows quite satisfactory results. From this study, it can be concluded that average stopped time while making journey has been more for passenger car than that of 2 wheeler than that of 3 wheeler. Travel time of passenger car will be less compared to 3 wheeler if the section length is increased while for shorter section passenger car travel time is more compared to others. The section wise travel time of 2 wheeler is less compared to other modes whereas apart from the off-peak period the journey time using passenger car and 3 wheeler fluctuates very significantly from link to link.

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