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TRAVEL TIME AND DELAY SURVEY: APPLICATION OF ICT

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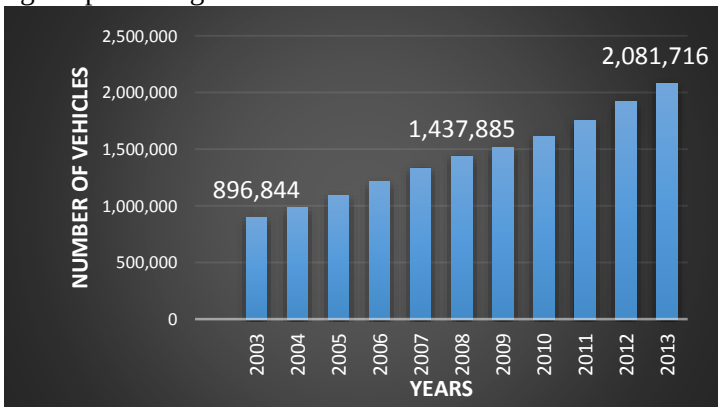
Abstract

Since, past many years, administrations have keep attempting to make transportation systems intelligent, however, conventional methods are applied for collection of data to a large extent. In general, these methods lack in availing real-time information, tedious and involve extreme cost-time consumption if not intelligent enough. In India, any ULB (Or personnel) initiate working for the traffic survey to address the transportation problem, the survey process consumes more time and observes difficulty in obtaining reliable and valid data. It makes the collected data obsolete (and not real time). As a result, proposed alternative solution based on this data may not fulfil the need as it could be different altogether. Alternatively, travel time and delay data collection system can be developed using mobile phones. This paper explores the use of Android-based application for obtaining travel time and delay using various types of mode of transit on selectively a busy road stretch in the core area of Surat. Employed personnel using different transit modes with mobile phone having an application "My Tracks" generated data on which conventional analysis is applied to search appropriate alternative. The application revealed the travel route, total travel time, total moving time and average speed of the vehicle. The route (2.4 km length) is being fixed with start and end nodes that further allowed for indirect assessment of traffic congestion that later can be addressed to identify remedial measures of relief or minimize the adversity. It shows that the use of such application for traffic data collection may prove to be advantageous giving real-time data using this technique. An idea for such system explored on a pilot basis that may be developed in full using a server-based system, keeping anonymity of the user through tracking road stretches and performances. Congestion affected locations then may be investigated further, to draw suggestive alternative remedial measures. Current paper limitedly explores the smart mode of data collection and analysis stages only.

Keywords: CBD, Congestion, FSI, GPS, ICT, Surat, Traffic, Urban local body

1 INTRODUCTION

As the number of vehicles is quickly increasing in the recent years, the urban traffic is facing serious problems. Every time, it is not always to construct new roads due to the limitation of space. With the use of innovative technologies, many application can be developed and used to improve traffic situations by exploiting the prevailing infrastructure itself.



Graph 1 Vehicular growth of Surat
(Source: Extracted from RTO data)

This study conducted was involving a stretch well known as Raj Marg (the road connecting Chowk to Delhi Gate) of Surat, (Gujarat, India) an oldest and most important link. It is located in the CBD area. It has been facing severe problem of traffic congestion due to its mixed land-use and direct connectivity with Railway station from Rander to Adajan. There are rare scopes for further expansion of available physical infrastructure within the CBD of Surat; it is the need of today to manage the scenario with resources in hand and make optimum use of it. Below the table shows the total road length of Surat city as of 2013.

Table 1 Length of Roads in Surat City

No.	Description	Total (in Km)
1	Total length of road as on 31-03-2012	2170.987
2	Road length added during 1-4-2012 to 31.03.2013 (New Roads)	370.455
3	Total road length as on 31-03-2013 (total of Sr. No. 1 and 2)	2541.442

(Source: Surat Municipal Corporation, 2013)

2 LITERATURE

2.1 TRAVEL TIME STUDY

As per Transportation Systems Engineering, (Dr. Tom V. Mathew, IIT Bombay) travel time is the time elapsed a vehicle takes to traverse a given segment of a street. Travel time studies provide the necessary data to determine the average travel time. In combination with the length of the corridor under study, this data can be used to produce average travel speed. In a roadway system performance, travel time and delay are significant principal measures used by traffic engineers, planners and analysts. Vehicle speed is in direct relation to travel time and delay; it is also an appropriate measure of performance to assess present traffic systems. In order to determine the amount of time required to traverse a particular route or section of a street or highway. The obtained data provide travel time and travel speed information but not necessarily delay. This term is often used to include speed and delay study.

2.2 DELAY STUDIES

Delay is an extra time spent by drivers against the time that would be taken to travel on posted speed without obstacles. Delay can have many forms depending on various locations. A study is made to provide information concerning the amount, cause, location, duration and rate of the delay, as well as travel time and similar value. The extra time spent by vehicle drivers due to traffic congestion and measures of traffic control device results in delay.

2.3 PURPOSE OF TRAVEL TIME AND DELAY STUDIES

The aim of the Travel time and delay study is to evaluate the quality of traffic movement along the route and determine the locations, types, and the extent of traffic delays by using a moving test vehicle.

- This technique have comparable operational conditions before and after the roadway or road crossing improvement. However, it is used as a tool to assist in prioritising projects by assessing the level of the operational deficiencies (like delays and stops) for each project under consideration.
- The Travel time and delay study can also be used by planners to monitor the level of service for ULB comprehensive plans.
- This survey method gives the engineer with quantitative information with that he can suggest recommendations for improvements of traffic signal re-timing, safety improvements, turn lane additions, and channelization enhancements.

2.4 VARIOUS METHOD FOR OBTAINING TRAVEL TIME AND DELAY STUDY

Conventionally, following methods are referred to, in many of the textbooks as well as when the field work is planned to address urban traffic issue.

1. Floating car method
2. Average speed method

3. Moving-vehicle method
4. Maximum-car method

3 USE OF ICT - AN ALTERNATIVE TO TRAVEL TIME AND DELAY SURVEY

Within the purview of this research paper, a pilot study was carried out. Travel time and delay survey were conducted using Android-based mobile application "My Tracks". It is a GPS tracking application that runs on the Android Operating System. Device's GPS is used to collect data; allowing real-time review of the travel path, speed, distance, and elevations throughout the route. This application also allows the user to record annotations along the path and hear periodic voice announcements of progress. Basic information on the software is:

Original author	Google
Developer	Google
Initial release	12th February, 2009
Stable release	30th January,2014
Written in	Java, XML
Website	www.google.com/mobile/mytracks/

The software has following set of characteristics:

- It can record path, speed, distance, and elevation;
- Display of live data during an outdoor activity;
- Annotate the path with text and photos during recording;
- Voice announcements about the progress;
- Sharing of tracks through Google Drive;
- Export routes to Google Drive, Google Maps Engine, Google Sheets, or external storage as selected by the user.

3.1 STUDY AREA

There are many arterial roads in Surat city having reached its saturation level of carrying out vehicular volume. Within the old town, some of the major urban arterial links are marked red on the map below. In support, the table shows major arterial roads with their carriageway width and PCU/hour which displays the need for study and analyse the problem of its own.

Figure 1 Major arterial road in connection with Walled City

Table 2 Major arterial road with its PCU count & carriageway width

Road	PCU per hour	Carriage way width (m)
Chowk -Station	4584	12
Mughal Sarai Road	4466	12
Athwa Gate	6612	18
Majura Gate	5938	45
Ring road (flyover)	3816	7.5 (Two Lane)
Ring road (below flyover)	5035	45

(Source: Traffic and Transportation Study of Surat city report, CRRI)

Study area location is within the old walled Surat. The walled city of Surat is having a geographical spread over 8.18 Sq Km That is about 7.28% of present city area under SMC administration. The walled Surat has development with a mixture of residential, commercial and industrial uses. The fixed route (of 2.4 Km length) having start and end nodes that further allowed for indirect assessment of traffic congestion. Business activities have developed along the East-West corridor from Chowk

Bazaar to Railway station (Chowk – Bhagatalao – Chautapul – Lal Gate – Bhagal – Delhi gate). The provision of frontage and margin is of lower order. The land price of this area is very high. A comparative Residex (Residential Index developed by the National Housing Bank) show the upfront property prices (residential sector only) trends in the central zone are of Surat. A consistent increase in past seven years displays the growing demands for developed residential land parcels, either for residential usage or conversion into commercial spaces.

Table 3 Residex in Surat Central Zone

Zones	Localities	2007 Index	Apr-Jun 2012 Index	Jul-Sep 2012 Index	Oct-Dec 2012 Index	Jan-Mar 2013 Index	Apr-Jun 2013 Index	Jul-Sep 2013 Index	Oct-Dec 2013 Index	Jan-March 2014 Index	Apr-June 2014 Index
Central	**Nanpura; Rustampura; Sonifaliya; Muglisara**	**100**	**192**	**192**	**221**	**201**	**218**	**217**	**203**	**188**	**182**

(Source: NHB Residex, http://www.nhb.org.in/Residex/SURATres.php)

Chowk area is having organic growth and has high population density and higher consumption of FSI. The fixed route to carry out present pilot study as shown in the image below with following details:

Figure 2 Study area (Chowk to Railway station road length)

Road Details:

Chowk Bazaar Road
Type of road = Undivided
Effective length of the stretch = 735 m
Right of way = 16.5 m to 18.5 m
Width of the carriageway = 9.5 m to 11.5 m
Width of the parking space = 2 m
Width of the footpath = 1.5 m

Bhagal Station Road
Type of road = Undivided
Effective length of the stretch = 540 m
Right of way = 17.8 m to 24.5 m
Width of the carriageway = 14.8 m to 20.5 m
Width of the parking space = 2 m
Width of the footpath = 1.5 m

Total length = 2.4 Km

Using the software application of "My Tracks" observations were recorded for different dates, times and travel modes keeping the start and end point uniform. The observations enabled to generate following results and interpretation.

Table 4 Travel time and delay survey by "My Tracks."

Mode	Date	Time	Total time	Total moving time	Avg. speed (Km/hr)	Avg. Moving speed (Km/hr)	Delay time with no movement
2W	13-09-2014	18:55	11:48	10:29	10.97	13.48	01:19
2W	06-11-2014	10:34	08:23	07:33	17.24	19.15	00:50
2W	06-11-2014	15:09	08:44	08:25	16.23	16.95	00:19
2W*	06-11-2014	16.38	13:44	12:21	10.47	11.64	01:23
2W	09-11-2014	9:29	06:56	06:51	20.48	20.73	00:05
2W	09-11-2014	16:22	06:17	06:04	22.7	23.49	00:13
2W	13-11-2014	19:32	07:35	06:49	18.45	20.59	00:46
2W	14-11-2014	19:00	08:30	07:21	16.82	19.38	01:09
2W	20-11-2014	16:00	09:15	08:37	15.34	16.48	00:38
2W	18-11-2014	13:10	09:56	09:35	16.38	17.52	00:21
2W	17-12-2014	8:58	05:55	05:49	23.82	24.19	00:06

3W	22-11-2014	12:18	13:18	12:18	10.74	11.6	01:00
3W*	23-11-2014	12:48	14:15	11:18	10.2	12.86	02:57
4W*	12-11-2014	16:28	12:40	11:43	11.81	12.75	00:57
4W	17-12-2014	7:33	06:14	05:59	23.18	24.14	00:15
4W	18-12-2014	7:46	06:01	05:51	24.36	25.06	00:10
2W	13-09-2014	19:07	12:39	10:58	10.83	12.49	01:41
2W	06-11-2014	10:43	07:15	06:55	19.16	20.09	00:20
2W	06-11-2014	15:19	09:09	08:47	15.48	16.13	00:22
2W	06-11-2014	17:14	08:37	08:19	14.27	14.78	00:18
2W	09-11-2014	9:46	05:56	05:56	23.71	23.71	00:00
2W	09-11-2014	16:28	06:27	04:59	17.01	22.03	01:28
2W	13-11-2014	19:40	08:37	08:35	16.4	16.46	00:02
2W	14-11-2014	19:15	08:48	07:14	16.08	19.52	01:34
2W	18-11-2014	13:23	11:56	10:02	11.93	12.84	01:54
2W	20-11-2014	16:26	11:04	07:14	21:36	17:16	03:50
2W*	22-12-2014	12:30	10:37	09:05	13.24	15.47	01:32
2W	17-12-2014	9:04	05:18	05:03	26.45	27.74	00:15
3W*	23-11-2014	19:30	09:11	08:02	15.77	18.01	01:09
3W	23-11-2014	20:02	08:56	07:48	15.91	18.25	01:08
4W*	12-11-2014	16:45	10:37	08:35	13.56	16.76	02:02
4W	17-12-2014	7:40	05:16	05:09	16:19	27.22	00:07

(Note: * are the set of randomly selected data under each mode considered for further analysis to evolve concept)

Following are the screen-snaps available from the application “My Tracks” showing mode selection, travel path, movement and ground elevation details along with speed and other information.

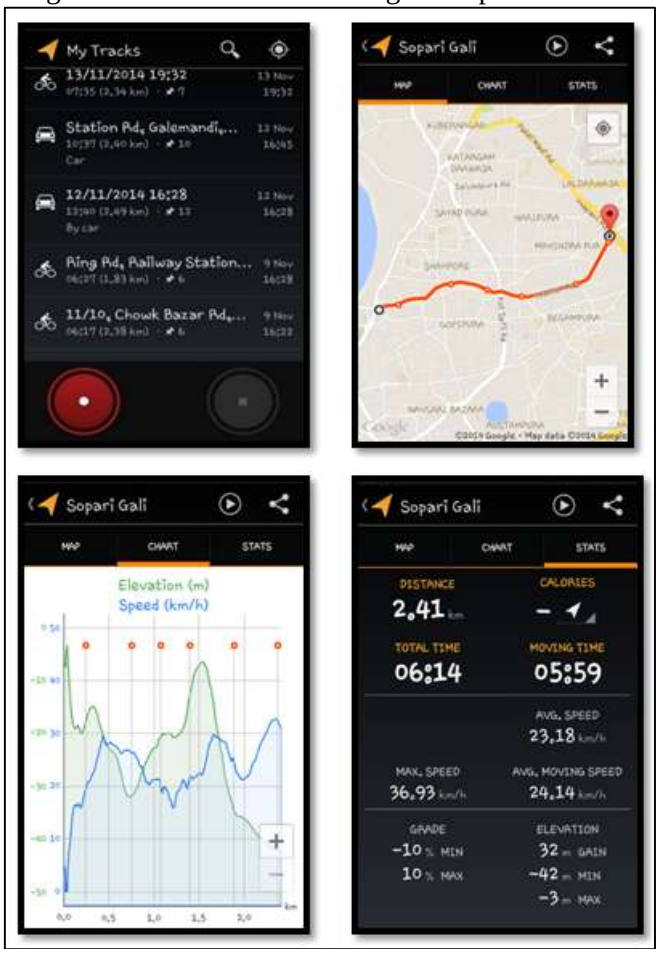
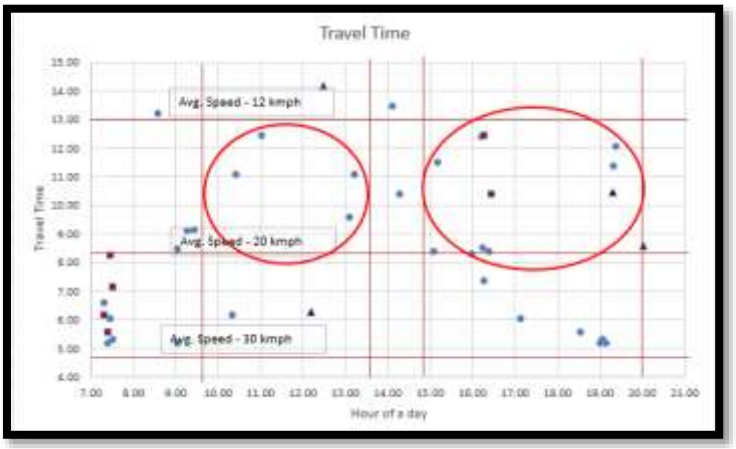


Figure 3 Screenshots of "My Tracks."

Table 5 Recorded data of Travel time and delay survey



The observation suggested that travel speed is below 30 kmph in entire of the stretch. Maximum delay in travel time exists during the morning (10:00-1:00), afternoon and evening (3:00-19:30) where travel speed average is approximately 20-12 kmph. Time loss while travelling along the stretch can be obtained in relation with distance and average speed using the Android application "My Tracks". Using observations, a relationship diagram as below shows the effect of average moving speed over "delay time with no movement" for the uniform road length.

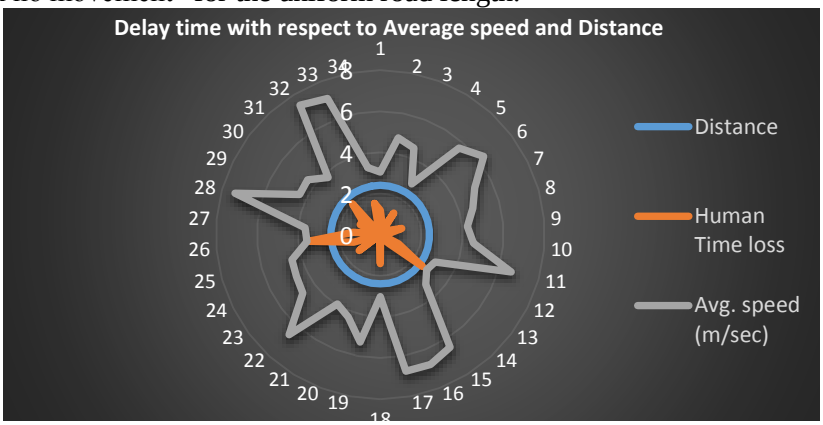


Figure 4 Delay time with respect to average speed & distance

From above the graph, it is established that as the travel speed increases, "delay time with no movement" decreases and vice-versa. Certain exceptional cases reveal the effect of congestion at certain spots though average moving speed is comparatively good, loss is more. This in particular leads for further spot specific investigation to identify and address congestion spots.

Based on the observations (highlighted in table-4), manual analysis was performed for 3-modes of transportation covering movement in either directions on the selected stretch under study. Below is table-6 that show the results obtained from the analysis regarding observed spots where these vehicles were identified as not in movement. Indirectly it represents the result of congestion. The repetition of spots show stopping of vehicle while in travel in a direction. This table show a commutative stopping of all modes. Based on the repetition of a location/ spot, the ranking may be provided. This operation is performed manually which may consume considerable time and resources and need to be performed by the software application as a feature therein.

Table 6 Congestion spots identification and priority

Repetitive occurrence	**Spots**	**Ranking/ Priority**
6	Chautapul-Police station	1
5	Bhagal	2
5	Lalgate	2
5	Tower	2

4	Bhaga talao	3
2	Janta market	4
2	Maskati hospital	4
1	Chutabazar	5
1	Moti Talkies	5
1	Parsi seri	5

These locations on a route map is identified as shown in the figure below wherein priority based markings is done manually. Presently a file with *.kmz* format can possible be obtained for carried out manual identification however, this shall be incorporated in software feature. Such identification allows planners, policy-makers and decision-makers to prioritize areas for investigation towards reducing traffic congestion on important links where congestion may have considerable effect on ongoing economic activates in the city.

Figure 5 Identified priority congestion spots

4 PROPOSAL FOR SMART TRAFFIC SURVEY USING ICT FOR ULB

Transport demand in most Indian cities is increasing substantially, due to natural increase and migration from rural areas and towns. For new development in a city, the first task is to carry out the survey for checking feasibility and identification of requirements. Due to increase in vehicle population, traffic congestion arises lately that needs a treatment meanwhile the roadside development has already taken place leaving no scope for road expansion. So as to address the issue of traffic congestion various props like widening of road, construction of flyovers, mass transportation system are explored later on within the constraints. To implement any measures against traffic congestion, the survey becomes the utmost requirement and shall be carried out regularly. As any ULB (Or Personnel) can start working for data collection of traffic to address its related problem, the survey process consumes more time. Over a period of time, the collected data become obsolete (Not real time) resulting in a remedial measure not effective though. On the other hand, the measure undertaken itself will consume resources unnecessarily.

A mechanism is proposed here to carry out the travel time & delay survey using the ICT-based-mobile application system that will provide an alternative means for the difficulties arising during data collection using travel time & delay study. A ULB may develop this sort of mobile application as discussed earlier to carry out the travel time & delay study. Advantage here is, many of the ULB provide mobile phones to its employees. By using ICT function in this type of survey work, real time & absolute result can be achieved with minimum cost.

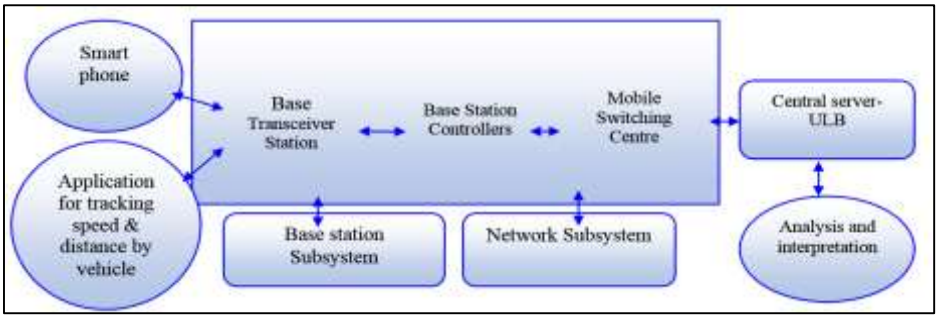


Figure 6 Schematic component arrangement

Mobile phones are identified based on Cell-ID. As the position of every Base Transceiver Station (BTS) is immovable, the location of a mobile phone can be expected through the Cell-ID information of the BTS. Physically, BTS is the access point of the mobile handset to the network. The Base Station Controllers (BSC) is a device that controls multiple BTS. The heart of the Global System for Mobile communications (GSM) network is the Mobile Switching Centre (MSC), which handles various BSC and also interfaces with other MSC.

Location identification is possible due Global Positioning System (GPS) activation in mobile phone. During a signal exchange between mobile and the tower, the location identification processes determine the position of the mobile at the Cell ID level. Detailed algorithm are required to be prepared.

This spatial interaction technique may be used effectively to identify location of the travellers & automatically initiating recording on the required path that needs to be looked into. This application may make records for the total travel time, total moving time, average speed, maximum speed & distance of a particular journey within municipal administrative limits. All these recorded data will get a transfer to centrally located server that maintain the data record & analyse it. Analysis will give the result in the form of total time loss during journey & automatically identify the congestion spots as done in above study with its priority for any treatment require to resolve the traffic problem.

5 CONCLUDING REMARKS

As discussed in the paper, it is the need of present time to use ICT empowerment in urban management. Conventional methods of traffic survey are resource consuming and become obsolete very soon as the urbanization itself is very dynamic. Urban areas are economic growth engines for any country wherein travel time delay may result as a major obstacle. Smarter ways to identify average travel speed and congestion spot identification using android based mobile phones by employees will not only help getting real-time data (without imposing large project capital costs) but also help generating data for trend analysis over any situation. It additionally will help understanding and establishing unique relationship between land-use in city and transportation as function, exclusively. In absence of similar mechanism, generalized traffic planning measures and models are observed to be less effective due to limitation in terms of absence of area specific considerations.

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