Comprehensive Study of Intelligent Transportation System and Comparison with Conventional Transportation System

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Abstract

Today, Traffic congestion has been increasing worldwide as a result of insufficient road development, growing number of vehicles, Low speed, increased accident rates, increased fuel consumption etc. It raises the demand for the concept of intelligent transportation system to the conventional transportation system. Intelligent Transportation System includes a wide and growing suite of technologies and applications. Intelligent Transportation Systems deliver superior benefit-cost returns when compared to traditional investments in highway capacity. Intelligent Transportation System maximizes the capacity of infrastructure, reducing the need to build additional highway capacity. ITS have a central role to play in funding countries' transportation systems. Increasing driver and pedestrian safety, Enhancing mobility and convenience, Delivering environmental benefit, Boosting productivity, economic, and employment growth. In this paper patch of highway in Gujarat has been selected and toll collection system i.e. existing conventional transportation facilities is studied and compared with intelligent transportation system.
Keyword- Fuel Consumption, Intelligent Transportation System, Traffic Congestion, Toll Collection System

I. INTRODUCTION

Now a day, Traffic congestion has been increasing worldwide as a result of insufficient road development, growing number of vehicles, Low speed, increased accident rates, increased fuel consumption etc. it raises the demand for the concept of intelligent transportation system to the conventional transportation system. The principal reason for traffic congestion in India is that the road, space and infrastructure have not improved on par with the traffic. The seriousness of the problem is reflected in the report of World Bank that estimates the economic losses incurred on account of congestion and poor roads alone run as high as 56 billion a year in India. There is, therefore, an urgent need to explore and develop better traffic management option to ease traffic congestion. Intelligent Transportation Systems (ITS) is a tested route to mitigate traffic congestion problems. ITS can be broadly defined as the use of technology for improving transportation systems. The major objectives of ITS is to evaluate, develop, analyse and integrate new technologies and concepts to achieve traffic efficiency, improve environmental quality, save energy, conserve time and enhance safety and comfort for drivers, pedestrians and other traffic groups. Intelligent Transport Systems represents the next step in the evolution of the entire transportation system. These technologies include the latest in computer, electronic, communication and safety systems. ITS have a central role to play in funding countries' transportation systems. The most common application is electronic toll collection (ETC), also commonly known internationally as "road user charging," through which drivers can pay tolls automatically. ITS can be applied to vast transportation infrastructure of highways, streets, bridges, tunnels, railways , port and infrastructure, as well as to a growing number of vehicles, including cars, buses, trucks and trains, as well as aircraft and waterborne vessels. They can be used both for passengers and freight transport. These information and communication technologies (ICT) provide the means to improve service quality, safety and management of transport systems. The write up of Introduction should contain Technical data related to your research paper and should contain details of other researchers who have did same experimental work in their regions and does not contain any other extra details which are not related with your topic.

Nikos Efstathopoulos et al. presents the cost-benefit analysis for the "Athens Greater Area Traffic Management System" (TMS), a public project consisting of the deployment of an integrated ITS with a budget of EUR 60,000,000. The benefits of the System implementation include improvement of the level of service in the road network, environmental benefits through the reduction of fuel consumption and emissions, and accidents' reduction. Three possible scenarios were considered in the analysis (pessimistic, basic, and optimistic). The project proved feasible for all possible scenarios.

B.T.P.Madhav et al. design and analysis of MSP Antenna, which will place at the toll gates to sense the information about toll payment process with the help of some advanced circuitry. Sangeeta Pandey et al. Study an electronic toll collection (ETC) system using radio frequency identification (RFID) technology. Research on ETC has been around since 1992, during which RFID tags began to be widely used in vehicles to automate toll processes. The proposed RFID system uses tags that are mounted on the windshields of vehicles, through which information embedded on the tags are read by RFID readers. The proposed system

eliminates the need for motorists and toll authorities to manually perform ticket payments and toll fee collections, respectively. Data information are also easily exchanged between the motorists and toll authorities, thereby enabling a more efficient toll collection by reducing traffic and eliminating possible human errors. E. D. Arnold concluded Ramp metering is an effective, viable, and practical strategy used to manage freeway traffic. It is a proven freeway management technique as various forms of ramp control have been in place since the 1960s in the Chicago, Detroit, and Los Angeles areas. Due in part to the success of these early applications, ramp metering has received increased emphasis in recent years under the umbrella of advanced traffic management systems (ATMS), a component of intelligent transportation systems (ITS). ITS America reports that there are currently more than 40 ATMS deployed, under construction, or in the planning stage in the U.S. by state transportation agencies. The future of ramp metering is also in this ITS context. Integration and interface with local street system control and other advanced ITS traffic control systems such as advanced vehicle control systems, dynamic route guidance, and advanced traveller information systems are the latest in ramp metering applications. Ramp meters are in place and working effectively on segments of1-395 and 1-66 in Northern Virginia. The Virginia Department of Transportation is very much interested in the feasibility of implementing ramp metering on other segments of freeways throughout the state. Accordingly, the purpose of this study was to review and synthesize the existing literature on ramp metering. Frans Middelham derived dynamic traffic management is an important part of the Dutch transport policy. All kinds of measures have been implemented and assessed on the motorway network, such as the motorway traffic management system with speed limits and queue tail warning, ramp metering, variable message signs, dedicated lanes, peak lanes, incident management, etc. In this paper the focus is on ramp metering, which is the management of traffic on an on-ramp, depending on the traffic conditions on the motorway and the on-ramp. The main purpose is the improvement of traffic conditions on the motorway, taking into account the conditions on the on-ramp and surface roads. Nicholas J. Mazzenga et al. stimulated Hard shoulders, variable speed limits, and ramp metering are several active traffic management systems simulated in. The simulation model was based on the geometric characteristics, ramp volumes, vehicle flows, and speeds of actual recorded conditions. Compared with the simulated control conditions, the results of the study indicated improvements in average fuel economy, travel delay, delay of the onset of congestion, and reduction of queues. The two active traffic management systems, i.e., variable speed limits and hard shoulders, showed the highest potential for reducing recurring congestion and should be considered as potential countermeasures in congested corridors.

II. STUDY AREA

A. Toll Plaza at Kamrej, Surat

Survey work carried out at toll plaza at Kamrej, Surat on NH-8.

B. Toll Plaza at Ahmedabad Vadodara Expressway

The Ahmedabad Vadodara Expressway also known as National Expressway 1 is a major artery of public transport connecting the cities of Ahmedabad and Vadodara in the state of Gujarat, India.

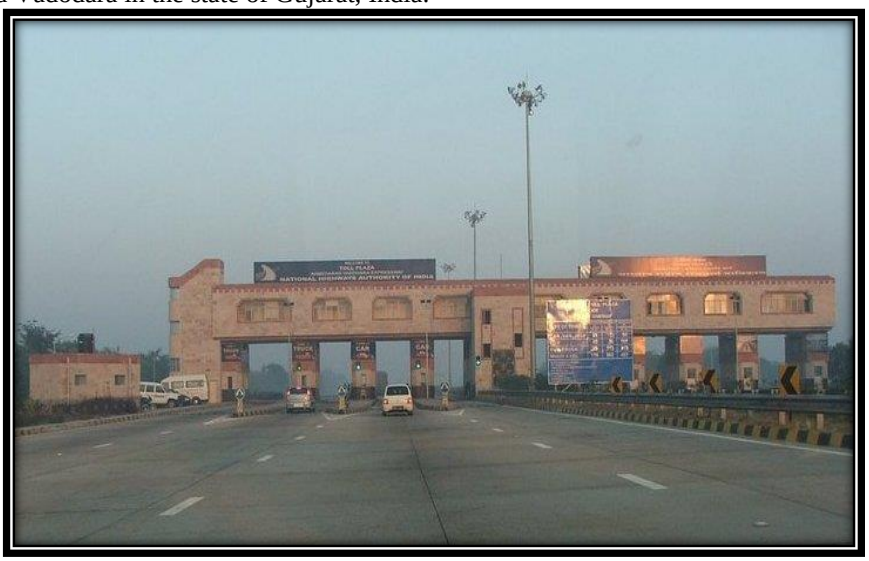

Fig. 1: Toll plaza Ahmedabad-Vadodara Expressway

III. SURVEY WORK

Survey work at Kamrej Toll Plaza was carried out on February 11, 2013 to February 13, 2013 and survey work at Ahmedabad - Vadodara expressway was carried out on March 12, 2013 and November 19, 2012. Total 1436 vehicle were surveyed and total time taken for each vehicle for toll clearance was measured with accuracy of millisecond. Details are presented in following table.

Location	*Peak Hour*	*Lane No.*	*Date*	*No. Vehicle Survey*
Ahmedabad – Vadodara Express Way	*11:00 AM – 1:00 PM*	*1*	*12/03/2013*	*30*
		2		*58*
		3		*60*
		4		*63*
	12:00 PM - 2:00 PM	*5*	*19/11/2012*	*80*
IRB Toll Plaza, Kamrej	*11:00 AM - 1:00 PM*	*5*	*13/02/2013*	*240*
		6	*12/02/2013*	*150*
		7	*11/02/2013*	*155*
		8	*13/02/2013*	*210*
		9	*12/02/2013*	*210*
		10	*11/02/2013*	*90*
		11	*11/02/2013*	*30*
		12	*11/02/2013*	*30*
		13	*11/02/2013*	*30*

Table 1: Survey work details

IV. ANALYSIS OF DATA

Following charts shows time taken for toll clearance in millisecond by no. of vehicles at toll plaza.

A. Kamrej Toll Plaza Data

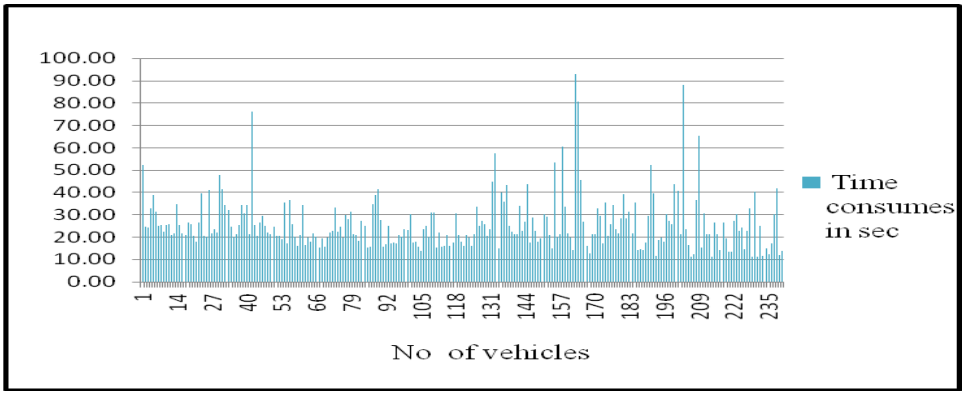

Fig. 2: Lane 5 (Kamrej Toll plaza)

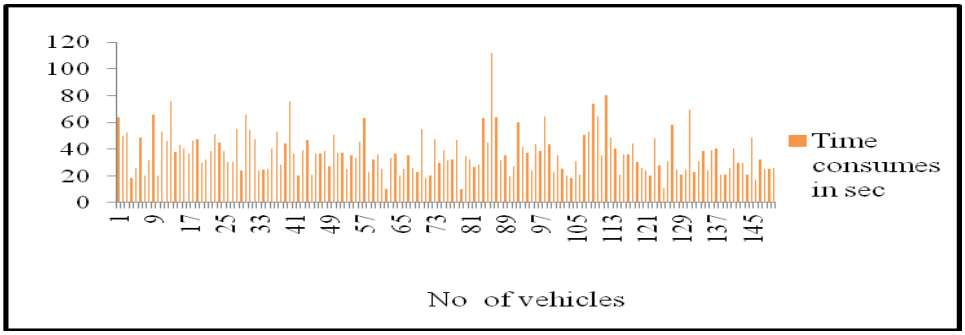

Fig. 3: Lane 6 (Kamrej Toll plaza)

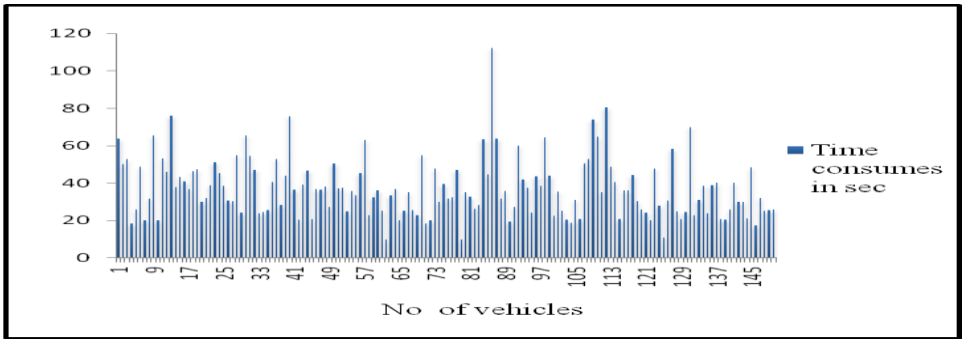

Fig. 4: Lane 7 (Kamrej Toll Plaza)

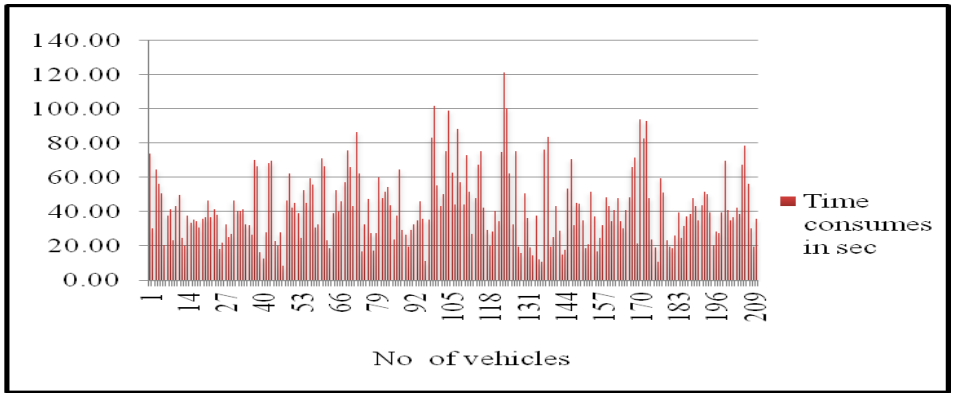

Fig. 5: Lane 8 (Kamrej Toll plaza)

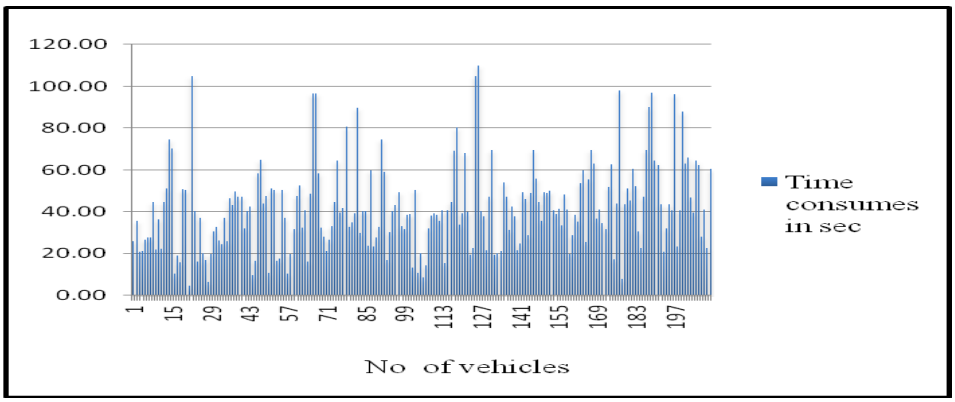

Fig. 6: Lane 9 (Kamrej Toll plaza)

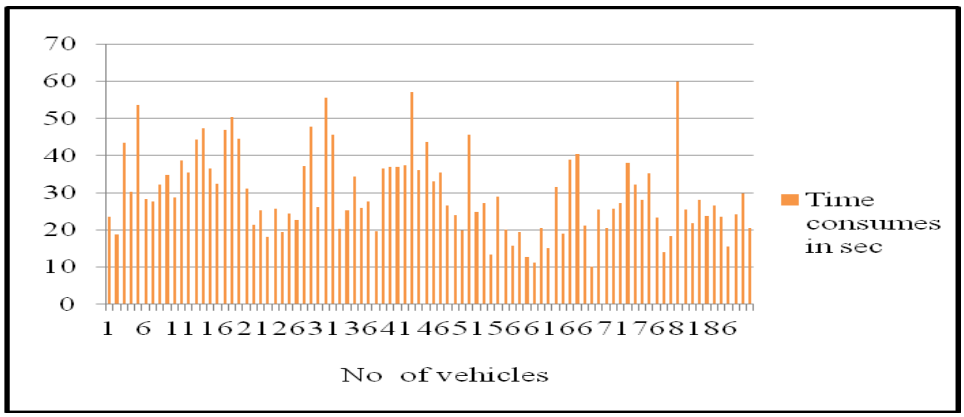

Fig. 7: Lane 10 (Kamrej Toll plaza)

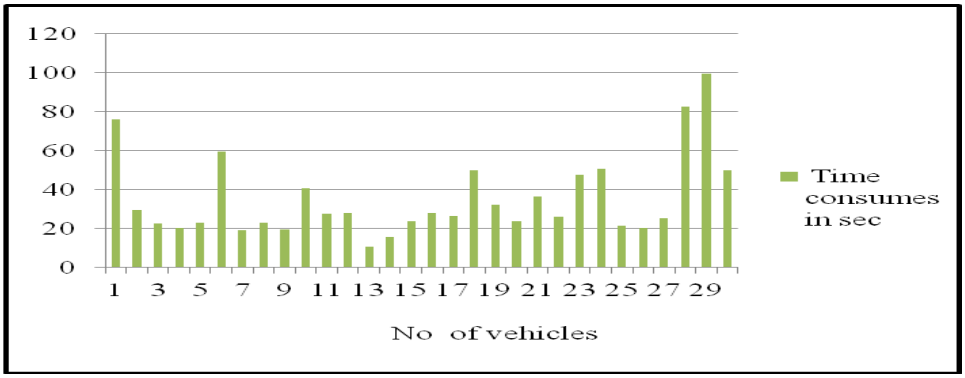

Fig. 8: Lane 11 (Kamrej Toll plaza)

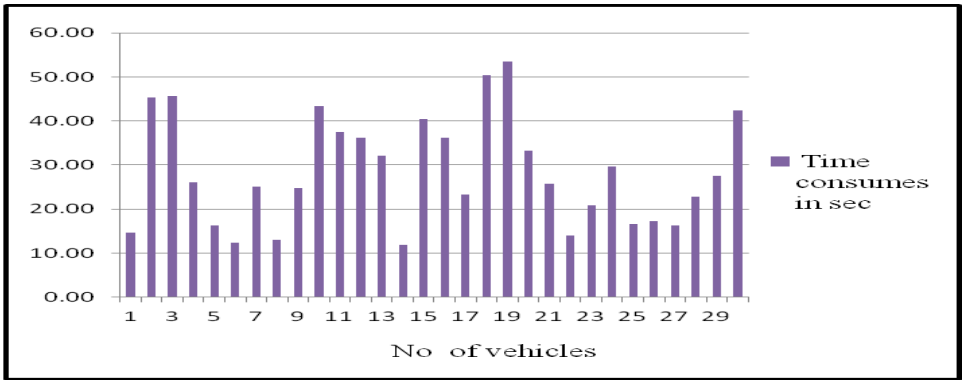

Fig. 9: Lane 12 (Kamrej Toll plaza)

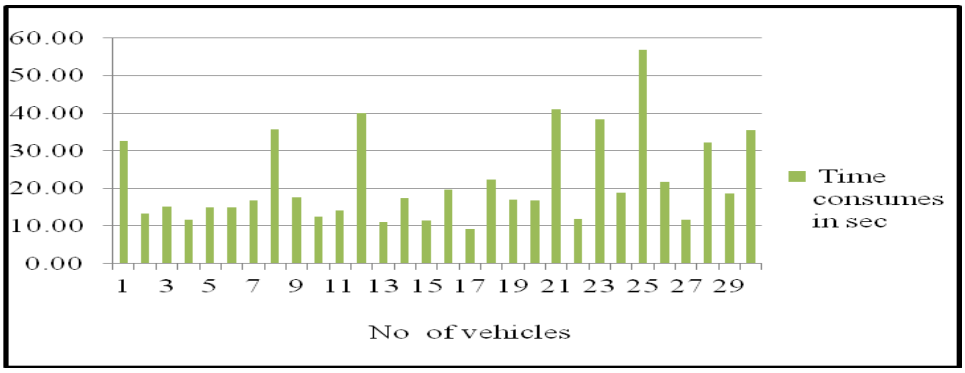

Fig. 10: Lane 13 (Kamrej Toll plaza)

B. Ahmedabad-Vadodara Toll Plaza Data

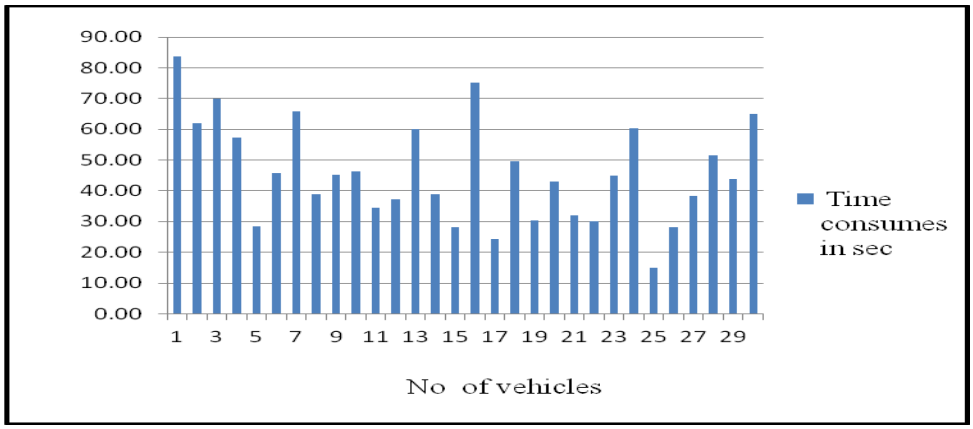

Fig. 11: Lane 1 (Ahmedabad-Vadodara Expressway)

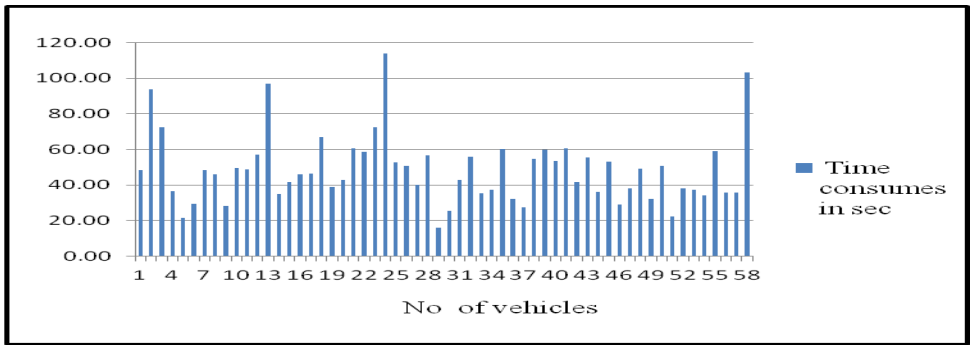

Fig. 12: Lane 2 (Ahmedabad-Vadodara Expressway)

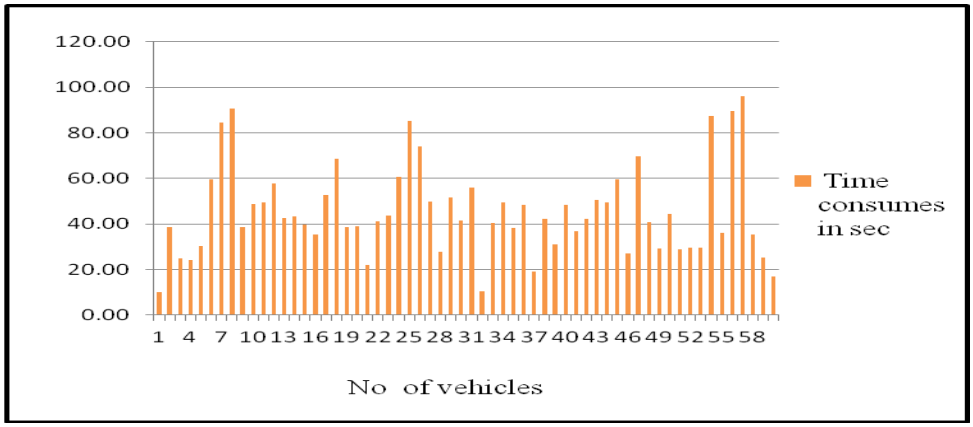

Fig. 13: (Ahmedabad-Vadodara Expressway)

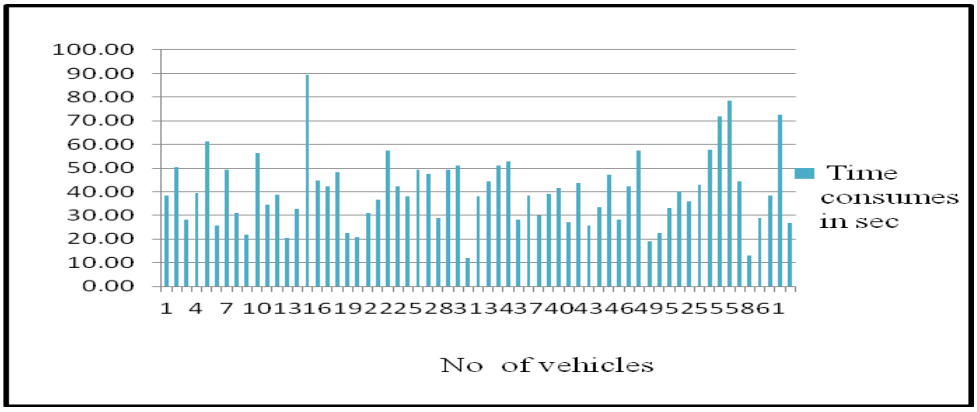

Fig. 14: Lane 4 (Ahmedabad-Vadodara Expressway)

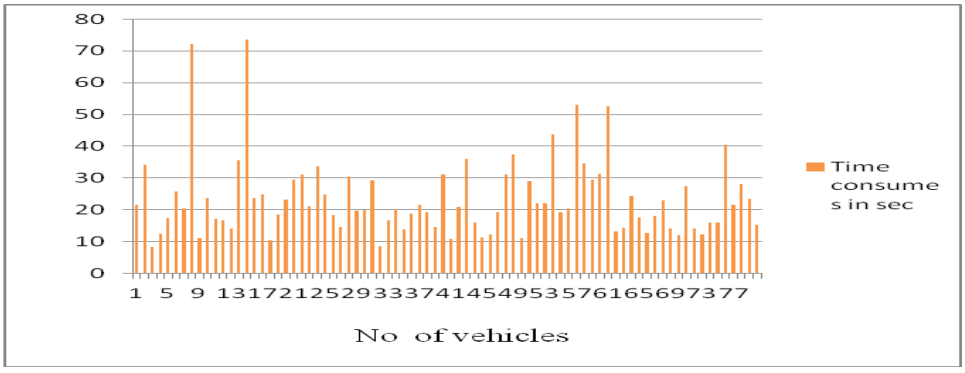

Fig. 15: Lane 5 (Ahmedabad-Vadodara Expressway)

Following table shows lane wise average time of vehicles

Toll plaza	*Lane No.*	*Average time in S*
Ahmedabad Vadodara Toll Plaza	*1*	*45.81*
	2	*48.48*
	3	*45.34*
	4	*40.24*
	5	*23.34*

Table 2: Survey work details at Ahmedabad Vadodara toll plaza

Toll plaza	*Lane No.*	*Average time in S*
Kamrej Toll Plaza	*5*	*25.95*
	6	*37.18*
	7	*36.30*
	8	*15.53*
	9	*41.57*

	10	*29.74*
	11	*35.35*
	12	*28.48*
	13	*21.69*

Table 3: Survey work details at Kamrej toll plaza

V. RESULTS

Average time obtained from for Kamrej Toll Plaza is obtained as 33.23 Sec and that for Ahmedabad-Vadodara toll plaza as 44.97 Sec. Average time taken by ETC is obtained by simulation on computer which show average only 7.9 Sec is taken by vehicle is ETC is adopted. Which show the average time Kamrej toll plaza in 33.23 sec, in this time span almost 4 vehicle can be passed if ETC is used. It means approximately four times capacity may increased at this toll plaza. At Ahmedabad-Vadodara toll plaza in average 44.97 sec approximately 5 vehicle may passed which shows approximately five times capacity can be increased.

VI. CONCLUSION

A. Advantages of Using Electronic Toll Collection System

1) Reduce Travel Time

As per results, we can conclude that one vehicle has to stop for 34.00 seconds on toll plaza in conventional system and only for 8.00 seconds in Electronic Toll Collection System. So it reduces the travel time to reach the destination point.

2) Increase Highway Capacity

As per results, capacity of highway increase 25.00 % at Kamrej toll plaza and 20.00 % at Ahmedabad-Vadodara toll plaza.
As per results, if Electronic Toll Collection System is provided, no. of vehicles increase per month at Kamrej toll plaza are 195801.

3) Reduce Traffic Congestion

Due to conventional toll collection the vehicle have to stay until the process complete. It ultimately accumulate the traffic at toll plaza site. But due to Electronic Toll Collection System, it does not accumulate traffic at toll plaza.

4) Environment Effect

During the process of toll collection in Conventional System, the vehicles have to be stopped at toll plaza. So it emits various pollutants like as, CO_2 (Carbon dioxide), CO (Carbon Monoxide), NOx (Nitrogen oxides), SO_2 (Sulphur dioxide) etc. which causes environmental effect.

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