

Development in the Intelligent Transportation System in India



Pankaj Mukhija, Priyanka

Abstract: In India, vehicles on the road are increasing very rapidly. Either more infrastructures are required to meet the needs of an increase in vehicles which are costly and time-consuming projects. An intelligent transportation system can also overcome traffic and other related problems. In this paper, developments and achievements in the intelligent transportation system in India are taken into consideration. Some projects on the intelligent transportation system in India are listed, recent services added to Intelligent Transportation Systems are discussed, challenges and the future requirement for the intelligent transportation system in India are also taken into consideration.

Keywords: Intelligent Transport System, E-Challan, Electronic Toll Collections, Expressways, and Highways.

I. INTRODUCTION

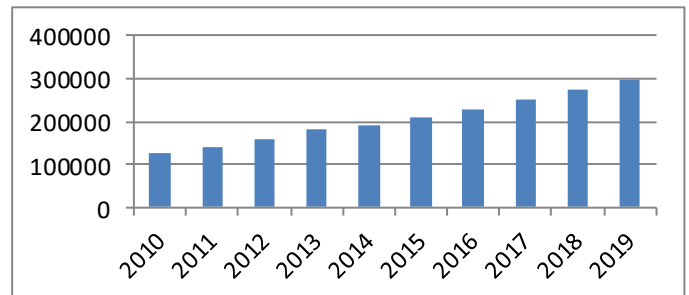
Due to the increase in traffic in India in the last two decades, the traffic management system is most required [1]. In India, vehicles are continuously increasing, as shown in Graph1. This increase in vehicles, leads to other problems like accidents (Graph 2 shows the number of accidents and deaths [2] due to road accidents), transportation delays, traffic congestion, and pollution emissions [3]. Various measures have been taken to overcome these problems in India, especially in metropolitan cities. An increase in the capacity of roads by widening and making them signal-free or laying new roads is not economical [4]. In India, there are various challenges in the transportation system, like poor light conditions, poor weather conditions, roads, etc., and traditional methods cannot provide the best solution [5]. With new technological innovations to manage transportation systems, there is a need for an intelligent and adaptive transportation system. [7]. Intelligent Transportation Systems (ITS) integrate various technologies to provide a better transportation system [8]. ITS consists of three primary components: Data collection, communication, and decision making.

India is a developing country; therefore, traffic in India differs from that of developed countries. India is also a thickly populated country. In most developed countries,

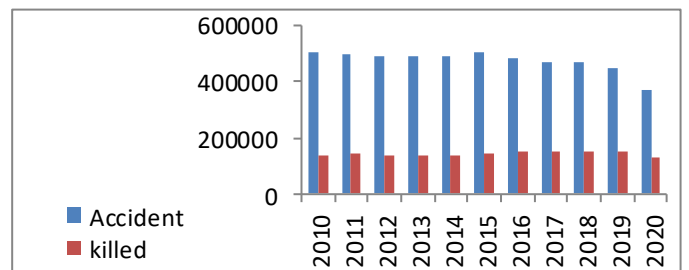
Lane driving is used, but in India, a single line is shared by different types of vehicles. Issues related to ITS in India differ from those the developed countries. There are so many challenges in adopting ITS in India. These challenges can be described as; I. the cost of the project, II. the technology used in ITS is not adaptable to the local level language, III. so far, there is no set of guidelines and policies for ITS in India, IV. most of the technologies in ITS are imported from developed countries and V. Lack of infrastructure is also a problem [9].

There are many areas where the ITS can effectively work. These areas can be divided into six main categories [5], as shown in Table 1. National Transport Development Policy Committee (NTDPC) advises setting up policies and guidelines for implementing ITS in India [10]. There are many advantages of ITS some of them can be listed as follows, I. ITS reduces stop and delay times at various intersections, II. controlling speed and its monitoring, III. ITS reduces travel time in multiple ways, IV. ITS also helps in proper utilization of capacity, ITS gives incident management. This paper provides various stages of developments of ITS, various projects and services of ITS, challenges of ITS, needs and future of ITS in India

Graph1



Graph2



Source: From Report on road accidents in India by Ministry of Road Transport and Highways [6].

Manuscript received on 18 October 2022 | Revised Manuscript received on 31 October 2022 | Manuscript Accepted on 15 November 2022 | Manuscript published on 30 November 2022.

* Correspondence Author (s)

Pankaj Mukhija*, Department of Electronic and Communication Engineering Deenbandhu Chhotu Ram University of Science and Technology, Murthal (Haryana), India. Email: pankajmukhija123@gmail.com

Priyanka, Department of Electronic and Communication Engineering Deenbandhu Chhotu Ram University of Science and Technology, Murthal (Haryana), India. Email: priyankait@gmail.com

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Table. 1 Applications of ITS

S.NO.	Its Category	Specific Its Applications
1	Advanced traveler information (ATIS)	Information on traffic in Real-time Route Navigation and guidance systems
2	Advanced Transportation management systems (ATMS)	Traffic Management centers, Dynamic signal for traffic
3	ITS-Enabled Transportation pricing systems (ITSETPS)	Electronic Toll collection, Dynamic Parking Fee
4	Advanced Public Transportation systems (APTS)	Real-time status information for public transit systems, Automatic vehicle location
5	Fully Integrated intelligent Transportation (FIIT)	Collision Avoidance, Intelligent Speed adaptation
6	Advanced Traffic Management systems(ATMS)	Real-time Traffic status, Dynamic Traffic control Incidence Response
7	Commercial vehicle operations (CVO)	Traceability and safety of commercial vehicles such as trucks, vans, and taxis
8	Advanced vehicle control systems(AVCS)	Collision warning of the vehicles
9	Advanced Rural Transportation systems (ARTS)	Provide Information about Remote Roads via Radio

II. DEVELOPMENT OF ITS IN INDIA

The developments of ITS in India can be divided into four stages or four generations.

A. First Generation ITS

The First Generation of ITS was from 1950 to 1980. During this period, India concentrated on building up essential highways and roads [11]. In this phase, technology was not grown much in India. More focus was on laying the national and state routes. The road connectivity in the rural areas was at its infant stage, and very little work was conducted on the automatic system which was limited to metropolitan cities. This Generation of ITS can be called one-way infrastructure based. In decade 50, automated traffic light signals were introduced in India, which is considered the first step in the intelligent transportation system. Many concepts were at their research level in the ITS in this phase. In the later 80s, with the invention of communication technologies and also in microprocessors & Microcontrollers, more features like traffic diversion/route guidance were added to the ITS

B. Second Generation ITS

Second Generation ITS in India is considered from 1980 to 1995. In this Generation of ITS, the Government of India and private industries started to work on the concept of an Intelligent Transportation system. New features of two-way communication were added to national highway projects. The toll collection system and Parking management services were improved in this phase of ITS. Inventions in Computer technology also help in adding more applications to ITS. But, work was limited to national-level highway projects and in a few cities. Less work in the area of ITS was noted in rural India.

C. Third Generation ITS

The third generation of ITS in India is considered from 1995 to 2010. In this phase, automatic and interactive vehicle operations were started. During this period, the main focus was on the alignment of different interests from different stakeholders, cooperative systems in ITS, standardization of activities so as to avoid conflicts, and commercial deployment. In this phase of ITS, Mobile ad hoc networks (MANET) and Vehicular ad hoc networks (VANET) were key technologies in Intelligent Transportation systems. More features like the Emergency Management system were added to ITS. More projects on Intelligent Transportation systems were started during this period.

D. Fourth Generation ITS

The fourth generation of ITS in India is considered from 2010 to the present. In this period, due to technological innovation, integration of different technologies, and more work in the field of the Internet of Things (IoT), a lot of features have been added to the intelligent transportation system. Real-time applications increased in this period, and specific solutions for individuals and localities were considered in this phase. More traffic management models were developed. More features like Advanced Driver Assistance, an intelligent system for pedestrian crossing [12], a real-time arrival information system of vehicles, E-Challan, variable message signs, and smart traffic lights. A summary of all four Generation of Intelligent transportation systems is given in Table 2

Table. 2 Summary of all four Generation of Intelligent transportation system

Generation	Period	Technology	Few Features of ITS
First Generation	1950 to 1980	One way infrastructure Based	Automatic Traffic Light System
Second Generation	1980 to 1995	Two-Way Communication Technology	Toll Collection and Parking Service
Third Generation	1995 to 2010	Automatic and interactive vehicle Operations	Traffic Status. Collision Avoidance
Fourth Generation	2010 to present	Technology Integration, Internet of Things, and Multimodal concept	Real-Time Traffic Information, E-Challan

III. VARIOUS PROJECTS OF ITS IN INDIA

In India, various projects on Intelligent transportation applications have been started but mainly in Metro or big cities [13] and on Expressways and Highways. These projects are individual or stand-alone in nature. Functions involved in various projects of ITS are management of traffic signals, management of parking; public transportation management; Automatic Toll collection. Some of these projects on ITS are pilot projects. Few of these projects are mentioned in Table 3.

Table. 3 List of some Projects on ITS in India [14]

Sr. No	Name of Project	Main Function of ITS used in Project
1	Traffic Regulatory Management System Chennai (TRMS)	A traffic monitoring system using surveillance cameras, mainly at road junctions.
2	Area Traffic Control Project Mumbai	Traffic Flow management
	Project on Chandigarh-Parwanoo on NH-5 and Ahmedabad-Mumbai Highway (RFID-based)	Automatic and Electronic Toll Collection
5	ITS on BRT Corridors	Signal priority, Vehicle Tracking, and Automatic Fare Collection in Indore BRT
6	Advance Parking Management System In New Delhi	The parking lot at Palika Bazar – Capacity to park 1050 cars and 500 two-wheelers - Electronic Parking Guidance and VMS Smart Cards Automated multi-level parking in Sarojini Nagar Market
7	The Traffic People Project in New Delhi (2009)	Real-time traffic conditions and updates of in-and-around New Delhi.
8	Rapid Transit Systems projects in various cities	Rapid transition of Buses
9	ITS Master Plan for Hyderabad	Automatic Traffic Counter-cum-Classifiers (ATCC), CCTVs, Variable Messaging System, Traffic Signals, Pedestrian Signals, Flood Sensors, Weather Stations, Pollution Sensors
10	B-TRAC, Bangalore of traffic police Bangalore	adaptive and controlled/monitored by the Traffic Management Center
11	6-Lane Eastern Peripheral Expressway (NH NO.NE-II), Kundli-Ghaziabad-Palwal expressway	Electronic Toll Collection and Emergency Management
12	2-Laning of Shillong Nongstoin Section of NH-44(E), Meghalaya	Electronic Toll Collection and Emergency Management, Law Enforcement
13	Construction bridge between Dhola and Sadia Ghats.	Automatic Navigation, Law enforcement
14	Two Laning of Chennai to Nashri Tunel	Automatic Signalling and routing
15	Improvement of NH connectivity to Char Dham, Uttarakhand state	Weather forecasting and route management
16	Development of 6-lane Delhi-Meerut Expressway	Electronic Toll Collection and Traffic Management
17	Construction of four-lane Signature Bridge, Delhi	Automatic Navigation, Law enforcement
18	Narmada Bridge, Bharuch	Electronic Toll Collection and Traffic Management
19	Zojila tunnel (ongoing)	All weather connectivity.
20	Nechipu-Hoj in the State of Arunachal Pradesh (ongoing)	Reduction in Travel time

With technological innovation and technological integration, many new services are added with the aim of One nation one system by state, and central government. A few of these add-on services are given in table 4.

Table. 4 Additional services of ITS in India [15]

E-Challan	very helpful in law enforcement. The offense of the vehicle is automatically detected, and the vehicle is automatically identified using the Automatic License Plate Recognition System thereafter, using a database of vehicles, a challan according to the offense is sent to the offender
M-Parivahan	Database management of various vehicles is maintained by M- Parivahan, which is being provided for various services like E- Challan, payment of Road tax, applying for various services and appointment with RTO, and upload of document
Electronic Monitoring and Enforcement of Road Safety	electronic monitoring and enforcement of road safety on National Highways and State Highways or in any Urban as per standard prescribed like route diversion, display boards, warning boards, etc.
Emergency	Integration of various Emergency services and helplines for quick response.

IV. CHALLENGES AND ISSUES OF ITS IN INDIA

Many challenges exist in implementing an intelligent transportation system in India. These challenges can be due to inefficient structures of roads [16], Financial constraints of government and private sectors, rapid increase in the population of India, more urbanization, Lack of technological upgradation, coordination in different departments involved in ITS, Less awareness in the End users of ITS services, most of the technology in ITS in India are imported from developed countries, but there is a difference in the situation of India. Therefore, technological customization is needed.

V. NEEDS AND FUTURE OF ITS IN INDIA

ITS operations are becoming favorable in the transportation system still; there can be a lot of scope for ITS to enhance. A systematic approach is needed to strengthen ITS in India [17]. ITS can be efficiently utilized by integrating different technologies and applications to be implemented on all types of roads in India. Presently in India, ITS applications are not efficiently used, more work is needed in utilizing ITS applications, and more focus is required on different services and applications. More projects are required keeping in mind the change in the number of vehicles [18]. The main steps that are needed to get betterment in the ITS implementation issues can be: ITS standards are required for different constituents and applications; There is a need for a policy on ITS for the implementation and management part of ITS projects; need of functional Traffic Management Centers to coordinate different activities in urban and rural areas; evolving a set of methodologies for automatic data collection techniques for Indian traffic conditions; setting up a national data repository for ITS; There is need of Coordination of different departments in implementing ITS projects in India; For enhancement of ITS application in a better way, there is a need to strengthen the current infrastructure.

VI. CONCLUSION

In this paper, the development of an Intelligent transportation system is considered, with origin of time various technologies and features added to ITS. ITS has grown from a one-way infrastructure-based system to an interactive two-way system. More and more features are added to ITS with innovation and integration of technology. Various projects in different cities/states in India are discussed.

ACKNOWLEDGMENT

The authors are thankful to DCRUST for providing the necessary facilities and infrastructure to conduct this project. The authors would also like to thank the anonymous reviewers for their valuable comments.

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AUTHORS PROFILE



Pankaj Mukhija, received her M.Tech degree in ECE from DCRUST University, Murthal, Haryana. Now, pursuing Ph.D in Electronics and Communication Engineering Department from DCRUST University, Murthal, Haryana, India. His major research areas are Image processing, Signal processing, Machine vision, Machine learning.



Priyanka, received her Ph.D degree from Center of Applied Research in Electronics, IIT Delhi, India. In 2008, she is joined DCRUST, Murthal. Presently she is working as Professor in DCRUST, Murthal, Haryana, India. Her major research areas are Image Processing, Signal Processing, SAW Filter Design, Multimedia Communication. She has more than 50 publications in various national and international reputed journals.