



RESEARCH ARTICLE

INTELLIGENT TRANSPORTATION SYSTEMS - A LITERATURE REVIEW FROM INDIAN PERSPECTIVE.

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Manuscript Info

Manuscript History

Received: 12 July 2016

Final Accepted: 19 August 2016

Published: September 2016

Key words:-

Intelligent Transportation System (ITS),
Traffic Congestion, Developing
Countries

Abstract

Objectives:- This paper aims to build a structured literature review to the field of Intelligent Transportation Systems (ITS). In this literature review an effort made to critically evaluate the earlier research work and methodologies related with Intelligent Transportation Systems to study, analyze and evaluate its relevance in today's changing environment. The recently published research articles related to ITS are undertaken for the study.

Prior work:- This paper is making an attempt to explore the knowledge in the areas of ITS by reviewing the related past publications in the field of ITS.

Approach:- The paper adopts the narrative review methodology to critically review the literature published in the areas of ITS.

Results:- The literature review focuses on different areas such as: ITS applicability in the developing countries like India with major issue of Traffic congestion, Infrastructure constraints, High Traffic Loads, Non-Lane Traffic System etc. There are few research gaps were identified in the field specifically in the areas of ITS and its practical implementation. To fill these gaps and extend previous studies within the field, there is a need for conducting research to investigate the relationship between ITS and its implementing issues.

Based on the findings the author highly recommends that the ITS implementation in Indian perspective requires very diverse approach than the developed countries.

Implications:- This study will give a substantial information which results into benefits for policy makers, entrepreneurs, researchers, and educators as giving clear view and detail understanding of the ITS and related issues in its implementation.

Value:- This paper will add to the body of knowledge by investigating and illustrating a survey and narrative review of the published work in the field of ITS and its implementation with special focus on Indian perspectives. Depending on this review, researchers and scholars in the field of ITS can have a clearer view to set their attitude towards suitable future research studies and methodologies which in turn will contribute to the related accumulated knowledge in the field.

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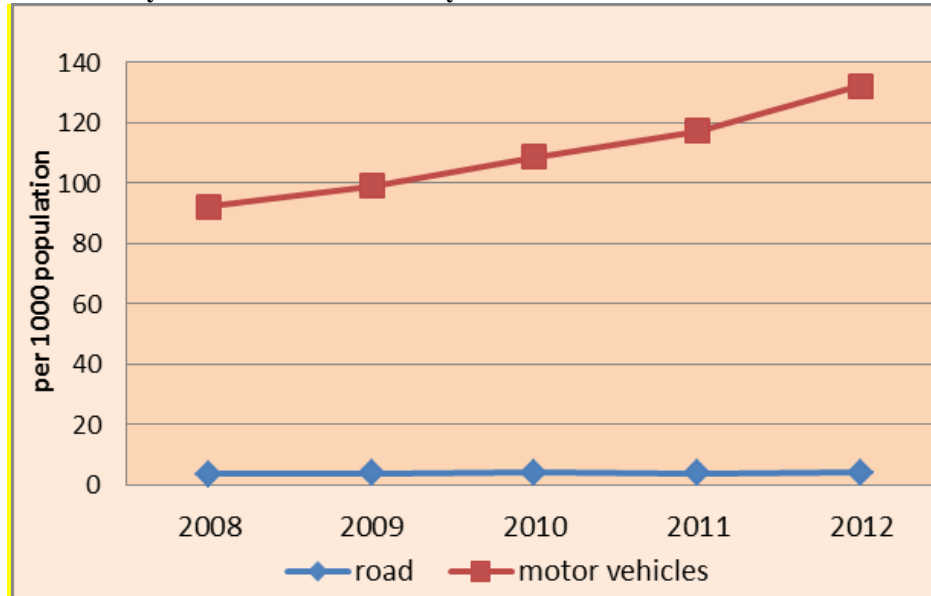
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Introduction:-

In the present dynamic environment the transportation system has been playing a very crucial role in the development of the different countries. As a high rate of development in various areas there is immense requirement of fast and efficient transportation system. Around 80% of passenger transportation is by road and rail together also 60% goods movement by road. In the Twelfth Plan of India the provision of Rs. 914536 Crore are made towards bridges and road infrastructure development. The graph shows the a higher raise in the density of the Motor Vehicles with respect to Road Density. The road density increased specifically in the urban areas which puts stress upon road traffic management.

Road Density vs. Motor Vehicle Density



The average time spend on the transportation is considerable, and due to high traffic congestion this travelling time increases which results into un-utilization of productive human-hours. The infrastructure available is required to be utilized more effectively. Indian conditions are way together different than other regions as there are different factors which impacts on the mobility of people, goods and other resources. The high density of the traffic particularly in the urban and sub urban areas requires a intelligent transportation system (ITS) which can address the major issue of traffic congestion. For overall requirement of ITS a well build plan is need of a hour. ITS applications are highly effective and efficient but they are required to be modified according to the Indian perspective. The road infrastructure of India is not enough to handle this high traffic loads which ultimately results into traffic congestion and very slow movement of traffic.

The primary concern area for the developing economics are rapid expansion of the urban and suburban areas which puts high stress upon the infrastructural requirements. The conventional ways of handling the traffic related issues are facing the difficulty in addressing this increased load on the system. There are different ITS applications which could be helpful in solving the traffic related problems. The literature reviewed focuses on these ITS implementation scenario from the Indian perspective.

Research Problem and Questions:-

The fundamental problem motivating this study is the need to know and understand the different research points covered by the researchers in the field of ITS as well as understanding the different methodologies applied by these researchers and trying to evaluate these methodologies to illustrate the suitable methodologies and methods for future research studies in the field of ITS.

Research Objectives:-

The main objective of this research is to develop a clear understanding about the different research points related to studies of ITS published. To study and analyze the different methodologies implemented by the researchers in the field of ITS.

Consequently, the objectives of this research are as follows:-

- To understand the ITS and its application in Indian perspective.
- To study and understand the possibilities of effective implementation of ITS in developing countries like India.
- Identification of barriers of ITS implementation.

Methodology:-**Sample and Procedures:-**

The author reviewed the literature related to ITS and its Indian perspective. The literature reviewed has direct relationship with the scope of the research study.

Classification Method:-

The research articles undertaken for the review are classified qualitatively and review as well as exploratory research articles are considered for this study.

ITS and its Indian context:-

The objective of study to understand ITS and its related areas with Indian context are illustrated in the literature review as follows.

ITS technology:-

The ITS utilization over the period in the developed countries has resulted into effective management of traffic, the ITS and its architecture with different elements are discussed in this section of study.

- **S.A.Mulay, C.S.Dhekne, R. M. Bapat, T. U. Budukh, S. D. Gadgil** ^[4] mainly focuses on the ITS covering various domains like evolutionary computing and intelligent systems, mobile computing and applications, GPS etc. During the peak hours such as office and school timings there is long traffic lines and more waiting time on traffic signals which probably leads to breaking of traffic rules. The researcher presented in this paper three modules which addressing the issues of traffic management. Congestion Detection and Management uses an approach of real time in which information about congestion on the road can be identified and communicated to the traveler to through internet, SMS on their mobile phones, so as traveler can modify their routes accordingly. Secondly, Intelligent Public Transportation system provides latest available positions of the buses nearby user. The expected time taken by the bus to reach to the destination, bus number, routes etc are communicated through mobile phones. Use of CCTV cameras, GPS devices in the bus provides real time information about the location of the bus and traffic density to the user. Third module focuses on the traffic signal synchronization which adjusts the signal timers according to the traffic congestion. Traffic jams at signals can be avoided by using this module. All these modules are operating without any intervention from human which leads to less amount of mistakes. A data centres are required to be get developed to use these modules which ultimately results into effective management of traffic and reduction in the fuel consumption at traffics and reduction in pollution as well.
- **Ioanna Spyropoulou, Matthew Karlaftis, John Golias, George Yannis, Merja Penttinen** ^[5] are discussed in their paper about present research carried out in the ITS impact assessment and future potential focusing upon road safety. In first section of this paper previous work carried out on the topic of ITS and its impact on road safety is evaluated. There are different studies are carried out and outcome of these studies are different and sometimes results and conclusions are contradicting, which results into unclear picture about ITS impact. A questionnaire is prepared and through Delphi study the answers and opinions from different groups covering engineers, psychologists, ergonomists and lawyers were recorded. In the second section of the study the Delphi study preliminary results were discussed. Different systems like intelligent speed adaptation, the lateral warning, intersection warning, traffic and environmental conditions, user Integration, driver comfort, anti-lock braking system and enhanced navigation and system are evaluated for their impact on road safety.

Paper conclude with opinion that the ITS is having impact on road safety but still there are unaddressed issues which are required to be focused.

- **Robert L. Bertini, Christopher M. Monsere** ^[6] represented in their research the benefits of ITS in the Urban areas addressing the congestion and safety issues. While reviewing the literature related to the ITS researcher discussed the scope of ITS benefits based upon real life experiences. This report highlights citing in each category national and international examples and blends documented benefits of ITS. Discussion on Arterial and Freeway Management Systems; Freight Management Systems; Incident Management Systems; Transit Management Systems; Regional Multimodal and Traveler Information Systems; Emergency Management Systems and

Information Management. ITS implementation in urban region can result into following potential benefits: Arterial Management System may decrease delays in implementation, Freeway Management System can decrease happening of crashes and also reduces overall travel time, Transit Management Systems focuses on automatic vehicle location and transit signal priority, Incident Management System improves public supports to the DOT activities. The benefits like enhanced safety, efficiency, accessibility, mobility etc can be more effective with regional cooperation.

- **Dinesh Mohan** ^[7] described the ITS and its application group with specific categorization like traveler information, traffic, commercial vehicles etc. The researcher identified that there is substantial relationship of ITS effectiveness with behavioral adaptation. By illustrating examples like anti break system, route guidance system, onboard driver assistance etc it is clear that the man – machine interaction outcome is highly complex and it is observed that technology alone can not deliver results in ITS. The major concern area about safety can be addressed with the use of ITS tools like Adaptive Cruise Control, Advanced Traveler Information System (ATIS), Violation detection system etc and vehicle based systems like Intelligent Speed Adaptation, Collision Avoidance System, Alcohol Interlock System etc are also being promising impact on effective transportation management. The public transportation system is addressed and its relevance in ITS is illustrated. To sought out the problem of traffic congestion, safety, pollution etc behavior adaptation is a critical issue.
- **D. Kandar, S.N. Sur, D. Bhaskar, A. Guchhait, R. Bera and C. K. Sarkar** ^[8] presented in their paper about relationship of communication and RADAR technologies with ITS. In the present scenario of road transportation the use of RADAR technology can make implementation of ITS more successful. This paper stresses on the different elements of RADAR technology and its linkage with ITS. The primary concern in implementation of ITS is communication, accuracy, cost and compactness of the equipment. Due to advantage in most of the concern areas RADAR technology is good tool for implementation of ITS.

Indian scenario in ITS:-

Indian traffic conditions are way together different than developed nations as the traffic density and available infrastructure have heavy impact on the ITS adaptation from Indian requirements. ITS technology with Indian context requires very different approach than other countries.

- **Gurdit Singh, Divya Bansal, Sanjeev Sofat** ^[9] presented in their paper existing techniques used in India for controlling of road traffic and ITS need in the present context. India is having non lane road traffic system where all types of vehicles are utilizing the roads which creates an congestion in the traffic at various locations. Particularly, in metro cities and medium cities this traffic congestion problem is intense. In India conventional traffic management system is utilized by use of traffic lights, traffic policemen, traffic signs etc. The restriction in development in road infrastructure due to space limitation creates a hurdle in controlling the traffic congestion problem. ITS techniques used in the developed countries may not be practicable in Indian context as there is huge difference in the developed countries traffic management and Indian traffic scenario. In India instead of focusing upon fixed sensor technique, use of sensors like GPS, Wi-Fi, Camera and microphone in the smartphones can be helpful in estimating traffic conditions and avoiding the traffic congestion.
- **Sumit Mallik** ^[10] undertaken a research to understand the problems due to traffic congestion and role of information technology in creating synergetic effect in communication networks. Due to traffic congestion transportation efficiency gets reduced and increase in the travel time, pollution etc. Development in the road infrastructure results into more number of accidents. In this paper attempt is made to discuss the impact on

different application field. Studying earlier work problems identified as grouped into three clusters. First, Lack of Traffic Management System due to heavy increase in the number of the vehicles, resulted into traffic congestion. Secondly, Homeland Security system and Vehicle Operations are not developed resulted into non tracking of the vehicles. Lastly, third cluster is Vehicle to Vehicle Co-ordination and implementation of new technologies. To overcome these problems some solutions are suggested by the researcher such as use of GPS, GIS, remote sensing etc resulted into efficient mobility of traffic. By keeping surveillance on the road traffic identification of the vehicles became easy for tracking. Use of Bluetooth, wifi, sensors will provides and better coordination between vehicle to vehicle. Due to ITS there is encouragement for use of public transportation and results into reduction in personal vehicles.

- **Rijurekha Sen and Bhaskaran Raman** ^[11] studied the congestion in the road traffic particularly focusing on developing nation or fast growing economy like India. Their study addresses particularly to the issue of slow infrastructural growth in terms of roads, highways etc and its relation with rapidly increasing volume of the vehicles. The reasons of cost and space constraints for hampering the infrastructure developments. The other problem identified in context with India is that the Indian traffic is non lane based, which causes difficulties in implementation in Intelligent Transportation Systems (ITS). As a result ITS used in Developed Countries cannot directly being implemented in India. In this paper different ITS applications for managing traffic are addressing Revenue collection, Incident detection, Vehicle classification, Monitoring, Intersection control etc issues. The information from road can be collected through sensing with different modes like static sensing, mobile sensing and hybrid sensing. The ITS architecture considering choice of application, choice of sensing and choice of communication mode is discussed in this study.
- **Partha Chakroborty** ^[12] through some lights on the relationship of sustainability and efficiency of transport system. Sustainable transportation focuses on safety, economy, efficient and controlling emissions as well as waste. Addressing Urban transport mobility issues such as Integration of Bicycles in system, Use of Public Transportation and cost of it, Road infrastructure and parking facilities, large number of vehicles have human-vehicle conflict and integration of suburbs with multimodal transportation system. In achieving sustainability road and public transportation is required to be balanced. Improved travel times, safety and better terminals (parking) can leads to efficient road transportation.

ITS impacts upon demand characteristics and road capacity by focusing on Telecommunicating reduces demand, Toll collection, improvement in Enforcement, integration of traffic information, monitoring traffic flow and diverting it to freeway, fast response to accidents by identifying accidents quickly, collecting correct information and non utilization of full road capacity due to not following of driving rules, driving decorum. Different ITS tools can be used such as collision avoidance system, cameras for over-speeding and non-compliance, modifications in turns reduces accidents. Efficient public transportation system can be achieved through better fleet management, routing and scheduling, more user friendly system.

- **M. Absar Alam and Faisal Ahmed** ^[13] studied in this paper issues related to non utilization of traffic demand management measures vis a vis public transport improvement measures. Higher urban population growth resulted into Traffic congestion which is major problem in asia and particularly in India. Increase in vehicles is not only problem of this traffic congestion, other areas like road infrastructure, private transport cost, psychological factor, policy implementations etc are also required to be addressed more carefully. With respect to average travel speed in Indian cities is very low due to traffic congestion. Some policy measures like integration in urban town planning, encouragement to public transpiration and emphasis on ITS will probably yield into effective transport management. In this study some research gaps were identified like withdrawal of fuel subsidies impacted upon the public transportation as its cost increased which affected majority of stake holders. The investment in the public transport and its required rate is mismatched which leads to shortage of public transport resulting into search for alternatives. There is very requirement of making awareness in the driver community about the safety aspect of the transportation. Another gap identified related to inadequate parking facilities. To overcome gaps following recommendations are suggested: more precise integration of transport policies and urban transport development, sustainable environment and urban growth in consultation with vehicle manufactures, more focus on parking facilities, adoption of separate lane system for public transport, empowering of state transport, and proper driving manual for drivers.

Implementation of ITS in India:-

As discussed in the earlier sections ITS in Indian context have requires altogether different approach as its conditions are unique in nature. The implementation of ITS requires adaption of local environment, accordingly the sensors, infrastructure, modules etc are customized from present local requirements. The traveler role in implementation of ITS in India is very crucial as the awareness among the users is required from Indian perspective.

- **Chinta Sudhakar Rao, M. Parida, and S.S. Jain** ^[14] studied in their paper the influence of the ITS devices in the exchange of information to drivers and response of the drivers towards traffic management. A survey conducted on the understanding of information produced using ITS modules like APMS, VMS, ATIS with special reference to Delhi. In their study it was observed that the age and education plays crucial role in information understanding through these ITS modules. As well as frequency of the trips has major impact upon the drivers understanding about the system. The parking sign boards are well recognized by the drivers during their travelling. There is expectation of the drivers for Parking guidance system and also Parking Site Map so as to make their parking of vehicles at appropriate place. The information displayed on VMS board has been observed by the most of the drivers and they reacted upon the information as per their requirement. In the survey it was primarily observed that due to heavy traffic congestion in Delhi, respondents are expected that there should be more display of traffic congestion information on the VMS board.
- **Prof. U.J Phatak, Mr. Lintu Abraham, Miss Nivedita Kaushik, Mr. Sudeep Mitra, Mr. Sagar Dalal** ^[15] undertaken a study on the traffic congestion in India with case study approach selecting Pune with targeted locality of SH60 from Kharadi Bypass to Bakoriphata. The nearby area of metro cities while commuting to city face a major problem of traffic. The researcher focused upon the major problems causing traffic congestion by studying the targeted region. The traffic congestion reasons are poor infrastructure planning which can create major problem in future. The survey for traffic intensity was performed by manually counting of the vehicles which gives information about traffic volume on the SH60 for a day. Road Profiling survey also carried out and it was observed that due to uneven road surface and elevation the heavy vehicles cannot able to keep steady pace which results into one of the reason for traffic congestion. This paper suggest to the town planning authorities to give more emphasis on the development road infrastructure in the forms of highways of outskirts of the metro cities so as transpiration problems can be addressed.

Conclusion:-

There is considerable development in the communication infrastructure and its utilization also highly penetrated in India. The traffic issues like congestion, pollution, passage time, accidents, etc creating major problems in the urban and suburban areas of India. In ITS applications different technologies are used with coordination with communication system. The major issues of awareness about disciplined driving habits can be addressed first which will results into effective implementation of ITS. The ITS module adaptation with Indian conditions has been biggest challenge due to diverse situations and surrounding. By adopting the mere latest technology does not lead to effective ITS in India as its problems are different and scenario is unique.

The Indian traffic problem increasing day by day and unless customized ITS is developed for this country, traffic issues cannot be tackled. Due to less synchronized traffic signal network with the intensity of traffic, congestion problem becomes more serious. The infrastructure development cost also required to be balance with the technology adaptation. The Developed countries and different industries dealing in ITS technology can give direction to the effective implementation of ITS in India. There is future scope of study to explore the suitable ITS modules which lead to effective address for traffic issues in developing countries like India.

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