Analysis of Possibilities and Proposals of its (Intelligent Transport Systems) Implementation in Madurai City

Yoganandhan. U
Post Graduate Student,
Department of Civil Engineering,
Thiagarajar College of Engineering, Madurai, Tamil Nadu, India.

Srividya. D
Assistant Professor,
Department of Civil Engineering,
Thiagarajar College of Engineering, Madurai, Tamil Nadu, India

***Abstract*: Madurai city is a historic and religious landmark located in the south of TamilNadu, a southern state in India. This city is a business hub which has a dedicated market place at the heart of the city, streets dedicated to various businesses and consumer movement is quite significant. Such factors that influence the traffic movement and options that are available for the betterment of the present traffic scenario. The use of advanced technologies including information and communication technologies (ICT) or telematics, data collection and storage, navigation systems and others fall under the aegis of intelligent transport systems (ITS) will improve the existing road networks. The main aim of using such technologies in transport is to alleviate existing concerns including traffic congestion, air and noise pollution by enhancing data collection for addressing the transport-related concerns. ITS covers all modes of and considers all elements of the transportation system − the vehicle, the infrastructure, and the driver or user, interacting together dynamically. This attempt of study showing estimation of ITS implementation in Madurai city, ITS vision, the conclusions of SWOT analysis, possible technical solutions of ITS deployment in Madurai city.**

Keywords: Traffic congestion, Madurai City, proposals and possibilities of ITS, traveller and traffic information, ITS subsystems, ITS planning. SWOT analysis.

I. INTRODUCTION

Over the past two decades, India has established itself as a leader in information technology (IT). India, the second most populous country in the world, and a fast growing economy, is seeing terrible road congestion problems in its cities, including Madurai city. Building infrastructure, levying proper taxes to curb private vehicle growth and improving public transport facilities are long-term solutions to this problem. However, the subsequent economic boom has also resulted in an exponential increase in motorization, urban traffic congestion and deterioration of air quality in the Indian megacities. With a robust IT and telecom infrastructure in place, India stands to gain from the use of ITS to alleviate many transport related urban issues. Use of such technologies can be either at a vehicular or infrastructural level.

Madurai hosts a population of 15,45,4 29 persons approximately. The city in itself is a historical and religious place which attracts a gross 3lakh floating population on average. With this kind of population flow in and out of the district, not to mention the flows within the city creates a traffic flow that is quite not handled well by the public transport modes available. Madurai has its economy boosted by various small scale businesses such as flowers, fruits and vegetables, jewelers and tourism infrastructure such as hotels and resorts. Road transport is the most efficient way of satisfying the needs of these various businesses and causes.

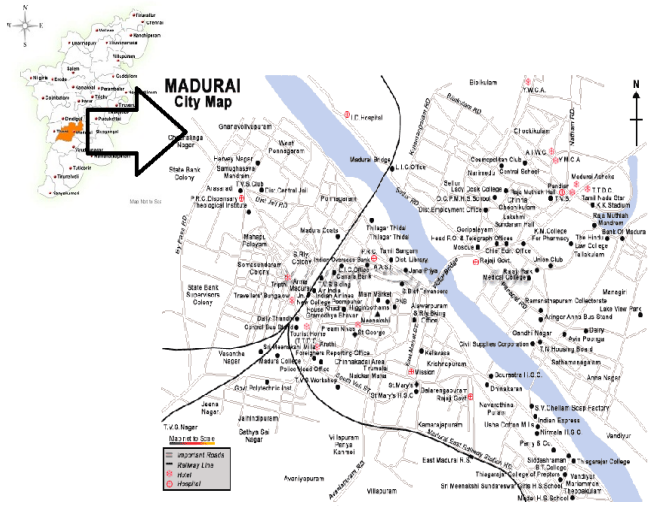

Fig.1. City map of Madurai city

A. Intelligent Transport Systems:

Intelligent Transport Systems and Services (ITS) refers to the integration of information and communication technologies with transport infrastructure to improve economic performance, safety, mobility and environmental sustainability. Addressing traffic congestion was one of the initial motivations to look at intelligent transport systems solutions for a better utilization of transport capacity through the exchange of real-time information on infrastructure and traffic conditions. Since then, new transport applications based on information and communications technologies (ICT) have emerged and continue to emerge, ranging from basic traffic management systems (e.g. navigation, traffic control) to management of containers; from monitoring applications such as closed-

circuit television (CCTV) security systems to more advanced applications integrating live data and feedback from a variety of information sources (e.g. parking guidance, weather information).

II. APPLICATION OF ITS AND USES

A. Advanced Traffic Management Systems (ATMS):

ATMS integrates various sub-systems (such as CCTV, vehicle detection, communications, variable messaged systems, etc.) into a coherent single interface that provides real time data on traffic status and predicts traffic conditions for more efficient planning and operation. Dynamic traffic control systems, freeway operations management systems, incident response systems etc respond in real time to changing conditions.

B. Advanced Traveller Information systems (ATIS):

Provide to users of transportation systems, Travel-related information to assist decision making on route choices, estimate travel times and avoid congestion. This can be enabled by providing different information using various technologies such as:

- GPS enabled in-vehicle navigation systems
- Dynamic road messaged signs for real time communication of information in traffic congestion bottlenecks, accidents and alternate route information.
- Website to provide a color-coded network map showing congestion levels on highways

C. Advanced Vehicle Control Systems (AVCS):

These are tools and concepts that enhance the driver's control of the vehicle to make travel safer and more efficient. For example, in vehicle collision warning systems alert the driver to a possible imminent collision. In more advanced AVCS applications, the vehicle could automatically break or steer away from a collision, based on input from sensors on the vehicle. Both systems are autonomous to the vehicle and can provide substantial benefits by improving safety and reducing accident induced congestion.

The installation of high tech gadgets and processors in vehicles allow incorporation of software applications and artificial intelligence systems that control internal operations, ubiquitous computing, and other programs designed to be integrated into a greater transportation system.

D. Commercial vehicle Operation (CVO):

It comprises an ensemble of satellite navigation system, a small computer and a digital radio, which can be used in commercial vehicles such as trucks, vans, and taxis. This system affords constant monitoring of truck operations by the control office and provides traceability and safety.

E. Advanced Public Transportation systems (APTS):

Here it applies state of art transportation management and information technologies to public transit systems to enhance efficiency of operation and improve safety. It includes real time passenger information systems, automatic vehicle location systems, bus arrival notification systems and the systems providing priority of passage to buses at signalized intersection (Transit signal priority)

F. Advanced Rural Transportation systems (ARTS):

It provided information about remote road and other transportation systems. Examples include automated road and weather conditions reporting and directional information. This type of information is valuable to motorists travelling to remote or rural areas. This has been widely implemented in the United States and will be a valuable asset to countries like India, where rural areas are widely distributed.

III. TECHNOLOGICAL COMPONENTS OF ITS

- Various forms of wireless communication for both short-range and long-range data exchange (UHF, VHF, WiMAX, GSM, etc.);
- Computational technologies – the present trend is towards fewer and more costly
- Microprocessors, allowing for more sophisticated applications such as model-based process control and artificial intelligence;
- Sensing technology – employing sensors to feed control systems with both vehicle-based data (from devices such as radar, RFID readers, infrared- and visible-band cameras) and infrastructure-based data (from similar devices, as well as inductive or pressure sensors installed or embedded in and around the road).

To meet the challenges of achieving virtually accident-free, clean and efficient mobility through ITS, it is crucial that all elements of transport systems are able to communicate and cooperate in exchanging real-time information. Bi-directional communication is needed from vehicle to vehicle (V2V) and vehicle to infrastructure (V2I). This requires the development of a communication architecture that provides a common frame for cooperative systems to work together. Examples of applications based on cooperative systems that are currently under development are: traffic control and management, intersection collision warning, weather and road conditions warning, and route guidance to avoid traffic congestion.

A. Data Acquisition:

Rapid, exhaustive and accurate data acquisition and communication is critical for real time monitoring and strategic planning. A good data acquisition-management-communication system combines tested hardware and efficient software that can collect reliable data on which to base further ITS activities.

B. Sensing:

To handle any road application, the first thing that we need is information from the road. Sensors on roads can provide such information. There are several existing modes of sensing:

Static sensing, where sensors are statically placed on the road, **mobile sensing**, where sensors are placed in the moving vehicles and **hybrid sensing**, where both in-vehicle and on-road infrastructure are needed. In this section, we discuss the key technologies in each category and outline some open questions in the context of Indian roads.

C. Static sensing: techniques

(1) Loops and magnetic sensors -Vehicle detection and counting using magnetic sensors or loops under the road surface, has been explored in research and deployed systems

(2) Images and videos - Video surveillance to monitor traffic states and detect incidents and hotspots is fairly common gives a comprehensive survey of the major computer vision techniques used in traffic applications

(3) Acoustic sensors - Some recent research is being done to use acoustic sensors for traffic state estimation, especially in developing regions, where traffic being chaotic is noisy

(4) RF sensors - Wireless radios placed across the road have communication signals affected
by vehicular movement in between. There are commercial products and research efforts using this for traffic monitoring.

D. Mobile sensing techniques:

(1) GPS on public transport or fleet vehicles –

Many public transport and fleet companies have GPS installed in their vehicles for real time tracking. Several research projects have tried to exploit these as a source of road information was one of the early papers to analyze GPS traces from buses to classify road segments as free-flow and congested using threshold based classification. The Mobile Millennium Project at Berkeley used GPS on a fleet of taxis and estimated travel times in London over 6 months is a recent large scale study of GPS traces of a taxi fleet in Singapore, to know fare and travel delays in real time. Another category of work using GPS on public transport has been to predict bus arrival times.

(2) GPS on smartphones–

With the recent proliferation of smartphones, smartphone GPS is being studied for hotspot detection and travel time estimation, after handling noise in GPS readings.

(3) *Sensors on smartphones*

Other than GPS, smartphones also have sensors that can provide interesting information solved the problem of reorienting the accelerometer of a smartphone to match the car axes. The accelerometer readings were then used to detect road events like bumps and brakes. A lot of braking, accompanied by honking (detected by smartphone microphone) was interpreted as congestion improves upon the accelerometer reorientation mechanism by using smart phone magnetometer uses smartphone accelerometer to detect if the phone is in a transit vehicle and if so, uses GPS to know travel times and arrival times of the vehicle uses the smartphone microphone for urban noise mapping and uses the smartphone camera to predict the traffic signal ahead for automatic speed control of vehicle.

(4) Using ordinary phones

Some researchers have tried using ordinary cell phones, instead of smartphones, for traffic sensing. Localizing ordinary phones based on only cellular tower and Wi-Fi information and adding sensors to ordinary phone hardware are two main research focus in this area This sensing using phones, popularly called *crowdsourcing* or *participatory sensing*, has related research on privacy and power issues, as these would affect user participation.

(5) Specialized hardware on vehicles

Some researchers have used specialized hardware in vehicles which detects road anomalies and which tracks stolen properties are examples which uses ultrasound transceivers to find empty parking spaces and which calculates fuel usage, are applications for individual vehicle owners using customized hardware.

(6) Social networking

New trend took a fresh perspective of getting information from crowd through blogs posted via smartphones and smart application and social websites like Facebook, Twitter etc.

E. Hybrid sensing: techniques

There are a set of techniques that use both static infrastructure and mobile sensors to gain traffic information.

(1)Teledensity

Cell phone operators can give approximate vehicle densities in the neighborhood of a given cell tower, based on subscribers seen at that tower. There are commercial systems like and research efforts based on this.

(2) Bluetooth

It is a system where roadside Bluetooth detectors sense Bluetooth radios in phones inside vehicles. Correlating the sensed Bluetooth addresses among different detectors, gives travel times of the vehicles between the detectors.

(3) RFID

Similar systems are being explored using RFID tags on vehicles and RFID readers on roads

IV. IMPLEMENTATION OF ITS IN INDIA

The ITS program in India is aimed at ensuring safe, affordable, quick, comfortable, reliable and sustainable access for the growing urban and rural population to jobs,

education, recreation and such other needs. A few ITS application have been introduced in India in metropolitan cities like New Delhi, Pune, Bangalore, Chennai etc. focusing on stand-alone deployments of area wide signal control, parking information, advanced public transportation, toll collection etc.. However, all of these are small scale pilot studies limited to major cities and are in beginning stage of deployment. Thus, at present, there are no exhaustive fully developed ITS applications with traffic management centers in India

A. Trial of Automatic Traffic management system in TamilNadu: (Sep 2009)

This involved a trial run of the fully automated Traffic Regulatory Management system (TRMS) involving usage of surveillance cameras in the city of Chennai; this project involved installing sophisticated cameras, wireless towers and poles, under the 3-crore-state government-funded project. Automatic number plate reader cameras were installed in 28 out of 12 busy junctions identified. Thee traffic police also plan to install 40 CCTV cameras at various junctions. This is to warn motorists who blatantly violate rules and monitor traffic on arterial road during peak hours.

B. Automated Traffic Control:

ATC has been setup in many cities in India including Delhi, Pune, and Mumbai etc.

Mumbai: The Area Traffic Control project of Mumbai Traffic Control Branch focused on synchronizing major junction and was implemented through MMRDA and MCGM with financial aid from World Bank.

Modern gadgets such as speed check gun and multi radar comprising smart cameras, radar sensor, screen manual control unit, flash light were used in this project

Chennai: The city traffic police set up 26 Automatic Traffic Control systems at major traffic signals around the new secretariat complex, the system monitors and regulates traffic without any manual intervention and helps police regulate VIP routes.

C. Advanced Traveller Information Systems:

Chennai, Delhi, Bangalore and Hyderabad: This project provides a platform for the public to check the real time traffic situation at important junctions and arterial roads, through SMS, FM radios, Internet, Application software (e.g. The Traffic People-Delhi).

D. Bus Rapid Transport (BRT):

BRT systems are best alternatives to light rail public transport. Instead of train or metro rail, BRT systems use buses to ply a dedicated lane that runs lengthwise along the center of the road. At specific locations, passengers can embark or disembark at conveniently located stations, which often feature ticket booths, turnstiles, and automatic doors. Studies have shown that a BRT is not only cheaper to build, but is also profitable for bus to operate and relatively inexpensive for commuters to use. The cities selected for implementing BRT include Ahmedabad, Pune, Rajkot, Bhopal, Indore, Visakhapatnam, Vijayawada and Chennai.

1. *PUNE(Dec 2006)*

The city of pune was the first to experiment with a BRT. The project consists of 13 kms of bus lanes along the pune sastra road, Under the JnNURM funding.

2. *Ahmadabad*

Ahmadabad BRT is a highly ambitious rapid transport system developed by Gujarat infrastructure development board. A part of first corridor connecting Pirana to R.T.O was opened to public on October 14 2009.

3. *Chennai*

It is a part of the medium term and long term Transport Scheme proposed in the Second Master Plan by CMDA. This is not a part of Chennai BRTS which is proposed on a separate elevated road that is to be constructed as 15 circular corridors.

E. *Advance Parking Management:*

APM was set up by New Delhi municipal council at Palika Bazar, with the capacity for 1050 cars and 500 scooters

V. IMPLEMENTATION OF ITS IN MADURAI CITY:

The rapidly increasing vehicle population in Madurai, spurred by the population boom and economic upturn lays a critical burden on traffic management in the city. While India has already made a foray into intelligent transport systems in organizing traffic, now its turn for the Madurai city. The adoption of location and information based technologies into vehicles, infrastructure , traffic management and traveller information services have shown dramatic improvements in safe, efficiency in mobility and freight all over the world. So we can adopt to ITS.

A. Possible Application of ITS for Madurai city

1) Automatic Traffic Management systems:

Most of the signaled intersection in the city is operated manually by traffic police, and many are not signalized. The system can adopt in Kalavasal signal, Arasaradi, and Guru theatre signal, Goripalyam-simmakal network when these signals are synchronize with each other the intersections can maintain congestion free traffic flow, The city in itself is a historical and religious place which attracts a gross 3lakh floating population on average, using these routes for in and out towards Theni and Dindukal district. Since Madurai is being a central hub for the southern districts of the state, it's been heavily motorized and urban sprawl is at its peak, for its economic development through Manufacturing, Tourism, agriculture, Education and Small and Medium Industrial sectors.

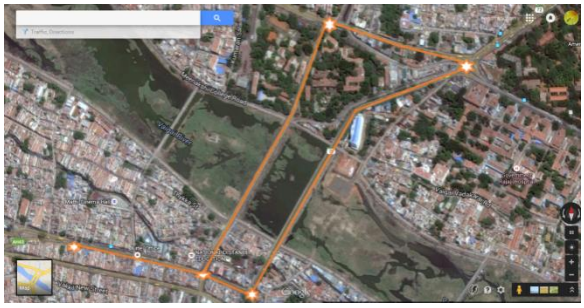

Fig.2. Goripalyam-Simmakal Road network

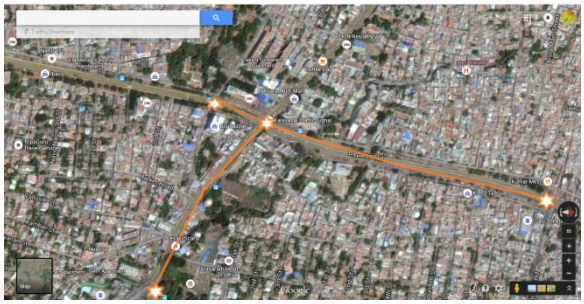

Fig.3. Arapalayam signal

2) Advanced Traveller Information systems (ATIS):

ATIS can provide the users Travel-related information to assist decision making on route choices, estimate travel times and avoid congestion inside the CBD of the Madurai city, The iconic Meenakshi Amman temple is being located inside the CBD of the city, often the tourist vehicle had struck inside the CBD and creates a heavy traffic congestion, This dilemma can be averted when the remote commuter knew about the real time traffic scenario in the network. Real time Traffic information can be disseminated through F.M Radio, Internet, Facebook, Mobile application for the daily commuter as well as occasional commuter. Fig 4 shows the sketch of Meenakshi Amman temple and the closely compacted central business district.

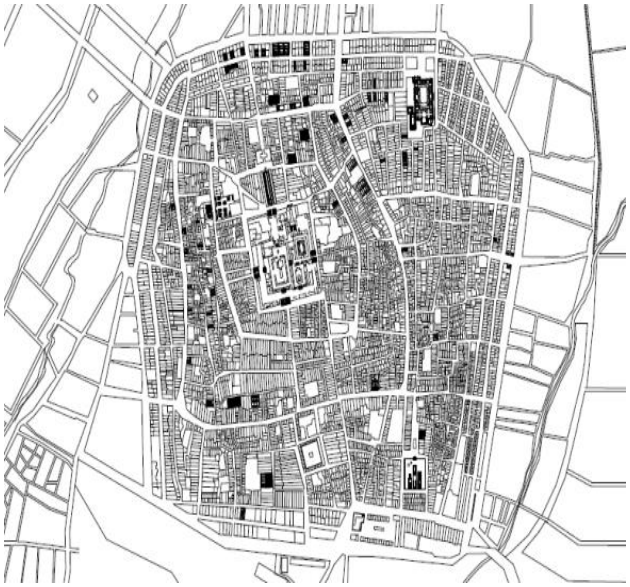

Fig.4. CBD of Madurai city

3) *Advanced Public Transportation systems (APTS):*

Here it applies state of art transportation management and information technologies to public transit systems to enhance efficiency of operation and improve safety. It includes real time passenger information systems, automatic vehicle location systems, and bus arrival notification systems providing priority of passage to buses at signalized intersections and main Bus terminal in the CBD, Dynamic display board which will give real time information about the municipality buses can be installed in the main bus stops, since the city hosts a middle class pilgrims from all over the country, the visitors will be utilizing the corporation buses to move along the temples in and around the city limit. Real time information about the buses and travel time will improve the efficiency in the network and will improve the Socio Economic state of the city.

4) Advance Parking Management Systems (APMS):

The rate at which a city's economy grows is very closely linked to the rate at which the transport sector grows. As road transport gives personal mobility to persons, the vehicle ownership rate has been increasing at a fast rate. Due to increase in car ownership, the problem of parking is becoming more and more acute day by day in the city. Vehicles may be parked on the kerb side but it creates lot of problems like congestion, jams, and accidents and also reduces effective road width. Traffic influencing factor analysis for the city shows that illegal and on street parking is at the first place. An advance parking management systems will give the real time information to the commuter about the space available in the particular facility and E-payment systems, parking guidance, advance parking reservation facility.

5) SWOT Analyais for implentationo of ITS in madurai:

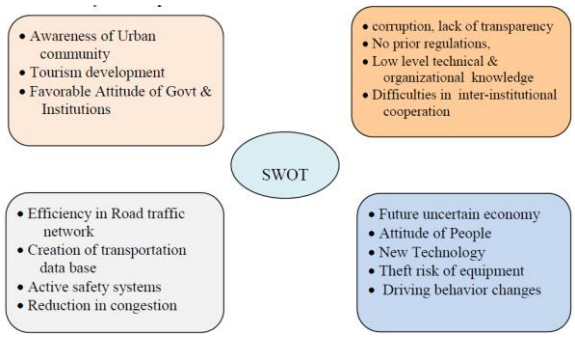

Fig.3. SWOT analysis

6) *Positive factors*

Urban and regional communities and society are more and more aware of the advantages given by application of solutions of Intelligent Transport Systems in terms of efficiency, safety and environment safety. However it is important to have in mind that ITS alone are not able to solve urban transport problems in full. They can create valuable packages of instruments enabling a significant reduction of such problems. It should be noted that for

further general development it is extremely important to have truthful information on ITS advantages that are inducing progress and on the actions that should be undertaken for ITS deployment, and on the organisation methods of their
wide propagation.

7)Future Work

For the Main thesis of the Masters program, Application of ITS in parking management is been taken, Analysing the existing parking scenario of the city's on and off street parking, Because its been identified that the Parking issue causing severe environmental issues with respect to air as well as noise pollution, increased fuel consumption and economy loss. Identifying new potential sites inside the CBD for multilevel advance parking facility will be proposed along with the appraisal of the facility will be carried on.

8)Conclusion

India's ITS cannot be entirely modeled on the existing successful ITS of other nations due to basic cultural, geographic and practical differences amongst the countries. The existing concepts have to be thoroughly understood in order to modify them to fit the Indian traffic scenario. The design of an intensive ITS program hinges on the following developments:

a. Technology

The development and implementation of advanced technologies is important to the successful management and operation of ITS in India. These technologies include electronic equipment such as sensors. Detectors and communication devices and application of global navigation satellite system (GNSS). This in turn hinges in cooperative work between the government, academic research institutions, and industry.

b. Modeling of Indian traffic

A proper understanding of the traffic system is important in the successful implementation of any reliable ITS systems. The existing models developed for the western traffic condition may not be suitable for the Indian traffic and hence there is a need to modify or develop models that can characterize the Indian traffic in a better way

c. Supply Chain

Seamless interconnectivity of the various branches of the transportation sector is essential to provide effective, efficient and secure movement of goods and services while improving the conservation of natural resources and reducing environmental impacts such as the effects of carbon emissions.

d. Energy and Sustainability

The ITS in India should closely work with the energy sector in the promotion of fuel efficient transport policies and practices, including the use of alternative transport fuels. Fuel efficient policies and practices will assist the country in achieving sustainable economic and environmental benefits through the application of ITS.

e. Human Capital Development

Human skills are important to ensure the development of seamless transportation systems. Given the population density of India and the varied skill sets available in the country, the ability of the work force to develop, manage and safely implement existing and emerging technologies is essential for ITS design and implementation.

REFERENCES

[1] http://www.cse.iitb.ac.in/˜riju/kyunqueue.
[2] Synthesis report on intelligent transport systems, by Lelitha Devi, Gitakrishnan Ramadurai, IIT-M, Center of Excellence in Urban transport.
[3] RijurekhaSen, Bhaskaran Raman {riju, br}@cse.iitb.ac.in, Intelligent Transport Systems for Indian Cities.
[4] Sarah Hasan, Edwin Yaz, (May 1999), Development of an ITS course, for Mack-Blackwell Transportation center, AR.
[5] Aldona Jarašūnienė, (Sep 2006), Analysis of possibilities and proposals of intelligent
[6] transport system (its) implementation in Lithuania, ISSN 1648-4142 print / ISSN 1648-3480 online, TRANSPORT – 2006, Vol XXI, No 4, 245–251Qureshi Intikhab Ahmed *, Huapu Lu, Shi Ye, Urban transportation and equity: A case study of Beijing and Karachi.
[7] Dmitry B. Efimenko , ITS-related aspects of development of Urban transport systems, Moscow State Automobile and Road Technical University
[8] Department «Telematics for Transport
[9] Dinesh Mohan, Transportation Research and Injury Prevention Programme, Indian Institute
[10] of Technology Delhi, India intelligent transportation systems (its) and
[11] The transportation system. Information Technology and Communications
[12] Resources for Sustainable Development, [Ed. Ashok Jhunjhunwala], in Encyclopedia of Life
[13] Support Systems (EOLSS)
[14] George Dimitrakopoulos and PanagiotisDemestichas, ITS- Systems Based on Cognitive Networking Principles and Management Functionality, ieee vehicular technology magazine
[15] Nancy Deboroh, Velkenndedy,'Road traffic factor analysis for Madurai city using Interpretive Structural Modeling', National conference on Recent Innovation in Science Engineering and Technology, march 8, 2015,Pune, India, ISBN : 978-93-82702-76-4
[16] Miles, J.; Chen, K. The intelligent transport System
[17] Handbook. PIARC, 2004. 387 p.
[18] Converge. Guidelines for the development and assessment of ITS architectures.TR 1101 (Jesty P. H.;
[19] Gaillet J. F.; Franko G.). European Commission DG XIII, Brussels, 2004.
[20] Jetsy, P. H. and Bossau, R. A. P. Involving stakeholders in ITS architecture creation.ITS word Congres, Madrid, 2003.
[21] Sage, A. P. System engineering. J. Wiley Sons, New York, 1992.
[22] OSI is Open System Integration, a 7-layer model development for digital communication in the early 1980s by several standards organisations, including the International Standards Organisation (ISO).
[23] Intelligent transportation system in work zones. A case study. USA. 2004. 44 p.