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A REVIEW ON DEVELOPMENT OF INTELLIGENT TRANSPORT SYSTEM TO COMPARE WITH NAGPUR TRANSPORT SYSTEM

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***Abstract**: supervision the development of traffic is a big problem all over the world. Intelligent Transportation System (ITS) provides solution to these problems with the help of new technologies. Intelligent Transportation Systems is the application of computer, electronics, and communication technologies and management strategies in an incorporated manner to provide traveler in sequence to increase the safety and efficiency of the road transportation systems, to work out and supervise the traffic troubles. In the present study we have studied major parts of the Intelligent Transportation System. The Objective of the paper is Study on the whole development of intelligent transport system in the human race and match up to with Nagpur intelligent transport system. Hence structural design and urbanized models over the years of major branches of ITS have been reviewed here to make a comparison analysis of Nagpur city Intelligent Transportation System. It will lead to the gaps in the awareness which can be further studied. The paper things to see the conclusions extracted from the studies of dissimilar systems and also give the future possibility in the field transportation to make it more users friendly and available.*

1. INTRODUCTION

Intelligent Transportation Systems (ITS) is an recognized route to resolve, or in any case minimize traffic problems. Intelligent Transportation Systems cover all modes of transportation - air, sea, road and rail, and intersects a variety of components of each mode - vehicles, infrastructure, communication and operational systems. Various countries have developed strategies and techniques, based on their geographic, cultural, socio-economic and environmental surroundings, to integrate the various components into an consistent system. In general, any of the ITS applications uses a Traffic Management Centre (TMC) where data is composed, analyzed and united with other operational and control concepts to deal with the complex transportation problems.

A) Intelligent Transportation Systems Taxonomy

the ITS categorization is mostly based on the application of the system to precise level like vehicle level, infrastructure level and cooperative level, where the sensors, information processors, communication system, roadside messages, GPS updates and automated traffic prioritization signals, etc, are the key facial appearance in these system. The most frequently used cataloging of ITS is based on the positioning of the system as specified below,

i) ***Advanced Traffic Management Systems (ATMS)*** integrates various sub-systems (such as CCTV, vehicle detection, communications, variable message systems, etc.) into a articulate single interface that provides real time data on traffic grade and predicts traffic circumstances for more efficient planning and operations. Dynamic traffic control systems, freeway operations management systems, incident response systems etc. respond in real time to changing conditions.

ii) Advanced Traveler Information Systems (ATIS) provide to users of transportation systems, travel-related information to support decision making on route choices, estimate travel times, and keep away from congestion. This can be enabled by providing different information using various technologies such as:

- GPS enabled in-vehicle direction-finding systems
- Dynamic road significance signs for real time communication of information on traffic congestions, bottlenecks, accidents and alternate route information during road closures and continuation.
- Website to provide a colour-coded network map showing congestion levels on highways.

iii) Advanced Vehicle Control Systems (AVCS) are tools and concepts that enhance the drivers' control of the vehicle to make travel safer and more efficient. For example, in vehicle collision admonition systems alert the driver to a potential about to happen 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 independent to the vehicle and can provide substantial reimbursement 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.

iv) Commercial Vehicle Operations (CVO) comprises an ensemble of satellite navigation system, a small processor 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 central office and provides traceability and safety.

v) Advanced Public Transportation Systems (APTS) applies state-of-art transportation management and information technologies to public transit systems to boost efficiency of operation and improve safety. It includes real-time passenger information systems, automatic vehicle location systems, bus arrival announcement systems, and systems providing precedence of passage to buses at signalized intersections (transit signal priority)

vi) Advanced Rural Transportation Systems (ARTS) provide information about remote road and other transportation systems. Examples include automated road and climate conditions reporting and directional information. This type of information is helpful to motorists travelling to remote or rural areas. This has been extensively implemented in the United States and will be a valuable asset to countries like India, where rural areas are widely dispersed.

2. LITERATURE REVIEW

Ganeshkumar and Ramesh (2010) designed Emergency Response Management and Information System (ERMIS) for Madurai city, Tamil Nadu. In this study a detailed GIS database of transportation network, accident locations, hospitals, ambulance locations, police and fire stations was prepared and spatial analysis was also carried out for accident records of years 2004–2008. Route finder was designed to find shortest, time saving routes and service areas.

Purushothaman et al. (2011) proposed a similar GIS based Emergency Response Management System for Mysore City, India. The developed system provides the network based spatial analysis such as connectivity, finding paths, allocation, finding the neighboring facility, defining service areas, dynamic segmentation.

Kumar et al. (2005) developed a GIS based advanced traveler information system for the Hyderabad city, India under Arc View GIS environment. GIS-enabled modules for the shortest path, closest facility, and city bus routes were incorporated in the system. The developed system provides information about fundamental facilities in Hyderabad City.

Logi and Ritchie (2001) described a real-time Knowledge Based System (KBS) for decision support in the assortment of integrated traffic control plans subsequent to the occurrence of non-recurring congestion. In this study, two algorithms were developed i.e. data fusion algorithm for the analysis of congestion and an algorithm for the selection of control plans. The substantiation results showed that by the use of Traffic Congestion Management (TCM) travel time reduced between 1.9% and 29.0% and typical stop speed reduced between 14.8% and 55.9%.

Faghri and Hamad (2002) studied the use of GPS in traffic management. In their study application of GPS was implicated in collecting traffic data such as travel time, speed and delay on 64 major roads in the state of Delaware. When mean and variance of the results obtained by both the methods were compared and no significant difference was observed. GPS data was found to be 50% more efficient in terms of manpower.

Hernandez et al. (2002) incorporated the use of artificial intelligence techniques in traffic management and gave a multiagent architecture for intelligent traffic management systems. Two multi-agent knowledge based systems, InTRYS and TRYSA2 were developed to perform decision support for real-time traffic management. The performance of both the systems was evaluated and general applicability of multi-agent architectures for intelligent traffic management was given.

Zhenlin et al. (2012) studied the efficiency of the Beijing Intelligent Traffic Management System (ITMS). In this study urban transportation systems, socio-economic system and energy environment system were taken as the input system and the road traffic management efficiency and urban transport putting indicators as the output system. The field data of Beijing from 2000 to 2010 are used for empirical analysis. The results of the study showed that the ITS improved the overall efficiency of the Beijing transportation.

Thapar (2001) presented a GIS based emergency response management system for Hyderabad city which can provide the useful information regarding different facilities and optimum routes during emergency situations.

In this study the probable risk zones were determined based on the land use, building activities as per National Building Code (NBC) guidelines. Efficiency and effectiveness of the fire service was studied and based on this an Emergency Response Management System was developed.

3. COMPONENTS OF INTELLIGENT TRANSPORT SYSTEM

A Traffic Management Centre (TMC) is the hub of transport administration, where data is collected, and analyses and combined with other operational and control concepts to manage the complex transportation network. It is the focal point for communicating transportation-related information to the media and the motoring public, a place where agencies can coordinate their responses to transportation situations and conditions. Typically, several agencies share the administration of transport infrastructure, through a network of traffic operation centers.

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. The different ITS hardware/equipment commonly used include sensors, cameras, automatic vehicle identifiers (AVI); GPS based automatic vehicle locators (AVL), and servers that can store huge amounts of data for meaningful interpretation.

A. Sensors

Sensors and detectors have been used for highway traffic counts, surveillance, and control for the last 50 years. Early sensors relied on visuals (e.g. optical detectors), sound (acoustic detectors), and vehicle weight induced pressure/vibration (seismic/piezoelectric sensors) on the road surface. The three main types of vehicle detectors used in current practice are inductive loop detectors magnetic detectors, and magnetometers. The advantage of the above sensors/detectors is that, unlike technologies such as AVI, GPS etc., these are autonomous detectors and do not require voluntary participation by the travelling public.

B. Automatic Vehicle Identifiers (AVI) and Automatic Vehicle Locators (AVL)

The AVI system uses a combination of AVI readers, AVI tags or transponders in the vehicles, and a central computer system. AVI readers/antennas are located on roadside or overhead structures or as a part of an electronic toll collection booth. The antennas emit radio frequency signals within a capture range across one or more freeway lanes.

C. GPS

The Global Positioning System (GPS) is a worldwide satellite navigation system that provides a fast, flexible, and relatively inexpensive data to determine a vehicle's position and velocity in real time. GPS is a US owned space-based system of twenty four satellites providing 24x7 monitoring of the earth. The 24 satellites are distributed uniformly in six orbital planes, at an altitude of approximately 20,200 km such that at least four satellites are visible at any time and from any point on the earth's surface. GPS positioning is based loosely on three- dimensional positioning of manmade landmarks/"stars" using trilateration related techniques. It provides fundamental location data in terms of latitude, longitude, elevation and UTC time. Based on these spatial and temporal data, traffic engineers can determine the most useful traffic information, including travel time, travel speed, travel distance and delay. To produce reliable traffic information from the GPS data, it is of significance to meet the sample size requirements and follow an appropriate field procedure.

DATA ANALYSIS

Data analysis includes data cleaning, fusion, and analysis. The data from the sensors and other collection devices that are transmitted to the TMC must be checked. Inconsistent data must be weeded out and clean data has to be retained. Further, data from different devices may need to be combined or fused for further analysis. The cleaned and fused traffic data will be analyzed to estimate and forecast traffic states. These traffic state estimation methods will be used to provide suitable information to users.

TRAVELERS INFORMATION

Travel advisory system facilities are used for relaying transportation-related information to the motoring public. These include: Variable Message Signs, Highway Advisory Radio, Internet, Short Messaging Services, automated cell phone messaging, public radio announcement, television broadcast and other modern media tools. Such systems can provide real-time information on travel times, travel speeds, delays, accidents, route closures and detours, and work zone conditions, among others.

4. INTELLIGENT TRANSPORTATION SYSTEM AROUND THE WORLD

Developments in intelligent transport system are driven strongly by socio-economic needs, and environmental demands. A research report titled "Intelligent Transportation Systems: A Global Strategic Business Report", published by Global Industry Analysts, Inc., provides a comprehensive review of trends, product developments, mergers, acquisitions and other strategic industry activities within the domain of ITS. According to this report, the global market for intelligent transportation systems (ITS) is projected to reach US $18.5 billion by 2015. The United States of America has the largest regional market for ITS, accounting for a share of almost 40% of global revenue generated.

ITS-America

Some US-ITS initiatives of special focus are Telephonic Data Dissemination, IntelliDriveSM, Next Generation 9-1-1, Cooperative Intersection Collision Avoidance Systems, Congestion Initiative, Integrated Corridor Management Systems, Clarus Initiative, Emergency Transportation Operations, Mobility Services for All Americans and Electronic Freight Management.

The Telephonic Data Dissemination scheme with the designation of a nationwide 3-digit telephone number (511) to disseminate current information about travel conditions, allowing travelers to make better choices - choice of time, choice of mode of transportation, choice of route. The IntelliDriveSM is a multimodal initiative that leverages on wireless technology to enable communications among vehicles, the infrastructure, and passengers‟ personal communications devices. Next Generation 9-1-1 initiative is aimed at extending the current emergency 9-1-1 system to establish public emergency communications services through all forms of communication media. The Clarus Initiative, as name (Latin "clear") suggests, aims at a system that can provide clear, accurate and relevant information about accidents, weather, road repairs and delays to users. The initiative will establish a coalition of private and federal weather forecasting agencies and industry such as the National Oceanic and Atmospheric Administration's [NOAA] National Weather Service [NWS] to provide weather information to road users. The current recognized weakness of the United States is the variability in implementation of ITS among states and regions, thus leading to sporadic, isolated, incremental, and a non-integrated ITS across the country.

ITS-Japan

ITS in Japan was formalized around the middle of the last decade. This period, called the initial stage of ITS. Japan is a pioneer in vehicle based navigation system. The first navigation system was sold by Honda and equipped in its Accord model in 1981 using a gas rate gyroscope as a direction sensor. In 1987, Toyota Electro Multivision was installed in its Crown model, which was the first car using a Cathode Ray Tube to display the map. Today, Japan uses the largest number of navigation systems in its vehicles. According to a survey in 2006 by Cross Marketing Inc., more than 50% of Japanese cars use advanced navigation systems.

First phase: - The use of in-vehicle navigation systems and electronic toll collection.

Second phase (2005):- included rapid emergency and rescue activities, establishment of public transport organizations as part of the ITS and improvement of information services to improve the convenience of transportation.

Third phase (2005-2010):- involves improvement of infrastructure and in-vehicle equipment, and organization of legal and social systems pertinent to travel and transport.

Fourth Phase (after 2010):-This would involve, among other activities, setting up a full-scale advanced information and telecommunications society with extensive optic fiber network and innovative social systems.

The Advanced Mobile Traffic Information and Communication System (AMTICS) were concurrently developed by Japan Traffic Management and Technology Association under the suggestion of the National Police Agency. It is an integrated traffic information and navigation system that displays on screen in each vehicle, traffic information gathered at Traffic Control and Surveillance Centers managed by the police.

The Universal Traffic Management System UTMS is another system that has been implemented in Japan by the National Police Agency since 1993 to provide drivers with real time traffic and guidance information. The goal of UTMS is effective management of traffic flow. Two-way infrared beacons are used for both monitoring and communication activities.

ITS-Europe

Europe's Intelligent Transport Systems falls under the umbrella of Road Transport Informatics (RTI). RTI focuses on two interacting programs - Road Infrastructures for Vehicle safety in Europe (DRIVE) and Program for European Traffic with Highest Efficiency and Unprecedented Safety (PROMETHEUS). System development is the primary goal of the PROMETHEUS project, while DRIVE focuses on human behavior issues and implementation of systems in the European community. Other European Union (EU) public-private partnership focusing on specific safety applications of ITS technologies initiatives are esafety, INVENT, and Prevent.

The esafety programme promotes the development, deployment, and use of intelligent vehicle Safety Systems to enhance road safety throughout Europe.

The INVENT program works towards improving traffic flow and traffic safety by development of novel driver assistance systems, knowledge and information technologies, and solutions for more efficient traffic management, to prevent or minimize the severity of accidents.

The PReVENT programme integrates a number of safety functions in order to create a safety belt around the vehicle.

The AGILE project developed a global navigation satellite service in the mobility sector having ultimate objective is to define a roadmap.

The CONNECT programme was aimed at uniting public authorities, road administrations and traffic information service providers, to coordinate and develop ITS in central and Eastern Europe. Austria, the Czech Republic, Germany, Hungary, Italy, Poland, Slovakia and Slovenia were some of the contributors to this project that helped improve cross-border traffic and transport through the use of ITS.

The NextMAP project evaluated the technical and commercial feasibility of enhanced map databases required for in-vehicle ITS applications. It defined and assessed new map requirements (geometric accuracy, additional information) for main Advanced Driver Assistance Systems (ADAS) applications.

5. PUBLIC TRANSPORTATION SYSTEM IN NAGPUR CITY

It is a rapidly growing metropolis and is the third most populous city in Maharashtra after Mumbai and Pune and also one of the country's most industrialized cities**.** Nagpur is one of the 11 administrative districts in the Vidarbha region of Maharashtra state. Nagpur district lies between 20.35 deg – 21.44 deg North latitude and 78.15 deg-79.40 deg East longitudes. It is almost triangular in shape. Nagpur district stretches over an area 9892 sq.kms Area under urban sector 364.66 sq.kms while the area under rural sector 9527.34 sq.kms In terms of area district Nagpur constitutes 3.21% the total area of state of Maharashtra. Due to increase in population as well as transportation NMPL company formed which gives the contract to Vansh Nimay Infraprojects (VNIL) to run city buses and On 22 February 2012, the Nagpur Improvement Trust (NIT) signed an agreement with Delhi Metro Rail Corporation (DMRC) to prepare the Detailed Project Report (DPR) for the metro in Nagpur. Public Transport is a mass transportation of people from one place to another place through Bus, Rail, and metro, LRT, BRT with efficient speed, frequency, facilities, comfort, convenience, and reliability.

Table No.-5.1: Nagpur transportation Inference as per MOUD Guidelines

SR. NO.	Benchmark	Inference as per MOUD Guidelines
1.	Public Transport Facilities	The system may require route rationalization and bus augmentation to improve the performance
2.	Intelligent Transport System(ITS) Facilities	The city lacks adequate ITS facilities.
3.	Sustainability of public transport	The Public Transport of a city is financial not sustainable and needs considerable improvement
4.	Travel speed	Small increase in flow may cause substantial increases in approach delay and hence decrease in arterial speed
5.	Integrated land use Transport system	Faint coherence between city structure and public transport system.
6.	Non Motorized Transport	The city lacks adequate NMT facilities.
7.	Pedestrian infrastructure	The city has pedestrian facilities which may need some improvements at intersections, footpaths and street lighting as some parts of the city are not served by it.

5.1 Intelligent Transport System (ITS) facilities in Nagpur

- Passenger Information System (PIS)
- Automatic Vehicle Location System (AVL)
- Security Camera Network System (SCN)
- Bus Driver Console (BDC)
- On Board Ticketing Machines
- Central Control Centre

A PIS is a real time information display unit which helps in providing passengers with the necessary information related to their commute. The information displayed varies from the Next/Current Stop information, current location, expected time to reach the destination or the nearest metro station etc. Route data may be presented as a linear map, highlighting the current position of the bus and the next stop that it is approaching. These maps are held as image files on the vehicle computer, and displayed when the bus reaches a pre-specified geo location. Likewise, audio files can be delivered in exactly the same way, notifying passengers of a particular stop as the vehicle approaches.

Automatic Vehicle Location System (AVLS) is a unit which provides real time information of the vehicle with the help of onboard GPS devices. The AVLS facilitates Central Control System (CCS) to enable public information system to act as a source of information to be displayed on the public display screens (for both on and off-board) and voice based information. The AVLS technology is also used in off-board passenger information system. The AVLS technology comprises of following components:

- Bus Mounted GPS based driver console
- On- Board passenger information system
- Off- board passenger information system
- GIS based fleet monitoring & control system

The AVLS system enables operations team to monitor vehicle movement in real-time and synthesizes the AVL field data to deliver the same on the public information system. The LED displays the upcoming stations on the board which can include the nearest Metro Station. The next stop messages shall be independently programmable for audio and visual presentation. The signs shall be capable of presenting the information listed below as vehicle travels between stops. The total amount of information and timing shall be dependent on where the vehicle is on the route, and the time between the stops. The timing of the delivery of messages shall be user configurable. The information may include:

- Route and Destination;
- Metro Stations covered;
- ‘Via’ information;
- Next Stop name;

- Special messages, e.g. for announcements; and
- Current time (visual only).

Bus Driver Console is a unit installed on board and assembled in a way that it integrates with the dashboard of the bus. The driver console will be a Man Machine Interface (MMI) to the system. The Driver Console Unit with wireless communication module (based on GPRS/EVDO/Wi-Fi) will be used to provide vehicle tracking accurately and reliably. The back end system shall be able to produce reports of the vehicle schedule adherence and operated kilometers by each bus, by route and by fleet. The unit will allow AFCS (Automatic Fare Collection System) devices such as handheld ticketing unit and bus card valuators' to use its GPRS/EVDO communication module as a data path to transmit AFCS data to the CCS (Central Control System). 54

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- Schedule Adherence (lateness or earliness in minutes)
- Alarms
- Headway (distance to leading and following vehicles on same service)
- Communications (both data and voice)
- Fuel efficiency

Electronic Display Boards are illuminated LED display boards placed at all the Bus Stations. The information generated on the server on-line, about arrival of a particular route bus at a bus station, would be processes by the CPU using a dedicated software and communicate to the respective stations the probable arrival time of a bus.

6. CONCLUSION

Based on the international understanding the best practices observed in the country which is urbanized such as USA, European nations, United Kingdom, etc, the function of ITS seem a promising solution for advanced traffic control and management. In array to complete the full potential of ITS in Nagpur, a careful systematic approach is required in the propose and scheduling, development and implementation, which tackle the problems of user needs and benefits, system architecture and integration issues while at the same time giving due intelligence to other national and international medium and long-term objectives related to such issues as land use and regional planning, infrastructure design, carrying system management, and many other important areas that are directly or indirectly inclined as a result of ITS accomplishment. Once implemented, it will bring Nagpur on the global map as one of the smartest cities of the world with best transport management. The great potential offered by technologically and economically viable ITS was rapidly recognized as an efficient way to resolve many simple and complex transportation problems. Recent expectations in relation to this potential have suggested, for example, that ITS will lead to a 50 per cent reduction in road fatalities; a 25 per cent reduction in travel time; a 50 per cent reduction in traffic delays; and a 50 per cent reduction in city pollution.

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