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Intelligent Transport System

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Abstract: Intelligent Transport System is an application of electronics and communication technologies and management strategies in an integrated manner to provide traveller information to increase the safety and efficiency of the road transportation system. Broad range of diverse technologies known collectively as Intelligent Transportation System (ITS) holds the answer to many of our transportation problem. ITS is comprised of a number of technologies including information processing, communication, control, sand electronics. Joining this technologies to our transportation system will save lives, save time and save money.

Keywords: ITS, Wireless Communications, GPS, Intelligent Vehicles.

I. INTRODUCTION

Intelligent Transportation System (ITS) is the application of electronics and communication technologies and management strategies in an integrated manner to provide traveller in formation to increase the safety and efficiency of the road transportation system.

The future of ITS is promising. Yet, ITS itself, is anything but futuristic. Already, real systems, products and services are at work throughout the world. Still, the wide-scale development and deployment of these technologies represents a true revolution in the way we, as a nation, think about transportation. While many aspects of our lives have been made more pleasant and productive through the use of advanced technologies, we have somehow been content to endure a transportation system whose primary controlling technology is the four-way traffic signal -- a technology that has changed little since it was first invented. It has taken transportation a long time to catch on, but now the industry is sprinting to catch up.

Fulfilling the need for a national system that is both economically sound and environmentally efficient requires a new way of looking at -- and solving -- our transportation problems. The decades-old panacea of simply pouring more and more concrete neither solves our transportation problems, nor meets the broad vision of an efficient transportation system.

II. INDIAN SCENARIO

In India out of the total population of 1210 million as on 1st April, 2011, about 377 million live in rural areas and 833 million in urban areas.

The percentage decadal growth of population in rural and urban areas during the 1990-2000 decade was 17.9 and 31.2 percent respectively.

The Ministry of Urban Development is in the process of framing a National Urban Transport Policy (NUTP) to address the various issues involved in urban transport.

The objective of this policy is to ensuresafe, affordable, quick, comfortable, reliable and sustainable access for the growing number of city residents to jobs, education, recreation and such other needs within our cities. This is sought to be achieved by incorporating urban transportation as an important parameter at the urban planning stage rather than being a consequential requirement; bringing about a more equitable allocation of road space - with people, rather than vehicles, as its main focus; investing in transport systems that encourage greater use of public transport and non-motorized modes instead of personal motor vehicles; reducing pollution levels through changes in traveling practices, better enforcement, stricter norms, technological improvements; building capacity (institutional and manpower) to plan for sustainable urban transport; and promoting the use of cleaner technologies.

Out of the total 3.3 million km road network in India, approximately 80 % are in rural areas.

Upgradation of about 3,70,000 km Rural Roads is estimated at a cost of Rs.53, 000 Crore (one crore = 10 million). Cost of New Connectivity is estimated at Rs. 79,000 crore.The total envisaged cost of the project is about Rs.1,32,000crore.

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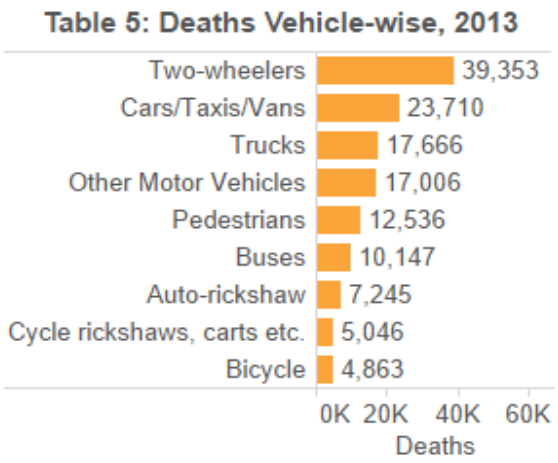


As part of the Indian Government's commitment to develop rural connectivity, the massive Prime Minister's GrameenaSadakYojana (Prime Minister's Rural Roads Programme) was launched on 25th December, 2000 to provide all-weather access to unconnected habitations.

III.INTELLIGENT TRANSPORTATION TECHNOLOGIES

Intelligent transportation systems vary in technologies applied, from basic management systems such as car navigation; traffic signal control systems; container management systems; variable message signs; automatic number plate recognition or speed cameras to monitoring applications, such as security CCTV systems; and to more advanced applications that integrate live data and feedback from a number of other sources, such as parking guidance and information systems; weather information; bridge deicing systems; and the like.

Additionally, predictive techniques are being developed in order to allow advanced modeling and comparison with historical baseline data. Some of the constituent technologies typically implemented in ITS are described in the following sections.

• There are many technologies involved in intelligent transportation system-

A) Wireless communications
B) Computational technologies
C) Floating car data/floating cellular data
D) Sensing technologies
E) Inductive loop detection
F) Video vehicle detection

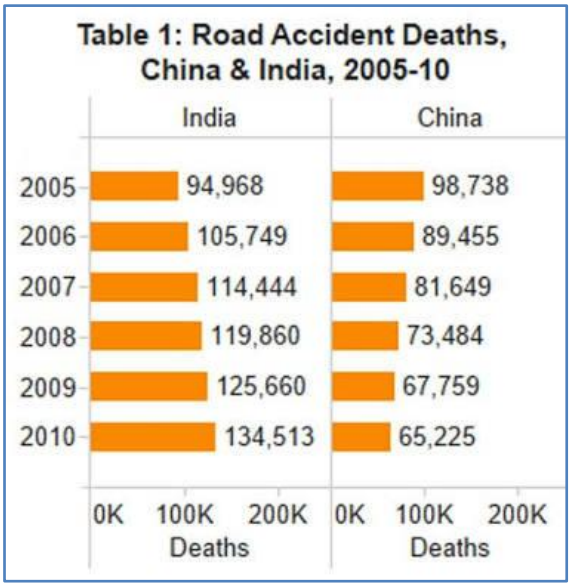
A) WIRELESS COMMUNICATIONS:

Various forms of wireless communications technologies have been proposed for intelligent transportation systems. Short-range communications (less than 500 yards) can be accomplished using IEEE 802.11 protocols, specifically WAVE or the Dedicated Short Range Communications standard being promoted by the Intelligent Transportation Society of America and the United States Department of Transportation. Theoretically, the range of these protocols can be extended using Mobile ad-hoc networks or Mesh networking.

Longer range communications have been proposed using infrastructure networks such as WiMAX (IEEE 802.16), Global System for Mobile.

Communications (GSM), or 3G. Long-range communications using these methods are well established, but, unlike the short-range protocols, these methods require extensive and very expensive infrastructure deployment. There is lack of consensus as to what business model should support this infrastructure.

B) COMPUTATIONAL TECHNOLOGIES:



Recent advances in vehicle electronics have led to a move toward fewer, more capable computer processors on a vehicle. A typical vehicle in the early 2000s would have

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between 20 and 100 individual networked microcontroller/Programmable logic controller modules with non-real-time operating systems. The current trend is toward fewer, more costly microprocessor modules with hardware memory management and Real-Time Operating Systems. The new embedded system platforms allow for more sophisticated software applications to be implemented, including model-based process control, artificial intelligence, and ubiquitous computing. Perhaps the most important of these for Intelligent Transportation Systems is artificial intelligence.

C) FLOATING CAR DATA/FLOATING CELLULAR DATA:

Virtually every car contains one or more mobile phones. These mobile phones routinely transmit their location information to the network – even when no voice connection is established. This allows them to be used as anonymous traffic probes. As the car moves, so does the signal of the mobile phone. By measuring and analyzing triangulation network data – in an anonymous format – the data is converted into accurate traffic flow information. With more congestion, there are more cars, more phones, and thus, more probes. In metropolitan areas, the distance between antennas is shorter and, thus, accuracy increases. No infrastructure needs to be built along the road; only the mobile phone network is leveraged. Floating car data technology provides great advantages over existing methods of traffic measurement:

- much less expensive than sensors or cameras
- more coverage: all locations and streets
- faster to set up (no work zones) and less maintenance
- works in all weather conditions, including heavy rain

D) SENSING TECHNOLOGIES:

Technological advances in telecommunications and information technology coupled with state-of-the-art microchip, RFID, and inexpensive intelligent beacon sensing technologies have enhanced the technical capabilities that will facilitate motorist safety benefits for Intelligent transportation systems globally. Sensing systems for ITS are vehicle and infrastructure based networked systems, e.g., Intelligent vehicle technologies. Infrastructure sensors are indestructible (such as in-road reflectors) devices that are installed or embedded on the road, or surrounding the road (buildings, posts, and signs for example) as required and may be manually disseminated during preventive road construction maintenance or by sensor injection machinery for rapid deployment of the embedded radio frequency powered (or RFID) in-ground road sensors. Vehiclesensing systems include deployment of infrastructure-to-vehicle and vehicle-toinfrastructure electronic beacons for identification communications and may also employ the benefits of CCTV automatic number plate recognition technology at desired intervals in order to increase sustained monitoring of suspect vehicles operating in critical zones.

E) INDUCTIVE LOOP DETECTION:

Inductive loops can be placed in a roadbed to detect vehicles as they pass over the loop by measuring the vehicle's magnetic field. The simplest detectors simply count the number of vehicles during a unit of time (typically 60 seconds in the United States) that pass over the loop, while more sophisticated sensors estimate the speed, length, and weight of vehicles and the distance between them. Loops can be placed in a single lane or across multiple lanes, and they work with very slow or stopped vehicles as well as vehicles moving at highspeed.

F) VIDEO VEHICLE DETECTION:

Traffic flow measurement and automatic incident detection using video cameras is another form of vehicle detection. Since video detection systems such as those used in automatic number plate recognition do not involve installing any components directly into the road surface or roadbed, this type of system is known as a "non-intrusive" method of traffic detection. Video from black and white or color cameras is fed into processors that analyze the changing characteristics of the video image as vehicles pass. The cameras are typically mounted on poles or structures above or adjacent to the roadway. Most video detection systems require some initial configuration to "teach" the processor the baseline background image.

This usually involves inputting known measurements such as the distance between lane lines or the height of the camera above the roadway. A single video detection processor can detect traffic simultaneously from one to eight cameras, depending on the brand and model. The typical output from a video detection system is lane-by-lane vehicle speeds, counts, and lane occupancy readings. Some systems provide additional outputs including gap, headway, stopped-vehicle detection, and wrong-way vehicle alarms.

• Intelligent transportation system i.e. ITS has wide range of applications as-

A) Electronic toll collection
B) Emergency vehicle notification systems
C) Automatic road enforcement
D) Collision avoidance systems
E) Dynamic Traffic Light Sequence
F) Intelligent Vehicle

A) ELECTRONIC TOLL COLLECTION

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Electronic toll collection (ETC) makes it possible for vehicles to drive through toll gates at traffic speed, reducing congestion at toll plazas and automating toll collection.

B) EMERGENCY VEHICLE NOTIFICATION SYSTEMS

The in-vehicle eCall is an emergency call generated either manually by the vehicle occupants or automatically via activation of in-vehicle sensors after an accident.

C) AUTOMATIC ROAD ENFORCEMENT

A traffic enforcement camera system, consisting of a camera and a vehicle-monitoring device, is used to detect and identify vehicles disobeying a speed limit or some other road legal requirement.

A traffic enforcement camera system, consisting of a camera and a vehicle-monitoring device, is used to detect and identify vehicles disobeying a speed limit or some other road legal requirement and automatically ticket offenders based on the license plate number. Traffic tickets are sent by mail. Applications include:

- Speed cameras that identify vehicles traveling over the legal speed limit. Many such devices use radar to detect a vehicle's speed or electromagnetic loops buried in each lane of the road.
- Red light cameras that detect vehicles that cross a stop line or designated stopping place while a red traffic light is showing.
- Bus lane cameras that identify vehicles traveling in lanes reserved for buses. In some jurisdictions, bus lanes can also be used by taxis or vehicles engaged in car pooling.
- Level crossing cameras that identify vehicles crossing railways at grade illegally.
- Double white line cameras that identify vehicles crossing these lines.
- High-occupancy vehicle lane cameras for that identify vehicles violating HOV requirements.
- Turn cameras at intersections where specific turns are prohibited on red. This type of camera is mostly used in cities or heavy populated areas.

E) COLLISION AVOIDANCE SYSTEMS

Japan has installed sensors on its highways to notify motorists that a car is stalled ahead.

F) DYNAMIC TRAFFIC LIGHT SEQUENCE

Intelligent RFID traffic control has been developed for dynamic traffic light sequence. It has circumvented or avoided the problems that usually arise with systems such as those, which use image processing and beam interruption techniques. RFID technology with appropriate algorithm and data base were applied to a multi vehicle, multi lane and multi road junction area to provide an efficient time management scheme. A dynamic time schedule was worked out for the passage of each column. The simulation has shown that, the dynamic sequence algorithm has the ability to intelligently adjust itself even with the presence of some extreme cases. The real time operation of the system able to emulate the judgment of a traffic policeman on duty, by considering the number of vehicles in each column and the routing proprieties.

V) ROAD SAFETY IN INDIA

- Ownership of cars in India - 6 per thousand of population as against 500 in developed economies.
- Number of fatalities per 10,000 vehicles - 14.39 in India, compared to 1.0 to 2.50 in many high income countries

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The Intelligent vehicle initiative

Where the metropolitan, Commercial vehicle and Rural program areas are focused primarily on the ITS infrastructure, the intelligent vehicle initiative aims to accelerate the development and availability of advanced safety and information systems applied to all types of vehicles. The goal is to integrate driver assistance and motorist information function so that vehicles operate more safely and effectively.

The intelligent vehicle initiative covers applications for passenger vehicles, commercial trucks, buses and specialized vehicles such as snowplows. Other special application to emergency response, law enforcement and highway maintenance vehicle are also included.

Many of these applications are based on ongoing and recently completed research on crash avoidance, in vehicle safety and automated highway systems. Continuing research on human factor, and advanced driver warning and vehicle control systems are a major thrust of the intelligent vehicle initiative.

This initiative seeks to bring together public and private stakeholders to ensure that in-vehicle systems are technologically, socially, institutionally and economically viable.

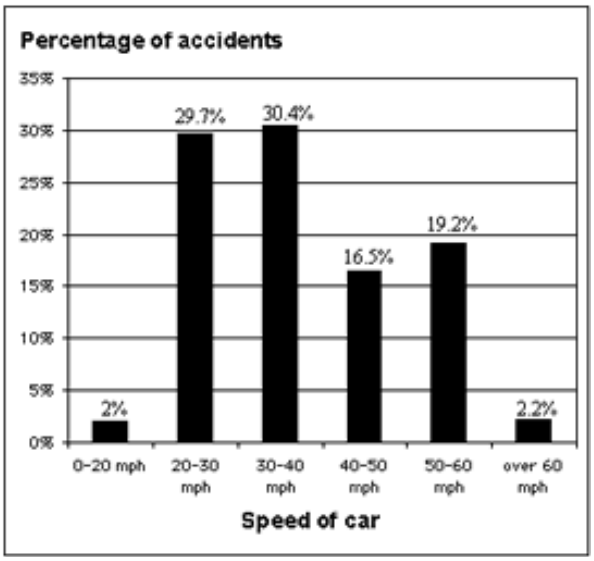
Partnership with the motor vehicle industry and its suppliers, states, government organizations, academic institutions and other interested parties are being aggressively pursued.

THE BENEFITS

In-vehicle devices addressing lane-change, rear end and roadwaydeparture crashes are estimated to offset crashes per year.

In Urban areas, crashes could be prevented annually by advanced lanekeeping and collision-avoidance technologies.

Enhancements in night time and bad weather vision applications may significantly improve driver's ability to stay in lanes and distinguish hazards in the road.



- **CAUSES OF ROAD ACCIDENTS**
- ➢ Driver's fault -83.5%
- ➢ Pedestrian fault/fault of passengers -4.7%
- ➢ Mechanical defect in vehicles -3%
- ➢ Bad roads -1.1%
- ➢ Bad weather -0.9%
- ➢ Other factors-6.8%
- eg cattle, fallen trees, road blockages, non-functioning of signals and
- absence of rear reflectors/road signs

IV. ESAFETY IN INDIA

- Car manufacturers
- Transport service providers
- eSafety
- Telecom companies

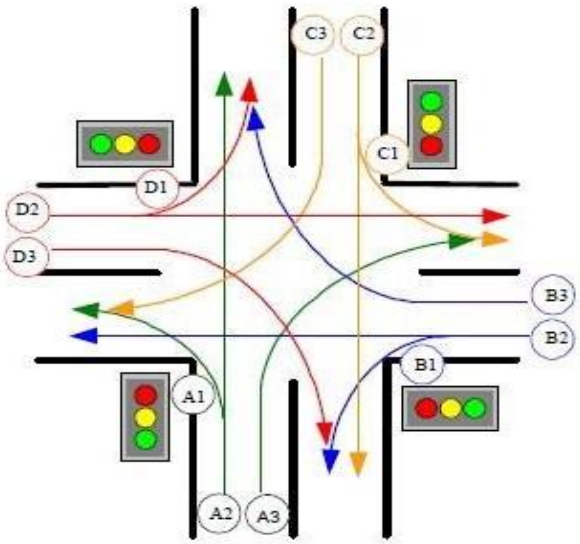


Fig. 2: Multilane traffic sequence flow

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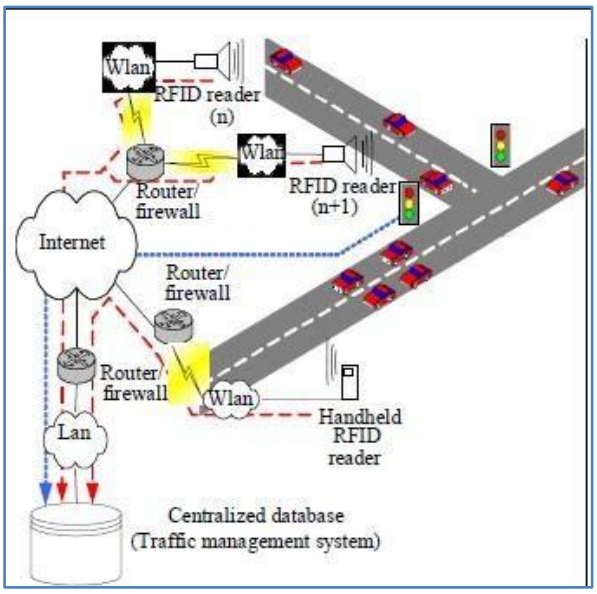

V. CONCLUSION

The RFID technology may lead to a revolution in traffic management, when it is properly deployed as an intelligent system with suitable algorithm. One of its main features is the ability to communicate operation commands from head-quarters or any other subsidiary command station to any location in the system via existing infrastructure such as GSM or Internet. This system can enhance the transportation system of the country, by efficient management. The dynamic management scheme operates in real-time and emulates the judgment of a traffic policeman on duty. The efficiency of the system may save many manhours usually lost in traffic problems. Accidents may also be prevented and lives can be saved as well as property. Priority emergency tags can be deployedon ambulance, fire, police and other emergency vehicles. The system saves valuable details in the records of the database, which can provides ample and valuable information to planners and investigators. However, the integration of the databases among the local authorities is a challenge that requires decisions at national level. Data sharing and secure hierarchical access to various levels of databases and protocols must be designed to integrate new information with existing systems. The issues of integration and collaboration may be a subject for future work. The legal issues and privacy laws relating to the monitoring of drivers all the time may cause a major public concern. Such study would need to address subjects relating to civil rights and personal freedom issues as well as social acceptance.

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