Intelligent Transport System

Intelligent Transport System – Case Studies of Implementation

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***Abstract*— Intelligent Transport System (ITS) is the application of Computer, Electronics and Communication Technologies and Management Strategies in an Integrated Manner to provide Traveler Information to enhance Safety, Reliability and Efficiency of Transportation System. It has several applications in Vehicle Design, Road Allied Infrastructure Design, Design of Public Transport Systems, Incident Management (Accidents, Landslides etc.), Traffic Control, Road Safety and Behavioral Control of Drivers or other Road Users. This paper focusses on the aspects of Road Safety and Public Transport Improvement applications while the other aspects are mentioned for information. Various systems already implemented or under implementation in India under these two topics are discussed in detail.**

I. INTRODUCTION

ITS is the application of Computer, Electronics and Communication Technologies and Management Strategies in an Integrated Manner to provide Traveler Information to enhance Safety, Reliability and Efficiency of Transportation System. It has several applications in Vehicle Design, Road Allied Infrastructure Design, Design of Public Transport Systems, Incident Management (Accidents, Landslides etc.), Traffic Control, Road Safety and Behavioral Control of Drivers or other Road Users.

Some of these aspects like Improved Vehicle Design for better Driver Assistance do not fall within the ambit of Civil Engineering or Transport Planning. Similarly Control of Traffic from Law & Order Perspective (jumping signals, Accident Cause and implication to specific Road User) also do not fall within this ambit. This paper restricts itself to Applications to Civil Engineering/Transport Planning with focus on Road Safety and Improvements to Public Transport.

II. GENERAL APPLICATION OF ITS IN TRANSPORT

ITS has found its application in a number of fields in Transportation as included below.

A. Route choice based on real time information

Route choice based on real time information (Google and other path finder Apps). These apps work in tandem with Global Positioning System (GPS) technology available in the vehicle or the mobile device and processing of satellite images to capture the congestion levels. These are most commonly used by general public and have found various commercial benefits for finding our places to eat, stay or treat for an emergency etc. Traveler is well informed of his choices right at the start of the journey and can plan his/her trip in such a way to minimize wastage of resources including time, fuel and other allied expenses.

B. Route Choice for trips with multiple destinations

Route Choice for trips with multiple destinations (delivery of courier), Route for collection and deposit of waste materials (Solid Waste Collection and deposit at processing sites) – These applications are more for target users – for example are delivery agents of a courier service. Depending on the whole set of parcels to be delivered complex programs are developed with road network and historic congestion levels to identify the best routes for a set of delivery agents and assign the different deliveries to a set of agents. This brings in efficiency and timely provision of service leading to better revenues and customer satisfaction.

C. Real time Signal Optimization

Synchronization of Signals and Area based Traffic Flow Systems have been tried for several years now in many countries including India. Creation of a Green wave through synchronization of Signals in a corridor had created some positive impacts in Mumbai - given the linear nature of the city with defined travel patterns in morning and evening peak. In other places like Delhi and Chennai - the measure did not evoke much positive result as the city is more spread out with traffic movements in all directions without a clear cut peak movement. This led to innovation in traffic activated signals where green time is decided based on the queue length - thus optimizing the available resources. Development of camera that can better identify the images along with data analytics helping to accurately estimate the vehicles waiting in a particular arm of a signal has helped these developments.

D. Integrated Command & Control Center (ICCC)

Most Smart Cities in India have a mandate of establishing a Centralized facility dealing with all city related management issues. Management of Traffic/Transport is one of the central component of an ICCC. The command center has all traffic, transit and any other service related information in one central data base from where it can be used for multiple purposes. This brings in huge possibilities for the users of the city – most of which is yet to be realized. Appropriate usage of such real time data helps a user to change modes, book services (like a taxi), have a Common fare with proper apportioning of revenue to

different operators, use shares systems like bicycle sharing through Apps, etc. Most Smart Cities intend to develop a "One City" App that provides all these facilities and more for a city dweller or a traveler to the city.

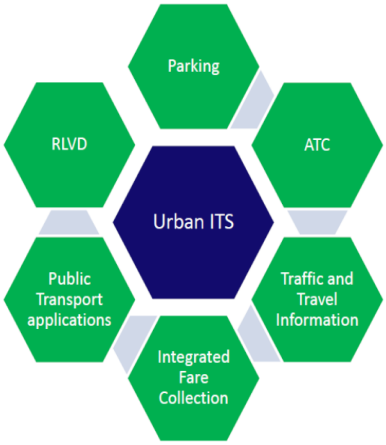

Fig 1. Urban Intelligent Transport System

E. *Toll Collection through FASTTag*

Another application being widely used is collection of Toll Fee through RFID based card. The system reduces the waiting time at toll plazas saving time, vehicle emissions during idling, fuel and human cost in appointment of manual toll collectors. This has also resulted in reduction in pilferage at toll plazas thus increasing the revenue for the Government.

III. ITS & ROAD SAFETY

Road Safety has rightfully attracted attention of the Government given the accident rates in the country. Road Safety measures through ITS comprise of the following aspects.

A. *Advanced Driver Assistance System*

A system to detect objects or hazardous road conditions and automatically stops or slows down the vehicle. Most cars have system to detect objects while parking already. Extension of the same technology to detect any impending danger in the front and braking or slowing is being researched.

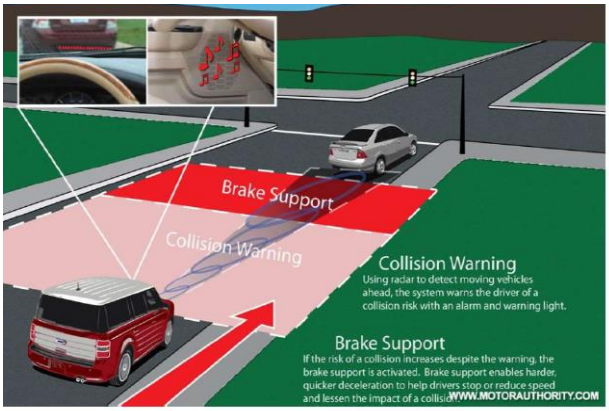

Fig 2. Collision warning system with break support

B. *Advanced Vehicle Control and Safety System*

Advanced vehicle control and safety system is used to monitor vehicles or other objects on all sides and maneuver the vehicle to avoid an incident.

Fig 3. Vehicle Control & Safety System

C. *Emergency Management System*

In case of any incident the vehicle or the sensor in the road way sends message to the Command Center of the incident. Emergency vehicle will get exact location of the spot and reach the place for rescue in the most direct route. The signals in the roadway will detect the emergency vehicle and readjust the signal phases to provide priority to the Emergency Vehicle.

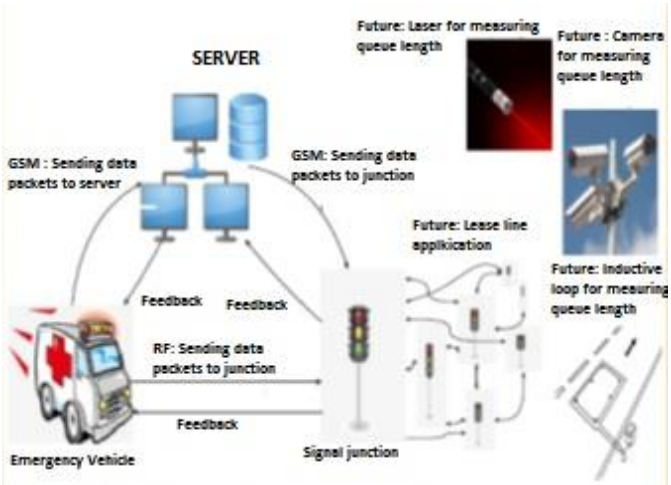

Fig 4. Emergency Management System

D. *Advanced Traveler Information System*

A city or network level system to inform the road users of the impending traffic jams or accident locations to facilitate choice of better routes. Google is one of the examples – others components being Variable Message signs on the road, announcements through Radio etc.

E. *Preventive Care Systems in Vehicles*

Vehicle gets more sensitive to understand the erroneous behavior of the driver and stops unsafe travel. A driver with no helmet or one who has drunk is not entertained and the vehicle does not start at all. Usage of seat belts in cars is one such example where the vehicle warns the driver to wear the seat belt continuously.

IV. ITS & PUBLIC TRANSPORT

Public Transport Facility can be made more attractive by active use of Technology. Location of the Bus at present, time it would take to arrive at a particular stop, seat availability, fare, time it may take to reach a particular location etc. can all be provided to the end user - if we know the exact location of a bus and the congestion on the road in route. Ministry of Urban

Development, Government of India came up with Specification for buses to be operated in Urban Areas in 2013 in which a separate section on ITS was included. The specifications suggest the following Broad Parameters.

A. Passenger Information System (PIS)

The system envisages uploading of a route file with information of Stops (GPS enabled so that the bus identifies the stop and give its name in English and Local Language) along with display of present location inside the bus at driver console and the Gates. This makes public transport more user friendly and allows people to get down at the stops by reading the Boards or listening to the voice message. Route can be changed by the Driver or remotely from the Control Center.

B. Automatic Vehicle Location System (AVLS)

GPS in the bus transmits the location of the bus to the control center continuously so that the control center can monitor the kilometers traveled, routes being taken and other parameters of the bus operation. This is particularly useful when buses are being contracted by the State Transport Undertakings (STU) on a wet lease model. Under this model the bus is provided by a private party (in many cases an operator along with Original Equipment Manufacturer {OEM}) along with driver and maintenance staff for a fixed period and the conductor is provided by the Government entity. The private party is paid a fixed per Km amount by the STU and fare box and advertisement revenue is retained by the STU. Distance traveled becomes a critical information in such models.

C. Security Camera Network System (SCN)

Buses have camera inside for security and any other incident monitoring. The feed is stored in the bus for two days or transmitted to the control center for long term storage. The feed is used to identify any law and order problem or any other incident that needs to be reviewed. This imparts a sense of safety to the travelers and this makes the Public Transport more safe and attractive – especially for women and children.

D. Vehicle Health Monitoring and Diagnostics(VHMD)

Various electrical and mechanical data from the bus would be transmitted to the Control Center which will be able to identify any mechanical or electrical problems with the system and take necessary actions to rectify the same.

E. Hand held and Pole Mounted Ticketing Machine

Ticketing is envisaged to have all modes of payment – cash, card, digital payment etc. The machines are connected on line with the center and provides information such as collection in a day, tickets brought in a particular service, hour wise tickets etc. which help studying the travel patterns in the buses and adjust the services to user needs and behavior.

Department of Heavy Industries (DHI), Govt. of India had come up with two schemes over the last 5 years for acquisition of Electric Buses by various STUs or Urban Bus Operators – Faster Adoption and Manufacturing of Electric Vehicles FAME I and FAME II. Several Electrical vehicles were either purchased or procured through Gross Cost Contract (GCC) model by various STUs. All Electric Vehicles being operated under the two FAME schemes were to follow the ITS infrastructure specified in the above guidelines. Several cities across the country including Delhi, Pune, Surat, Ahmedabad, Dehradun, Indore, Bhopal etc. have buses that have these features.

V. ITS Application in Dehradun Electric Bus Service – Case Study

Under Dehradun Smart City Program a new public transport system is being introduced in the city of Dehradun. In the first phase a set of 30 Electric buses are procured out of which 5 buses started operation by the end of February 2021 and another 25 buses are to be introduced over next one year. The present public transport in the city is by private mini bus operators and shared Auto system (called Vikram which can carry about 7 passengers apart from the driver). The system has no specified stops with poorly maintained and highly polluting vehicles. The E-buses are air conditioned with all modern facilities including provision for boarding a wheel chair, variable display signs, announcement of stops, video recording of bus during operation, Emergency switch and mobile charging points at each seat.

Following aspects of the ITS Technology are being implemented as part of the Project:

- *Tracking of Bus and sharing of Bus Position with users :* Bus has a GPS which sends feed on the bus position to the Integrated Command and Control Centre (ICCC)of Dehradun Smart City. An App is being developed by which any citizen having a Smart Phone can find when the next bus is expected in a particular stop. Bus Stops are also being fitted with Variable Messaging Signs that will display the likely arrival time of the next bus.

- *Announcement of Next Stop* : Data on the location of the stops (Latitude and Longitude) and their names are entered in the Bus Control Software. This data is used to announce the Stop where the bus is standing and the next stop. Announcements are made in English, Hindi and Gadwali the local language spoken in the hills of Uttarakhand. This makes the system more user friendly for local people – especially from villages who may not be able to read the boards in the bus.

- *Video Feed of Bus Journey* : The bus has video camera that records the journey. Efforts are being made to share this video feed with the ICCC where it will be stored for a month or so. Any law and order or other issues in the bus will be available for the agencies to investigate for a fixed time – increasing the safety of the travelers in the bus.

- *Ticketing* : Ticketing in the buses is through a hand held ticket vending machine available with the conductor. This machine is equipped to accept payment through any digital mode including credit cards, App based Payments or National Common Mobility Card (NCMC) being promoted by Ministry of Urban Development, Govt. of India. Ticketing also allows the depot managers and other senior officials to monitor usage and collection on a real time basis. This also makes available any type of data needed for revenue optimisation and research on travel patterns.

All the above has generated positive reviews of the system in the media and among general public. Its effect on actual ridership and mode shift from private vehicles can be studied

only after the full system gets implemented and operational for a stabilization period.

VI. CONCLUSION

Overall ITS provides huge opportunity for improvement in Transport. Lot of research is happening in the sector and we will see more applications of the Technology in the Transport Sector. Application of ITS in Road Safety plays a critical role in trying to reduce the accidents in Indian Roads and also limit the negative impact by ensuring arrival of Emergency Vehicle as quickly as possible. Increase in Public Transport Usage in India is critical to reduce various negative effects of traffic congestion due to excessive private vehicle presence in Indian Roads. ITS provides several tools that would make Public Transport more attractive to the road users. Application of the ITS tools in Dehradun E Bus system has generated positive reviews of the system among media and general public. Its effect on actual ridership and mode shift can be studied after full system gets implemented. Even a 10% shift to Public Transport would bring in major benefits for better utilization of available resources and reducing pollution in the country.

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