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Intelligent Transportation System Model For A City

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Abstract

Increasing traffic congestion coupled with improved technology, funding constraints, and increasing environmental consciousness has provided an impetus to develop cost effective systems aimed at improving the efficiency and effectiveness of the transportation system. Intelligent Transportation Systems (ITS) include a wide range of diverse technologies, including information processing, communications, control, and electronics.

ITS have evolved with applications, including collision warning systems, ramp meters, advanced signal control systems, transit and emergency vehicle management systems, and others. The goals of ITS deployments include improving traveler safety, traveler mobility and system efficiency; increasing the productivity of transportation providers; and conserving energy while protecting the environment. The strain on the transportation system as a whole is thus eased through the application of modern information technology and communications. Some technologies provide more cost effective benefits than others, and as technology evolves, the choices to deployers are bound to improve. These technologies are often combined into a single integrated system, providing benefits that exceed the benefits of any single technology (Proper and Maccubbin, 2000).

ITS aims to improve the safety and efficiency of the transportation system. ITS systems themselves offer opportunities for new methods of evaluation and continuing assessment. As an indication of the degree of commitment to ITS in the U.S., during the last decade, federal, state, and local governments have appropriated billions of dollars for ITS programs. In 1998, the Transportation Equity Act for the 21st Century (TEA-21) provided more than $1.2 billion in funding to support ITS through 2003. Of that, $603 million was targeted toward research and development. Another $679 million was intended for deployment of ITS projects (Sundeen, 2002). Further, the Intelligent Transportation Society of America (ITS America) estimates that more than $209 billion will be spent on ITS programs by 2011.

Introduction

In 1997 in the U.S., automobiles traveled 1.4 trillion vehicle miles (2.3 trillion vehicle kilometers) and households spent an average of 19 percent of their income on transportation—less than housing but more than food (Northeast-Midwest Institute, 2002). Further, drivers in the 68 largest urban areas in the U.S. experienced an increase in traffic delays due to congestion from 11 hours per year in 1982, to 36 hours per year in 1999 (Schrank and Lomax, 2002). The estimated cost of traffic congestion in these 68 areas totaled $78 billion, representing a cost of 4.5 million extra hours of travel and 6.8 billion gallons (25.7 billion liters) of wasted fuel (Schrank and Lomax, 2002). The average rush-hour trip takes 32 percent more time than the same trip taken during non-rush-hour conditions. Congested travel periods (rush hours) in the nation's major cities have doubled in less than 20 years, increasing from nearly three hours (morning and evening combined) in 1982, to almost six hours in 1999 (Schrank and Lomax, 2002). Congestion is now found during almost half of the daylight hours on workdays (Schrank and Lomax, 2002). Increasing traffic congestion coupled with improved technology, funding constraints, and increasing environmental consciousness has provided an impetus to develop cost effective systems aimed at improving the efficiency and effectiveness of the transportation system. Intelligent Transportation Systems (ITS) include a wide range of diverse technologies, including information processing, communications, control, and electronics.

ITS Components

ITS deployments themselves typically include surveillance systems that enable a more comprehensive understanding of how the existing transportation system operates and facilitates proactive strategies for managing it more efficiently. ITS deployments have benefited from advances in computer processing and miniaturization, communications technology, and enhanced institutional arrangements. Ten ITS systems will be introduced with some examples of how archived data have been used to provide evidence for the effectiveness of these systems. The ITS benefits and unit costs database has classified the benefits of implementing ITS into the following 10 program areas (USDOT, 2002a). Note that each program area includes different ITS applications and that there is some potential overlap:

- Freeway management
- Incident management
- Transit management
- Arterial management
- Emergency management
- Electronic payment
- Traveler information
- Crash prevention and safety
- Operations and maintenance
- Road weather management.

The ITS benefits and unit cost database also describes seven categories of benefits to be used for ITS deployment evaluations:

Transit Management Systems

Transit management systems are concerned with increasing operational efficiency of all transit modes and increasing ridership by making the transit system more reliable. (McQueen and McQueen, 1999) The emergence of the global positioning systems (GPS) and the increase in its accuracy has helped this field substantially. Several transit agencies have equipped their vehicles with GPS to create automatic vehicle location (AVL). AVL technology has been widely implemented in North America and Europe. In the year 2000 about 35 bus systems had AVL technology implemented in the U.S., in both light-rail and bus systems (APTA, 2001).

The Tri-County Metropolitan Transportation District of Oregon (TriMet) operates 97 bus routes and a 38-mile light rail line within the tri-county Portland metropolitan region. TriMet's bus lines carry approximately 200,000 trips per day, serving a total population of 1.3 million persons within an area of 590 square miles (1,530 square kilometers). TriMet is considered as one of the leading ITS deployers in the U.S. TriMet has implemented a Bus Dispatch System (BDS) as a part of its overall operation and monitoring control system. (Strathman et al., 2002; Strathman et al., 2000; Strathman et al., 1999).

Funtions of ITS

The origin of the formal ITS program dates back to the nineteen sixties with the development of the Electronic Route

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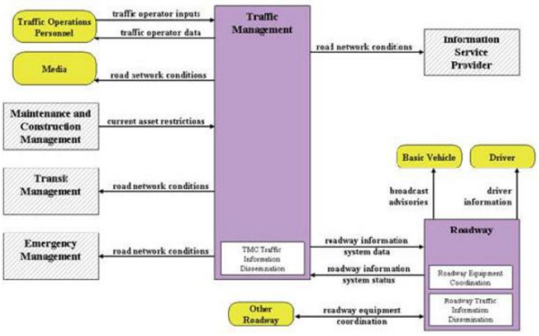
Guidance System, or ERGS in the United States, to provide drivers with route guidance information based on real-time traffic analysis. The system used special hardware located at various intersections across the road network, on-board 2-way devices in vehicles that would form the hub of communication between the driver and the ERGS system, and a central computer system that processed the information received from the remote systems. During the early seventies, the ERGS program led to a more sophisticated, automated system comprising interactive visual digital maps called the Automatic Route Control System or ARCS. The Urban Traffic Control System was developed concomitantly, connecting various traffic signals and computer generated predetermined signal timings for better traffic organization. The same era saw the development of the Japanese Comprehensive Automobile Traffic Control System (CACS) program, presumably one of the earliest public-private partnership effort in the world to test an interactive route guidance system with an in-vehicle display unit.

Components of ITS

A Traffic Management Centre (TMC) is the hub of transport administration, where data is collected, and analysed 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 centres. There is, often, a localized distribution of data and information and the centres adopt different criteria to achieve the goals of traffic management. This inter-dependent autonomy in operations and decision-making is essential because of the heterogeneity of demand and performance characteristics of interacting subsystems.



Schematic of the workings of a TMC

Issues and Challenges of ITS

The rapidly advancing economy of India, in par with the rest of the world has resulted in a phenomenal increase in use of personal automobiles on Indian urban roads. The cumulative growth of the Passenger Vehicles segment in India during April 2007 – March 2008 was 12.17 percent. In 2007-08 alone, 9.6 million motorized vehicles were sold in India. It is expected that India will surpass China as the fastest growing car market within the next few years.

Economy-induced automobile usage is complicated further by the constant influx of rural population into urban areas, thus making enormous demands on the transportation infrastructure in an overloaded region. In 2001, India had 35 cities with a population of more than one million people. The heterogeneity of economy and the physical limit on how much additional infrastructure a city can hold complicate transport management further. Some of the main issues facing the deployment of ITS in developing countries like India, reported by a World Bank study are: an underdeveloped road network, severe budget restrictions, explosive urbanization and growth, lack of resources for maintenance and operation, less demand for automation, lack of interest among government decision makers, and lack of user awareness. While a number of small scale ITS projects have been introduced in various cities in India - including New Delhi, Pune, Bangalore, Indore and Chennai - these systems have focused on isolated deployments such as of parking information, area-wide signal control, advanced tollcollection, web based traveller information etc. (Eg. Ref 73). Most of these are small-scale singlecity based pilot studies. At present, there are not many comprehensive, fully developed ITS applications with traffic management centers in India. Thus, it can be seen that the penetration of ITS in Indian road scenario is relatively less and much more is needed to be done. To make this a reality, there is a need for more systematic approach to the ITS implementation.

Conclusions

The rapidly increasing vehicle population in India, spurred by the population boom and economic upturn lays a critical burden on traffic management in the metropolitan cities and towns of the country. While India has already made a foray into intelligent transport systems in organizing traffic, more extensive and urgent integration of advanced technology and concepts into mainstream traffic management is imperative. The adoption of location and information based technologies into vehicles, infrastructure, traffic management and traveler information services have shown dramatic improvements in the safe, and efficient mobility of people and freight in USA, European nations, UK, Japan, Middle East and Canada. ITS is still in its infancy in India, with decision-makers, key planners and agencies still in the process of understanding its potential.

India"s ITS cannot be entirely modelled 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.

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