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Auto Bytes

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Achieving smart transportation to resolve traffic congestion

Introduction

The future of mobility in India will be shaped by smart roads, which are expected to solve the problem of traffic congestion and as a result improve ease of living, reduce stress on natural resources and minimise carbon footprint. From safety to traffic management and infotainment, vehicles are offering new challenging applications in the current industrial revolution 4.0, where smart roads interact with smart vehicles and the overall smart infrastructure.

Road traffic can be described using speed, flow and density on a specific segment of the road. When estimating the traffic state, different types of traffic models are commonly used. The use of Advanced Traffic Management Systems (ATMS) and Advanced Traveller Information Systems (ATIS) as key components of efficient management and control of traffic flows is expected to improve the overall traffic system performance in future smart cities by reducing emissions, noise and travel times.

Concurrently, governmental entities, with planned investment of USD 14.6 billion towards building smart cities, have provided immense support towards designing and implementation of smart road infrastructure to further enable efficient interaction with smart vehicles, e.g., connected self-driving or autonomous vehicles. The Digital India campaign is also driving growth in the Internet of Thing (IoT) segment, and its market is projected to grow at a CAGR of 28.2% during 2016-22.

Plans of Indian government for smart transport

USD 500 billion investment is expected through current government policies and missions including projects for highways, rail, metro, air and seaports, etc.

Autonomous vehicle technology

Vehicle-to-vehicle (V2V) technology is the core of autonomous driving technology, where sensors detect what is going on around the vehicle and additional technology shares that data with other vehicles on the road.

V2I Smart Corridors

In Vehicle-to-infrastructure (V2I) technology, the infrastructure includes physical things such as traffic signals and weather alert systems. The vehicle can send data out while simultaneously the infrastructure can send important data back.

Tracking pedestrian traffic

V2I technology not only tracks how many vehicles go through a given intersection at different times but also how many pedestrians are crossing streets and even jaywalking — so the city can reroute vehicle traffic at times of high pedestrian traffic, and so on.

The city can also get alerts when a pedestrian is in a roadway and the light is about to change so that they can delay the light if needed, increasing the safety of the streets as well.

Big data in transportation

In the last decade, commercial vehicles (CVs) have witnessed an exponential growth in their sensing, computational and communication capabilities. Traffic signals have been made smarter through V2I technology, allowing them to gather new data that was earlier inaccessible. Strategic sensing would lead to smart parking by detecting the availability of the nearest parking, saving time and fuel. Moreover, on-board mobile devices are natural sensing devices, owing to a large set of on-board sensors (e.g., inertial, voice, magnetic, video, etc.), with widely available direct internet connectivity. The implementation of IoT-oriented smart roads involving smart parking, traffic management, fleet tracking, road condition sensing, passenger usage analysis, ETA systems and IoT sensors across the city is expected to drive real-time data on the cloud. Information from IoT (drones, wearables, connected devices), social media, crowdsourcing and shared economy companies will have a greater impact on cities. At the same time, next-generation cellular communication technologies such as 5G are expected to provide significant data collection and dissemination capabilities.

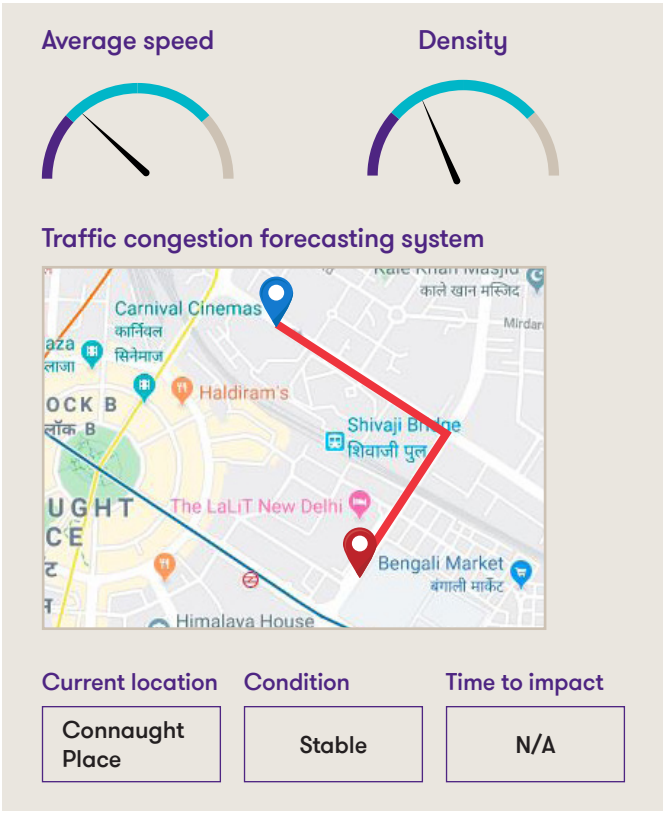
Cities have generated large volumes of data from different systems, such as cellular networks, social networks and participatory sensing. However, for employing sensors and IoT technology, there are challenges like funding and having the right skilled workforce that is able to plan, implement, maintain and analyse a smart city network. In this scenario, estimation of accurate traffic and road monitoring are the two major challenges to resolve traffic congestion which would formalise through innovative sensor networks in innovative smart roads. This would enable a new dynamic understanding of travel times, as well as departure time, mode and route choices. If detailed data is available, activity patterns at an individual level can also be captured. Thus, with the advent of new sensor technology, which makes massive volume of new traffic data available, there is a need for new techniques and methodologies to combine the vast amount of data from different sources.

Instead of traditional sensors like loop detectors and radars, significant efforts have been made in the area of sensors to analyse cities travel times or point speed observations from Global Positioning System (GPS) devices for real-time traffic state estimation. Perimeter control algorithms have been suggested for reducing congestion in urban areas and improving travel times with the use of macroscopic fundamental diagrams (MFDs), also known as network fundamental diagrams. MFDs are used in an automatic control loop and provide a bridge between the signal timing and the traffic state without requiring microsimulation of the traffic, which makes it appealing for large scale on-line applications. The key concept of perimeter control includes sensors and a control algorithm. The sensors provide real-time measurements of the density, and the control algorithm makes use of these measurement, through the MFD, to determine the most suitable signal timings. Further, automatic vehicle identification (AVI) is an aggregate name for data collection techniques where vehicle identities are captured in selected locations. The most common systems are based on licence plate recognition (LPR) and re-identification of Bluetooth or Wi-Fi physical addresses where Bluetooth is used in hands-free devices and for communication between different devices in vehicles.

The future of transportation

Overall, the emerging road traffic sensors not only enable a better understanding of long-term travel demand and travel pattern dynamics, but also make it possible to estimate and predict travel demand and wide-area traffic densities more accurately in real-time. This would enable the introduction of wide-area traffic control by making use of new data sources shared by communication between vehicles, and between vehicles and the infrastructure, called as cooperative systems, with great potential to improve the performance of existing traffic control strategies in the country and make synergies to achieve the goal of smart cities transportation.

Client interface of traffic congestion monitoring system



Sources

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- Auto Tech Review
- Reports of the Association for the Advancement of Artificial Intelligence

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