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Intelligent transport systems in India: State of the art

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ABSTRACT

Road transport is the important mode of transport next to Railway transport in Land transport of India. Road transport has the advantages of low cost, connecting the most number of places including villages, accessibility to all levels of people. Indian road carries 85 percent of the passengers and 70 percent of the freight traffic of the country. Artificial Intelligence (AI) is a branch of computer science that aims to create intelligent machines. It has become an essential part of the technology in road transport. Digitalization, electrification, automation and the sharing economy are fast transforming transport services. Intelligent Transport System (ITS) is a part of AI which plays an important role in making the road transport smarter by applying various techniques. This paper deals with the techniques used in ITS, ITS technologies used in developed countries, the scenario of Indian cities where congestion is the main issue, participation of government organization in ITS, utilities of ITS in India and Sensing technologies used in ITS.

Keywords— *Intelligent transport system, Indian scenario, Utilities of ITS, Sensing on roads*

1. INTRODUCTION

In this fast-growing century, people do not wish to spend their time in any time-consuming things. We can observe this attitude in the study of the transportation scenario, particularly in road transport. This fast going behavior sets the path to increase the usage of different types of vehicles including two-wheelers, four wheelers, and others. This scenario brings the issues of increased vehicle counts, high traffic, pollution, tragedies of accidents. ITS comes into place not for avoiding all of these types of issues, but it prevents the most of these problems by avoiding in prior. It provides different levels of technological support for dealing with road transportation issues. ITS is an integrated system that includes a wide range of communication, control, vehicle sensing, and electronic technologies. We can see the implementation of ITS in developed countries like USA, UK, and Singapore. Advanced Traveler Information System (ATIS), Advanced Traffic Management System (ATMS), Advanced Public Transportation System (APTS) and Emergency Management System (EMS) are the main categories in ITS. The technologies of the internet, telephones, cellular phones, television, radio, etc. are used in ATIS. The drivers and travelers get the benefits of getting information about departures, optimum routes, and available modes of travel. Traffic police departments and traffic regulation authorities use ATMs to control and manage the traffic by monitoring the flow of traffic and making appropriate decisions in a timely manner. It helps to optimize the movement of vehicles by using real-time information to intervene and adjust controls such as traffic signals to improve traffic flow. With the use of APTS, the way the public transportation system operates is transformed. EMS is the newest research field in ITS concerned with the application of different intelligent transport system technologies to develop a transport system which can provide help in emergency conditions. EMS can provide great help in reducing the fatality rate in the accidents [1].

2. INTELLIGENT TRANSPORT SYSTEM IN DEVELOPED COUNTRIES

Various developed countries are providing improvements in their transport systems through ITS. The knowledge about the technologies used in these countries paves a path to compare the technologies with the available scenarios in India. In the country of Japan, the people use deployed ITS apps and maturity of those apps. It gives real-time traffic updates. The technologies they use involve embedding fixed sensors in or on roadsides and mobile probes like taxis or mobiles. South Korea implemented electronic fare payment, advanced public transport and information about real-time traffic and traffic information via vehicle closed circuit camera deployed in one-kilometer intervals. Closed circuit cameras are deployed in every 2 to 3 kilometers. The probe vehicles store data at information systems and share via its communication means. In Singapore, they are also using probe vehicles to collect real-time traffic information and the technologies of road pricing, deployment of computerized traffic signals nationwide. They deliver the services of traffic information to commuters through in-vehicle devices. Pedestrians and other users get benefits from congestion management systems. United States implemented RITA- Research and Innovative Technology, Telephonic Data Dissemination, Intelli Drive, Co-Operative Intersection Collision Avoidance Systems, Integrated Corridor Management Systems, Emergency Transportation Operations, Mobility Services, and Electronic Freight Management. Australia concentrates into improving Traffic scenarios,

enhancing public safety. It uses FRAME as its architecture basis. United Kingdom uses MIRA transportation system as its base ITS architecture. It also uses military grade self-healing communication network technologies and topologies. [2]

3. ITS IN INDIA

ITS is designed to deal with all these kinds of different scenarios in Urban/state/private and public road transport organization. ITS consists of mainly a backend and a hardware component to provide an integrated solution for driver console unit, electronic ticking machine, passenger information system. Advanced Technologies like GPS, WIFI and GPRS and sensors are used in ITS to schedule and monitor transport companies. In-depth ITS functions by communication from microwave, Internet, Bluetooth and geographical locations, geographical information system, Data acquisition, and exchange camera system and artificial vision, detection and classification, In-vehicle system and Digital Mapping. In India, ITS needs to adaption to local environment, accordingly the sensors, Infrastructure, modules are customized from present local requirements. The knowledge of the commuters and pedestrians is a key issue in Indian perspective. The traveler who overrules the traffic rules also can be identified by those technologies which is one of cause for accidents, Age and education plays an important role to learn about the modules of ITS. ITS is known from the survey conducted on Delhi about the understanding of ITS modules like APMS, VMS, ATIS. Drivers are in the need of the information about parking the vehicles that reduce the traffic congestion Real-Time Traffic Information (RTTI) is the most focused area which gives the updated traffic alerts to the drivers, passengers, and other users. By the dynamic route guidance system, drivers can be get alerted to avoid accidents, congestion, and hazardous driving conditions. Floating vehicle data, floating phone data and other advanced data collection techniques help the people in accordance with the partnerships of the public and private organization [3].

4. SCENARIOS OF MOST CONGESTED CITIES IN INDIA

If we consider top congested cities in our discussion it shows the picture of the most common scenario of the situation. Mumbai has the problems of narrow roads very high population, high volume of private vehicles, long queues on road. The lack of broad road, pedestrians and in traffic keeps this city as one of the top congested city. Kolkata has narrow lanes, lacks the footpath, faulty traffic signals and traffic sense. Bangalore city has more unregistered vehicles unplanned, congested and narrow roads. New Delhi doesn't meet a severe problem in traffic, but due to lakhs of vehicles every day and unplanned roads it meets pollution in high. Hyderabad is having good infrastructure and broad roads, due to lack of traffic sense of people, it faces the issues. Jaipur has a high volume of traffic and a huge number of private vehicles, narrow roads, and lack of proper infrastructure. Factories and industries create pollution from its wastes in Kanpur. The challenges here are poor roads, pedestrian movement, street parking, and lack of public transport. Chennai city faces the issues of narrow roads, lack of infrastructure, faulty signals and traffic sense is not AP to the mark. In India, the ITS projects on small-scale level went through in the cities of Delhi, Pune, Bangalore, Chennai, and Indore. It was done in the areas of toll collections, parking information, web-based traveler information, Emergency, Congestion management, advanced traffic management, and vehicle control system. The implementation of ITS in India faces the hurdles from the aspects of lifestyle and physical differences, the range of cultures, diverse range of vehicular velocities, poor lane discipline.[3] When we compare the ITS applications used in developed nations with our Indian scenario we meet a number of challenges. The available infrastructure in India cannot adapt in direct with the available ITS technologies. Either we need to change our infrastructure or the ITS technologies according to our necessity. When comparing with these countries, Our Indian road transport varies in types of vehicles, road infrastructure, and people understanding about traffic rules, societal aspects, and traffic management system. Even though In India we are in the time of switching over to modernization in every field, the traffic management system uses the traditional mode of techniques like traffic signals, traffic signs and traffic polices. In recent times, using sensor techniques like GPS, WIFI, Camera, and Microphone in smartphones are helpful in the estimation of traffic conditions and avoiding congestion. When these like techniques are implemented, the critical issues on road transport will be reduced drastically. The issues are divided into 3 categories involving missing of the vehicle to vehicle coordination, lack of homeland security systems and vehicles operations, failing of traffic management covering the range of vehicles.[4][5]

5. PARTICIPATION OF GOVT.ORGANISATIONS IN ITS

Without the serious involvement of Government Organisations, ITS system cannot get the success. As the government has the intention to implement advanced technologies in road transport, these are a need of a good leadership who overviews the overall operations of ITS. As of April 2018, there were 1,529 projects in India, of which 740 were related to roads. The Union Minister of State for Road, Transport, and Shipping has stated that the Government aims to boost corporate investment in roads and shipping sector, along with introducing business-friendly strategies that will balance profitability with effective project execution. The Ministry of Road Transport and Highways has taken a number of steps to prevent road accidents and road accident fatalities. The Government has approved a National Road Safety Policy. This Policy outlines various policy measures such as promoting awareness, establishing road safety information database, encouraging safer road infrastructure including the application of intelligent transport, enforcement of safety laws etc. Advocacy/Publicity campaign on road safety through the electronic and print media. High priority has been accorded to identification and rectification of black spots (accident prone spots) on national highways. Ministry of Road Transport & Highways has constituted a District Road Safety Committee in each district of the country to promote awareness amongst road users under the chairmanship of Hon'ble Member of Parliament (Lok Sabha) from the district [6]. To map road with GIS (Geographical Information System) The GIS-based Road Information System will cover all roads, including the national highways, state highways, major district roads, and other roads. The system, which will provide the information related to physical position and attributes of the roads, would be available online for use, an official aid. The GIS images of all places would be posted online and by clicking on the image of any road, one could get the coordinates of any particular site on the road. By submitting these coordinates in a box provided on the same web page, all the information of that road would appear on the screen. The information would be updated annually. The PWD team conducts a survey of every road in the state every year and collects information on 59 points, including location, length, width, depth, the thickness of the upper layer, smoothness, connectivity, traffic, and roadside features. The GIS-based road

information system will enable people to find the shortest and best suitable route for any destination. It will also help the government in planning development works in the area [7].

6. UTILITIES OF ITS IN INDIA

In traffic management, the ITSs are utilized in broad areas. One set of the utilities that takes place at the road management side falls under the following six categories.

(a) **Intersection control:** At the intersection of roads, deciding the total signal cycle and managing the green times among different flows is one of the most basic traffic management concern.

(b) **Incident detection:** Most of the areas are identified as the accident-prone places by road safety control. Moreover to that unexpected accident in any area of the road have to be identified immediately before reaching seriousness.

(c) **Vehicle classification:** Knowing what kind of vehicles are operated in a particular area helps to improve the development of ITS applications in local level depending on their requirements.

(d) **Monitoring:** pollution and road quality monitoring give a torch to take any protective measures at that particular noted areas.

(e) **Revenue collection:** Toll taxes and collecting fines from rule violators can be made auto-generated application oriented to enhance the current situation

(f) **Historical traffic data:** Long-term data helps to plan new infrastructure, calibrate traffic signal times, add public transport, and so on.

Another set of utilities operates at the commuters and other beneficiaries' side which falls under the remaining six categories:

(a) **Congestion maps and travel time estimates:** commuters can be get benefited in selecting their route when they know the congestion maps and estimation of traveling time.

(b) **Public transport information:** Information about the arrival of public transport helps in the choice of selecting the travel mode and to avoid wasting time.

(c) **Individual vehicle management:** Getting information about parking places or estimates of carbon footprint, help owners of private vehicles. Individual vehicle management uses the techniques of accelerometer reorientation mechanism by using smartphone magnetometer, usage of GPS to know travel times and arrival times of vehicles and using of smartphone camera to predict the traffic signal ahead for automatic speed control of the vehicle.

(d) **Using ordinary phones:** ordinary cell phones are also used based on the cellular tower and wi-fi information and adding sensors to ordinary phone hardware popularly known as crowdsourcing or participatory sensing.

(e) **Specialized hardware on vehicles:** some researchers have used specialized hardware in vehicles, which detects road anomalies and tracks stolen properties. It uses ultrasound transceivers to find empty parking spaces and calculate fuel usage.

(f) **Social networking**: It plays an important role to pass out the latest alert messages and to share the information with the broad range of people at a time.

Sensors help to sense a wide range of different energy forms such as movement, electrical signals, radiant energy, thermal or magnetic energy etc. There are a variety of sensors available based on its functionality and the user's dependency. It works in the areas of the light level, temperature, force, position, speed and sound. The automotive manufacturers are developing in-vehicle Sensors, and their applications include safety, traffic management& infotainment. In equivalent to usage of cameras at roadsides, Sensors are also used most is to collect data about environmental and traffic conditions, to obtain the scenario about the road conditions and ongoing traffic information, using Sensors on roads is helpful. The different types of sensing and hybrid sense. These sensors are used both in–vehicle and on-road.

Static sensing: In magnetic sensors or loops under road surface the vehicle counts can be detected. Most of the traffic applications use video surveillance to monitor traffic states & detect incidents. Acoustic sensors are useful in developing regions. Where the traffic is chaotic. Wireless radios using RF Sensors placed across the road have communication signals affected by vehicle movement in between. The challenges that we meet when we implement the static sensing techniques are the methods to count and classify vehicles working for heterogeneous traffic, image processing algorithms. For chaotic traffic, computational overhead, real-timeliness and accuracy of the designed algorithms. The new sensing solutions for chaotic traffic are pollution sensors, infrared sensors, vibration sensors etc. For each technique, some of the key questions to explore are, what to sense, how long to sense to handle the real-timeliness VS accuracy trade-off, how to build sensing models for different road widths and vehicle type with minimum manual supervision. Mobile sensing Real-time tracking of vehicles estimated by installed GPS in vehicles that were implemented by manes public transport and fleet companies. This technology predicts bus arrival times too. Smartphone GPS is being studied for hotspot detection and travel time estimation after handling noise in GPS readings. [8]

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