**Intelligent Transportation Systems (ITS) in Smart Cities**

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***Abstract***

*Revolutionary transportation has facilitated and prioritized coming of newer technologies. This study aims to figure out how intelligent transportation has proven to be major factor in enforcing more efforts and liveliness to the growth of smart cities. Study also shows that parallel control and management in transportation has played an accountable role in managing traffic congestion. Vehicle cognitive management has been also described briefly. Implementation of intelligent transportation system can be looked upon as executed in Poland and Poznan. Data driven intelligent transportation system(DDITS) has gained popularity over the last few years. DDITS has brought a revolutionary change in ITS as huge amount of collected data can be utilized in several aspects to facilitate transportation. Further it has trended to spread awareness among people and be a public centric cum intelligent system.*

**Introduction**

A smart city can be explicated as a city in which technology goes hand in hand with conventional methods harmonized with new technologies .The main focus of smart cities is to advance the compassion of common problems .Currently many cities are facing problems related to social and economic development .These challenges can be overcome with the notion of smart cities .The base initiatives of smart cities are- administration, technology, government and policy context, it’s inhabitants ,careful budgeting, infrastructure, and environment .

Since the need to travel has grown tremendously, the weakened transportation infrastructure has resulted in problems like traffic congestion, accidents, delays, pollution, etc. The existing solutions, which involve execution of safety systems (such as usage of safety belts and airbags) and construction of more &amp; better roads, are not good enough to be executed further. This is due to the reason that their implementation is quite expensive and requires a large space, which cannot be managed in urban areas. The difficulties related with this topic have prompted the researchers to give their attention to the area of ITS (Intelligent Transport Systems).

ITS studies the technology and scientific aspects with the motive to develop new system which are efficient to give a solution to the above-mentioned problems. The road-vehicle system can be made more risk-free, more systematic and more nature – friendly by making full use of the rising intelligent transport systems technologies. ITS depends on the outcomes of several other researches which involve different areas like such as electronics, information systems, etc.

**Literature Review**

**1.Introduction**

Intelligent transportation system (ITS) mainly practise advanced communication like wireless sensor network (WSN) that is mainly used to monitor physical or environmental condition, google street view and information and electronics technology for solving basics day to day problems like traffic crowding, rapid growth in pollution, high misuse of fossil fuels. ITS is one of the best working area for safer mobility in transport area through information and communication technology. ITS even targets in reducing cost factors through decrease in minimization of load in telecommunication network. . The most symbolic role of ITS is to increase the levels of security of mobility. ITS also focuses to increase the level of intelligence embedded in vehicle. Hence ITS aims to discover more intelligent roads, vehicles and more importantly "users".  Overall this review focuses on how Intelligence transportation system (ITS) plays a major role in upgrading a city to a smarter one.

**2.History**

The major implementation of ITS came into light around 1930, majorly in Europe, U.S and Japan. In the years 1980-1995, major outbursts were bought in industry and government subsidies in these countries. This was the basis of ITS during the given phase. After 1995, a lot of projects like " a truck following another one" were developed in Europe. At the same time in US, the focus of ITS programs shifted to large-scale assimilation and formation integration and deployment. For the last two decades (ITS) have effective way of improving the performance of travel systems, travel security, and providing more options to migrants. A significant change in ITS in recent years is that many goods are collected from a variety of sources and can be executed into various forms for different shareholder.

**3.Data-Driven Intelligent Transportation Systems:**

ITS has been changed from a   typical technology-driven system into a more dynamic multifunctional "Data-driven intelligent transportation system (D2ITS)": with many sources, and learning algorithm driven to advance its performance. In this paper, we provide a review on the improvement of D2ITS, considering the functionality of its major components and some issues related with D2ITS.

The working of   fundamental components in ITS which basically includes Advanced transportation management systems(ATMS) and Advanced traveller information systems(ATIS) and many more depends on how data has been collected and refined into useful data. “D2ITS are organisations that would benefit users to interactively utilize data resources that pertain to transportation systems, approach and apply data through further convenient and decisive services to boost the work of transportation systems, and realize and extend the functions of fundamental components of ITS”. The concept of D2ITS studied here covers the present state of ITS and define a possible framework for futuristic ITS. Unlike traditional ITS, D2ITS give significance particularly on real time ITS data. According to the type of data used, the way that data is executed, and the precise D2ITS applications, a full D2ITS can be classified into several major categories, as discussed below:

**A. Vision-Driven ITS:** Vast figure of operation in ITS are achieved with vision-driven robotization, where input information are accumulated from video sensors, and result is utilized for ITS-related applications .Here are some of the following issues that are to be taken:

1) Complex open air circumstance can expand issues to the plan of a general vehicle divulgence and depiction framework.

2) The computing function is generally very demanding due to the fast movement of on-road vehicles.

3) It is not that easy to figure out a system that is robust to a vehicle’s moves and drifts.

Thus Vision- Driven system  provide an competitive and automatic way of identifying  incidents without a need for human operators.

**B. Multisource-Driven ITS:** D2ITS can be helped by data from different sources, e.g. Inductive-loop radar, laser radar, and GPSs. Unlike vision-driven systems that are subjected to environmental constraints multisource-Driven play a supportive role .  One of the multisource -driven ITS that are most periodically  used is  GPSs . GPSs serve real-time positioning knowledge that would allow us to trace the location  of vehicles, a feature that is especially  useful to ITS but GPSs have equally drawbacks also like  multipath issue, missing data issue . .To address the given issue " Schleischer et al." considered "visual information as a complementary data source for GPS data" which  blended these two different  data sets to generate the vehicle positioning information with high precision by guessing through the fingerprint of each vehicle pose  with stereovision and then elevating  the vehicle orientation estimation with a low cost GPS.

**C. Learning-Driven ITS:** Although video devices and multiple sources can create data of transportation systems for a huge opportunity of applications in ITS, it is not enough to rely on only these devices to generate data to handle as input used for traffic regulation, particularly for real-time traffic control and transportation system analysis. Furthermore, the latest development in ITS display a direction toward proactive control as opposed to traditional indifferent control and management .

Most commonly used Learning-Driven ITS are given below :

1) Online Learning

2) Data Fusion

3) Rule Extraction

4) ADP-Based Learning Control

**D. Visualization-Driven ITS:** From a affective viewpoint, visualization, as a clear-cut application of D2ITS, is the most intuitive way of helping people understand and analyse traffic data.

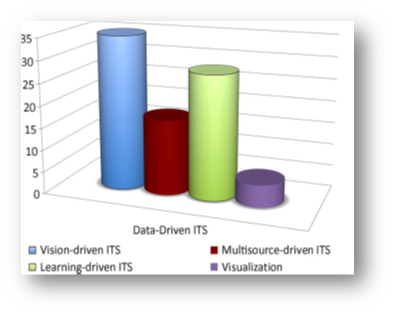
The approaches which are frequently used are the following :

1) line charts

2) bidirectional bar charts

3) rose diagrams

4) data images



**Figure 1: Data-driven ITS**

**4.Parallel control and management for Intelligent Transport Systems:**

Use of navigation systems is not new to world of intelligent transportation system.  Their application comprises of new transit systems. Location technologies are prominently used are –stand alone, satellite-based, and terrestrial radio based. In location technologies utilizing the network signal used to determine location of cellular phone or to help in location determination.

A totally new model has been initiated-parallel transportation management systems .Under this comes integrated traffic operation platform .it comprises of existent control as well as management of traffic through computerised sources .it concludes the following–

**A. Traffic data collection:** Traffic databases, social media, floating probe vehicle and sensing devices etc. Normally video cameras at intersections and roadsides are used.

**B. Processing of traffic information:** Information related to traffic is accessed and evaluated from computer resources which help in improvising traffic congestion and related consequences.

**C. Traffic analysis and evaluation:** This technique helps to further evaluate the levels of traffic services which can be used for further enhancements in standardisation of rules and future transportation planning.

**D. Traffic information services:** It circulates information regarding traffic (present as well as historic) to resolution makers for developing socio-economic policies ,administrators of transportation .common people(travellers) and commerce vehicle operators for route guidelines and mode selection.

**E. Operations for controlling traffic:** This provides real time information to regulate traffic flows and crowded events such as music concerts and sport games.

**Computational experiments –Jinan field study:**

“From 2004to 2007, a field study in the effectiveness of  ITS has been carried out in a district of Jinan city ,which is the capital of Shandong Province and a populous region and a major economic power in northeast China .We have focused on the area within the second ring of the Jinan urban traffic arterial network. An ITS with 324 traffic nodes and 646 road links, which is called Jinan ITS, has been established using      Transworld specifically for this area, and various traffic computational experiments have been conducted based on Jinan ITS. The study presents the impact of population on the average speed of vehicles driving within the traffic network of the selected area when regulated by a simple time of day (TOD) strategy. As expected, the average speed of vehicles in the network is gradually decreased as the population is increased from 50 to 230 thousand. Note that the minimum average speed, which occurred during the morning peak, drops from about 28 km/h to about 10 km/h. Three   15 types of speed distribution, which are a common index used in urban traffic evaluation are also studied.”

**5.Vehicle cognitive management functionality:**

Vehicle cognitive management functionality (V-CMF) comprises of information regarding various aspects of the vehicle-speed, direction of motion vehicles nearby, levels of traffic congestion etc. Wireless technology has played a significant role in improvising ease of travelling from one destination to another as well as it has reduced the root cause of accidents.

**6.Implementation of an Intelligent Transport System (ITS) and some emerging lessons, Poznan, Poland:**

It is the main motive of the new ITS to balance both public and private transportation in a cross-system concept to improve the efficiency of complete transportation systems in the smart cities. The data from real-time traffic are collected from many measurement points (for example: intersections, parking lots and public transportation) in the traffic management centre, assessed and processed. The Intelligent Transport System informs us about the current condition of the traffic system, parking lots which are available and the timings of public transportation which are nearby.  Wherever needed, the traffic light control (which involves around hundreds of traffic lights) affects the speed of the flow of public transport. Around 80-90 information panels have been formed at the bus and tram stations which provide the current information of the arrival and departure timings of the vehicles. To make it more user friendly, all the information related to the traffic system is also forwarded to the Internet and radio station, texting, and mailing services. To give important information for driver, several variable message signs (VMS) have been mounted along the roads. The project has been able to make the transport system in Poznan more efficient. On the other hand, the emergence of a better public transport has led to reduction in the number of individual vehicle users, Thus, resulting in the lowering of traffic congestions. It provides the required knowledge to the people who use public transport as well as individual drivers, thus encouraging traffic safety. Along with this, it has a great contribution in sustainability of the nature by lessening fuel consumption and emission of fumes from vehicles.

The three prominent challenges and associate consequences are the following:

A. To begin with, the existing staff lacked in skills associated with information and communications with suitable experience and qualification in the municipal office as well as in municipal entities which were engaged in implement executing the project. The cooperation with the scientific and research institutions along with the support from ICT entities acted as a great step to overcome the above challenge.

B. Secondly, a problem of interoperability of new systems and the existing systems, to boost the cooperation. This was considered as one of the most crucial issue due to the implementation of several systems and on-board computers. In addition to this, it was also needed to assure the openness of

communications protocols to lessen this risk in the forthcoming years.

C. Lastly, some disturbance has also been caused because of delay in the construction. This needs a good manageable organization.

**Methodology**

**Research Design:**

The research design which is most appropriate for this research question is the descriptive one. It can efficiently explain how the Intelligent Transport Systems can act as a beneficiary tool in the development of the smart cities.

To carry forward the research with the descriptive type of design, we can include data from different interviews of people concerned with ITS and smart cities. We can also conduct a questionnaire on relevant subjects to get information associated with this research paper. Several visual records can be included to gain knowledge as well as to make the paper more interesting. We can also conduct surveys and experiments, and obtain the related observations. These observations can be analysed and further used to make proper conclusions.

**Research Methodology:**

If we were to govern this study, the best suitable method to proceed it further is the combination of both qualitative as well as quantitative. The study can be well- explained or elaborated by conducting a survey on how the commencement of Intelligent Transport Systems (ITS) has led to the abatement of number of road accidents. A questionnaire can also be devised which can act as a helping hand in comprehending challenges faced by common people and accordingly, an answer to these problems.

**Sample selection:** For our sample, we can do a study on local drivers and passengers in more populated areas. A smart city can be chosen to carry out this survey. We will focus on a group of five hundred people who are keen to participate in the survey.

**Procedure:** For our study, we would like to have a questionnaire comprising of 12-15 questions. By maintaining the anonymity of the participants of the survey, we would ask them to answer the questions some of which are mentioned below:

●     Are you using some or the other form of ITS in your daily life?

●     How often are you delayed by bad traffic?

●     Do you follow all the safety measures while travelling from one destination to another?

●     Have you ever been caught by the police officers in drink and drive case?

●     How navigation tools have benefitted you in reaching your destination in time?

We will form a group of fifteen people who will coordinate the whole survey. These people will circulate in the different parts of the city and record the responses of the participants on a computerized device. The responses of all the five hundred participants will be brought all together and analysed & evaluated further. Finally, we will combine all the collected data which will provide an answer to the proposed research question.

**Summary**

Finally, we summarize our given proposal.

Data -Driven Intelligent transport system (D2ITS) are supported by a considerable volume of data that are gathered from various resources, are systems that would grant users to interactively exploit data resources that refer to transportation systems, access and employ data through more beneficial and decisive services to upgrade the performance of transportation systems, and realize and extend the functions of the fundamental components of ITS. Here we have discussed the development of D2ITS and introduced several important components of D2ITS, including vision (which have particularly received high attention from researchers in the ITS community), multisource, and learning-driven ITS.

Wireless technology is has gained pace in the last few years. It has spread all over as a blanket over whole world without which we cannot imagine ourselves. Recently developed technologies have pristine forms which has benefitted the world in many ways. New policies to regulate traffic, new inbuilt security systems ,navigation tools, wireless interfaces have broaden our vision towards coming advancements.

Countries like Poland and Poznan have introduced new ITS which maintain a balance between public & private transportation by collecting real-time traffic data, evaluating, and processing it. The ITS system gives current information about the traffic system, available parking areas, etc. The information is forwarded to Internet, radio stations and mailing services. The challenges associated with this project include delay in the construction, interoperability of new systems and the existing systems and lack of well-experienced staff.

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