

# Review Paper on Intelligent Traffic Control system using Computer Vision for Smart City

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**Abstract**— In today scenario city will try to modify in the form of smart city with better facilities in terms of education, social-economic life, better transportation availability, noise free – Eco-friendly environment availability, and ICT- Information and communication technology enabler for development in the city. In this paper, we are reviewing different work already done or draft by some research in the field of traffic control system – for better monitoring, tracking and managing using a computer vision system. Nowadays, most of the city installed with C.C.T.V. – camera for monitoring the traffic related activity.

**Keywords**— Transportation Management System (TMS), CCTV camera, Gaussian mixture model, Video, Image processing, smart city, parking system, smart phone, Vehicle Tracking

## 1. INTRODUCTION

The Currently Indian government is trying to develop smart cities and already announces 3 stages, in which nearly 60 cities are selected. In the near future the list of the smart cities will further increase [A]. First list displayed by government mentioning 2 cities from Gujarat – Ahmedabad and Surat. Urbanization increases rapidly within the last few years. In this intelligent transportation system or traffic management in real time must be done with available resource to avail better and better lifestyle for everyone with less congestion of traffic so less noisy environment, less time required to reach one place to another place, proper parking availability etc. Currently, many of researchers trying to work on developing algorithms for solving traffic related issues.

This paper further goes on with discussing - what is smart city?, Challenges under smart city mainly due to traffic control systems in Section II for motivation of research, then moves to discussing section III with different algorithms discussed in various research papers, Section IV discussed about smart phone or android application useful for traffic monitoring, Section V gives a conclusion and finally give some idea about future works or what will be done for better implementation of traffic management in smart city?

## 2. SMART CITY

A city can be defined a smart when investment in human and social capital, traditional (transport) and modern (ICT), communication, infrastructure, fuel, sustainable economic development and a high quality of life with a wise management of natural resource through participatory action and engagement. Smart city is an urban space that tries to improve the daily life of all citizens (with the knowledge of their habits, experiences, culture, education, behaviour and different facilities available. Smart City is capable of sensing what is happening in the city – real time parking availability, traffic management, route navigation, intelligent transportation system, availability of beds in hospitals, energy consumption, water and air quality, temperature, noise, solid waste management, security, transparency and accountability etc.

### A. Smart city infrastructure

Smart city infrastructure divided along 4 parts [B] as shown in the fig. 1 and from that our discussion more focusing on Physical infrastructure- in that transportation module.

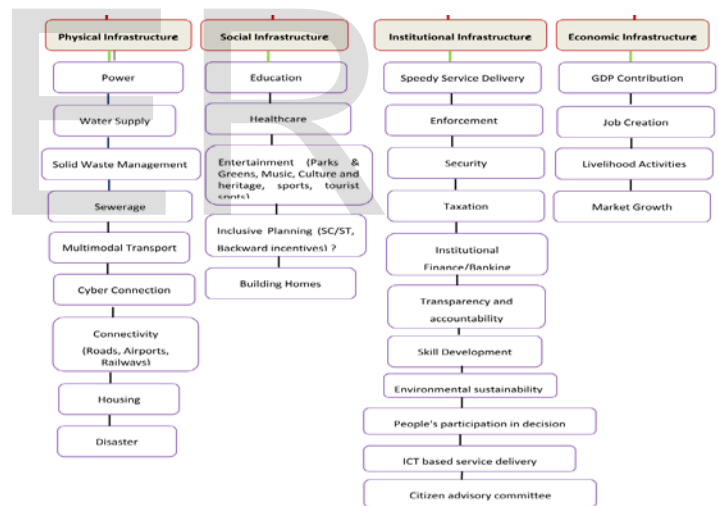


Fig. 1 Smart city infrastructure [B], from that our research of interest is transportation module.

### B. Smart city example

1. Iowa: smart water meter, can compare with neighbours usage.
2. Dublin (Ireland): IBM's "ParkYa" app for finding a parking slot.
3. London: Mayor gets constant data analysis of twitter feeds.
4. Surat: online monitoring of water quality and much more.

### C. Traffic related problem

Here some problem related to traffic is mentioned, which will be solved for real time traffic monitoring, and these are...

- Creating online tool for traffic management.
- Selection of hardware platform and its sensor drivers, proper collection and synchronization of different sensors.

- Smart applications like mobile applications for smart cities, smart mobile application for connecting driver and passenger, humidity, pollution, traffic congestion monitoring.
- Increasing safety, comfort, economy of the citizen, while also providing new entertainment options.
- Provide capabilities for real-time sensing, signal and multimedia processing, and sharing of information with other users and server applications, like real time transportation information sharing with all other stakeholders.
- Real time vehicle tracking system under challenging light conditions.
- Real time parking availability for vehicles in smart cities.
- Intelligent traffic light system with the use of different sensors, especially in those junctions where maximum traffic increased.
- Reduce traffic congestion to avoid pollution, accident like situation.
- Management requires in transportation, that every employee, whose duties are at fixed times, should avoid their personal vehicle, but use public transportation to reduce the amount of pollution and traffic congestion places.
- Novel approaches required to implement intelligent transportation systems within smart cities using a computer vision system.

### 3. DIFFERENT METHODS ALREADY IMPLEMENTED

The approaches described by, Benjamin Coifman and his team members [1] for vehicle tracking using four steps. Firstly automated segment vehicle from background, detection of all types of road vehicle and vehicle detection under challenging light conditions, that's second and third stage and lastly operate in real time. But according to their description all vehicle tracking in different light condition is not up to the mark. They also discussed different algorithms for vehicle tracking, like model based tracking, region based tracking with the use of Kalaman filters, active contour based tracking and feature based tracking with the use of Kalaman filtering, normalized correlation and Texas instruments C40 digital signal processor chips.

Mohamed S. Shehata [2] and his team members describe difficulties for detection of shadow, snow, rain and glare. And from that snow detection is the most difficult task. In such incident detection most common problem is wrongly detection not actually presents that particular incident. They have discussed method based on pixel's brightness, normalized red, green and blue concept, hue-saturation-value (HSV) color space concept. And then concentrated on Gaussian mixture model with EM method, then use of Kalaman filtering for better detection of certain incidents. There is difficulty in finding rain road incidents. In that case morphological operations required. Similar manner glare detection can also be focused as a future research area.

Authors of [3] explain their arguments on Parking, Deposit System (PDS) as an alternative arrangement for road pricing as a study case. They had collected some information based on, basic questionnaire related to traffic and parking with end users, based on that designed study case with user benefit in terms of implementation of PDS. Smart Parking further discussed in [4] based on wireless networks and sensor communication. In that hardware architecture

implementation with the help of wireless transceivers, parking belts, computer, infrared devices etc. And software architecture developed with driver module, communication module, function module and application module. This implementation is done with different reaction scheme steps. Calculation can be done with the help of binomial distribution, Poisson distribution with its mean. Simulation result verified using Matlab version.

From, Faculty of engineering and architecture, Kore University of Emma [10], gives architecture for vehicular parking in smart cities – Intelligent Parking assistants (IPA) with 4 modules. (1) User interface module (2) Communication module (3) Functional module (4) Parking space control module. IPA in preliminary stage and it can be modified further by including a smart phone.

Static and dynamic traffic assignment (DTA) problem discussed in [5] with concluding that average travel time under a pre-time signal policy is better than time actuated signal policy. Normally for traffic related computation research based on a static assumption not considers temporal flow distribution, so equilibrium with signal setting and traffic assignments are required [5]. For that bi-level framework theory required to solve problem related DTA. In bi-level framework upper level and lower level solve different problems related to DTA. For achieving Equilibrium DTA, Mathematical based model, iterative Heuristic algorithm, Genetic algorithms, Webster's formulation; game-theoretical methodology, Mean absolute percentage error (MAPE) and root mean square percentage error (RMSPE) are explained.

Other papers [6] [7] gives attention towards decreasing public transportation service. That is new thinking towards decreasing traffic congestion as well as noise and sound pollution generated by personal vehicle. Anutosh maitra [7] and his team members gives new idea for controlling traffic, in the sense that more and more awareness regarding public transportation uses for daily office users, or daily passengers in real time. To achieve this, a description based on (1) Commuter views (2) Vehicle operator/Driver View and (3) Control centre view all these 3 works together. To implement this scheme proper management with all 3 views required at time to time and perfectly. And in [6] location of all the bus stops with its current position and route accurately if available, to end user, may be most of the people give their first choice to select public transportation. For that 2 different algorithm discussed (1) Initial mapping algorithm (2) Map Algorithm.

Although from earlier discussion public transportation more healthy in terms of environment and traffic management, currently more and more vehicle – two and four wheeler are shown in daily life. For that scenario smart phone based traffic control management gives better option. This thing discussed in [8] with SMaRTCaR. Discussion based on, General packet radio service (GPRS), Universal mobile telecommunication system (UMTS), and Vehicular ad-hoc Network (VANET), an Arduino board.

The minimum time required to reach the destination from the source with particular routes gives attention of many researchers from industry as well as academic. As per [9] different vehicle routing algorithms are Dijkstra's algorithm, A\* algorithm, Tabu search, Ant based colony Genetic algorithm, Hybrid genetic algorithm. In this paper comparison of these algorithms, with a scope of improvement discussed with use of Simulation of Urban Mobility (SUMO) and Traffic control interface (TRACI). Real time implementing gives many benefits, Likes Company who wants to take and give orders on time to the customers, serious life can be saved by saving time, etc.

Two different types of congestion [11] are (1) recurrent and (2) Non-recurrent congestion. Some open challenges related to traffic

management system are- Data Fusion, processing and aggregation (DFPA), lack of traffic parameter accuracy discussed. To solve that problem wireless sensor, machine to machine (M2M) communication, use of cellular/3G/LTE Networks, multimedia oriented social area network (MMSN), fuzzy rough concept, novel fusion technique based on yegar's formula, neural network concept discussed.

Said alabdallaoui and [12] his teammate indicate, Random early detection (RED) approach in some heavy traffic congested area or junction, using the concept of (1) Average queue size and (2) Pocket dropping probability. RED explained by four phases (a) Learning phase and traffic estimation (b) setup phase (c) Calculate real load for each lane (d) RED algorithm application. Here major problem implementation complexity and its deployment costs.

Another initial stage research going on intelligent transportation by Fenghua [13] and his team members from IEEE explained parallel transportation management in smart cities based on artificial systems, computational experiment and parallel execution (ACP) approach.

Gitae, Yew soon [14] and their team members try to find a solution of dynamic vehicle routing problems under traffic congestion, with the help of Markov decision process Model. Dijkstra's algorithm and Bellmen's iteration scheme for finding shortest path also explained by their limitations. And finally roll-out algorithms with approximate dynamic programming (ADP) and Neuro-dynamic programming method for better solution explained with a case study.

#### 4. SMART APPLICATIONS

Nowadays all people used smart phone for not only communication purpose but also for entertainment, for social media interaction, education, health tips and many more. If we combine a smart phone with vehicle together make smart transportation system. Smart phone support GPS location, Wi-Fi availability, in building the blue tooth device and many more things are very much useful for better transportation management.

For maximum use of public transportation, GBUS [6] consist mobile application for data related to bus stop and its route respectively, build a route from the collection and synchronization using map- matching and string matching algorithms.

My Ford mobile application [8] useful for monitoring of electrical vehicles, charging status of electrical vehicles, other electric vehicle charging station, etc. The other Smart-phone application discussed in same paper which can be able to detect and notify accidents, for that smart phone camera also useful for awareness about accident situation. TOMTOM and GRAMIN [11] systems are useful for drivers, due to their services regarding location, shortest route towards destination, etc. Easy tracker [6] systems are developed for tracking, mapping and measure different parameter in the context of traffic management. For location, purpose we can use Google maps and Map Quest such like applications.

FastPrk [11] application uses M2M technology, for servicing fast parking in certain areas. Toyota developed- Toyota friend [8], private social network for Toyota car owners for their facilities. And so many other companies also trying to make better and better application for transportation management system (TMS) like – sharing your personal details with your vehicle, with other groups and members so maybe, if they want to wish to join they can join you. So in this way also we can reduce use of traffic and that is also one great step moment towards TMS services.

#### 5. DIFFERENT PROJECT AND COMPANIES WORKED IN TMS SERVICE

Nowadays Indian government keep quite interested, in developing smart city in INDIA. So naturally industry hopes their some eyes on gaining something from it, with developing some interest of area to get fruit from smart city structure. Better transportation management, system availability is one of the highest interests of the area. Here from different research papers listed some companies or project, which are already running their system for better TMS service.

With the help of video-image processing system – TRIPWIRE [1] follow the movement of vehicles in terms of time respect to another vehicle. Commercial TRIPWIRE systems are: AUTOSCOPE, CCATS, TAS, IMPACTS. Other systems developed with the help of computer vision systems are CMS Mobilizer, Eliop EVA, PEEK VideoTrak, Nestor Traffic Vision, Sumitomo IDET- and these systems used region based tracking.

For different automated incident detection (AID) related systems in North America [2], Guidestar in Minnesota, Transtar in Houston, TX and COMPASS in Torronto, Canada and in all Dallas-ft worth, TX Area. Europe developed similar things throughout European union roadways. Econolite and Citilog Companies had suffered problem with false detection, for AID. A fog detection system developed in Holland using visibility sensors to monitor different weather conditions. Some models or say the systems are already developed in other countries for coordination of bus stops, their photographs and other parameters, Automated transmits Stop inventory model (ATSIM) and ESRI Arc-pad [6].

Furthermore good architecture, planning of transportation with respect to smart city becomes easier for transportation management services. Keystone Architecture Required for European Networks (KAREN) Projects, Framework Architecture Made for Europe smart (FRAME –S), Extending the FRAME architecture (E-FRAME), European Project COOPERative SystEMS for Intelligent Road Safety (COOPERS), Cooperative Vehicle Infrastructure Systems (CVIS) and Cooperative Vehicles and Road Infrastructure for Road Safety (SAFESPOT). For Preparation for Driving Implementation and Evaluation of C2X Communication Technology (PREDRIVE C2X) FP7-integrated project and many more listed by Soufiene Djahel and his team, in their research paper [11].

In these research projects are still going on, due to system problems with traffic congestion, snow, glare, rain, shadow such like incidents, different lighting conditions makes CCTV work difficult and many more.

#### 6. CONCLUSION AND FUTURE WORK

In this paper, based on different research paper read in the context of transportation management service, explain different algorithms already used, different project and systems working related to TMS, smart-phone involvement regarding improvement in traffic monitoring as well as tracking and in other applications also. Most of the work explained or designed in a foreign country for smart city and what's actually required as per our Indian government, they are trying to develop smart city concept step by step. So for that initiative from the smart city different parameter better implementation TMS is required. So now from these review papers, our aspects of future work –on transportation management service for INDIAN smart cities and give some solution regarding problem related to traffic management already discussed in section II C.

#### ACKNOWLEDGMENT

In this paper, we review TMS service with reference to different literature available from TRANSPORTATION RESEARCH Part and different IEEE conference and journal Papers.

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