PRIORITY LANE FLOW SIGNAL SYSTEMS

Using IPT and GPS

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Traffic congestion together with emissions has become a big problem in urban areas. Traffic-responsive control systems aim to make the best use of the existing road capacity. Vehicles growth leads to a big problem over the world including in crowded cities. The Intelligent traffic-signal control system may be implemented to introduce various parameters, such as peak time analysis, priority lane flow routes, emergency vehicles management and creation of statistical historic data base. The proposed concept using these parameters will help smoothen the traffic flow, reduce the average commuting times and thus considerably reduces vehicular emission concentration at signal junctions using layer based overlapping of vehicular population density obtained from Image Processors and GPS.

***Index Terms*—Traffic, GPS, IPT**

I. INTRODUCTION

The exponential rise in vehicular population is a conundrum the modern world is facing. The present-day traffic control systems are not capable of providing a safe ecosystem for vehicular movement while maintaining minimal negative environmental and economic impact. A non-adaptive system not only has detrimental implications on the present society but also on the future generations. Intelligent traffic-signal control systems are being implemented to refine the existing peak time analysis methodologies, prioritize the lane flow routes, optimize emergency vehicles' movement and create a statistical historic database. The proposed "Priority Lane Flow Signal System" targets critical parameters like traffic flow, existing road capacity, commuting time, and vehicular emissions.

TRADITIONAL SIGNAL SYSTEM

As of today, Traffic-signal control systems synchronise discrete traffic signals to attain network-wide traffic operational objects. These traditional systems comprise of intersection traffic light signal system, a network to bind them together, and a central network of processors to manage the system. The synchronized network is implemented by methods like time-base and hardwired interconnection.

Traditional Signal System

Fig. 1

II. PROPOSED SYSTEM

The concept proposes the integration of real-time traffic data into the Signal System functioning. This will be done by cross integration of output data from Intelligent cameras that are connected for capturing real-time traffic flow images of each direction and real-time traffic density data from GPS systems. The control system can automatically adjust traffic light control variables in accordance with the deviations in traffic flow in multiple directions, thereby increasing traffic efficiency at the intersection of roads and achieving best control over traffic.

PLFSS

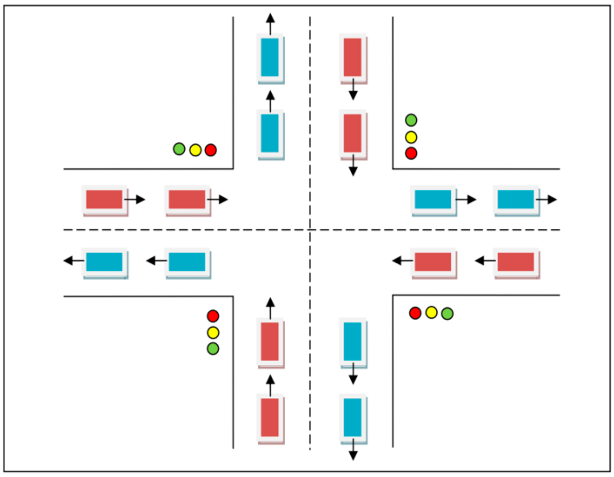

Fig. 2

Approach: A cross data approach combining the real-time data from Global Positioning Systems (GPS) and Intelligent Cameras (Image Processing Technique). It means a system capable of cross integration of an online as well as an offline system to provide optimal and most efficient signal timings.

Working of the PLFSS

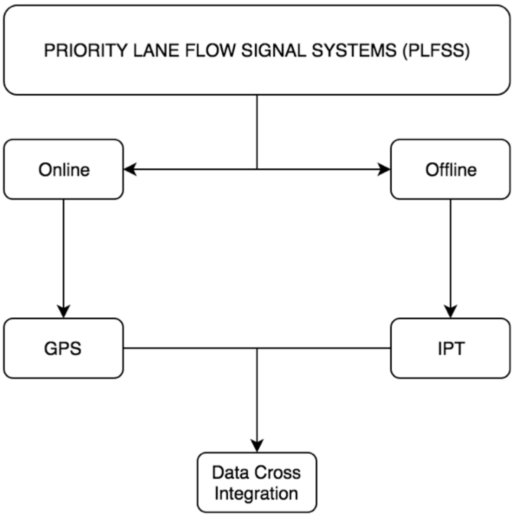

Fig. 3

Components of the System:

1. **Global Positioning System- Online System**
2. **Image Processing Technique- Offline System**
3. **Emergency Vehicles Pre-emption System**
4. **Central Control Unit (CCU)**

Global Positioning System

One of the most crucial components of GPS is Spatial data. The important sources of spatial data are the already existing digital files, maps, which can be digitized, and more recently GPS. A Global Positioning System (GPS) device is proposed to be used in this study to measure traffic characteristics. GPS technologies provide traffic engineers a new tool for obtaining accurate measurements related to vehicle motions. The GPS device used on a test vehicle is capable of recording the test vehicle's positions (latitudinal and longitudinal coordinates) and speeds at specified time intervals. When the test vehicle travels at the normal speeds of the majority of the vehicles in a traffic flow (perceived by the test vehicle driver), the exact trajectory of the test vehicle is identified through satellite signals and recorded by the GPS device. Each data point recorded by the GPS device includes the vehicle position, speed, time, and the distance between the current and the last time points. Because the test vehicle travels at the representative speeds of the traffic flow, the GPS data depicts a speed profile of the traffic flow as well as the test vehicle on the traversed highway section. In addition, when GPS data is used at a work zone, the data can also provide values of traffic delay, vehicle queue, average travel speed, and vehicle acceleration and deceleration before and after the work zone.

Working of the online system

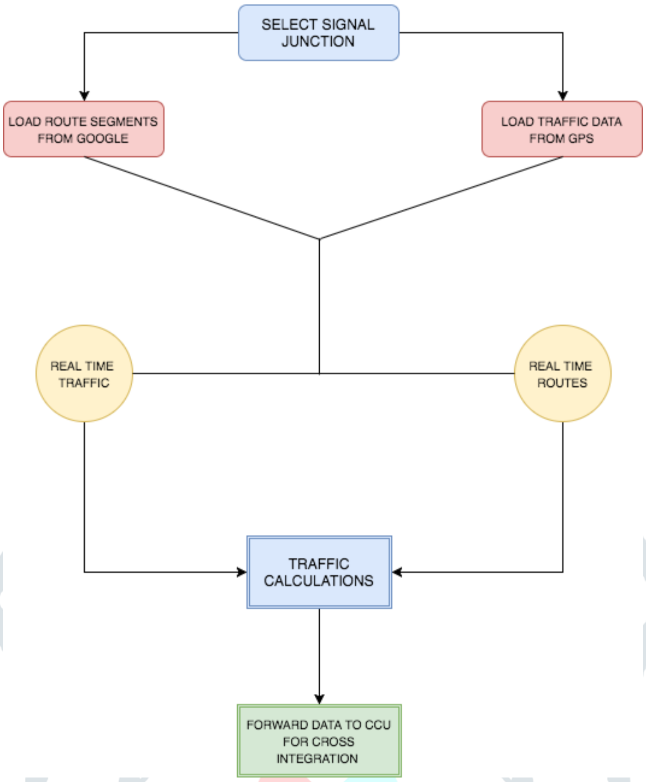

Fig. 4

Image Processing Technique: To acquire necessary travel and traffic volume approximations, essential to satisfy the needs in the area of road planning, construction, maintenance and complete administration of the state it is important to monitor Indian traffic scenario and calculate peak hours and density count every day. We propose an algorithm based on the image processing theory for advance Traffic studies by vehicle counting and cataloguing. Vehicular population counting is done by a method called as Background subtraction. It involves finding the centroid. Cataloguing is done by thresholding method and the peak hour indicates the time in which the traffic increases or is maximum which would surely lead to traffic jams. Video sequences have been captured and are furthered tested with a proposed algorithm. The obtained results can be used for planning of routes or any other diversion the vehicles need to take during the peak hours.

Working of Image Processor

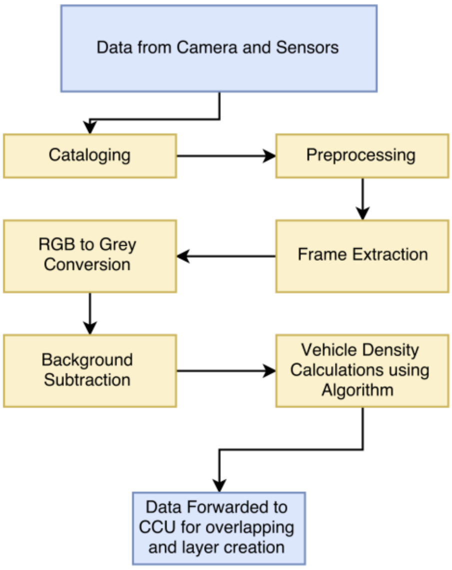

Fig. 5

Traffic Signal Pre-Emption for Emergency Vehicles: Emergency vehicle pre-emption systems are devised to give emergency response mediums a green light on their approach to a signalized intersection while providing a red light to opposing approaches. The most frequently stated benefits of using EVP include enhanced response time, superior safety, and cost savings. Emergency vehicle pre-emption can ameliorate Emergency Vehicles response times by reducing the likelihood that responding EVs will reach at intersections during the red signal phase and confront substantial queues. In congested areas, Emergency Vehicles may come across extended queues that force them to slow to a crawl, thus escalating seconds or minutes to the time required to reach the destination. A green light gets the queue moving and the traffic dispersed before the Emergency Vehicles arrival permitting the Emergency Vehicles to maintain higher than average speeds that would be expected given intersection spacing along the route and regular traffic circumstances.

Working EMP System

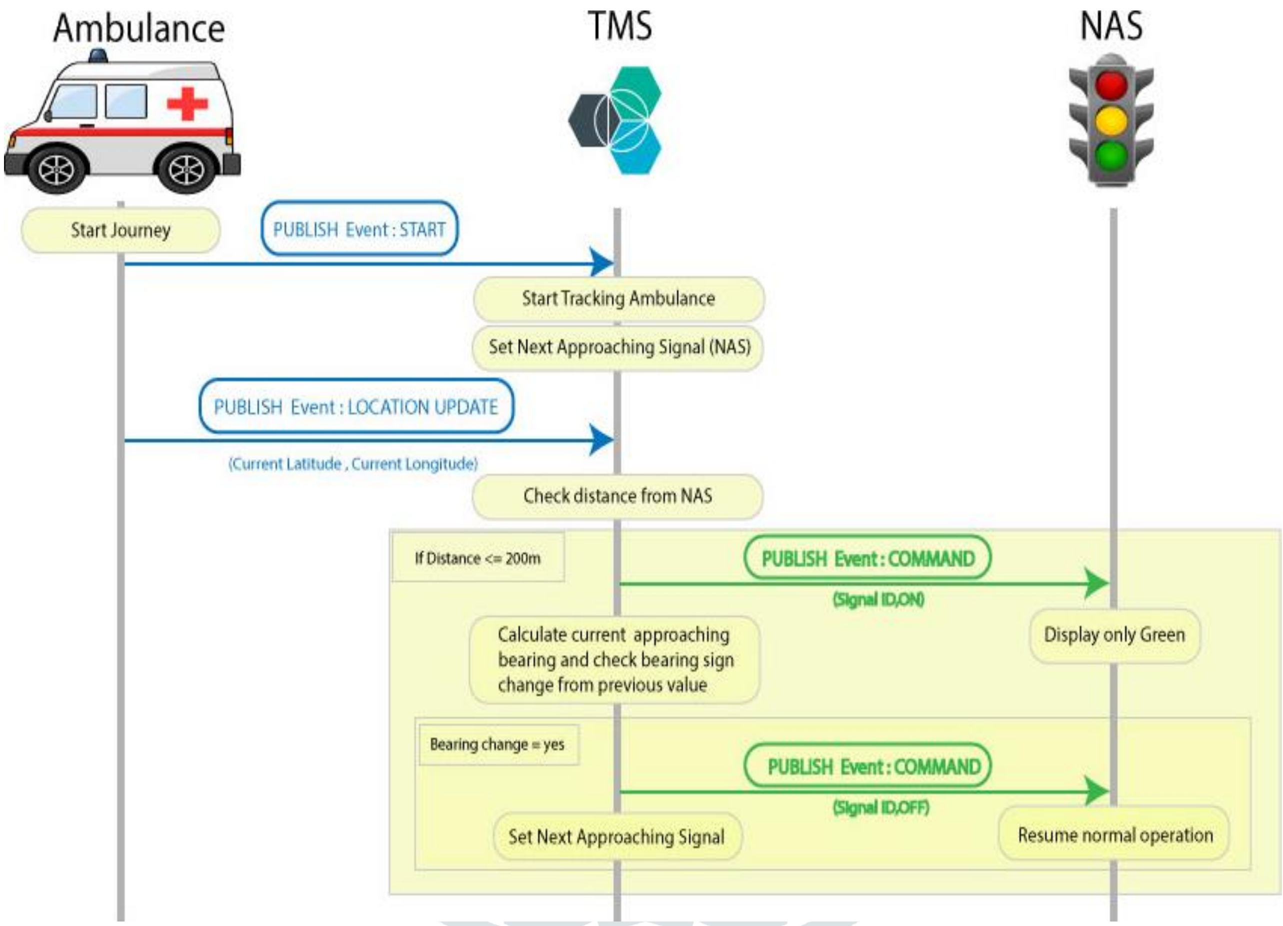

Fig.6

Central Control Unit (CCU): The Central Control Unit (CCU) takes input from the GPS and IP Systems and provides a medium for their cross integration. Cross integration is done in the form of comparing both data sets and overlapping them to form a super imposed layer based image on the route to give the most accurate traffic density details. After this the route at the specified intersection which has the highest number of vehicles on it would be given priority by the CCU. The following command will be the sent to the signal system and hence the green signal timings for the route with the highest vehicle count will be changed and given first priority.

The factors that will be considered while implementing and changing the signal timings are:

1) Importance of the route.
2) Traffic density on other routes of the same junction. (The selected priority route shall have at the least 20% more traffic than the other routes)
3) Special conditions for Emergency Vehicles.
4) Peak Hours.
5) Downtown Routes.
6) Routes towards Airports and Stations.

Working of the CCU

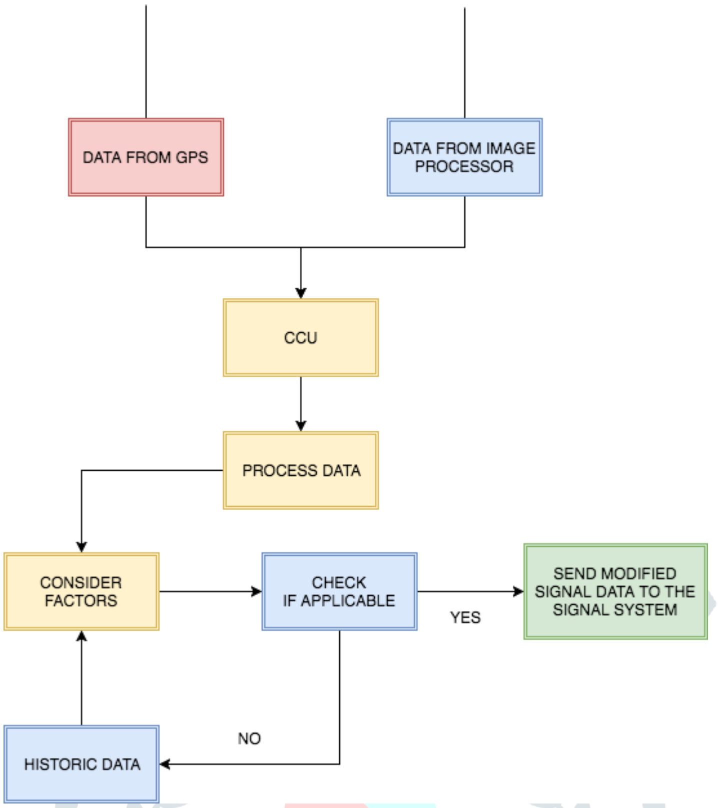

Fig.

III. Implementation and Costs

This concept does not involve installation of new traffic signals. Instead, it involves addition of cameras and IPT into existing ones; and modifications in existing algorithmic structures of signals. Further, it would involve data collection from NAVIC (Navigation with Indian Constellation), which would be more cost efficient as compared to private sources such as Google. It will include the pairing of the GPS, IP and the CCU with the existing system.

Installation and operation of cameras

Procedures used as part of the installation and operation of traffic light and speed cameras vary to some degree between force areas. However, the research suggested that typically the process will include the following elements:

1. **Planning:** The effective deployment of camera technology requires close coordinated effort between the police and the authority. In the Pune City area, a Traffic Signal Control System works to support deployment planning, installation and maintenance for cameras on behalf of the local authority. In different regions, the relationship is less formalized and the procedure usually starts with the local authority setting up a rundown of high hazard locales. Sites may in some cases be recommended by the police on the premise of local knowledge.
2. **Procurement**: Keeping in mind the end goal to cost effective use of assets, most forces have additionally gained 'dummy' cameras (which can, for instance, flash at speeding vehicles as though a photo was being taken). These are proposed to augment the effect of the technology. The expenses of obtaining both genuine and dummy camera hardware are met by the either the police or the local authority or shared between them.
3. **Installation**: The establishment of an operational wet film camera site requires the erection of a settled position post and the arrangement of a constant supply of power. Street markings are normally made to permit an auxiliary evaluation of vehicle speed. Camcorder hardware requires street sensors to quantify vehicle speed. These might be either versatile – through tubing introduced by the police- or permanently set in the streets.
4. **Signing:** The presence of traffic enforcement cameras should be signed in order to maximize the deterrent effect.
5. **Publicity:** The authorities can also use publicity to promote awareness of the new system among drivers in order to encourage them to modify their behavior without need for enforcement.
6. **Operation and Maintenance**: Authorities may have service contracts with suppliers and manufacturers for periodic maintenance.

7. **CCU Organization:** Central Control Units will be set up in every ward/sector of the city, which will have control over the operation and maintenance of the signals and its timings. CCUs will be the place where integration of data from GPS and IPT takes place which ultimately leads to Priority Lane Flow Signal Systems (PLFSS)**.**

Benefits of Implementation:

Non-Tangential Benefits:

1. Time Savings.
2. Improved Surface Transport.
3. Reduced Crashes and Fatalities.
4. Energy and Environmental Benefits.

Tangential Benefits:

As of today, the cumulative Economic losses due to long waiting periods at signal junctions amounts to Rs. 60,000 crores. Implementation of this proposed concept could save a considerable amount of this loss. Average commute timings by implementation of current Intelligent Transportation Systems is reduced by an average of 20%. It is expected that adopting the PLFSS concept would further reduce the average commute time. Hence leading to more non-tangible benefits.

Costs:

The aim of the project is to review and investigate the functioning of traffic management only and to perform a technical feasibility analysis. This was done by looking at two topics, namely applications and technology. The implementation of ITS is absolutely necessary, leading to a more integrated approach for the benefit of end-users by using more of efficient transport system. **The Traditional Signal Systems that are implemented world-wide cost approx. 8-10 lakhs**.

IPT Costs:

These costs can be grouped into two types as follows:

Fixed Costs: These costs are incurred on a one-off basis and include, in this instance, planning, procurement, installation and Image processing software costs. More than 80% of the costs for intelligent cameras related to the procurement and installation of systems. Signing accounted for just under 5% of total fixed costs and other equipment for just over 10%. The costs accompanying planning are relatively very small. The average fixed cost per site across any signal junction would usually depend upon the number of routes at the junction and would add approximately Rs. 1,00,000-2,00,000/per route.

The fixed costs would vary from site to site and hence the factors affecting the fixed costs are as follows:

Number of Routes at a junction: The more the number of junctions at route the more the equipment and installations required which will increase the fixed costs and vice versa.

Degree of urbanization: The costs of installation of cameras in rural areas can be substantially inflated.

Support equipment: Force strategies affected the amount of additional or support equipment costs to be covered.

Recurrent costs: Costs associated the operation and maintenance of cameras, related liaison and publicity and enforcement constitute recurrent costs.

Other costs: The other, less obvious costs which might be associated with the introduction of camera technology and system processing.

IV. Conclusion

The project "Priority Lane Flow Signal Systems" is proposed to develop a system that considers real-time traffic data analysis to help create an efficient transport network which is capable of functioning with complete automacy. Development of such a system would thus reduce commuting times and waiting times thus reducing emission concentrations at signal junctions. It will also help efficiently manage emergency vehicle movement thus saving lives and improve response times for disaster management.

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