Adaptive Traffic Signal Control System

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Abstract- *The adaptive traffic signal control system is a useful tool for reducing traffic congestion in cities. The system may alter signal timing settings in real time in response to seasonal changes and short-term fluctuations in traffic demand, resulting in improved traffic operation efficiency on metropolitan road networks. The advancement of information technology in computing science, autonomous driving, vehicle-to-vehicle communication, and mobile Internet has resulted in an abundance of traffic data gathering methods. The amount of holographic data available, the sorts of data available, and the quality of data collecting have all improved dramatically. Signal control solutions for diverse traffic flows containing linked and autonomous cars. The article looks into the evolution of widely used self-adaptive signal control systems around the world, their technical characteristics, the current research status of self-adaptive control methods, and signal control methods for heterogeneous traffic flows involving connected and autonomous vehicles. Finally, the article concluded that signal control based on multivalent reinforcement learning is a type of closed-loop feedback adaptive control method that outperforms many counterparts in terms of real-time characteristic, accuracy, and self-learning, and will thus be an important research focus of control method in the future due to the property of "model-free" and "self-learning," which well accommodates the abundance of traffic information data.*

Keywords- Signal control solutions, self-learning, Internet of vehicles, ITS

I. INTRODUCTION

One of the indicators of a country's economic growth is the rapid increase in car ownership. However, vehicle ownership has an indirect effect on severe traffic congestion. For numerous reasons, exploitation of new trends and technologies necessitates rapid transit of products, machinery, and labour. Each person's purpose is to arrive at their destination without wasting time or money. However, contemporary infrastructures have limited resources. As a result, road traffic management is critical for reducing waiting and travel times, as well as saving fuel and money. Despite the fact that the current traffic signal management system manages traffic at junctions, it frequently causes congestion and accidents due to its poor performance. Assume a vehicle must travel 100 miles through a city to reach its destination, passing through multiple city intersections along the route. The car will spend valuable time at most junctions if the traffic system at those intersections is governed by preset timers. Traffic control centres support traffic operators such as pilots, drivers, and masters with guidance, advise, and information. One of the primary responsibilities of traffic controllers is to monitor traffic conditions and identify potentially dangerous situations. It was discovered that when humans worked on a long, monotonous, and dull monitoring task, their cognitive energy quickly diminished. Furthermore, early researchers had noted that monitoring misses were common due to temporary diversions. When dealing with traffic at crossroads, traffic signals must often be studied and installed. The most common bottleneck points in cities around the world are signalized intersections. Heterogeneity, lack of discipline, and inconsistent geometric design, to name a few, all add to the complexity of traffic in Indian towns. Using a combination of evaluation and modeling, this publication presents a set of traffic signal best practices for Indian cities.

II. METHODOLOGY

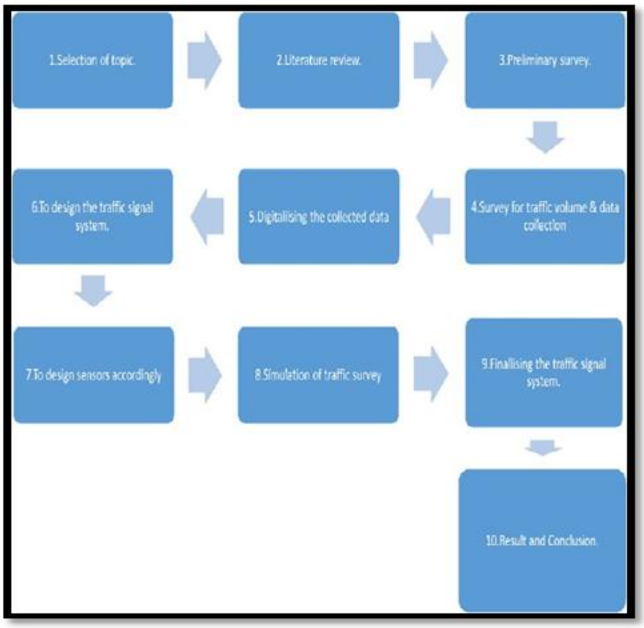

Fig.1Methodology

PROBLEM STATEMENT

Normally time cycle of signal is designed based on peak hours. This often results in wastage of time during off peak period. For ex., if green phase is for 60secs, the flow of traffic for that direction is much less than 60secs. Due to this, traffic on other side is on hold for no good reason.

III. OBJECTIVE

1. Achieve a smooth and easy traffic flow at the intersection.
2. To create strategies for general improvement and for fixing specific problems in particular.
3. To cut down on road travel delays.
4. To provide safe, convenient, quick, and cost-effective transportation of people and products.
5. Increase the road's traffic carrying capacity.
6. To make the streets safe for both pedestrian and vehicular traffic.

1. Criteria for identifying where signal lights should be installed:

a) Sections of traffic congestion with an average travel speed of less than 10 km/h, which are commonly identified as traffic congestion levels in major cities around the world due to long periods of waiting for traffic signal lights to change;
b) A high ratio of total stopping time to total travel time:
c) Major bottlenecks cause a spill-back effect downstream
d) The locations are in the action plan area's high-traffic main road network.

IV. FIXING THE POSITION OF SENSORS

For deciding the placing the sensors we have consider following two criteria's:

1) Stopping sight distance:

Necessity of SSD-

It helps in underscoring an acceptable design speed, based on a driver's ability to visually identify and stop for a particular, unanticipated roadway hazard or overhaul a vehicle without being in dissonance with opposing traffic. As velocities on a roadway are increased, the design must be catered to allowing additional viewing distances to allow for adequate time to stop.

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2) Traffic length:

While managing the traffic system the position of sensors are fixed on the basis of available length of traffic volume. This particular length is obtained by the data on the basis of survey which is conducting on site.

Stopping Sight Distance- The clear distance ahead needed by a driver to bring his vehicle to a stop before meeting stationary object on the road is called as stopping sight distance.

$SSD = Vt + V^2/ 2gf$

Where, V= speed of vehicle in km/hr. t = reaction time
f= coefficient of friction.

In this paper calculated the stopping sight distance for a level road in Nashik city at the design speed of 30kmph.

As per Indian Road Congress (IRC), recommendations assume the reaction time of 2.5sec coefficient of friction of 0.35 and a brake efficiency of 50% a stopping sight distance for one of the vehicle is

$SSD= VT+V^2/2gf$

$V = 30kmph = 30x1000/60x60$

$= 8.33m/sec$
$SSD= 8.33*2.5 + 8.33^2/2*9.81*0.35$

Name of road	Total Green Time(sec)	Zero Traffic Flow	Excess Time(sec)
Peth road	30	17	13
Mhasrul road	25	10	15
Nimani road	35	18	17
Gangapur road	30	13	17

Hence, SSD = 30.92m.

V. CONCLUSION

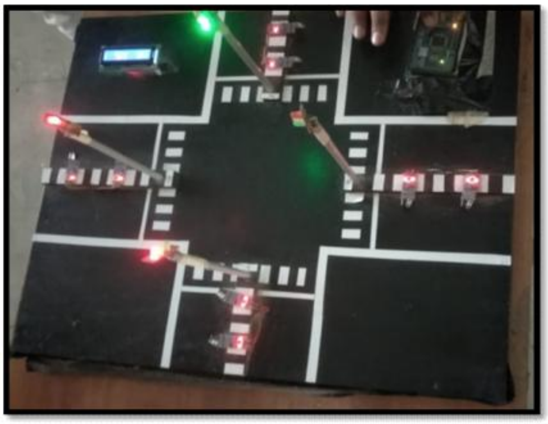
Multimode traffic, which includes traditional automobiles, intelligent linked vehicles, and automated vehicles, is quickly becoming the norm around the world. As a result, a new generation of traffic control systems is required to match the development and application requirements. The majority of current traffic control systems use "prior" feed forward control or delay-based restricted information control. The control effect is dependent on the model's correctness in characterising the actual traffic situation, and it cannot learn and change control knowledge online based on control effect feedback.

Clearly, the widespread development and implementation of new technologies such as floating vehicles, vehicle-to-vehicle communication (V2V), Internet of vehicles (V2I), V2X, and automatic driving would considerably aid the transition of urban traffic control systems from a data-poor to a data-rich future. Real-time detection of spatiotemporal data based on traffic status on urban road networks can provide comprehensive and high-quality basic data as well as a fine-grained assessment of control impacts for traffic control. Faced with the main flaws in the existing self-adaptive traffic control system, relying on a large amount of traffic control data and using a data-driven approach to develop a closed-loop feedback self-adaptive control system with better uncertainty response capability and a higher level of intelligent decision-making is unavoidable.

As a result, addressing the limitations and major flaws of existing traffic signal control systems, relying on a wealth of traffic control interaction conditions and data, and developing a collaborative control system with a high level of refinement, precision, and improved responsiveness and intelligence are the objective need and development direction of traffic control technology. Despite the fact that the paper's conclusion is multi-intersection coordination control theory in an oriented future traffic environment, it can provide scientific support for the construction of future road network traffic control systems and be widely employed in new generation traffic control systems.

It can also boost the efficiency of the road network.

Minimize traffic operating expenses, avoid and ameliorate intersection traffic congestion, and reduce energy consumption and emissions to a larger extent. Traffic signal control based on reinforcement learning is a real sense of closed-loop feedback self-adaptive control, with guaranteed instantaneity, precision, and self-learning, which will be a future research trend. It will also serve as a point of entry and technical assistance for the development of V2X systems, the Internet of Vehicles, and the autonomous driving sectors. As a result, the adaptive control system's achievements for the future traffic environment have tremendously extensive application potential



Model

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